OKANAGAN

Subbasin Plan

Prepared for the Northwest Power and Conservation Council

Okanogan

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May 2004

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Science is best defined as a careful, disciplined, logical search for knowledge about any and all aspects of the universe, obtained by examination of the best available evidence and always subject to correction and improvement upon discovery of better evidence. What's left is magic. And it doesn't work.

James Randi

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Canadian Okanagan Basin Technical Working Group

Okanogan County Board of Commissioners & the Colville Tribes

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If any individuals or organizations have been left off of these lists, it is inadvertent and the Subbasin Coordinators apologize for the comission of omission.

Okanagan Subbasin Plan

Table of Contents

List of Figures

List of Tables

List of Acronyms

BLM	Bureau of Land Management
BPA	Bonneville Power Administration
BOR	Bureau of Reclamation
BiOP	Biological Opinion
COBTWG	Canadian Okanagan Basin Technical Working Group
CDC	B.C. Conservation Data Center
cfs	cubic feet per second
Corps	US Army Corps of Engineers
Colville Tribes	Colville Tribes
CRITFC	Columbia River Inter-Tribal Fish Commission
CRMP	Cultural Resources Management Plan
CWA	Clean Water Act
DFO	Department of Fisheries and Oceans
DOE	US. Department of Energy
DOI	US Department of the Interior
EA	Environmental Assessment
Ecology	Washington State Department of Ecology
EC	Environment Canada
ECP	Eco-regional Conservation Planning
EDT	Ecosystem Diagnostic & Treatment
EIS	Environmental Impact Statement
EMS	Energy Management System
EPA	US Environmental Protection Agency
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
FWS	US Fish and Wildlife Service
GIS	Geographic Information System
HCP	Habitat Conservation Plan
HEP	Habitat Evaluation Procedure

HGMP	Hatchery Genetic Management Plan
huc	habitat
IBIS	Interactive Biological Information System
ISRP	Independent Scientific Review Panel
JFC	Joint Fisheries Committee
LAW B.C.	Land and Water B.C.
LFA	Limiting Factors Analysis
LUCO	Land Use Coordination Office
LRMP	B.C. Land and Resources Management Plan
MSRM	B.C. Ministry of Sustainable Resource Management
MWLAP	B.C. Ministry of Water, Land and Air Protection
MOF	B.C. Ministry of Forests
NEPA	National Environmental Policy Act
NGO	Non-governmental Organization
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPCC	Northwest Power Planning and Conservation Council
OCD	Okanogan Conservation District
OLAP	Okanagan Lake Action Plan
ONA	Okanagan Nation Alliance
ONFC	Okanagan Nation Fisheries Commission (ONA)
OSBFP	Okanagan-Similkameen-Boundary Fisheries Partnership
PA	Programmatic Agreement
PFRCC	Pacific Fisheries Resource Conservation Council
PUD	Public Utility District
RC&D	North Central Washington Resource Conservation & Development Council
RM	river mile
SSHIAP	Salmon and Steelhead Habitat Inventory and Assessment Project
TMDL	Total Maximum Daily Load

TSS	Total Suspended Sediment
UCSRB	Upper Columbia Salmon Recovery Board
UCRFEG	Upper Columbia River Fisheries Enhancement Group
USFS	US Forest Service
USGS	US Geological Survey
WQI	water quality index
WDFW	Washington Department of Fish and Wildlife
WSCC	Washington State Conservation Commission
Yakama Nation	Tribes and Bands of the Yakama Nation
YFRM	Yakama Fisheries Resource Management

1 Executive Summary

The Okanogan Subbasin Plan is designed to provide the Northwest Power and Conservation Council with a method for allocating fish and wildlife mitigation and conservation resources within the Okanogan subbasin. To involve the community and public, an outreach program was developed and put into practice during the building of the plan and will continue as the plan moves towards implementation.

The plan begins with an expression of the vision for the subbasin and an outline of the founding principles for the plan. It then moves into an overview of the Basin, and its fish and wildlife species and their habitats. Current projects and management programs are discussed and a detailed management plan is then defined. A framework for monitoring the progress of the plan is presented, and, finally, linkages across the plan elements are established and described. A brief overview follows.

Vision

Our Vision for the Okanogan subbasin includes viable, self-sustaining, harvestable and diverse populations of fish and wildlife and their habitats, along with the recognition of the need to support the economies, customs, cultures, subsistence and recreational opportunities within the basin.

To provide a strategy for attaining this future desired condition, a set of principles was developed to guide strategy development. These "actions" represent the most detailed aspect of the subbasin plan, and while they provide tangible direction, they are neither prescriptive nor defined to the discrete project level. The next step in our development progression had the planners use the assessment results to provide impetus and direction for developing the working hypotheses and the objectives contained within the management plan. These in turn provided the testable benchmarks for measuring progress towards achieving the subbasin plan vision.

Subbasin Assessment

The Okanagan *(Canadian spelling used here)* subbasin has its origin in forested mountains of Canada at elevations of over 7,000 feet and drops down into gently sloping valley floors at elevations of less than 1,000 feet. This great diversity of habitat supports a wide range of fish and wildlife, with many listed as Endangered, Threatened or as Species of Concern or at Risk. Notably, the Okanogan subbasin shares an international border containing political boundaries. However, this subbasin plan is predicated upon the biological needs of the fish and wildlife species dependent upon the watershed; and this plan, while sensitive to the geopolitical and socio-economic differences between the United States and Canada, focuses on the Okanogan *ecosystem* as an uninterrupted continum.

Over 300,000 people live within the Okanogan. The Canadian economy is centered chiefly on the tourism, agriculture, and the service industry while the US economy revolves around forestry and agriculture (orchards and livestock).

Focal Species and Limiting Factors

Focal fish and wildlife species and focal habitats have been chosen to evaluate the health of the ecosystem to ensure we can detect the effectiveness of management actions by monitoring their trends. This plan discusses habitat requirements of the focal species and the factors that limit their numbers. These metrics then guided the development of the management objectives and strategies for this plan.

The review of limiting factors for the focal species of wildlife shows that the presence, distribution, and abundance of wildlife species in the Okanogan subbasin have been affected by habitat losses. Losses are primarily the result of commercial and residential development, flood control, water extraction, agricultural development, timber extraction, and livestock grazing. These activities have resulted in large areas of high-quality habitat being rendered inaccessible and in significant mortality associated with low flow, the loss of riparian zones, wildlife habitat loss and fragmentation, conversion of land to different ecotypes, vegetation removal and invasion by non-native species of animals and plants.

Throughout the Okanagan highlands timber extraction has had the main impact though in 2003 wildfires changed the landscape considerably. In the lowlands urbanization, flood control, water extraction, and agriculture have been the major causes of habitat alteration

To address factors limiting the focal wildlife species, the Plan calls for protection of the full size and condition of core areas, suitable, yet unoccupied habitats, the physical connections between areas, and buffer zones to ameliorate impacts from incompatible land uses. Attendant with these steps will be the monitoring of improvements in long-term trends and population status. Monitoring of habitat attributes and focal species will provide a means of tracking progress toward recovery and/or meeting trust and mitigation obligations.

Hypotheses, Goals, Objectives and Integrated Strategies

The review of limiting factors for focal species of fish was carried out using a detailed and powerful tool called EDT (Ecosystem Diagnosis and Treatment). The major results of EDT are captured under the plan sections entitled Major Findings and Assessment Unit Summaries. The Assessment Unit Summary Sheets are intended to be used as a *guide* for developing future strategies, projects and direct actions as they relate to salmon and steelhead habitat. They support and form the basis for the Management Plan, and are in turn supported by the subbasin plan's individual sections: Goals and Vision, Species Objectives, Hatchery Integration and the Monitoring and Evaluation Framework.

Taken together and as integrated sections, they form our scientific and socio-economic foundation, and ultimately, the core of the Management Plan itself.

The ecosystem diagnosis method used was intended primarily to address the question: *Is there potential to improve anadromous salmonid population status through improvements to habitat conditions in tributary environments*?

Said in a form of a **central subbasin hypothesis** (for fish, but adaptable for wildlife): *Improvements in habitat conditions will have a positive effect on habitat productivity and thus, improve fish population status through increased abundance, diversity, and spatial structure*

Results

In brief, results from the assessment shows that in the Okanogan Basin habitat losses have chiefly resulted from artificial and natural fish passage barriers, alteration and reduction of riparian habitat, loss of habitat connectivity, instream and floodplain habitat degradation, low flows and dewatering, and increased water temperatures. Added to these limiting factors within the Okanogan are significant out-of-basin problems including fish passage over mainstem dams and harvest.

To date much of the effort and resources allocated to addressing the limiting factors of fish in the US portion of the subbasin have centered on supplementation with hatchery reared fish. This has resulted in tangible benefits for certain species in certain areas. The Plan states that while the protection of existing wild stocks and the building of self self-recruiting wild populations must be paramount in this region of the Columbia Basin, there is a need to continue with hatchery supplementation in a careful, well-planned and documented fashion into the foreseeable future. Uncertainty about population structure, poor adult returns, and a desire to spread the risk of hatchery intervention strategies will require long term monitoring of population trends and changes in gene pools. On the Canadian side, fisheries authorities often pursue an ecosystem-based approach with wild stocks, using supplementation only where necessary. This comports with the view of the US managers and this plan's measures and strategies.

Inventory of Existing Activities

The section of the plan that provides an inventory of existing activities outlines the extent to which present programs address the limiting factors outlined in the plan. This section of the plan is essential if program overlaps are to be avoided. Of equal importance, this section illustrates the gaps and unknowns that require more resources for inventory, research, monitoring and evaluation.

Management Plan and Monitoring

The final section of the report brings together all the analyses and strategies into a management plan, and presents a vision of what future conditions could be and identifies the route to get there (follow the plan). It concludes by linking the Plan with other major initiatives such as the Endangered Species Act, state and federal recovery planning effort, watershed planning, and the Clean Water Act and recommending a framework program for monitoring and evaluating the recommendations of the Plan.

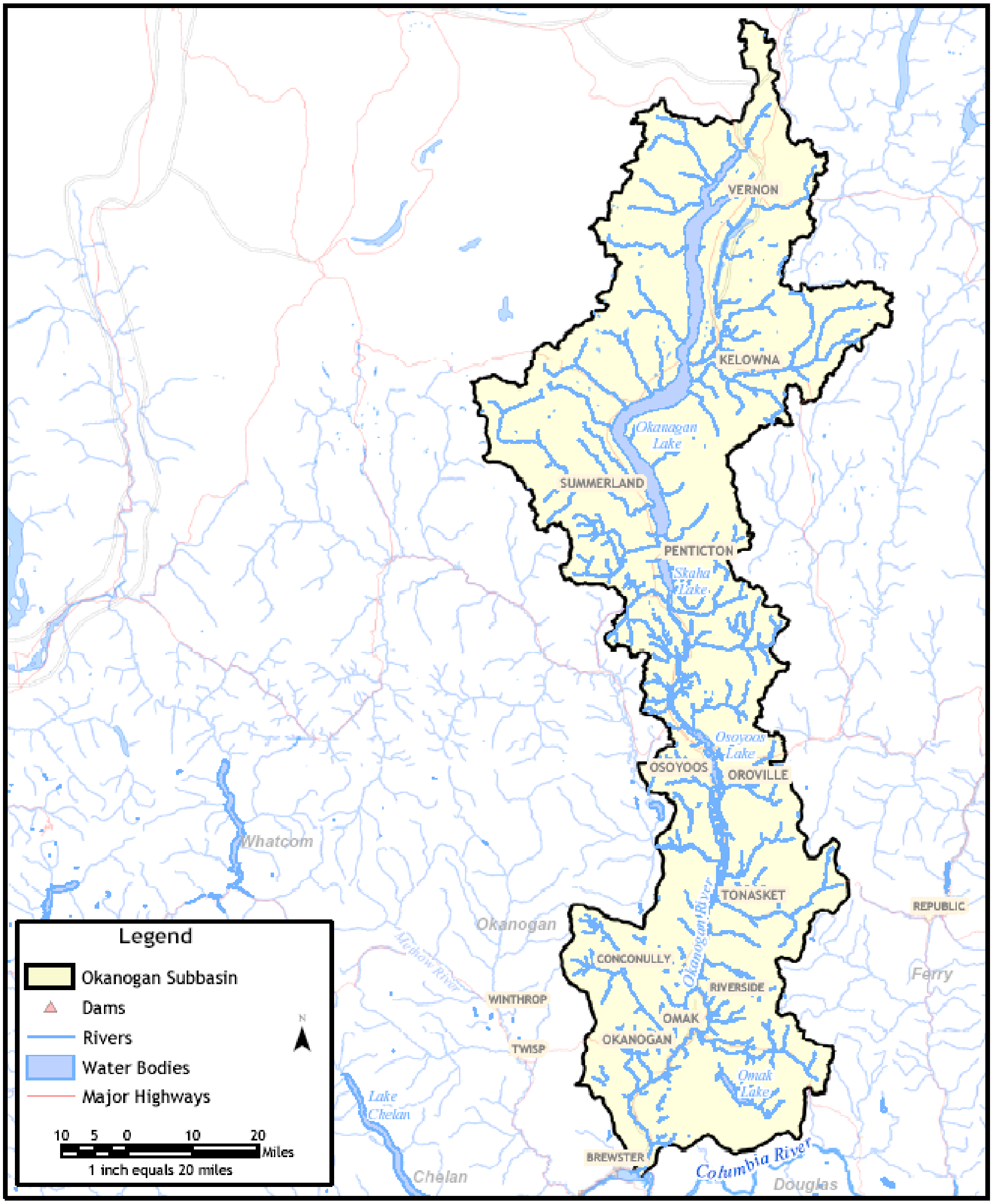
Implementation

This plan has limitations, and is, in sum, unfinished in terms of its ability to chart a full term course for sustainability. This is due to the significant resource constraints placed on this process and the fact that the Okanogan suffered from a lack of an organized planning framework and a paucity of existing analyses. The fact that this plan was developed within the span of less than a year, unlike any other plan of similar scope or significance, did not escape the planners initially, or in the end. Nevertheless, all parties persisted to produce the best product possible, and have in turn, taken a significant step forward to meet a long list of challenges facing natural resources and communities in the region.

Consequently, this plan represents a thoughtful and credible approach; one collectively derived from a tremendous effort on the part of local governments, state, federal and tribal agencies and the public. Notably, this multifaceted effort was carried out in the largest watershed in North America and home to the *most* imperiled and impacted populations of fish and wildlife in the Columbia Basin. The universal consensus is that the vision, goals, preliminary findings and management plan that anchor this document outline a reasonable and strategic course for fish and wildlife in the Okanagan basin.

Thus, we are confident that this subbasin plan will now guide state, local, federal and tribal governments, and the Northwest Power and Conservation Council and The Bonneville Power Administration in meeting their respective obligations and implementing various programs to conserve and enhance fish and wildlife.

2 Introduction



Source: Data Layers: Subbasins (Streamnet and TRIM), Dams (Streamnet), Counties & Major Rivers (WA Ecology, TRIM), Highways (WashDOT, TRIM). Projection: Washington State Plane North Zone NAD83. Produced by Jones & Stokes for KWA Ecological Sciences, Inc. Map Date: 5/15/2004

Figure 1. Okanogan subbasin, topography and general hydrology

The Okanogan subbasin comprises one of the largest geographic subbasins in the Columbia River basin (Figure 1). The factors influencing fish and wildlife survival, and population status overlap and extend beyond the geographic boundaries of the Okanogan, and of the United States.

Thus, to achieve ecosystem-based objectives, it is important to coordinate fish and wildlife management across the US-Canada border.

The basin is home to over two dozen species of plants and animals that are currently listed in the US and Canada as nationally Threatened, Endangered, or Vulnerable, and is currently home to one of only two viable populations of sockeye salmon left in the entire Columbia basin. A full one-third of all Red-listed species in British Columbia reside in the Canadian Okanagan, and the National Marine Fisheries Service has concluded that the upper Columbia, where spring Chinook and steelhead are listed as Endangered, is the first priority for recovery planning efforts in the Columbia basin.

The subbasin is also an important ecological corridor for migratory megafauna. Species such as mule deer utilize the north-south corridor that connects the dry landscapes of British Columbia's interior with the grasslands to the south. In addition to salmon and megafauna, this corridor is a crucial part of the flight path for many species of birds during annual migrations between summer and winter ranges.

The Okanogan subbasin plan addresses the limiting factors for fish and wildlife ecosystems in the subbasin. However, the needs of watershed residents, and their critical role in ecosystem stewardship, have been expressly considered as part of overall ecosystem recovery and the benefits of shared stewardship. Although considered throughout the plan, the Similkameen subwatershed above Enloe Dam was not included in salmon ecosystem analysis.

The revised Columbia Basin Fish and Wildlife Program calls for an ecosystem-based approach for planning and implementing fish and wildlife recovery. The Okanogan subbasin plan will lay the foundation to achieve this goal by integrating fish and wildlife assessments, inventories, and management plans in a manner that begins to connect communities of science, interest, and place in the Okanogan subbasin across the US-Canada border.

2.1 Subbasin Planning

In October of 2000, the Northwest Power and Conservation Council adopted a revised Fish and Wildlife Program for the Columbia River Basin. The new program is intended to be more comprehensive than, but complementary to, regional efforts related to the Northwest Power Act, the Endangered Species Act, State-sponsored recovery and watershed planning and coordination efforts, and tribal recovery initiatives and plans.

The revised Program calls for an ecosystem-based approach for planning and implementing fish and wildlife recovery. To accomplish this, the Program divides the Columbia Basin into ecological provinces that are further divided into individual subbasins.

At the heart of the Program is the subbasin plan, consisting of a comprehensive description of the basin general ecology including the identification of specific fish and wildlife needs. Future action strategies and project funding are to be based upon these identified needs.

Subbasin summaries were developed in 2002 as an interim step to organize key planning attributes, to allow near-term implementation of the revised Fish and Wildlife Program until comprehensive subbasin plans can be completed.

The Okanogan Subbasin Plan is the subject of one of six subbasin plans being generated from within the Columbia Cascade Ecoprovince. The Methow, Wenatchee, Lake Chelan, Entiat, and Upper–middle (mainstem) Columbia River subbasins comprise the remainder of this province. The provincial boundaries are also nearly identical to the federal Ecologically Significant Unit (ESU) boundaries for listed salmon and steelhead in the Upper Columbia.

The Okanogan Subbasin Plan draws from the Okanogan Subbasin Summary (NPCC 2002) and the Salmon and Steelhead Habitat Limiting Factors Assessment WRIA 49 (Entrix and Golder 2004), which included an information summary for fish, wildlife, and their habitats, relevant land use planning, human population patterns, and overall management issues for 72 subwatersheds and tributaries. In Canada, the Okanagan Basin Study (1974), the Thompson-Okanagan Land and Resources Management Plan (LUCO 2001), and the draft State of the Okanagan Basin report (in prep., ONA 2004) provide baseline information on the Canadian sections of the subbasin. The Okanogan subbasin plan will also draw from a significant body of additional US and Canadian science to facilitate coordinated recovery planning for the Okanogan salmon and steelhead ecosystem.

Subbasin planning efforts in the Okanogan subbasin were initiated in May 2003. These efforts are guided by the policies of cross-border collaboration on salmon recovery initiated by the Tribes of the Colville Tribes Reservation (Colville Tribes) and the Okanagan Nation Alliance from Canada. However, the work of coordination and collaboration in the development of this plan drew from the leadership of a great many agencies sharing this vision.

Watershed Fish Sustainability Planning, a Canadian fisheries planning strategy, is underway in a parallel, albeit distinct, regional effort in the Canadian Okanagan. Although the US and Canadian subbasin planning efforts in the Okanogan are distinct, and designed to meet differing statutory objectives in B.C. and Washington, salmon ecosystem restoration is an imperative that spans the international border to include the entire watershed system.

Watershed planning in Canada and associated sciences are presently being led by a Canadian Okanagan Basin Technical Working Group (COBTWG) involving federal, provincial and First Nations' fisheries agencies.

Unless references to the Canadian Okanagan River are explicitly Canadian, the Okanogan subbasin plan will defer to the American spelling of the Okanogan River for purposes of brevity; which implicitly includes the entire watershed, subject to law and policy in either country.

The Okanogan Subbasin Plan addresses the limiting factors for fish and wildlife ecosystems; however, the needs of watershed residents and their critical role in ecosystem stewardship have been expressly considered as part of ecosystem recovery and its benefits.

2.2 Planning Process

Writers

Dave Moore (Fisheries Development Services from British Columbia) was the lead editor for the Okanogan subbasin plan, with drafting support from Keith Wolf (KWA) and Julie Dagnon (Okanogan County). Caryn Stroh, Chris Bull, Dave Whiting, Dawn Machin and Deana Machin provided editorial support.

Contributors

Contributors included agency leads from the Colville Tribes, Okanogan County, the Washington Department of Fish and Wildlife (WDFW), the US Forest Service (USFS), the US Fish and Wildlife Service (FWS), specialists from the region, and local stakeholders. A detailed list of contributors is provided at the beginning of the plan.

Reviewers

The Subbasin Core Team led the review of materials and the original manuscripts. Scott Fitkin from WDFW and Sandra Streiby of Highlands Associates Consulting provided editorial review of wildlife materials; Casey Baldwin from WDFW provided editorial review of fisheries materials. Review of the Canadian data sets undertaken in the Ecosystem Diagnostic & Treatment (EDT) analysis was provided through the Okanagan Basin Technical Working Group. Keith Wolf (KWA) reviewed all EDT results and related assessments. Keith Wolf (KWA) Julie Dagnon (Okanogan County), Kurt Danison (Highlands Associates Consulting), and Sandra Streiby, (Highlands Associates Consulting) reviewed management plans and the final manuscript.

Technical Team

Wildlife Technical Teams included Paul Ashley and Stacey Stovall, Scott Fintkin (WDFW), and Sandra Strieby, Highlands Associates Consulting.

Fisheries Technical Teams included Keith Wolf and Sammi Buzzard (KWA), Casey Baldwin Mark Cookson, Kirk Trucsott, and Scott Fitkin (WDFW), Kate Terrell, (FWS), Nancy Wells, (USFS), John Arterburn, Jerry Marco, Chris Fisher (Colville Tribes), Howie Wright, Deana Machin, and Betty Retenolla (Okanagan Nation Alliance [ONA]) and Chris Bull (Glenfir Resources).

The technical team also worked and consulted with over 70 experts during the course of the planning and assessment phase. These included representatives from Canadian resource management agencies, the University of Washington, the Department of Ecology, The Bureau of Reclamation, The United States Geological Service, the United States Department of Agriculture, and others.

2.2.1 Participation

The Colville Tribes, Okanogan County, and the Washington Department of Fish and Wildlife partnered to coordinate Subbasin Planning for the Okanogan subbasin. Okanogan County has been responsible for outreach and public involvement while the state and tribes led the technical effort. However, it must be noted that all parties worked together in a fully collective and integrated fashion in order to bring this plan to completion.

Current participation in discussions and decision-making regarding the Okanogan subbasin's natural resources involves private citizens, irrigation districts, environmental groups, county government, state, provincial and federal agencies, and spans the US-Canada border. In addition, both the Colville Tribes in Washington State and the First Nations represented by the Okanagan Nation in British Columbia (B.C.) have a long history of traditional resource use in the subbasin, also taking an active interest in fish, wildlife and habitat management.

The timeline established by the Northwest Power Planning and Conservation Council (NPPC) has necessitated a compressed process that has allowed limited stakeholder involvement on early drafts completed in May of 2004. A total of 43 formal planning team and various communications meetings were convened between August 2003 and May 2004. E-mail circulars and media releases provided regular updates on Subbasin Planning to more than 250 formal public contacts. These circulars and releases provided a description of next steps, and encouraged stakeholder participation.

Outreach Strategy

Outline-level manuscripts were distributed to the Subbasin Core Team (SCT) for review in February and March and to the public in rough draft form in April and May of 2004. Early drafts of the subbasin plans were placed in local public libraries, sent to stakeholders upon request, and posted on an 'ftp' website. Stakeholders were encouraged to submit comments on the first outline draft (February 11, 2004 – April 16, 2004), and again for the final two-week comment period on the completed draft (April 23, 2004 – May 10, 2004).

The NPCC public review and comment period (June 4 - August 12, 2004), and the proposed three-year rolling review of subbasin plans (2007), should build on these important first contributions. It is expected that the building of the subbasin plan only begins with drafting, and can only end through effective iteration and critical updates. Future refinement based on public and agency comment, and new contributions, knowledge and information will make the subbasin plans more relevant and responsive to the subbasin Vision.

Commitment to public outreach

Okanogan County staff and contractors have used the media and a series of public meetings to communicate progress. In September 2003, the Coordinators assembled an initial outreach list comprising about 130 contacts. The list included representatives of the following interests:

Agriculture

Business

Conservation and the environment

Government (including local government, and local and regional representatives of state, tribe and federal agencies)

Media

Recreation

The list has continued to grow as individuals express interest in Subbasin Planning. It has been used throughout Subbasin Planning to share information, facilitate dialogue among communities of interest, science, and place. The list was also used to distribute public information; an information bulletin describing ongoing progress on the development of subbasin plans, was regularly sent to the stakeholders, enabling them to track the process and any changes to the planning schedule.

Fact sheet

Okanogan County developed a Fact Sheet to introduce Subbasin planning to stakeholders and the media and explain opportunities for public involvement. The Fact Sheet included a telephone number, email, postal mail, and web site addresses that individuals could use to obtain more information, and to provide input and comment on plan drafts.

2.2.2 Infrastructure and Organization

Subbasin Core Team (SCT)

Okanogan County and a working group of co-managers and public stakeholders initiated formation of the Okanogan and Methow SCT. The SCT met 22 times to review and refine the Ecosystem and Diagnosis and Treatment outcomes (refine hypothesis based on local knowledge), and to develop management strategies. Evening summary meetings were convened to accommodate stakeholders who were not able to attend daytime meetings, to provide a window into the outcomes of successive developments.

Briefings were provided to interested groups on eight occasions, and media representatives by request. Three formal public meetings were convened to facilitate public dialogue on the direction of the plan and to answer pertinent questions. Regular e-mail circulars and media releases provided regular updates on Subbasin planning, next steps, and invitations welcoming additional stakeholder participation. More extensive review, including ISRP and the public will be complete by August 2004.

Public comments

Comments collected at public meetings and during public review of draft Subbasin Plans have been appended to this plan as Appendix G. Every effort has been made to fully consider and implement applicable comments that were received during the formal public comment periods for the subbasin plan. However, given this, it is recognized that it may be possible that this was not completely accomplished because of the time constraint of meeting the May 28, 2004 NPCC deadline. During the Response Period, comments received on the initial plan will then be re-reviewed.

2.3 Local and Regional Implementation Conditions

The Okanogan subbasin exemplifies the popularity of the modern rural lifestyle and a paradox of pioneering versus protection practiced by the new valley residents over the last two centuries.

Constraints to the sustainability of anadromous and resident fish, wildlife, and their habitats resulted from growth within the basin; many of these impacts and their resolution have cross-border implications. The economics of the region were founded on what are now stable valley-bottom developments and infrastructure, matured forest and hydroelectric industries, and agriculture, including the growing vineyard businesses (particularly in Canada). The impacts of population growth in the subbasin are cyclic and localized, and have extended their reach from the alpine mountaintops to the confluence with the Columbia River and beyond.

Hydro facilities and their operations (both inside the valley and downstream), water control/management (quality and quantity), urban and infrastructure development, and introduced species strain to keep a salmon ecosystem in balance with the demands of a growing population.

Dealing with these constraints and sustaining a healthy local economy will require both institutional and technical approaches, and links between communities of science, interest, and place in the implementation of the subbasin plan. The complexity of the jurisdictional arrangements, and the differences in management objectives within the basin and across the US-Canada border, necessitates an extensive and comprehensive process. The successful Okanogan subbasin plan will be sensitive to the needs of federal, state/provincial and local governments, public utility districts and federal hydropower authorities, tribal entities, stewardship bodies, landowners, and other stakeholders.

2.4 Overall Direction and Goal of Subbasin Plan

Many good efforts are already underway to facilitate the coordination and planning needed to recover fish and wildlife in the subbasin, but such coordination with strategic links to ecosystem-base management is still in its infancy, and much remains to be done. Coordination of the Vision contained in this plan, and the parallel efforts being undertaken in the Canadian reaches of the subbasin, are a priority over the next three to five years.

The technical components of this subbasin plan are, undoubtedly, important and useful in the development of projects provided by the framework in this subbasin plan; however, success can only truly occur if the impacts to local communities are considered. Though the continuing balance between technical and community priorities is always a challenge, this planning process, as well as others must continue to try to strike that balance.

Though it is suggested that the vision and supporting items be provided in the management plan portion of the document, the subbasin planners have chosen to provide it at the beginning of the document to “set the tone” for the document. The vision, planning assumptions, foundation principles, and supporting principles are intended to provide the overall direction and goal of this subbasin plan. The logic path for development of the subbasin plan is illustrated in Figure 2

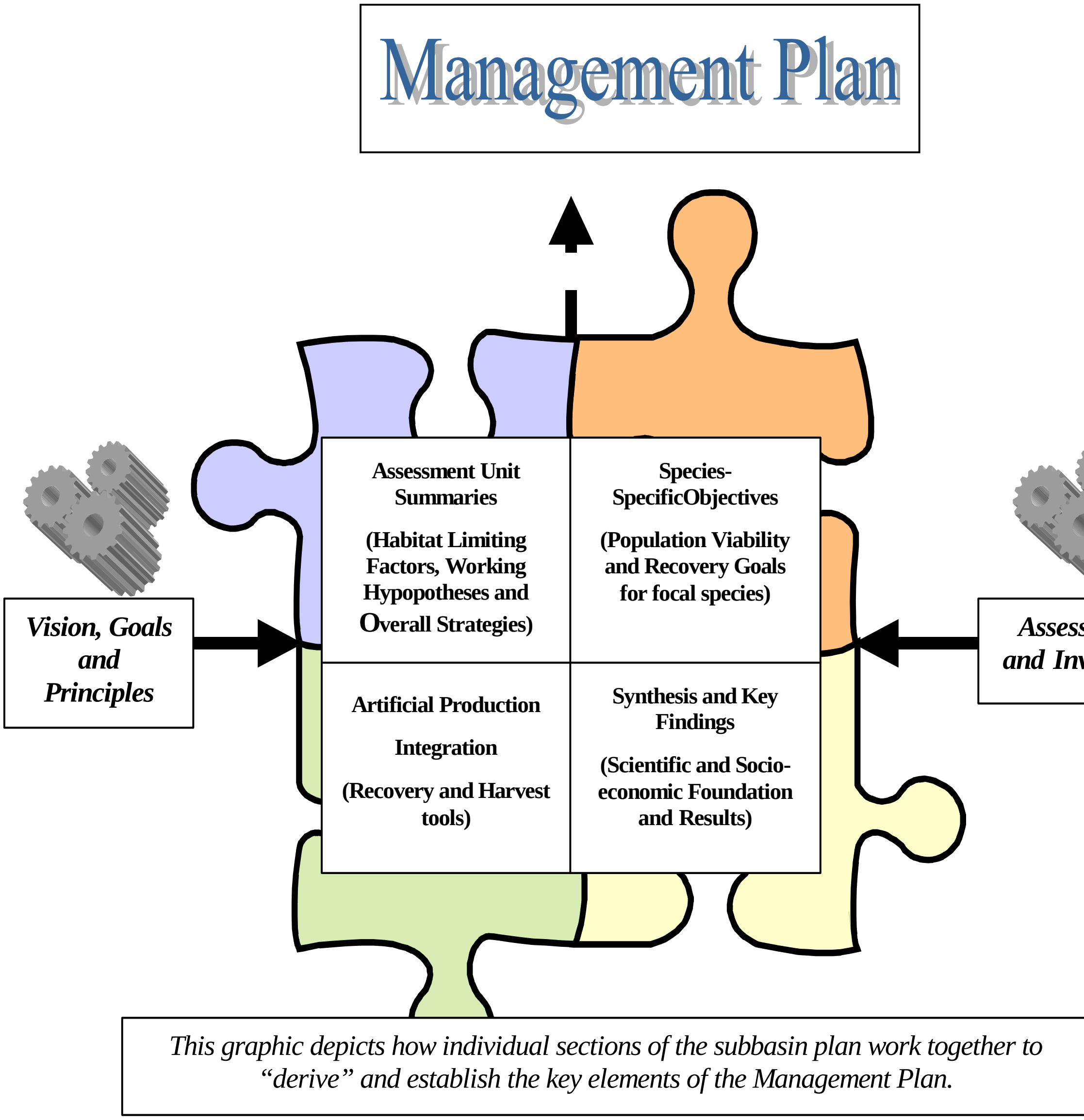


Figure 2 Logic Path for the Development of the Subbasin Plan

2.5 Our Vision for the Okanogan Subbasin

Consistent with the 2000 Columbia Basin Fish and Wildlife Program's vision, yet tailored specifically to the geographic region of the Okanogan subbasin and its citizenry, within 15 years it is envisioned that we will have:

An Okanogan Subbasin that supports self-sustaining, harvestable and diverse populations of fish and wildlife and their habitats, and supports the economies, customs, cultures, subsistence and recreational opportunities within the basin. Decisions to improve and protect fish and wildlife populations, their habitats and ecological functions are made using open and cooperative processes that respect different points of view, statutory responsibilities, and are made for the benefit of current and future generations.

This vision and subbasin plan to follow is the outcome of an open process, and is intended to provide a framework under which future projects, programs and actions can be developed and implemented. Actions taken in the subbasin should be consistent with the Okanogan subbasin plan, the NPCC Columbia Basin Fish and Wildlife Program, Clean Water Act, and the Endangered Species Act.

2.5.1 Specific Planning Assumptions

Planning assumptions were developed to incorporate into project plans or actions developed within the framework provided by this subbasin plan. Actions taken in the subbasin should be consistent with these planning assumptions.

As a part of this vision, the subbasin plan adopts the following policy judgments and planning assumptions for the Okanogan subbasin plan:

The ultimate success of the projects, process, and programs used to implement the subbasin plan will require a cooperative and collaborative approach that balances the economies, customs, cultures, subsistence, and recreational opportunities within the basin with the federal/state mandates to protect fish and wildlife.

The subbasin plan is not a land use management plan and contains no regulatory authority, but it is, however, intended to guide Bonneville Power Administration (BPA) in meeting its mitigation obligations.

No single activity is sufficient to recover and rebuild fish and wildlife species in the Okanogan subbasin or in the Columbia River Basin. Successful protection, mitigation, and recovery efforts must involve a broad range of strategies for habitat protection and improvement, as well as improvements to the operations of the hydrosystem, effective and equitable harvest management, and the continued incorporation of artificial production.*

The Bonneville Power Administration should make available sufficient funds to implement projects developed within the framework providing by this plan in a timely fashion.*

This is a habitat-based program, for rebuilding healthy, naturally producing fish and wildlife populations by protecting, mitigating, and restoring habitats and the biological systems within them, including anadromous fish migration corridors. Artificial production and other non-natural interventions will be used judiciously, and will be consistent with the central effort to protect and restore habitat and avoid adverse impacts to native fish and wildlife species.*

It is important to consider out-of-basin effects, including ocean habitat and predation, on salmonid species when evaluating freshwater habitat management, in order to understand all stages of the salmon and steelhead life cycle.*

There is an obligation to provide fish and wildlife mitigation where habitat has been permanently lost because of hydroelectric development. Artificial production of fish may be used to replace capacity, bolster productivity, aid recovery, and alleviate harvest pressure on weak, naturally spawning resident and anadromous fish populations. Restoration of anadromous fish into areas blocked by dams should be actively pursued where feasible.*

Management and artificial production actions must have an experimental, adaptive management design. This design will allow the region to evaluate benefits, address scientific uncertainties, and improve survival. It is important that actions be integrated with research and monitoring activities to evaluate their effects on the ecosystem.*

Harvest can provide significant cultural and economic benefits to the region, and the program should seek to increase harvest opportunities consistent with sound biological management practices. Harvest rates should be based on population-specific adult escapement objectives designed to protect and recover naturally spawning populations.*

Achieving the vision requires that actions in habitat, artificial production, harvest and hydrosystem are thoughtfully coordinated with one another. There also must be coordination among actions taken at the subbasin, province, and basin levels, including actions not funded by this program.

Participation of stakeholders, local and regional planning organizations, and/or groups in implementation of subbasin plans should be fostered to the fullest extent possible, or where appropriate.

These specific planning assumptions are to be incorporated into projects developed within the framework provided by this subbasin plan. Actions taken in the subbasin should be consistent with these planning assumptions.

2.5.2 Foundation Principles

A set of foundation principles have been developed that are reflected in the following framework of six key elements that include the natural and cultural systems from which the subbasin plan is built.

1. Economies, customs, cultures, subsistence, and recreational opportunities within the basin;
2. Regulation of land use;
3. Out of basin effects;
4. Viability and long term sustainability;
5. Healthy fish and wildlife habitats; and
6. Connectivity

Application of our principles

The Okanogan subbasin plan recognizes the following principles of general application. It is intended that all projects developed from the framework provided in this subbasin be consistent with these principles:

The people of the Okanogan subbasin are diverse and independent. They value a wide range of customs and cultures. Actions, strategies, programs, and projects for fish and wildlife and their habitats will be more successful if developed in context with the basin's economic needs, opportunities, and with an understanding of the impacts to the human environment in the basin

Activities associated with the subbasin plan, undertaken to protect and/or restore fish and wildlife, have the potential to improve opportunities for cultural and recreational uses and, thus, the social and economic well being of the communities. Strategies and projects should be reviewed and evaluated based on the potential for such positive impacts and methods developed to measure and monitor the success of such efforts.

The cost of actions to implement the Okanogan subbasin plan is estimated in relation to benefits. Within the context of priorities established to recover listed species, alternatives that achieve the greatest benefits at the least costs are preferred.

Consideration of social costs should include the effects of implementation on short- and long-term economic stability in the subbasin. Consideration should include (but is not limited to) project feasibility, cost-share opportunities, longevity, effects of increased electrical rates, increased development costs, and increased public land ownership.

Actions derived from the Okanogan subbasin plan are undertaken with the understanding that the natural environment, including its fish and wildlife resources, is the cultural heritage that is common to the diversity of human existence; and that such actions play a key role in the long-term sustainability of the common cultural heritage within the subbasin.

Acknowledgement, integration and balancing of human, fish and wildlife needs will be necessary to ensure the successful implementation of this plan. Okanogan subbasin stakeholders' values are clearly stated and reflected in this process.

Actions derived from the Okanogan subbasin plan will be consistent with Federal Tribal Trust responsibilities.

Recreational opportunities are provided for diverse user groups, consistent with conservation and enhancement of subbasin resources.

Programs and actions are monitored and evaluated for effect, and may be altered as necessary to achieve the intended results, recognizing that science, strategies, and the art of restoring ecosystems are evolving.

Regulation of land use. The ability to implement protection or restoration strategies will require a close and cooperative relationship between federal, state, tribal, and local governments and a wide range of interest groups. Protection and/or restoration strategies that affect land use will require action (both for the adoption and implementation) by local, state, federal and/or tribal governments.

No existing water right is affected by actions derived from Okanogan subbasin plan without the consent of the holder of that right.

The processes of subbasin plan preparation, implementation (including project development and planning), and amendment are open, voluntary, and collaborative.

Actions derived from the Okanogan subbasin plan acknowledge the statutory authority of local, state, federal and tribal governments and existing plans, programs, and processes.

Future land use planning and activities that involve potential impacts to fish and wildlife and their habitats should be fully discussed with the agencies and tribes with management authority prior to implementation.

Out of basin effects. The Columbia River basin is characterized by natural environmental variability, fluctuation in production and established human urban and rural activities. Restoration and management of fish and wildlife and their habitats in the Okanogan subbasin must consider both in- and out-of-basin effects within the entire Columbia River basin ecosystem, natural and cultural, including freshwater, estuary, and ocean.

Strategies for recovery or maintenance of self-sustaining populations need to be evaluated within the context of the entire life history of the populations, and not just within the life history stages within the subbasin geographic area.

Important environmental attributes that determine the distribution and productivity of fish and wildlife populations have been influenced by natural and cultural activities in and outside the subbasin.

Long-term sustainability. Life history, genetic diversity, and metapopulation organization are ways that fish and wildlife adapt to their habitat. Diversity and population structure are how fish and wildlife species adapt to spatial and temporal environmental variations. Such diversity promotes production and long-term persistence at the species level.

In addition to fish and wildlife populations that support the custom, culture, subsistence, and recreational opportunities in the subbasin, indigenous fish and wildlife species should be enhanced and restored to be self-sustaining.

For aquatic- and fish-related interests, selection of a broad range of focal species provides a basis for development holistic management strategies. For terrestrial- and wildlife-related interests, the selection of focal habitats and related focal species provide a basis for developing holistic management strategies.

Biological inter- and intra-specific interactions shape fish and wildlife populations. Restoration of individual populations may not be possible without restoring other fish and wildlife populations with which they co-evolved.

Most native fish and wildlife populations are linked across large areas and do not consider political borders, thus reducing the possibilities for extinctions or extirpations. An important component for recovery of depressed populations is to work within this framework and maintain or recreate large-scale spatial diversity.

Populations with the least amount of change from their historic spatial diversity are the easiest to protect and restore, and will have the best response to restoration actions.

Small populations are at greater risk of extinction than are large populations, primarily because they are more vulnerable to environmental changes such as catastrophic events.

Fish and wildlife habitat. Fish and wildlife productivity requires a network of complex, interconnected habitats that are created, altered, and maintained by both natural and human processes in terrestrial, freshwater, estuary, and ocean areas.

The habitat in the Okanogan subbasin should be capable, of supporting self-sustaining, harvestable, and diverse populations of fish and wildlife.

Physical characteristics of the alluvial valley and floodplains of the Okanogan River have changed ecosystem attributes, and restoring watershed processes, where possible, will require a long-term collaborative commitment to fish and wildlife recovery.

The Okanogan subbasin is a dynamic system that will continue to change through natural events and human activities.

Biological Interactions and Connectivity. Population, abundance, and diversity, and the biotic community reflect ecosystem attributes. Co-evolved assemblages of species share requirements for similar ecosystem attributes, and require connectivity among them.

Sustainable, harvestable and diverse populations of fish and wildlife are dependent upon properly functioning environments and the processes that sustain them.

Changes to the physical characteristics and connectivity of the Okanogan subbasin have contributed to the changes of native fish and wildlife populations; therefore reconnecting the native ranges of fish and wildlife species is critical.

Okanogan County Comments on Land Acquisition

In the subbasin plan, a potential management strategy is the protection of existing habitat for both fish and wildlife. Protection of habitat happens mainly by two actions – conservation easements or land acquisition. The Okanogan County Board of Commissioners (Board) believes that these protection activities potentially impact Okanogan County's economic base and culture. The Board believes that other innovative solutions exist to achieve the same benefit, and urge individuals using the plan to propose actions to explore them.

Though the Board strongly opposes further acquisition of private lands in Okanogan County, they respectfully acknowledge a private landowner's right to do with their property as they choose. It has been the Board's experience that, in some instances, government entities often offer a private landowner exorbitant prices for a property, thereby disallowing those in the private sector to compete in purchasing the land.

When the state, federal government, or other groups, such as not-for-profits and the Bonneville Power Association acquire properties in Okanogan County, the Board of County Commissioners desire that the following be considered:

Consider and mitigate the economic impacts of removing the property from the County tax base or decreasing the amount of revenue generated by the property. (Economic impacts can occur not only from lost taxes but also from money spent in the community to maintain the property, the equipment necessary to do so, and possible wages to individuals working on the property).

Develop a multi-use land management plan that is consistent with Okanogan County's comprehensive plan.

Incorporate the cost to implement the land management plan when requesting funds for the land purchase.

Implement the land management plan.

The Board also wishes to point out that social and economic impacts occur to rural school districts (decreasing enrollment), hospitals, as well as to downtown businesses as a result of poorly developed and implemented land acquisition or easement policies. Typically, removing land from private ownership creates nuisances such as noxious weed control and fire danger, often derived because of the lack of land management.

With the numerous economic impacts from permanently removing private properties from the County's tax base as well as the increasing disturbance to the County's culture, the Board strongly recommends that other actions other than land acquisition occur to assist in the mitigation of impacts to fish and wildlife.

Ecosystem-based Management Principles Adopted in the Canadian Subwatershed

The Canadian Okanagan Basin Technical Working Group (COBTWG) has adopted an ecosystem approach to the management of fisheries to guide the implementation of fisheries actions in the Canadian reaches of the Okanagan subbasin. The COBTWG meets regularly with the US Co-managers and other interested agencies in an ad-hoc forum.

The Canadian approach is guided by agreements that include principles (paraphrased from the COBTWG Terms of Reference, January 2003) related to conservation and protection of indigenous fish stocks considered at imminent risk, and rehabilitation or restoration of highly valued indigenous fish populations and their habitats to satisfy requirements for sustainable use patterns. In addition, management efforts are directed at maintenance or restoration of normative ecosystem processes (C. Coutant 2000) considered essential to ecosystem health, and are to reflect a balance of multi-species ecosystem concerns.

Management actions are further directed by a precautionary approach, including application of an adaptive management framework for implementation of any project considered to involve moderate-to-high levels of risk or uncertainty to long-term sustainability of indigenous species within a healthy aquatic ecosystem. The adaptive management approach includes:

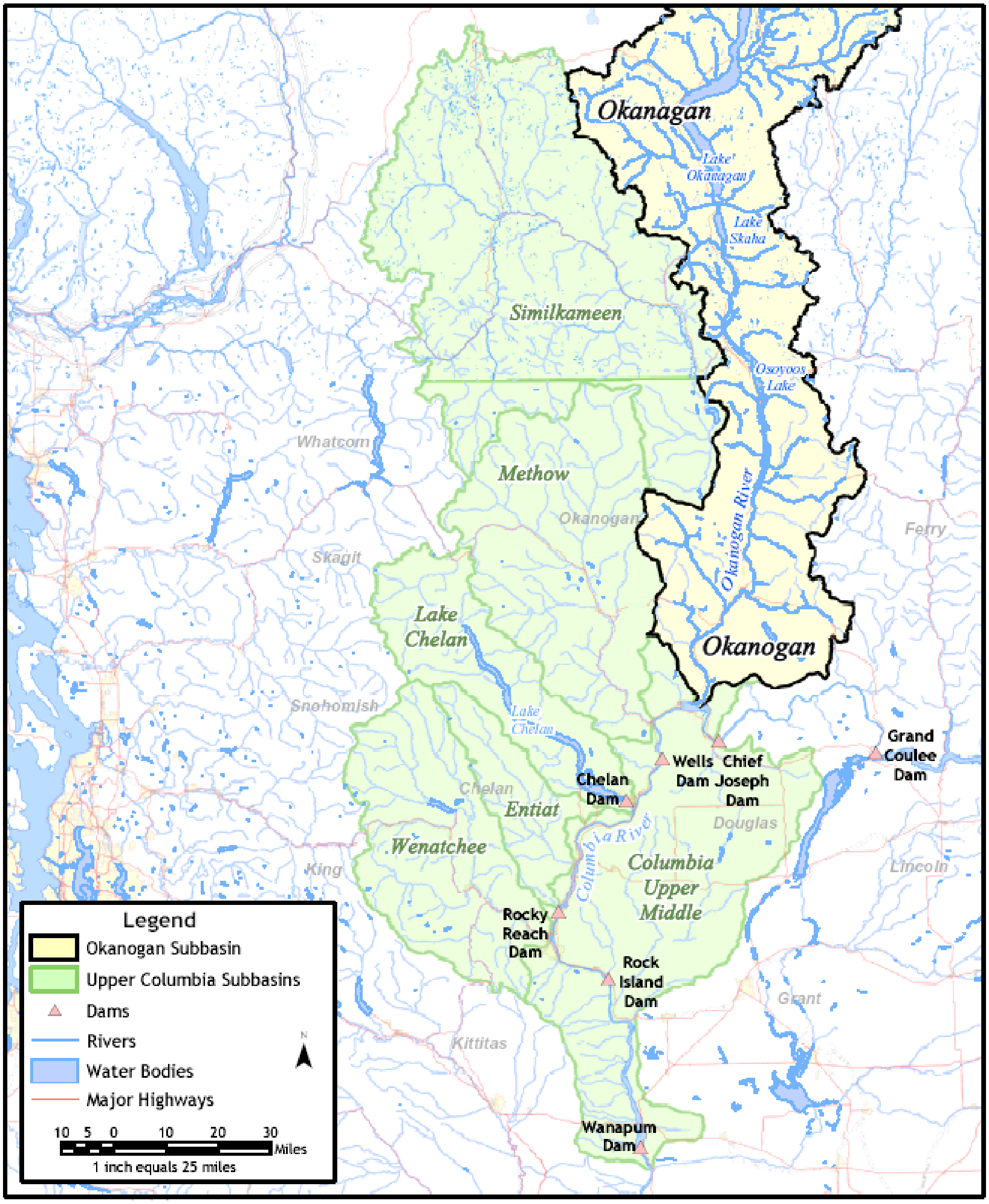
- adoption of a ‘stepwise’ approach to project implementation;
- a commitment to assessment and monitoring prior to, during, and after completion of the project; and
- a cyclical review of incoming assessment information to support a stepwise decision-making process that includes the option of project termination or reversal at any point where information clearly indicates the costs are likely to outweigh the benefits.

In addition to the elements noted under the first two bullets above, the COBTWG acknowledges support for adherence to the set of general ecosystem principles and operational guidelines adopted in May 2000 by Canada as one of the Parties to the United Nations 1992 Convention on Biodiversity.

3 Subbasin Assessment

3.1 Subbasin Overview

The Okanogan Subbasin enters the Columbia River between Wells and Chief Joseph Dams, straddling B.C. and Washington at Osoyoos Lake (Figure 3). The Subbasin is the third largest of Columbia River Basin’s 20 major subbasins, with its confluence at Columbia RM 533. The Okanogan subbasin comprises 16.2% of the Columbia Cascade Ecoprovince, and consists of 5,723,010 acres in the entire watershed.



Source: Data Layers: Watersheds & Dams (Streamnet, TRIM), Major Rivers (WA Ecology, TRIM), Major Highways (WashDOT, ESRI). Projection: Washington State Plane North Zone NAD83. Produced by Jones & Stokes for KWA Ecological Sciences, Inc. Map Date: 5/15/2004

Figure 3. Location of Okanogan subbasin in relation to the Upper Columbia River (Similkameen is part of the Okanogan watershed, but is inconspicuous in terms of the current scope of this subbasin plan. Water quality and some cultural issues are included in context.)

3.2 Subbasin Description

The Okanogan River originates in B.C. and flows south through a series of three large, and one small lake before reaching the US border. The border bisects Osoyoos Lake where the Okanagan River enters American territory in Washington State. Seventy-four percent of the subbasin is in British Columbia (B.C.), Canada, and 26% is in Washington State.

The Okanagan Watershed in Canada extends north from the Columbia Plateau in Washington State to the topographical divide separating the drainage basins of the Columbia and Fraser Rivers at Armstrong B.C. The majority of the Canadian Okanagan River mainstem lies in a valley that is a long north-south trench located in the interior plateau of B.C. The valley is 18 kilometres (11.2 miles) wide at the northern end, and only 3 – 6 miles (5 to 10 kilometres) wide at the southern end. From a few miles north of Armstrong, B.C., the entire valley drains south to the Columbia River. Many of the tributaries of the Okanogan River are small systems that arise in the hills that surround this valley. A total of 71 US subbasin tributaries were mapped for the purposes of the Okanogan Subbasin Summary 2002. In Canada, the B.C. Ministry of Water, Air and Land Protection (MWLAP) Watershed Atlas identifies an additional 94 watersheds in B.C. portions of the Okanagan watershed, including 81 greater than 50 hectares. In addition, the Similkameen River is Okanogan River's largest tributary, and includes another 110 Canadian subwatersheds (Glenfir Resources, 2002 from Watersheds, B.C. A B.C. Watershed Atlas. http:/home.gdbc.gov.bc.ca/watershedsbc) (Figure

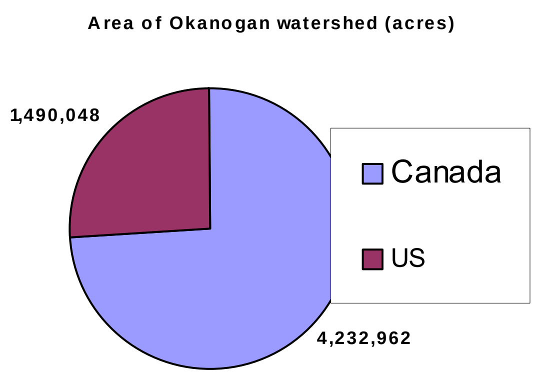


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Figure 4. Area of Okanogan watershed.

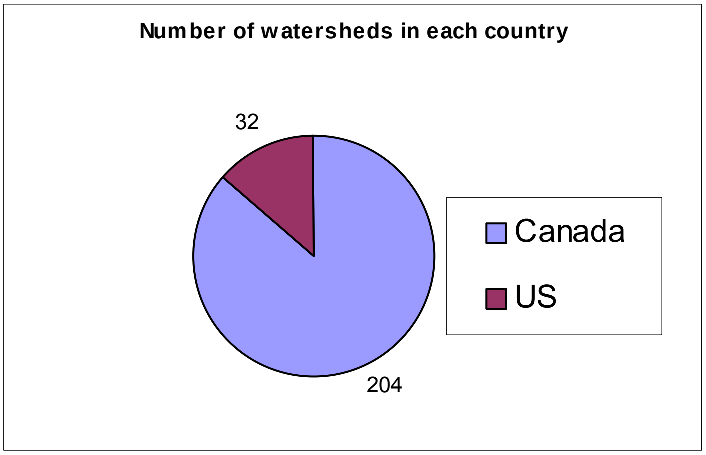


Figure 5. Number of watersheds in Canada and the U.S.

The Similkameen River enters the Okanogan River from the west approximately 20 miles south of the US-Canada border, measures approximately 317 miles in length (197 kilometres), and drains 2900 square miles (7,600 square kilometres in Canada).

The large number of Similkameen River tributaries provides lake-headed systems with more stable flow regimes. The largest subwatersheds of the Similkameen include the Tulameen River, Pasayten River and Ashnola River. Important lake-headed tributaries include Hayes Creek, Wolfe Creek, Allison Creek, and Summers Creek (tributary to Allison Creek). While most of the Similkameen River watershed lies in Canada, the confluence of the Similkameen and Okanogan rivers lies in Washington State, just south of Oroville.

The Okanogan River joins the Columbia River at river mile (RM) 533.5, between Chief Joseph and Wells dams, near the town of Brewster, Washington.

Within the United States, the watershed is about 65 miles long, averages about 35 miles wide, and covers about 1.49 million acres. There are 32 subbasins within Washington. The Similkameen River, located primarily in Canada, contributes 75% of the flow to the Okanogan River.

3.2.1 Cultural Features of the Okanogan Subbasin

Historic occupation of the Okanogan subbasin

Humans have been living in the Okanogan Basin for at least 7,000 years (Wilson, 1990). Before European settlement, native tribes lived in small, autonomous bands or villages (Honey, 1979). Most of the Okanogan natives of the region spoke Okanagan Interior Salish or Sxwuyi'71hp (Kennedy and Bochard 1975), but there were seven languages in the Okanogan area alone (Wilson, 1990).

The word "Okanogan" is derived from a Salish word that refers to the place on the Okanogan River that marks the furthest ascent of salmon up the river. Okanogan territory stretched from where the Okanogan River flows into the Columbia in the south, to beyond Lake Okanogan in the north. The tribe's territory stretched east from the crest of the Cascades for 100 miles. Okanogans did not recognize the United States/Canadian border as a demarcation dividing the tribe, but the boundary has created somewhat different lifestyles for those north and south of the border.

At least five bands of Okanogans lived south of the United States/Canadian border in at least twelve villages. Native peoples of the region hunted, fished, and gathered throughout that territory. There were salmon traps at locations near Oroville, Monse, Malott, and Omak. Other fish were caught in various locations inland from the Okanogan River. Bear, deer, mountain goats, rabbits, and other small game, ducks, geese, and grouse were hunted throughout Okanogan territory.

Foods gathered included service berries, thorn berries, huckleberries, blueberries, raspberries, strawberries, and Oregon grape. Bitterroot was also dug up, as was some Camas. Various native medicines were also gathered, and soapstone, dyes, and paints were collected at locations west of the Okanogan River. The stretch of Okanogan River controlled by the Okanogan Tribes also constituted a portion of an important trade route, with the mouth of the Okanogan being an especially important trading location.

In the US, currently over 8,700 descendants of 12 aboriginal tribes are presently enrolled in the Colville Tribes Reservation. In Canada, over 2,000 members of the Okanagan Nation Bands reside on seven federal Indian Reserves. They are non-treaty, and are associated with the Okanagan Nation Alliance (ONA) located in Westbank.

In 1886, the Colville Tribes reservation was opened to non- settlement, but a few Okanogans received allotments west of the Okanogan River and continued to live there. Most Okanogans moved onto the Colville Tribes Reservation. Tribal members continue to utilize their traditional food resources throughout their territory, fishing for salmon, digging camas, and gathering berries (Hart 2001).

Settling of the Okanogan subbasin

Trappers and traders began moving to the area in the early to mid-1800s.

Gold mining brought a major influx of people to the subbasin in the late 1800s. Many boom towns sprang up. The most famous town was Ruby, which became the first county seat of Okanogan County in 1888. The county seat was moved 11 months later to Salmon City (now named Conconully). Soon afterwards, the gold diminished, the miners moved away, and the boom towns declined in size and distinction. Mining in the Fraser River basin in British Columbia spurred large cattle drives up the Okanogan River Valley. The British customs station at Osoyoos collected duty on 22,256 head of beef cattle between 1859 and 1870.

The mining economy was slowly replaced by dry land farming and ranching. Agriculture, primarily orchards (vineyards in Canada), livestock feed, and wheat are predominant in the valley bottom. There are also several population centers and municipalities along the river and the lower reaches of the tributaries. During high spring flows, paddle-wheel riverboats traveled up the Okanogan River to the town of Riverside to offload goods and new settlers. Orcharding gradually became the mainstay of the local economy; growth was slow because of limited transportation and the lack of irrigation (Wilson 1990). In 1914, the Great Northern Railroad came to the basin, virtually replacing the paddle wheelers.

Following in the path of the railroad and local population centers was the extensive expansion of irrigation systems throughout the valley. With the relatively fast and reliable railroad service to the area, farmers were able to convert more and more land into agricultural production. Better transportation and a solid economic base allowed the communities to become more settled and permanent.

Throughout the 1900s orchards, cattle and timber provided the primary economic generators in the Okanogan subbasin. However, by the end of the century, all three economic mainstays had undergone substantial change, reducing their economic importance, and slowly being replaced by tourism, services and value-added manufacturing.

Tribal Interests

The Okanagan Nation Alliance and the Colville Tribes

The Okanogan Bands were not parties to any treaty with the United States or Canada, and remained relatively isolated from settlers until the Colville Tribes Reservation was created by Executive Order of July 2, 1872. This was followed by ceding the northern half of the reservation in 1891, reducing the overall reservation size to 1.5 million acres. However, the "right to hunt and fish in common with all other persons on lands not allotted to said Indians shall not be taken away or otherwise abridged." (Article 6, Colville Tribes Reservation Agreement 1891).

The Okanagan Nation Alliance is an assemblage of seven Okanagan Bands located in the traditional territories in Canada. There have been no treaties signed by Canadian Okanagan Bands. The Canadian Constitution Act (1982) recognizes and affirmed the continued existence of aboriginal rights, and in 1990, the Supreme Court of Canada in its"Sparrow Decision" confirmed that fishing rights are a priority, second only to conservation.

The entire Okanogan subbasin, south of the US-Canada border, lies within the Colville Tribes' Reservation or the usual and accustomed lands and waters utilized by the Okanogan Tribe. The Okanogan Tribe is now one of 12 tribes affiliated with the Colville Tribes Reservation. Many tribal allotments still exist along the Okanogan and Similkameen Rivers and smaller creeks.

East of the Okanogan River lies the present Colville Tribes Reservation and the ceded North Half Reservation. On the Colville Tribes Reservation, the Colville Tribes have jurisdiction and management plans for natural resources within the exterior boundaries of the Reservation. On the North Half Reservation, the Colville Tribes retain hunting, fishing and gathering rights reaffirmed by the Antoine v. Washington Decision of 1975. To this day, under the management of the Colville Tribes, members continue to harvest game and fish and gather wild plant materials on or in traditional lands and waters.

The Colville Tribes hold federally reserved fishing rights through the establishment of the Colville Tribes Reservation by Executive Order in 1872. The US Court of Appeals for the 9th Circuit ruled that a primary purpose of the 1872 Executive Order was to preserve tribal fisheries and access to traditional tribal fishing areas. The Court also ruled that the Colville Tribes possess federally reserved water rights to stream flows sufficient to preserve or restore tribal fisheries. The Colville Tribes also reserved their rights to fish and fishing in the waters of ceded lands, including the Okanogan River up to the Canadian border.

In 2000, the Bureau of Reclamation agreed with the Colville Tribes that the federal government had not completed its authorized anadromous fish mitigation for construction of Grand Coulee Dam over 60 years ago. Planned artificial production programs were not implemented for the Okanogan River Basin when the outbreak of World War II halted non-war related construction projects.

Tribes of the Colville Reservation have been seriously harmed by the lack of Grand Coulee mitigation, with ceremonial and subsistence fisheries declining to minimal levels, even in years of substantial runs entering the Columbia River. Fishing opportunity is now severely limited to summer/fall Chinook immediately below Chief Joseph Dam and an occasional sockeye fishery in the Okanogan River.

This situation has been adversely compounded by later formulas for mitigation of mid-Columbia Public Utility District dams where the Federal Energy Regulatory Commission does not require mitigation for now, non-existing.

Additional hatchery production under the proposed mitigation agreement with the Public Utility Districts (PUDs) is based on the run sizes of salmon and steelhead in a 10-year period during the 1970s and 1980s (Bugert 1998). Most of these post-dam runs were supported in large part by the initial hatchery mitigation programs funded by the PUDs and the federal government. Since the Colville Tribes did not receive the initial mitigation from the construction of federal and PUD dams, the basis for the new agreements discounts obligations to the Colville Tribes.

Without the initial federal salmon mitigation that other watersheds in the province obtained, the Okanogan Basin and Colville Tribes again were provided without mitigation.

Additionally, the federal government has never provided Okanogan anadromous fish mitigation for the Colville Tribes' loss of adult and juvenile fish passing through the four Corps of Engineers' (Corps) hydroelectric projects on the Lower Columbia River. Fish mortality at these projects has been generally estimated at about 10% per project, but was historically higher. Finally, Chinook mitigation by Douglas PUD for losses, because of inundation and passage, has been sited downriver at Wells Hatchery and in the Methow River, away from the Colville Tribes' reservation fisheries.

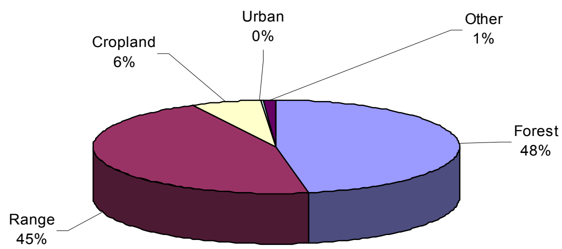
The Colville Tribes' total anadromous salmonid harvest is normally below 1,000 salmon and steelhead combined, and similar estimates are reflected in the Okanagan Nation fisheries upstream in Canada. Yet, in the 1800s, prior to over-harvest in lower river commercial fisheries and subsequent habitat destruction, the Colville Tribes were estimated to have harvested in excess of 2 million pounds of salmon and steelhead annually (Koch 1976).

3.2.2 Land Use and Water Developments

Land Use

United States

Forestry and range are by the far the major uses of land in the Okanogan subbasin in the US, followed by croplands (Figure 6). Most of the landscapes, from the riparian areas to the upper elevation forests, have been used for residential homes. The valley bottom is dominated by agriculture, primarily fruit crops, with some grain and hay production. The bench lands are dominated by livestock grazing and hay production, and most of the lower to mid-upper elevation forests have been harvested for timber and used for livestock grazing.



Source: NRCS, 2000

Figure 6. Land Use in the Okanagan subbasin

Table 1. US Okanogan subbasin land use overview

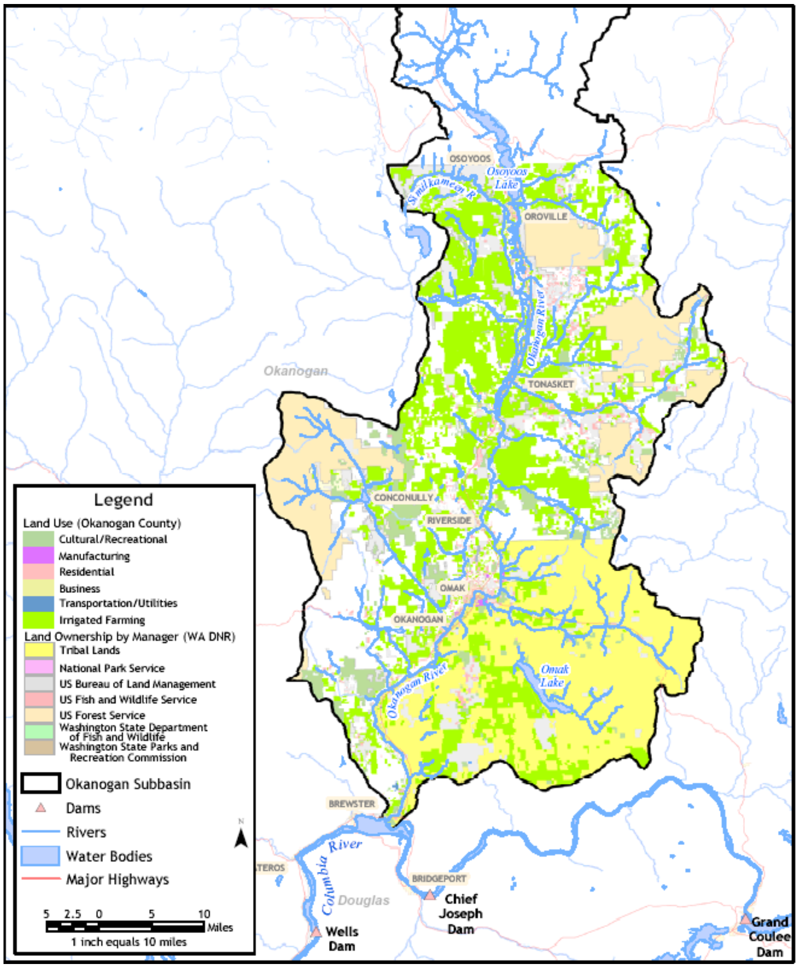
			Private Ownership			Public Ownership[1]		
Land Use	Number of Parcels	Acres	Number of Parcels	Acres	% of Total	Number of Parcels	Acres	% of Total
Single Family Residential	4,046	17,678	3,976	17,534	99.19%	70	144	0.81%
Other Residential[2]	357	728	344	650	89.29%	13	78	10.71%
Vacation/Cabins	439	6,314	438	6,313	99.98%	1	1	0.02%
Manufacturing	70	784	45	760	96.98%	25	24	3.02%
Transportation, Communication, Utilities	236	1,225	152	339	27.67%	84	886	72.33%
Trade	472	493	468	491	99.66%	4	2	0.34%
Services	448	952	279	314	32.98%	169	638	67.02%
Cultural, Entertainment, Recreational	600	30,856	194	607	1.97%	406	30,249	98.03%
Agriculture, Resource, Open Space	11,473	483,738	10,944	465,313	96.19%	529	18,425	3.81%

[1] includes Federal (USFS, BoR, BLM, BPA etc…), State (WDFW, DNR, Parks, DOT, etc…), Tribal (Trust, allotments, etc…), Local (County, Cities, Schools, Hosptials, Fire Districts, Housing Authorities, PUD's)

[2] - includes duplexes, apartments, manufactured home parks , condominiums and motels

			Private Ownership			Public Ownership[1]		
Undeveloped Land	5,293	109,120	4,675	63,903	58.56%	618	45,217	41.44%
Unclassified[3]	2,982	579,795	0	0	0.00%	2,982	579,795	100.00%
Totals	**26,416**	**1,231,683**	**21,515**	**556,225**	**45.16%**	**4,901**	**675,458**	54.84%

Source: OFM, 19



Source: Data Layers: Watersheds & Dams (Streamnet, TRIM), Major Rivers (WA Ecology, TRIM), Major Highways (WashDOT, ESRI). Projection: Washington State Plane North Zone NAD83. Produced by Jones & Stokes for KWA Ecological Sciences, Inc. Map Date: 5/15/2004

Figure 7. Land use types in the US Okanogan Subbasin (NRCS 2000)

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[3] - unclassified lands included State, Federal, Tribal, City, Schools and other public lands including rights-of-way, river corridors, etc…..

Canada

In British Columbia, the surrounding forested areas are public lands (Provincial Crown), and the valley bottom is predominantly privately owned or Reserve. The surrounding grass and scrub bench-lands are dedicated to cattle grazing tenures from Provincial agencies. Much of the land ownership along the Okanagan Valley bottom from Oliver north to Kelowna is dedicated to intensive orchard and vineyard agriculture, and urban development. Many transportation corridors and most settlement have occurred along the river corridor.

Water development

Stream flow in the mainstem Okanogan River is affected by a series of dams and channelization projects dating back to 1920. Water releases in mainstem lakes to meet fishery needs are negotiated yearly by a consortium of fisheries and irrigation managers from both Canada and the US Zosel dam flows are operated under the auspices of Orders set out by the International Joint Commission.

Irrigation Districts

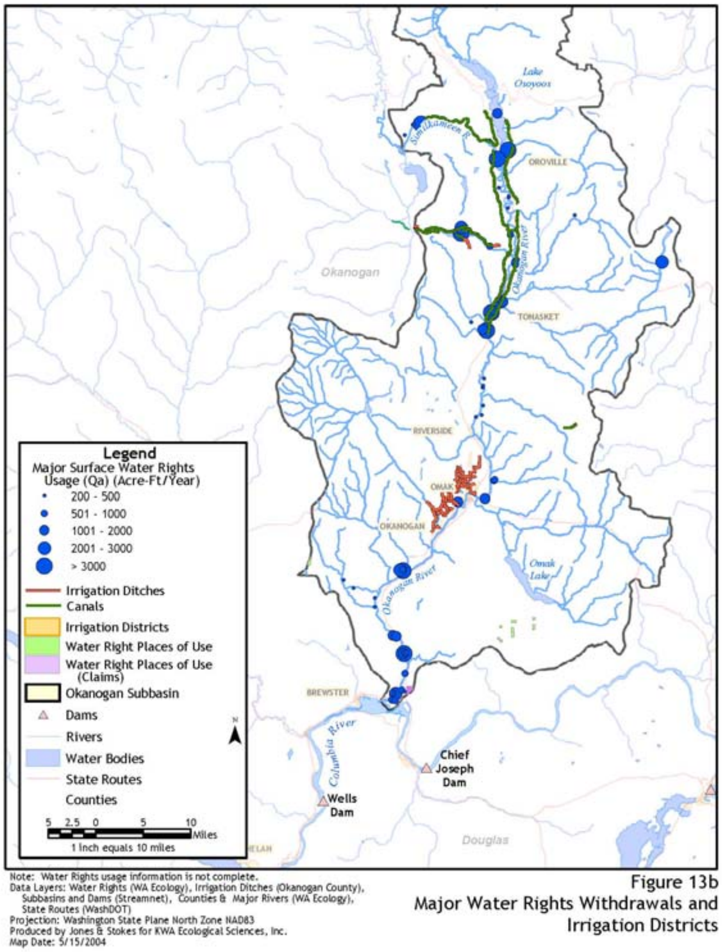
The watershed contains approximately 36,000 to 40,000 acres of irrigated area in the US portion of the subbasin. About 60 % of that acreage (24,421 acres) is contained within irrigation districts or ditch companies (Ecology 1995).

There are nine irrigation districts, reclamation districts, and canal companies operating in the Okanogan Watershed (Table 2). Major irrigation withdrawals and major water rights are illustrated in Source: Note: Water Rights usage information is not complete. Data Layers: Water Rights (WA Ecology), Irrigation Ditches (Okanogan County), Subbasins and Dams (Streamnet), Counties & Major Rivers (WA Ecology), State Routes (WashDOT). Projection: Washington State Plane North Zone NAD83. Produced by Jones & Stokes for KWA Ecological Sciences, Inc. Map Date: 5/15/2004.

Figure 8. These water providers comprise the bulk of irrigation water delivery from surface water sources to approximately 24,710 acres (OCD 1989).

Table 2. Irrigation Districts of the Okanogan Subbasin

Irrigation District	Source	Irrigated Acres	Length	Flow
Okanogan Irrigation District	Salmon Ck, Okanogan R.	5,032	50 mi. piped. 7.6 mi. lined canal	15,000 acre ft/yr.
Oroville Tonasket Irrigation Project	Similkameen R., Lk Osoyoos, Okanogan R.	10,300	110 mi. pipe 10 mi. canal	41,200 ac ft/yr.
Whitestone Irrigation and Power Company	Toats Coulee	3,000	16 mi. pipe 14 mi. lined canal	45 cfs max
Pleasant Valley Irrigation Project	Loup Loup Creek, Okanogan River	2,000	3 mi. pipe 3 mi. canal	17 cfs max
Helensdale Irrigation District	Loup Loup Ck., Okanogan River	225	2 mi. pipe	
Brewster Flat Irrigation Project	Columbia River @ Chief Joseph Dam	2,832	28 mi. pipe	60 cfs max
Aeneas Lk. Irrigation District	Aeneas Lake	1400	4 mi. pipe	12 cfs
Alta Vista		40	1 mi. pipe	1 cfs
Black Bear	Sinlahekin Ck	105	2.5 mi. pipe	2 cfs



Source: Note: Water Rights usage information is not complete. Data Layers: Water Rights (WA Ecology), Irrigation Ditches (Okanogan County), Subbasins and Dams (Streamnet), Counties & Major Rivers (WA Ecology), State Routes (WashDOT). Projection: Washington State Plane North Zone NAD83. Produced by Jones & Stokes for KWA Ecological Sciences, Inc. Map Date: 5/15/2004.

Figure 8. Major irrigation withdrawals and major water rights.

The most common irrigation system is a permanent solid-set sprinkler using micro sprinklers or conventional impact sprinklers. Overhead permanent sprinkler systems are selectively used. Some irrigation systems may be used for spring frost control efforts and for summer temperature modification.

Dams

There are 20 dams in the US portion of the Okanogan subbasin including 9 states, 7 private, 3 federal, and 1 PUD (Table 3). Another 15 are located on the subwatersheds, including Chiliwist, Summit, Trail, Bonaparte, and Tallant.

Table 3. Dams in the US Okanogan Subbasin (StreamNet, 2000)

Dam Name	Stream Name	Ownership	Year completed	Dam Length (ft)	Height (ft)t	Normal Storage (acft)	Max Storage (acft)
Fanchers Dam	Antoine Creek	Private	1926	450	68	500	600
Bonaparte Lake Dam	Bonaparte Creek	Private	1957	180	9	535	995
Stout Reservoir Dam	Chiliwist Creek	Private	1958	250	25	18	24
Horse Spring Coulee Dam	Columbia River	Private	1924	650	67		7,000
Fish Lake Dam	Johnson Creek	State	1920	50	7	2815	2,815
Schallow Lake Dam	Johnson Creek	State	1954	330	13	46	76
Osoyoos Lk. Control Dam (Zosel)	Okanogan River	State	1986	321	40	1,700	55,000
Leader Lake Dam	Okanogan River & tributaries	Private	1910	300	53	5,900	6,750
Leader Lake Saddle Dam	Okanogan River & tributaries	Private	1910	650	11	1,000	1,850
Little Green Lake Dam	Okanogan River & tributaries	State	1959	88	11	400	730
Salmon Lake Dam	Okanogan River & tributaries	Federal	1921	1,250	54	15,700	17,280
Sasse Reservoir Dam	Okanogan River & tributaries	State	1910	140	10	60	60
Spectacle Lake Dike	Okanogan River & tributaries	Federal	1969	1,110	25	13,450	14,080
Whitestone Lake Dam	Okanogan River & tributaries	Private	1930	375	9	2,144	2,720
Conconully	Salmon Creek	Federal	1910	1,075	72	13,000	16,570
Enloe	Similkameen River	PUD	1923	316	54	400	400
Blue Lake Dam	Similkameen River & tributaries	State	1923	1,500	32	4,416	4,416
Sinlahekin Dam No. 1	Sinlahekin Creek	State	1949	180	14	175	333
Sinlahekin Dam No. 2	Sinlahekin Creek	State	1949	248	18	52	82
Sinlahekin Dam No. 3	Sinlahekin Creek	State	1950	285	9	304	593

In 1913, a reported 11 dams had been constructed on the Canadian Okanagan watershed, and by 1998 there were 150. Currently, three Provincial dams are located on the mainstem Okanagan River, including McIntyre Dam located just north of Oliver at Vaseux Lake, Skaha Lake Dam at

Okanagan Falls, and Okanagan Lake Dam located in Penticton. Another 147 private dams are located on tributaries upstream of Okanagan Lake (Ken Hall et al. 2001).

There are also 13 vertical drop structures in the Canadian Okanogan mainstem between Osoyoos Lake and McIntyre Dam, designed to alleviate hydraulic energy that would have been dissipated in natural river meanders before channelization.

Enloe Dam is located on the Similkameen River at an abandoned power generation facility 8.8 miles above its confluence with the Okanogan River, just north of Oroville. Recently there has been interest in re-licensing the Enloe Dam, eliciting a renewed focus on upstream habitat suitability for salmon and conditions relating to cooling water flows to meet salmon needs downstream.

Fish Passage

United States

In the late 1800s, over-fishing in the lower Columbia River severely depleted salmon runs to upper Columbia River tributaries including the Okanogan River (Chapman et al. 1994a). In 1939, an extensive hatchery program was launched to offset the loss of access and mitigate for impacts created by the soon to be completed Grand Coulee Dam. Grand Coulee Dam blocked all fish passage starting in 1941 for over 1,000 miles of upstream salmon and steelhead habitats, including the Okanogan subbasin. Despite ongoing hatchery programs, resource managers have not been able to reestablish salmon and steelhead populations to self-sustaining levels.

Fish passage is not blocked in the US Okanogan mainstem, but periodically may aggravate fish passage by elevated temperatures in the Okanogan River. Dewatering in Salmon Creek occurs during low flow periods. Until 1999, fish passage was blocked on Omak Creek at two sites. All but 4 of the 15 dams on US subwatersheds are considered impassable. The 4 passable dams are on Omak and Tallant Creeks.

Enloe Dam on the Similkameen River blocks anadromous fish access to much of the Similkameen River, replacing Coyote falls, which was an historic barrier to upstream salmon migration (Chapman, 1995; Veddan, 2001). Current and historic salmon production is limited to the 8.8 miles below the dam. Recently there has been interest in re-licensing the Enloe Dam, eliciting a renewed focus on upstream habitat suitability for salmon and conditions relating to cooling water flows to meet salmon needs downstream.

Zosel Dam (RM 78) is passable by fish and controls the level of Osoyoos Lake. Reconstruction work in 1987 has improved fish passage into the lake.

Canada

The upper-most limit to migration in the Okanagan River mainstem currently remains McIntyre Dam at Vaseux Lake since 1954, although passage was partially impeded by the initial dam construction in 1919 (Butler 1974). The current structure offers some limited passage, allowing passage through Vaseux Lake up to the dam at Skaha Lake during freshet some years (pers. com. H. Wright). This allows access to limited salmon spawning habitats in the lake outlet and below Skaha Lake. Fish passage facilities are located in Skaha and Okanagan Lake, however have remained non-operational since 1954 as a function of increased vigilance over upstream flood control and a concern about invasion of exotic species. Drop structures in the engineered reaches of the Okanagan River are currently not considered an obstruction to fish passage.

Mainstem fish passage is also blocked by dams below Skaha and below Okanagan Lakes, limiting what is believed by many to be historic passage to the upper watershed. The deep cool-water refugia of Skaha and Okanogan Lake are considered important for the survival of Okanogan sockeye (H. Wright, pers. comm.). Fish-ways exist in Skaha and Okanogan Lake Dams, however have been closed since the construction of McIntyre Dam in 1920.

Impassable barriers to fish passage also exist on McIntyre (Vaseux) Creek caused by a natural obstruction in canyon approximately 1 kilometre upstream from confluence with Okanagan River. This may compound low flow and high temperature barriers in late summer and fall.

Dams on smaller tributaries upstream of Okanagan Lake are believed to be impassable to upstream fish migration and are thought to exacerbate seasonal dewatering or temperature barriers.

3.2.3 Populations and Growth Management

United States

The major US cities in the US portion of the subbasin include Oroville, Tonasket, Omak, Okanogan and Brewster. The population for the Okanogan subbasin is not readily available; however, in 1998, the population of Okanogan County (inclusively the Okanogan and Methow subbasins) (Table 4) was approximately 38,400, according to the Washington State Office of Financial Management (WOFM 1999).

Table 4. Population of major Okanogan subbasin counties, 1990-2000 (US Census Bureau, 2000)

City	1990	1998	% Increase
Brewster	1,633	2,050	25.5%
Conconully	174	205	17.8%
Okanogan	2,370	2,415	1.9%
Omak	4,117	4,435	7.7%
Oroville	1,505	1,595	5.9%
Pateros	570	595	4.3%
Riverside	223	365	63.7%
Tonasket	900	995	10.6%

Colville Reservation

On the Colville Reservation, tribal members make up approximately 61% of the population (4,760 members of 7,826 on 4/1999) within the Reservation boundaries. According to the Colville Tribes' Anadromous Fish Plan (Colville Tribes 2004 in press); the lands of the Reservation will be managed in 15 Resource Management Units (RMUs) that are further stratified into 209 Watershed Management Units (WMUs).

Canada

The population in 2001 of the plan area in Canada is estimated to be 281,140 (Statistics Canada). It is projected that the population will rise to 395,000 in the plan area by 2010. Much of this growth is occurring in and around the city of Kelowna, which has a population in excess of 100,000. Other cities in the Canadian portion of the plan area include Penticton, Vernon, Summerland, Oliver and Osoyoos. Similarly, the city of Penticton has approximately 32,000 people, and the city of Vernon has some 34,000 people. In many places this urban development is now occurring on former agricultural lands, extending well up the lower slopes because of the presence of the Agricultural Land Reserve, a provincial zoning system to maintain the production opportunity of agricultural lands.

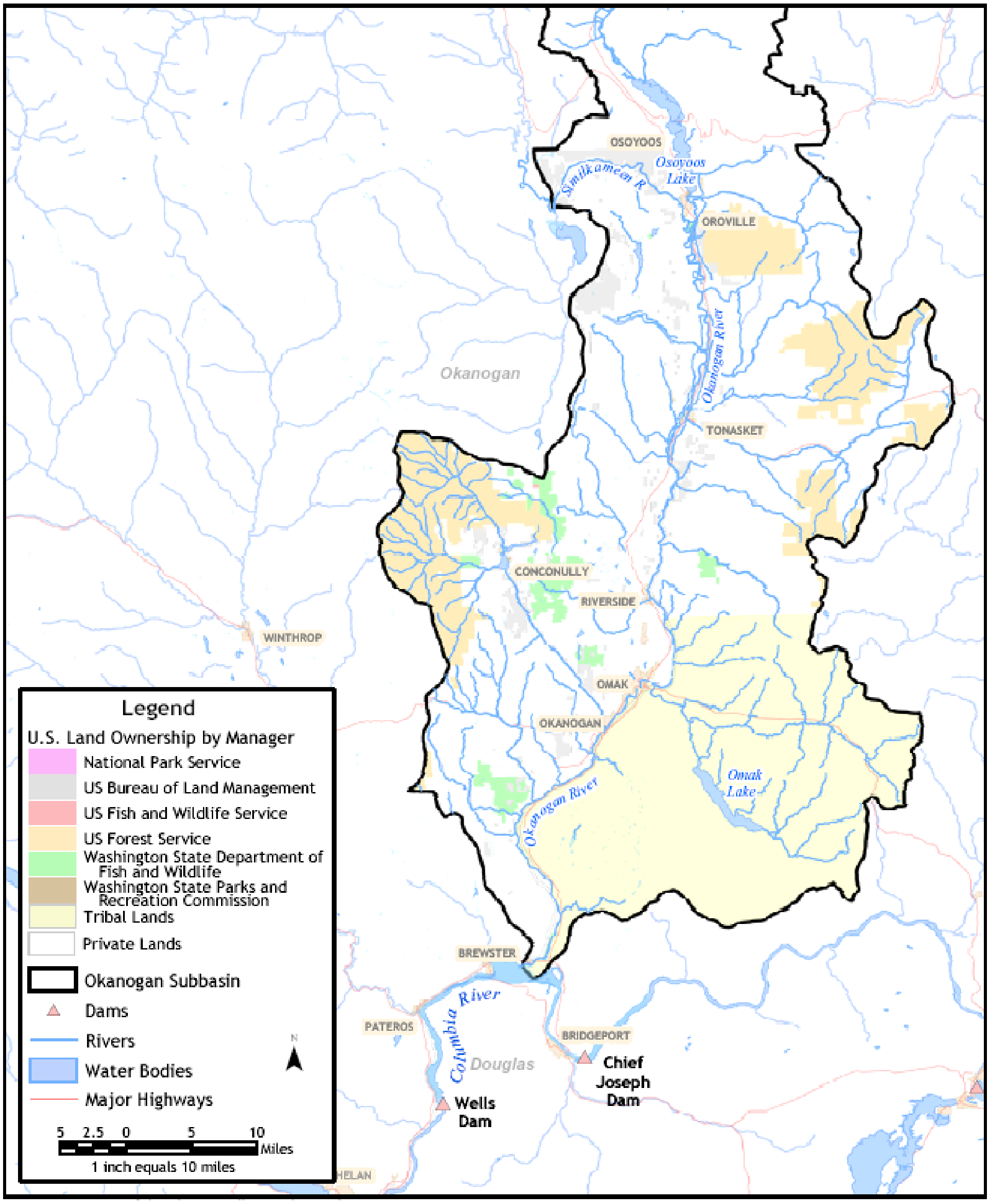
In response to the rapid growth of population in the Okanagan Valley, local government is responding to the planning challenges using various legislative tools including the Growth Management Act. The Central Okanagan Regional District, which includes the rapidly growing City of Kelowna, has Growth Management Strategies in place to provide strategic direction to land and water allocation decisions within its jurisdiction.

3.2.4 Jurisdictions and Land Ownership

Table 5. Land Jurisdictions in Okanogan Watershed

Land Jurisdictions in Okanogan Watershed				
(Percent of land area within each country)				
	US		Canada	
Public land	41		83	
	State Lands	17	Provincial Crown land	74
	Federal - USFS	21	Provincial Parks	9
	Federal - BLM	3		
Private land	34		14	
	Municipalities and Counties	34	Municipalities and Regional Districts	14
Indian (First Nation) land	21		3	

In the US, land use is managed according to Federal, State, Tribe, County and City governments (Figure 6). Land ownership within the Okanogan River subbasin is split almost evenly among public, private, and tribal ownership. The variety of land ownership and management jurisdictions across the US-Canada border complicates management of fish and wildlife corridors in the Okanogan subbasin.



Source: Note: For purposes of this plan, not all areas depicted. Data Layers: Land Ownership (WA DNR), Major Rivers and Water Bodies (WA Ecology, TRIM), Major Roads (WashDOT, TRIM). Projection: Washington State Plane North Zone NAD83. Produced by Jones & Stokes for KWA Ecological Sciences, Inc. Map Date: 5/15/2004

Figure 9. Land Ownership in the Okanogan subbasin

United States

Colville Tribes' tribal lands include both private and tribal ownership. Land ownership is primarily shared by the Colville Tribes Reservation, the USDA Forest Service, and private holdings. United States land ownership is primarily shared by the Tribes of the Colville Reservation, the USDA Forest Service, and private holdings

The north shore of the Columbia River between Chief Joseph Dam and the Okanogan River is within the Colville Tribes Reservation. The Colville Tribes reserve rights and interests for protection, enhancement, management, and harvest of anadromous fish in the upper Columbia basin. The Colville Tribes Reservation is comprised of 311,826 acres and makes up 21% of the subbasin.

Colville

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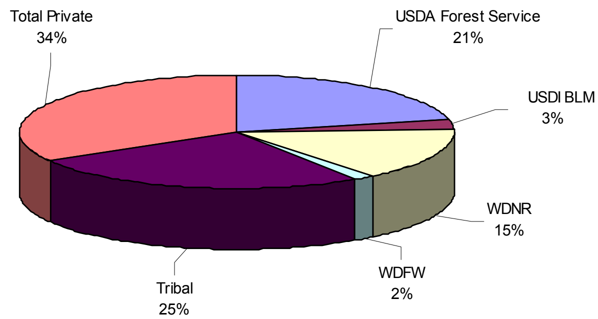
The Reservation is comprised of lands in both fee (20%) and trust (80%) status. The east half of the Reservation lies within Ferry County, the west half within Okanogan County.

Public

Public ownership comprises 41% of the subbasin, including 21% managed by the USFS, 17% managed by the State of Washington, 3% owned by the Bureau of Land Management (BLM), and the rest owned by miscellaneous agencies. The USFS manages 58% of commercial forests on public lands, the Bureau of Affairs manages 24%, and the WDNR manages 16%.

Private

The remaining 34% of the watershed is under private ownership (OWC 2000). Conversion of privately owned timber areas into other uses, such as residential subdivisions, is a trend, but not on the large scale that it is further south, in Wenatchee and Entiat (NMFS 1998). During a recent four-year period (1994 -1997), approximately 11,000 acres of forestland were subdivided (OWSAC 2000).



Source: NRCS 2000

Figure 10 Land ownership in the US Okanogan Subbasin

Canada

In Canada, land use is managed by federal, provincial, local and First Nation governments. Within the plan area in Canada, the land base is made up of varied public land (Provincial Crown land), private property, and Indian Reserves.

Public land

The provincial government, through various ministries and Crown agencies, manage most of the land and resources within the plan area, including all water allocation decisions. The major exception relating to the purpose of this plan document is the management of salmon by the Department of Fisheries and Oceans, an agency of the federal government.

Within the plan area, most Crown land is located outside the valley bottoms. These are the provincial parks (9% of the subbasin) as well as the resource lands (74% of the subbasin) that support most of the forest harvesting, range, and mining activity. Crown land also includes all aquatic land in the plan area (the beds of all lakes, rivers, and streams).

In 2001, the provincial government approved a comprehensive, strategic land and resource management plan. The Okanagan-Shuswap Land and Resource Management Plan (LRMP) provides strategic legal and/or policy direction to all provincial agencies on the use and management of Crown land and resources, and applies to most of the resource land in the subbasin. This plan was the outcome of a consensus agreement from a broad range of stakeholders and agencies. It led to the establishment of new provincial parks, as well as the establishment of resource management zones (RMZs) with associated management direction in the form of resource management objectives and strategies (Appendix E). The Okanagan-Shuswap LRMP is available online at http://srmwww.gov.bc.ca/sir/lrmp/okan/

Private land

In British Columbia, local governments regulate the use of private land. Local governments consist of municipalities and regional districts. Regional districts have many similar functions to the counties in Washington State; they regulate private property in rural areas outside urban centers. Within the plan area, the major municipalities are Vernon, Kelowna, and Penticton. The plan area comprises all of the Central Okanagan Regional District (CORD), as well as portions of the North Okanagan Regional District (NORD) and the Okanagan-Similkameen Regional District (RDOS).

Within the plan area, private lands occupy the valley bottoms and are dedicated mainly to settlement and agricultural uses.

First Nation Lands

Indian reserves are located within the plan area at Osoyoos, Penticton, Westbank and Vernon in close proximity to municipalities. The land and resources of these reserves are administered through the provisions of the Indian Act, a statute of the federal government, and through regulations of band councils. The reserve lands are used primarily for settlement, agricultural, and traditional uses.

The entire plan area lies within the traditional territory of Okanagan First Nations. Recent court decisions have affirmed that First Nations must be consulted on the potential infringement of aboriginal rights and title by proposed land and resource management decisions. First Nations are to be accommodated when infringement occurs.

3.2.5 Socio-economic Conditions

The major US cities in the subbasin include Okanogan, Oroville, Tonasket and Omak. In Canada, the major cities include Vernon, Kelowna, Penticton, Okanagan Falls, Oliver and Osoyoos. During the period 1971 to 1986, urban population increased by 63 percent, twice the rate of increase for B.C. as a whole (Okanagan Basin Study, 1974).

The population of the Canadian Okanagan Valley more than doubled from 1970 to 275,000 by 2001. At current growth rates of 2.5 percent, the Canadian subbasin population could exceed 390,000 by 2010). Rural population growth was also strong, increasing by 62 percent for the same time period (Okanagan Basin Study, 1974). Even so, the population primarily resides in urban areas with approximately 74% living in cities or smaller communities.

The Canadian portion of the plan area has become “Canada’s California.” The favorable climate, attractive scenery, excellent highway links to the Vancouver area, and local amenities have led to a highly diversified and thriving regional economy based on tourism, services, retirement, agri-business, high-tech and manufacturing.

More concise descriptions of socio-economic conditions and land use management in Canadian Reaches of the Okanagan Valley are contained within the Okanagan Shuswap Land and Resource Management Plan and the State of the Okanagan Basin report (COBTWG, 2004).

In US reaches of the subbasin, the timber, cattle and orchard industries have matured and along with a growing tourism industry impacting much of the subbasin particularly along lower elevations streams and lakes. Rural property owners and crop farmers over the last 100 years have developed much of the subbasin bottom. Table displays population figures and recent changes in population in cities in the US portions of the Okanogan subbasin.

Table 6. Population of major Okanogan subbasin cities, 1990-2000 (US Census Bureau, 2000)

City	1990	1998	% Increase
Brewster	1,633	2,050	25.5%

City	1990	1998	% Increase
Conconully	174	205	17.8%
Okanogan	2,370	2,415	1.9%
Omak	4,117	4,435	7.7%
Oroville	1,505	1,595	5.9%
Pateros	570	595	4.3%
Riverside	223	365	63.7%
Tonasket	900	995	10.6%

Agriculture- livestock and croplands

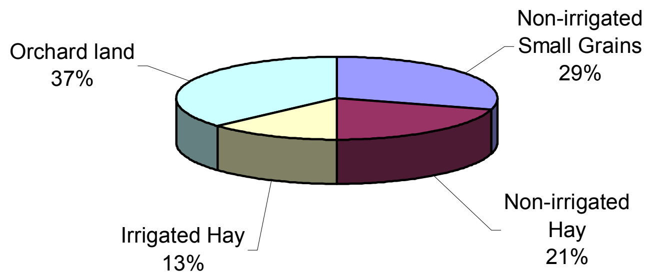
Agriculture is the dominant land use throughout the middle to lower elevation areas within both US and Canada subwatersheds. In US, livestock production is a major part of the economic base of the County. There are 754,996 acres of rangeland in the US Okanogan subbasin, owned and managed by USFS, BLM, DNR, Colville Tribes, and private owners. Cattle are grazed on forested lands and grass lands. Much of the Okanogan floodplain is used for forage crops and livestock wintering grounds (PNRBC 1977).

During the summer, cattle graze at high elevations, on state, federal, and private lands. Historically, sheep were grazed on public lands, but in 1998 the last band of sheep grazed on public lands was sold off. Currently small flocks of sheep and goats, and some horses, are grazed on private parcels in the lower basin (Keller, 2001).

The growth of the orchard industry in the semi-arid Okanogan Valley required an inexpensive supply of water available to all orchardists. Between 1860 and 1920 agriculture moved from stock raising and grain growing to intensive orcharding thus increasing demand for irrigation. This increased demand for water resulting in long, high volume, elaborate and expensive irrigation systems requiring storage, conveyance and application of water. By 1920 such a system was in place and the Okanogan fruit industry flourished.

Most of the Okanogan River valley bottom has been converted to agricultural uses, including cropland and orchards. Cropland in the Okanogan Basin is devoted to row crops, close-grown field crops, orchards, rotation hay and pasture, improved hayland, and summer fallow. Vegetables, berries, and nuts are also grown, but acreage figures were not available.

In many places in the subbasin plan, it identifies that conservation of land to agricultural use has resulted in, or contributed to, loss of habitat or negative impacts to the species that utilizes those habitats (fish and wildlife). These types of statements require that the following two discussion points be provided in the subbasin plan: 1) Not all agriculture provides negative impacts to fish and wildlife and their habitats. As such, each situation should be evaluated on an individual-by-individual basis; and 2.) In the US portion of the Okanogan subbasin, land being converted to agriculture is not occurring. In fact, agriculture as a whole is declining in the US portion of the subbasin. However in Canada, conversion of land to agriculture is occurring at quite a rate. (J. Dagnon 2004, pers. comm.).



Source: NCRS, 1998

Figure 11. Major crops of the Okanogan subbasin

Forestry

Timber production for the Okanogan National Forest increased from World War II until the mid-1960s (USFS 1998a). Timber production since the 60s has declined somewhat. Most of the forested land in the US Okanogan Subbasin is publicly owned, and it is mainly managed for timber. The major timber-producing areas in the basin are Toats Coulee, managed by the USFS, and the Loomis Forest, managed by WDNR. Forest productivity in the basin is relatively low because of the arid climate, the short growing season at high elevations, and steep, rocky terrain (NMFS, 1998).

Mining

In the US, the extraction of non-metallic minerals, including sand, gravel, gypsum, and limestone is more extensive in the basin than hard rock mining, and has played a larger role in the economy of the region. The USFS operates few gravel mine sites on the National Forest. The Okanogan County maintains numerous gravel mines, the WDNR maintains a few, and several are located on private property.

The only major placer mine in the US Okanogan Basin is located on the Similkameen River, between Oroville and Nighthawk. Within the last five years, the Kabba Texas Mine tailings area near Nighthawk was rehabilitated.

Transportation

The road and rail systems in the Okanogan subbasin were established around the turn of the century. A web of routes was developed along traditional travel corridors, typically along rivers and streams. Many of the current road locations were established at that time (Okanogan Conservation District).

During the 1920s and 1930s a number of railroad lines were built in the forested drainages of the basin. The most notable and by far the longest lasting of these was the narrow-gauge rail line into the Omak Creek watershed (Lewis, 1980). The construction of this line included a railroad grade through Omak Creek Canyon near St. Mary's Mission, and hard rock excavation was required.

There are approximately 85.5 miles of railroad in the Okanogan River Watershed (OWSAC, 2000). Almost all of the lines are located in the Okanogan River corridor. The main line is located within one half mile of the Okanogan River, from its confluence with the Columbia River to Oroville. There is no new construction of railroad lines planned in the Okanogan River Watershed.

Tourism

Tourism is a major activity within the Canadian Okanagan basin and to a lesser degree in the US portions of the subbasin because of the predominance of large Lakes. In Canada, the number of tourists in the basin noticeably increases during the summer. The US Okanogan subbasin as other historic generators decrease, tourism is starting to slightly increase. Attractive because of its considerable natural beauty and recreational opportunities, and it is emerging as the weekend getaway for those living in more populated areas.

Topographic / Physio-geographic Environment

The basin covers approximately 8,200 square miles (5.2 million acres), with 2,500 square miles or approximately 30% of the watershed in the United States. The eastern and western boundaries are steep, jagged, forested ridges at elevations ranging from 1,500 feet to over 5,000 feet above the basin floor. Tiffany Mountain is the highest peak in the drainage, at 8,242 feet above sea level.

The coastal and Cascade Mountains cast a rain shadow on the basin, creating the dry climates associated with this most northern extension of the western American deserts. The interior portion of the Okanogan is considered true desert – it receives about 3.0 to 3.3 inches of rain annually.

The open waters of the Okanogan’s finger lakes moderate local temperatures, however, cooling the air in summer and warming it in winter.

The floodplain of the Okanogan River averages approximately one mile in width. The elevation of the valley floor ranges from 920 feet at the international boundary, to about 780 feet at Lake Pateros. Lake Osoyoos covers the northernmost 4 miles of the valley floor in the US, and extends several miles into Canada. Natural terraces, created mostly of glacially deposited gravel and sands, rise as much as 500 feet above the floodplain to the foot of, and between, the lateral ridges (WSDOE, 1995).

Climate and Weather

Cold, snowy winters and hot, dry summers characterize the semi-arid climate of the Okanogan River Watershed. The climate is influenced by the barrier to marine air that the Cascade Mountain Range provides, and by the mountain and valley formations of the region. Precipitation in the watershed ranges from more than 40 inches in the western mountain region to approximately 8 inches at the confluence of the Okanogan and Columbia Rivers. Precipitation in the main river valley averages approximately 12 inches annually (NOAA, 1994).

The Okanogan Highlands, in the easternmost part of the basin, receives an average of 25-35 inches per year. About 50 to 75% of annual precipitation falls as snow during the winter months. Okanogan County's forestlands receive approximately 75% of the total annual precipitation (Gullidge 1977). July, August, and September are the driest months.

Mean annual temperature for the Okanogan Watershed is 49° F. The average temperature for January is 21° F and the July average is 73° F. Temperatures and weather conditions vary widely by elevation. Wind velocities throughout the region are calm to moderate, and winds generally originate from the north or south.

Thunderstorms occur occasionally in the watershed during late spring and early summer. Summer months have approximately 5 cloudy days per month, and winter has about 20 cloudy days per month.

On average, there are 150 frost-free days each year in the main Okanogan River Valley, and about 75 frost-free days in the surrounding uplands (NOAA, 1994).

3.3 Habitat Areas and Quality by Subwatershed

3.3.1 The Canadian Subwatershed and Tributary Descriptions

The Lakes

The character of the Okanagan subbasin in Canada is, to a large extent, shaped by the lakes. The lakes moderate the climate, store the water necessary for agricultural and urban development and provide holding and rearing areas for the focal fish species.

Okanagan is by far the largest lake. It covers 35,000 hectares (88,000acres) and has a maximum depth of about 240 m (800 ft). It is cooler and more oxygen rich than the lakes downstream and may be the most suitable lake in the Basin for spawning and rearing sockeye salmon and other focal species.

McIntyre Dam has excluded anadromous fish from Okanagan Lake and Skaha Lake for about 80 years. Consideration has been given to re-introducing sockeye salmon into Okanagan Lake but fisheries authorities have expressed concerns about competition between sockeye and an already declining kokanee population. To determine the benefits and risks of reintroducing sockeye salmon into Okanagan Lake the authorities decided to use Skaha Lake for an a experimental re-introduction. Test results will eventually show whether it is wise to re-introduce sockeye to Okanagan Lake.

Skaha Lake lies south of, and downstream from Okanagan. It is smaller, more productive, and more shallow than Okanagan, and has a flushing rate of 1 year as compared with 65 years for Okanagan. Despite these characteristics Skaha may be as good or better than Osoyoos Lake for rearing sockeye and other focal species and it may be needed as climate change continually reduces the rearing capability of Osoyoos Lake.

Vaseux Lake lies south of Skaha. Most of the lake is shallow, silty and weedy and although it supports low numbers of salmonids (rainbow trout and kokanee), introduced warm-water species such as largemouth bass and smallmouth bass seem to thrive.

Osoyoos Lake spans the Canada/US Border and includes three basins. Fisheries habitat is limited in summer by a combination of low oxygen at depth and high water temperatures near the surface. The tolerable zone in between is limited in the north basin and often non-existent in the central and south basins.

Intolerable conditions in Osoyoos Lake may partially or totally responsible for the disappearance of the returning sockeye between Wells Dam and the Canadian spawning grounds.

One of the limiting factors for focal fish species within the lakes of the Okanagan is the shrimp *Mysis relicta*. Introduced into Okanagan Lake as a food source for kokanee in 1966, they have slowly emigrated downstream and they have colonized Osoyoos Lake about 5 years ago. Numbers in Osoyoos Lake are thought to be increasing and managers are concerned that competition for food and space might adversely impact sockeye salmon. Control measures involving harvesting of mysids are being tried experimentally on Okanagan Lake and the results may be useful in managing Osoyoos Lake.

The Mainstem Okanagan River – Canadian Headwaters to the US Border

Over the last one hundred years man-made changes have substantially altered Okanagan River. Major alterations have included changes in the hydrograph resulting from the impoundment of Okanagan Lake, the construction of McIntryre Dam without a fishway, and straightening, shortening and channellization of all but a few kilometres of the river.

Fortunately the river still has a short stretch of exceptionally good spawning habitat that continues to support annual runs of sockeye salmon and remnant runs of Chinook and steelhead.

The uppermost 6 km (4 mile) stretch of Okanagan River, located between Okanagan and Skaha Lakes, has been completely channelized and the grade of the lower portion is too low to be useful to the focal species except as a migration path. The middle and upper portions of this stretch of river have a suitable gradient and are presently used by spawning kokanee. This stretch of river is expected to support spawning sockeye once they are re-introduced to Skaha Lake.

The stretch of Okanagan River from the outlet of Skaha Lake downstream to McIntyre Dam Vaseux Lake is, for the most part, too low in gradient to be used by focal species. The exception is the northernmost (upstream) reach, which runs from the outlet of Skaha Lake down to the confluence with Shuttleworth Creek. This reach has not been channeled and it has a good gradient and a mixture of cobble and gravel substrate. A modest fishery for rainbow trout occurs in this reach and the area may be suitable for steelhead if they are allowed past McIntyre Dam.

McIntyre Dam is a low head dam that was constructed to divert water into a very large, and as yet unscreened, irrigation ditch. It also balances water levels for Vaseux Lake. Many years ago, when largemouth bass had just moved into the Okanagan, McIntyre Dam was rebuilt. In an attempt to restrict further upstream movement of the bass, fisheries officers decided that McIntyre Dam should not be equipped with a fishway. The dam has blocked migration for all anadromous species since then. Major efforts and discussions are underway to remove this dam or provide fish passage through improvements.

The 9 km (5 ½ mile) section of Okanagan River from McIntyre Dam downstream to the Town of Oliver is unsurpassed from a fisheries viewpoint. It is the most productive waterway in Canada for Columbia River sockeye, steelhead and Chinook. A small portion of this section (1.1 km or 3/4 mile) remains completely natural with a fully functional floodplain and ideal grade and substrate. The remainder of the section is not completely natural but much of it has setback dykes, a meandering channel and ideal characteristics needed for sockeye spawning. The setback dyke portions of the river have high potential for habitat restoration. Some riverfront properties have already been purchased in this area with the idea of restoring a fully functional river with connectivity to the existing natural section. The protection and restoration of habitat in this short section of river is without a doubt the most critical need for anadromous fish in the Canadian portion of the Okanagan Basin.

The lower 15 kilometres (9 miles) of the river, from the Town of Oliver downstream to Osoyoos Lake, have been channelized. In the main this part of the river lacks habitat diversity and features such as a floodplain, riparian vegetation, LWD, cover and pools and riffles. Furthermore much of this portion of the river is low gradient and has silty substrates. There are, however, some riffles with gravel substrate and both sockeye and Chinook spawning has been recorded.

The tributary streams

The arid conditions of the Okanagan Basin within Canada limit the number and size of the tributary streams. Many (Hester, Marron, Reed, Testalinden, and Wolfcub Creeks) are small and ephemeral, remaining dry for most of the year. Others (Ellis and Shuttleworth) have major problems with silt loading, steep gradient and confinement and the benefits to be gained by working on them outweigh the gains to fish production. Both these categories of streams are considered low priority for protection or restoration in comparison with higher-quality tributaries.

Within the present planning unit (from Trout Creek south to the Canada/US Border) the higher quality streams are (from north to south) Trout, Penticton, Shingle, Ellis, McLean, Shuttleworth, Vaseux, Park Rill and Inkaneep creeks. Each of these is discussed below.

Trout Creek

Trout Creek runs east into Okanagan Lake 7 km (4 ½ miles) north of the lake outlet in Penticton. It drains a watershed of 45,107 hectares (111,458 acres) that is 80% forested and less than 2% is agricultural in nature.

Historically, Trout Creek was a major spawning area for kokanee and both fluvial and adfluvial rainbow trout. At present both stocks are depressed. Most of the flow of Trout Creek is diverted for use by the Town of Summerland, and a massive land slippage creates heavy silt loads. In addition the lowest reach of the creek has been channeled and stripped of riparian vegetation. Fisheries and Oceans Canada and the Town of Summerland are discussing base flows and reconnaissance studies are ongoing to investigate the possibility of rehabilitation.

Despite its problems, Trout Creek is considered to be a significant producer of kokanee at least some of the time (Rae, 2004).

In order for anadromous fish to use Trout Creek they would need passage over the dams located at Okanagan Lake and Skaha Lake outlets as well as McIntyre Dam. The former two dams have fishways that just need stoplogs. McIntyre Dam could be equipped with a fishway but changes in the way the dam gates are operated could provide passage prior to the construction of a fish facility (Brian Symonds, B.C. Water Management, pers. comm.).

Penticton Creek

Penticton Creek runs into the south end of Okanagan Lake approximately 1 km east of Okanagan River. Prior to channellization in 1949 the creek was reportedly a major producer of kokanee, rainbow trout and salmon. At present most of the lower end of the stream is confined in a concreted chute. However, the Penticton Flyfishers and other stewardship groups manually transport kokanee to spawning beds upstream and over the years they have maintained a significant run.

The province of B.C. and private industrial concerns have set aside funding for rehabilitation of the lowest reach on Penticton Creek and this work is scheduled for completion in time for the fall 2004 kokanee run.

Like Trout Creek, Penticton Creek is separated from the limits of anadromy by 3 dams.

Shingle Creek

Shingle Creek and its tributary, Shatford Creek, drain a watershed of 22,040 hectares (54,460 acres). The watershed is 80% to 90% forested with 3% agricultural use.

Shingle Creek flows east into the Okanagan River in the middle of the City of Penticton. The lower part of the creek passes through the Penticton Reserve. A low 3 foot dam is located 0.6 miles upstream from the mouth to divert water, but it is equipped with a fishway.

Both Traditional and non-native historical information confirms that Shingle Creek was historically a major fishing area for First Nations. The name for this creek translates to place of the steelhead (H. Wright, ONA, pers. comm.). McIntyre Dam has cut off access for anadromous fish but the stream continues to be an important producer of fluvial and adfluvial rainbow trout and kokanee.

Ellis Creek

Ellis Creek runs west through the industrial section of Penticton and drains a watershed of 12,182 hectares (30,101 acres). It is intermittent, steep and has a substrate of large boulders and cobbles. In freshet it carries heavy loads of silt and in mid summer it dries completely. A few kokanee spawn in the lowest reach of Ellis Creek but they soon encounter an impassable concrete dam. Costs of laddering the dam would probably outweigh benefits since the upstream habitat is steep and confined.

McLean Creek

McLean Creek enters Skaha Lake from the east about 2/3 of the way down the lake. The creek is small, intermittent and channelized but it is said to support spawning kokanee in at least some years (John Gibson, resident, deceased, pers. comm.).

McLean Creek is not of importance for the focal anadromous species and like Shingle and Ellis Creeks, it is separated from the limits of anadromy by Skaha Outlet Dam and McIntyre Dam.

Shuttleworth

Shuttleworth Creek enters the Okanagan River from the east in the Town of Okanagan Falls a short distance downstream from the outlet dam of Skaha Lake. This creek has significant problems with mass wasting and unstable banks higher up in the watershed. It introduces vast quantities of silt into Okanagan River between its confluence and Vaseux Lake. A sediment catching basin has been constructed at the mouth of Shuttleworth Creek but it appears ineffective.   Upstream of the sediment basin the stream is confined in a concrete chute.

Shuttleworth Creek is not considered worthy of attention at this time since costs of rehabilitation would probably outweigh the benefits.

Vaseux (alias McIntyre) Creek

Vaseux Creek enters Okanagan River from the east 1363 m downstream from McIntyre Dam. The watershed of Vaseux Creek is 80% forested and 0.7% agricultural. There is negligible urban development.

Presently this creek runs intermittently in the lower reach although there is a voluminous and continuous flow at the canyon further upstream. Local residents report that the lower section of the creek also used to run continuously and supported large numbers of sockeye and some steelhead and Chinook. Sockeye were reportedly so numerous they plugged irrigation canals. Carcasses were spread on adjacent fields as fertilizer (Blake Kennedy, resident, pers. comm.). Some say that channelization in the 1950s scoured the riverbed and opened up filtration galleries which now allow the stream to percolate underground during the summer (Barry Barrisoff, resident, pers. comm.).

Sockeye and Chinook still frequent this stream when flows are adequate (Howie Wright-ONA, pers. comm.) as do rainbow trout/steelhead. Members of Colville Tribes and Okanagan Nation Alliance visited the stream recently and were greatly impressed by its potential for the focal species. They wrote, "This stream could be key to salmon recovery effort in the Okanogan River basin…" and "… a huge potential for anadromous fish production exists."

Park Rill

Park Rill runs from the west into the Okanagan River north of the Town of Oliver. Prior to channelization in the mid 1950,s Okanagan River split into 2 channels and the western-most fork ran through the lower end of what is now Park Rill. Beds of watercress and cool summer temperatures show the presence of groundwater return at several locations along the old watercourse.

Sockeye and Chinook do not use the creek but rainbow/steelhead trout do and possibly rely on it as a critical thermal refuge since water temperatures in mid summer remain some 2 degrees C. less than those in the mainstem.

Inkaneep

Inkaneep Creek flows through the center of the Osoyoos Reserve and empties into the northern basin of Osoyoos Lake. Its watershed is 80% forested and 20% burned and agriculture uses 1.8% of the watershed. .

A natural falls about 5 kilometres (3 miles) from the mouth is a complete barrier to anadromous fish. Stream habitat below these falls is largely intact and appears to be suitable for summer steelhead and Chinook salmon (Howie Wright, ONA, pers. comm.).

Summer water temperatures are believed to be a limiting factor, which would restrict salmonid rearing to areas near ground water, but anglers reportedly catch large *O. mykiss* in the stream. These might be adfluvial rainbow trout from Osoyoos Lake or Okanogan River steelhead.

Habitat disturbances in the lower reaches include diking and riprapping as well as unscreened water diversions. In the upper stream reaches mass wasting occurs along the highway to Mount

Baldy Ski Area and this adds to the silt load experienced below. Further investigation of the factors limiting the production of focal species in this stream is warranted.

3.3.2 The US Subwatershed and tributary descriptions

The US Okanogan subbasin includes 17 tributaries. An overview of the mainstem Okanogan and its tributaties are described below, drawn from the Okanogan LFA (Entrix 2004). A useful and more detailed description of the tributaries and their limiting factors may be found in the Okanogan LFA – WRI 49 (Entrix 2004). Table 7 summarizes the subwatershed area and tributary status of Okanogan subbasin.

Table 7. Subwatershed Area and Tributary Status Of Okanogan River Subwatersheds

	Area (acres)	Tributary to:
Okanogan River – Interfluve	204,398	Columbia River
Nine Mile Creek	13,516	Okanogan River Interfluve
Tonasket Creek	37,874	Okanogan River Interfluve
Mosquito Creek[1]	6,093	Okanogan River Interfluve
Antoine Creek	46,690	Okanogan River Interfluve
Siwash Creek	31,032	Okanogan River Interfluve
Bonaparte Creek	97,877	Okanogan River Interfluve
Chewiliken Creek	17,125	Okanogan River Interfluve
Tunk Creek	45,586	Okanogan River Interfluve
Wanacut Creek	12,595	Okanogan River Interfluve
Omak Creek	90,691	Okanogan River Interfluve
Chiliwist Creek	27,842	Okanogan River Interfluve
Loup Loup Creek	40,868	Okanogan River Interfluve
Tallant Creek[1]	9,832	Okanogan River Interfluve
Salmon Creek	98,625	Okanogan River Interfluve
Johnson Creek	28,694	Okanogan River Interfluve
Fish Lake Basin Area[1]	23,124	Self Contained Basin
North Fork Pine Creek[1]	23,841	Self Contained Basin
Aeneas Creek	6,890	Okanogan River Interfluve
Aeneas Lake[1]	21,246	Self Contained Basin
Whitestone Creek (Spectacle Lake)	27,333	Okanogan River Interfluve
Similkameen River	228,536	Okanogan River Interfluve

	Area (acres)	Tributary to:
Sinlahekin Creek[1]	189,521	Similkameen River
Wanacut Lake[1]	13,853	Self Contained Basin
Omak Lake	68,685	Self Contained Basin
Duley Lakes/Joseph Flats Area	51,319	Self Contained Basin
Swamp Creek	64,158	Columbia River
Columbia River Interfluve - East	139,955	Columbia River
Total	1,667,798	

Reach 1

Reach 1 of the Okanogan River is shaped by the Wells Dam on the Columbia River, which creates a lentic influence to the lowermost 17 miles of the Okanogan River for approximately 17 miles. Consequently, the majority of the reach is essentially an elongated pool. Water level fluctuates frequently because of operational changes (power generation, storage) at Wells Dam. The stream banks are rarely exposed to high energy flows and remain relatively intact, because of low gradient and storage influences. Substrate consists almost entirely of mud, silt, and sand. Riparian vegetation consists of a dense layer of shrubs and saplings, which further protect the banks from scouring and erosion. There are few mature trees. In 1988, WDFW (1988) reported 70,619 summer Chinook smolts, and 22,897 summer steelhead smolts in reach 1 of the mainstem Okanogan.

Reach 2

Reach 2 is a broad, shallow, low gradient, channel with relatively homogenous habitat. There are few pools, and limited large woody debris. Sediment levels are high and substrate embeddedness is relatively widespread. There are highways on either side of the river for most of the length of Reach 2, and several communities along the river. Agricultural fields and residential areas are adjacent to the river. In 1988, WDFW (1988) reported 1,076,182 summer Chinook smolts, and 27,160 summer steelhead smolts in reach 1 of the mainstem Okanogan. The report (WDFW 1988) sites an error in the summer Chinook estimates, but does not account for the error in the reach estimates. Total summer Chinook smolts counted in the mainstem Okanogan were 1,499,712, a 352,911 difference between the individual reach information and the total mainstem information. This error may be because of the production available above Osoyoos.

Chiliwist Creek

The Chiliwist Creek subwatershed comprises approximately 27,842 acres, representing approximately 1.7% of the Okanogan watershed (OWC 2000). It is located in the southwestern corner of the Okanogan watershed, and is the lowest Okanogan subwatershed upstream of the Columbia River confluence that drains lands from the west. Chiliwist Creek enters the Okanogan River on its western side at approximately RM 15.1 (WDNR 1982).

The subwatershed includes all the habitat along the southeast border of the subwatershed (i.e., the western shore of the mainstem Okanogan) for approximately 27 kilometres (before entering the Columbia. The principal stream within this subwatershed area is Chiliwist Creek, a second order tributary, with approximately 5.9 miles of mainstem channel length. However, the subwatershed delineated for this LFA also includes the self-contained drainages of Sullivan Creek, Smith Lake, and Starzman Lake. None of these other waters within the subwatershed regularly convey surface waters to the Okanogan.

Previous problems identified for the Chiliwist Creek subwatershed by the OWC (2000) include: winter feeding areas adjacent to the stream, sediment from roads, irrigation de-watering the creek (i.e. diversions to outside of the subwatershed), and noxious weeds.

Only about the lower ½ mile of Chiliwist Creek is accessible to anadromous salmonids because a natural gradient barrier likely prevents further access upstream (Okanogan TAG). The use of this area for juvenile rearing or refuge by Chinook, steelhead and sockeye has not been formally determined. However, water quality in the lower basin would not preclude its use by any of the salmonid species in the basin for these functions. The cooler waters found within this tributary relative to the mainstem Okanogan suggest that it may be important in providing thermal staging during summer migrations of adult Chinook, steelhead and sockeye, with permissible flows. In 1988 41 summer steelhead smolts were counted in the Chiliwist subwatershed (WDFW 1988).

Dan Canyon

Dan Canyon is an intermittent, third-order tributary to the Okanogan River located entirely on the southwest plateau of the Colville Tribes Reservation. The southwest plateau also incorporates the Duley Lakes and Felix Creek subwatersheds that have been delineated for this LFA. The Dan Canyon subwatershed covers 9,081 acres and drains to the west. Dan Canyon enters the eastern side of the Okanogan River at approximately RM 5, although surface flows from Dan Canyon rarely (if ever) reach the Okanogan River. The watershed is a dense network of small, Type 4 and 5 intermittent streams, with a total stream length of 40.4 miles.

Fish presence in this area is minimal, as most streams are intermittent, and most lakes are highly alkaline or saline. Productivity in the pothole lakes is limited currently and historically by the alkaline waters condition, high water temperatures, and the fact that most of the lakes have no outlet, so no flushing can occur (Colville Tribes 2001). There are no anadromous species in the streams of the southwest plateau, including Dan Canyon. There is no historical information on fish presence, but anecdotal reports suggest that the creek may never have supported fish (Colville Tribes 2001).

The Colville Tribes Tribe used the Unified Watershed Assessment Categories (UWAC), a part of the EPA Clean Water Action Plan Criteria (EPA 1998) to characterize the condition of the watersheds on the reservation. Dan Canyon received a Category I rating, indicating that the subwatershed does not meet clean water and other natural resource goals, and needs restoration. This rating was based on general knowledge of the area, and should be field checked (Colville Tribes 2001).

Loup Loup Creek

Loup Loup Creek enters the Okanogan River at RM 16.9, in the small community of Malott, WA. Nearly the entire 40,868 acres of the watershed is categorized as forested (86.5%). Peak elevation in the subwatershed is approximately 6,100 feet (Buck Mt.), with several other peaks nearing 5,000 ft. Land ownership includes the Bureau of Land Management (BLM), Washington

Department of Natural Resources (WDNR), United States Forest Service (USFS) and private owners, with WDNR responsible for managing 31,506 acres. The Loup Loup Creek mainstem is approximately 19.8 miles long, with a total of approximately 75.9 miles of stream channel in the subwatershed.

Previous problems identified for the Loup Loup Creek subwatershed by the OWC (2000) includes: sediment from roads (i.e. SR 20 winter maintenance), irrigation de-watering the creek, 303(d) listings in the Tallant Creek area, confined pastures (also corrals) adjacent to the stream in the Tallant Creek area, heavy grazing having an adverse effect upon the plant community, herbicide and fertilizer application in an orchard near the creek and noxious weeds.

Historically, cutthroat trout likely existed in the upper reaches of Loup Loup Creek, and reliable anecdotal evidence of bull trout presence in the upper drainage reaches have also been reported (K. Williams, WDFW [retired], pers. comm. to N. Wells [Okanogan TAG]). Anadromous and resident forms of rainbow trout also existed in Loup Loup Creek. The anadromous forms of rainbow trout (i.e. steelhead) migrated as far as the falls (approximately RM 2.5). Currently fish species in Loup Loup Creek include rainbow trout and brook trout. The rainbow trout are likely remnants of a historical anadromous form. Eastern brook trout were planted by the Washington Department of Fish & Wildlife and have either hybridized or out-competed the native bull trout. Today, the range of anadromous fish in Loup Loup Creek is limited by man-made fish passage barriers and discontinuous flows. The lowermost barrier is a perched culvert at approximately RM .1. At ~ RM 2.0 water is diverted for irrigation. Typically the lower reach becomes dry during early summer (June/July), thus voiding all possible natural reproduction.

Leader Lake in the Loup Loup subwatershed is a popular recreational sport fishery. WDFW stock the Lake annually with 25,000 rainbow trout fry. During 1998 the WDFW rehabilitated Leader Lake to remove largemouth bass introduced by an unauthorized planting. Species known to exist in the upper reaches of the basin include rainbow and brook trout. There have been accounts of steelhead utilizing the lower reaches of Loup Loup Creek when adequate flows were present (Entrix 2001) and are presumed to be steelhead.

Duley Lakes/Joseph Flats

The Duley Lakes/Joseph Flats subwatershed covers 51,000 acres, and is located in the southwest plateau of the Colville Tribes Reservation, in the southeastern corner of the Okanogan River watershed. This area covers about 51,000 acres. Pothole lakes and ponds make up over 1300 acres of open water and there are no surface water connections to the Okanogan River from this subwatershed.

Previous problems identified for the Duley Lakes/Joseph Flats subwatershed by the OWC (2000) include: heavy grazing having an adverse effect upon the plant community and noxious weeds.

There are no anadromous species in the streams of the plateau. Resident fish presence in this subwatershed is minimal as most lakes are highly alkaline or saline. Carp are likely the only fish species in Duley Lake. Rainbow trout and largemouth bass have been planted in the past, but are no longer present. The lake is alkaline and does not support most species of fish. This is true of most of the lakes in the area. Little Goose Lake, north of Duley Lake, is relatively deep, and does support a population of stocked rainbow trout (J. Marco 2001, pers. comm.).

Felix Creek

The Felix Creek subwatershed comprises a variety of intermittent tributaries to the Okanogan River that drain the southwestern plateau of the Colville Tribes Reservation on the eastern side of the Okanogan River. The subwatershed is adjacent and north of the Dan Canyon subwatershed. Felix Creek, a second-order stream for which the subwatershed has been named, is the largest of the Okanogan tributaries within the subwatershed and no others have been named. Felix Creek enters the Okanogan River along the eastern side at approximately RM 24.

Surface flows from Felix Creek rarely reach the Okanogan River. The mainstem of Felix Creek is 2.6 miles long, and, based on USGS map-wheel projects, there are approximately 6.7 miles of stream channel in Felix Creek when its tributaries are included. Within the subwatershed as a whole, a total of 64.7 miles of stream channel have been identified from the USGS, although most of these channels are generally dry or ephemeral.

The Felix Creek subwatershed area is 3,405 acres, and elevation ranges from 820 feet at the mouth, to approximately 3,120 feet at the edge of the plateau from which surface waters could convey to the creek. (Colville Tribes 2001). A series of potholes dot the landscape in the Felix Creek subwatershed, the largest of which is Soap Lake. The potholes in the basin are fed by intermittent streams and groundwater, and hold water seasonally or year round. Fish presence in this area is presumed minimal to non-existent, as most streams are intermittent, and most lakes are highly alkaline or saline.

No anadromous species are known to utilize any of the streams in the Felix Creek subwatershed. However, presence/absence has not been recently confirmed in formal studies, and there is no historical information on fish presence (Colville Tribes 2001). Access would appear to be prevented by naturally inadequate flows under most conditions.

Productivity in the lakes of the Felix Creek subwatershed is limited presently and historically by the alkaline condition, high water temperatures.

Omak Creek

Omak Creek is a fourth order tributary of the Okanogan River that flows into the mainstem at RM 31. Of the 90,683 acres in this watershed, 73,029 acres are owned and managed by the Colville Tribes (Colville Tribes) (USDA 1995). The Omak Creek mainstem is approximately 22.4 miles long, with a total of approximately 272 miles of stream channel in the subwatershed. The climate of the subwatershed varies from arid to montane, with an average annual precipitation of 12 inches in the lower elevations to over 45 inches at Moses Mountain. Average daily temperatures range from 23o F in winter to 70o F in the summer. The average growing-season in the watershed lasts 120 days.

Approximately 8,112 (~9%) of the 90,683 acres within the Omak Creek watershed were burned or affected by the St. Mary's fire complex during August of 2001. The misapplication of fire-retardant chemicals inadvertently applied to Omak Creek and its riparian habitat in 2001 and 2003, resulted in a total fish kill from RM 8.4 to RM 2.9. A partial fish kill continued to nearly the confluence of the creek with the Okanogan River (RM 2.9 to RM 1.2). Over this length of creek, an estimated 10,400 fish were killed, principally resident rainbow trout, sculpin, and brook trout (Fisher and Fisher 2001, Fisher and Arterburn 2003). It is presumed that all offspring from the steelhead that successfully spawned in the creek in the spring of 2001 and 2003 were also killed from the retardant. Juvenile steelhead densities recorded upstream of the spill zone yet within the burn zone (1.12/m) were higher than the highest density of steelhead recorded in surveys of 25 arid-montane streams of Owyhee county Oregon (1.05/m) (Allen et al. 1998).

Previous problems identified for the Omak Creek subwatershed by the OWC (2000) include 303(d) listings, rural development, commercial impacts on the riparian zone adjacent to the mouth of the creek, sediment from roads, poor past forest practices such as skid trail placement, hoof shear by livestock, heavy grazing having an adverse effect upon the plant community, and noxious weeds.

The Omak Creek watershed supports a variety of fish species, including resident rainbow and brook trout, and the federally Endangered anadromous summer steelhead trout. Other species (e.g., *Cottis sp*., *Prosopium williamsoni*) also inhabit the creek, particularly in its lower reaches. In an effort to reestablish a locally adapted steelhead stock the Colville Tribes Fish and Wildlife Department, in a coordinated effort with Washington Department of Fish and Wildlife, has been stocking steelhead smolts in Omak Creek since 1980, with an increasing trend in returns.

The Colville Tribes has also recently embarked upon the re-introduction of Carson Stock spring Chinook salmon into the creek, and some 100,000 fry and 40,000 smolts were released into the upper watershed in the spring of 2001. (The National Marine Fisheries Service has considered spring Chinook to be extinct in the upper Columbia for many years). These fish were obtained from the Leavenworth National Fish Hatchery Complex as part of the US v. Oregon Agreement. Historically, Omak Creek supported steelhead and Chinook salmon, which were culturally important to the members of the Colville Tribes. It is presumed that steelhead utilized most of the perennial stream channels within the watershed, although Mission Falls (RM 8) was likely an effective barrier to Chinook salmon. Counts for summer steelhead included 901 smolts for 1988 (WDFW 1988). Sampling conducted by the Colville Tribes have identified 39 steelhead redds in 2002, 22 in 2003, and 104 adult steelhead at a weir located near the confluence with the Okanogan River in 2004. Fisher and Arterburn 2003, Colville Tribes unpublished data).

Salmon Creek

Salmon Creek is a perennial tributary of the Okanogan River with a total watershed area of about 167 square miles. The Salmon Creek mainstem is approximately 42.4 miles long, with a total of approximately 167.5 miles of stream channel in the subwatershed. Salmon Creek enters the Okanogan River at the town of Okanogan. Mountains surround Salmon Creek forming its hydrologic divides. The basin is generally oriented on a northwest-southeast axis, with a broad upper watershed about 8 to 10 miles wide and 12 to 15 miles long. The North Fork, West Fork, and South Fork of Salmon Creek converge at Conconully draining the 119 square-mile upper Salmon watershed. This portion of watershed is inaccessible to anadromous fish because of Conconully Dam and Reservoir. Conconully Dam is approximately 15 miles upstream from the mouth of Salmon Creek.

The Okanogan Irrigation District (OID) manages Conconully Reservoir to serve District lands east of the watershed. Controlled releases for irrigation deliveries are made from Conconully Reservoir between April and October. These releases are conveyed through 11 miles of natural and modified stream channel (referred to as the middle reach of Salmon Creek) to the OID diversion dam, located 4.3 stream miles above the mouth of Salmon Creek. For more than eighty years, the 4.3 miles of Salmon Creek downstream of the OID diversion dam (referred to as lower

Salmon Creek) have been dewatered, except during snowmelt events that result in uncontrolled spill at the OID diversion dam.

Previous problems identified for the Salmon Creek subwatershed by the OWC (2000) include: 303(d) listing, irrigation de-watering the creek, hoof shear by livestock, heavy grazing having an adverse effect upon the plant community, sediment from roads, fish passage blockages, poor past forest practices such as skid trail placement, rural development, winter feeding areas adjacent to the stream, and noxious weeds. Colville Tribes and the Okanogan Irrigation District formed a partnership in 1997 to evaluate the feasibility of restoring year-round instream flows. Currently, an EIS is being prepared to evaluation options and select a preferred alternative to address flow and habiat issues

Anadromous salmonids known to have historically occurred in Salmon Creek include spring Chinook (*Oncorhynchus tshawytscha*) and summer steelhead (*O. mykiss*). Before the construction of Conconully Dam in 1910, these anadromous fish may have utilized the north, west and south forks of Salmon Creek for 2 to 3 miles above the dam site. Both spring Chinook and summer steelhead are listed as "Endangered" under the Endangered Species Act. Spring Chinook are thought to be extirpated from Salmon Creek. Summer steelhead are occasionally observed in the creek during high water years.

NMFS considers all Columbia River steelhead returning to spawning areas upstream of the Yakima River confluence as belonging to the same ESU (NMFS 1997). This ESU is currently listed as "Endangered," and includes the Wenatchee, Entiat, Methow, and Okanogan watersheds. The Wells Hatchery steelhead stock is also included in this ESU because it is considered essential for the recovery of the natural population.

Historically, bull trout were thought to use the North Folk of Salmon Creek. Currently, FWS has documented bull trout in this area as "unknown occupancy". The Columbia DPS for bull trout was listed under ESA as Threatened June 1998.

Wanacut Creek

Wanacut Creek is a third order intermittent tributary to the Okanogan River located on the Colville Tribes Reservation immediately north of the Omak Creek subwatershed. Wanacut Creek flows westward, entering the eastern side of the Okanogan River at approximately RM 30, (Colville Tribes 2001). The total area of the Wanacut Creek subwatershed is 12,595 acres, representing 0.76% of the total Okanogan watershed (OWC 2000). The Wanacut Creek mainstem is approximately 7.6 miles long, with a total of approximately 38.7 miles of stream channel in the subwatershed.

Previous problems identified for the Wanacut Creek subwatershed by the OWC (2000) include: heavy grazing having an adverse effect upon the plant community, sediment from roads, rural development and noxious weeds.

Brook trout, an introduced species, is the only fish species recorded in Wanacut Creek, both currently and historically (Colville Tribes 1997). There may be rainbow trout in the upper reaches (Marco 2001, pers. comm.). The stream is not currently stocked, but the presence of brook trout suggests that it was stocked in the past. There are several culverts in the lower reaches, some of which may be passage barriers to fish (Marco 2001, pers. comm.).

Johnson Creek

The Johnson Creek subwatershed area delineated for this LFA includes the self-contained basins of Fish Lake and Pine Creek that do not flow into the Okanogan River. The Johnson Creek subwatershed, independent of Fish Lake and Pine Creek, comprises approximately 28,694 acres. When these basins are included, the subwatershed area comprises 75,659 acres. The Johnson Creek mainstem is approximately 7.9 miles long, with a total of approximately 28.6 miles of stream channel in the subwatershed—excluding the Pine Creek and Fish lake drainages. It is located on the western portion of the Okanogan Watershed with the Okanogan River as its eastern boundary, the Sinlahekin State Wildlife Recreation Area as its northwest boundary, and the Salmon Creek subwatershed to southwest. Johnson Creek joins the Okanogan River along its western shore at approximately RM 35, just south of town of Riverside. The Johnson Creek subwatershed runs parallel to the Okanogan River for about 11 miles. There is a series of 21 lakes found in the south-central terraced region of this subwatershed (USGS 1984a).

The climate within the Johnson Creek valley is semiarid. The highest mountain reaches change to a subhumid, but most of the subwatershed topography is below 2500 ft. There are large seasonal temperature extremes and daily temperature and precipitation variations. For example, temperature can range annually between 112°F - -31°F in the valley. Annual precipitation is less than 12.5 inches in the main valley (MWG et al. 1995).

Previous problems identified for the Johnson Creek subwatershed by the OWC (2000) include: winter feeding areas adjacent to the stream; confined pastures (also corrals) on the stream in the North Fork Pine Creek area, lack of riparian vegetation (both rural and urban areas); heavy grazing having an adverse effect upon the plant community (specifically the NF Pine Creek area), toxicity from urban-sewage treatment, individual wells and septic systems; sediment from roads (specifically Riverside Cut-Off Road); rural development; and noxious weeds.

All runs of summer/fall Chinook, sockeye and summer steelhead occur in the mainstem Okanogan River. No spawning, rearing or migratory activities are known to occur in the Johnson Creek tributary (Okanogan TAG). According to the 1998 study on the Methow and Okanogan Basins, the section of the Okanogan River that is in the vicinity of Johnson Creek contains the third highest density (0.8) of summer Chinook redds within the Okanogan (Murdoch and Miller 1999). A total of 21 redds were documented in ground surveys, of the section between the Riverside Bridge and the Tonasket Bridge, completed during the study. There is no documentation of sockeye salmon spawning in this area.

The thermal barriers and irrigation diversions found along the length of the Okanogan adjacent to the Johnson Creek subwatershed provide migration barriers that may decrease the number of returns. Sedimentation, cover, and high temperatures provide additional constraints to overall survival and reproduction of the salmon population (MWG et al. 1995). Adult sockeye will not migrate in waters higher than 69-70°F (MWG et al. 1995).

The Johnson Creek subwatershed has two dams within its network of waterways: Fish Lake Dam and Schallow Lake Dam (NWPPC 2001). Both dams are state-owned. The three main Species of Concern do not utilize tributaries within Johnson Creek; therefore these dams are not of direct concern.

Tunk Creek

Tunk Creek is a 3rd order tributary of the Okanogan River with a total watershed area of approximately 45,585.7 acres (OWC 2000). The Tunk Creek mainstem is approximately 19 miles long, with a total of approximately 76.5 miles of stream channel in the subwatershed. The creek enters the Okanogan River approximately 5 miles north of the town of Riverside, draining lands east of the river. The basin is generally oriented on an east-west axis. The watershed consists primarily of forest (40%) and rangeland (59.1%). Resource information regarding this subwatershed is very limited. (OWC 2000).

Previous problems identified for the Tunk Creek subwatershed by the OWC (2000) include: confined pastures (also corrals) adjacent to the stream, heavy grazing having an adverse effect upon the plant community, sediment from roads, commercial impacts on the riparian zone adjacent to the mouth of the creek, rural development, and noxious weeds.

Two of the main Species of Concern (Chinook and sockeye) do not migrate or spawn in Tunk Creek. Steelhead have a current distribution to McAllister Falls, approximately ¾ to 1 mile from the Okanogan confluence. The use of lower mile Tunk Creek below the falls is predicated upon adequate flows, thus, it is generally accessible to anadromous salmonids during the winter and spring months.

Resident rainbow trout occupy habitats upstream of the anadromous zone in Tunk Creek.

Chewiliken Creek

Chewiliken Creek is a second order Okanogan tributary that drains the eastern slopes of the Okanogan watershed in between Tunk Creek to the south, and Bonaparte Creek to the north. The mainstem of the creek is approximately 11 miles long, with a total of roughly 22 miles of stream channel within the subwatershed's boundaries. Peak elevations in the subwatershed ascend to Tunk Mt. (6,054 ft), although only the northwestern flanks of this peak should drain towards Chewiliken Creek.

Of the 26.8 square miles in the subwatershed, the PSIAC estimates a total sediment recruitment into the Okanogan River mainstem of 0.33 ac-ft/sq mi, 0.99 tons/acre, and 16,954 tons/yr (as cited in OWC 2000). The sediment yield from this subwatershed represents approximately 1.1% of the 1,581,950 tons recruited into the mainstem Okanogan per year.

According to MWG et al. 1995, there are 16 groundwater claims for 144 gpm, but no groundwater permits. There are an additional 27 surface water claims for 2.3 cfs.

The TAG did not identify Chewiliken Creek as a significant tributary of the Okanogan for supporting anadromous salmonid spawning or rearing.

Aeneas Creek

Aeneas Creek enters the Okanogan River along the west side at approximately river mile 50. The Aeneas Creek mainstem is approximately 8.0 miles long, with a total of approximately 27 miles of stream channel in the subwatershed. The subwatershed comprises approximately 0.41% of the total Okanogan watershed (OWC 2000). Aeneas Creek flows in a southeasterly direction from the slopes of 3,107 ft. Aeneas Mountain to the Okanogan River (approx. 900 ft el.). The second order Okanogan tributary has a total stream length of approximately 8 miles, and flows through an area referred to as the "lime belt region." The affect of this lime belt land-type region is evident by the accumulation of calcium carbonate along the streambed channel.

Previous problems identified for the Aeneas Creek subwatershed by the OWC (2000) include: heavy grazing having an adverse effect upon the plant community, undersized culverts on private drives, and noxious weeds.

Information regarding the aquatic resources of Aeneas Creek is limited. Most information that does exist originates from reconnaissance surveys and anecdotal observations (L. Hoffman 1998, C. Fisher 1998). Two adult fish passage barriers were identified during joint surveys conducted by the Colville Tribes and Washington Department of Fish Wildlife during the summer of 1998 (Okanogan TAG). The lowermost partial barrier is a concrete box culvert located approximately ¼ mile upstream from the mouth. Potential anadromous fish use is restricted to habitat up to the lowermost falls in the system at approximately RM ¾. A private trout farm once operated in the system upstream of the falls, approximately 1 mile above the Pine Creek Rd bridge crossing (~ RM 3). It is not known whether this was simply a grow-out facility, or a complete hatchery operation.

The Whitestone Creek Watershed encompasses six main bodies of water (from north to south): Blue Lake, Wanacut Lake, Spectacle Lake, Whitestone Creek, Whitestone Lake, and Stevens Lake (DOI and BOR 1976). The Okanogan River flows along its eastern border, running 33.1 kilometre along the subwatershed from Oroville to Tonasket (Murdoch and Miller 1999). The Whitestone Creek subwatershed is an island surrounded by larger subwatersheds of the Okanogan watershed. To the west is the Similkameen River subwatershed, to the southwest is Aeneas Creek, to the southeast is the Siwash Creek, to the east is the Antoine Creek and to the northeast is the Tonasket Creek. The Whitestone Creek mainstem is approximately 2.8 miles long, with a total of approximately 83.4 miles of stream channel in the subwatershed.

Summer Chinook spawn from about early October to early November in the Okanogan and related tributaries near the Whitestone Creek confluence. The 33.1 kilometres of the Okanogan River that runs along the Whitestone Creek subwatershed's eastern border supported the highest density of summer Chinook redds throughout the Okanogan River in 1998 (Murdoch and Miller 1999). The ground and aerial survey taken from September to November counted a total of 29 redds, 33% of the total found that year (Murdoch and Miller 1999). The 1998 study estimated that, based on a 3.6 fish/redd ratio, 317 Redds expanded through tributary escapements. Compared to the total of 88 Redds found in the Okanogan, the tributaries potentially play a more dominant role in summer Chinook spawning than the Okanogan itself.

The Bonaparte Creek watershed is of mixed ownership. The acres are a mixed ownership as follows: Private ownership, 59,000 acres (58%); Washington Department of Natural Resources, 9,000 acres (9%); Bureau of Land Management managed lands, 1000 acres (1%); and the remaining 33,000 acres (32%) are managed by the US Forest Service (USFS).

Bonaparte Creek

Bonaparte Creek, a significant 4th order tributary that encompasses 102,120 acres. It enters the Okanogan River in the city of Tonasket, Washington, at River Mile (RM) 56.7 of the Okanogan River. The subwatershed at its longest (straight) axis is approximately 24 miles long; its widest point is approximately 17 miles wide. There are approximately 126 miles of stream channel throughout the subwatershed. The elevation of the confluence of Bonaparte Creek with the Okanogan River is 880 feet. The highest point in the Bonaparte Creek watershed is Bonaparte Mountain at 7,240 feet. The Bonaparte Watershed is oriented on an east to west axis.

Previous problems identified for the Bonaparte Creek subwatershed by the OWC (2000) include: winter feeding areas adjacent to the stream, hoof shear by livestock, lack of riparian vegetation, rural development (i.e. sprawl east of Tonasket along Bonaparte Creek), sediment from roads (i.e. SR 20), and noxious weeds.

Anadromous fisheries resources are restricted to the lower 1.0 mile of the Bonaparte Creek subwatershed because of an impassable waterfall. Resident trout and sculpin are found above these falls. By estimate, less than 100 square meters of suitable spawning habitat occurs in Bonaparte Creek in the accessible zone. A large area, 200 square meters (.049 acre) with suitable spawning substrate is 300 meters (328 yards)downstream in the Okanogan River.

Use of Bonaparte Creek by summer steelhead is assumed up to the impassable falls at river mile 1.0. WDFW (1988) counted 65 summer steelhead smolts from the mouth to Peony Creek. In the spring of 2001, 2 steelhead redds were observed in Bonaparte Creek (C. Fisher [Okanogan TAG], confirming the use of this system by this Endangered stock. Summer/fall Chinook salmon are known to spawn in the mainstem Okanogan River just downstream of the Bonaparte Creek confluence.

The mainstem Okanogan River is used for migration northward to Canadian waters. Most of the known summer/fall Chinook spawning areas are in the Similkameen River. It is unlikely that Chinook salmon use Bonaparte Creek, as flows in the fall are less than 5 cubic feet per second (cfs), but spawning has occurred in the mainstem Okanogan River below Bonaparte Creek. Sockeye salmon are known to use the mainstem Okanogan River by the Bonaparte Creek confluence as a migration pathway to their spawning areas in Lake Osoyoos and the upstream reaches of the Canadian Okanogan River. Sockeye salmon are not known to use Bonaparte Creek, but could use its accessible habitat during migration for holding or refuge.

Siwash Creek

The Siwash Watershed is 30,946 acres. Of these acres, 10,567 (34%) acres are managed by the USFS, the remaining 20,379 (66%) acres are a combination of ownership that includes private owners (60%), Washington Department of Natural Resources (5.5%), and Bureau of Land Management managed lands (<1%). The Siwash Creek mainstem is approximately 21 miles long, with a total of approximately 42.5 miles of stream channel in the subwatershed.

Previous problems identified for the Siwash Creek subwatershed by the OWC (2000) includes: irrigation de-watering creek, sediment from roads, confined pastures (also corrals) adjacent to the stream, and noxious weeds.

Anadromous fisheries resources are restricted to the lower 1.4 miles of the Siwash Creek subwatershed because of an impassable steep gradient channel. Suitable spawning habitat occurs in Siwash Creek only when flows are sufficient to allow migration upstream.

No data are available about the use of Siwash Creek for rearing or spawning of Upper Columbia River Summer Steelhead. It is assumed that passage of adults is not restricted up to river mile

1.4, to the steep gradient channel area. Juvenile fish, either resident rainbow trout or steelhead do invade the lower reaches in the spring.

Antoine Creek

The Antoine Creek watershed encompasses 46,695 acres of mixed ownership. The acres are a mixed ownership as follows: Private ownership, 30,000 acres (72%); Washington Department of Natural Resources, 2800 acres (6%); Bureau of Land Management managed lands, 459 acres (<1%); and the remaining 9,806 acres (21%) are managed by the US Forest Service (USFS).

Antoine Creek enters the Okanogan River 4 miles north of the city of Tonasket, Washington, at River Mile (RM) 61.2 of the Okanogan River. The watershed at its longest axis is approximately 16.5 miles long and its widest point is approximately 10 miles wide. There are approximately 55 miles of stream channel within the subwatershed.

Fancher Dam impounds Antoine Creek at approximately RM 12. Approximately 40% of the watershed acres drain to Antoine Creek above Fancher Dam, with the remaining 60% of the watershed draining to Antoine Creek below Fancher Dam. The Fancher Dam reservoir covers approximately 20 acres and is approximately 55 ft deep at its deepest point. The water stored in the Fancher Dam reservoir is used for irrigation of croplands.

Previous problems identified for the Antoine Creek subwatershed by the OWC (2000) include: sediment from roads, hoof shear by livestock, heavy grazing having an adverse effect upon the plant community, and noxious weeds.

Potential anadromous salmonid use of Antoine Creek is restricted to the lower 11.5 miles of the subwatershed due waterfalls and a steep gradient channel that begins at RM 11.5. Steelhead adults are known to use the confluence area of Antoine Creek with the Okanogan River (C. Hinkley, pers. comm.). Sockeye and Chinook salmon are not known to use Antoine Creek, but their use of the accessible habitat near the confluence for holding and limited rearing cannot be precluded. There are no data or anecdotal information indicating bull trout ever used the Antoine Creek watershed, likely because of inhospitable temperatures.

Tonasket Creek

Tonasket Creek enters the Okanogan River east of the city of Oroville, Washington, at River Mile (RM) 77.8 of the Okanogan River. The watershed at its longest axis is approximately 12 miles long and its widest point is approximately 8 miles wide. The mainstem channel of the creek is 14 miles long, and there are approximately 75 miles of stream channel total in the sub-watershed.

During July of 2001 the subwatershed experienced localized flash flooding. This event resulted in the loss of human life, and significant channel realignment and provided a vivid example of one of the major forces in the Okanogan watershed in shaping aquatic habitats.

Previous problems identified for the Tonasket Creek subwatershed by the OWC (2000) include: sediment from roads (i.e. SR 20 winter maintenance), irrigation de-watering creek, herbicide and fertilizer application in orchard near creek, and noxious weeds.

Anadromous fisheries resources are restricted to the lower 1.9 miles of the Tonasket Creek subwatershed because of the steep gradient of the channel that initiates at this point and continues to approximately RM 2.3. Above RM 2.3, it is suspected that eastern brook trout are present, though some fish shocking done in preparation for the replacement of a culvert on the paralleling County Road 9480 did not reveal any fish (L. Hofmann, pers. comm.).

Steelhead fry are observed in the confluence area where Tonasket Creek joins the Okanogan River by Ken Williams, Area Fish Biologist Region 2 WDFW (retired). He surmised that the fry were using the confluence area for rearing, and to evade predators found in the mainstem Okanogan River, and perhaps to make use of relatively warmer water temperatures in Tonasket Creek compared to the Okanogan River (K. Williams, pers. comm.). Summer steelhead smolt counts totaled 148 from the mouth to the headwaters in 1988 (WDFW 1988). An adult steelhead was caught at approximately RM 1.8 in the late 1970s (D. Buckmiller, pers. comm.)

Similkameen River

The Similkameen River is the largest tributary to the Okanogan River that originates in the Canadian Cascade range and drains the northeastern Washington Cascades. The Similkameen River enters the Okanogan River from the west approximately 20 miles south of the US-Canada border, and measures approximately 317 miles in length (197 kilometres), and drains 2900 square miles (7,600 square kilometres in Canada).

The US portion of the Similkameen Basin is approximately 666.5 square miles with a perimeter of 226.9 miles. The total Similkameen drainage basin is approximately 228,536 acres, 80% of which is in the Canadian portion of the watershed (OWC 2000, USDI 1986). It is a hydrologically complicated watershed, bordered to the southwest by the Sinlahekin River watershed, which joins the mainstem Similkameen at the Palmer Lake Reservoir. In the US, the 189,521-acre Sinlahekin subwatershed comprises the vast majority of the stream channel miles of the Similkameen subwatershed.

The large number of Similkameen River tributaries provides spawning and rearing for the tributary’s mainstem resident fish, particularly lake headed systems with more stable flow regimes. The largest subwatersheds to the Similkameen include the Tulameen River, Pasayten River and Ashnola River. Important lake headed tributaries include Hayes Creek, Wolfe Creek, Allison Creek, and Summers Creek (tributary to Allison Creek). While most of the Similkameen river watershed lies in Canada, the confluence of the Similkameen and Okanogan rivers lies in Washington State, just north of Oroville.

Previous problems identified for the Similkameen River subwatershed by the OWC (2000) includes: 303(d) listings, unstable streambanks from Shankers Bend to the Canadian border and Palmer Creek to Toats Coulee Creek in the Sinlahekin Creek area, sediment from roads, lack of riparian vegetation, heavy grazing having an adverse effect upon the plant community, a monitored EPA a monitored EPA Super Fund Site, and noxious weeds.

Even though there are problems with sedimentation and water temperature, Chinook salmon runs returning to the lower reaches of the Similkameen and Okanogan Rivers have increased slightly, as a primary result of returns to the Similkameen River. Escapements have declined slightly in the Okanogan (OWC 2000).

Passage for salmon in the Similkameen is restricted at Enloe Dam, approximately 8.8 miles above the confluence with the Okanogan River (WDNR 1982). This 54 ft dam built between

1916 and 1923, was originally constructed for hydropower generation, but is no longer operational in that capacity.

Enloe Falls, prior to the construction of the dam, is believed to have restricted anadromous access to the upper Similkameen watershed, although photographic interpretations of the falls has suggested possible passage under certain flows. There is no historic record of anadromy upstream of the falls (OWC 2000), and the Okanagan Nation acknowledges the legends of the Coyote that have always prohibited salmon passage to the upper watershed.

The Canadian fisheries agencies have also committed to a policy of no salmon passage to preserve the historic ecosystem. In Canada, the Umatilla dace, chizelmouth, and mottled sculpin are on Provincial conservation lists (Appendix C). Rainbow trout stocking in the upper watershed support a recreational fishery.

The Similkameen River below Enloe Dam is one of the most heavily utilized sections of the Okanogan watershed by summer/fall Chinook. Spawning is concentrated between the dam and Driscoll Island, just upstream from the confluence with the mainstem Okanogan. Between 1977 and 1985, 17 to 43% of the Chinook redds counted from all Chinook that passed Wells Dam were recorded in the Similkameen (Mullan 1987).

The escapement into the Similkameen, where natural production is occurring, ranged from 395 to 654 fish between 1977 and 1983, and jumped up to over 1200 fish in 1984 and 1985 (Mullan 1987). Detailed studies conducted in 1991show the highest density of spawning occurs in the lower 5 miles of river (Hillman and Ross 1991).

The use of the Similkameen by other anadromous salmonids is more limited. The Similkameen historically produced steelhead, and limited use by this species continues today. No escapement or spawning data were reviewed specific to this species from this system. Sockeye salmon do not use the Similkameen for spawning, although it is likely a staging area during immigration and emigration that depends upon the cool waters as refugia during warm summer migrations. There are no records of bull trout in the Similkameen River.

Ecology of the Okanogan subbasin

Geology of the Subbasin

The Okanogan River subbasin geology and geomorphology is influenced by the Cascade Range, Northern Rockies, and Columbia Plateau Systems that border it on the west and south sides, respectively. During the Quaternary Period, glaciers sculpted the landscape below 5,000 feet, covering large areas with glacial drift and fluviolacustrine sediments.

Small alpine glaciers were also active at higher elevations. Cascade volcanoes were active during the Pleistocene and into the Holocene. Deposits of volcanic ash from these eruptions occur within the area (Hansen 1998). Due to glacial activity, rock outcrops were exposed in many places and formed a complex pattern with the materials deposited by glaciation. Much of the bedrock has been weathered to shallow soils (SCS 1980).

The erosive action at the base of the glacial ice create unconsolidated and unsorted mixtures of silt, sand, gravel, and stones. Glacial fluvial meltwater streams carried large quantities of sand and gravel, creating thick deposits of sorted materials. In areas of low gradient or local impoundment, glacial meltwater created lacustrine deposits of clay soils. Some deposits of glacial drift are mantled by volcanic ash (SCS 1980).

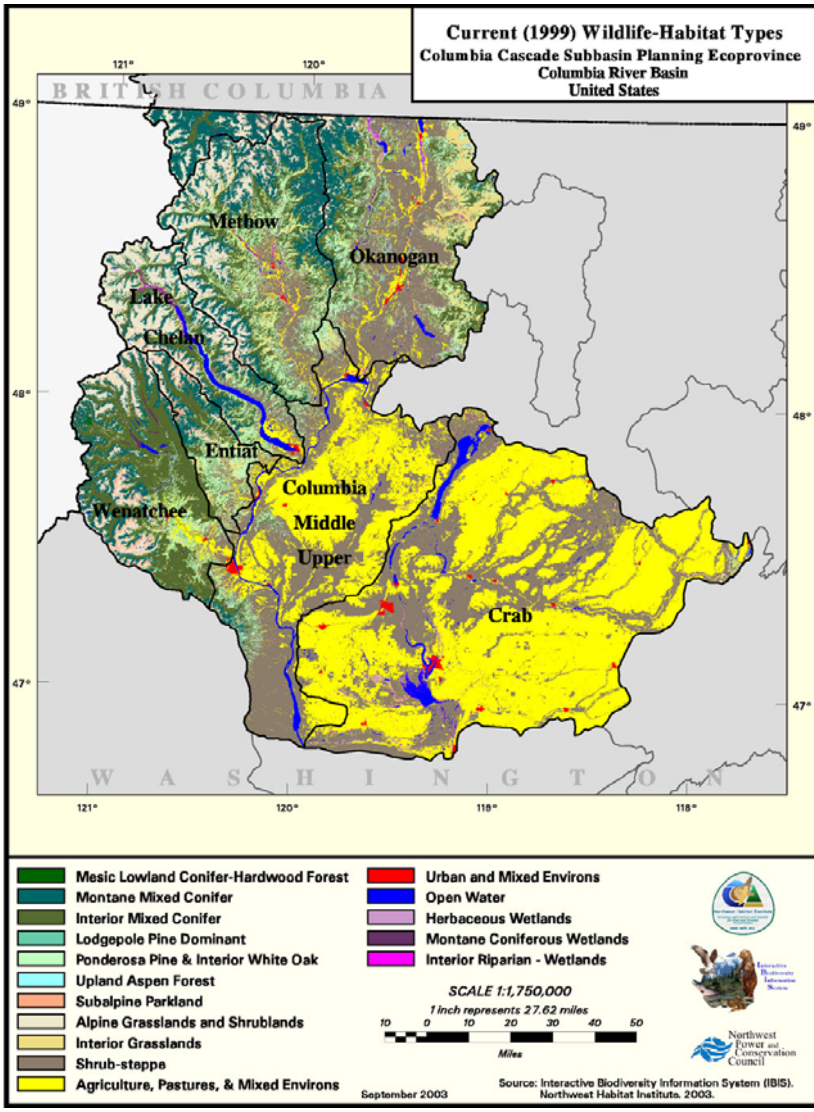
The Okanogan valley represents a northern extension of the western American deserts, and an important link between the arid regions of Washington and British Columbia. The retreat of the Wisconsinian glaciers approximately 11, 000 years ago, left behind a broad terraced valley, lined with fertile benchlands, intersected by a network of small streams draining into the chain of large Okanogan lakes.

The Okanogan River valley is broad and flat. Given the topography and geology, the river probably once meandered across the valley, and riparian habitat formed an extensive mosaic of diverse species. It was dominated by some combination of grass-forbs, shrub thickets, and mature forests with tall, deciduous trees.

The Okanogan subbasin's riparian and wetland corridor today embodies an essential artery to the Columbia Basin, supporting Threatened populations of fish, plants and wildlife within the Columbia-Cascade eco-province (CCP). The subbasin also provides important contiguous habitats, across the Canada-US border and surrounding the riparian/wetland corridor, which connect similar vegetative zones and landscapes to the south, including the Great Basin Sonoran, Mohave and Chihuahuan deserts.

This complex of habitat corridors provides migration paths for fish and wildlife, migrating across jurisdictions that bisect the CPP. These include pine forests, shrubsteppe, riparian and herbaceous wetland plant communities, and the rugged terrains comprised of cliffs, caves and talus slopes. These habitats support a large number of fish, birds, mammals, reptiles and amphibians including several Endangered species.

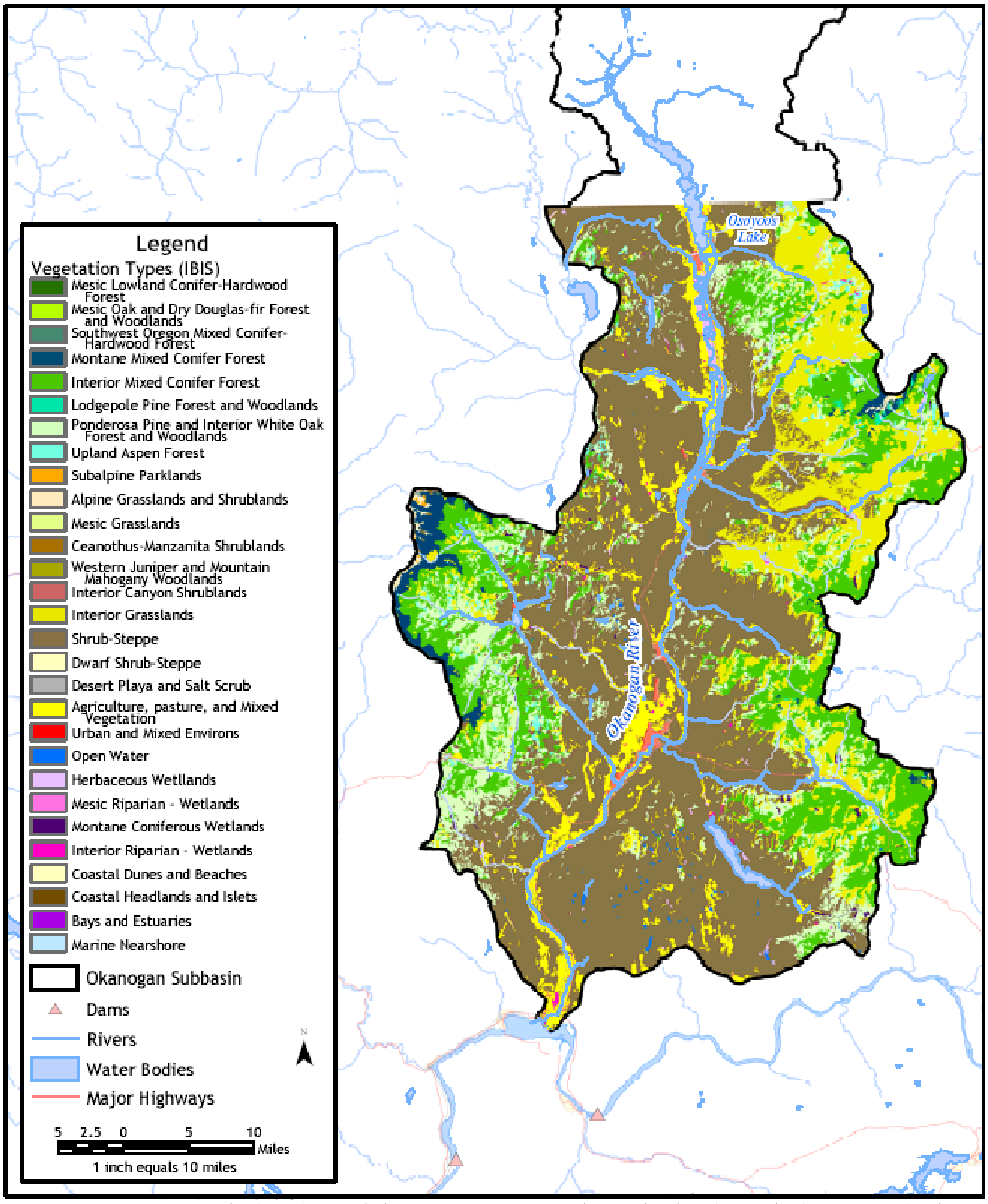
The combination of an arid/semi-arid climate with hot summers and mild winters and complex physiography provides the conditions for a wide array of ecological communities connecting the Okanogan subbasin to the CCP (**Figure 12**). A significant number of the Columbia Basin's species and landscapes are at risk in the Okanogan, elevating the current threats to Okanogan biodiversity to an international conservation priority.



Source: IBIS 2003

Figure 12. Okanogan subbasin in relation to other Upper Columbia River subbasins and vegetative zones

The Okanogan subbasin consists of 15 wildlife habitat types, which are illustrated in Figure 12, and briefly described in Table 4. Detailed descriptions of these habitat types can be found in the Columbia Cascade Ecoprovince Wildlife Assessment and Inventory.



Source: Data Layers: Vegetation (NWHI), Watersheds & Dams (Streamnet), Counties & Major Rivers (WA Ecology), State Routes (WashDOT). Projection: Washington State Plane North Zone NAD83. Produced by Jones & Stokes for KWA Ecological Sciences, Inc. Map Date: 5/15/2004

Figure 13. Vegetation Types in the Okanogan subbasin

Table 8 Habitat types in the Okanogan subbasin

Habitat Type	Brief Description
Montane Mixed Conifer Forest	Coniferous forest of mid-to upper montane sites with persistent snowpack; several species of conifer; under-story typically shrub-dominated.
Eastside (Interior) Mixed Conifer	Coniferous forests and woodlands; Douglas-fir commonly present, up to 8 other conifer species present; under-story shrub and grass/forb layers typical; mid-

Habitat Type	Brief Description
Forest	montane.
Lodgepole Pine Forest and Woodlands	Lodgepole pine dominated woodlands and forests; under-story various; mid- to high elevations.
Ponderosa Pine and Interior White Oak Forest and Woodland	Ponderosa pine dominated woodland or savannah, often with Douglas-fir; shrub, forb, or grass under-story; lower elevation forest above steppe, shrubsteppe.
Upland Aspen Forest	Quaking aspen (Populus tremuloides) is the characteristic and dominant tree in this habitat. Scattered ponderosa pine (Pinus ponderosa) or Douglas-fir (Pseudotsuga menziesii) may be present.
Subalpine Parkland	Coniferous forest of subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*) and lodgepole pine (*Pinus contorta*).
Alpine Grasslands and Shrublands	This habitat is dominated by grassland, dwarf-shrubland (mostly evergreen microphyllous), or forbs.
Eastside (Interior) Grasslands	Dominated by short to medium height native bunchgrass with forbs, cryptogam crust.
Shrubsteppe	Sagebrush and/or bitterbrush dominated; bunchgrass under-story with forbs, cryptogam crust.
Agriculture, Pasture, and Mixed Environs	Cropland, orchards, vineyards, nurseries, pastures, and grasslands modified by heavy grazing; associated structures.
Urban and Mixed Environs	High, medium, and low (10-29 percent impervious ground) density development.
Open Water – Lakes, Rivers, and Streams	Lakes, are typically adjacent to Herbaceous Wetlands, while rivers and streams typically adjoin Eastside Riparian Wetlands and Herbaceous Wetlands
Herbaceous Wetlands	Generally a mix of emergent herbaceous plants with a grass-like life form (graminoids). Various grasses or grass-like plants dominate or co-dominate these habitats.
Montane Coniferous Wetlands	Forest or woodland dominated by evergreen conifers; deciduous trees may be co-dominant; under-story dominated by shrubs, forbs, or graminoids; mid- to upper montane.
Eastside (Interior) Riparian Wetlands	Shrublands, woodlands and forest, less commonly grasslands; often multi-layered canopy with shrubs, graminoids, forbs below.

Alpine-tundra

The upper Canadian subbasin includes an Alpine-tundra biogeoclimatic zone in elevations greater than 1,350 metres (4,429 feet).

Forests

US Forestland comprises approximately 47% of the American Okanogan River Basin. Dominant forest species include ponderosa pine, Douglas-fir, lodgepole pine, Englemann spruce, western larch, subalpine fir, and aspen. Whitebark pine and subalpine larch occupy alpine settings. Dominant riparian species include black cottonwood, water birch, and white and thinleaf alder (Arno1977), but riparian forests and shrub steppe have been virtually eliminated in the subbasin.

In the Canadian Okanagan, forests represent 2 biogeoclimatic zones, including Interior Douglas-fir and Englemann-spruce subalpine fir. Aspen are present in upland forests where sufficient moisture is present. Historic riparian cottonwood galleries are scarce but a few strongholds of cottonwood forest remain along the un-engineered reaches of the Canadian Okanagan subbasin and in patches along the major tributaries.

Harvest of large trees has also contributed to the current condition of dense stands dominated by small, suppressed Douglas-fir that is prone to insect infestation, disease, and catastrophic fire. An extensive road system in the forest has increased the sediment delivery to the stream channels. Sediment-laden runoff is exacerbated by the predominance of loose soil types that have high erosion potential. The road system is also a major source of weed transport, and weed infestations are present throughout the basin.

Shrubsteppes

Shrubsteppe habitat was originally a major component of the landscape in the Okanogan Basin, extending from the outer edge of the floodplain to the beginning of the lower elevation forest, at roughly 2500-foot elevation. Shrubs and perennial bunch grasses, with a microbiotic crust of lichens and mosses on the soil surface, dominate native shrubsteppe habitat. Sagebrush was the dominant shrub; bitterbrush was also an important component (Oregon-Washington Partners in Flight, 2000).

Native shrubsteppe communities have been diminished in both extent and condition as a result of overgrazing by livestock, invasion of non-native plants, agricultural conversion, and wildfire suppression. Most extant shrubsteppe may appear to be in a natural condition, but it is actually a considerably altered ecosystem, compositionally and functionally different than pre-European settlement conditions (Partners in Flight, 2000).

In Canada the Bunchgrass- Ponderosa Pine biogeoclimatic zone occupies elevations between 250 and 1000 metres (3,281 feet).

Riparian wetlands and the valley floodplain

The Okanogan River valley is broad and flat. Given the topography and geology, the river probably once meandered across the valley, and riparian habitat formed an extensive mosaic of diverse species. It was dominated by some combination of grass-forbs, shrub thickets, and mature forests with tall, deciduous trees. Common shrubs included willows, red-osier dogwood, hackberry, mountain alder, Wood’s rose, snowberry, and currant. Trees included cottonwood, aspen, and water birch (Oregon-Washington Partners in Flight, 2000). Hunner and Jones (1997) have noted that wetlands across the Colville Reservation are quite variable because of precipitation patterns, but in general their area has been shrinking over time.

There are also several population centers and municipalities along the river and the lower reaches of the tributaries. Riparian vegetation such as cottonwood, spruce, alder and a dense shrub layer have been largely lost. Agriculture, private residences, and associated roads contribute to changes in the natural watershed hydrograph, and add chemical contaminants and sediments to the streams and rivers.

Cliffs, caves and talus slopes

Although not identified as a focal species in this draft, there are significant opportunities to enhance connectivity and coordinate recovery programs for species of bat and reptile at risk in this habitat type.

Rugged terrains, predominantly cliffs, caves and rocky talus slopes are crucial habitats for many species of birds, mammals and reptiles. These habitats in the Okanogan subbasin provide important habitats for Endangered snakes, bats and raptors. Although these habitats are not as heavily impacted as other habitat types in the subbasin, they are being threatened by recreation and urbanization activities.

Fire

Prior to European settlement, frequent fires in the mid elevations, (2000 to 4500 ft) created open stands of predominantly mature, fire-resistant Ponderosa pine, with a smaller larch component above 3,000 feet. Unpublished preliminary data of forest reconstruction plots in North Central Washington indicate 12 to 20% canopy closure at these elevations. In the 1900s, fire suppression led to a dramatic increase in seedling survival, creating stands with 100% canopy closure. Shade tolerant, fire sensitive Douglas-fir is now favored over fire-tolerant, but shade-intolerant pine and larch.

Soils and Vegetation

Most Okanogan County soils are formed in materials derived mainly from volcanic ash and glaciation from the last 10,000 years. Those soils most influenced by ash are in the northern part, at elevations above 3,000 feet (SCS 1980). Because the Okanogan Valley is narrow with steep slopes, there is a high amount of runoff into the river. High rates of drainage are also attributed to streambank instability, which introduces a large amount of sedimentation.

The most erosive soils along the Okanogan River are the Colville Tribes silt loams, and the Bosel fine sandy loams. Some factors that accelerate erosion are over grazing, mining sites, logging activities, roadwork and irrigation. The lack of woody vegetation on the streambanks along the Okanogan may be increasing erosion rates. Soils are slightly acid to alkaline, and originate from sandy loam to silt loam soils formed in volcanic ash, glacial materials, and weathered granite, schist, limestone, shale and gneiss.

A semiarid climate, with dry warm summers and moderately cold winters supports such native species as big sagebrush, rabbitbrush, and bitterbrush in the valleys and on terraces (SCS 1980). The climate is influenced by the barrier to marine air that the Cascade Mountain Range provides, and by the mountain and valley formations of the region. Precipitation in the watershed ranges from more than 40 inches in the western mountain region to approximately 8 inches at the confluence of the Okanogan and Columbia Rivers.

Where annual precipitation is 8 to 11 inches, grassland is the dominant type of vegetation. In areas where the annual precipitation is 11 to 14 inches (such as in the middle and lower reaches of the Salmon watershed), the importance of Idaho fescue and bluebunch wheatgrass in the plant community increases. Perennial grasses include bluebunch wheatgrass, and giant wild rye.

Non-native plant species include wheatgrass, Russian thistle, common mullein and wooley plantain. Forested lands comprise approximately 47% of the Okanogan watershed and receive approximately 75% of the total annual precipitation (Gullidge 1977).

The density of the forest vegetation increases at elevations above 3,000 feet, where the annual precipitation is greater than 14 inches. Yellow pine (*Pinus ponderosa*) dominates in areas where the annual precipitation is 14 to 16 inches (e.g., the upper Salmon watershed). Douglas-fir (*Pseudotsuga douglasii*) is dominant in areas where the annual precipitation is 16 to 18 inches (SCS 1980).

Vegetation status

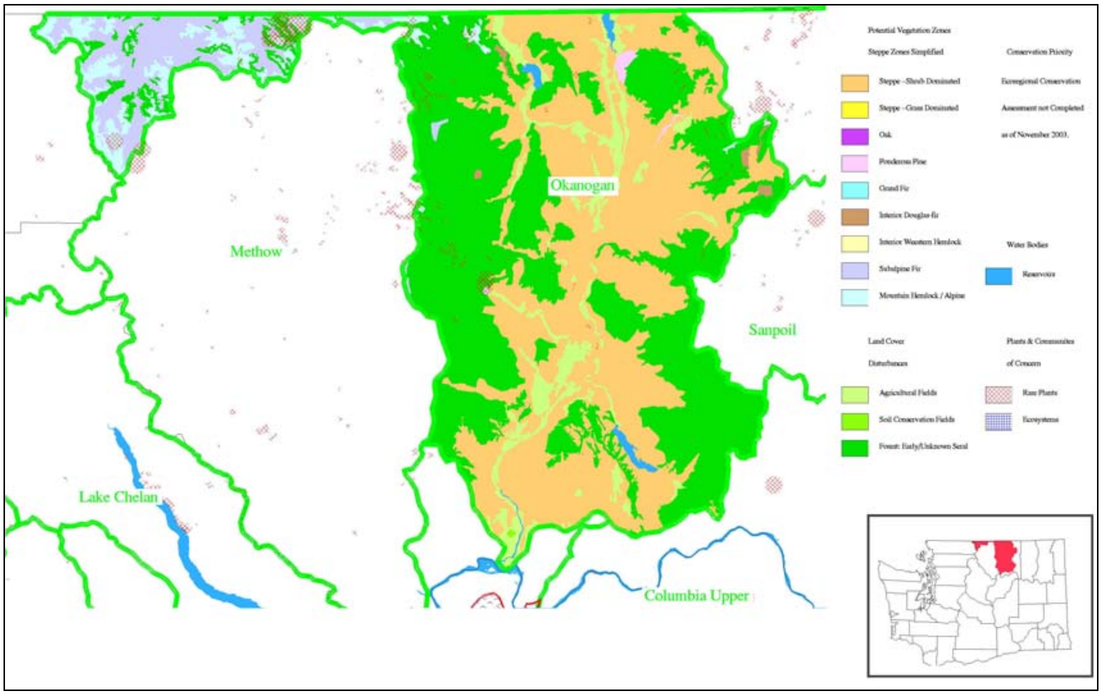
There are 71 species of state and federally listed plants in Okanogan County. (this list is available at http://www.wa.gov/dnr/htdocs/fr/nhp/refdesk/lists/plantsxco/okanogan.html).

In Canada 61plant species are listed as nationally Threatened or Endangered, along with an additional 33 considered vulnerable.

To consult current listing status in Canada, provincial listings are available at www.elp.gov.bc.ca/rib/wis/cdc/tracking.htm National listings are available at www.sis.ec.gc.ca/cgi-eas/endanew.exe - electronic summary to list these

These plants are vitally important to the quality of the fish and wildlife habitat of the region. Virtually every plant in the region is important to the Okanagan Nation and the Colville Tribes and tribal memberships for their cultural, historic, and subsistence value. The Colville Tribes and the Okanagan Nation have been involved in plant inventories in Canada and US.

The US Okanogan subbasin contains 50 rare plant communities (Appendix ?). Approximately 26% of the rare plant communities are associated with shrubsteppe habitat, 16% with riparian or wetland habitats, and 58% with upland forest habitat. Rare/high-quality plant occurrences and communities are illustrated in Figure 15.



Source: Cassidy 1997, WNHP 2003

Figure 14 Rare plant occurrence and high quality plant communities in the Okanogan subbasin, Washington

Special plant species are considered in habitat associations for wildlife, and in particular where associated with riparian areas of shared value between fish and wildlife. Approximately 26% of the rare plant communities are associated with shrub steppe habitat, 16% with riparian or wetland habitats, and 58% with upland forest habitat.

Noxious Weeds

In Okanogan County, the location and extent of noxious weed infestations are currently being mapped by the County Noxious Weed Control Office, using a Geographic Positioning System (GPS). Key weed classifications were mapped in 2000. Okanogan County has continued noxious weed mapping (Sheila Kennedy 2001, pers. comm.).

The Okanogan National Forest (ONF) has mapped noxious weed infestations on the GIS system, and continues to add more sites. They currently have 31,000 acres weed infestations across the forest, including 24,000 acres of very dense knapweed.

The ONF completed environmental assessments for their Integrated Weed Management Program in 1996, 1999, and 2001. The 1996 EA covered 34 sites, on a total of 3000 acres. The 1999 EA covered 15-18 sites, and a total of 75 acres, and the 2001 EA primarily covers the road system, a total of 1,700 miles of road.

Climate change

Study of the nutrient sources and ecological impacts on Okanagan Lake (Hall, 2001), the climate of the subbasin is getting warmer, with more precipitation during winter and spring. This is resulting in earlier snowmelt, greater run-off, lower summer flows, the peaks of run-off have increased. Increased turbidity is increasing nutrient loads and exacerbating eutrophication. There is a need for systematic review of engineering (water and flood control), operating rules, contingency plans (drought and flood) and water allocation policies.

Water Resources

The hydrology of the Okanogan River Watershed is characterized by high spring run off and low flows occurring from late summer through winter. Peak flows coincide with spring rains and melting snowpack. Low flows coincide with minimal summer precipitation, compounded by the reduction of mountain snowpack. Irrigation diversions in the lower valley also contribute to summer low flows.

Hydrography and watersheds

The average annual flow for the Okanogan River, measured at Ellisforde, is 3200 cubic feet per second (cfs). About 75% of the flow comes from the Similkameen River, located primarily in Canada. The gradient on the US portion of the mainstem Okanogan averages about 0.04%. The first 17 miles of the river are within the backwater of Wells Dam (NMFS, 2000). The gradient on the US portion of the mainstem Okanogan averages about 0.04%. The first 17 miles of the river are within the backwater of Wells Dam (NMFS, 2000).

Stream flow in the US portion of the Okanogan River is controlled by a series of 13 dams in British Columbia, and the Zosel Dam on Osoyoos Lake in Washington. Water releases to meet fishery needs are negotiated yearly by a consortium of fisheries and irrigation managers from both Canada and the US

The USGS has been recording flows in the Okanogan Basin continuously since 1911. **Table 9** summarizes USGS flow data for the basin.

Table 9. USGS Flow Records for Okanogan and Similkameen Rivers, 1911 – 1996 (USGS, 1995).

Station #	Location	Year Started	Average Flow (cfs)	High Flow (cfs)	Low Flow (cfs)
12438700	Oliver, B.C.	1944	639	3,740	55.9
12439500	Oroville, WA	1942	676	3,730	-2,270*
12445000	Tonasket, WA	1929	2,940	44,700	126
12447200	Malott, WA	1958	3,063	45,600	288 **
12442500	Nighthawk (Similk. R.), WA	1911	2,289	45,800	65

**During high flows, backflow from the Similkameen River results in negative flow values on the Okanogan at this station.*

***This record was observed.*

The WSDOE established base flows for the Okanogan and Similkameen rivers in 1976 (**Table 10**). Data are based on measurements made at the USGS Tonasket gauging station and snow survey data collected by NRCS. This table is a simplified version of the flow standards set in the Washington Administrative Code.

At the time these base flows were established, WSDOE ruled that no further appropriations of surface water shall be made from the Okanogan River and its tributaries if they would conflict with these base flows (NOAA, 2000).

Table 10. Base Flows (cfs) for the Okanogan River, as Set by WSDOE in 1976 (NMFS, 1998).

Reach	April*	May*	June*	July*	August *	September*	October*
Lower Okanogan RM 17.4 - 51	1120 1,250	1,400 4,000	4,000 4,000	2,400 1,400	1,050 800	800 800	940 1,100
Middle Okanogan RM 51 - 70	910 1,070	1,200 3,800	3,800 3,800	2,150 1,200	840 600	600 600	730 900
Upper Okanogan RM 70 - 77.6	330 340	350 500	500 500	420 350	320 300	300 300	330 370
Similkameen RM 0 - 27.3 (Canadian border)	510 640	800 3,000	3,000 3,000	1,650 900	590 400	400 400	450 500

Hydrologic regimes

Snowfall represents about 50-75% of the annual precipitation during the winter months. Rainfall and snowmelt runoff contribute approximately 3% to the average annual gauged stream flow of the Okanogan River at Mallot (USGS Gauge No. 12447200) with the remainder provided from Canadian contributions upstream.

Average annual runoff for the Okanogan River as measured at Mallot is 2,220,000 acre-foot. With about 2,150,000 acre-foot contributed annually from British Columbia and from the Similkameen tributary (OWC 2000). Annual runoff at Mallot has ranged between a minimum of 860,000 acre-foot and maximum of 4,000,000 acre-foot.

Average annual flows on the Okanogan and Similkameen Rivers have not changed significantly since gauging began in 1911 (WDOE 1995). However, seasonal low stream flows are very much affected by water usage for irrigation, water supply, and other activities.

Peak annual flows occur usually occur during a two or three week period in late May and early June, but the timing of the peak can vary substantially based on snowpack. On average, these hydrographic peaks account for approximately one-half of the annual runoff volume into the watershed.

Minimum annual flows occur in early fall to mid-winter (September through March). In arid climates such as the Okanogan valley, almost all precipitation occurring during the warm months either evaporates or is absorbed by the soil layer.

Usually only a very small amount of precipitation directly contributes to stream flow from late June through October. However, isolated summer thunderstorms in discrete sub-watersheds can yield flash flooding, resulting in devastating consequences to riparian habitats and aquatic biota. Such flooding events are non-uniform in their distribution among tributary drainages, with occurrence intervals approximately every 2 years in the Okanogan watershed overall. These events play a highly significant role in shaping aquatic habitats in the Okanogan watershed, especially within its tributaries.

The average annual flow for the Okanogan River, measured at Ellisforde, is 3200 cubic feet per second (cfs). About 75% of the flow comes from the Similkameen River, located primarily in Canada.

Groundwater

There have been several groundwater studies conducted in the US subbasin, but little is known about the deep, hard-rock aquifers. The shallow aquifers are characterized in the following quotation from a WSDOE report:

Alluvial and glacial sedimentary deposits, ranging from a few feet to several hundred feet thick, contain the main volume of groundwater in the basin, with sand and gravel layers constituting the principal water bearing zones. Most of the sedimentary deposits occur in or adjacent to major valleys and are underlain by rather impermeable bedrock which consists principally of granitic and various metamorphic rocks; limestone, dolomite, and basalt form the bedrock in small areas. Generally, the bedrock establishes the floor of the groundwater reservoir, although cracks in the bedrock below the water table become filled with water, and limestone, dolomite, and basalt formations yield small quantities of water to springs and wells.

In some places, the sedimentary deposits are thick and consist almost entirely of sand and gravel containing large quantities of groundwater. In other cases, the deposits hold little water, being thin or consisting mostly of clay or poorly permeable glacial till. (WSDOE, 1974)

Groundwater in the Okanogan tends to be more mineralized than surface water, and the chemical composition varies more. There have been occurrences of excessive iron and sulfates, but generally the water is usable for most purposes. Groundwater in the basin is typically hard to very hard. Ground water temperature ranges from 110C to 160C; the shallower zones tend to produce cooler water. Nitrate levels in tested wells ranged from 0.3 to 4.9 parts per million (Walters, 1974).

The shallow aquifers tend to be high in sediments, indicating that it is fairly susceptible to pollution during ground-disturbing activities.

The coarse soils in the basin create hydraulic continuity between the ground and surface waters. Most municipal water is supplied from wells that penetrate the groundwater aquifers.

Water quality

According to nutrient studies in Canada, 70% of nitrogen loads result from stream discharge, including forest impacts, 15% from sewage treatment, 9.6% from stormwater and 4.7% from septic tanks. There is a nitrogen deficit from agricultural activities (Hall et al. 2001). The nitrate values recorded on the Okanogan and Similkameen Rivers are well below any action level for health standards and thus acceptable for all Class A water uses.

The Okanogan and Similkameen rivers are classified by the State of Washington as Class A waters (Chapter 173 201 A 130 WAC, 1992). Classes range from A to AAA, with AAA being the highest quality. Class A waters are required to meet, or exceed, the standards established for the various uses including: water supply, recreation, fish (migration, rearing, spawning, and harvesting), wildlife, agriculture, and commercial uses.

Compliance for Class A waters includes:

- Temperature should not exceed 180°C(conversion), and pH should occur within the range of 6.5 to 8.5.
- Dissolved oxygen should not fall below 8 mg/L.
- Fecal coliform counts should be below the geometric mean of 100/100ml.
- When natural conditions result in water temperatures exceeding 180C, no discharges will be allowed which raise the receiving water temperature by greater than 0.30C. In addition, the USEPA has established the drinking water standard for nitrate at 10 parts per million.

3.3.3 Fish Populations

The Okanogan River represents the uppermost tributary of the Columbia River currently accessible to anadromous and resident fish populations. Historically, 28 indigenous species of fish populated the subbasin; 25 of these remain (**Table 11**)), and another 16 introduced species have successfully colonized the subbasin.

Table 11. **Fish species of the Okanogan/Okanagan River Subbasin**

#	Indigenous Fish Species	Characteristics	Source
1	chinook (*Oncorhynchus tshawytscha*)[2]	Spring	Ernst 2000; NMFS 1998; Miller and Hillman 1994, 1996, 1997, 1998; Utter 1993; Pinsent et al. 1974a; Butler 1974; Fulton 1968; Craig and Suomela 1941; Clemens et al. 1939; Gartrell 1936
		Summer/fall mixed	
2	sockeye (*Oncorhynchus nerka*)	Summer: lake and river rearing smolts	Hyatt and Rankin 1999; Ernst 2000; Chapman et al. 1995; McPhail and Carveth 1994; Shepherd 1990; NOAA 1977; Butler 1974; Allen and Meekin 1973
		Early summer?	H. Wright, ONA, pers. comm.
	kokanee (*Oncorhynchus nerka*)[4]	Stream and shoal spawners	MOLAP 2003
3	pink (*Oncorhynchus gorbuscha*)[1]		Butler 1974
4	chum (*Oncorhynchus keta*)[1]		Ernst 2000; Butler 1974;
		Early summer	ONA
5	steelhead (*Oncorhynchus mykiss*)[2]	Winter	Ernst, 2000; MFS 1998
		Summer	
6	Coho (*Oncorhynchus kisutch*)[1]		Ernst 2000; Butler 1974; Clemens et al. 1939

#	Indigenous Fish Species	Characteristics	Source
7	bull trout (*Salvelinus confluentus*)[2]		NMFS 1998, 2002; CTC 2001; Mullan et al. 1992 CPa
8	rainbow trout (*Salmo gairdneri*)	Fluvial and adfluvial	Bull 2003; NMFS 1998; McPhail and Carveth 1994; Pinsent et al. 1974a
9	Pacific lamprey (*Entosphenus tridentatus*)		Peven 2003; Clemens et al. 1939
10	mountain whitefish (*Prosopium williamsoni*)		Pinsent et al. 1974a; McHugh 1936
12	pygmy whitefish (*Prosopium coulted*)		McPhail and Carveth 1994; Pinsent et al. 1974a
13	bridgelip sucker (*Catostomus columbianus*)		PRC 1996; McPhail and Carveth 1994
14	largescale sucker (*Catostomus macrocheilus*)		PRC 1996; McPhail and Carveth 1994; Pinsent et al. 1974a
15	mountain sucker (*Catostomus platyrhynchus*)[3]		BC Conservation Data Centre 1999
16	longnose sucker (*Catostomus catostomus*)		McPhail and Carveth 1994; Pinsent et al. 1974a
17	sculpin (*Cottus rhotheus*)		PRC 1996; McPhail and Carveth 1994
18	sculpin (*Cottus confuses*)		PRC 1996
19	mottled sculpin (*Cottus bairdi hubbsi*)[3]		McPhail and Carveth 1994
20	slimy sculpin (*Cottus cognatus*)		McPhail and Carveth 1994; Pinsent et al. 1974a
21	chiselmouth (*Acrocheilus alutaceus*)3		PRC 1996; McPhail and Carveth 1994; Pinsent et al. 1974a
22	peamouth (*Mylocheilus caurinus*)		PRC 1996; McPhail and Carveth 1994; Pinsent et al. 1974a
23	northern pikeminnow (*Ptychocheilus oregonensis*)		PRC 1996; McPhail and Carveth 1994; Pinsent et al. 1974a
24	longnose dace (*Rhinichthys cataractae*)		PRC 1996
25	Umatilla dace (*Rhinichthys umatilla*)[2]	Similkameen	MOLAP 2000
26	redside shiner (*Richardsonius balteatus*)		PRC 1996; McPhail and Carveth 1994; Pinsent et al. 1974a
27	burbot (*Lota lota*)		PRC 1996; McPhail and Carveth 1994; Pinsent et al. 1974a
28	white sturgeon (*Ancipenser transmontanus*)	Okanagan lake	McPhail and Carveth, 1994

[1] Extirpated (National) or Red listed (Provincial)
[2] Endangered (National), Depressed (State) or Red listed (Provincial)

[3] Vulnerable or Blue listed (Provincial)
[4] Management concern

Classification fish species are identified in Table 8, including ratings from Canada, US and Global Rankings. Population characterization, an overview of species status and management regimes can be found in 2.2 “Focal Species.” Detailed classifications and status ranking may be found in Appendix C.

United States

In the US Okanogan Subbasin, part of the Upper Columbia River ESU, steelhead and spring Chinook are listed as “Endangered”, and Columbia River population segment bull trout are listed as “Threatened”. Bull trout critical habitats are proposed for critical listing here as well. Local populations of summer/fall Chinook are considered depressed. The FWS has documented bull trout within the Okanogan Watershed as “unknown occupancy” (K. Terrell personnel communication May 2004 to Keith Wolf).

Okanogan summer/fall Chinook stock is listed as Depressed based on a short-term severe decline in escapement. The Okanogan sockeye stock is currently listed in the US as Healthy (SASSI) based on escapement. However management concerns related to long-term declines exist.

Salmon Creek and Loup Loup Creek historically supported bull trout populations (*Salvelinus confluentus*). The introduction of brook trout and resulting hybridization of the two species has resulted in the decline of wild bull trout in the Okanogan River Basin (FWS 2000).

The Methow/Okanogan summer steelhead stock is listed as Depressed based on chronically low numbers (WDF and WDW, 1993).

Canada

In Canada, management agency concerns exist for Okanagan sockeye and Okanagan Lake kokanee. Bull trout, chiselmouth, and mountain Sucker are Blue Listed under Provincial designation, although the current presence of bull trout in the Canadian Okanagan subwatershed is unknown. Umatilla dace are Red Listed by the B.C. Conservation Data Center, and are candidates for federal listing under the Canadian Species at Risk Act (SARA). There are no current records of historic white sturgeon populations in the Okanagan, although the Okanagan Nation Alliance is currently verifying historic knowledge of sturgeon in Okanagan Lake.

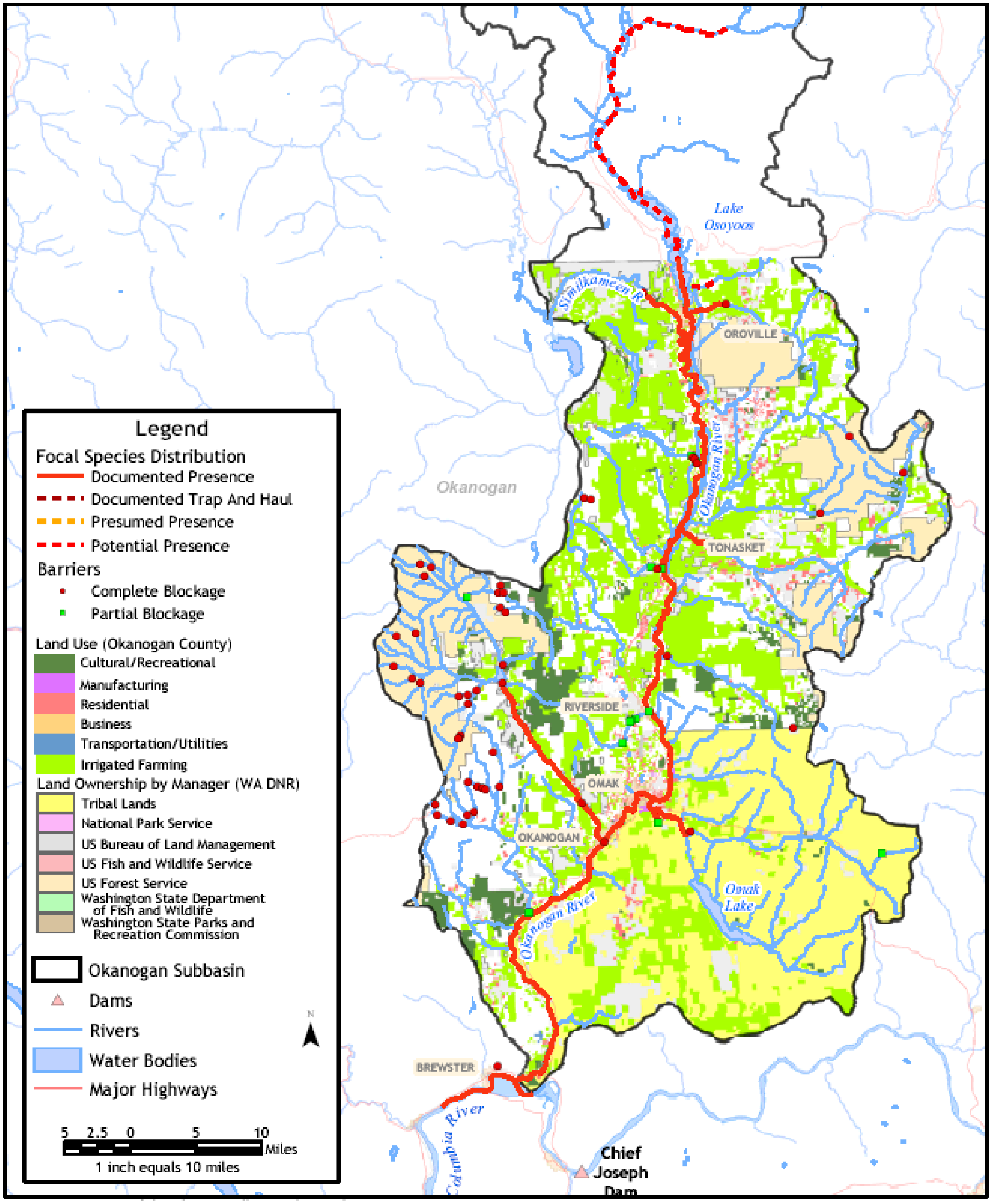
Naturally reproducing stocks of coho have been extirpated in the mid- upper Columbia for at least 70 years. Recent (after GCFMP) programs to restore coho in the mid-upper Columbia began in the 1960s with releases from WDFW hatcheries for Rocky Reach Dam mitigation. It was determined that naturally producing runs were not establishing themselves, primarily because of the stock of fish used (Lower Columbia River stock – see Mullan 1984). More recently, the Yakama Nation has been trying different rearing techniques to establish naturally reproducing runs of coho in the Wenatchee and Methow basins.

3.3.4 Aquatic/fish associations

Traditionally, as many as six runs of salmon would come up the Columbia River and its Okanagan tributary, and ascend into Skaha and Okanagan Lakes (Adrienne Vedan, 2002;

Clemens 1939). Native Okanagan Indians (Syilx) enjoyed year round fisheries on both resident and anadromous fish stocks.

Settlement of the subbasin over the last century initiated significant alterations to both natural river structure and hydrology, and was accompanied by a shift in species composition and abundance. The aquatic ecosystem changes, including the loss of some species, were coincident with exotic fish species invasions from downstream and local fish introductions (H. Wright, KD Hyatt, and C.J. Bull, 2002).



Source: Note: For purposes of this plan, not all areas depicted. Note: No information on Pacific Lamprey distribution available. Data Layers: Fish Distribution and Barriers (WDFW), Land Ownership (WA DNR), Land Use (Okanogan County), Counties & Major Rivers (WA Ecology), State Routes (WashDOT). Projection: Washington State Plane North Zone NAD83. Produced by Jones & Stokes for KWA Ecological Sciences, Inc. Map Date: 5/15/2004

Figure 15 Fish focal species distribution in relation to land use, production, irrigation, and degraded habitat features in the Okanogan subbasin.

Introduced exotic species originated from both European (carp, tench) and eastern North American sources, including a Mississippian refuge complex of fish, (smallmouth bass and yellow perch). In addition, aquatic milfoil first appeared in the lakes in the 1970s, and its growth and spread has altered littoral habitats and species utilization (H. Wright et al. 2002). Native species of macroinvertebrates (i.e. crayfish) have virtually disappeared, while mysid shrimp introduced to support recreational fish production have exhibited explosive growth.

The chain of large lakes which separate the upper and lower watershed moderates river flows, contribute nutrients and thermal units, while offering the possibility of deep water refuge for temperature sensitive salmonids during seasonal warm water events. Current barriers to upstream migration by anadromous fish have isolated the river valley bottom fish populations from the upper subbasin for at least 5 decades, and may have affected both species diversity and productivity, while some populations have become extirpated (H. Wright et al. 2002).

Recent surveys of exotic species in the large lakes suggest that exotic fish are dominant throughout the littoral zones of two out of the three large lakes (H. Wright, 2002), while significant variability in salmonid production is most visible in kokanee populations.

The loss of shoreline spawning habitats, nutrient imbalances resulting in a decline of lake productivity, and mysid competition with kokanee for macrozooplanters are all considered responsible for the decline of resident kokanee populations over the last 3 decades (Okanagan Lake Action Plan Year 6 report, 2002).

Historic accounts of a barrier to upstream fish migration in the Similkameen are contained in the traditional Okanagan story of S'enklip (A. Vedan, 2002) and refer to an impassable falls at Coyote Rock. That falls was altered during the construction of Enloe Dam in 1919 and remains the upstream barrier to fish migration.

3.3.5 Salmon and Steelhead Stocks Overview

The upper Columbia continues to support anadromous stocks of summer/fall Chinook, spring Chinook, sockeye salmon, and steelhead, while populations of coho and possibly other salmon stocks are believed to be extirpated.

In 1939, during construction of Grand Coulee Dam, the US Fish and Wildlife Service initiated a program to mitigate for the upcoming loss of over 1,100 miles of available habitat to Upper Columbia River salmonid populations (Fish and Hanavan 1948). Construction of the dam without fish passage facilities led to the program that centered on trapping at Rock Island Dam.

During the GCFMP (1939-1943), all salmon and steelhead that reached Rock Island Dam were trapped there and mixed. These fish were either transplanted to alternative spawning streams and "forced" to spawn there, or taken to newly completed hatcheries on the Wenatchee (Icicle Creek), Entiat, or Methow Rivers.

Trapped and transported spring and late-run Chinook and steelhead of mixed origins were allowed to spawn naturally in Nason Creek upstream from a rack 0.25 miles upstream from the creek mouth. Steelhead were also released in the upper Wenatchee River (upstream of Tumwater Canyon) and the Entiat River in 1939. The fish were released between two racks that forced the fish to spawn in the area selected by the biologists of the USFWS (Fish and Hanavan 1948). Sockeye and coho were raised in hatcheries and liberated in various places.

The long-term affect of the obstructions to natal spawning and rearing habitats coupled with early hatchery intervention are manifest in the presence and distribution of species and the general loss of distinct population segments. This over-all loss of diversity has altered the productivity and stability of the remaining populations, and has changed ecosystem structure and function (possibly irrevocably).

Distinct Salmon Population

Distinct salmon population segments exist within the Mid-Columbia Region for salmon and steelhead stocks, based on assessments in the SASSI (WDFW et al. 1993a, 1993b) and the WDFW Genetic Unit (GUD) classification (Busack and Shaklee 1995) which is summarized in Table 12.

Table 12 Distinct salmon population segments within the Mid-Columbia Region, including Okanogan Subbasin

#	Indigenous Fish Species	Characteristics	Source
1	Chinook (*Oncorhynchus tshawytscha*)[2]	Spring	Ernst 2000; NMFS 1998; Miller and Hillman 1994, 1996, 1997, 1998; Utter 1993; Pinsent et al. 1974a; Butler 1974; Fulton 1968; Craig and Suomela 1941; Clemens et al. 1939; Gartrell 1936
		Summer/fall mixed	
2	Sockeye (*Oncorhynchus nerka*)	Summer: lake and river rearing smolts	Hyatt and Rankin 1999; Ernst 2000; Chapman et al. 1995; McPhail and Carveth 1994; Shepherd 1990; NOAA 1977; Butler 1974; Allen and Meekin 1973
		Early summer?	H. Wright, ONA, pers. comm.
	Kokanee (*Oncorhynchus nerka*)[4]	Stream and shoal spawners	MOLAP 2003
3	Pink (*Oncorhynchus gorbuscha*)[1]		Butler 1974
4	Chum (*Oncorhynchus keta*)[1]		Ernst 2000; Butler 1974;
		Early summer	ONA
5	Steelhead (*Oncorhynchus mykiss*)[2]	Winter	Ernst, 2000; MFS 1998
		Summer	
6	Coho (*Oncorhynchus kisutch*)[1]		Ernst 2000; Butler 1974; Clemens et al. 1939
7	Bull trout (*Salvelinus confluentus*)[2]		NMFS 1998, 2002; CTC 2001; Mullan et al. 1992 CPa
8	Rainbow trout (*Salmo gairdneri*)	Fluvial and adfluvial	Bull 2003; NMFS 1998; McPhail and Carveth 1994; Pinsent et al. 1974a
9	Pacific lamprey (*Entosphenus tridentatus*)		Peven 2003; Clemens et al. 1939
10	Mountain whitefish (*Prosopium williamsoni*)		Pinsent et al. 1974a; McHugh 1936
12	Pygmy whitefish (*Prosopium coulted*)		McPhail and Carveth 1994; Pinsent et al. 1974a

#	Indigenous Fish Species	Characteristics	Source
13	Bridgelip sucker (*Catostomus columbianus*)		PRC 1996; McPhail and Carveth 1994
14	Largescale sucker (*Catostomus macrocheilus*)		PRC 1996; McPhail and Carveth 1994; Pinsent et al. 1974a
15	Mountain sucker (*Catostomus platyrhynchus*)[3]		BC Conservation Data Centre 1999
16	Longnose sucker (*Catostomus catostomus*)		McPhail and Carveth 1994; Pinsent et al. 1974a
17	Sculpin (*Cottus rhotheus*)		PRC 1996; McPhail and Carveth 1994
18	Sculpin (*Cottus confuses*)		PRC 1996
19	Mottled sculpin (*Cottus bairdi hubbsi*)[3]		McPhail and Carveth 1994
20	Slimy sculpin (*Cottus cognatus*)		McPhail and Carveth 1994; Pinsent et al. 1974a
21	Chiselmouth (*Acrocheilus alutaceus*)3		PRC 1996; McPhail and Carveth 1994; Pinsent et al. 1974a
22	Peamouth (*Mylocheilus caurinus*)		PRC 1996; McPhail and Carveth 1994; Pinsent et al. 1974a
23	Northern pikeminnow (*Ptychocheilus oregonensis*)		PRC 1996; McPhail and Carveth 1994; Pinsent et al. 1974a
24	Longnose dace (*Rhinichthys cataractae*)		PRC 1996
25	Umatilla dace (*Rhinichthys umatilla*)[2]	Similkameen	MOLAP 2000
26	Redside shiner (*Richardsonius balteatus*)		PRC 1996; McPhail and Carveth 1994; Pinsent et al. 1974a
27	Burbot (*Lota lota*)		PRC 1996; McPhail and Carveth 1994; Pinsent et al. 1974a
28	White sturgeon (*Ancipenser transmontanus*)	Okanagan lake	McPhail and Carveth, 1994

[1] Extirpated (National) or Red listed (Provincial)
[2] Endangered (National), Depressed (State) or Red listed (Provincial)
[3] Vulnerable or Blue listed (Provincial)
[4] Management concern

Distinct population segments exist for summer Okanogan River sockeye (possibly early summer and river-rearing populations are geographically distinct - ONA pers. com.). Also, population segments exist for Methow/Okanogan River summer steelhead, and historic populations of summer/fall Chinook (SASSI, 2002).

3.3.6 Fish distribution

The Okanagan subbasin headwater areas hold a complex of small, low productivity, high gradient creeks, populated largely by a ubiquitous slow growing fluvial rainbow trout (Bull, 2003). Many of these tributaries are currently affected by forest development, are heavily subscribed for licensed water use, and a significant number contain some water control structures which are a barrier to fish migration.

The valley bottom is characterized by networks of small second- and third-order streams that are warmer, more fertile and hydraulically diverse watercourses (Bull, 2003). Here, productive fish habitats support a greater diversity of aquatic flora and fauna. It is also here that the greatest concentration of human settlement, flood control, and linear development has led to the most significant alteration of fish habitats, where fish populations have changed most significantly, and remain most vulnerable.

The current spatial distribution of fishes is affected by lake outlet dams at Vaseux (McIntyre Dam), Skaha and Okanagan Lakes on the Okanagan mainstem, and Enloe Dam on the Similkameen, and various water control structures on various tributaries. Changes to the valley bottom and riparian habitats, associated with settlement and land development, are significant to both understanding the current ecology and utilization of fish ecosystems.

Anadromous stocks have been limited to the mainstem river below McIntyre Dam since 1920 as a result of combined concerns over colonization of new exotic species upstream from the Columbia River, and flood and irrigation control. The Skaha and Okanagan Lake dams fishways were decommissioned at that time, although their structures remain functional.

The loss of access to alternative cold deep water large lakes of the Okanogan (above Osoyoos) may exacerbate temperature-induced migration mortalities in adult sockeye and possibly other anadromous salmon stocks (i.e. spring Chinook), and may also limit sockeye smolt production in the subbasin where converging deep water anoxic and warm surface waters restrict Osoyoos lake rearing habitats.

The cold water influence from the Canadian reaches of the Similkameen River may provide some limited refuge to migratory salmonids during warm water events. Many of both US and Canadian tributary habitats are restricted to the valley bottom or have limited use value because of high water temperatures, habitat alterations or impasses created by water reservoirs. Cold spring water refugia are the subject of a mapping project underway in the US subwatershed, however the results of this project are not complete. Most tributary flows are heavily subscribed by water licenses and lower than normal flows may exacerbate the affects f warm water events.

3.4 Wildlife Populations Overview

United States

There are 31 wildlife species, indigenous to the Okanogan Subbasin, that are contained in the federal ESA list as Endangered (1), Threatened (3) or are of Special Concern (26). Wildlife and plant species indigenous to the Okanogan Subbasin, with federal status classifications, global or provincial ranking, or that warrant state listing are contained in Appendix D. Plant communities in the basin range from the sub alpine in the high elevations of the Tiffany Mountain area and

Pasayten Wilderness to shrubsteppe in the lower elevations along the Similkameen and Okanogan rivers.

The Washington States List includes 2 plant and 2 wildlife species indigenous to the Okanogan Subbasin which are considered Endangered, 2 wildlife populations considered Threatened, and over 70 fish and wildlife Species of Concern. In addition, critical habitats have been identified at critical levels for several species including the spotted owl.

Canada

In Canada, the Province of B.C.'s Conservation Data center lists 67 wildlife Species at Risk including 19 that are either Extirpated, Endangered, or Threatened, and another 38 that are considered Vulnerable.

3.4.1 Terrestrial / Wildlife Associations

The subbasin supports a wide diversity of species within grassland/shrub steppes, coniferous forests and rugged terrain habitats. The Okanagan-Similkameen includes one of the greatest concentrations of Threatened species in Canada, including eight species of invertebrates found nowhere else in the world (South Okanagan-Similkameen Conservation Program, 1999). The subbasin also supports a reservoir of the remaining Canadian Columbia River stocks of salmon and the uppermost surviving tributary salmon ecosystem in the Columbia River.

Populations of Endangered yellow breasted chat, tiger salamander and peach-leaf willow share oversubscribed water resources and shrinking riparian and wetland corridor habitats with several Threatened fish populations. Grassland/shrubsteppe environments suffer from the combined affects of overuse and new exotic inhabitants and face greater threats to indigenous flora and fauna than the riparian corridor.

Historically, sage dominated steppe vegetation occurred throughout the majority of the Subbasin. Shrublands were historically co-dominated by shrubs and perennial bunchgrasses with a microbiotic crust of lichens and mosses on the surface of the soil.

Large, widely spaced, fire-resistant trees and an understory of forbs, grasses, and shrubs once characterized Okanogan subbasin forests. Periodic fires historically maintained this habitat type. With the settlement of the subbasin, most of the old pines were harvested for timber, and frequent fires have been suppressed. As a result, much of the original forest has been replaced by dense second growth of Douglas fir and ponderosa pine with little understory. Heavy grazing of Ponderosa pine stands has led to the introduction of competing exotic species.

Effects related to hydropower development and operations on wildlife and its habitats may be direct or indirect. Although there are no direct impacts of hydropower operations to wildlife in the Okanogan subbasin, indirect effects include the building of numerous roads and railways, presence of electrical transmissions and lines, the expansion of irrigation, and increased access to and harassment of wildlife.

3.5 Fish and Wildlife Species Richness and Associations

The Okanogan subbasin has the highest percentage (99) of species richness than any other subbasin in the Columbia Cascade Ecoprovince. The class and % of total richness in the CCP is provided in **Table 13**(CCP Ecoprovince Wildlife Assessment 2004).

Ninety-nine % of the wildlife species that occur in the Ecoprovince occur in the Okanogan subbasin. In addition, 100 % of the amphibian species and 100 % of the reptile species that occur in the Ecoprovince occur in this subbasin.

Table 13. Species richness and wildlife associations for CPP including the Okanogan subbasin (IBIS 2003)

Class	Subbasin														
	Entiat	%	Lake Chelan	%	Wenat chee	%	Meth ow	%	Okano gan	%	Upper Middle Mainstem	%	Cra b	%	Total (Eco prov)
Amphibians	11	65	11	65	16	94	11	65	9	53	17	100	9	53	17
Birds	218	93	221	94	215	92	221	94	222	95	234	100	214	91	234
Mammals	91	94	93	96	91	94	93	96	86	89	97	100	78	80	97
Reptiles	16	84	16	84	19	100	16	84	13	68	19	100	16	84	19
Total	336	92	341	93	341	93	341	93	328	89	367	100	317	86	367
Association															
Riparian Wetlands	72	92	73	94	70	90	73	94	73	94	77	99	73	94	78
Other Wetlands (Herbaceous and Montane Coniferous)	30	81	32	86	26	68	32	86	31	84	36	95	33	89	38
All Wetlands	102	89	105	91	96	83	105	91	104	90	113	97	106	92	116
Salmonids	77	93	75	90	76	93	75	90	71	86	81	98	72	87	82
Note: % = % of Total															

Source: Ibis 2003

3.6 Focal Species: Population and Habitat Characterization and Status

The subbasin plan used the concept of "focal species" as a way to manage both the size of the subbasin plan and the scope of the assessment, inventory and management plan. In its truest sense, this was simply a means to target management resources and cover as many species and habitats as possible.

In some limited instances this approach was also used to prioritize some actions across fish and wildlife needs or to more properly ascribe responsibilities (e.g., CWA, PCSRF, Power Act, ESA). Mitigation obligations, ESA listing status, coterminious habitat use and overlapping jurisdictions were some of the considerations used to designate focal species. However, we must clearly point out, and caution the reader, that it was not the intention of the subbasin planners to impart any value judgement, placing an emphasis or de-emphasis on the need or responsibility to protect and/or restore a particular or species or their habitats or to decouple any species from any legal, policy, or trust obligations.

A focal species has special ecological, cultural, or legal status and represent a management priority in the subbasin and by extension the ecoprovince. Focal species are used to evaluate the health of the ecosystem and the effectiveness of management actions.

Criteria used in selecting the focal species include a) designation as federal Endangered or Threatened species, or management priority as designated by a management authority b) cultural significance, c) local significance and d) ecological significance, or ability to serve as indicators of environmental health for other species.

Each of the focal species and their assemblages for the Okanogan subbasin and their associated habitats is introduced in the text below and their distribution is outlined in Table 16.

Table 14 Wildlife and fish focal species and their association with the Habitats of the Okanogan subbasin

Focal Species	Focal Habitat Represented		
	Ponderosa pine	Shrubsteppe	Riparian wetlands
Wildlife			
Brewer's sparrow			
Grasshopper sparrow			
Sharp-tailed grouse			
Mule deer			
Red-eyed vireo			
Yellow-breasted chat			
American beaver			
Pygmy nuthatch			
Gray flycatcher			
White-headed woodpecker			

Focal Species	Focal Habitat Represented		
	Ponderosa pine	Shrubsteppe	Riparian wetlands
Flammulated owl			
Fish			
Spring Chinook			
Summer/Fall Chinook			
Coho			
Steelhead			
Bull Trout			

3.7 Focal Fish species and their Habitats

3.8 Fish Focal Species Selection

Initially, seven aquatic species were chosen as focal for Columbia Cascade Province (CCP) Subbasin Planning: steelhead and rainbow trout; spring, and summer/fall Chinook; Bull Trout; Pacific lamprey; White sturgeon; and Westslope cutthroat trout. The criteria used to select focal species was the varied aspects of the CCP ecosystems that the life histories represent; the Endangered Species Act (ESA) status; the cultural importance of the species and whether or not there was enough knowledge of the life history of the species to do an effective assessment.

These were then presented to the Regional Technical Team for the Okanogan, the citizens advisory group, and the subbasin core planning team, including by extension the relevant Canadian agencies. Consensus was achieved on their selection for the subbasin. Okanogan sockeye, summer/fall Chinook, kokanee (Canadian), rainbow trout (Canadian) and steelhead were chosen as the anadromous focal species in the subbasin.

CCP summer steelhead, spring, summer/fall Chinook, bull trout, Pacific lamprey, white sturgeon, and Westslope cutthroat trout life histories intersect a broad range of the CCP aquatic ecosystems. Given the wide range of both the spatial and temporal aspects of these life histories it can be assumed that having habitat conditions that are appropriate for these seven species will also produce conditions that allow for the ecological health of other aquatic life in the CCP.

The Okanogan subbasin represents fish and wildlife habitats, important to sustain the ecological integrity of the CCP.

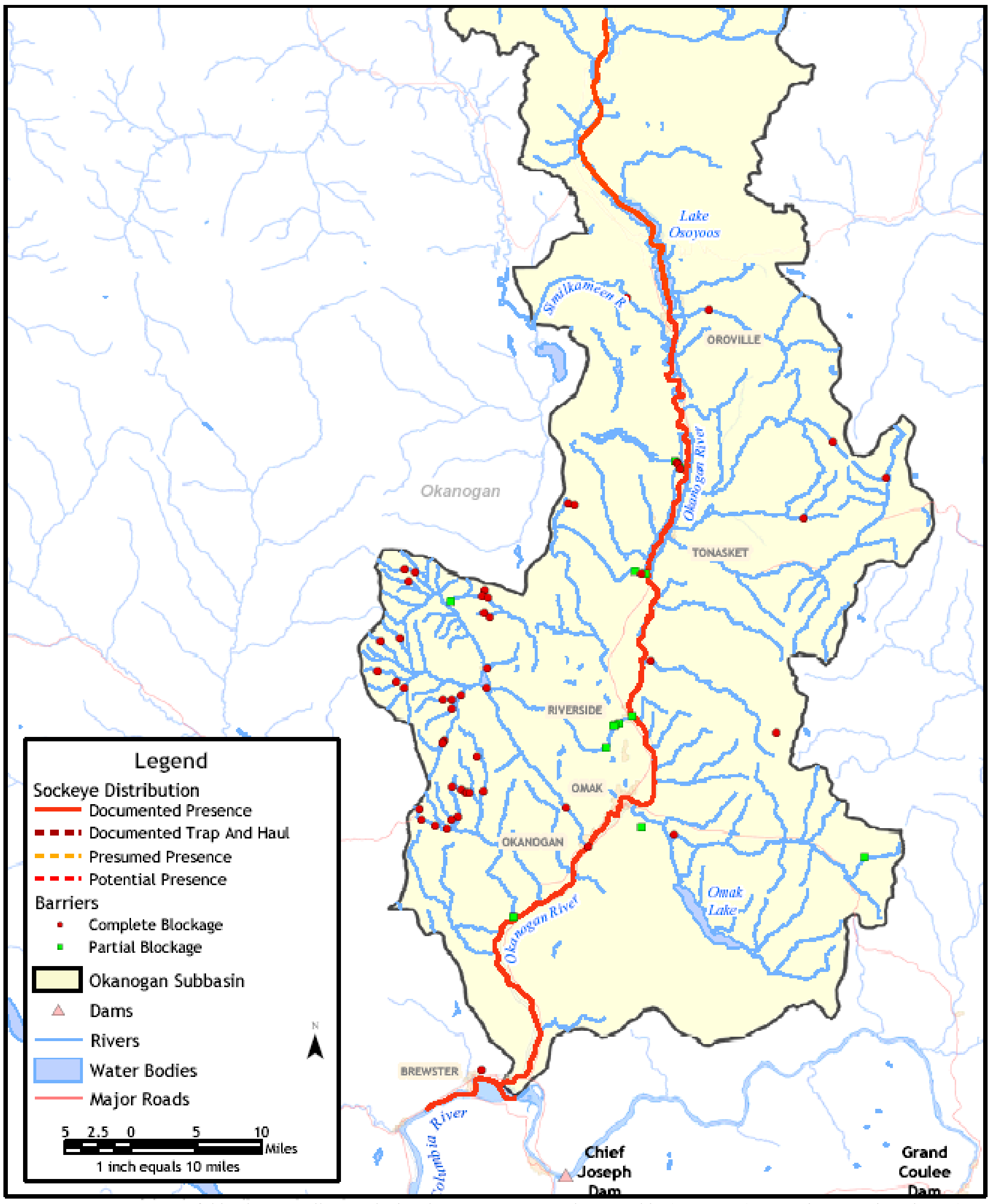
3.8.1 Sockeye

Rationale for Selection

Okanagan and Wenatchee Basin stocks are the only remaining viable populations of sockeye salmon in the Columbia drainage. They are neither considered in danger of extinction nor likely to become so according to NMFS (Gustafson et al. 1997). However, NMFS has concerns in regard to the health of both the Okanogan and Wenatchee sockeye stocks. Both these populations appear to be somewhat cyclic in nature, suggesting that out-of-basin effects such as downstream smolt survival may be dictating overall abundance.

Key Life History Strategies, Relationship to Habitat

Okanagan and Wenatchee stocks are genetically distinct (NOAA, 1997; Mullan, 1986; WDF/WDW, 1993; Chapman et al., 1995 CPb; and Shaklee et al. 1996) and are listed as separate ESUs (Gustufson et al. 1997). Okanogan adults begin migrating slightly later than Wenatchee fish, beginning to arrive at Bonneville in early to mid-June, and peaking at Bonneville in early July (WDFW, 1996). Upstream migration to Lake Osoyoos () is sometimes delayed by high water temperatures in the lower Okanogan River during July and August (Pratt 1991; Stockwell and Hyatt 2003). Peak spawning usually occurs in mid to late October, but may occur as early as September 15 depending upon water temperatures. Peak spawning takes place at approximately 11 degrees Celsius and lower according to Hatch et al., as cited in Hansen (1993).



Note: For purposes of this plan, not all areas depicted. Data Layers: Land Ownership (WA DNR), Counties & Major Rivers (WA Ecology), State Routes WashDOT). Projection: Washington State Plane North Zone NAD83. Produced by Jones & Stokes for KWA Ecological Sciences, Inc. Map Date: 5/15/2004

Figure 16 Okanogan subbasin sockeye distribution

Sockeye spawning in the Okanogan River occurs predominantly in the mainstem, upstream of Lake Osoyoos (RM 90) to McIntyre Dam (RM 106) (Peven 1992 CPb). The majority of sockeye salmon spawn in a five-mile reach of the river immediately below McIntyre Dam down to the Highway 97 bridge (Hagen and Grette, 1994).

In all but very unusual circumstances McIntyre Dam is the upstream limit of spawning and has been for over 50 years. Very infrequently, under high flow conditions and with the dam gates set to allow fish to jump through, sockeye do pass McIntyre Dam, and have been observed spawning up to the outlet of Skaha Lake (Hyatt et al. 2003).

Some spawning may occur in tributaries of Lake Osoyoos but it is unconfirmed. In addition, spawning sockeye have been observed in McIntyre Creek, a major tributary to Okanagan River immediately downstream of McIntyre Dam. They have also been recorded on occasion in the US reaches of the Okanagan and Similkameen Rivers (Chapman 1941; Bryant and Parkhurst 1950; Chapman et al. 1995 CPa). Enloe Dam blocks access to all but the lower six miles of the Similkameen River.

Lake Osoyoos is the primary rearing area for sockeye salmon in the Okanogan Basin. Eutrophic productivity and ample supplies of food produce larger smolts than Lake Wenatchee (Allen et al. 1972). In fact, Osoyoos Lake smolts are some of the largest reported anywhere. Probably as a result of their large size the smolts tend to spend less time at sea and most return at age 3 having spent two years in freshwater and one at sea (Mullan, 1986). Thus relative to sockeye from Lake Wenatchee, Lake Osoyoos fish tend to be larger upon out-migration and younger and smaller as returning adults (Mullen, 1986, Peven 1987, Peven 1991 and Carlson and Matthews 1990, 1992).

Smolt out-migration varies but generally the peak at Rocky Reach Dam occurs about mid- May (Park and Bentley, 1968; Peven 1987 CPb; Carlson and Matthews 1990, 1992; Hays et al., 1978).

Population Status

Fisheries and Oceans Canada (DFO) shares the worry with NMFS regarding downstream smolt survival and has also expressed concerns over deteriorating rearing conditions in Osoyoos Lake and climate change (Hyatt pers. com.). They consider Okanagan sockeye to be generally declining and likely to continue to do so unless a recovery plan is implemented.

DFO's conclusions stem partially from results of enumeration. A compilation of escapement data within the Canadian reaches of the Okanagan and at Wells Dam was undertaken by Stockwell and Hyatt (2003) and is known as "The Core Numbers and Traits" sockeye escapement data review. CNAT is the common reference for escapement data used as a baseline for sockeye management in the Canadian Okanagan. CNAT escapement data (shows that run strength is variable, ranging from a low of 1,662 in 1994 to a high of 127,857 in 1966, measured at Wells Dam. The 10-year average from 1986 to 95 is 28,460. Within the variability are indications of a general decline. Hyatt (pers. comm.) considers that without intervention there is a good chance of eventual extirpation.

Table 15. Sockeye escapement data at Wells Dam and on the Okanagan River spawning grounds.

Year	Wells	SEDS	PLD_{river}	PLD_{river} as % Wells	AUC_{river}	AUC_{river} as % Wells
2002	10,586		2,789	*26*	4,898	*46*
2001	74,453		24,256	*33*	33,971	*46*
2000	59,944		18,704	*31*	26,596	*44*
1999	12,228		4,376	*36*	6,907	*56*
1998	4,404	1,500	1,048	*24*	2,048	*47*
1997	24,621	12,000	11,671	*47*	16,661	*68*
1996	17,701	19,000	11,154	*63*	15,950	*90*
1995	4,892	2,669	3,900	*80*	5,972	*122*
1994	1,666	700	2,174	*130*	3,597	*216*
1993	27,894	21,505	12,163	*44*	17,338	*62*
1992	41,951	15,000	22,624	*54*	33,184	*79*
1991	27,490	10,000	10,058	*37*	14,442	*53*
1990	7,609	2,500	4,150	*55*	6,316	*83*
1989	15,976	15,000	11,763	*74*	16,787	*105*
1988	33,978	25,000	14,480	*43*	20,525	*60*
1987	40,120	15,000	22,568	*56*	31,649	*79*
1986	34,788	13,000	15,373	*44*	21,753	*63*
1985	52,989	30,000	20,742	*39*	29,137	*55*
1984	81,054	37,500	35,298	*44*	49,160	*61*
1983	27,925	3,500	6,839	*24*	10,015	*36*
1982	19,005	7,000	8,778	*46*	12,681	*67*
1981	28,234	15,000	12,293	*44*	17,516	*62*
1980	26,573	5,000	11,660	*44*	16,646	*63*
1979	26,655	2,000	11,691	*44*	16,689	*63*
1978	7,644	1,050	963	*13*	1,932	*25*
1977	21,973	8,475	8,260	*38*	11,970	*54*
1976	27,619	11,040	16,396	*59*	23,160	*84*
1975	22,286	10,000	11,711	*53*	16,716	*75*
1974	16,716	3,500	9,325	*56*	13,434	*80*
1973	37,178	8,000	8,813	*24*	12,904	*35*

Year	Wells	SEDS	PLD_{river}	PLD_{river} as % Wells	AUC_{river}	AUC_{river} as % Wells
1972	33,398	35,000	13,083	*39*	21,925	*66*
1971	48,172	35,000	30,234	*63*	53,370	*111*
1970	50,667	7,500	20,837	*41*	29,268	*58*
1969	17,352	3,500	8,148	*47*	11,815	*68*
1968	81,530	15,000	32,591	*40*	45,436	*56*
1967	107,978	35,000	17,956	*17*	25,305	*23*
1966	128,000	44,865	50,290	*39*	69,781	*55*
1965	30,655	5,408	13,214	*43*	18,784	*61*
1964	39,478	12,000	16,575	*42*	23,406	*59*
1963	45,159	35,000	18,930	*42*	26,646	*59*
1962	12,243	7,500	4,392	*36*	6,648	*54*
1961	7,554	3,500	2,075	*27*	3,462	*46*

Peven (2003) has calculated the risks of extirpation and his projections indicate the extirpation risk 100 years from now may reach 100 % depending upon the effectiveness of spawning.

Another agency expressing strong concern for the health of the stock is the Okanagan Nation Alliance. ONA points out that present day production is extremely limited by access. This is evidenced by both Traditional Okanagan and non-native knowledge that prior to blockage by dams starting about 1915, sockeye had access into both Skaha and Okanagan Lakes (Bryant and Parkhurst 1950; Fulton 1970; Mullan 1986; Vedan 2002).

Given these many concerns it is logical that sockeye should be selected as one of the focal species.

Throughout their freshwater life history stages, Okanagan sockeye are adversely affected by a number of factors including hydroelectric development, land use practice, water extraction, flood control, habitat destruction, harvest and climate change (Chapman et al. 1995, Fryer 1995). In the face of these adversities sockeye have been resilient, and have rebounded somewhat from very low counts in the 1930s. Lower harvest rates and habitat improvements in the natal systems have contributed to the recovery.

Presently, within the basin, the population is believed to be chiefly limited by reduced rearing habitat in the north basin of Osoyoos Lake because of high temperatures and low oxygen (C. Fisher, TAG), and by mortalities associated with delayed adult migration during high water temperature events (Hyatt, K D., M. M. Stockwell and D.P. Rankin. 2003). Climate change and the recent arrival of *Mysis relicta* into Osoyoos Lake are exacerbating the situation.

Recovery efforts will likely include an extension of the run into the more hospitable rearing lakes they once occupied as well as attempted improvements of current rearing conditions through the use of flushing flows and perhaps aeration. To be effective, these recovery efforts will have to be closely linked with other limiting factors such as passage at the mainstem hydroelectric project, water withdrawals and habitat loss.

Also, attention will need to be paid to losses and delays during migration. Schools of adult sockeye stage at the mouth of the river to wait for a drop in water temperatures, which is often brought on by an upstream rain event. Annual migration from Wells Dam to the spawning grounds ranges from one to three weeks, but temperature delays of several days to several weeks have been observed (Hyatt pers. com.). This may be partially or wholly responsible for annual losses averaging about 50% between Wells Dam and the spawning grounds.

Population Management Regimes and Activities

Sockeye represent one of the primary species for recovery and protection focus because they represent a life history type unique to the warm water conditions in the Okanogan. Climate extremes and global warming affects are a major concern. Escapements have continued to decline since the middle of last century (Hyatt, Stockwell and Rankin 2003) and are expected to continue to decline in the long-term (Hyatt, pers. com.). Mortalities may be direct or indirect because of loss of performance.

Based upon spawning and rearing habitat availability, Hyatt and Rankin (1999) recommend a minimum escapement objective of 58,730 adults past Wells Dam and the Canadian fisheries agencies have agreed to that objective.

Past Management Practices

Adult sockeye from several different sources were translocated to Lake Osoyoos in 1939 and 1940, as part of the GCFMP and juveniles were released there between 1941 and 1958 (Mullan 1986).

As plans were developed to channelized the Okanagan River for flood control in the 1950s, international attention was given to the fate of sockeye and that resulted in the preservation of key spawning areas, the re-design of drop structures to ensure safe passage, and pre-treatment inventories of sockeye escapements and spawning distribution.

For many years there have been annual counts of adults returning to the Okanagan. These counts are taken at both Wells Dam and the spawning grounds. Counts at the dam are usually about twice as high as those on the spawning grounds and it is not known whether this is because of differences in counting methods or mortalities en route.

In the early 1990s, Douglas PUD sponsored a sockeye hatchery program that was operated by the Colville Confederated Tribes at the Cassimer Bar Hatchery (Chapman et al. 1995 CPb). Adult brood was captured at Wells Dam and rearing took place at Cassimer Bar near the confluence of Okanagan and Columbia rivers. Resulting juveniles were released into Lake Osoyoos. Adult returns for this program were never documented and the program was abandoned in the late 1990s.

Current Management Practices

One current management program involves manipulation of flow releases to avoid egg desiccation or redd scour. An elaborate flow modeling procedure known as the Fish Water Management Tool has been designed and implemented. The work is managed by Canadian

Okanagan Basin Technical Working Group (Canadian fisheries agencies) and funded by Douglas County Public Utility District.

Another current initiative is re-introduction of sockeye into Okanagan and Skaha Lakes. The initiative, lead by Okanagan Nation Alliance and Colville Confederated Tribes and authorized by the Canadian Okanagan Basin Technical Working Group involves using Skaha Lake as an experiment. Should it prove fruitful consideration would be given to extending the run into Okanagan Lake. The program has started and will continue in 2004 if funding is available.

Facilities and Programs

When the sockeye re-introduction project was initiated in October 2003, wild Okanagan sockeye were captured as broodstock and incubated at Shuswap Falls Hatchery. Juveniles will be released into Skaha Lake in spring of 2004 if funding for the program is approved. The monitoring and evaluation program has been approved by the COBTWG and the Okanagan Nation Alliance is currently pursuing funding for the program.

One of the main concerns with the sockeye re-introduction is the possible affect on kokanee. The B.C. fisheries ministries have reported a dramatic decline of Okanagan Lake kokanee over the last three decades. Annual escapements have declined from hundreds of thousands of spawners, to fewer than 10,000 in 1999, (Andrusak et al. 1999). This has become the focus of the government-led Okanagan Lake Action Plan (OLAP) since 1996.

Declines in kokanee populations are attributed to a combination of factors, primarily including the loss of kokanee spawning habitat, nutrient imbalance (resulting in a decline of over-all lake productivity), and mysid shrimp competition. These factors enhance the concern that sockeye may add to the problem or that sockeye may experience the same problems that have caused the kokanee to decline.

Hatchery Effects on Population

Hatchery programs have been influencing the Okanagan sockeye stocks for a long period of time. Present populations are probably descendants of mixed origin fish that were captured during the GCFMP. The origin of these fish could have been from Lakes Wenatchee and Osoyoos, but most were likely from lakes upstream of Grand Coulee Dam (WDF 1938).

The extent of the contribution of these various stocks is somewhat moot, since the present two current independent populations (Wenatchee and Osoyoos) are easily separated genetically.

Hatchery fish have influenced present stocks both positively and negatively. Mullan (1986) made three conclusions in regard to the early (1940s-1960s) hatchery programs:

- contribution of hatchery sockeye to run size was substantial in some years;
- survival of hatchery juveniles to returning adults was about threefold greater in the 1940s than in the 1960s; and
- adults sacrificed for artificial propagation . . . showed no consistent increased efficiency, in point of returning adults, over natural recruitment based on spawner-recruit ratios . . .”

Chapman et al. (1995 CPb) concluded that the GCFMP was successful in reestablishing sockeye runs in the Wenatchee and Okanogan basins. They also felt that while the releases of sockeye in the 1950s and 1960s did not appear cost-effective in contributing to the commercial harvest, there was probably some benefit to the resource by adding numbers of fish to the spawning grounds.

Mullan 1986, Peven 1992 CPb, and Anas and Gauley (1956) all felt that hatchery fish influenced the run timing of juvenile sockeye. The authors found, however, that run timing is difficult to assess.

The use of artificial production strategies for recovery efforts, such as supplementation, has become a part of recovery planning in the Okanogan subbasin, as evidenced by current reintroduction experiments above Skaha Lake. While these are in the pilot phase they are currently ready for full implementation and funds for implementation are being pursued.

3.8.2 Summer/fall Chinook

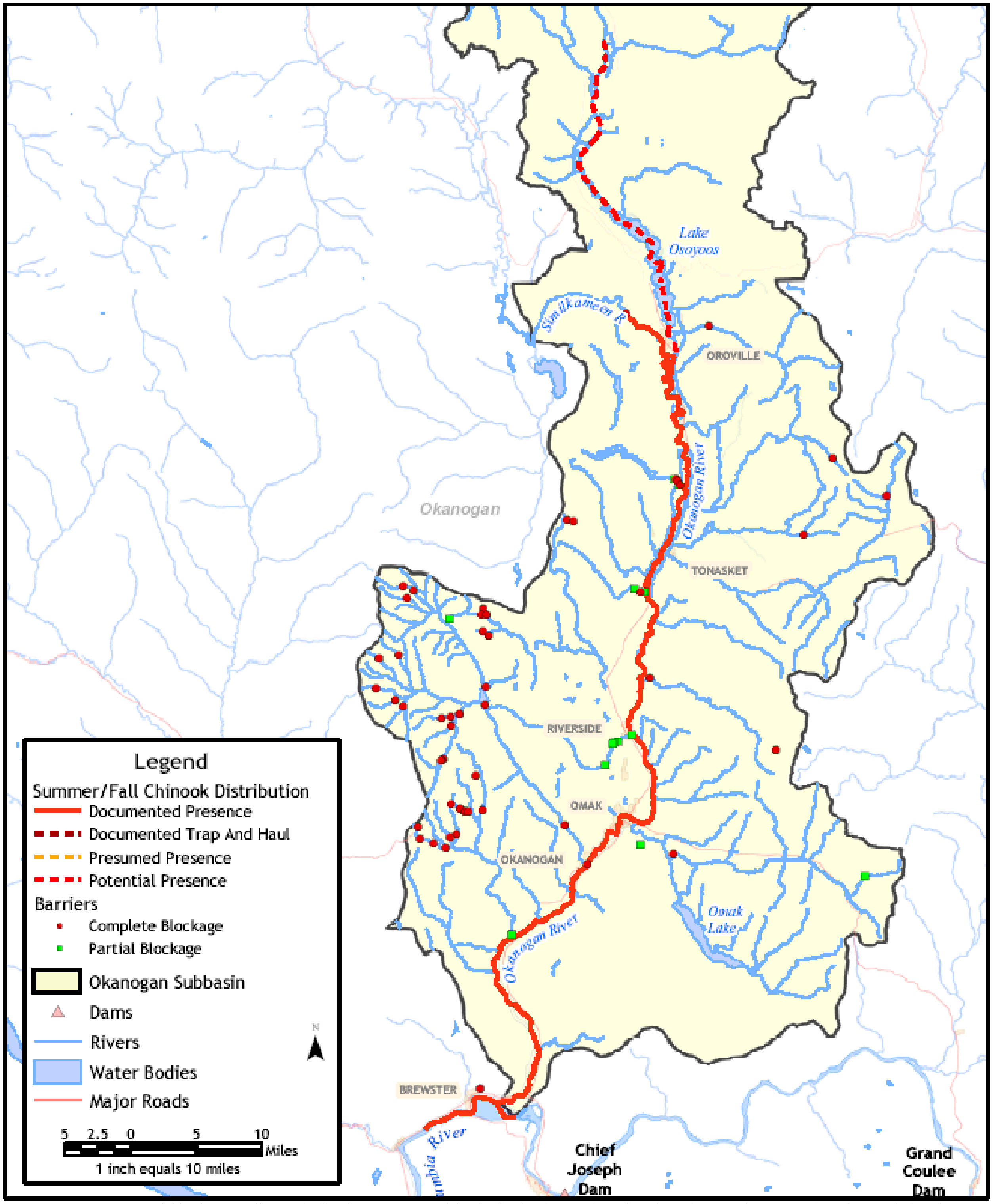
Rationale for Selection

In the 1997 "Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California", NMFS indicated that summer/fall Chinook salmon in this ESU were not in danger of extinction as a metapopulation, nor were they likely to become so in the foreseeable future (Myers et al.1998). Recent (since 2000) counts of summer/fall Chinook have surpassed historic (since the early 1930s) numbers of fish spawning in the area, which comports well with this conclusion.

However, the long-term trend for the Okanogan population is –5.2% and –8.8% in the short term (1987-96) (Brown, 1999). Highly variable escapements, the lack of productive populations utilizing Canadian Okanagan Subbasin habitats, and the desire to increase the proportion of wild origin stock in the upper Columbia River populations, makes the Okanogan River summer/fall Chinook an important stock for management attention. In addition, some tributaries that harbor historic habitat may need special management actions to increase use (and numbers).

Key Life History Strategies, Relationship to Habitat

The distribution of Chinook salmon is known upstream in the Okanogan to McIntyre Dam in Canada (Figure 1). Historically Chinook had access up into Okanagan Lake (Clemens et al. 1939, Ernst 2000, Vedan 2002). Some radio tagged fish classed as "fall Chinook" appeared in the Okanogan River when last seen in 1993 (Stuehrenberg et al. 1995). These stocks however are considered a mix between summer and fall stocks (NMFS 1998; Miller and Hillman 1994, 1996, 1997, 1998).



Note: For purposes of this plan, not all areas depicted. Data Layers: Fish Distribution (WDFW), Major Rivers (WA Ecology, TRIM), Major Roads (WashDOT, RIM). Projection: Washington State Plane North Zone NAD83. Produced by Jones & Stokes for KWA Ecological Sciences, Inc. Map Date: 5/15/2004

Figure 17 Okanogan Subbasin summer/fall Chinook distribution

Summer/fall Chinook spawning occurs primarily in the Similkameen River associated with the WDFW artificial production program. Lesser amounts of spawning have occurred in the

Okanogan River below Osoyoos Lake. Other than the Similkameen River, historic spawning habitat for summer/fall Chinook throughout the Okanogan River has been largely underutilized for decades.

Adults enter the Okanogan River from July through late September, and spawn from late September through early November, peaking in mid-October (Peven and Duree 1997, Murdoch and Miller 1999). Current Chinook spawning occurs in spatially discontinuous areas from the town of Malott upstream to Zosel Dam, approximately RM 64 of the Okanogan River (Murdoch and Miller 1999).

In the past two years, however, returns of summer/fall Chinook to the Similkameen River and upper Okanogan have increased substantially. High smolt-to-adult survival of the hatchery fish from the Similkameen Pond has produced an extremely high spawner density in the Similkameen River (>400 redds/km). Unfortunately, this has not produced the expected increase in natural-origin fish (the capacity of the Similkameen spawning habitat is being exceeded because of redd superimposition).

Of the returning adult hatchery fish between 1995-2000, 78% of the fish spawned in the Similkameen River. Of the hatchery fish that spawn in the Okanogan River, 76% spawn above Riverside (Rkm 65). Thus, a large portion of the Okanogan River is underutilized by hatchery-origin fish and the spawning habitat is under seeded. This is also seen for wild/hatchery origin Chinook observed above Osoyoos Lake in the Okanagan River. For example, in 2003 the total adult peak live plus dead Chinook enumerated was nineteen (Phillips and Wright 2004b, in press). However, the available Chinook habitat is estimated at approximately 4,300 spawning pairs based on a detailed evaluation of Okanagan River habitat between Oliver bridge and McIntyre Dam using water depth/velocity and substrate Chinook parameters (Phillips and Wright 2004a, in press).

Uneven distribution of spawners has led to a need for additional US acclimation sites to disperse the returning adults to underutilized habitat. (H. Bartlett, per. comm.). However, in Canada consideration will need to be given to the genetics of returning as preliminary genetic data suggests that adult Chinook returning to the Okanagan above Osoyoos Lake may be two additional separate populations in addition to hatchery origin fish (Phillips and Wright 2004b). Table 16 .

Year	Summer Chinook Adult	% Rocky Reach Count	Summer Chinook Jack	Total Run
2001	33,244	74	4,882	38,126
2000	6,447	44	3,709	10,156
1999	7,335	70	541	7,876
1998	3,237	48	733	3,970
1997	2,570	46	153	2,723
1996	2,225	44	165	2,390
1995	2,767	62	289	3,056

1994	4,613	80	378	4,991
1993	3,404	74	170	3,574
1992	1,343	65	631	1,974
1991	1,774	59	270	2,044
1990	3,207	78	217	3,424
1989	3,115	66	223	3,338
1988	2,411	74	360	2,771
1987	2,790	78	347	3,137
1986	3,787	78	515	4,302
1985	4,018	76	499	4,517
1984	4,768	87	1,173	5,941
1983	2,002	83	819	2,821
1982	2,223	90	1,126	3,349
1981	3,141	76	1,135	4,276
1980	3,910	79	982	4,892
22-yr average	4,742	70	878	5,620
22-yr median	3,272	74	507	3,499
22-yr range	1,343 – 33,244	44 – 90	153 – 4,882	1,974 – 38,126

Table 17

Table 16. Counts of Early-arriving Summer/fall Chinook at Wells Dam (1980 – 2001)

Year	Summer Chinook Adult	% Rocky Reach Count	Summer Chinook Jack	Total Run
2001	33,244	74	4,882	38,126
2000	6,447	44	3,709	10,156
1999	7,335	70	541	7,876
1998	3,237	48	733	3,970
1997	2,570	46	153	2,723
1996	2,225	44	165	2,390
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1987	2,790	78	347	3,137
1986	3,787	78	515	4,302
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1983	2,002	83	819	2,821
1982	2,223	90	1,126	3,349
1981	3,141	76	1,135	4,276
1980	3,910	79	982	4,892
22-yr average	4,742	70	878	5,620
22-yr median	3,272	74	507	3,499
22-yr range	1,343 – 33,244	44 – 90	153 – 4,882	1,974 – 38,126

Table 17. Counts of Late-arriving Summer/fall Chinook at Wells Dam (1980 – 2001)

Year	Chinook Adult	% Rocky Reach Count	Chinook Jack	Total Run
2001	6,928	76	2,672	9,600
2000	2,211	38	1,206	3,417
1999	1,925	35	631	2,556
1998	1,047	37	158	1,205
1997	611	25	156	767
1996	707	20	210	917
1995	1,007	27	175	1,182

1994	2,462	55	555	3,017
1993	1,061	52	160	1,221
1992	770	52	747	1,517
1991	577	43	272	849
1990	592	30	149	741
12-yr average	1,658	41	591	2,249
12-yr median	1,054	38	241	1,213
12-yr range	577 – 6,928	20 – 76	149 – 2,672	741 – 9,600

Usually 50% or more of spawning adults have a total age of 5 years, with the remainder predominantly 4-year-old fish (Murdoch and Miller 1999). In the past, sporadic reports of Chinook spawning above Lake Osoyoos have been recorded during sockeye salmon spawning ground surveys. Spawning ground data in the Similkameen River indicate that summer Chinook spawn from Enloe Dam to Driscoll Island, a total distance of 14 kilometres.

In the Okanogan River, Chinook usually spawn between RM 14.5 (just downstream of Malott) and Zosel Dam (RM 77.4). In the Similkameen River, Chinook spawn between its mouth and Enloe Dam (RM 8.9). Upstream access to spawning areas is reported to be McIntyre Dam (RM 106) in Canada, although passage beyond the structure may occur during some high flow periods (ONA, 2003).

Vaseux (McIntyre) Creek in Canada, immediately below Vaseux Lake appears to contain suitable substrates for Chinook, however it is dewatered annually from the mouth to a distance 1 kilometre upstream from its confluence with Okanagan River as a result of historic alterations to the stream bed and water withdrawal.

In both Okanogan and Similkameen Rivers, redds are highly clumped, and those distributions have not changed since 1987 when ground surveys were first conducted (Hillman and Miller 1993; Miller 2003). During that period, densities of redds in the Okanogan River were highest between Okanogan and Omak (RM 26.1-30.8), McLoughlin Falls and Tonasket (RM 48.9-56.8), and the Similkameen River confluence and Zosel Dam (RM 74.1-77.4); they were lowest between Tonasket and the Similkameen River confluence (RM 56.8-74.1) (Hillman and Miller 1993).

In the Similkameen River during the same period, densities of redds were highest between the mouth and the county road bridge (RM 0-5). Unlike in other mid-Columbia streams, Hillman and Miller (1993) found that summer/fall Chinook in the Okanogan Basin constructed most of their redds near islands, i.e., in braided segments.

Emergence timing probably occurs from January through April, although specific data on emergence studies was not identified in reviews for this LFA. Juveniles generally emigrate to the ocean as subyearling fry, leaving the Okanogan River from one to four months after emergence.

However, there is evidence that some fish undergo an extended residence period, with a protracted downstream migration. Many subyearlings rear in the mid-Columbia impoundments for various periods of time during their outmigration (Peven and Duree 1997).

Population Delineation and Characterization

In 1995, NMFS concluded that summer Chinook salmon in the mid-Columbia River are not a "distinct population segment" of a species (as defined by Waples 1991) or ESU as defined by the NMFS Policy on the Definition of Species under the U. S. Endangered Species Act (56 FR 58612 58618). Rather, they are part of a larger ESU that includes all late run (summer and fall) ocean type Chinook salmon from the mainstem Columbia River and its tributaries (excluding the Snake River) between Chief Joseph and McNary Dams (Waknitz et al. 1995).

For the purposes of sub-basin planning, it is assumed that there is one large metapopulation of summer/fall Chinook between the confluence of the Snake River and Chief Joseph Dam, but specific tributaries, in addition to limited areas of mainstem Columbia spawning, contain independent populations that need to be considered in management actions.

Population Status

In the 1997 “Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California”, NMFS indicated that summer/fall Chinook salmon in this ESU were not in danger of extinction, nor were they likely to become so in the foreseeable future (Myers et al.1998). However, the long-term trend for the Okanogan population is –5.2% and –8.8% in the short term (1987-96) (Brown, 1999).

Highly variable escapements, the lack of productive populations utilizing Canadian Okanagan Subbasin habitats, and the desire to increase the proportion of wild origin stock in the upper Columbia River populations, makes the Okanogan River summer/fall Chinook an important stock for management attention.

As mentioned earlier, recent preliminary genetic evidence suggests a potential two additional populations that will most likely fall into the summer/fall ESU (Phillips and Wright 2004b, in press). However, conclusive determinations are difficult at this stage as small sample sizes and life history observations such as high rates of spawning residualized Chinook and sporadic yearling Chinook observations are more indicative of stream type populations (Phillips and Wright 2004b, in press). An additional implication from the presence of mature spawning residualized (no ocean phase) Chinook above Osoyoos Lake is some of the genetic diversity of the population may have been maintained during the GCFMP (Phillips and Wright 2004b, in press). Numerous mature male residual Chinook and one mature female were documented in 2003. However, additional genetic analysis of this stock will determine whether this is the case.

Population Management Regimes and Activities

Hatchery Effects

In 1939, during construction of Grand Coulee Dam, the US Fish and Wildlife Service initiated a program to address the upcoming loss of over 1,100 miles of available habitat to Upper Columbia River salmonid populations (Fish and Hanavan 1948). Construction of the dam without fish passage facilities led to the program that centered on trapping at Rock Island Dam.

Past Management Practices

During the GCFMP (1939-1943), all salmon and steelhead that reached Rock Island Dam were trapped there and mixed. These fish were either transplanted to spawning streams and "forced" to spawn there, or taken to newly completed hatcheries on the Wenatchee (Icicle Creek), Entiat, or Methow rivers.

Trapped and transported spring and late-run Chinook and steelhead of mixed origins were allowed to spawn naturally in Nason Creek upstream from a rack 0.25 miles upstream from the creek mouth. Steelhead were also released in the upper Wenatchee River (upstream of Tumwater Canyon) and the Entiat River in 1939. The fish were released between two racks that forced the fish to spawn in the area selected by the biologists of the USFWS (Fish and Hanavan 1948). Sockeye and coho were raised in hatcheries and liberated in various places.

Upper Columbia River Summer/Fall Chinook migrate past Wells Dam from mid-July through November. Historically, propagation of this ESU used fish passing Wells Dam from July 10th through November 15th. However since 1987, the early portion of the run, those fish passing Wells Dam from July 10th through August 28th have been collected for broodstock.

Current Management Practices

Since the mid-1940s, over 50 years have elapsed, the equivalent of about 12 generations of summer/fall Chinook. This may be sufficient time for spawning populations to develop adaptive traits appropriate for each tributary upstream from Rock Island Dam (Quinn et al. 2000; Unwin et al. 2000).

With implementation of the Upper Columbia summer/fall Chinook HGMP, the full Chinook run will again be propagated. In this plan, those Chinook passing Wells Dam from mid-July to August 28th are referred to as early-arriving summer/fall Chinook, while the Chinook passing the Dam from August 29th through November are referred to as later-arriving summer/fall Chinook. The summer/fall Chinook in the Okanogan River will be managed as a single population with a common broodstock, but recognizing the continuum in run timing and spawn timing from the upper Okanogan subbasin to the lower river reaches.

Management also includes the summer/fall Chinook destined for the Methow River in this population. This management strategy will continue until separate broodstock collection capabilities are developed in the Okanogan subbasin and at the proposed Chief Joseph Dam Hatchery. At that time, fishery co-managers will need to consider the benefits and risks of managing the Methow and Okanogan Chinook as separate populations. In addition, consideration will also be given to the preliminary genetic evidence of potentially two additional populations in the Okanagan if additional genetic analysis confirms whether this is the case.

Facilities and Programs

The summer/fall Chinook propagation program described in the Upper Columbia summer/fall HGMP is designed, first and foremost, to restore the abundance, diversity, and distribution of historical populations. Additionally, these programs are designed to restore a base level of ceremonial and subsistence fisheries for the Tribes and recreational fisheries. These primary program objectives are designed to be consistent through the marking of hatchery-origin fish and the development of live-capture, selective fishing gear.

There is currently no management of Chinook in the Canadian portion of the Okanagan River. However, efforts are underway to begin understanding the life history patterns of Chinook returning to Canada and to set the stage for recovery planning of Canadian Okanagan Chinook. A status report and habitat evaluations of Chinook habitat potential are being prepared (Phillips and Wright 2004a, Phillips and Wright 2004b). Additional monitoring may include: adult migration, spawning escapement, biological sampling, habitat mapping, genetic analysis, fry emergence, and freshwater rearing (stream and lake).

Current propagation of the Okanogan summer/fall Chinook has focused solely on (and selected for) the earlier portion of the run. The proposed artificial propagation program for summer/fall Chinook is designed to disperse production throughout the Okanogan River to rebuild viable natural spawning populations throughout their historical habitats, rather than just in the uppermost reaches of the US portion of the river.

The program is also designed to propagate Chinook from the full run, July – November, rather than July – August. Finally the program will include the release of sub-yearling fish to emulate the natural life history of the population. The current hatchery program for summer/fall Chinook is outlined below:

1. Eastbank Hatchery, Similkameen Pond, Bonaparte Pond – release of 576,000 yearling summer Chinook – Integrated Recovery Program
2. Summer/fall Chinook Integrated Recovery Program – 1,876,000 yearlings and fingerlings (576,000 is existing)
3. Summer/fall Chinook Integrated Harvest Program – 700,000 yearlings and fingerlings (new)
4. 476,000 yearling release of early-arriving summer/fall Chinook from Similkameen Pond.
5. 100,000 yearling release of early-arriving summer/fall Chinook from Bonaparte Pond.

Effects on Population

The present Wenatchee, Entiat, Methow, Similkameen, Okanogan, and Columbia River spawning summer/fall Chinook all originated from a mix of summer/fall Chinook collected at Rock Island Dam 1939-1943. The only possibility that adults of unmixed stock might have escaped the GCFMP would have returned in 1944 of progeny of the 1938 brood that went to sea in 1939 and remained there for five years. This possibility seems remote. Not only is the fraction of age 0.5 fish (six years from parent brood return to progeny adult return; see below) very small in summer/fall Chinook of the Columbia River (see below), but the likelihood that a 0.5 female would find a 0.5 male of the same natal origin rather than spawning with a colonizing mixed-origin adult is small also. Lake resident Chinook have also been recently identified in Osoyoos Lake in addition to numerous males and one spawned out female documented. This may also have the possibility of a unique upper Columbia Okanagan population that may have escaped the GCFMP. Preliminary genetic analysis suggests a separate population to that of Similkameen and Okanagan Chinook. However, more research is required.

The GCFMP extensively homogenized spring and summer/fall Chinook, steelhead, and sockeye that were of mid- and upper-Columbia river origin. Homogenization was both temporal and geographic. The manipulations of the GCFMP may have reduced the genetic uniqueness of any distinct populations, or subpopulations in the mid-Columbia.

While Fish and Hanavan (1948) concluded that the relocation of fish to the natural spawning areas "was successful to a degree exceeding expectations," Ricker (1972) felt the program "was a salvage operation which in the long run seems to have salvaged nothing." Mullan (1987) believed the program was successful in maintaining genetic diversity of the stocks to some unknown degree. Fish and Hanavan (1948) believed that the overall success of the artificial propagation part of the program was "only fair at best" which Mullan (1987) agreed with, pointing out that survival to adult for fish released was generally 1% or less.

Regardless of the degree of success of the GCFMP, the current stocks of fish that spawn in the Upper-Columbia River basin are at least partially descended from the progeny of the program.

The release of hatchery summer/fall Chinook has a substantial effect on the abundance and distribution of spawning fish as evidenced from Table 3. Dams in the US Okanogan Subbasin (StreamNet, 2000).

Table 18. Proportion of hatchery summer/fall Chinook recovered on the spawning grounds

Can't get (Colville salmon-steelhead status cd)

Harvest Effects

Harvest of summer/fall Chinook is premised on an escapement objective of 3,500 fish. Based on Chinook passing Wells Dam from 1990 – 2001, the later-arriving component of this run has averaged 24.5% of the total summer/fall Chinook run (median of 24%).

Tribal fishery

The Confederated Colville Tribes manage a C&S fishery in the tailrace immediately below Chief Joseph Dam. The fishery uses hook-and-line gear to snag UCR Summer/Fall Chinook. UCR steelhead are caught incidentally. Historically the fishery commenced on July 1 and ended no later than September 30. The fishery is designed to harvest summer/fall Chinook in excess of the current escapement objective, 3,500 fish.

Because the tailrace fishery is located in a terminal site and uses hook-and-line gear, it has very limited capacity to harvest large numbers of Chinook surplus to escapement needs. From 1980 – 2000, the fishery harvested 200 – 1,100 summer/fall Chinook and 12 – 819 steelhead. Even with the extraordinary, record run of summer/fall Chinook past Wells Dam of 47, 700 in 2001, the Tribes' harvest was estimated at only 3,400 Chinook.

There has been no recent documented Okanagan Nation Chinook harvest in the waters above Osoyoos Lake (Wright, pers. comm.).

Recreational fishery

Recreational fisheries for summer/fall Chinook in the Okanogan and upper Columbia rivers are opened when forecasted runs of summer Chinook indicate a significant surplus to broodstock and escapement needs.

A surplus is calculated as the anticipated run at Priest Rapids Dam less 5,750 fish required for broodstock at hatchery programs upstream of the Dam, less 2.5% of the Priest Rapids count for lower-river recreational fisheries, less 5% harvest by the Wanapum Tribe, less an allocation for natural escapement in the Wenatchee, Methow, Similkameen, Okanogan, Entiat, and Chelan rivers.

As escapement goals for each of these rivers has not yet been established, WDFW has conservatively used the sum of the maximum annual escapements to each river for 1996-2000, (about 11,000 fish at Priest Rapids Dam) as the limitation on recreational fisheries.

The recreational fishery in and about the Okanogan River has been very infrequent because of the consistently poor runs of summer Chinook until recent years. Anglers are allowed to harvest hatchery-origin and natural-origin Chinook.

3.8.3 Spring Chinook

Rationale for Selection

The Upper Columbia River Spring Chinook were listed as an Endangered species on March 24, 1999. The listed ESU includes all naturally spawned populations of spring Chinook in accessible reaches of Columbia River tributaries between Rock Island and Chief Joseph dams, excluding the Okanogan River, which supported large spring Chinook populations historically, but are not deemed extirpated. Several hatchery populations from the Methow and Wenatchee subbasins where included in the listed ESU.

Key Life History Strategies, Relationship to Habitat

WDW et al. (1989) states: Natural spring Chinook production in the Okanogan and Similkameen subbasins is currently not feasible because of extensive habitat alterations in the accessible reaches. Failure of inclined-plane traps to capture spring Chinook smolts during trapping of sockeye smolts in the lower Okanogan River (McGee and Truscott 1982; McGee et al. 1983) empirically supports that judgment.

Bryant and Parkhurst (1950) and Fulton (1970) claim spring Chinook used Omak Creek, although the affidavits in Craig and Suomela (1941) do not mention such use. Weitkamp and Neuner (1981) captured a handful of Chinook juveniles in a floating trap in the Okanogan River in 1981 that were large enough to be spring Chinook. The trap was downstream from the confluence of Salmon Creek, and could have resulted from spring Chinook that spawned in Salmon Creek. None were captured in 1982 or 1983 (McGee and Truscott 1982; McGee et al. 1983).

In the Mid Columbia Region, juvenile spring Chinook salmon generally spend one year in freshwater before they migrate downstream (Mullan 1987; Healey 1991); most spend two years in the ocean before migrating back to their natal streams (Mullan 1987; Fryer et al. 1992). The adults enter the tributaries to the mid Columbia River from late April through July, and hold in the deeper pools and under cover until onset of spawning. They may spawn near their holding areas or move upstream into smaller tributaries.

Spawning occurs from late July through September, usually peaking in late August (Chapman, et al. 1995a). This extended period, both as adults and juveniles, makes spring Chinook salmon typically more susceptible than ocean type Chinook salmon to impacts from habitat alterations.

Water withdrawal in some areas has a deleterious effect upon stream type salmonid spawning distribution, incubation survival, and late summer rearing habitat quality (Chapman et al. 1995a).

In the Mid Columbia Region, stream type Chinook salmon exhibit a much more diverse manifestation of life history strategies than ocean type salmonids, which is probably related to their extended freshwater residence. While the percentage of fish employing any particular strategy now or historically has not been determined, it is highly likely that the percentage shifted in response to varying environmental conditions (Stearns 1989). For example, juvenile fish that may have been inclined to overwinter in an upper tributary might instead migrate to the lower mainstem or nearby side channels and tributaries during a particularly cold winter (Bustard and Narver 1975; Beschta et al. 1987).

All stream type Chinook salmon discussed in this document are within the Upper Columbia River Spring Chinook Salmon GDU (Marshall et al. 1995). The White River population (a tributary to the Wenatchee River) has relatively distinctive allele frequencies among the stocks within this GDU. Also included in this GDU are the fish propagated at Leavenworth, Entiat, and Winthrop NFH, which was partially derived from Carson NFH, a nonlocal stock (Bugert 1996).

Critical habitat for the spring Chinook ESU was designated on February 16, 2000, and included all river reaches accessible to listed spring Chinook in Columbia River tributaries between Rock Island and Chief Joseph dams, excluding the Okanogan River (Talayco, 2001).

The Upper Columbia River Spring Chinook ESU includes stream-type Chinook salmon spawning above Rock Island Dam in the Wenatchee, Entiat, and Methow rivers. All Chinook salmon in the Okanogan River are now believed to be ocean-type and are considered part of the Upper Columbia River Summer/Fall Chinook ESU (Meyers 1998). However, historically, spring Chinook salmon were numerous in the Okanogan sub-basin as they were harvested by the Colville Tribes Confederated Tribes in the Okanogan River during their May thru October salmon fisheries (Post 1938 as quoted in NWPPC 1986).

Fulton reported that while spring and summer Chinook were limited to the Okanogan and lower 2 kilometres of the Similkameen by the late 1960s, they formerly spawned in Salmon and Omak creeks and most of the Similkameen River. These former runs were lost to irrigation development. Parkhurst reported that the large, early-day runs of Chinook were depleted because of a combination of over-exploitation by the commercial fisheries in the lower Columbia River and the destructive Indian fishery.

By 1874 over one-half of the normal salmon run reaching the Colville Tribes Confederated Tribes was destroyed by lower river commercial fisheries. In 1884, the tribes had lost about three-fourths of their fishery and by 1890, salmon runs to the Colville Tribes Confederated Tribes was almost completely destroyed (Ray 1972). The large Chinook run into Salmon Creek was lost when the Bureau of Reclamation built Conconully Dam in 1916. When surveyed in 1936, no Chinook were present in Salmon Creek (Parkhurst 1950 as cited in NWPPC 1986)

Historical Indian fisheries for Okanogan salmon in May, June, and early July were likely spring Chinook. Alexander Ross in 1811 wrote that the Southern Okanogans assembled in large bands in June for the purpose of fishing during the summer season (Ray 1972). French and Wahle (1965) designated all Chinook arriving at Rock Island Dam by June 18 to July 9 as spring Chinook. Chapman reported that fifty % of the spring Chinook run passes Rock Island Dam in mid-May with passage at Wells Dam occurring slightly later. These fish inhabited at least Salmon Creek and Omak Creek.

Production in the Similkameen River is uncertain, as a 15-foot falls was believed to be a passage barrier at lower flows. Fulton, however, reported the falls as passable. Chapman (Chapman 1995) stated that, "No reliable information indicates that spring Chinook ever used the Similkameen River."

As with sockeye, spring Chinook did migrate above Lake Osoyoos into Canada and spawned in the upper Okanogan River and other tributaries. Chapman reports that, "In 1936, spring Chinook were observed in the Okanogan River upstream from Lake Osoyoos by Canadian biologists (Gartrell 1936). That observation for May estimated 100-300 adults present on the spawning grounds." In the late 1950s and early 1960s, spring Chinook were observed in the Okanogan River as far as Okanogan Falls. Chinook were observed spawning from the falls downstream to Oliver, with concentrated spawning occurring mainly about 1½ miles above Oliver near Vaseux Creek (Roy Wahle, pers. comm.).

In recent years, Chinook have been reported in small numbers spawning in the Okanogan River above Lake Osoyoos (Langness 1991, Bartlett 2001 per. com). These remnant runs could now be summer/fall Chinook.

In addition to spring Chinook spawning in Salmon and Omak creeks, they may have inhabited several other smaller, Okanogan tributaries (e.g. Bonaparte and Loup Loup creeks) prior to irrigation development in the late 19th century. As may have occurred in other Columbia sub-basins with similar characteristics as the Okanogan, many of the juvenile spring Chinook may have migrated out of the warming waters of the Okanogan subbasin as 0-age pre-smolts or smolts. It is also probable that spring Chinook spawning above Osoyoos Lake reared in the lake prior to smoltification, a life history strategy that is very successful for sockeye and coho salmon. Large, juvenile or residual Chinook have recently been captured in gill nets set in upper Osoyoos Lake (H. Wright 2003, pers. comm.).

Spring Chinook salmon historically spawned above Redfish Lake in Idaho with the juveniles rearing in the lake with the sockeye salmon prior to their ocean migration. It is also highly likely the juvenile spring Chinook from the White and Little Wenatchee rivers rear in Lake Wenatchee (Bugert, 1998).

Reservoir rearing of juvenile spring Chinook was a successful strategy in Fall Creek and Green Peter reservoirs in the Willamette sub-basin that produced large smolts and sizeable adult runs.

Historically, spring Chinook in the Okanogan may have included the following life history types:

- Spawn, rear, and overwinter in Salmon Creek.
- Spawn and rear in Salmon Creek, overwinter in mainstem Okanogan River.
- Spawn and rear in tributaries above Lake Osoyoos; overwinter in the lake.
- Spawn, rear, and overwinter in mainstem Okanogan above Lake Osoyoos.
- Spawn, rear, and overwinter in Omak Creek.

Some of the life history observations (Chinook jack and jills) and high river temperatures where they may migrate as 0+ indicate a spring type of population (H. Wright pers. com.).

In 2001, the USFWS Winthrop Hatchery released Carson stock spring Chinook smolts and fry into Omak Creek.

Population Delineation and Characterization

The Upper Columbia River Spring Chinook ESU includes stream-type Chinook salmon spawning above Rock Island Dam in the Wenatchee, Entiat, and Methow rivers. All Chinook salmon in the Okanogan River are now believed to be ocean-type and are considered part of the Upper Columbia River Summer/Fall Chinook ESU (Meyers 1998). However, historically, spring Chinook salmon were numerous in the Okanogan sub-basin as they were harvested by the Colville Tribes Confederated Tribes in the Okanogan River during their May thru October salmon fisheries (Post 1938 as quoted in NWPPC 1986).

Population Status

Spring Chinook are considered extirpated from the Okanogan River drainage, although historical records indicate that they occurred in at least three systems: (1) Salmon Creek, prior to construction of the irrigation diversion dam (Craig and Suomela 1941), (2) tributaries upstream of Lake Osoyoos (Chapman et al. 1995), and (3) possibly Omak Creek (Fulton 1968).

Population Management Regimes and Activities

In the Chelan HCP, hatchery compensation for Okanogan Basin spring Chinook will be assessed in 2007 following the development of a continuing spring Chinook hatchery program and/or the establishment of a Threshold Population of naturally reproducing spring Chinook in the Okanogan watershed (by an entity other than the District and occurring outside this Agreement).

The Hatchery Committee shall determine whether a hatchery program and/or naturally reproducing population of spring Chinook is present in the Okanogan Basin. Should the Hatchery Committee determine that such a program or population exists, then the Hatchery Committee shall determine the most appropriate means to satisfy the 7% hatchery compensation requirement for Okanogan Basin spring Chinook.

Programs to meet the 7% hatchery requirement for Okanogan Basin spring Chinook may include but not be limited to: (1) operation and maintenance funding in the amount equivalent to 7% project passage loss or (2) replace project passage losses of hatchery spring Chinook with annual releases of equivalent numbers of yearling summer Chinook into the Okanogan River Basin or (3) provide funding for acclimation or provide funding for adult collection facilities in the amount equivalent to 7% juvenile passage loss at the Rocky Reach Project.

The programs selected to achieve NNI for Okanogan Basin spring Chinook will utilize an interim value of project survival, based upon a Juvenile Project Survival estimate of 93%, until project survival studies can be conducted on Okanogan Basin yearling Chinook.

Current Management Practices

Recent spring Chinook mitigation programs of the federal government and public utility districts have excluded the Okanogan subbasin. Only since 2002, has a small, pilot program been initiated with releases of Carson stock spring Chinook in the Okanogan River and Omak Creek.

Facilities and Programs

Artificial propagation:

Spring Chinook Isolated Harvest Program – 800,000 yearlings (new)

Spring Chinook Integrated Recovery Program – 100,000 yearlings (new

1. 50,000 yearling release in Omak Creek
2. In 2002, a pilot release of 300,000 spring Chinook from Ellisforde Pond.
3. In 2003, a pilot release of 100,000 spring Chinook from Bonaparte Pond.

2004 will be the first year for adult returns from the releases of spring Chinook in the Okanogan River and Omak Creek.

Hydroelectric Effects

WDF (1938) describes existence of potential spawning habitat in the area upstream from Enloe Dam, but provides no documentation of historical use of the area by salmon or steelhead (NMFS, 1998). Chapman et al. (1995 CPa) found no evidence that such use occurred. The underlying source for Fulton's (1968) inclusion of the Similkameen River upstream from the site of Enloe Dam as anadromous salmon habitat was WDF (1938). Review of that source does not support the Fulton observation. Cox and Russell (1942) state:

> From testimony of a Mr. McGrath at Nighthawk, who had been in that country over 40 years, we learned that before any power dam was built (Enloe Dam), the 15' to 20' natural falls already mentioned prevented salmon ascending any farther. He had often fished the river at Nighthawk but had never heard of a salmon being seen or caught above the natural falls. He stated that the Indians came in to fish at these falls each summer.....Therefore, we conclude that this power dam did not interfere with any salmon runs....

Accounts of the traditional story of coyote suggest that salmon never passed upstream of the falls, and the Native people of the Similkameen valley never sought to have fish passage there, further confirming that anadromous fish never passed the falls (Vedan 2002).

Harvest Effects

Spring Chinook are extirpated in the Okanogan River. Consequently the Colville Tribes Confederated Tribes have been denied their spring Chinook trust fisheries. It should also be noted that the Canadian Species-At-Risk act requires extirpated species to be part of the recovery plan. Currently, there is a listing petition for spring Chinook in Canada and actions in the US portion of the Okanogan watershed will have to be part of the recovery equation.

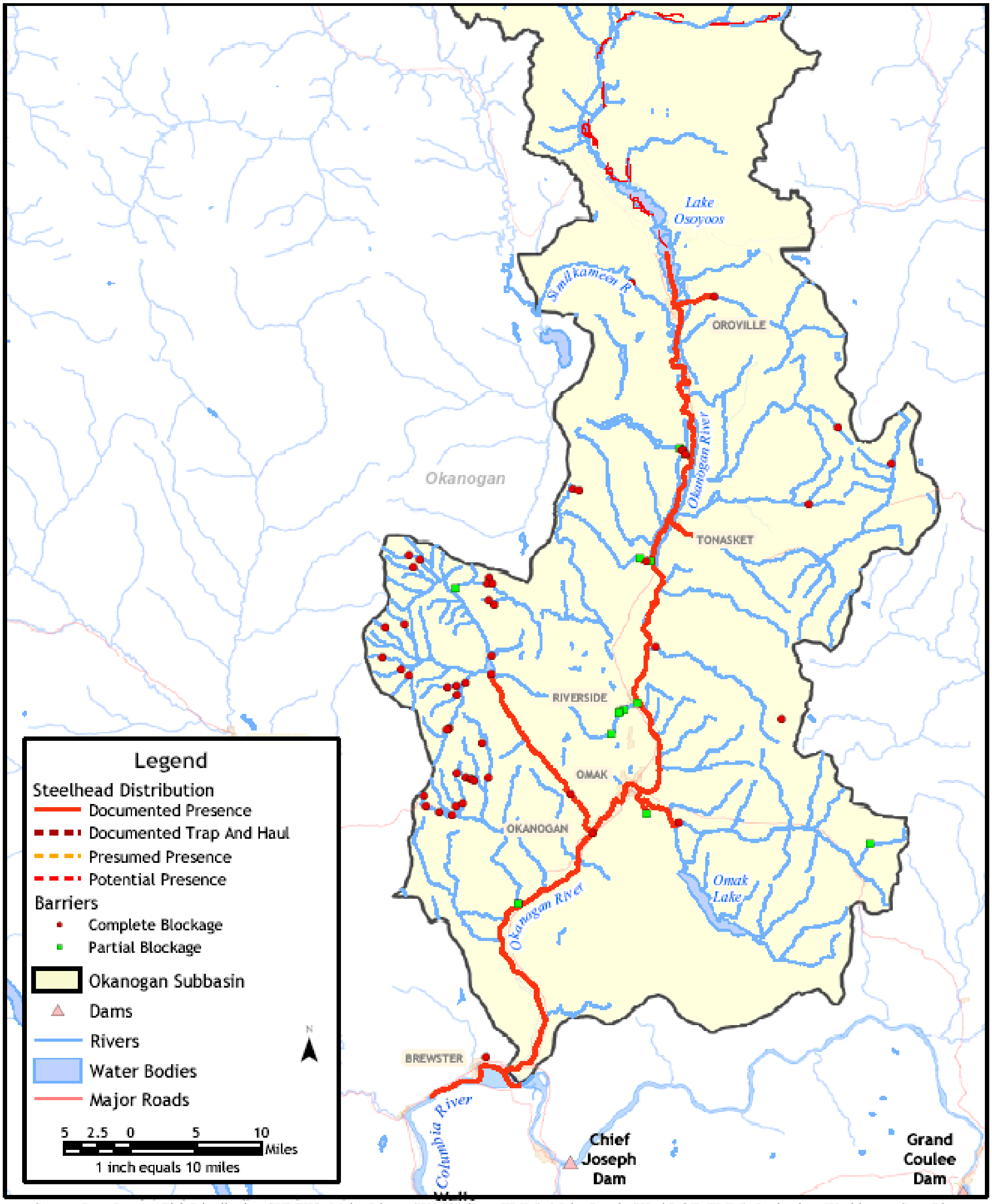
3.8.4 Steelhead

Rationale for Selection

Upper Columbia steelhead in the Okanogan are considered depressed according to SASSI (WDFW & WWTIT 1994). In addition, Upper Columbia ESU Steelhead, of which the Okanagan is a population (Busby et al. 1996), are classified as Endangered by NMFS Although the historical record for steelhead in the Okanogan Watershed is not complete, Mullan et al. (1992) asserts that few steelhead historically used the Okanogan River. . It should be noted that the NMFS review did not include the Canadian Portion of the Okanagan Basin. However, it is unknown if other historical assessments such as Mullan et al. (1992) included the Canadian portion of the Okanagan River.

Key Life History Strategies, Relationship to Habitat

Steelhead are widely distributed and have been recorded upstream in the Okanogan to the mid-reaches of the Okanagan River above Osoyoos Lake (Figure 1). Peven (2003) concluded that, for the purposes of sub-basin planning, there are four independent populations of steelhead within the larger metapopulation that spawns naturally upstream from Rock Island Dam (Wenatchee, Entiat, Methow, and Okanogan).



Source: Data Layers: Fish Distribution (WDFW), Major Rivers (WA Ecology, TRIM), Major Roads (WashDOT, TRIM). Projection: Washington State Plane North Zone NAD83. Produced by Jones & Stokes for KWA Ecological Sciences, Inc. Map Date: 5/15/2004

Figure 18. Okanogan Subbasin Steelhead distribution

The Okanogan River mainstem is primarily used as a migration corridor to clearer, colder tributaries. Current habitat conditions in the migration corridor are poor for most if not all history types. However above Osoyoos Lake, a more natural section of the mainstem river does have suitable habitat but little effort to document spawning has occurred.

Historically, steelhead had access to Okanagan Lake (Ernst 2000, Rebellato and Wright 2004, in press, Vedan 2002). However, their present day access is limited to below McIntyre Dam. The historical record for steelhead trout in the Okanogan Basin is incomplete (Mullan, et al., 1992), but it is unlikely that Okanogan River produced large numbers of steelhead. Salmon Creek, Omak Creek, and the Similkameen River supported small runs, but these were eliminated or reduced by passage barriers (NMFS, 1998). Few wild steelhead currently spawn successfully in the Okanogan Basin because many of the tributaries with spawning habitat are dewatered during the summer months. Elevated temperatures and sedimentation in the Okanogan River limit quality and quantity of cold water refugia.

Only summer-run steelhead are known to utilize the Okanogan watershed. Winter-run steelhead were not known to ever use this system, likely owing to the long migration involved. The summer run steelhead of the Okanogan are considered part of the upper Columbia summer steelhead ESU, and were listed as Endangered on August 18, 1997.

In the Okanogan Basin, Fulton (1970) named Omak and Salmon creeks as producing steelhead, and the upper Similkameen, but that seems unlikely based on evidence that fish were unable to ascend Enloe Falls prior to the dam (Chapman et al. 1994 CPa).

Mullan et al. (1992CPa) stated that steelhead never used the Okanogan in great numbers, and that Salmon Creek (blocked by a dam in 1916) and Similkameen (see discussion above concerning fish upstream of the falls) were the most probable steelhead producing streams in the basin. It is unlikely that this assessment included the Okanagan River above Osoyoos Lake.

Salmon Creek historically supported self-sustaining steelhead runs, but lack of flow currently restricts access in most years. Some evidence suggests that steelhead may also have historically used other tributaries in the Okanogan Basin (Chapman et al. 1994b). The current suitability of habitat throughout much of the Okanogan basin is generally considered poor in regard to supporting most life history requirements of steelhead.

Although steelhead were probably never abundant in the Okanogan River because of natural habitat limitations, an estimated half of the steelhead production may have been lost as a result of fish access restrictions to Salmon Creek by irrigation water withdrawals (WDF and WDFW 1993).

In 1955-56, the escapement estimate to the Okanogan was about 50 fish, from a total run size of about 97 fish (WDFW 1990). Assuming a 50 % loss in production from Salmon Creek since 1916, the average run-size prior to the extensive hydroelectric development in the mid-Columbia River reach is believed to have been about 200 fish. The estimated total run-size of naturally produced summer steelhead to the Okanogan Subbasin declined to between 4 and 34 fish, from 1977 to 1988 (WDFW 1990).

Nevertheless, 19 adult summer steelhead were trapped in Omak Creek in 2001 (C. Fisher, TAG). When considered against a total escapement to the entire system of between 4 to 34 fish from 1977 to 1988 (WDFW 1990), such populations, although small, become disproportionately important. Regardless of whether the 2001 Omak Creek steelhead returns originated from earlier smolt transplants from the Wells Hatchery into the system, the creek may be especially important for the reestablishment/recovery of the summer-run steelhead ESU within the Okanogan watershed.

Steelhead production from Salmon Creek was estimated to represent roughly 50% of the native production throughout the US portion of the watershed prior to the erection of Conconully Dam.

Documentation of steelhead utilization above Osoyoos Lake is extremely limited. No records have been kept since 1972 (Rebellato and Wright 2004). However, confirming the anadromous forms of *O. mykiss* above Osoyoos Lake is confounded by the presence of adfluvial rainbow trout which are similar in appearance, distribution and behavior to steelhead (for further details see the section on rainbow trout).

Despite the lack of information on the Canadian side, two major tributaries below McIntyre Dam (Vaseux Creek and Inkaneep Creek) plus the natural section of the mainstem river are thought to support steelhead.

Steelhead counts began at Rock Island Dam in 1933, and annual counts averaged 2,800 between 1933 and 1939 (these numbers do not reflect large fisheries in the lower river that took place at that time, estimated by Mullan et al. (1992CPa) as greater than 60%). Average decadal numbers changed little in the 1940s and 1950s (2,600 and 3,700, respectively). Large hatchery releases began in the 1960s, and the average counts increased to 6,700. In the 1970s, counts averaged 5,700 and 16,500 in 1980s (record count of about 32,000 in 1985). In the 1990s, counts decreased to 7,100, following a similar trend to Chinook. Also following a trend similar to Chinook steelhead increased substantially in the 2000s, averaging over 18,000. A high of 28,600 was experienced in 2001 (Figure 3, Table 1).

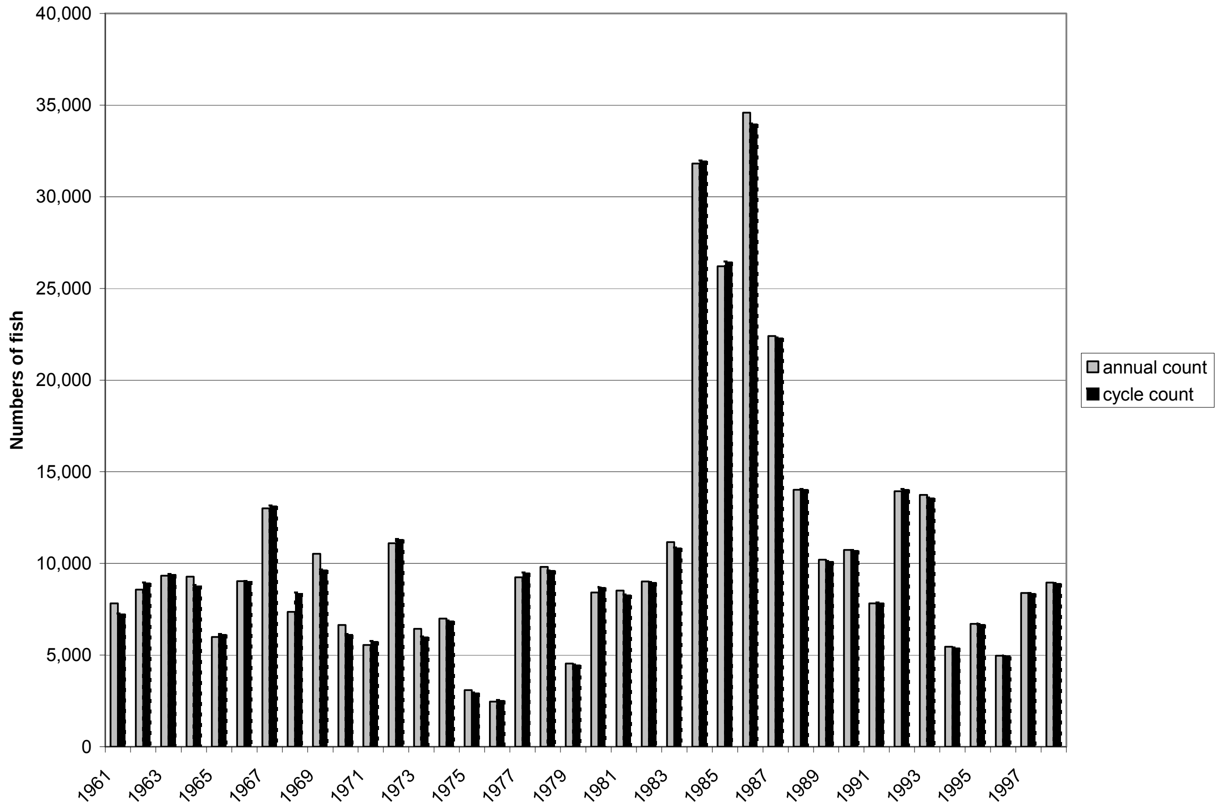


Figure 19. Comparison of cycle and annual counts of steelhead ascending Priest Rapids Dam, 1961-1999 (Grant PUD, unpublished data)

Table 19. Annual (calendar) counts of steelhead ascending Upper Columbia River Dams (1933-2002)

			Dam counts						Decadal averages		
				Wells					Wells		
	Rock	Rocky	Stlhd.	Stlhd.	Total		Rock	Rocky	Steelhead	Steelhead	Total
	Island	Reach	passed	trapped	steelhead		Island	Reach	passed	trapped	steelhead
1974	1,885	1,063	580	260	840						
1975	2,725	1,134	517	227	744						
1976	7,820	5,893	4,664	337	5,001						
1977	9,926	7,416	5,282	355	5,637						
1978	3,348	2,453	1,621	356	1,977						
1979	7,424	4,896	3,695	367	4,062		5,455	3,661	2,545	364	2,909
1980	7,017	4,345	3,443	372	3,815						
1981	7,559	5,524	4,096	650	4,746						

			Dam counts						Decadal averages		
				Wells					Wells		
	Rock	Rocky	Stlhd.	Stlhd.	Total		Rock	Rocky	Steelhead	Steelhead	Total
	Island	Reach	passed	trapped	steelhead		Island	Reach	passed	trapped	steelhead
1982	9,879	6,297	7,984	590	8,574						
1983	29,666	19,698	19,525	670	20,195						
1984	25,096	17,228	16,632	690	17,322						
1985	31,999	22,718	19,867	750	20,617						
1986	22,885	15,157	13,303	650	13,953						
1987	12,732	7,178	5,493	603	6,096						
1988	9,241	5,677	4,401	651	5,052						
1989	9,351	6,039	4,600	716	5,316		16,543	10,986	9,934	634	10,569
1990	6,946	5,033	3,815	735	4,550						
1991	10,927	7,645	7,751	726	8,477						
1992	12,478	7,516	7,027	658	7,685						
1993	4,829	2,816	2,494	633	3,127						
1994	5,620	2,818	2,163	620	2,783						
1995	4,175	1,758	942	619	1,561						
1996	7,305	5,774	4,128	509	4,637						
1997	7,726	6,722	4,107	630	4,737						
1998	4,963	4,442	2,984	460	3,444						
1999	6,269	4,814	3,504	416	3,920		7,124	4,934	3,892	601	4,492
2000	10,516	8,278	6,280	369	6,649						
2001	28,612	22,050	18,528	392	18,920						
2002	15,295	11,870	9,478	373	9,851		18,141	14,066	11,429	378	11,807
Source: Chelan and Douglas PUDs, unpublished data.											

Fish habitat in the upper Similkameen drainage, the largest tributary of the Okanogan basin, is cut off by Enloe Dam, approximately 8.5 mi from the confluence of the Similkameen River with the mainstem Okanogan. Although upstream habitats appear suitable for Chinook and steelhead, cultural stories of the Similkameen Indian Bands describe a history without anadromous fish migrations above the historic Coyote Falls, where Enloe Dam now sits, suggesting an ecology without anadromous fish populations in the upper watershed. This legend is supported by a large body of evidence that says the falls were impassable.

In the spring of 2001, Heather Barlett, WDFW fisheries biologist, and Chris Fisher, CTCR fisheries biologist, observed two steelhead redds in Bonaparte Creek and witnessed a steelhead spawning in Tonasket Creek. Whether or not the environmental conditions of Bonaparte Creek remained conducive for steelhead this year is unknown, however, Tonasket Creek is dry (Fisher, 2001).

Six life history types are identified for Okanogan steelhead:

4. Spawn, rear and overwinter in Salmon Creek, outmigrate in spring.
5. Spawn and rear in Salmon Creek, overwinter in Okanogan River; outmigrate in spring.
6. Spawn and rear in Okanogan River and tributaries upstream of Lake Osoyoos, overwinter in the lake or stream, and outmigrate in spring.
7. Spawn and rear in Okanogan River and tributaries upstream of Lake Osoyoos, overwinter in the lake or stream, and outmigrate one or more years later.
8. Spawn, rear, and overwinter in Omak Creek, outmigrate in spring.
9. Spawn and rear in Omak Creek, overwinter in Okanogan River, outmigrate in spring.

Population Delineation and Characterization

Steelhead in the Columbia River are usually designated as either "summer-or winter" types (Busby et al. 1987), which is based, again, on their entry into freshwater to spawn.

Brannon et al. (2002) combined all of the first-order metapopulations of summer steelhead upstream of the Yakima River into one metapopulation.

The ICBTRT recently listed the Okanogan Basin steelhead as an independent population: "The current status of steelhead endemic to the Okanogan is unknown. Currently, low numbers of natural steelhead return to this system, but may be offspring from hatchery returns.

The Okanogan appears to have supported an independent population of steelhead historically. Although habitat conditions for rearing are highly degraded in the system, the Okanogan and its tributaries in the US and Canada appear to have contained sufficient habitat to have supported an independent population of steelhead. In addition, the Okanogan is found in a substantially different habitat than other populations in this ESU, further supporting delineation of this population" (ICBTRT 2003). The relationship between Steelhead and adfluvial RBT is unknown.

For the purposes of sub-basin planning, it is assumed that there are four independent populations (Wenatchee, Entiat, Methow, and Okanogan) of steelhead within the larger metapopulation that spawns naturally upstream from Rock Island Dam (Peven, 2003).

Population Status

As mentioned earlier, the works of Fulton (1970), Chapman et al. (1994 CPa) and Mullan et al. (1992 CPa) indicate that steelhead never used the Okanogan in great numbers but that Omak Creek, Salmon Creek, the Similkameen River below Enloe Dam and perhaps the Canadian mainstem and tributaries were the most probable steelhead producing streams in the basin.

Busby et al. (1996) determined that the ESU for Upper Columbia summer steelhead comprised the populations that currently spawn in the Wenatchee, Entiat, Methow, and possibly Okanogan rivers.

The BRT felt that because of past hatchery practices (see below) there has been substantial homogenization of the gene pool. However, there is probably remnant genetic material from ancestral populations that could have been "stored" in resident populations (Mullan et al. 1992 CPa). Ford et al. (2001) agreed with the delineation described by Busby et al. (1996), but described each subbasin, with the possible exception of the Okanogan, as an independent population.

Spawning population escapement estimates are not available for below McIntyre Dam and above Osoyoos Lake largely because spawning occurs in May and June when tributary streams are in freshet and too colored to allow visual fish counting.

Population Management Regimes and Activities

Past Management Practices

In 1939, during construction of Grand Coulee Dam, the US Fish and Wildlife Service initiated a program to address the upcoming loss of over 1,100 miles of available habitat to Upper Columbia River salmonid populations (Fish and Hanavan 1948). Construction of the dam without fish passage facilities led to the program that centered on trapping at Rock Island Dam. During the GCFMP (1939-1943), all salmon and steelhead that reached Rock Island Dam were trapped there and mixed. These fish were either transplanted to spawning streams and "forced" to spawn there, or taken to newly completed hatcheries on the Wenatchee (Icicle Creek), Entiat, or Methow rivers.

Steelhead were also released in the upper Wenatchee River (upstream of Tumwater Canyon) and the Entiat River in 1939. The fish were released between two racks that forced the fish to spawn in the area selected by the biologists of the USFWS (Fish and Hanavan 1948).

Trapping at Rock Island Dam extended over five brood years, 1939 through 1943. The last brood to spawn naturally in natal streams was that of 1938. The GCFMP extensively homogenized steelhead that were of mid- and upper-Columbia river origin. Homogenization was both temporal and geographic. The manipulations of the GCFMP may have reduced the genetic uniqueness of any distinct populations, or subpopulations in the mid-Columbia. There may be the potential to make use of the remaining wild genetic *O. mykiss* stock contained within the adfluvial Osoyoos Lake population. However, more research of their interrelationship is required.

Peven (1992 CPb) and Chapman et al. (1994 CPa) list the extensive hatchery releases of steelhead and resident *O. mykiss* in the Upper Columbia Basin. Introduction of exogenous steelhead were from donor stocks from other parts of Washington State, primarily (e.g., Skykomish, Snoqualmie, Samish, Chambers Creek, Carson, Naches, Skamania, and Ringold), and made up winter- and summer-run populations.

Records of stocking rainbow trout into Okanagan mainstem lakes are available through (http://srmapps.gov.bc.ca/apps/fidq/stockingQuery.do). Within the current range of steelhead the stocking of Osoyoos Lake applies. A total of 900,000 rainbow trout fry were stocked sporadically between 1930 and 1964. Donor stocks came primarily from upriver areas with the Okanagan. In addition, approximately 620,000 eyed eggs were placed between 1956 and 1960 in the Okanagan River above Osoyoos Lake with approximately half from Washington State. Whether these stocking projects impacted steelhead is unknown. Rainbow Trout stocking hasn't occurred in the Osoyoos Lake since 1964 and Skaha Lake since 1979.

Current Management Practices

A steelhead program began in the early 1960s, with broodstock collected at Priest Rapids Dam. This effectively mixed adults destined for all upstream tributaries and hatcheries. That practice continued until the early 1980s, although some of the broodstock was taken at Wells Dam periodically in the 1970s (Chapman et al. 1994 CPa). Beginning in 1982, all broodstock was captured at Wells Dam and fish from this program were released into all of the main tributaries upstream of Rock Island Dam, further homogenizing the populations.

Since the late 1990s, a change in the broodstock program has emphasized more tributary-specific hatchery programs. In the Integrated Recovery Program the goal is to restore the abundance, distribution, and diversity of steelhead in the Okanogan subbasin.

Facilities and Programs

The Steelhead Integrated Recovery Program calls for reintroductions, kelt reconditioning, and broodstock improvement. To achieve target productions levels the construction of a Chief Joseph Dam Hatchery has been proposed along with the expansion of Cassimer Bar Hatchery or Colville Trout Hatchery for steelhead programs.

Hatchery Effects on Population

Chapman et al. (1994 CPa) found no information that suggested that any of the exogenous broodstock releases in the Upper Columbia have had much of an effect on the population structure. The current naturally spawning populations appear to be mostly indistinguishable from the Wells Hatchery broodstock.

Harvest Effects

Incidental harvest of steelhead is restricted under regulation of the Endangered Species Act. In 2001, steelhead mortality was limited to 200 fish.

Starting in 2002, the fishery can be extended in time, to October 31, and in location, downriver 12 miles to the confluence of the Okanogan River. Mortality of hatchery-origin and natural-origin steelhead is each specified as a percentage of the run over Wells Dam (COLVILLE TRIBES 2002).

There is a small Okanagan Nation spring harvest and a recreational fishery in tributaries, lake and the river for adfluvial rainbows and this raises the question of whether the fish captured may in fact be steelhead.

3.8.5 Rainbow Trout

Rationale for Selection

Rainbow trout are being considered a focal species by the Canadian fisheries agencies because of their significance to the subbasin's ecosystem. However, rainbow trout have not been addressed through the subject of any additional assessment as a function of this subbasin plan. Rainbow trout have been selected as a focal species because they are:

- poorly understood, but almost assuredly heavily affected by the changes that have taken place in recent times (kokanee collapses, habitat degradation, climate change etc.);
- made up of a variety of stocks, some of which are limited in number, very vulnerable to overharvest, and poorly inventoried (e.g. large lake adfluvial rainbow);
- a species of choice for harvest, consumption and non-consumptive use;
- sensitive to environmental change and thus excellent environmental indicators; and
- routinely considered a focal species and a species of management concern in other projects.

Key Life History Strategies

There are three distinct types of wild rainbow trout stocks in the Okanagan Basin. Fluvial rainbow trout spend their lives in streams and are abundant, ubiquitous and usually limited in size because streams in the Okanagan tend to be unfertile and cold.

Adfluvial rainbow trout spend most of their life in lakes but enter streams to spawn and often rear in lake tributaries for a year or more. Lake dwelling rainbows are found in two forms. The first are those that live in the small headwater lakes of the Okanagan and are insectivorous. The second form is found in the pelagic zone of large lakes of the Okanagan where they become piscivorous and grow to extremely large sizes. These fish are very limited in number and are very aggressive feeders and thus extremely vulnerable to overharvest. These rainbows require special management attention.

Spawning population escapement estimates are seldom available for pelagic adfluvial rainbows. Spawning occurs in May and June when tributary streams are in freshet and too colored to allow fish counting. In an attempt to estimate numbers of rainbow spawners in Mission Creek (the major tributary of Okanagan Lake), Pinsent et al. (1974) divided the area of spawning gravel by the estimated redd size of rainbows. They calculated a spawning population of 33,000 rainbows. A decade later a trap was placed in Mission Creek and the annual spawning count was found to vary between 200 and 500 fish. This emphasizes the vulnerability of the population and the importance of adequate inventory.

Relationship to Habitat

Small fluvial rainbow trout occupy many of the Okanagan headwater streams where temperature and flow characteristics are favorable. Often the suitability of these habitats is intermittent, particularly in third order tributaries with annually variable flows. The presence and relative abundance of these small fluvial rainbow trout provides an indicator over time of the stream and associated ecosystem health and may be valuable for managers and local residents to recognize ecosystem-level changes not otherwise apparent. However, the diversity and their broad occupation of these stream habitats provides population resilience to change.

Lake rainbow trout populations are often closed to genetic mixing with other populations except where streams connect them to other lake populations. The natural mixing is believed to broaden genetic variability providing for long-term genetic fitness. Many “closed” system lakes have been stocked over time and the genetic fitness of populations is unknown or of little management concern. Some of these lakes may winter or summer kill and may be restocked by managers.

Piscivorous adfluvial rainbow trout are of particular management interest as their pelagic and stream spawning habitats are limited and populations are less diverse. Representing both a strong indicator of lake/stream ecosystem health and a concern by managers about limited and possibly diminishing populations.

Large piscivorous lake rainbows spawn in tributary streams where their young rear for a year or more before entering the lake. The extent and quality of stream habitats is one of the limiting factors for the population. Of particular concern in the tributaries is low flow, high temperatures, and the destruction of habitat. Taylor and Galbraith (1974) showed that 90% of the stream habitats adjacent to Okanagan Lake had been lost by 1974.

In the mainstem Okanagan River high summer temperatures are a concern (Pinsent et al., 1974) and loss of habitat because of channelization has taken a major toll.

In Osoyoos, Vaseux and Skaha Lakes the combination of hypolimnetic oxygen depletion and excessive epilimnetic heating limits the rearing potential.

In all the large lakes declines in sockeye and kokanee populations must also have had a major effect, since pelagic rainbow have been shown to feed almost exclusively on these fish.

Population Status

Little information exists about population status of fluvial rainbows, but they are believed to be generally, healthy with some notable local exceptions where local tributary quality is limiting. Lake insectivorous rainbows are managed on a lake-by-lake basis.

Little is known of the populations in other tributaries but since Mission Creek is by far the largest tributary stream in the Canadian Okanagan it is assumed to support the dominant run. Nothing is known of the harvest numbers in Okanagan or any of the other lakes and this represents a large and important data gap.

In addition there is little known of the life history characteristics of rainbow in the Okanagan River mainstem. Attempts are just now being made to determine whether the large *Oncorhynchus mykiss* that spawn in the river are in fact rainbow trout from Osoyoos Lake or steelhead.

Population Management Regimes and Activities

In the 1970s and 1980s a 2-day winter fishing derby was held annually for trophy sized rainbow trout in Okanagan Lake. This event provided researchers with an efficient way to measure, age and examine the catch and also provided an inter-annual comparison of catch per unit effort. At about the same time a trap was run at a fishway in Mission Creek. This allowed an annual count of escapement. Creel surveys augmented the information.

Eventually the obstruction in Mission Creek was in-filled and no escapement counts were possible. Similarly the Fish Derbies were stopped because of conservation concerns and that source of information was no longer available. Even the creel surveys were curtailed because of government cutbacks.

No information on large lake rainbow has been gathered in recent years and no management schemes have been undertaken. These information gaps are a major management concern particularly in view of the massive declines in kokanee populations; the major food source for large pelagic rainbow.

3.8.6 Okanagan Lake Kokanee

Rationale for Selection

Kokanee are the non-anadromous form of sockeye (*O. nerka*) are, along with sockeye, sometimes referred to as 'nerkids.' Resident kokanee populations are found in all mainstem Okanagan basin lakes. The health of the resident nerkid populations is considered an important indicator of the water quality and hydrology of Okanagan lakes ecosystem. Kokanee also represent a potential source of genetic diversity. They also often support a recreational fishery. For example, Okanagan Lake supported a fishery valued at nearly Can $ 9 million annually prior to being closed in 1995 (S. Matthews Pers. com.).

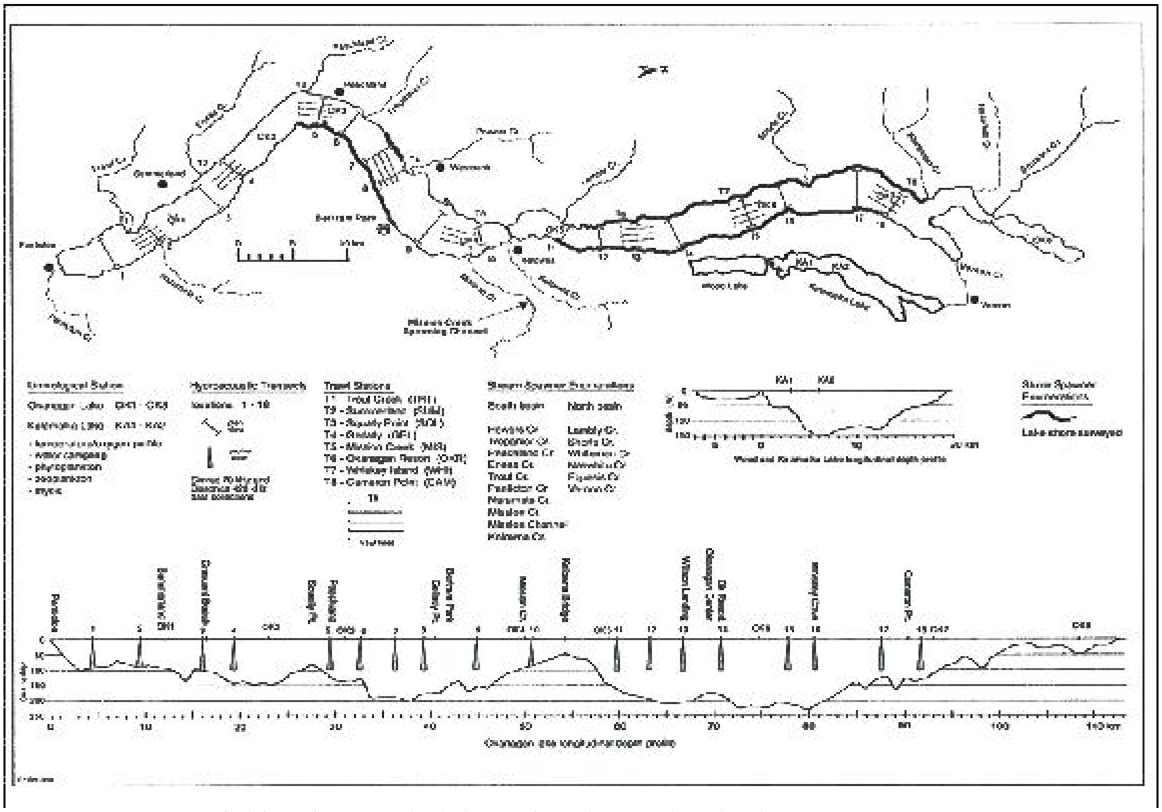
Population declines in Okanagan Lake have warranted a closure of the fishery and the development of the Okanagan Lake Action Plan to determine the causes for population declines and address the broad range of recovery issues.

Kokanee in Skaha and Osoyoos lakes are also considered depressed. Focus for sub-basin planning will be focused on Okanagan, Skaha and Osoyoos Lakes because of the importance of Okanagan Lake to the recovery effort of provincial agencies, the reintroduction of sockeye into Skaha Lake and the interactions between kokanee and anadromous fish in Osoyoos Lake.

Key Life History Strategies, Relationship to Habitat

Osoyoos, Vaseux, Skaha, Okanagan, Kalamalka, Woods, and Duck Lakes are all located within the Okanagan mainstem chain and all contain indigenous kokanee populations. Okanagan Lake is considered to have had the most historically productive kokanee populations in the Okanagan Valley. Vast shorelines complement a number of small to medium-sized tributaries to support both shoreline and tributary spawning populations.

Approximately 17 linear miles (27 kilometres) of Okanagan Lake shoreline are utilized by shore spawning kokanee (Figure 9) and are routinely monitored for spawner densities by the B.C. fisheries agencies (Northcote et al. 1972). The shoreline spawning areas are considered vulnerable to shoreline development, water quality, and water drawdown, and are the subject of conservation efforts by B.C. fisheries agencies.



Source: Map courtesy of Ministry of Water, Land and Air Protection. Okanagan Lake Action Plan 2000

Figure 20. Kokanee distribution in Okanagan Lake

Okanagan Lake has 46 named tributaries, 20 of which may support kokanee (Shepherd, 1990), and up to 16 regularly monitored (2-15 years) for kokanee spawning success. Of these, twelve support spawning populations greater than 500 fish. Stream escapements ranged from 300,000 to 850,000 in the 1970s (Andrusak et al. 1999).

Immediately downstream of Okanagan Lake is Skaha Lake. Kokanee spawn in the mainstem channel or in two tributaries (Shingle and Ellis). Shingle and Ellis Creek kokanee generally have peak spawning in the third week of September while mainstem spawners peak in mid to late October. In Osoyoos Lake kokanee are also known to spawn in Inkaneep creek and mainstem Okanagan River and peak in early to mid October.

Kokanee life history types include:

- spawn in Okanogan tributaries, rear in mainstem lake for one to four years, spawn in fall in natal tributary, and
- spawn in Okanagan lake shoreline, rear in Okanagan Lake for one to two years, spawn in late fall.

Population Delineation and Characterization

Genetic differences have been identified between shore and shoal spawning kokanee (Ashley et al. 1999). The shoal spawning population is considered 3 – 4 times larger than the stream spawning cohort (Andrusak et al. 1999) and the two populations are genetically separate (Taylor et al. 1997). However, hatchery supplementation of sockeye and kokanee that occurred during the Grand Coulee Fish Maintenance Project and other stockings may have confounded the genetic make up of stocks in Skaha and Osoyoos lakes. No genetic work has been conducted on these lakes but samples have been collected (H. Wright, pers comm.).

Population Status

The total population of all ages of kokanee in Okanagan Lake has increased since 2000 from 3.5 million to 11 million (S. Matthews, pers comm.). However, this has not correlated well with stream and shore spawning adult enumerations. Stream spawners have been consistently low. Shoal spawners may be a result of the increase in in-lake abundance but enumeration methods look at trends only.

The large increase in the total population is most likely attributed to the large 0+ population but has not resulted in a subsequent increase in age 1-3 year old kokanee in-lake abundances. This suggests that there is a low underyearling survival possibly attributable to low over-winter survival.

From the early 1990s to 2001 Skaha Lake kokanee escapements have averaged about 9,800 and this has correlated well with in-lake abundance data from 1999-2001 (P. Rankin, pers. comm.). However, in 2002 and 2003 there was an unexplained almost 10-fold increase in adult escapement. However, this has not translated in subsequent increase in in-lake population, suggesting that the quantity and/or quality of spawning habitat may be substandard.

Little work has been conducted on Osoyoos Lake kokanee but annual counts are made each year during sockeye enumerations (H. Wright, pers. comm.). The data have not been fully reported but they seem to indicate that the peak of spawning for kokanee occurs approximately one week earlier than sockeye.

Population Management Regimes and Activities

The current management emphasis for kokanee within the Okanagan basin is centered on habitat protection and water management. Additionally, MOELP and DFO have allocated resources in recent years to encourage resource stewardship with Okanagan municipalities and regional districts. MOELP has worked on optimal base flow requirements for spawning tributaries and developed tools to manage lake levels in cooperation with DFO (see below).

Emphasis on lake productivity and mitigating competition with exotic species is shaping future management plans.

Past Management Practices

Differences among resident and anadromous Okanagan valley nerkids are attributed to geographic isolation and stocking programs. For Okanagan Lake, stocking programs utilized kokanee from local populations as well as from Meadow Creek, a tributary to Kootenay Lake. A recorded 2,140,000 eyed eggs and 699,733 fry were stocked into Okanagan lake between 1928 and 1951 (B.C. Fisheries Stocking Records: http://srmapps.gov.bc.ca/apps/fidq/stockingQuery). The genetic similarities and differences between Meadow Creek kokanee and Okanagan Lake kokanee are unknown.

Skaha Lake was also stocked in the late 1930s with 240,000 eyed eggs from Meadow Creek stock. In addition, from 1981 to 1989, 2.5 million fry were stocked from Okanagan Lake and Meadow Creek kokanee.

Finally, for Osoyoos Lake, kokanee were stocked in the Okanagan River in 1971. This involved the transplantation of 33,500 fry.

Current Management Practices

Current management for Okanagan Lake is guided by the Okanagan Lake Action Plan (OLAP). The recreational fishery for kokanee has been closed since 1995 because of a kokanee collapse. Several initiatives under the OLAP are underway.

One OLAP initiative is the consideration of balancing lake nutrients. The focus is on nitrogen and phosphorous ratios and their effect on diatoms and green algae, which in turn support high food value macrozooplankton such as Daphnia.

Another OLAP initiative involves experimental selective harvest of mysid shrimp populations as a means of decreasing competition.

Water management coordination involving B.C. water managers and the Canadian Okanagan Basin Technical Working Group is another important step in managing kokanee populations. It is designed to balance salmon maintenance flows in Okanagan River with the needs of kokanee shoal spawners in Okanagan Lake (Hyatt et al. 2003).

For Skaha Lake the province conducts annual adult enumeration monitoring of the Okanagan River (1989-present). In addition, Fisheries and Oceans Canada have conducted in-lake abundance estimates in partnership with Okanagan Nation Alliance Fisheries Department. Additional effort will be given to monitoring Skaha Lake, as it is the site for the experimental reintroduction of sockeye. Considerable effort will be given to Okanagan sockeye for monitoring but data on kokanee will also be collected.

Harvest Effects

The kokanee fishery has been closed since 1995 for kokanee in Okanagan Lake. However, the rainbow fishery is still open and there is most likely a bycatch of kokanee. Under the OLAP, there will be efforts this year to examine the harvest effects on kokanee. The recreational fisheries for Skaha and Osoyoos Lakes are still open. The effects of these fisheries are unknown.

Ecologic Effects/Relationships (at subbasin scale)

As identified before, there has been numerous stocking in mainstem lakes and the resultant ecological effects/relationships are unknown.

Skaha and Okanagan lakes are of interest with the immediate experimental and long-term reintroduction of sockeye respectively. Effects will be monitored as directed by the Skaha sockeye reintroduction monitoring and evaluation plan.

The genetic and behavioral interrelationships between sockeye and kokanee in Osoyoos Lake are also unknown. With the recent identification of resident/anadromous Chinook and the presence of both adfluvial rainbow and steelhead in Osoyoos Lake, one would expect ecological interactions between sockeye and kokanee and these should be investigated further.

3.8.7 Bull trout

Rationale for Selection

In the state of Washington, population declines of bull trout have primarily occurred in the eastern part of the state. The listing of bull trout in 1998 has led to the examination of residual bull trout populations in the Okanogan subbasin as the source of future restoration efforts. Bull trout are considered to have occurred historically in the Okanagan River in British Columbia (USFWS 2002). Currently, the FWS has identified bull trout use in the Okanogan as a data gap. The Service believes that bull trout may use the Okanogan mainstem for over-wintering, foraging and possibly rearing during a portion of the year (K. Terrell personnel communication to Keith Wolf, May 2004).

Key Life History Strategies, Relationship to Habitat

Historically, there were most likely three life histories (or ecotypes) of bull trout within the CCP (adfluvial, fluvial and non-migratory), with distribution and population levels dictated by temperature and gradient (Mullan et al. 1992 CPa).

Salmon Creek and Loup Loup Creek historically supported bull trout populations (*Salvelinus confluentus*). The introduction of brook trout and resulting hybridization of the two species are considered primary factors for the decline of bull trout in the Okanogan River Basin (FWS, 1998).

Peven (2003) concluded that current distribution of bull trout within the CCP appears to be reduced from historic, especially in the lower Okanogan Basin and Lake Chelan where they are listed as occupancy unknown. The FWS concluded in their draft Bull Trout Recovery Plan that the distinct bull trout populations exist in the Wenatchee, Entiat, and Methow Rivers, which overlap with the core recovery area. The Okanogan River is not included among known distinct populations, however bull trout population, abundance and distribution in the Okanogan has been listed as a data gap (FWS 2000).

3.9 Other Important Fish Species for Management

3.9.1 Westslope Cutthroat Trout (WSCT)

The status of Westslope cutthroat (*Oncorhynchus clarki*) in the basin is unknown. They are believed to have originated from early stocking. However, the remaining stocks are believed to have become naturalized.

Key Life History Strategies, Relationship to Habitat

The only known WSCT in the Canadian portions of the Okanagan Subbasin are found in Cathedral Lakes located in the headwaters of the Similkameen River. WSCT are present in the North Fork Salmon Creek subbasin, the Sinlahekin headwaters, and in numerous US alpine lakes in the CCP. In at least some locations, these waters were known to be stocked with cutthroat in the past.

Through stocking programs that began with Washington state’s first trout hatchery in the Stehekin River valley in 1903 (that targeted WSCT), WSCT have been transplanted in almost all available stream and lake habitat, including the Okanogan River Basin (Williams 1998).

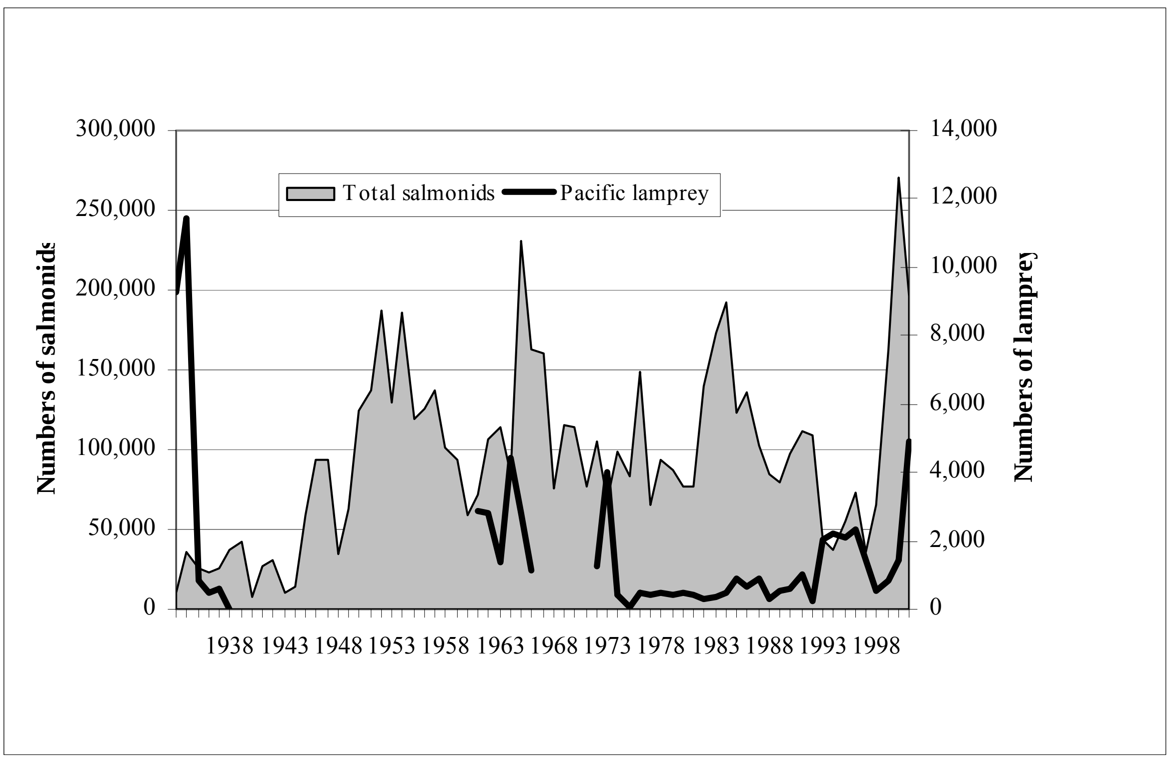
Currently, in the CCP, WSCT are found throughout the Wenatchee, Entiat, Chelan, Methow, and Okanogan River basins (Williams 1998). WSCT are found within streams and lakes throughout these basins, but spawning (for stream populations) usually occurs in the upper portions of each basin (Peven 2003). WSCT are found in the North Fork Salmon Creek, Sinlahekin headwaters, and in numerous alpine lakes (Williams 1998). They were most likely introduced into these waters (Fisher et al. 2002).). The USFS is completing a genetic analysis in 2004 for this area (Ken MacDonald personnel communication).

Limiting factors for WSCT in the Okanogan River Basin may be channel stability, habitat diversity, obstructions, temperatures and riparian. These factors need to be considered in relation to life history of WSCT (e.g., temperatures probably always limited WSCT distribution within Okanogan River streams, especially the mainstem). However, conservation of known areas of abundance would increase the likelihood that they could persist in high quality habitats. The historic temperature of the mainstem may have always limited connectivity between spawning streams in this basin, assuming that they existed at all.

Peven (2003) concluded that Westslope cutthroat appear to have expanded their range within the CCP from historic distribution, primarily from hatchery plants.

3.9.2 Pacific lamprey

Historical distribution of Pacific lamprey in the Columbia and Snake Rivers was coincident wherever salmon occurred (Simpson and Wallace 1978). A record of migration trends illustrates a significant decline in lamprey abundance over the last 50 years).



Source: Pevan 2004

Figure 21 Comparison of salmonids and Pacific lamprey ascending Rock Island Dam, 1933 – 2002

It is likely that Pacific lamprey occurred historically throughout the Okanogan basin in association with anadromous salmon (Clemens 1939). In the Okanogan Basin, Pacific lamprey were utilized by the Okanagan natives (Okanagan Historical Society, Anonymous 1954) and may have used the Okanogan River, Similkameen River, Salmon Creek, and Omak Creek.

In the upper Columbia, counts over Rock Island and Rocky Reach dams show a precipitous drop from the 1960s through the 1980s (Close et al. 1995), and appear to be rebuilding once again.

There is little information on the abundance of Pacific lamprey in the upper Columbia region. Abundance estimates are limited to counts of adults and juveniles at dams or juvenile salmonid traps. There are no estimates of redd counts or juvenile and adult counts in tributaries.

Counts of adult lamprey at dams cannot be considered total counts because there was no standardized sampling across years and counting was restricted to certain hours (BioAnalysts 2000). For example, fish counters in the past counted for a 16-hr-day shift for the main part of the salmon runs (Close et al. 1995). Because the highest movement of lamprey occurs at night (Close et al. 1995), these day counts should be considered conservative estimates.

Currently, fish counting occurs throughout the 24-hr period at most dams. At Rocky Reach and Rock Island dams, videotape or digital video record fish passage over 24 hours per day. This counting method began at Rock Island in 1992 and at Rocky Reach in 1996.

Additional problems with adult counts exist because some lamprey pass dams undetected. For example, adult lamprey can move near the bottom of the fish counting chamber making it difficult to detect them (Jackson et al. 1996). They can also bypass counting station windows by traveling behind the picketed leads at the crowder (Starke and Dalen 1995). Because of these shortcomings, adult counts at dams should only be viewed as crude indices of abundance.

Counts of juvenile lamprey at dams also suffer from sampling inconsistencies. Collection of juvenile lamprey at mainstem dams is incidental to sampling juvenile salmonids. Thus, numbers of migrants outside the juvenile salmonid migration period are unknown, since most of the literature suggests that migration occurs between fall and spring (Pletcher 1963; Beamish 1980; Richards and Beamish 1981). In addition, unknown guidance efficiencies of juvenile lamprey and unknown spill passage to turbine passage ratios reduce precise estimates of abundance (BioAnalysts 2000). Also, juveniles tend to hide in various locations in the bypass systems (Jackson et al. 1997). These problems, combined with highly variable sampling rates during periods of juvenile salmonid passage, confound estimates of juvenile lamprey abundance (BioAnalysts 2000). Juvenile counts at dams as should also be viewed as crude indices of abundance.

Large declines of adults occurred at most mainstem dams during the late 1960s and early 1970s. During the period between about 1974 and 1993, numbers of adult lamprey counted at Rock Island Dam was quite low (Figure 12). Counts of adults have increased since that time; however, this increase corresponds closely with the time that the projects began day and night counts, which may have some effect on the comparison. However, recent increases in the last few years are far greater than those in the last 10, suggesting that a true increase in abundance is occurring.

Comparing counts among different projects is problematic because of sampling inconsistencies, the behavior of lamprey in counting stations, and the ability of lamprey to bypass counting stations undetected (BioAnalysts 2000).

In summary, while it is difficult to determine the historical abundance of lamprey in the Columbia Basin, and in the CCP, circumstantial evidence suggests that they have declined. Counts of juvenile and adult lamprey fluctuate widely. It is unknown whether these fluctuations represent inconsistent counting procedures, actual population fluctuations, or both. Although these factors may make actual comparisons difficult, it appears that lamprey in the upper Columbia are increasing.

More information needs to be gathered for Pacific lamprey before any determinations of extinction risks can be made.

The American Fisheries Society's Western Division reviewed the US FWS petition to list four species of lamprey in 2001, and found strong evidence to support listing of Pacific lamprey on the Columbia, Umqua and Snake Rivers (WDAFS, 2001).

3.9.3 White sturgeon

Historically, white sturgeon moved throughout the mainstem Columbia River from the estuary to the headwaters, although passage was probably limited at times at large rapids and falls (Brannon and Setter 1992). Beginning in the 1930s, with construction of Rock Island, Grand Coulee, and Bonneville dams, migration was disrupted, because sturgeon do not pass upstream through fishways that were built for salmon, although they apparently can pass downstream (S. Hays, pers. comm.).

Current populations in the Columbia River Basin can be divided into three groups: fish below the lowest dam, with access to the ocean (the lower Columbia River); fish isolated (functionally but not genetically) between dams; and fish in several large tributaries. In the CCP, construction of Wells, Rocky Reach, Rock Island, and Wanapum Dam have disrupted upstream movement of sturgeon.

Peven (2003) concluded that white sturgeon distribution has been affected by construction of mainstem Columbia River dams. What was believed to be a relatively continuous population, traveling the length of the mainstem Columbia River below migrational barriers, is now a number of potentially disjunct populations between hydroelectric projects, although there does appear to be immigration and emigration from downstream recruitment.

3.9.4 US Rainbow Trout

In US they are present in Salmon Creek, Omak Creek, Toats Coulee, Sinlahekin Creek, Bonaparte Creek, and Tonasket Creek, and other smaller tributaries. The headwater fluvial varieties appear to have one life history pattern: to spawn and rear in upper tributaries. The population size and distribution of rainbow trout in these streams is not known (NMFS, 1998).

3.9.5 Eastern Brook Trout

Eastern Brook trout are an introduced species that is present throughout the basin. In drainages where brook trout and bull trout are both present, they hybridize. Brook trout appear to be more tolerant to disturbed habitat conditions than bull trout. Salmon Creek and Loup Loup Creek historically supported bull trout populations (*Salvelinus confluentus*). The introduction of brook trout and resulting hybridization of the two species has resulted in the decline of bull trout in the Okanogan River Basin (FWS 2000).

3.9.6 Umatilla Dace

Umatilla dace is Endangered in Canada because of an extremely small population size, restricted distribution, and limited available preferred habitat. Original habitat use by the Umatilla dace has been disrupted by the construction of dams within the watersheds. Conversely, rocks used in dike construction have increased available habitat.

Although immediate threats to populations appear to be small, one natural process that may be dangerous is eutrophication. The excessive algae that grows during the stages of eutrophication may deter Umatilla dace, as they tend to not be found around large growths of algae.

Canadian populations of Umatilla dace are found in the lower Columbia, Kettle, Kootenay, and Similkameen rivers and in parts of the Slocan River. Umatilla dace are found in the Okanagan system north of the Canadian-American border (B. Shepard, pers. Com), and it presumably could become further established if appropriate management actions are implemented. It prefers riverine habitat with cobble or stone bottom and relatively warm, productive waters.

3.10 Wildlife Focal Species and Their Habitats

3.11 Wildlife Species Richness

The Okanogan subbasin has the highest percentage (99) of species richness than any other subbasin in the Columbia Cascade Ecoprovince. The class and % of total richness in the CCP is provided in Table 20 (CCP Ecoprovince document 2003).

Ninety-nine % of the wildlife species that occur in the Ecoprovince occur in the Okanogan subbasin. In addition, 100 % of the amphibian species and 100 % of the reptile species that occur in the Ecoprovince occur in this subbasin.

Table 20. Species richness and associations for the Okanogan subbasin (IBIS 2003). – from Okanagan Subbasin Wildlife Assessment & Inventory

Class	Upper Middle Mainstem	% of Total	Total (Ecoprovince)
Amphibians	17	100	17
Birds	234	99	235
Mammals	97	98	99
Reptiles	19	100	19
Total	367	99	370
Association			
Riparian Wetlands	87		78
Other Wetlands (Herbaceous and Montane Coniferous)	56		31
All Wetlands	143		109
Salmonids	81	98	83

Representative habitat types include shrub steppe, riparian and herbaceous wetlands, and cliff, cave and talus slopes. These habitat types and their associated wildlife species are provided in Table 21

Table 21. Wildlife species occurrence by wildlife habitat type in the Okanogan subbasin (IBIS 2003).

Shrub-steppe	Eastside (Interior) Riparian Wetlands	Herbaceous Wetlands
American Avocet	American Badger	American Avocet
American Badger	American Beaver	American Beaver
American Crow	American Crow	American Bittern
American Goldfinch	American Dipper	American Coot
American Kestrel	American Goldfinch	American Crow
American Robin	American Kestrel	American Dipper
Bank Swallow	American Marten	American Goldfinch
Barn Owl	American Redstart	American Kestrel
Barn Swallow	American Robin	American Pipit
Barrow's Goldeneye	American Tree Sparrow	American Robin
Big Brown Bat	American Wigeon	American Wigeon
Black Bear	Bank Swallow	Baird's Sandpiper
Black-billed Magpie	Barn Owl	Bank Swallow
Black-chinned Hummingbird	Barn Swallow	Barn Owl
Black-necked Stilt	Barred Owl	Barn Swallow
Black-tailed Jackrabbit	Belted Kingfisher	Barrow's Goldeneye
Black-throated Sparrow	Big Brown Bat	Big Brown Bat
Blue Grouse	Black Bear	Black Bear
Bobcat	Black Swift	Black Swift
Brewer's Blackbird	Black-backed Woodpecker	Black Tern
Brewer's Sparrow	Black-billed Magpie	Black-billed Magpie
Brown-headed Cowbird	Black-capped Chickadee	Black-capped Chickadee
Bullfrog	Black-chinned Hummingbird	Black-chinned Hummingbird
Burrowing Owl	Black-crowned Night-heron	Black-crowned Night-heron
Bushy-tailed Woodrat	Black-headed Grosbeak	Black-necked Stilt
California Myotis	Black-tailed Deer	Black-tailed Deer
California Quail	Black-throated Gray Warbler	Blue-winged Teal
Canada Goose	Blue Grouse	Bobcat

Shrub-steppe	Eastside (Interior) Riparian Wetlands	Herbaceous Wetlands
Canyon Wren	Bobcat	Bobolink
Chipping Sparrow	Bobolink	Brewer's Blackbird
Chukar	Bohemian Waxwing	Brown-headed Cowbird
Cliff Swallow	Brewer's Blackbird	Bullfrog
Columbia Spotted Frog	Brown Creeper	Burrowing Owl
Columbian Ground Squirrel	Brown-headed Cowbird	California Gull
Common Garter Snake	Bullfrog	California Myotis
Common Nighthawk	Bullock's Oriole	Calliope Hummingbird
Common Poorwill	Bushy-tailed Woodrat	Canada Goose
Common Porcupine	California Myotis	Canvasback
Common Raven	California Quail	Cascade Frog
Cooper's Hawk	Calliope Hummingbird	Caspian Tern
Coyote	Canada Goose	Cedar Waxwing
Deer Mouse	Canyon Wren	Cinnamon Teal
Eastern Kingbird	Cascade Frog	Clark's Grebe
European Starling	Cassin's Finch	Cliff Swallow
Ferruginous Hawk	Cassin's Vireo	Columbia Spotted Frog
Fringed Myotis	Cedar Waxwing	Columbian White-tailed Deer
Golden Eagle	Chipping Sparrow	Common Garter Snake
Golden-mantled Ground Squirrel	Chukar	Common Loon
Gopher Snake	Cliff Swallow	Common Nighthawk
Grasshopper Sparrow	Coast Mole	Common Porcupine
Gray Flycatcher	Columbia Spotted Frog	Common Raven
Gray Partridge	Columbian Ground Squirrel	Common Yellowthroat
Great Basin Pocket Mouse	Columbian Mouse	Cooper's Hawk
Great Basin Spadefoot	Common Garter Snake	Coyote
Great Horned Owl	Common Merganser	Deer Mouse
Greater Yellowlegs	Common Nighthawk	Double-crested Cormorant
Hoary Bat	Common Porcupine	Eared Grebe
Horned Lark	Common Raven	Eastern Kingbird
Killdeer	Common Redpoll	European Starling
Lark Sparrow	Common Yellowthroat	Forster's Tern

Shrub-steppe	Eastside (Interior) Riparian Wetlands	Herbaceous Wetlands
Least Chipmunk	Cooper's Hawk	Fringed Myotis
Lesser Yellowlegs	Cordilleran Flycatcher	Gadwall
Little Brown Myotis	Coyote	Glaucous Gull
Loggerhead Shrike	Creeping Vole	Golden Eagle
Long-billed Curlew	Dark-eyed Junco	Great Basin Spadefoot
Long-eared Myotis	Deer Mouse	Great Blue Heron
Long-eared Owl	Double-crested Cormorant	Great Egret
Long-legged Myotis	Downy Woodpecker	Great Gray Owl
Long-tailed Vole	Dusky Flycatcher	Great Horned Owl
Long-tailed Weasel	Eastern Cottontail	Greater Yellowlegs
Long-toed Salamander	Eastern Fox Squirrel	Green-winged Teal
Mallard	Eastern Kingbird	Grizzly Bear
Merriam's Shrew	Ermine	Gyrfalcon
Mink	European Starling	Herring Gull
Montane Vole	Evening Grosbeak	Hoary Bat
Mountain Bluebird	Fisher	Hooded Merganser
Mourning Dove	Flammulated Owl	House Finch
Nashville Warbler	Fox Sparrow	Killdeer
Night Snake	Fringed Myotis	Lapland Longspur
Northern Flicker	Golden Eagle	Least Sandpiper
Northern Goshawk	Golden-crowned Kinglet	Lesser Yellowlegs
Northern Grasshopper Mouse	Golden-mantled Ground Squirrel	Lincoln's Sparrow
Northern Harrier	Gopher Snake	Little Brown Myotis
Northern Leopard Frog	Gray Catbird	Loggerhead Shrike
Northern Pocket Gopher	Gray Jay	Long-billed Curlew
Northern Rough-winged Swallow	Great Basin Spadefoot	Long-billed Dowitcher
Northern Shrike	Great Blue Heron	Long-eared Myotis
Nuttall's (Mountain) Cottontail	Great Egret	Long-eared Owl
Orange-crowned Warbler	Great Horned Owl	Long-legged Myotis
Osprey	Greater Yellowlegs	Long-tailed Vole
Pacific Chorus (Tree) Frog	Green-winged Teal	Long-tailed Weasel
Painted Turtle	Grizzly Bear	Long-toed Salamander

Shrub-steppe	Eastside (Interior) Riparian Wetlands	Herbaceous Wetlands
Pallid Bat	Hairy Woodpecker	Mallard
Prairie Falcon	Harlequin Duck	Marsh Wren
Pygmy Rabbit	Heather Vole	Meadow Vole
Racer	Hermit Thrush	Mink
Red-tailed Hawk	Hoary Bat	Montane Vole
Ringneck Snake	Hooded Merganser	Moose
Ring-necked Pheasant	House Finch	Mountain Lion
Rock Dove	House Wren	Muskrat
Rock Wren	Killdeer	Northern Bog Lemming
Rough-legged Hawk	Lazuli Bunting	Northern Goshawk
Rough-skinned Newt	Least Chipmunk	Northern Harrier
Rubber Boa	Lesser Yellowlegs	Northern Leopard Frog
Sage Grouse	Lewis's Woodpecker	Northern Pintail
Sage Sparrow	Lincoln's Sparrow	Northern Pygmy-owl
Sage Thrasher	Little Brown Myotis	Northern River Otter
Sagebrush Lizard	Long-eared Myotis	Northern Rough-winged Swallow
Sagebrush Vole	Long-eared Owl	Northern Shoveler
Savannah Sparrow	Long-legged Myotis	Northern Shrike
Say's Phoebe	Long-tailed Vole	Northwestern Salamander
Sharp-shinned Hawk	Long-tailed Weasel	Nutria
Sharp-tailed Grouse	Long-toed Salamander	Pacific Chorus (Tree) Frog
Short-eared Owl	Macgillivray's Warbler	Pacific Jumping Mouse
Short-horned Lizard	Mallard	Pacific Water Shrew
Side-blotched Lizard	Masked Shrew	Painted Turtle
Snow Bunting	Meadow Vole	Pallid Bat
Solitary Sandpiper	Mink	Pectoral Sandpiper
Spotted Bat	Montane Shrew	Pied-billed Grebe
Spotted Sandpiper	Montane Vole	Pine Siskin
Striped Whipsnake	Moose	Raccoon
Swainson's Hawk	Mountain Bluebird	Redhead
Tiger Salamander	Mountain Chickadee	Red-necked Grebe

Shrub-steppe	Eastside (Interior) Riparian Wetlands	Herbaceous Wetlands
Townsend's Big-eared Bat	Mountain Lion	Red-tailed Hawk
Townsend's Ground Squirrel	Mourning Dove	Red-winged Blackbird
Townsend's Solitaire	Muskrat	Ring-billed Gull
Turkey Vulture	Nashville Warbler	Ring-necked Duck
Vagrant Shrew	Northern Alligator Lizard	Ring-necked Pheasant
Vesper Sparrow	Northern Flicker	Roosevelt Elk
Washington Ground Squirrel	Northern Flying Squirrel	Rough-legged Hawk
Western Fence Lizard	Northern Goshawk	Rough-skinned Newt
Western Harvest Mouse	Northern Harrier	Ruby-crowned Kinglet
Western Kingbird	Northern Leopard Frog	Ruddy Duck
Western Meadowlark	Northern Pocket Gopher	Rufous Hummingbird
Western Pipistrelle	Northern Pygmy-owl	Savannah Sparrow
Western Rattlesnake	Northern River Otter	Sharp-shinned Hawk
Western Skink	Northern Rough-winged Swallow	Short-eared Owl
Western Small-footed Myotis	Northern Saw-whet Owl	Shrew-mole
Western Terrestrial Garter Snake	Northern Waterthrush	Silver-haired Bat
Western Toad	Northwestern Salamander	Snowy Owl
White-crowned Sparrow	Olive-sided Flycatcher	Solitary Sandpiper
White-tailed Jackrabbit	Orange-crowned Warbler	Song Sparrow
White-throated Swift	Osprey	Sora
Woodhouse's Toad	Pacific Chorus (Tree) Frog	Spotted Bat
Yellow-bellied Marmot	Pacific Jumping Mouse	Spotted Sandpiper
Yuma Myotis	Pacific Water Shrew	Striped Skunk
	Painted Turtle	Swainson's Hawk
	Pallid Bat	Thayer's Gull
	Pied-billed Grebe	Tiger Salamander
	Pileated Woodpecker	Townsend's Big-eared Bat
	Pine Siskin	Tree Swallow
	Prairie Falcon	Tundra Swan
	Pygmy Nuthatch	Turkey Vulture
	Raccoon	Vagrant Shrew
	Racer	Vaux's Swift

Shrub-steppe	Eastside (Interior) Riparian Wetlands	Herbaceous Wetlands
	Red Crossbill	Violet-green Swallow
	Red Fox	Virginia Rail
	Red-breasted Nuthatch	Western Grebe
	Red-breasted Sapsucker	Western Harvest Mouse
	Red-eyed Vireo	Western Jumping Mouse
	Red-naped Sapsucker	Western Meadowlark
	Red-tailed Hawk	Western Sandpiper
	Red-winged Blackbird	Western Screech-owl
	Ring-necked Duck	Western Small-footed Myotis
	Ring-necked Pheasant	Western Terrestrial Garter Snake
	Rough-legged Hawk	Western Toad
	Rough-skinned Newt	White-crowned Sparrow
	Rubber Boa	White-throated Swift
	Ruby-crowned Kinglet	Wilson's Phalarope
	Ruffed Grouse	Wilson's Snipe
	Rufous Hummingbird	Wood Duck
	Savannah Sparrow	Woodhouse's Toad
	Say's Phoebe	Yellow-bellied Marmot
	Sharptail Snake	Yellow-headed Blackbird
	Sharp-tailed Grouse	Yellow-rumped Warbler
	Shrew-mole	Yuma Myotis
	Silver-haired Bat	
	Snowshoe Hare	
	Solitary Sandpiper	
	Song Sparrow	
	Southern Alligator Lizard	
	Southern Red-backed Vole	
	Spotted Bat	
	Spotted Sandpiper	
	Spotted Towhee	
	Steller's Jay	

Shrub-steppe	Eastside (Interior) Riparian Wetlands	Herbaceous Wetlands
	Striped Skunk	
	Swainson's Hawk	
	Swainson's Thrush	
	Tailed Frog	
	Three-toed Woodpecker	
	Tiger Salamander	
	Townsend's Big-eared Bat	
	Townsend's Solitaire	
	Townsend's Warbler	
	Tree Swallow	
	Trowbridge's Shrew	
	Turkey Vulture	
	Vagrant Shrew	
	Vaux's Swift	
	Veery	
	Violet-green Swallow	
	Virginia Opossum	
	Warbling Vireo	
	Water Shrew	
	Water Vole	
	Western Bluebird	
	Western Harvest Mouse	
	Western Jumping Mouse	
	Western Pipistrelle	
	Western Rattlesnake	
	Western Screech-owl	
	Western Small-footed Myotis	
	Western Tanager	
	Western Terrestrial Garter Snake	
	Western Toad	
	Western Wood-pewee	
	White-breasted Nuthatch	

Shrub-steppe	Eastside (Interior) Riparian Wetlands	Herbaceous Wetlands
	White-crowned Sparrow	
	White-headed Woodpecker	
	White-tailed Jackrabbit	
	White-throated Swift	
	Wild Turkey	
	Williamson's Sapsucker	
	Willow Flycatcher	
	Wilson's Warbler	
	Winter Wren	
	Wood Duck	
	Woodhouse's Toad	
	Yellow Warbler	
	Yellow-bellied Marmot	
	Yellow-breasted Chat	
	Yellow-pine Chipmunk	
	Yellow-rumped Warbler	
	Yuma Myotis	

3.12 Wildlife Status

The basin is home to over two dozen species of plants and animals that are currently listed in the US and Canada as nationally Threatened, Endangered, or Vulnerable. An estimated 85% of wetland and riparian habitats in Canadian reaches are now gone (South Okanagan-Similkameen Conservation Program, 2001). A full one-third of all Red-listed species in British Columbia reside in the Okanogan. See Appendix D for classification of wildlife species within the Okanogan Subbasin.

The Okanogan Basin is an important ecological corridor for migratory megafauna. Species such as mule deer utilize the north-south corridor that connects the dry landscapes of British Columbia's interior with the grasslands to the south. In addition to important megafauna populations, this corridor is a crucial part of the flight path for many species of birds during annual migrations between summer and winter ranges.

3.13 Wildlife Focal Species Selection

Subbasin planners selected focal wildlife species based on their ability to serve as indicators of environmental health for other species, in combination with several other factors, including:

- primary association with focal habitats for breeding;
- specialist species that are obligate or highly associated with key habitat elements/conditions important in functioning ecosystems;
- declining population trends or reduction in their historic breeding range (may include extirpated species);
- special management concern or conservation status such as Threatened, Endangered, Species of Concern and management indicator species; and
- professional knowledge on species of local interest.

Wildlife species associated with focal habitats, including agriculture, are listed in Appendix B. A focal species matrix for the Okanagan Subbasin is shown in Table 22.

The pages that follow describe the wildlife focal species and focal habitat types, including limiting factors. Additional information, including information about habitat requirements, limiting factors, distribution, population trends that will be useful to recovery project planners, is included in Ashley and Stovall (unpublished report, 2004). Rugged lands (habitat of concern) are described in the Subbasin Overview. (The Subbasin Overview also includes more general descriptions of the focal habitat types and other habitat types in the Subbasin.)

3.14 Focal Wildlife Species Overview

Nine bird species and two mammalian species were selected to represent three priority habitats in the Subbasin (What about cliffs, caves and talus slopes?). Life requisite habitat attributes for each species assemblage were pooled to characterize a "range of management conditions", to guide planners in development of future habitat management strategies, goals, and objectives.

General habitat requirements, limiting factors, distribution, population trends, and analyses of structural conditions, key ecological functions, and key ecological correlates for individual focal species are included in Ashley and Stovall (unpublished report, 2004). The reader is further encouraged to review additional focal species life history information in Appendix F in Ashley and Stovall (unpublished report, 2004).

Establishment of conditions favorable to focal species will benefit a wider group of species with similar habitat requirements. Wildlife species associated with focal habitats including agriculture are listed in Appendix B. A focal species matrix for the Okanagan Subbasin is shown in Table 22.

Table 22 Focal species selection matrix for the Okanogan subbasin

Common Name	Focal Habitat [1]	Status [2]		Native Species	PHS	Partners in Flight	Game Species
		Federal	State				

Sage thrasher	SS	n/a	C	Yes	Yes	Yes	No
Brewer's sparrow		n/a	n/a	Yes	No	Yes	No
Grasshopper sparrow		n/a	n/a	Yes	No	Yes	No
Sharp-tailed grouse		SC	T	Yes	Yes	Yes	No
Sage grouse		C	T	Yes	Yes	No	No
Pygmy rabbit		E	E	Yes	Yes	No	No
Mule deer		n/a	n/a	Yes	Yes	No	Yes
Willow flycatcher	RW	SC	n/a	Yes	No	Yes	No
Lewis woodpecker		n/a	C	Yes	Yes	Yes	No
Red-eyed vireo		n/a	n/a	Yes	No	No	No
Yellow-breasted chat		n/a	n/a	Yes	No	No	No
American beaver		n/a	n/a	Yes	No	No	Yes
Pygmy nuthatch	PP	n/a	n/a	Yes	No	No	No
Gray flycatcher		n/a	n/a	Yes	No	No	No
White-headed woodpecker		n/a	C	Yes	Yes	Yes	No
Flammulated owl		n/a	C	Yes	Yes	Yes	No
Red-winged blackbird	HW	n/a	n/a	Yes	No	No	No

[1] SS = Shrubsteppe; RW = Riparian Wetlands; PP = Ponderosa pine; HW = Herbaceous Wetlands

[2] C = Candidate; SC = Species of Concern; T = Threatened; E = Endangered

3.15 Focal Wildlife Habitats and Representative Species

The process used to develop wildlife assessments and management plan objectives and strategies is based on the need for a landscape level holistic approach to protecting the full range of biological diversity at the Ecoprovince scale with attention to size and condition of core areas (subbasin scale), physical connections between core areas, and buffer zones surrounding core areas to ameliorate impacts from incompatible land uses. As most wildlife populations extend beyond subbasin or other political boundaries, this "conservation network" must contain habitat of sufficient extent, quality, and connectivity to ensure long-term viability of obligate/focal wildlife species. Subbasin planners recognized the need for large-scale planning that would lead to effective and efficient conservation of wildlife resources.

In response to this need, subbasin planners approached subbasin planning at two scales. The landscape scale emphasizes focal habitats and associated species assemblages that are important to Ecoprovince wildlife managers while the needs of individual species are addressed at the subbasin level.

Subbasin planners agreed with Lambeck (1997) who proposed that species requirements (umbrella species concept) could be used to guide ecosystem management. The main premise is that the requirements of a demanding species assemblage encapsulate those of many co-occurring less demanding species. By directing management efforts toward the requirements of the most exigent species, the requirements of many cohabitants that use the same habitat type are met. Therefore, managing habitat conditions for a species assemblage should provide life requisite needs for most other focal habitat obligate species.

By combining the “coarse filter” (focal habitats) with the “fine filter” (focal wildlife species assemblage) approach, Ecoprovince and subbasin planners believe there is a much greater likelihood of maintaining, protecting and/or enhancing key focal habitat attributes and providing functioning ecosystems for wildlife.

This approach not only identifies priority focal habitats, but also describes the most important habitat conditions and attributes needed to sustain obligate wildlife populations within these focal habitats. Although recovery strategies are directed towards focal species, establishment of conditions favorable to focal species will also benefit a wider group of species with similar habitat requirements.

Focal species can also serve as performance measures to evaluate ecological sustainability and processes, species/ecosystem diversity, and results of management actions (USFS 2000). Monitoring of habitat attributes and focal species will provide a means of tracking progress toward recovery. Monitoring will provide essential feedback for demonstrating adequacy of conservation efforts on the ground, and guide the adaptive management component that is inherent in this approach.

3.16 Selection of Focal Habitat Types and Species Assemblages

Drawing on the umbrella concept described in the technical overview above, ecoregion/subbasin planners assumed that by focusing resources primarily on selected habitat types, the needs of most listed and managed terrestrial species dependent on those habitats would be addressed during this planning period. While other listed and managed species occur within the subbasin—primarily forested habitat obligates—needs of those species are addressed primarily through the existing land management frameworks of the federal agencies within whose jurisdictions the overwhelming majority of forested habitats occur within the Okanogan subbasin (Okanogan/Wenatchee National Forest and Washington Department of Natural Resources).

Subbasin planners selected three focal habitat types: ponderosa pine, shrubsteppe, and riparian wetlands. The planners also identified rugged lands as a habitat of concern.

Ecoprovince/subbasin planners then identified an assemblage of focal species for each focal habitat type. The focal species that compose the assemblage for each focal habitat type will serve as indicators of environmental health for species that use that habitat type. The planners combined life requisite habitat attributes for each species assemblage to form a recommended range of management conditions, that, when achieved, should result in functional habitats. The rationale for using focal species assemblages is to draw immediate attention to habitat features and conditions most in need of conservation or most important in a functioning ecosystem. The corollary is that factors that affect habitat quality and integrity within the Ecoregion and subbasins also impact wildlife species. As a result, identifying and addressing limiting factors that affect focal habitats should support the needs of obligate wildlife populations as well. Planners recognize, however, that addressing factors that limit habitat does not necessarily address some anthropogenic limiting factors, including effects of human presence on wildlife species.

The focal species, focal habitat types, and habitat of concern identified in this plan will be used in other planning efforts in the Subbasin and the Ecoregion, including the South Okanagan/Similkameen Conservation Program (Canada), the Okanogan-Similkameen Conservation Corridor Program (U. S.), Ecoregional Planning (Canada and the U. S.), and Priority Habitat and Species planning (U. S.). The habitat types and their associated focal species are summarized in Ashley and Stovall, 2004.

3.16.1 Brewer’s Sparrow

General Habitat Requirements

Brewer’s sparrow is a sagebrush obligate species that prefers abundant sagebrush cover (Altman and Holmes 2000). Vander Haegen et al. (2000) determined that Brewer’s sparrows were more abundant in areas of loamy soil than areas of sandy or shallow soil, and on rangelands in good or fair condition than those in poor condition. Knopf et al. (1990) reported that Brewer’s sparrows are strongly associated throughout their range with high sagebrush vigor.

Brewer’s sparrow is positively correlated with shrub cover, above-average vegetation height, bare ground, and horizontal habitat heterogeneity (patchiness). Brewer’s sparrows prefer areas dominated by shrubs rather than grass. They prefer sites with high shrub cover and large patch size (Knick and Rotenberry 1995). In southwestern Idaho, the probability of habitat occupancy by Brewer’s sparrows increased with increasing % shrub cover and shrub patch size; shrub cover was the most important determinant of occupancy (Knick and Rotenberry 1995).

Brewer’s sparrow abundance in Washington increased significantly on sites where sagebrush cover approached the historic 10 % level (Dobler et al. 1996).

In contrast, Brewer’s sparrows are negatively correlated with grass cover, spiny hopsage, and budsage (Larson and Bock 1984; Rotenberry and Wiens 1980; Wiens 1985; Wiens and Rotenberry 1981). In eastern Washington, abundance of Brewer’s sparrows was negatively associated with increasing annual grass cover; higher densities occurred in areas where annual grass cover (i.e., cheatgrass) was less than 20 % (Dobler 1994). Removal of sagebrush cover to less than 10 % has a negative impact on populations (Altman and Holmes 2000).

Recommended habitat objectives include the following: patches of sagebrush cover 10-30 %, mean sagebrush height greater than 24 inches, high foliage density of sagebrush, average cover of native herbaceous plants greater than 10 %, bare ground greater than 20 % (Altman and Holmes 2000) Table 27.

Table 23 Recommended habitat objectives for plants (Altman and Holmes 2000)

Limiting Factors

Habitat loss and fragmentation, livestock grazing, introduced vegetation, fire, and predators are the primary factors affecting Brewer’s sparrows. Direct habitat loss because of conversion of shrublands to agriculture coupled with sagebrush removal/reduction programs and development have significantly reduced available habitat and contributed towards habitat fragmentation of remaining shrublands. Within the entire Interior Columbia Basin, over 48% of watersheds show moderately or strongly declining trends in source habitats for this species (Wisdom et al. in press) (from Altman and Holmes 2000).

Livestock grazing can trigger a cascade of ecological changes, the most dramatic of which is the invasion of non-native grasses escalating the fire cycle and converting sagebrush shrublands to annual grasslands. Historical heavy livestock grazing altered much of the sagebrush range, changing plant composition and densities. West (1988, 1996) estimates less than 1% of sagebrush steppe habitats remain untouched by livestock; 20 % is lightly grazed, 30 % moderately grazed with native understory remaining, and 30 % heavily grazed with understory replaced by invasive annuals. The effects of grazing in sagebrush habitats are complex, depending on intensity, season, duration and extent of alteration to native vegetation. Rangeland in poor condition is less likely to support Brewer's sparrows than rangeland in good and fair condition.

Introduced vegetation such as cheatgrass readily invades disturbed sites, and has come to dominate the grass-forb community of more than half the sagebrush region in the West, replacing native bunchgrasses (Rich 1996). Cheatgrass has altered the natural fire regime in the western range, increasing the frequency, intensity, and size of range fires.

Fire kills sagebrush and where non-native grasses dominate, the landscape can be converted to grasslands dominated by introduced vegetation as the fire cycle escalates, removing preferred habitat (Paige and Ritter 1998). Crested wheatgrass and other non-native annuals have also fundamentally altered the grass-forb community in many areas of sagebrush shrubsteppe, altering shrubland habitats.

Predators (of eggs and nestlings) include gopher snake (*Pituophis melanoleucus*), Townsend's ground squirrel (*Spermophilus townsendii*); other suspected predators include loggerhead shrike (*Lanius ludovicianus*), common raven (*Corvus corax*), black-billed magpie (*Pica pica*), long-tailed weasel (*Mustela frenata*), least chipmunk (*Eutamias minimus*), western rattlesnake (*Crotalus viridis*), and other snake species. Nest predation is the most significant cause of nest failure.

The American kestrel (*Falco sparverius*), prairie falcon (*Falco mexicanus*), coachwhip (*Masticophis flagellum*) have been observed preying on adult sparrows (Rotenberry et al. 1999). Wiens and Rotenberry (1981) observed significant negative correlation between loggerhead shrike and Brewer's sparrow density.

Current Distribution

Undoubtedly, the Brewer's sparrow was widely distributed throughout the lowlands of southeast Washington when it consisted of vast expanses of shrubsteppe habitat. Large-scale conversion of shrubsteppe habitat to agriculture has resulted in populations becoming localized in the last vestiges of available habitat (Smith et al. 1997). Washington is near the northwestern limit of breeding range for Brewer's sparrows (Figure 22). Birds occur primarily in Okanogan, Douglas, Grant, Lincoln, Kittitas, and Adams Counties (Smith et al. 1997).

Population Trend Status

Brewer's sparrow is often the most abundant bird species in appropriate sagebrush habitats. However, widespread long-term declines and threats to shrubsteppe breeding habitats have placed it on the Partners in Flight Watch List of conservation priority species (Muehter 1998). Saab and Rich (1997) categorize it as a species of high management concern in the Columbia River Basin.

Historically, the Brewer's sparrow may have been the most abundant bird in the Intermountain West (Paige and Ritter 1998) but BBS trend estimates indicate a range-wide population decline during the last twenty-five years (Peterjohn et al. 1995).

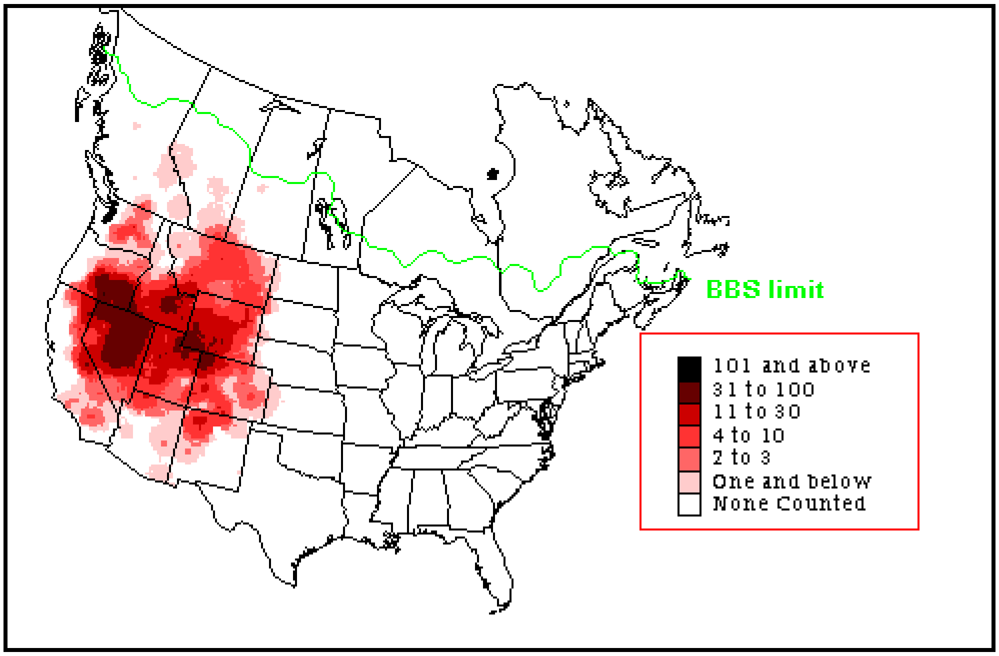
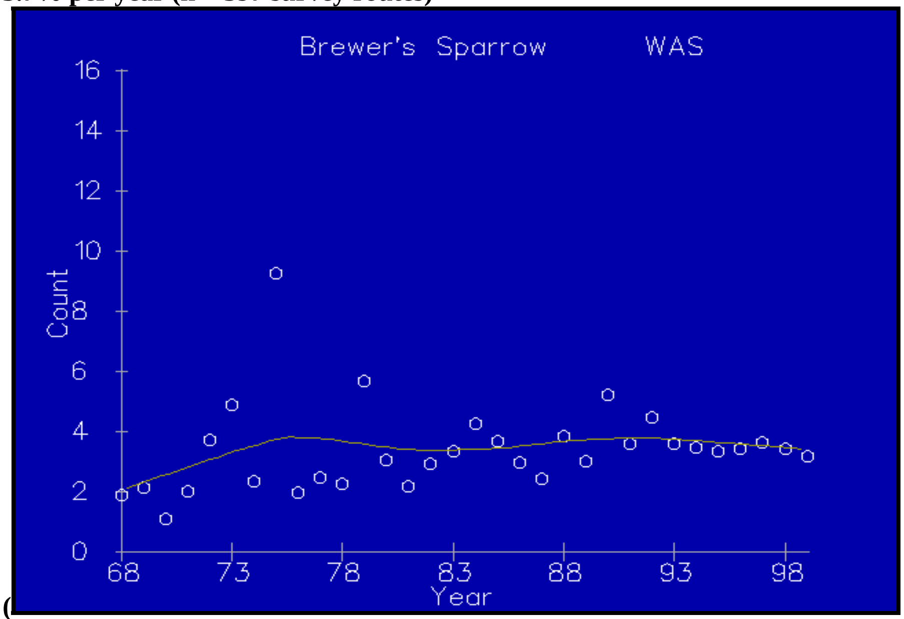


Figure 22 Brewer's sparrow breeding range and abundance (Sauer et al. 2003).

Brewer's sparrows are not currently listed as Threatened or Endangered on any state or federal list. Oregon-Washington Partners in Flight consider the Brewer's sparrow a focal species for conservation strategies for the Columbia Plateau (Altman and Holmes 2000).

Breeding Bird Survey data from 1966 to1996 show significant and strong survey-wide declines averaging -3.7% per year (n = 397 survey routes)



(Figure 23). The BBS data (1966-1996) for the Columbia Plateau are illustrated in Figure 24. Significant declines in Brewer's sparrow are evident in California, Colorado, Montana, Nevada, Oregon, and Wyoming, with the steepest significant decline evident in Idaho (-6.0 % average per year; n = 39). These negative trends appear to be consistent throughout the 30-year survey period. Only Utah shows an apparently stable population. Sample sizes for Washington are too small for an accurate estimate. Note that although positively correlated with presence of sage thrashers (Oreoscoptes montanus), probably because of similarities in habitat relations (Wiens and Rotenberry 1981), thrashers are not exhibiting the same steep and widespread declines evident in BBS data (see Sauer et al. 1997).

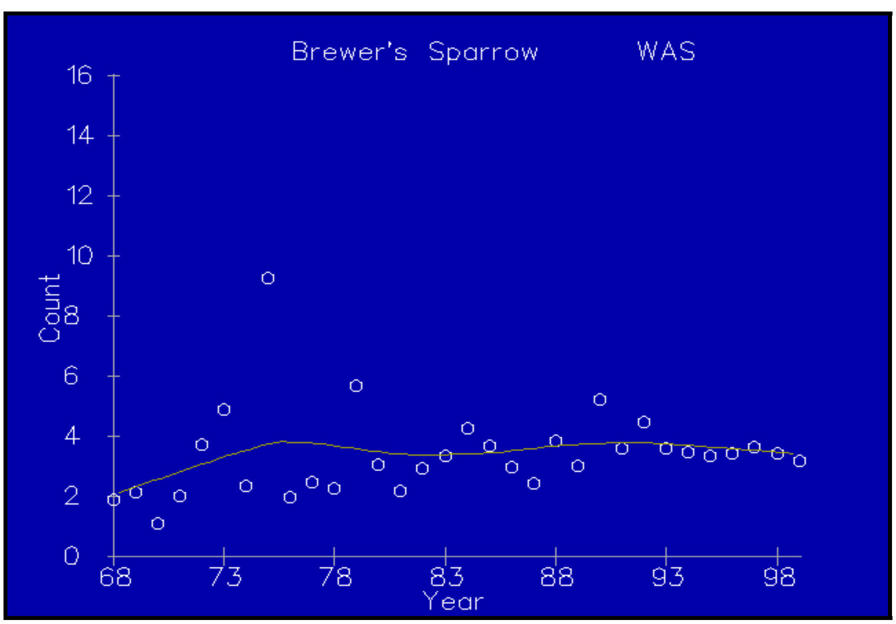


Figure 23. Breeding Bird Survey data for 1966 -1996

3.16.2 Grasshopper Sparrow

General Habitat Requirements

Grasshopper sparrows prefer grasslands of intermediate height and are often associated with clumped vegetation interspersed with patches of bare ground (Bent 1968; Blankespoor 1980; Vickery 1996). Other habitat requirements include moderately deep litter and sparse coverage of woody vegetation (Smith 1963; Bent 1968; Wiens 1969, 1970; Kahl et al. 1985; Arnold and Higgins 1986). In east central Oregon, grasshopper sparrows occupied relatively undisturbed native bunchgrass communities dominated by *Agropyron spicatum* and/or *Festuca idahoensis*, particularly north-facing slopes on the Boardman Bombing Range, Columbia Basin (Holmes and Geupel 1998). Vander Haegen et al. (2000) found no significant relationship with vegetation type (i.e., shrubs, perennial grasses, or annual grasses), but did find one with the % cover perennial grass.

In portions of Colorado, Kansas, Montana, Nebraska, Oklahoma, South Dakota, Texas, Wisconsin, and Wyoming, abundance of grasshopper sparrows was positively correlated with % grass cover, % litter cover, total number of vertical vegetation hits, effective vegetation height, and litter depth; abundance was negatively correlated with % bare ground, amount of variation in litter depth, amount of variation in forb or shrub height, and the amount of variation in forb and shrub heights (Rotenberry and Wiens 1980).

Grasshopper sparrows occasionally inhabit cropland, such as corn and oats, but at a fraction of the densities found in grassland habitats (Smith 1963; Smith 1968; Ducey and Miller 1980; Basore et al. 1986; Faanes and Lingle 1995; Best et al. 1997).

Limiting Factors

The principal post-settlement conservation issues affecting grasshopper sparrow populations include: habitat loss and fragmentation resulting from conversion to agriculture; and habitat degradation and alteration from livestock grazing, invasion of exotic vegetation, and alteration of historic fire regimes.

Fragmentation resulting from agricultural development or large fires fueled by cheatgrass can have several negative effects on land birds. These include: insufficient patch size for area-dependent species, and increases in edges and adjacent hostile landscapes, which can result in reduced productivity through increased nest predation, nest parasitism, and reduced pairing success of males. Additionally, habitat fragmentation has likely altered the dynamics of dispersal and immigration necessary for maintenance of some populations at a regional scale. In a recent analysis of neotropical migratory birds within the Interior Columbia Basin, most species identified as being of "high management concern" were shrubsteppe species (Saab and Rich 1997) that include the grasshopper sparrow.

Making this loss of habitat even more severe is that the grasshopper sparrow like other grassland species shows a sensitivity to the grassland patch size (Herkert 1994; Samson 1980; Vickery 1994; Bock et al. 1999). Herkert (1991) found that grasshopper sparrows in Illinois were not present in grassland patches smaller than 74 acres despite the fact that their published average territory size is only about 0.75 acres. Minimum requirement size in the Northwest is unknown.

Grazing can trigger a cascade of ecological changes, the most dramatic of which is the invasion of non-native grasses escalating the fire cycle and converting sagebrush shrublands to annual grasslands. Historical heavy livestock grazing altered much of the sagebrush range, changing plant composition and densities. West (1988, 1996) estimates less than 1% of sagebrush steppe habitats remain untouched by livestock; 20 % is lightly grazed, 30 % moderately grazed with native understory remaining, and 30 % heavily grazed with understory replaced by invasive annuals. The effects of grazing in sagebrush habitats are complex, depending on intensity, season, duration and extent of alteration to native vegetation. Extensive and intensive grazing in North America has had negative impacts on this species (Bock and Webb 1984).

The grasshopper sparrow has been found to respond positively to light or moderate grazing in tallgrass prairie (Risser et al. 1981). However, it responds negatively to grazing in shortgrass, semi-desert, and mixed grass areas (Bock et al. 1984).

The degree of degradation of terrestrial ecosystems is often diagnosed by the presence and extent of alien plant species (Andreas and Lichvar 1995); frequently their presence is related to soil disturbance and overgrazing. Increasingly, however, aggressive aliens are becoming established even in ostensibly undisturbed bunchgrass vegetation, wherever their seed can reach.

Cheatgrass has altered the natural fire regime in the western range, increasing the frequency, intensity, and size of range fires. Fire kills sagebrush and where non-native grasses dominate, the landscape can be converted to annual grassland as the fire cycle escalates, removing preferred habitat (Paige and Ritter 1998).

Studies on the effects of burns on grassland birds in North American grasslands have shown similar results as grazing studies: namely, bird response is highly variable. Confounding factors include timing of burn, intensity of burn, previous land history, type of pre-burn vegetation, presence of fire-tolerant exotic vegetation (that may take advantage of the post-burn circumstances and spread even more quickly) and grassland bird species present in the area.

It should be emphasized that much of the variation in response to grassland fires lies at the level of species, but that even at this level results are often difficult to generalize. For instance, mourning doves have been found to experience positive (Bock and Bock 1992; Johnson 1997) and negative (Zimmerman 1997) effects by fire in different studies. Similarly, grasshopper sparrows have been found to experience positive (Johnson 1997), negative (Bock and Bock 1992; Zimmerman 1997; Vickery et al. 1999), and no significant (Rohrbaugh 1999) effects of fire. Species associated with short and/or open grassy areas will most likely experience short-term benefits from fires. Species that prefer taller and denser grasslands most likely will demonstrate a negative response to fire (CPIF 2000).

Mowing and haying affects grassland birds directly and indirectly. It may reduce height and cover of herbaceous vegetation, destroy active nests, kill nestlings and fledglings, cause nest abandonment, and increase nest exposure and predation levels (Bollinger et al. 1990). Studies on grasshopper sparrow have indicated higher densities and nest success in areas not mowed until after July 15 (Shugaart and James 1973; Warner 1992). Grasshopper sparrows are vulnerable to early mowing of fields, while light grazing, infrequent and post-season burning or mowing can be beneficial (Vickery 1996).

Grasshopper sparrows may be multiply parasitized (Elliott 1976, 1978; Davis and Sealy 2000). In Kansas, cowbird parasitism cost grasshopper sparrows about two young/parasitized nest, and there was a low likelihood of nest abandonment occurring because of cowbird parasitism (Elliott 1976, 1978).

Current Distribution

Grasshopper sparrows are found from North to South America, Ecuador, and in the West Indies (Vickery 1996; AOU 1957). They are common breeders throughout much of the continental United States, ranging from southern Canada south to Florida, Texas, and California. Additional populations are locally distributed from Mexico to Colombia and in the West Indies (Delany et al. 1985; Delany 1996; Vickery 1996).

The subspecies breeding in eastern Washington is *Ammodramus savannarum perpallidus* which breeds from northwest California, where it is uncommon, into eastern Washington, northeast and southwest Oregon, where it is rare and local, into southeast British Columbia, where it is considered Endangered, east into Nevada, Utah, Colorado, Oklahoma, Texas, and possibly to Illinois and a (Vickery 1996).

3.16.3 Sharp-tailed Grouse

General Habitat Requirements

The Columbian sharp-tailed grouse (CSTG) is one of six subspecies of sharp-tailed grouse and the only one found in Washington. Native habitats important for CSTG include grass-dominated nesting habitat and deciduous shrub-dominated wintering habitat, both of which are critical for sharp-tailed grouse (Giesen and Connelly 1993; Connelly et al. 1998).

Residual grasses and forbs are necessary for concealment and protection of nests and broods during spring and summer (Hart et al. 1952; Parker 1970; Oedekoven 1985; Marks and Marks 1988; Meints 1991; Giesen and Connelly 1993). Preferred nest sites are on the ground in relatively dense cover provided by clumps of shrubs, grasses, and/or forbs (Hillman and Jackson 1973). Fields enrolled in agricultural set-aside programs are often preferred. Giesen (1987) reported density of shrubs less than 3 feet tall were 5 times higher at nest sites than at random sites or sites 33 feet from the nest.

Meints (1991) found that mean grass height at successful nests averaged less than 1 foot, while 7 inches was the average at unsuccessful nests. Hoffman (2001) recommended that the minimum height for good quality nesting and brood-rearing habitat is 8 inches, with 1 foot being preferred. Bunchgrasses, especially those with a high percentage of leaves to stems like bluebunch wheatgrass, is preferred by nesting sharp-tailed grouse over sod-forming grasses such as smooth brome.

Columbian sharp-tailed grouse are able to tolerate considerable variation in the proportion of grasses and shrubs that comprise suitable nesting habitat, but the most important factor is that a certain height and density of vegetation is required. Canopy coverage and visual obstruction are greater at nest sites than at independent sites (Kobriger 1980; Marks and Marks 1987; Meints 1991).

After hatching, hens with broods move to areas where succulent vegetation and insects can be found (Sisson 1970; Gregg 1987; Marks and Marks 1987; Klott and Lindzey 1990). In late summer, riparian areas and mountain shrub communities are preferred (Giesen 1987).

Food items in the spring and summer include wild sunflower (*Helianthus* spp.), chokecherry, sagebrush, serviceberry, salsify (*Tragopogon spp*.), dandelion (*Taraxacum* spp.), bluegrass, and brome (Hart et al. 1952; Jones 1966; Parker 1970). Although juveniles and adults consume insects, chicks eat the greatest quantity during the first few weeks of life (Parker 1970; Johnsgard 1973). In winter, CSTG commonly forage on persistent fruits and buds of chokecherry, serviceberry, hawthorn, snowberry, aspen, birch, willow, and wild rose (Giesen and Connelly 1993; Schneider 1994).

Columbian sharp-tailed grouse numbers have drastically declined in Washington over the past 100 years, and they are now a federally and state listed species. The breeding population of sharp-tailed grouse in Washington is currently estimated at 380. Shrubsteppe and riparian habitat are critical habitat for sharp-tailed grouse, and both have been heavily manipulated in the basin (OWSAC, 2000). The USFWS recently issued a 90-day Finding on a petition to list sharp-tailed grouse as Threatened under the ES (USFWS, 1999).

According to early explorers sharp-tails used to be plentiful in Eastern Washington. A total of 112 sharp-tailed grouse leks (courtship areas) were documented between 1954 and 1994. Lek counts are used to estimate population size and stability. The number of males per lek and active leks also indicate stability of the population. Males per lek declined from 13 in 1954 to 5 in 1994. In Douglas County from 1954 to 1994, 46% of active leks disappeared, 65% disappeared in Okanogan County, and 61% disappeared in Lincoln County.

Limiting Factors

The primary factors affecting the continued existence of sharp-tailed grouse in Washington relate to habitat loss and alteration and the precarious nature of small, geographically isolated subpopulations. Three of the major factors that contributed to the decline of sharp-tailed grouse and their habitat in Washington are still threats today: conversion to agriculture, conversion to pastureland for livestock, and overgrazing. The removal of shrubs as part of agricultural practices reduces the quantity and quality of winter habitat, and the degradation of shrub and meadow steppe habitat as a result of livestock management reduces the quality of breeding habitat. The remaining subpopulations are small and isolated from one another, which increases the risk of extirpation.

Population isolation is potentially a major factor influencing the continued existence of sharp-tailed grouse in Washington. As grouse populations naturally fluctuate because of environmental conditions, the lower the population level, the greater the risk of extirpation. The isolation of populations may have important ramifications for their genetic quality and recruitment (Lacy 1987). It may require human transport of individuals to counteract loss of fitness because of genetic drift.

It is not clear if the Washington populations are declining because of their isolation or because of a combination of other factors. Initial evidence (M. Schroeder, pers. comm.) indicates that most movements of radio-marked birds are insufficient to allow interchange of individuals among populations in north-central Washington. Although current estimates of the total population range up to 1000 individuals, it is divided among eight small isolated subpopulations. Four of these populations are estimated to contain fewer than 25 birds. These populations are under immediate threat of extirpation (Reed et al. 1986).

Near-term extirpation risks because of population size are present for two of three other populations remaining outside the Colville Tribes Reservation (Gilpin 1987), as less than 100 individuals are estimated at each site (M. Schroeder, pers. comm.). These populations are likely much less tolerant of environmental changes, such as habitat degradation and weather extremes, than populations in Lincoln County and the Colville Tribes Reservation. Predation is more of a concern for these very small populations than it would be for larger populations in good habitat.

A wide variety of genetic problems can occur with small populations, and these genetic problems can interact with demographic and habitat problems and lead to extinction (Gilpin and Soule 1986). Overall threats to sharp-tailed grouse are greater with individuals spread through small subpopulations than one larger population.

Sharp-tails in Douglas and Okanogan counties, and to a lesser degree in Lincoln County, are now restricted to high-elevation areas, specifically those areas that have both shrubs and grasses (Schroeder 1996). High winter mortality resulting from declining quantity and quality of winter habitat is likely the most significant factor causing the decline in the sharp-tail population in Washington (Schroeder 1996). Protecting and enhancing high quality habitat where sharp-tails continue to concentrate, and restoring key low-elevation winter sites is vital to conservation of sharp-tailed grouse in Washington.

Habitat quality overall is improving for sharp-tailed grouse in Lincoln County, where WDFW and the Bureau of Land Management are actively managing habitat for sharp-tailed grouse. Continuation of lands enrolled in the Conservation Reserve Program is also important to improve habitat quality in Lincoln and Douglas counties. WDFW acquisition of lands in Okanogan County near Tunk Valley, Chesaw and Conconully should also result in improving habitats. Private and tribal lands with sharp-tailed grouse that are grazed change in habitat quality with the intensity of grazing. Trends on these grazed lands are not predictable.

Increases in grazing pressure on currently occupied sharp-tailed grouse habitat is a principal threat to the continued existence of populations. In general, when grazing by livestock reduces the grass and forb component, sharp-tailed grouse are excluded (Hart et al. 1950, Brown 1966b, Parker 1970, Zeigler 1979). Loss of deciduous cover is especially severe near riparian areas that attract livestock in summer because of water and shade; this cover provides critical foraging areas and escape cover for sharp-tails throughout the year (Zeigler 1979, Marks and Marks 1987a). Trampling, browsing, and rubbing decrease the annual grass and forbs, deciduous trees, and shrubs needed for food and shelter in winter (Parker 1970, Kessler and Bosch 1982, Marks and Marks 1987a). Mattise (1978) found overgrazing very detrimental in nesting and brood-rearing habitat.

In Montana, Brown (1968) reported that the reduction in habitat because of intensive livestock grazing resulted in the elimination of sharp-tails in particular areas. Sharp-tails were observed shifting use to ungrazed areas following livestock use of traditional sites (Brown 1968). Marks and Marks (1988) also found sharp-tails in western Idaho selecting home ranges that were least modified by livestock grazing.

The effects of grazing on sharp-tailed grouse reported vary and appear to depend primarily on intensity, duration of grazing, kind of livestock, site characteristics, precipitation levels, and past and present land-use practices. Grazing systems currently used in range management include seasonal, deferred, and rotation grazing (Stoddard, et al. 1975). Hart et al. (1950) found light to moderate grazing benefiting landowners and sharp-tails on the foothills and benchlands of Utah. Weddell (1992) concluded that rest rotation and deferred grazing were less detrimental to sharp-tailed grouse than season-long grazing, and suggested the disadvantages of increasing grazing under any of these systems outweigh the advantages for sharp-tailed grouse. Even light to moderate grazing can be detrimental in areas with a history of overgrazing, because it may prevent recovery of the native vegetation.

Kessler and Bosch (1982) surveyed sharp-tailed grouse management practices and concluded that grazing and the resulting habitat loss are the most serious threats to sharp-tailed grouse survival. Their survey of states and provinces with past or present Columbian sharp-tailed grouse populations found respondents regarded low intensity grazing as beneficial and high intensity grazing to be negative in its effects on sharp-tails (Kessler and Bosch 1982). Twenty % more respondents found moderate grazing negative in its effects and twice as many preferred deferred and rest rotation over continuous grazing. Five of the seven states or provinces with Columbian sharp-tailed grouse listed overgrazing as a major issue/problem related to maintaining this species and its habitat (Braun 1991).

Grazing is a continuing threat to sharp-tailed grouse because of unpredictable changes in land ownership, grazing economics, and the needs of private landowners. Grazing pressure is increasing in several important sharp-tail areas in Washington (M. Schroeder, pers. comm.).

The removal of CRP habitat in Lincoln, Douglas, and Okanogan counties could cause further declines in sharp-tailed grouse numbers. Contracts for approximately 318,000 ha expired in 1997. Washington farmers submitted applications for new contracts on 239,000 ha and nearly 196,000 ha were accepted. CRP lands placed back into grain production could cause further declines in the number of sharp-tailed grouse, depending upon how sharp-tailed grouse use these areas. CRP land and other habitat enhancement areas must be near existing sharp-tail populations to be beneficial (Meints et al. 1992). Although the WDFW is assisting landowners in applying for CRP funding, the long-term status of these areas is uncertain.

The loss of deciduous trees and shrubs by chemical control was associated with declining sharp-tail populations in Washington (Zeigler 1979) and Utah (Hart et al. 1950). Chemical treatment of vegetation in sharp-tailed grouse habitat is detrimental because of the direct loss of vegetation (McArdle 1977, Blaisdell et al. 1982, Oedekoven 1985, Klott 1987). Kessler and Bosch (1982) found most biologists regarded chemical brush control as a negative management practice for sharp-tails. However, in Michigan, herbicidal treatment was used to open dense areas and provide more adequate sharp-tailed grouse habitat (Van Etten 1960). In Washington, continued use of herbicides to control sagebrush and other vegetation may cause additional reductions in sharp-tailed grouse habitat.

Fire is a continual threat to sharp-tailed grouse populations. Fire has become a major tool for altering large blocks of sagebrush rangelands. In Lincoln County, three large prescribed fires and one chemical control of sagebrush in the 1980s in areas containing active leks, were believed to be directly responsible for the decline of both sharp-tailed and sage grouse populations (Merker 1988). McArdle (1977) found less use by sharp-tails in burned areas compared to other vegetation manipulations. Likewise, Hart et al. (1950) reported Columbian sharp-tails abandoning a lek site following a fire, which also caused accelerated erosion, loss of nests, and loss of winter food and cover.

Under some circumstances, burning can help improve sharp-tailed grouse habitat. Burning dense sagebrush and thickly wooded areas was found to improve sharp-tailed grouse habitat in Utah (Hart et al. 1950), North Dakota (Kirsh et al. 1973), Colorado (Rogers 1969), and Wyoming (Oedekoven 1985). In Manitoba and British Columbia, a large movement of sharp-tailed grouse occurred from a high-use lek site to a burned area following a fire that eliminated all residual grass and forbs but did not greatly affect shrub or tree cover.

Modern fire suppression policies have allowed conifers to invade bunchgrass-prairie habitats in some areas to the detriment of sharp-tailed grouse populations. In these situations, prescribed burning may be effective in maintaining suitable habitats (Giesen and Connelly 1993). In Washington, prescribed fire is not recommended in shrub/meadow steppe but may be acceptable for creating habitat where conifers have invaded traditional shrub/meadow steppe areas.

Current Distribution

Currently, Columbian sharp-tails occupy <10 % of their historic range in Idaho, Montana, Utah, Wyoming, and Washington; approximately 50 % in Colorado, and 8% in British Columbia (Oedekoven 1985; Sullivan 1988; Ritcey 1995). Columbian sharp-tailed grouse are extirpated from California and possibly Oregon and Nevada (Wick 1955; Evanich 1983; Oedekoven 1985). Possible sightings in Nevada (Goose Creek south of Twin Falls, Idaho) and Oregon (Baker County) were recently reported (Braun 1991). Columbian sharp-tails are being reintroduced in Oregon (Starkey and Schnoes 1979; Crawford 1986).

The current range of Columbian sharp-tailed grouse in Washington consists of eight small, severely fragmented populations in Douglas, Lincoln, and Okanogan Counties. Sightings of sharp-tails were reported in Asotin County in the mid-1980s; however, the Idaho Department of Fish and Game transplanted sharp-tails in Idaho at that time, and some probably dispersed to Asotin County. Sharp-tailed grouse found outside Douglas, Lincoln, and Okanogan Counties are likely transient birds that periodically occupy pockets of remaining shrub/meadow steppe. They contribute little to the statewide population in terms of reproduction or genetics.

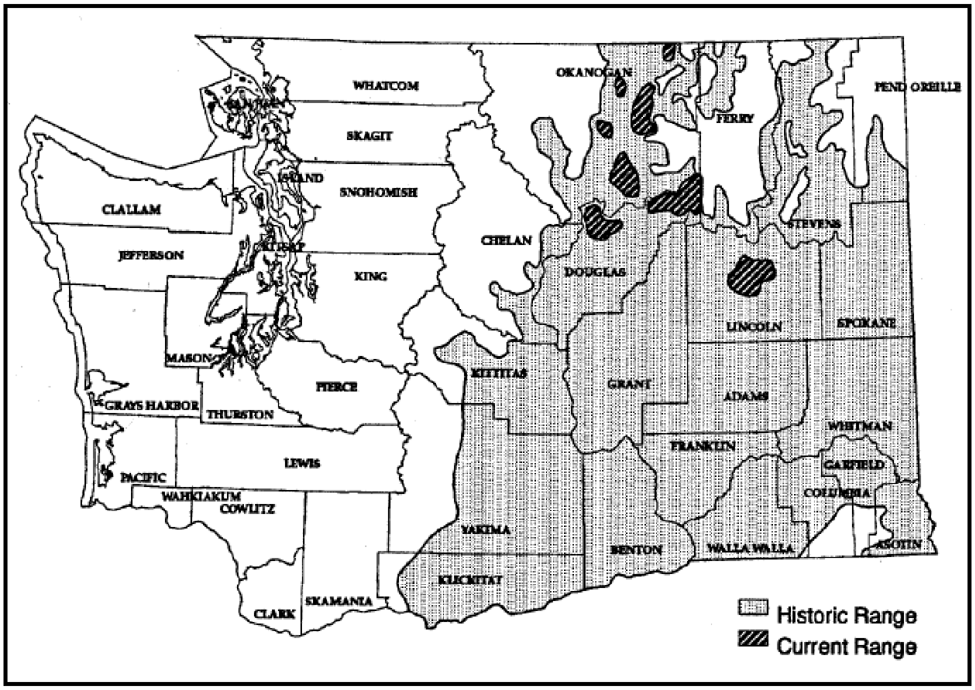


Figure 24 Historic and current range of sharp-tailed grouse in Washington (Hays et al. 1998).

Population Trend Status

The 1997 breeding population of sharp-tailed grouse in Washington has been estimated through lek counts and a population model. During spring surveys, 358 grouse were counted on 44 leks in 3 counties (Table 24). A model based on scientific literature, input and survey data from WDFW biologists, and current research in Washington was used to estimate the size of the 1997 breeding population.

Table 24 Results of 1997 sharp-tailed grouse lek counts in Washington (Hays et al. 1998).

County	Birds	Leks	Birds/lek
Okanogan	169	17	9.9
Lincoln	88	10	8.8
Okanogan (off Colville Reservation)	59	9	6.5
Douglas	42	8	5.3
TOTAL	358	44	8.1

The model assumed all leks were known and surveyed, all males were on leks during counts, and the male to female sex ratio was 1:1. This model would underestimate actual population size if some leks were not located, if all males were not on leks during counts, if the sex ratio was not 1:1, and if surveys were flawed (e.g., bad weather, incomplete counts, etc.).

The model would overestimate actual population size if lek counts included females (which are difficult to distinguish). The population estimate based on the model is 716 sharp-tailed grouse in Washington in 1997 (Table 25). Allowing for additional unsurveyed habitat, M. Schroeder (pers. comm.) suggests as many as 1000 sharp-tailed grouse may remain in Washington.

Table 25. Estimated size of the Washington sharp-tailed grouse breeding population in 1997

Sex	Population Estimate	Estimate Source
Male	358	Statewide lek counts
Female	358	1:1 sex ratio
TOTAL	716	Males + Females

The remaining sharp-tailed grouse in Washington are distributed in eight fragmented subpopulations. Of these, the subpopulation on the Colville Tribes Reservation is the largest remaining in the state (Table 26). It is estimated to include about 352 grouse and is considered self-sustaining. Of the subpopulations outside of the Reservation, the largest population is in western Lincoln County (177 birds).

The subpopulation south of Bridgeport in Douglas County contains about 31 birds. Outside the reservation, Okanogan County supports a total of only 138 birds. This includes four subpopulations that each support fewer than 25 grouse and they are likely unstable and near extirpation. Sharp-tailed grouse in each of the eight geographic areas (Figure_45) appear to be isolated (Schroeder 1996).

Table 26 Sharp-tailed Grouse populations in the State of Washington

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Structural Condition Associations

Several environmental and habitat changes appear to have led to improved sage grouse and sharp-tailed grouse populations. Sharp-tails are present in Douglas, Lincoln, and Okanogan counties. Areas supporting the most sharp-tails include West Foster Creek, East Foster Creek, Cold Springs Basin, and Dyer Hill in Douglas County; Swanson Lakes Wildlife Area in Lincoln County; and the Tunk Valley and Chesaw Units of the Scotch Creek Wildlife Area in the Okanogan Basin. Ziegler (1979) documented a 51% decline in waterbirch and aspen from 1945 to 1977 in Johnson Creek.

Waterbirch buds are the primary food of sharp-tailed grouse during the winter (Hays et al., 1988). In addition, 13% of landowners contacted in Okanogan County were planning to remove waterbirch or aspen (OWSAC, 2000). Much winter habitat in Okanogan County has been lost to residential development. One lek was destroyed by a recreational subdivision (OWSAC, 2000). Hofmann and Dobler (1988a) also reported the loss of waterbirch in two locations in Okanogan County in less than three months of observation. Sharp-tails no longer used these areas after waterbirch was removed (Hofmann and Dobler, 1988a).

WDFW has an active survey and management program for sharp-tailed grouse because of their state-listed status, and the Okanogan population is considered to be one of the last strongholds for the species. There is an augmentation program underway. Populations and habitat are surveyed annually. Birds are transplanted from elsewhere, research is underway, and WDFW is pursuing land acquisition for habitat.

The Colville Tribes is currently managing sharp-tailed grouse within the Reservation boundaries to eliminate habitat alteration, fragmentation, and human-caused events that put these populations at risk. The Colville Tribes has recently begun a study of this species in coordination with Washington State University to address limiting factors and habitat restoration within the region.

Sharp-tailed grouse structural conditions and association relationships are shown in Table 27.

Table 27 Sharp-tailed grouse structural conditions and association relationships (IBIS 2003).

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
Sharp-tailed Grouse	Shrubsteppe	Grass/Forb-Closed	B	C
		Grass/Forb-Open	B	C
		Low Shrub-Open Shrub Overstory-Mature	B	C
		Low Shrub-Open Shrub Overstory-Old	B	A
		Low Shrub-Open Shrub Overstory-Seedling/Young	B	C
		Medium Shrub-Open Shrub Overstory-Mature	B	A
		Medium Shrub-Open Shrub Overstory-Old	B	P
		Medium Shrub-Open Shrub Overstory-Seedling/Young	B	C

3.16.4 Mule Deer

General Habitat Requirements

Mule deer occupy a variety of habitat types across eastern Washington. Consequently, habitat requirements vary with vegetative and landscape components contained within each herd range. Forested habitats provide mule deer with forage and snow intercept, thermal, and escape cover.

Mule deer occupying mountain-foothill habitats live within a broad range of elevations, climates, and topography that includes a wide range of vegetation; many of the deer using these habitats are migratory. Mule deer are found in the deep canyon complexes along the major rivers and in the channeled scablands of eastern Washington; these areas are dominated by native bunch grasses or shrubsteppe vegetation. Mule deer also occupy agricultural areas which once where shrubsteppe.

Limiting Factors

Mule deer and their habitats are being impacted in a negative way by dam construction, urban and suburban development, road and highway construction, over-grazing by livestock, inappropriate logging operations, competition by other ungulates, drought, fire, over-harvest by hunters, predation, disease and parasites.

Weather conditions can play a major role in the productivity and abundance of mule deer. Drought conditions can have a severe impact on mule deer because forage does not replenish itself on summer or winter range, and nutritional quality is low. Drought conditions during the summer and fall can result in low fecundity in does, and poor physical condition going into the winter months. Severe winter weather can cause result in high mortality depending on severity.

Severe weather can result in mortality of all age classes, but the young, old, and mature bucks usually sustain the highest mortality. If mule deer are subjected to drought conditions in the summer and fall, followed by a severe winter, the result can be high mortality rates and low productivity the following year.

Habitat conditions in the Ecoprovince have deteriorated in some areas and improved dramatically in others. The conversion of shrubsteppe and grassland habitat to agricultural croplands has resulted in the loss of thousands of acres of mule deer habitat. However, this has been mitigated to some degree by the implementation of the CRP. Noxious weeds have invaded many areas resulting in a tremendous loss of good habitat for mule deer.

Fire suppression has resulted in a decline of habitat conditions in the mountains and foothills of the Cascade Mountains. Browse species need to be regenerated by fire in order to maintain availability and nutritional value to big game. Lack of fire has allowed many browse species to grow out of reach for mule deer (Leege 1968; 1969; Young and Robinette 1939).

The reservoirs created by dams on the Columbia River inundated prime riparian habitat that supported many species of wildlife, including mule deer. This riparian zone provided high quality habitat (forage/cover), especially during the winter months. The loss of this important habitat and the impact it has had on the mule deer population along the breaks of the Columbia River may never be fully understood.

Current Distribution

Deer damage is a chronic problem in the Omak district. During severe winters, deer are often forced onto low elevation private property in close proximity to human development. At such times, damage to orchards, haystacks, and landscaping can be significant" (OWSAC, 2000).

The WDFW conducts annual mule deer and white-tail deer population surveys, and manages its wildlife areas for winter mule deer range. The USFS and WDNR also manage portions of their lands for winter deer range.

The Colville Tribes is a major financial contributor to, and is involved in, an ongoing long-term mule deer study with WFWD, Chelan Co. PUD, Forest Service, Inland NW Wildlife Council, WSU, UW, and UI. Colville Tribes is actively monitoring habitat, limiting factors and population trends. Colville Tribes performs annual aerial surveys, regulates tribal hunting seasons and manages hunter check stations.

Population Trend Status

Mule deer populations have varied dramatically throughout recorded history of the region. In the 1800s mule deer populations were reported to be extremely low (OWSAC, 2000). In the 1900s, deer populations fluctuated widely, with historic highs in the 1950s and 1960s.

Population lows are because of a number of factors, including severe weather conditions, overused winter range, and hunting pressure. Severe winter weather conditions have significantly reduced mule deer populations since 1992. The winter of 1996/97 was especially hard on the local herds.

Qualitative observations from land managers, biologists, and long time residents, and harvest figures, suggest the populations may be half of what it was in the mid 1980s and early 1990s (OWSAC, 2000).

A shorter season and reduced number of hunters in 1997 along with easier overwintering conditions during the 1997/98 winter has been beneficial to the herds (OWSAC, 2000).

Mule deer on the reservation are suffering long –term declines attributed to habitat changes, habitat fragmentation, severe weather conditions and overgrazing. Data from Colville Tribes aerial trend counts indicate severe declines in both mule deer and white-tail populations. (Sanpoil Subbasin Summary). Mule deer are important for cultural and subsistence reasons.

Mule deer structural conditions and association relationships are shown inTable 28.

Table 28 Mule deer structural conditions and association relationships (IBIS 2003).

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
Mule Deer	Shrubsteppe	Grass/Forb-Closed	B	A
		Grass/Forb-Open	B	A
		Low Shrub-Closed Shrub Overstory-Mature	B	A
		Low Shrub-Closed Shrub Overstory-Old	B	A
		Low Shrub-Closed Shrub Overstory-Seedling/Young	B	A
		Low Shrub-Open Shrub Overstory-Mature	B	A
		Low Shrub-Open Shrub Overstory-Old	B	A
		Low Shrub-Open Shrub Overstory-Seedling/Young	B	A
		Medium Shrub-Closed Shrub Overstory-Mature	B	A
		Medium Shrub-Closed Shrub Overstory-Old	B	A
		Medium Shrub-Closed Shrub Overstory-Seedling/Young	B	A
		Medium Shrub-Open Shrub Overstory-Mature	B	A
		Medium Shrub-Open Shrub Overstory-Old	B	A
		Medium Shrub-Open Shrub Overstory-Seedling/Young	B	A
		Tall Shrub-Closed Shrub Overstory-Mature	B	A
		Tall Shrub-Closed Shrub Overstory-Old	B	A
		Tall Shrub-Closed Shrub Overstory-Seedling/Young	B	A

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
		Tall Shrub-Open Shrub Overstory-Mature	B	A
		Tall Shrub-Open Shrub Overstory-Old	B	A
		Tall Shrub-Open Shrub Overstory-Seedling/Young	B	A

3.16.5 Red-eyed Vireo

General Habitat Requirements

Partners in Flight established biological objectives for this species in the lowlands of western Oregon and western Washington. These include providing habitats that meet the following definition: mean canopy tree height greater than 50 feet, mean canopy closure greater than 60 %, young (recruitment) sapling trees greater than 10 % cover in the understory, riparian woodland greater than 64 feet wide (Altman 2001). Red-eyed vireos are closely associated with riparian woodlands and black cottonwood stands and may use mixed deciduous stands.

The patchy distribution in Washington for this species correlates with the distribution of large black cottonwood (*Populus trichocarpa*) groves, which are usually limited to riparian areas. The red-eyed vireo is one of the most abundant species in northeastern United States, but is much less common in Washington because of limited habitat.

Limiting Factors

Habitat loss because of hydrological diversions and control of natural flooding regimes (e.g., dams) has resulted in an overall reduction of riparian habitat for red-eyed vireos through the conversion of riparian habitats and inundation from impoundments.

Like other neotropical migratory birds, red-eyed vireos suffer from habitat degradation resulting from the loss of vertical stratification in riparian vegetation, lack of recruitment of young cottonwoods, ash (*Fraxinus latifolia*), willows (*Salix spp*.), and other subcanopy species.

Streambank stabilization (e.g., riprap) narrows stream channels and reduces the flood zone and extent of riparian vegetation. The invasion of exotic species such as canarygrass (*Phalaris* spp.) and blackberry (*Rubus* spp.) also contributes to a reduction in available habitat for the red-eyed vireo. Habitat loss can also be attributed to overgrazing, which can reduce understory cover. Reductions in riparian corridor widths may decrease suitability of riparian habitat and may increase encroachment of nest predators and nest parasites to the interior of the stand.

Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites, such as brown-headed cowbirds and domestic predators (cats), and can be subject to high levels of human disturbance. Recreational disturbances, particularly during nesting season, and particularly in high-use recreation areas may have an impact on red-eyed vireos.

Increased use of pesticide and herbicides associated with agricultural practices may reduce the insect food base for red-eyed vireos.

Current Distribution

The North American breeding range of the red-eyed vireo extends from British Columbia to Nova Scotia, north through parts of the Northwest Territories, and throughout most of the lower United States (Figure 25). They migrate to the tropics for the winter.

The patchy distribution in Washington for this species correlates with the distribution of large black cottonwood (*Populus trichocarpa*) groves, which are usually limited to riparian areas. The red-eyed vireo is one of the most abundant species in the northeastern United States, but is much less common in Washington because of limited habitat. Red-eyed vireo breeding and summer distribution is illustrated in Figure 26 and Figure 27.

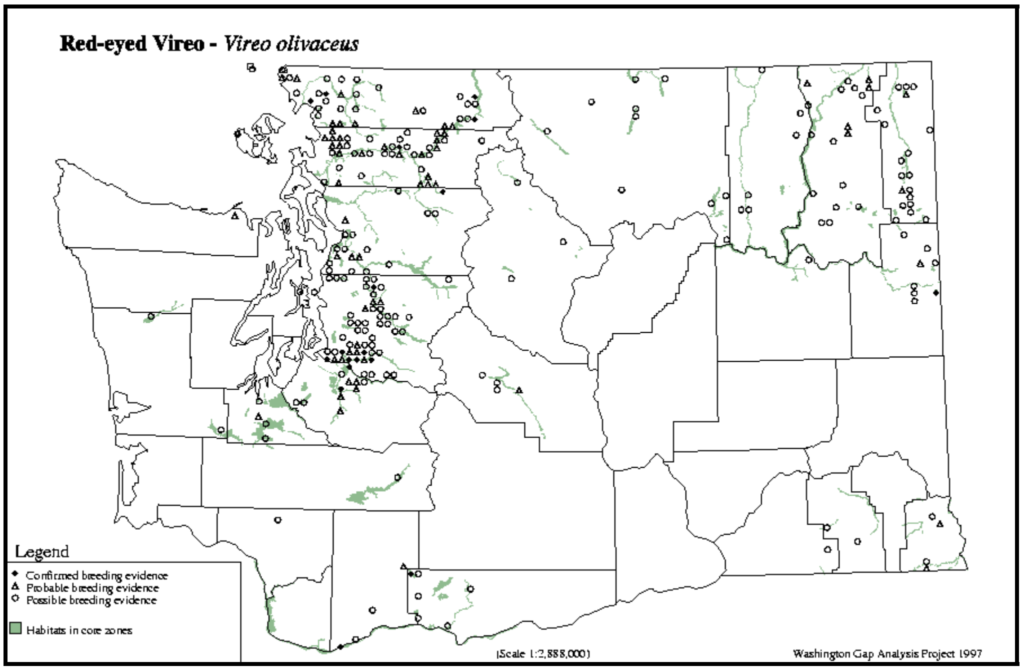

Figure 25. Breeding bird atlas data (1987-1995) and species distribution for red-eyed vireo (Washington GAP Analysis Project 1997).

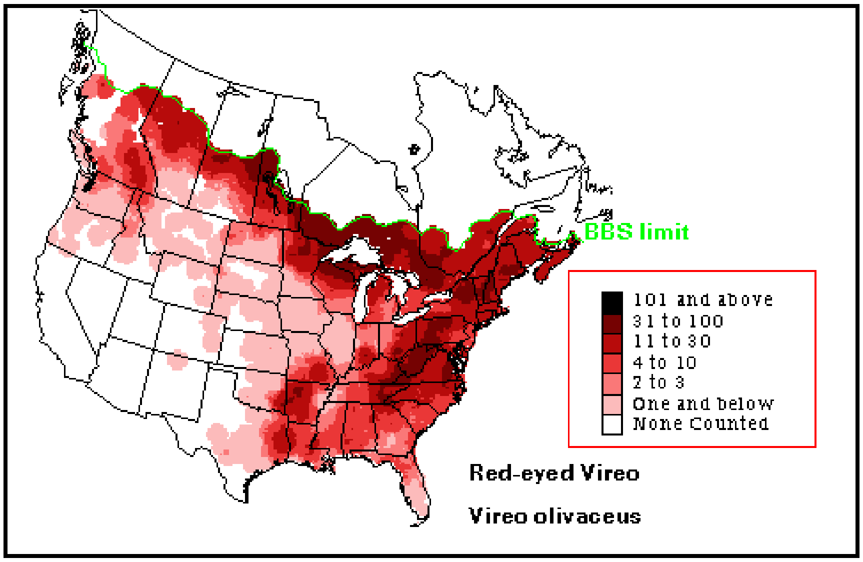

Figure 26. Red-eyed vireo breeding distribution (Sauer et al. 2003).

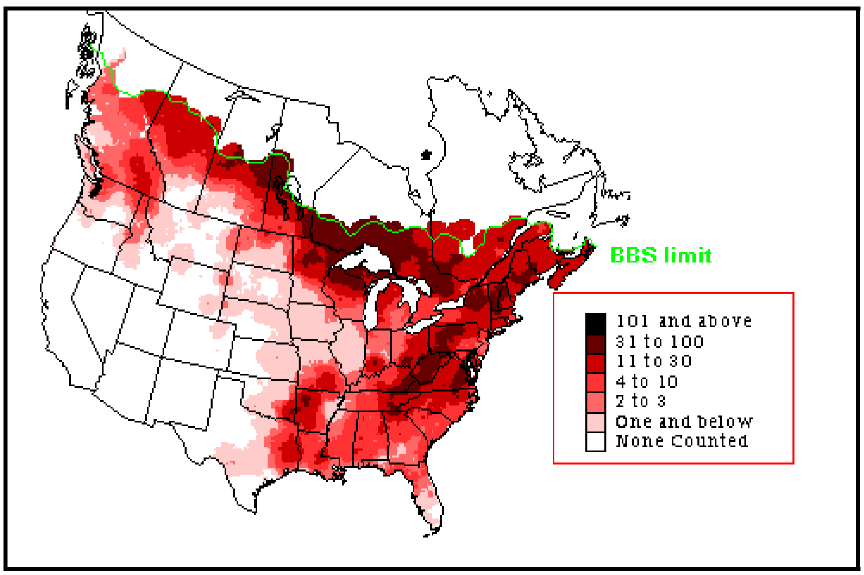

Figure 27. Red-eyed vireo summer distribution (Sauer et al. 2003).

Population Trend Status

The red-eyed vireo is secure, particularly in the eastern United States. Within the state of Washington, the red-eyed vireo is locally common, more widespread in northeastern and southeastern Washington and not a conservation concern (Altman 1999).

Red-eyed vireos are currently protected throughout their breeding range by the Migratory Bird Treaty Act (1918) in the United States, the Migratory Bird Convention Act (1916) in Canada, and the Convention for the Protection of Migratory Birds and Game Mammals (1936) in Mexico.

In Washington, BBS data show a significant population increase of 4.9% per year from 1982 to 1991 (Peterjohn 1991) (Figure 55). However, long-term, this has been a population decline in Washington of 2.6% per year, although the change is not statistically significant largely because of scanty data (Sauer et al. 2003). Because the BBS dates back only about 30 years, population declines in Washington resulting from habitat loss dating prior to the survey would not be accounted for by that effort.

3.16.6 Yellow-breasted Chat

General Habitat Requirements

Yellow-breasted chats are found in second growth, shrubby old pastures, thickets, bushy areas, scrub, woodland undergrowth, and fence rows, including low wet places near streams, pond edges, or swamps; thickets with few tall trees; early successional stages of forest regeneration; commonly in sites close to human habitation. In winter, establishes territories in young second-growth forest and scrub (Dennis 1958, Thompson and Nolan 1973, Morse 1989).

Limiting Factors

Threats include habitat loss because of successional changes and clearing of land for agricultural or residential development. Frequently parasitized by the brown-headed cowbird (*Molothrus ater*), but whether this has a significant impact on reproductive success is not well known.

Current Distribution

Yellow-breasted chat breeding range includes southern British Columbia across southern Canada and the northern US to southern Ontario and central New York, south to southern Baja California, to Sinaloa on Pacific slope, to Zacatecas in interior over plateau, to southern Tamaulipas on Atlantic slope, and to Gulf Coast and northern Florida (AOU 1998).

Yellow-breasted chat non-breeding range includes southern Baja California, southern Sinaloa, southern Texas, southern Louisiana, and southern Florida south (rarely north to Oregon, Great Lakes, New York, and New England) to western Panama (AOU 1998).

Population Trend Status

North American Breeding Bird Survey (BBS) data indicate a significant population decline in eastern North America, 1966-1988; a significant increase in western North America, 1978-1988 (Sauer and Droege 1992); in North America overall from 1966-1989; there was a nonsignificant decline averaging 0.8% per year from 1966-1989 (Droege and Sauer 1990); a nonsignificant 9% decline from 1966 to 1993, and a barely significant increase of 8% from 1984 to 1993 (Price et al. 1995).

Yellow-breasted chats may have declined in south central and southeastern New York between the early 1900s and mid-1980s (Eaton, in Andrle and Carroll 1988). Numbers have steadily declined in some areas of Ohio, though the range has not changed much since the 1930s (Peterjohn and Rice 1991).

Yellow-breasted chat has declined in Indiana and Illinois since the mid-1960s. Yellow-breasted chat has declined along the lower Colorado River with loss of native habitat (Hunter et al. 1988).

In Canada, they are thought to be slowly declining because of habitat destruction in B.C. Populations in Alberta and Saskatchewan appear to be stable; population has declined at Point Pelee National Park in Ontario, which contains a considerable proportion of the province's small population; the species no longer breeds at Rondeau Provincial Park (Ontario), although the population on Pelee Island (Ontario) appears to be stable (Cadman and Page 1994).

Washington trends are illustrated in. Yellow-breasted chat breeding season abundance (from BBS data) is illustrated in .

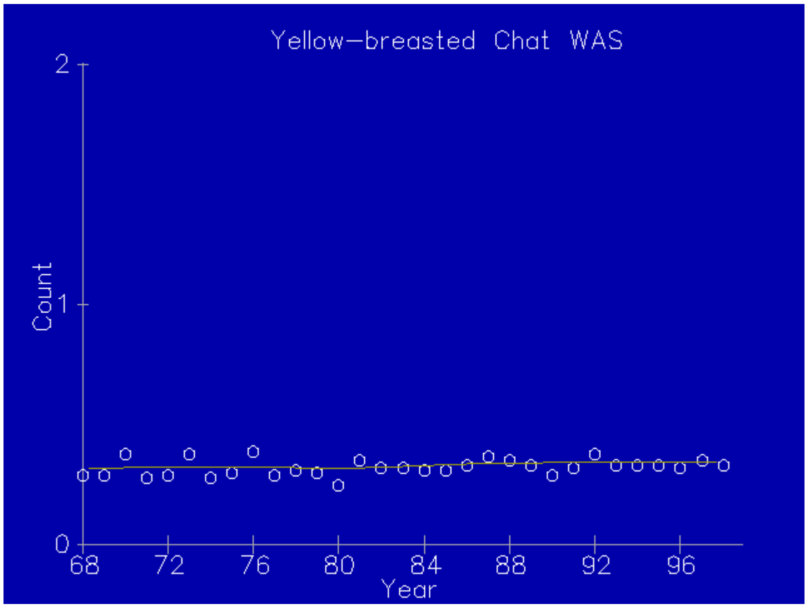

Figure 28. Population trends for Yellow-breasted chat in Washington

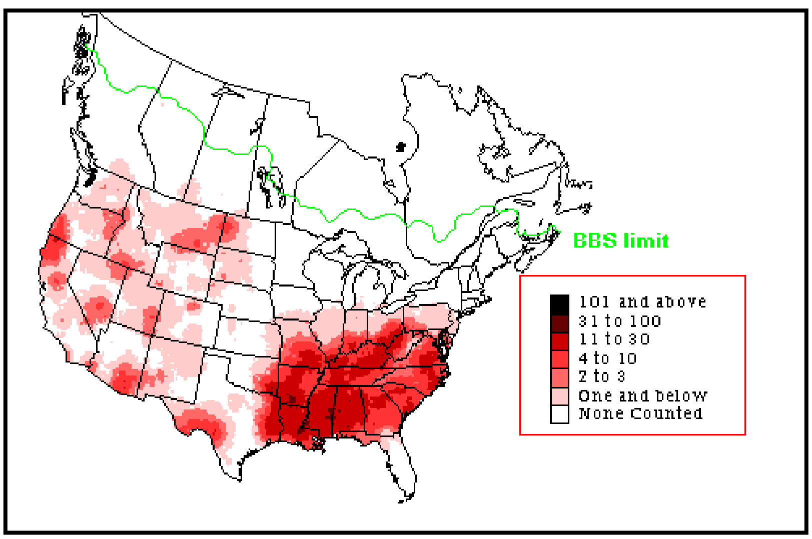

Figure 29. Yellow-breasted chat breeding abundance

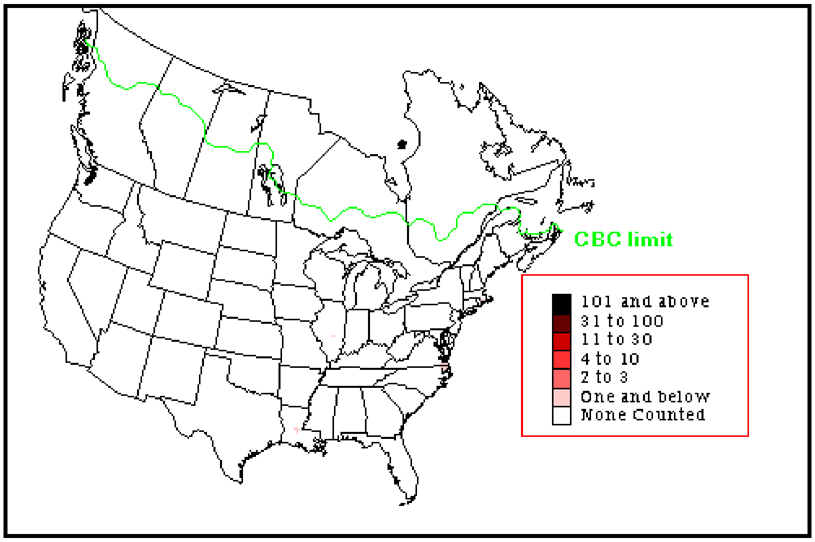

Figure 30. CBC data on winter season abundance of Yellow-breasted chat.

3.16.7 American Beaver

General Habitat Requirements

Suitable beaver habitat in all wetland cover types (e.g., herbaceous wetland, riparian wetland, and deciduous forested wetland) must have a permanent source of surface water with little or no fluctuation (Slough and Sadleir 1977). Lakes and reservoirs that have extreme annual or seasonal fluctuations in the water level will be unsuitable habitat for beaver. Similarly, intermittent streams, or streams that have major fluctuations in discharge (e.g., high spring runoff) or a stream channel gradient of 15% or more will have little year-round value as beaver habitat. Assuming that there is an adequate food source available, small lakes less than 20 acres in surface area are assumed to provide suitable habitat. Large lakes and reservoirs greater than 20 acres in surface area must have irregular shorelines (e.g., bays, coves, and inlets) in order to provide optimum habitat for beaver.

Beavers are generalized herbivores and appear to prefer herbaceous vegetation such as duck potato (*Sagittaria* spp.), duckweed (*Lemna spp*.), pondweed (*Potamogeton* spp.), and water weed (*Elodea* spp.) to woody vegetation during all seasons of the year, if it is available (Jenkins 1981). The leaves, twigs, and bark of woody plants are eaten, and many species of aquatic and terrestrial herbaceous vegetation.

Beaver show strong preferences for particular woody plant species and size classes (Jenkins 1975; Collins 1976a; Jenkins 1979). Denney (1952) reported that beavers preferred, in order of preference, aspen, willow, cottonwood, and alder. Woody stems cut by beavers are usually less than 3 to 4 inches DBH (Bradt 1947; Hodgdon and Hunt 1953; Longley and Moyle 1963; Nixon and Ely 1969). Jenkins (1980) reported a decrease in mean stem size cut and greater selectivity for size and species with increasing distance from the water's edge. Food preferences may vary seasonally, or from year to year, as a result of variation in the nutritional value of food sources (Jenkins 1979). Specific habitat attributes are shown in Table 29.

Table 29. Habitat attributes of beaver.

Focal Species	Focal Habitat Type	Key Habitat Relationships		Comments	Life Requisite	Selection Rationale
		Conservation Focus	Habitat Attribute (Vegetative Structure)			
Sage thrasher	Shrub-steppe	sagebrush height	sagebrush cover 5-20%	not area-sensitive (needs > 40 ac); not impacted by cowbirds; high moisture sites w/ tall shrubs	Food, Reproduction	The sage thrasher is a shrubsteppe obligate species and an indicator of healthy, tall sagebrush dominated shrubsteppe habitat.
			sagebrush height > 80 cm		Food, Reproduction	
			herbaceous cover 5-20%		Food, Reproduction	
			other shrub cover > 10%		Food, Reproduction	
			non-native herbaceous cover < 10%		Food, Reproduction	
Brewer's sparrow	Shrubsteppe	sagebrush cover	sagebrush cover 10-30%		Food, Reproduction	The Brewer's sparrow is a shrubsteppe obligate species and is an indicator of healthy sagebrush dominated shrubsteppe habitat.
			sagebrush height > 60 cm		Food, Reproduction	
			herbaceous cover > 10%		Food, Reproduction	

Focal Species	Focal Habitat Type	Key Habitat Relationships		Comments	Life Requisite	Selection Rationale
		Conservation Focus	Habitat Attribute (Vegetative Structure)			
			open ground > 20%		Food, Reproduction	
			non-native herbaceous cover < 10%		Food, Reproduction	
Grasshop per sparrow	Shrubsteppe	Native steppe/ grasslands	native bunchgrass cover > 15% and comprising > 60% of the total grass cover		Food, Reproduction	The grasshopper sparrow is an indicator of healthy steppe habitat dominated by native bunch grasses.
Sharp-tailed grouse	Shrubsteppe	Deciduous trees and shrubs	mean VOR > 6"		Reproduction	Sharp-tailed grouse is a management priority species and an indicator of healthy steppe/shrubsteppe habitat w/ healthy imbedded mesic draws.
			> 40% grass cover		Reproduction	
			> 30% forb cover		Reproduction	
			< 5% cover introduced herbaceous cover		Reproduction	
			> 50% optimum area providing nest/brood cover		Reproduction	
			> 0.25 km between nest/brood rearing habitat and winter habitat		Reproduction	
			> 75% cover deciduous shrubs and trees		Winter	

Focal Species	Focal Habitat Type	Key Habitat Relationships		Comments	Life Requisite	Selection Rationale
		Conservation Focus	Habitat Attribute (Vegetative Structure)			
			> 10% optimum area providing winter habitat		Winter	
Sage grouse	Shrubsteppe	diverse herbaceous understory, sagebrush cover	sagebrush cover 10-30%	area sensitive; needs large blocks	Reproduction	shrubsteppe obligate; State threatened, Federal Candidate species
			forb cover > 10%		Food	
			open ground cover > 10%			
			non-native herbaceous cover < 10%			
Pygmy rabbit	Shrubsteppe	deep, rock-free soil	sagebrush cover 21-36%	area sensitive, needs large blocks	Reproduction	Shrubsteppe obligate; Federal, State endangered species
			shrub height 32”			
Mule deer	Shrubsteppe	antelope bitterbrush	30-60% canopy cover of preferred shrubs < 5 ft.		Food	The mule deer is a management priority species and an indicator of healthy diverse shrub layer in east-slope shrubsteppe habitat.
			number of preferred shrub species > 3			
			mean height of shrubs > 3 ft.			
			30-70% canopy cover of all shrubs < 5 ft.			
Willow	Eastside (Interior)	shrub density	dense patches of native vegetation in the	> 20 ac; frequent cowbird host; sites	Reproduction	Indicator of healthy, diverse

Focal Species	Focal Habitat Type	Key Habitat Relationships		Comments	Life Requisite	Selection Rationale
		Conservation Focus	Habitat Attribute (Vegetative Structure)			
flycatcher	Riparian Wetlands		shrub layer > 35 ft.^{2} in size and interspersed with openings of herbaceous vegetation	> 0.6 mi from urban/residential areas and > 3 mi from high-use cowbird areas		riparian wetland habitat
			shrub layer cover 40-80%		Reproduction	
			shrub layer height > 3 ft. high		Reproduction	
			tree cover < 30%		Reproduction	
Lewis' woodpeck er	Eastside (Interior) Riparian Wetlands	large cottonwood trees/snags	> 0.8 trees/ac > 21" dbh	Dependent on insect food supply; competition from starlings detrimental	Food	Indicator of healthy cottonwood stands with snags
			canopy cover 10-40%			
			shrub cover 30-80-%			
Red-eyed vireo	Eastside (Interior) Riparian Wetlands	canopy foliage and structure	canopy closure > 60%		Food, Reproduction	The red-eyed vireo is an obligate species in riverine cottonwood gallery forests and an indicator of healthy canopy cover.
			riparian zone of mature deciduous trees > 160 ft.		Food, Reproduction	
			> 10% of the shrub layer should be young cottonwoods		Food, Reproduction	

Focal Species	Focal Habitat Type	Key Habitat Relationships		Comments	Life Requisite	Selection Rationale
		Conservation Focus	Habitat Attribute (Vegetative Structure)			
Yellow-breasted chat	Eastside (Interior) Riparian Wetlands	dense shrub layer	shrub layer 1-4 m tall	vulnerable to cowbird parasitism; grazing reduces understory structure	Food, Reproduction	The yellow-breasted chat is an indicator of healthy shrub dominated riparian habitat and is a management priority species in the Canadian Okanogan.
			30-80% shrub cover		Food, Reproduction	
			scattered herbaceous openings		Food, Reproduction	
			tree cover < 20%		Food, Reproduction	
Beaver	Eastside (Interior) Riparian Wetlands	canopy closure	40-60% tree/shrub canopy closure		Food	The beaver is an indicator of healthy regenerating aspen stands and an important habitat manipulator.
			trees < 6" dbh; shrub height ≥ 6.6 ft.			
		permanent water	stream channel gradient ≤ 6% with little to no fluctuation		Water (cover for food and reproductive requirements)	
		shoreline development	woody vegetation ≤ 328 ft. from water		Food	
Red-winged blackbird	Herbaceous Wetlands	Open water with emergent wetlands				Wetland obligate species
Pygmy	Ponderosa Pine	large trees	> 10/ac > 21" dbh with	large snags for	Food,	The pygmy nuthatch is a

Focal Species	Focal Habitat Type	Key Habitat Relationships		Comments	Life Requisite	Selection Rationale
		Conservation Focus	Habitat Attribute (Vegetative Structure)			
nuthatch			> 2 trees > 31" dbh	nesting; large trees for foraging	Reproduction	species of management concern and is an obligate for healthy old-growth Ponderosa pine forest with an abundant snag component.
			> 1.4 snags/ac > 8" dbh with > 50% > 25"			
Gray flycatcher	Ponderosa Pine	shrubsteppe/ pine interface; pine savannah w/ shrub-bunchgrass understory	Nest tree diameter 18" dbh		Reproduction	The gray flycatcher is an indicator of healthy fire-maintained regenerating ponderosa pine forest.
			Tree height 52'		Food	
White-headed woodpecker	Ponderosa Pine	large patches of old growth forest with large trees and snags	> 10 trees/ac > 21" dbh w/ > 2 trees > 31" dbh	large high-cut stumps; patch size smaller for old-growth forest; need > 350 ac or > 700 ac	Reproduction	The white-headed woodpecker is a species of management concern and it is an obligate species for large patches of healthy old-growth Ponderosa pine forest.
Flammulated owl	Ponderosa Pine	interspersion; grassy openings and dense thickets	> 10 snags / 40 ha > 30 cm dbh and 1.8m tall	thicket patches for roosting; grassy openings for foraging	Food	The flammulated is an indicator of a healthy landscape mosaic in Ponderosa pine and Ponderosa pine/Douglas-fir forest and it is a Washington State priority species.

Limiting Factors

Beavers readily adapt to living in urban areas near humans and are limited primarily by the availability of permanent water with limited fluctuations and accessibility of food.

Riparian habitat along many waterways has been removed in order to plant agricultural crops, thus removing important habitat and food sources for beaver.

Beavers create dams that restrict fish passage, and are removed in order to restore fish passage.

Current Distribution

The beaver is found throughout most of North America except in the Arctic tundra, peninsular Florida, and the Southwestern deserts (**Figure 31**) (Allen 1983; VanGelden 1982; Zeveloff 1988).

Figure 31. Distribution of beaver.

3.16.8 Pygmy Nuthatch

General Habitat Requirements

Among all breeding birds within ponderosa pine forests, the density of pygmy nuthatches is most strongly correlated with the abundance of ponderosa pine trees (Balda 1969). In Colorado 93% of breeding bird atlas observations occurred in coniferous forests, 70 % of those in ponderosa pines. Indeed the distribution of pygmy nuthatches in Colorado coincides with that of ponderosa pine woodlands in the state (Jones 1998).

Several studies identify the pygmy nuthatch as the most abundant or one of the most abundant species in ponderosa forests (e.g., Mt. Charleston, Nevada, Arizona's mountains and plateaus, New Mexico, Colorado statewide, and Baja California) (Reassumes 1941; Brandt 1951; Norris 1958; Stallcup 1968; Balda 1969; Farris 1985; Travis 1992; Kingery 1998) and in other yellow long-needled pines such as those of coastal California and Popocatépetl, Mexico (Norris 1958, Paynter 1962).

In California's mountains, it favors open park-like forests of ponderosa and Jeffrey pines in the Sierra Nevada Mountains (Gaines 1988) but also ranges to 3,050 m in open stands of large lodgepole pine in the White Mountains of California (Shuford and Metropulos 1996). In the Mogollon Rim region of central Arizona, it breeds and feeds in vast expanses of ponderosa pine that extend throughout the Colorado plateau, and, is also common in shallow snow-melt ravines that course through the pine forests. These snowmelt drainages contain white fir (*Abies concolor*), Douglas-fir, Arizona white pine (*Pinus strobiformis*), quaking aspen (*Populus tremuloides*), and an understory of maples (*Acer* sp.) (Kingery and Ghalambor 2001).

In New Mexico, it is most common in ponderosa pine, including ponderosa/oak and ponderosa/Douglas-fir forests (Kingery and Ghalambor 2001). In Washington, it uses Douglas-fir zones rarely, and then only those in or near ponderosa pines (Smith et al. 1997). In Summit County, Colorado, a small group of pygmy nuthatches occupy a small section of lodgepole pine at the edge of an extensive lodgepole forest (Kingery and Ghalambor 2001).

In coastal California (Sonoma, Marin, Monterey, San Luis Obispo Counties) pygmy nuthatches occur in the "coastal fog belt" (Burridge 1995) in Bishop pine (*Pinus muricata*), Coulter pine (*Pinus coulteri*), natural and planted groves of Monterey pine (*Pinus radiata*) (Roberson 1993, Shuford 1993), other pine plantations (Burridge 1995), and wherever ponderosa pines grow (e.g., Santa Lucia Mountains, Monterey County) (Roberson 1993).

In Mexico, where it occurs in arid pine forests of the highlands, it follows pines to their upper limits at tree line on Mount Popocatépetl (Paynter 1962) and Pico Orizaba (Cox 1895). Almost no other contemporary information is available on the habitat preferences of pygmy nuthatches in Mexican mountain ranges (S. Howell, J. Nocedal, A. Sada, pers. comm.). It is known to favor pine and pine-oak woodlands; these pine species include ponderosa-type pines: *Pinus engelmanii, P. arizonica, P. montezumae* and non-ponderosa-types *Pinus teocote, P. hartwegii, P. leiophylla*, and *P. cooperi*. Associated Mexican tree species in Pygmy nuthatch habitat include oaks (*Quercus rugosa, Q. castanea, Q. durifolia*, and Q. *hartwegii*), madrones (*Arbutus xalapensis* and *A. glandulosa*), and alders (*Alnus firmifolia*; Nocedal 1984, 1994, A. Sada, pers. comm.). It also occurs, in small numbers, in fir (*Abies religiosa*) forests (Nocedal 1984, 1994).

Limiting Factors

There is good evidence for at least two main limiting factors in pygmy nuthatch populations: 1) the availability of snags for nesting and roosting, and 2) sufficient numbers of large cone-producing trees for food.

Pygmy nuthatches are dependent on snags for nesting and roosting, and reduced snag availability has been shown to have negative effects on populations. Because pygmy nuthatches nest and roost in excavated tree cavities, the importance of snags is manifested during both the breeding and non-breeding season. During the breeding season, numerous studies have documented a decline in the number of breeding pairs and a reduction in population density on sites where timber harvesting reduced the number of available snags. During the non-breeding season, studies show that timber harvests that remove the majority of snags, cause communally roosting groups to use atypical cavities with poorer thermal properties.

Pygmy nuthatches choosing roost sites during the non-breeding season use a different set of characteristics compared to nest sites. A considerable reduction in snag densities may affect overwinter survivorship and possibly reproduction by forcing pygmy nuthatches to use cavities in snags they would normally avoid (Hay and Güntert 1983; Matthysen 1998). More research on the differences among snags is clearly needed in order to distinguish those factors that make some snags more desirable than others.

Pygmy nuthatch populations rely heavily on the availability of pine seeds and arthropods that live on pines. In comparison to other nuthatches and woodpeckers, pygmy nuthatches forage more amongst the foliage of live trees rather than on the bark. The preferred foraging habitat for pygmy nuthatches appears to contain a high canopy density, low canopy patchiness, and increased vertical vegetation density, a common feature of mature undisturbed forests.

Pygmy nuthatch populations are very sedentary. Young birds have been observed to only move 286.5 m from their natal territories. Such limited dispersal reduces the number of individuals that emigrate and immigrate from local populations, which in turn reduces gene flow and demographic stability. Thus, in contrast to the majority of North America's songbirds, movement and dispersal patterns in pygmy nuthatch populations are limited to a relatively small geographic area. Therefore, pygmy nuthatches may need a greater amount of connectivity between suitable habitats in comparison to other resident birds.

In a recent review of the effects of recreation on songbirds within ponderosa pine forests, Marzluff (1997) hypothesized that "nuthatches" would experience moderate decreases in population abundance and productivity in response to impacts associated with established campsites (although pygmy nuthatch was not specifically identified).

Impacts associated with camping that might negatively influence nuthatches include changes in vegetation, disturbance of breeding birds, and increases in the number of potential nest predators (Marzluff 1997). However, other recreational activities associated with resorts and recreational residences might moderately increase nuthatch population abundance and productivity (Marzluff 1997). This positive effect on nuthatch populations is likely to occur through food supplementation, such as bird feeders, that are frequently visited by pygmy nuthatches.

Current Distribution

The pygmy nuthatch is resident in ponderosa and similar pines from south central British Columbia and the mountains of the western United States to central Mexico. The patchy distribution of pines in western North America dictates the patchy distribution of the pygmy nuthatch throughout its range. The reliance on pines distinguishes pygmy nuthatches from other western nuthatches such as the red-breasted and white breasted, which are associated with fir/spruce and deciduous forests respectively (Ghalambor and Martin 1999). The following is a review of the distribution of populations in the United States, Canada, and Mexico (based on Kingery and Ghalambor 2001).

The pygmy nuthatch occurs in southern interior British Columbia, particularly in Okanagan and Similkameen valleys and adjacent plateaus (Campbell et al. 1997) south into the Okanagan Highlands and the northeast Cascades of Washington. It is scattered along the eastern slope of the Cascades from central Washington (Jewett et al. 1953; Smith et al. 1997) into Oregon and in the Blue Mountains in southwest Washington (Garfield County only) (Smith et al. 1997) but widespread in Oregon along the west slope of the Cascades (Gabrielson and Jewett 1940; Jewett et al. 1953; Gilligan et al. 1994). It ranges south from the Cascades in Oregon into northern California and south into the Sierra Nevadas and nearby mountains of Nevada (Brown 1978).

In the southern Sierra Nevadas it is found on the east and west side of the range in the Mono Craters and Glass Mountain region (Gaines 1988, Shuford and Metropulos 1996) and in the White Mountains of Nevada and California (Norris 1958; Brown 1978; Shuford and Metropulos 1996). It is also found throughout the mountain ranges of southern California, including the Sierra Madres in Santa Barbara County, the Mt. Pinos area (Kern and Ventura Counties), the San Gabriel and San Bernardino Mountains in Los Angeles and San Bernardino Counties (Norris 1958; B. Carlson, K. Garrett pers. comm.), the San Jacinto and Santa Rosa Mountains in Riverside County (Norris 1958; B. Carlson pers. comm.), and in the Laguna and Cuyamaca Mountains, and Mt. Palomar, Volcan and Hot Springs Mountains of San Diego County (San Diego County Breeding Bird Atlas preliminary data, B. Carlson, P. Unitt, pers. comm.). The range extends south into the Sierra Juarez and Sierra San Pedro Mártir Mountains in Baja California Norte, Mexico (Grinnell 1928; Norris 1958;).

In eastern Washington, the pygmy nuthatch is common in the pine forests of Spokane County (Jewett et al. 1953; Smith et al. 1997) and adjacent Kootenai County, Idaho (Burleigh 1972). Only scattered records exist for the rest of Idaho’s mountains (Burleigh 1972; Stephens and Sturts 1991) but pygmy nuthatches are well distributed in the Rocky Mountains of far western Montana (Montana Bird Distribution Committee 1996).

Population Trend Status

Survey-wide estimates of all BBS routes suggest pygmy nuthatch populations are stable (Sauer et al. 2000). However, these estimates are based on small samples that do not provide a reliable population trend nor reliable trends for any states or physiographic regions, because of too few routes, too few birds, or high variability (Sauer et al. 2000). The lack of reliable data is particularly the case in the Black Hills, where there are too few data to perform even the most basic trend analysis (Sauer et al. 2000).

Where long-term data are available for particular populations, natural fluctuations in population numbers have been documented. For example, a constant-effort nest-finding study in Arizona recorded a major population crash. On this site between 1991 and 1996 the number of nests found each year varied from 23-65 (mean = 50.2), whereas in the same site from 1997 to 1999, only 2-5 nests were found each year (Kingery and Ghalambor 2001). Likewise, Scott’s (1979) study also portrays a pygmy nuthatch population swing, but no clear factor has been identified as being responsible for rapid changes in population numbers. No definitive explanation currently exists for why some pygmy nuthatch populations may be prone to large fluctuations, but it is suspected that an intolerance to cold winter temperatures and/or a poor cone crop may play a role.

3.16.9 Gray Flycatcher

General Habitat Requirements

[Need information]

Limiting Factors

Gray flycatchers would be vulnerable to land clearing, but generally found in very arid environments that are not usually converted to agriculture (USDA Forest Service 1994). Clearing of pinyon-juniper for mining of coal and oil shale deposits or in favor of grassland for livestock grazing, or widespread harvesting of pinyon-juniper could be detrimental (O'Meara et al. 1981, cited in Sterling 1999).

Current Distribution

Gray flycatchers are found in extreme southern British Columbia (Cannings 1992) and south-central Idaho south to southern California, southern Nevada, central Arizona, south-central New Mexico, and locally western Texas (Terres 1980, AOU 1983).

Gray flycatchers during the non-breeding season occur in southern California, central Arizona, south to Baja California and south-central mainland of Mexico (Terres 1980).

Population Trend Status

North American Breeding Bird Survey (BBS) shows a survey-wide significantly increasing trend of 10.2% average per year (n = 89), 1966-1996; a nonsignificant decline of -1.0 % average per year (n = 22), 1966-1979; and a significant increase from 1980 to 1996 of 10.0 % average per year (n = 84) (**Figure 32**). Data for Oregon reflect strong long-term increase of 7.9% average per year (n = 29), 1966-1996. Sample sizes too low for accurate trend estimates in other states (Sauer et al. 1997). Gray flycatcher breeding season abundance is illustrated in

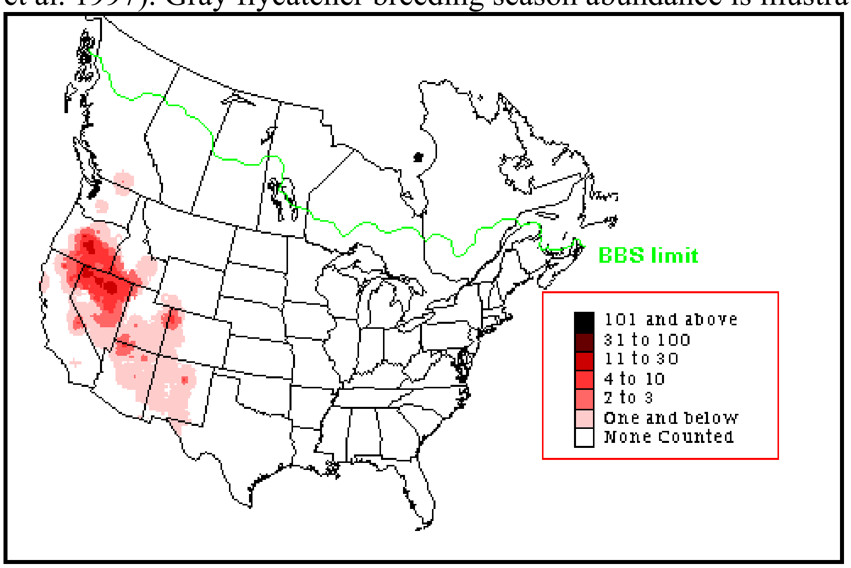

Figure 33.

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Figure 32. Gray flycatcher population trend data (from BBS data) (Sauer et al. 1997).

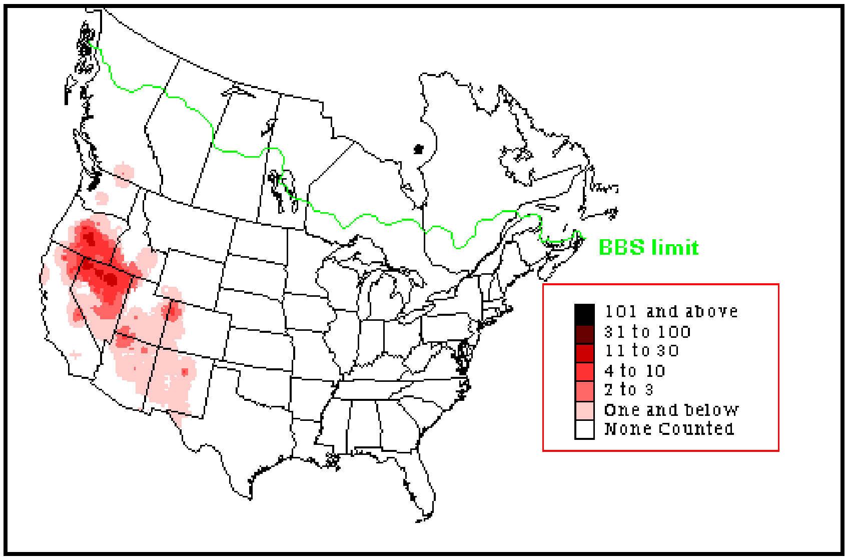

Figure 33. Gray flycatcher breeding season abundance (from BBS) (Sauer et al. 1997).

Christmas Bird Count (CB.C.) data for 1959 to 1988 show a significant survey wide increase of 4.3% average per year, and a significant increase in Arizona (4.6% average per year, n = 28). Trend for California apparently stable over the period (nonsignificant increase of 0.2% average per year, n = 21; Sauer et al. 1996).

Reportedly declining as a wintering bird in southern California; extensions in Washington and California at western edges of breeding range noted in the 1970s (USDA Forest Service 1994).

3.16.10 White-headed woodpecker

General Habitat Requirements

White-headed woodpeckers prefer a conifer forest with a relatively open canopy (50–70 % cover) and an availability of snags (a partially collapsed, dead tree) and stumps for nesting. The birds prefer to build nests in trees with large diameters with preference increasing with diameter. The understory vegetation is usually very sparse within the preferred habitat and local populations are abundant in burned or cut forest where residual large diameter live and dead trees are present. In general, open ponderosa pine stands with canopy closures between 30-50 % are preferred. The openness, however, is not as important as the presence of mature or veteran cone producing pines within a stand (Milne and Hejl 1989).

Highest abundances of white-headed woodpeckers occur in old-growth stands, particularly ones with a mix of two or more pine species. They are uncommon or absent in monospecific Ponderosa pine forests and stands dominated by small-coned or closed-cone conifers (e.g., lodgepole pine or knobcone pine).

Limiting Factors

Logging has removed much of the old growth cone producing pines throughout this species' range, which provide winter food and large snags for nesting. The impact from the decrease in old growth cone producing pines is even more significant in areas where no alternate pine species exist for the white-headed woodpecker to utilize.

Fire suppression has altered the stand structure in many of the forests. Lack of fire has allowed dense stands of immature ponderosa pine and the more shade tolerant Douglas-fir to establish. This has led to increased fuel loads resulting in more severe stand replacing fires where both the mature cone producing trees and the large suitable snags are destroyed. These dense stands of immature trees has also led to increased competition for nutrients and a slow change from a ponderosa pine climax forest to a Douglas-fir dominated climax forest.

Predation does not appreciably affect the woodpecker population. Chipmunks are known to prey on the eggs and nestlings of white-headed woodpeckers. There is also limited predation by the great horned owl on adult white-headed woodpeckers.

Current Distribution

White-headed woodpeckers live in montane, coniferous forests from southern British Columbia in Canada, to eastern Washington, southern California and Nevada and northern Idaho in the United States (**Figure 34**).

Population Trend Status

White-headed woodpecker abundance appears to decrease north of California. They are uncommon in Washington and Idaho and rare in British Columbia. However, they are still common in most of their original range in the Sierra Nevada and mountains of southern California.

This species is of moderate conservation importance because of its relatively small and patchy year-round range and its dependence on mature, montane coniferous forests in the West. Knowledge of this woodpecker's tolerance of forest fragmentation and silvicultural practices will be important in conserving future populations. Breeding Bird Survey population trend data are illustrated in **Figure 35**.

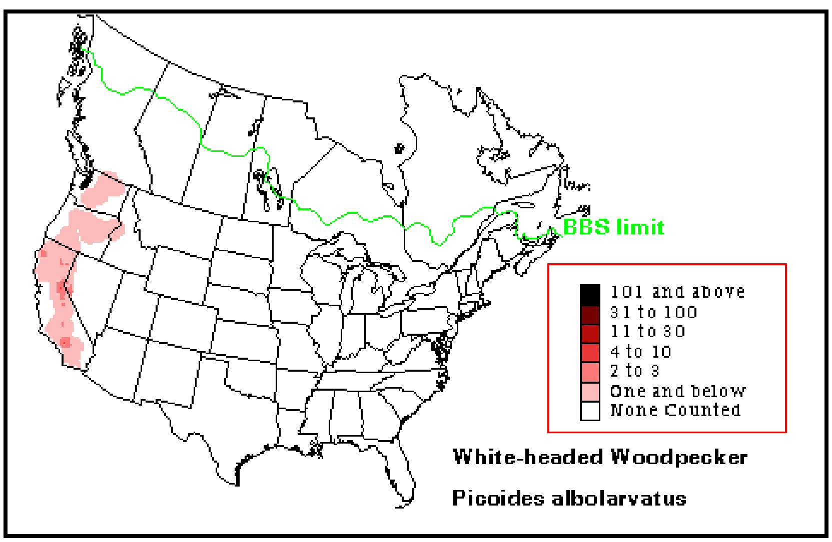

Figure 34. Current distribution/year-round range of white-headed woodpeckers (Sauer et al. 2003).

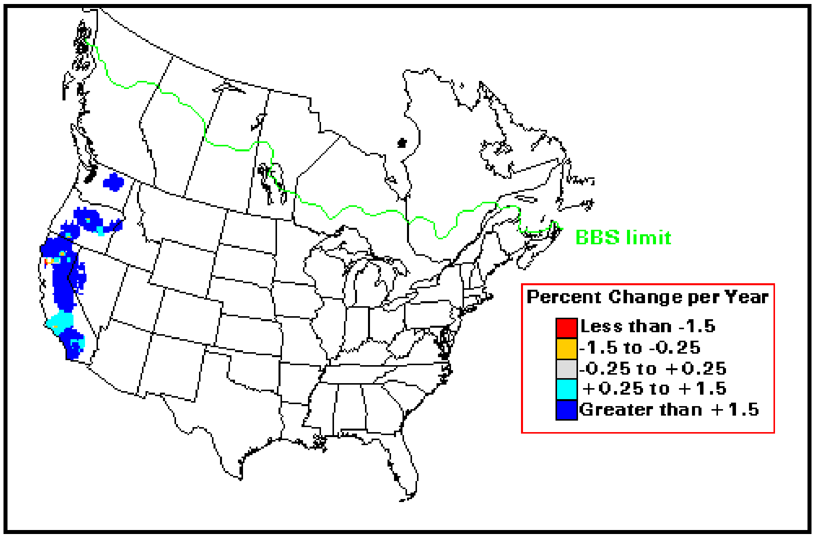

Figure 35. White-headed woodpecker BBS population trend: 1966-1996 (Sauer et al. 2003).

Structural Condition Associations

Structural conditions (IBIS 2003) associated with white-headed woodpeckers are summarized in (Table 30). White-headed woodpeckers feed and reproduce (F/R) in and are generally associated (A) with a multitude of structural conditions within the ponderosa pine habitat type. Similarly, white-headed woodpeckers are present (P), but not dependent upon sapling/pole successional forest. According to IBIS (2003) data, white-headed woodpeckers are not closely associated (C) with any specific ponderosa pine structural conditions.

Table 30. White-headed woodpecker structural conditions and association relationships (IBIS 2003)

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
White-headed Woodpecker	Ponderosa Pine	Giant Tree-Multi-Story	F/R-HE	A
		Grass/Forb-Closed	F/R-HE	A
		Grass/Forb-Open	F/R-HE	A
		Large Tree-Multi-Story-Closed	F/R-HE	A
		Large Tree-Multi-Story-Moderate	F/R-HE	A
		Large Tree-Multi-Story-Open	F/R-HE	A
		Large Tree-Single Story-Closed	F/R-HE	A
		Large Tree-Single Story-Moderate	F/R-HE	A
		Large Tree-Single Story-Open	F/R-HE	A
		Medium Tree-Multi-Story-Closed	F/R-HE	A
		Medium Tree-Multi-Story-Moderate	F/R-HE	A
		Medium Tree-Multi-Story-Open	F/R-HE	A
		Medium Tree-Single Story-Closed	F/R-HE	A

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
		Medium Tree-Single Story-Moderate	F/R-HE	A
		Medium Tree-Single Story-Open	F/R-HE	A
		Sapling/Pole-Closed	F/R-HE	P
		Sapling/Pole-Moderate	F/R-HE	P
		Sapling/Pole-Open	F/R-HE	P
		Shrub/Seedling-Closed	F/R-HE	A
		Shrub/Seedling-Open	F/R-HE	A
		Small Tree-Multi-Story-Closed	F/R-HE	A
		Small Tree-Multi-Story-Moderate	F/R-HE	A
		Small Tree-Multi-Story-Open	F/R-HE	A
		Small Tree-Single Story-Closed	F/R-HE	A
		Small Tree-Single Story-Moderate	F/R-HE	A
		Small Tree-Single Story-Open	F/R-HE	A

3.16.11 Flammulated Owl

General Habitat Requirements

The flammulated owl is a Washington State candidate species. Limited research on the flammulated owl indicates that its demography and life history, coupled with narrow habitat requirements, make it vulnerable to habitat changes. The flammulated owl occurs mostly in mid-level conifer forests that have a significant ponderosa pine component (McCallum 1994b) between elevations of 1,200 to 5,500 feet in the north, and up to 9,000 feet in the southern part of its range in California (Winter 1974).

Flammulated owls are typically found in mature to old, open canopy yellow pine (ponderosa pine and Jeffrey pine [*Pinus jeffreyi*]), Douglas-fir, and grand fir (Bull and Anderson 1978; Goggans 1986; Howie and Ritchie 1987; Reynolds and Linkhart 1992; Powers et al. 1996). It is a species dependent on large diameter ponderosa pine forests (Hillis et al. 2001) and is obligate secondary cavity nesters (McCallum 1994b), requiring large snags in which to roost and nest.

Flammulated owls nest in habitat types with low to intermediate canopy closure (Zeiner et al. 1990). The owls selectively nest in dead ponderosa pine snags, and prefer nest sites with fewer shrubs in front than behind the cavity entrance, possibly to avoid predation and obstacles to flight.

Limiting Factors

Logging disturbance and the loss of breeding habitat associated with it has a detrimental effect on the birds (USDA 1994a). The owls prefer late-seral forests. The main threat to the species is the loss of nesting cavities, as this species cannot create its own nest and relies on existing cavities. Management practices such as intensive forest management, forest stand improvement, and the felling of snags and injured or diseased trees (potential nest sites) for firewood effectively remove most of the cavities suitable for nesting (Reynolds et al. 1989). However, the owls will nest in selectively logged stands, as long as they contain residual trees (Reynolds et al. 1989).

Wildfire suppression has allowed many ponderosa pine stands to proceed to the more shade resistant fir forest types, which is less suitable habitat for these species (Marshall 1957; Reynolds et al. 1989).

Roads and fuelbreaks, often placed on ridgetops, result in removal of snags for safety considerations (hazard tree removal) and firewood can result in the loss of existing and recruitment nest trees.

Pesticides including aerial spraying of carbaryl insecticides to reduce populations of forest insect pests may affect the abundance of non-target insects important in the early spring diets of flammulated owls (Reynolds et al. 1989). Although flammulated owls rarely take rodents as prey, they could be at risk, like other raptors, of secondary poisoning by anticoagulant rodenticides. Possible harmful doses could cause hemorrhaging upon the ingestion of anticoagulants such as Difenacoum, Bromadiolone, or Brodifacoum (Mendenhall and Pank 1980).

Predators/competitors include spotted owl and other larger owls, accipiters, long-tailed weasels (Zeiner et al. 1990), felids and bears (McCallum 1994b). Nest predation has also been documented by northern flying squirrel in the Pacific Northwest (McCallum 1994a). Saw-whet owls, screech owls, and American kestrels compete for nesting sites, but flammulated owls probably have more severe competition with non-raptors, such as woodpeckers, other passerines, and squirrels for nest cavities (Zeiner et al. 1990, McCallum 1994b).

Birds from the size of bluebirds upward are potential competitors. Owl nests containing bluebird eggs and flicker eggs suggest that flammulated owls evict some potential nest competitors (McCallum 1994b). Any management plan that supports pileated woodpecker and northern flicker populations will help maintain high numbers of cavities, thereby minimizing this competition (Zeiner et al. 1990). Flammulated owls may compete with western screech-owls and American kestrels for prey (Zeiner et al. 1990) as both species have a high insect component in their diets. Common poorwills, nighthawks, and bats may also compete for nocturnal insect prey especially in the early breeding season (April and May) when the diet of the owls is dominated by moths. (McCallum 1994b).

Exotic species impact flammulated owl populations. Flicker cavities are often co-opted by European starlings, reducing the availability of nest cavities for both flickers and owls (McCallum 1994a). Africanized honeybees will nest in tree cavities (Merrill and Visscher 1995) and may be a competitor where natural cavities are limiting, particularly in southern California where the bee has expanded its range north of Mexico.

Current Distribution

Flammulated owl distribution is illustrated in **Figure 36**. Flammulated owls are uncommon breeders east of the Cascades in the ponderosa pine belt from late May to August. There have been occasional records from western Washington, but they are essentially an east side species. Locations where they may sometimes be found include Blewett Pass (straddling Chelan and Kittitas Counties), Colockum Pass area (Kittitas County), and Satus Pass (Klickitat County) (**Figure 37**).

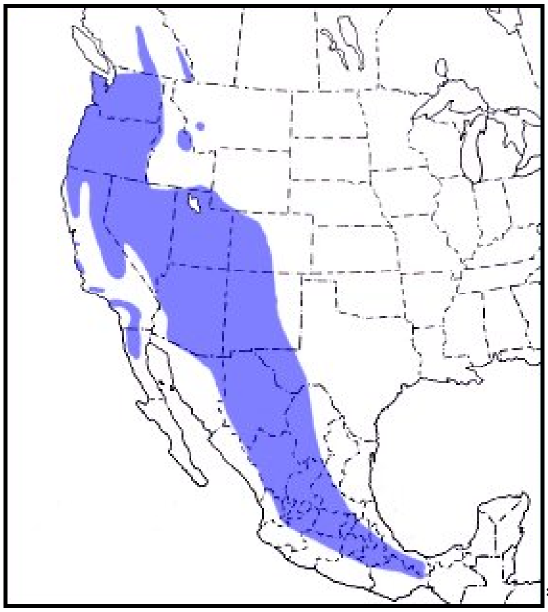
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Figure 36. Flammulated owl distribution, North America (Kaufman 1996).

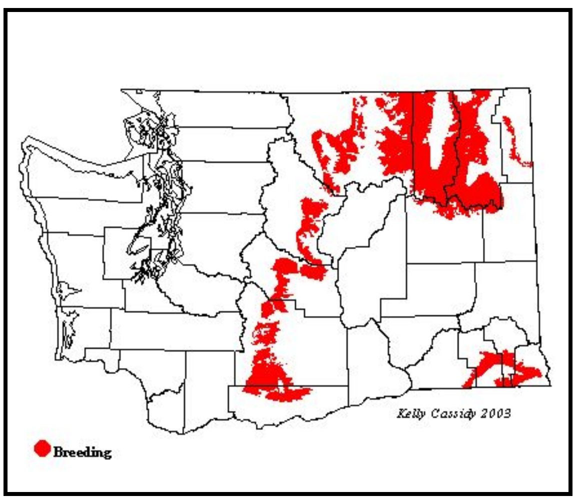

Figure 37. Flammulated owl distribution, Washington (Kaufman 1996).

Population Trend Status

Because old growth ponderosa pine is rarer in the northern Rocky Mountains than it was historically, and little is known about local flammulated owl distribution and habitat use, the USFS has listed the flammulated owl as a sensitive species in the Northern Region (USDA 1994b). It is also listed as a sensitive species by the USFS in the Rocky Mountain, Southwestern, and Intermountain Regions, and receives special management consideration in the States of Montana, Idaho, Oregon, and Washington (Verner 1994).

So little is known about flammulated owl populations that even large-scale changes in their abundance would probably go unnoticed (Winter 1974). Several studies have noted a decline in flammulated owl populations following timber harvesting (Marshall 1939; Howle and Ritcey 1987). However, more and more nest sightings occur each year, but this is most likely because of the increase in observation efforts.

Structural Condition Associations

Structural conditions (IBIS 2003) associated with flammulated owl are summarized in Table 31.

Table 31. Structural conditions associated with flammulated owls.

Common Name	Focal Habitat	Structural Condition (SC)	SC Activity	SC Assoc.
Flammulated Owl	Ponderosa Pine	Giant Tree-Multi-Story	F/R-HE	C
		Large Tree-Multi-Story-Closed	F/R-HE	C
		Large Tree-Multi-Story-Moderate	F/R-HE	C
		Large Tree-Multi-Story-Open	F/R-HE	A
		Large Tree-Single Story-Closed	F/R-HE	P
		Large Tree-Single Story-Moderate	F/R-HE	P
		Medium Tree-Multi-Story-Closed	F/R-HE	C
		Medium Tree-Multi-Story-Moderate	F/R-HE	C
		Medium Tree-Multi-Story-Open	F/R-HE	A
		Medium Tree-Single Story-Closed	F/R-HE	P
		Medium Tree-Single Story-Moderate	F/R-HE	P
		Small Tree-Multi-Story-Closed	F/R-HE	A
		Small Tree-Multi-Story-Moderate	F/R-HE	A
		Small Tree-Multi-Story-Open	F/R-HE	P

Flammulated owls feed and reproduce (F/R) in and are closely associated (C) with medium to large, multi-story, moderate to closed canopy ponderosa pine forest conditions. Similarly, flammulated owls are associated (A) with medium to large multi-story/open canopy forest and will utilize dense stands of small trees. In contrast, flammulated owls are present (P), but not dependent upon open canopy forest (IBIS 2003). Of the three ponderosa pine focal species, flammulated owls are the most structural dependent species.

3.17 Other Important Wildlife Species

3.17.1 Elk

Elk populations in Eastern Washington are strong and relatively stable due primarily to the large amount of elk winter range controlled by WDFW. Data compiled by Colville Tribes indicate that elk numbers appear to be declining reservation-wide while the population is becoming more distributed.

The Omak Creek drainage provides good elk habitat and hunter report records verify that elk are being harvested in that area. Colville Tribes collect information on herd size and structure, regulate tribal member hunting seasons, and utilize check stations. Elk are extremely important to the tribes for subsistence and ceremonial purposes.

3.17.2 Bighorn sheep

Prior to 1900, bighorn sheep roamed over much of the area, but by the turn of the century had all but disappeared. The last native bighorn sheep was killed near Loomis about 1915 (Pacific Northwest River Basins Commission, 1977). They were reintroduced to the basin starting in 1957. (WDFW 1995). Currently The WDFW is transplanting bighorn sheep to the basin.

There are isolated herds of bighorn sheep on both the North Half and on the reservation portion of the Okanogan Subbasin. The Colville Tribes does manage a tribal member bighorn sheep hunt with a drawing for one tag per year. Current information regarding total numbers and structure of the Omak Reserve herd is incomplete.

3.17.3 Small Mammals

Small mammals of particular interest to the Tribes in the Okanogan drainage area are the myotis and pallid bats, the western gray squirrel, and Merriam's shrew. Tribal management efforts extend to supporting and enhancing existing and potential habitat through reduced fragmentation of wildlife habitat necessary to provide for the life requisites of viable populations of terrestrial, avian, and aquatic species (Colville Tribes 1999).

The Tribes goal of increasing numbers of rabbits and small mammals to help support recovery of the lynx may in turn provide a prey diet base for coyote and cougar. This could help to lessen pressure on deer and elk populations.

3.17.4 Raptors

There are currently 21 known active bald eagle nesting territories on the Colville Tribes Reservation (Bald Eagle Survey 2000). Nesting activity appears to be expanding because of an increase in breeding adults produced in previous years and presence of abundant potential habitat. Nests are checked twice annually: once in April for occupancy and again in July for production (Annual Report 2000.) The Colville Tribes was an active participant in a five-year peregrine falcon reintroduction project, concluded in 1997 (Colville Tribes, 1998).

The hope is that the falcons have dispersed throughout the reservation. Additionally, golden eagle, goshawk, ferruginous hawk, merlin, prairie falcon, and flammulated owl, and other birds of prey, are currently or have been known to inhabit the Okanogan Subbasin area of the reservation.

The CRCT holds as a guideline the protection of raptor nest sites that are currently being used, and important roost trees and associated habitat in the area surrounding the nest trees (Colville Tribes, 1999). Status of all raptors is, other than bald eagles, is virtually unknown. Raptors are particularly important to the Tribes culturally and spiritually.

3.17.5 Upland and Game Birds

There are numerous upland birds and small game animals in the Okanogan Basin. Most of these species are dependent upon the riparian zone along rivers and creeks.

Upland game bird populations increased in the early years of dry-land farming, which provided winter feed for the birds and fence rows for cover. More recently, bird populations have been negatively impacted by changes in crops, farming methods, grazing, and abandonment of upland dry-land farms. (Pacific Northwest River Basins Commission 1977).

The Colville Tribes reservation supports many species of upland and other game birds. The Colville Tribes wildlife staff run annual grouse and dove counts, in cooperation with the USFWS. The Tribes provide an annual non-member game bird hunt. Dove numbers on the Okanogan route are down from the early 1990s and chukar numbers are depressed as well (Colville Tribes 2001). Doves are particularly important in a cultural aspect. Tribal members engage in turkey and grouse hunting and all game birds hold economic, subsistence and cultural value for the tribal membership. Status of birds, other than doves and chukar, is unknown.

3.17.6 Waterfowl

The 1997-98 midwinter waterfowl inventory was completed by WDFW and US Fish and Wildlife Service (USFWS). During the 1980s, ducks declined in the Pacific Flyway midwinter survey, from about 7,000,000 in the 1970s. Numbers increased from 5,473,691 in 1996-97 to 6,607,263 in 1997-98.

Principal waterfowl species of the Okanogan Basin include Canada goose, mallard, wood duck, common merganser, coot, teal, green winged teal, American widgeon, common goldeneye, Barrow's goldeneye, ruddy, ring necked duck, lesser scaup, and bufflehead. Less common species included northern pintail, shoveler, harlequin duck, redhead, canvasback, blue winged teal, cinnamon teal, gadwall, and whistling swan.

The Colville Tribes performs annual waterfowl surveys that have indicated that waterfowl numbers peaked on the Colville Tribes Reservation during the mid-80s, and though numbers are still low by comparison, they seem to be slowly increasing (Colville Tribes 2001) Waterfowl are also part of the non-member hunt, and are important, not only economically, but culturally as well.

3.17.7 Neotropical birds

Surveys for neotropical birds and their habitats have been done only in recent times on forested uplands. There is little or no existing data on which to base trends that might relate to watershed condition. Wild turkeys are being transplanted to the area to augment existing populations.

The Colville Tribes is planning to conduct surveys to assess neotropical bird populations and their habitat. There is presently little data available to determine the limiting factors on neotropical birds.

3.17.8 Reptiles and Amphibians

Very little is currently known of the herptile (reptile and amphibian) in the Okanogan subbasin area. Sagebrush lizard and western toad, both federally listed, have been documented in this area.

The Colville Tribes Wildlife department acknowledges the need to survey and does plan to collect that information and develop management objectives as resources allow.

3.17.9 Exotic wildlife species

Exotic wildlife species are considered a disturbance to indigenous populations and their habitats, but are not always considered a threat. Several species of exotic wildlife have thrived in the subbasin habitats. Little is known about their status. A listing of the species introduced into the Okanogan subbasin is provided in the Assessment section of this plan.

3.18 Environmental Conditions of the Okanogan Subbasin

Historic Reference Condition

Dramatic changes in wildlife habitat have occurred throughout the Subbasin since pre-European settlement (circa 1850). IBIS data limitations for describing historic and current habitat conditions at the subbasin level are described in section 1.1 (Ashley and Stovall, unpublished report, 2004). Due to the limitations and inaccuracies associated with the IBIS mapping, the IBIS historic vs. current characterizations of habitats is not used for subbasin level analyses. A course scale representation of current habitat types is presented in **Figure 38**.

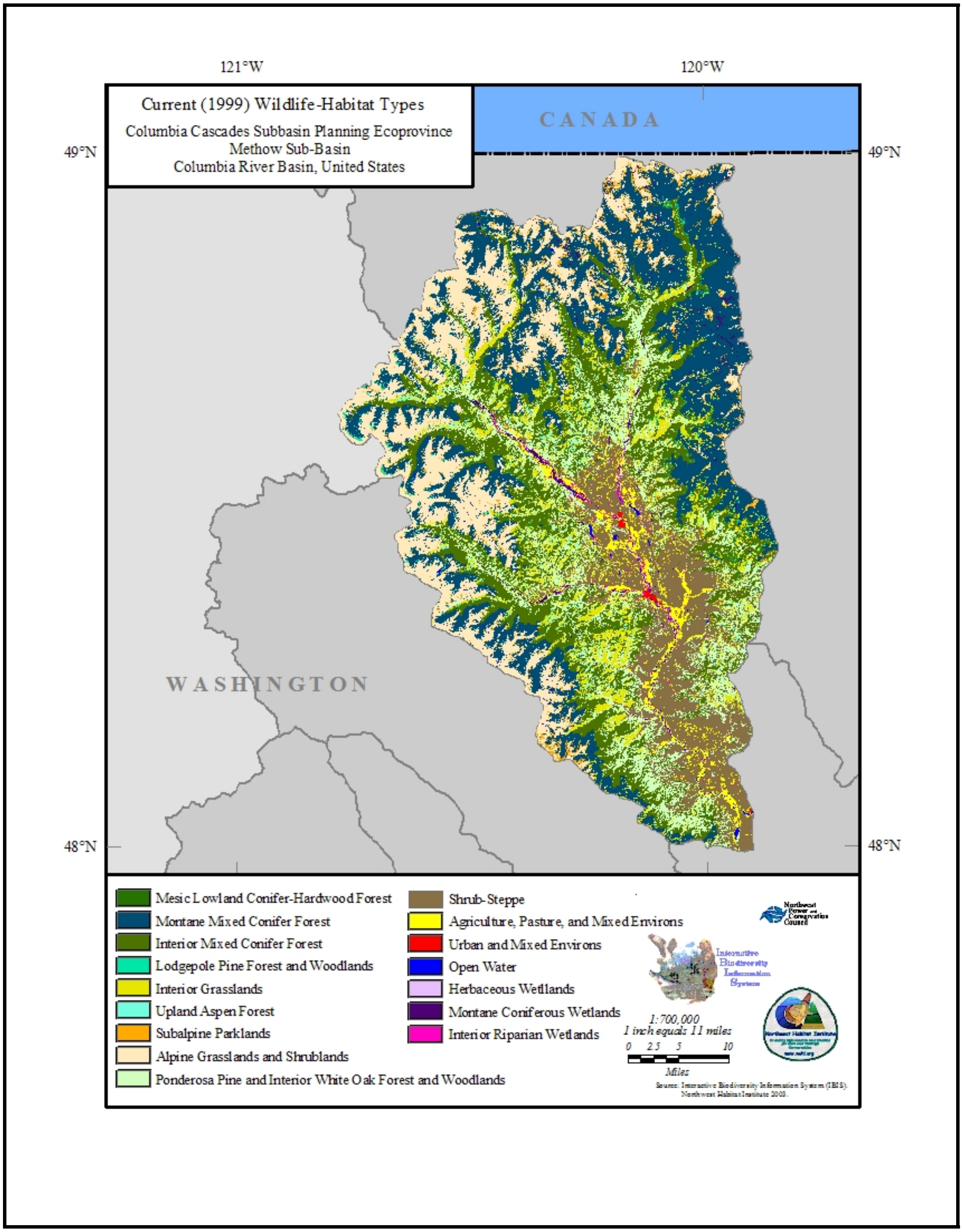

Figure 38. Current wildlife habitats in the Okanogan subbasin, Washington (IBIS 2003)

The most dramatic change in wildlife habitat type is in the loss of Ponderosa pine, riparian woodland, and steppe vegetation communities.

The most dramatic change in aquatic habitats is visible in the loss of channel sinuosity in the Okanagan mainstem in Canada, however the loss of shoreline vegetation throughout the subbasin is symptomatic of development.

Minimum flows associated with water withdrawal are considered by managers to have reduced both the magnitude and diversity of aquatic and wetland habitats in the Okanogan.

Agricultural land use has significantly changed the composition and structure of shrub and steppe vegetation communities from historic conditions. Livestock grazing tends to decrease perennial graminoids (i.e. steppe and/or grasslands and increase shrub density). In the Canadian portion of the subbasin, the Agricultural Land Reserve (ALR), a provincial zoning designation over areas of both private and public land, has slowed the conversion of agricultural lands to residential uses since its establishment in 1974. Most of the native grasses and forbs are poorly adapted to heavy grazing and trampling by livestock (Cassidy 1997).

True interior grassland habitat was not likely historically present in the subbasin and may be more appropriately described as central arid steppe.

The IBIS data also suggest that all wetland habitat types have increased over historic amounts. This in part may be because of the construction of tributary dams and the creation of reservoirs. However, accurate habitat type maps, especially those detailing the desired diversity of riparian and wetland habitats, are needed to improve assessment quality and support management strategies/actions.

Subbasin wildlife managers believe that significant physical and functional losses have occurred to these important wetland habitats from agricultural and residential development and livestock grazing.

Exotic wildlife

There are numerous introduced wildlife and plant species in the basin. Some of these were purposeful and others were incidental (migration from other areas). Many of these were introduced were introduced for recreational angling or hunting, others were associated with natural range extension from downstream or out of region introductions.

The practice of stocking exotic wildlife for hunting ended in 1983 (OWSAC, 2000). Declines in pheasant and chukar populations since may be a result of this policy change and changes in habitat and weather conditions provides a listing of wildlife species introduced into the Okanogan Subbasin (Table 32).

Table 32. Introduced wildlife species to the Okanogan subbasin

Species	When Introduced	Current Status/Remarks
California bighorn sheep	Native – reintroduced in 1957, 1970, and currently	Program to supplement native populations
Chukar	Unknown	Unknown
Hungarian partridge	Unknown	Unknown
Ring-necked pheasant	Unknown	Unknown
Turkey (Rio Grande subspecies)	1991 through 1995	Stable
California quail	Unknown	Unknown
Red fox	Unknown	Documented

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Exotic terrestrial plants/Noxious Weeds

Changes in biodiversity have been closely associated with changes in land use. Grazing, agriculture, and accidents have introduced a variety of exotic plants, many of which are vigorous enough to earn the title "noxious weed." Twenty-six species of noxious weeds occur in the Okanogan subbasin. These are listed in Table 33 along with their origin.

Table 33.Exotic terrestrial plant/noxious weed species in the Okanogan subbasin (Callihan and Miller 1994)

Common Name	Scientific Name	Origin
Babysbreath	*Gypsophila paniculata*	
Canadian thistle	*Cirsium arvense*	Eurasia
Cheat grass	*Bromus tectorum*	
Cocklebur	*Xanthium spionosum*	
Dalmatian toadflax	*Linaria dalmatica*	Mediterranean
Diffus knapweed	*Centaurea diffusa*	Eurasia
Hounds tongue	*Cunoglossum officinale*	
Japanese knotweed	*Polygonum cuspidatum*	
Kochia	*Kocha scoparia*	
Leafy spurge	*Euphorbia esula*	Eurasia
Longspine sandbur	*Cenchrus longispinus*	
Meadow hawkweed	*Hieracium caespitosum*	Europe
Mullein	*Verbascum thapsus*	
Musk thistle	*Carduus nutans*	Eurasia
Orange hawkweed	*Hieracium aurantiacum*	Europe
Oxeye daisy	*Leucanthemum vulgare*	
Perennial sowthistle	*Sonchus arvengis*	

Common Name	Scientific Name	Origin
Plumeless thistle	*Carduus acanthoides*	
Puncturevine	*Tribulus terrestris*	Europe
Purple loosestrife	*Lythrum salicaria*	Europe
Russian knapweed	*Centaurea repens*	Southern Russia and Asia
Russian thistle	*Salsola iberica sennen*	
Scotch cottonthistle	*Onopordum acanthium*	Europe
Scotchbroom	*Cytisus scoparius*	Europe
Spotted knapweed	*Centaurea Maculosa*	Europe
Spurge flax	*Thymelaea passerina*	
St. Johnswort	*Hypericum perforatum*	
Sulfur cinquefoil	*Potentilla recta*	
Tansy ragwort	*Senecio jacobaea*	Eurasia
Whitetop	*Cardaria draba*	Europe
Wild Four o'clock	*Mirabilis nyctaginea*	
Yellow star thistle	*Centaurea solstitialis*	Mediterranean and Asia
Yellow toadflax	*Linaria vulgaris*	Europe

Exotic fish and aquatic plants

Recent examination of the presence and impacts of exotic fish species introductions on indigenous aquatic environments in Okanagan mainstem lakes was undertaken in 2002 (H. Wright et al. 2002).

A detailed list of exotic fish species is found in Table 34. Some of these species are the target of sports anglers. They also provide a large biomass of fish in the basin. Inter-species competition and disease transfer are considered detrimental to indigenous fish populations, and particularly problematic to the long-term sustainability of salmonid populations.

Table 34. Exotic fish and aquatic plants first recorded in the Okanagan Subbasin, their method of entry and current distribution (adapted from H. Wright et al. 2002)

Species	Common Name	Earliest Year Stocked	Latest Year stocked	Numbers Stocked	Present limit of Range	Source
Coregonus clupeaformis	Lake Whitefish	1894	1929	Approx. 16,000,000	Throughout	www.bcfisheries.gov.bc.ca/fishinv/db and Vernon News, 1937
Oncorhynchus nerka	Kokanee	1928	1991	14,391,000	Throughout	www.bcfisheries.gov.bc.ca/fishinv/db
O. mykiss	Rainbow Trout or steelhead	1923	1979	10,185,000	Throughout	www.bcfisheries.gov.bc.ca/fishinv/db
O. nerka	Sockeye	1939	1958	4,700,000	South of McIntyre Dam	(Fryer 1995)
Salvelinus fontinalus	Brook Trout	1924	1990	617,000	Throughout	www.bcfisheries.gov.bc.ca/fishinv/db
Salvelinus	Lake Trout	1909	1978	136,000	Kalamalka Lake	www.bcfisheries.gov.b

namaycush					only	c.ca/fishinv/db
O. tshawytscha	Chinook	1928	1928	100,000	South of Vaseux Lake (occasional)	Penticton Herald, April 19, 1928
Micropteruus dolomieui	Smallmouth Bass	1985	1985	????	South of Penticton	(Shepherd 1999, per comm)
O. clarki	Cutthroat	1913	1931	33,000	Not thought to be present	www.bcfisheries.gov.bc.ca/fishinv/db

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3.19 Descriptions of Focal Wildlife Habitat Historic, Current, and Desired Future Condition

3.19.1 Ponderosa Pine

Historic

Historically in the Okanogan subbasin, old-growth ponderosa pine forests occupied large areas between the shrubsteppe zone and moister forest types at higher elevations.

Large, widely spaced, fire-resistant trees and an understory of forbs, grasses, and shrubs characterized these forests. Periodic fires maintained this habitat type. With the settlement of the subbasin, most of the old pines were harvested for timber, and frequent fires have been suppressed. As a result, much of the original forest has been replaced by dense second growth of Douglas fir and ponderosa pine with little understory.

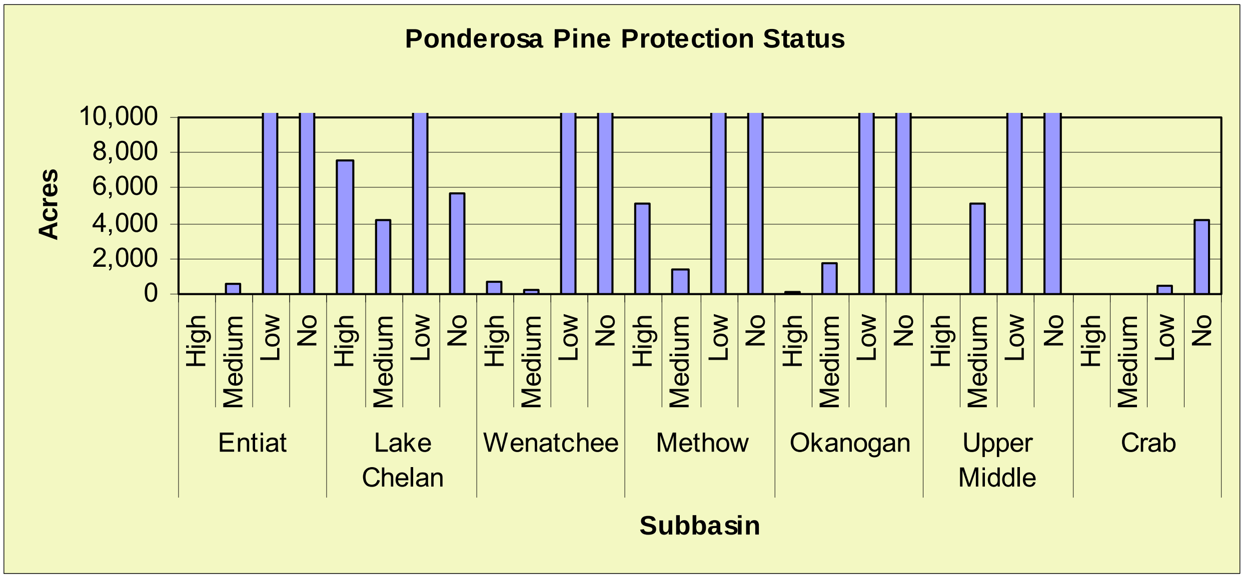
Current

The ponderosa pine zone is most narrowly defined as the zone in which ponderosa pine is virtually the only tree. Cassidy (1997) defined this zone more broadly to encompass most warm, open-canopy forests between the steppe vegetation zone and closed forest, thus it includes stands where other trees, particularly Douglas-fir, may be codominant with ponderosa pine.

Ecoprovince planners have used Cassidy's definition of the ponderosa pine vegetation zone. The aspect dependence of this zone creates a complex inter-digitization between the steppe and ponderosa pine stands, so that disjunct steep zone fragments occur on south-facing slopes deep within forest while ponderosa pine woodlands reach well into the steppe along drainages and north slopes.

The major defining structural feature of this zone is open-canopy forest or a patchy mix of open forest, closed forest, and meadows. Frequent disturbance by fire is necessary for the maintenance of open woodlands and savanna (Cassidy 1997). Fire suppression favors the replacement of the fire-resistant ponderosa pine by the less tolerant Douglas-fir and grand fir.

Heavy grazing of ponderosa pine stands has lead to swards of Kentucky bluegrass (*Poa pratensis*) and Canada bluegrass (*Poa compressa*) and replacement of native understory species by introduced annuals, especially cheat grass (*Bromus tectorum*). Four exotic *Centaurea* species are spreading rapidly through the ponderosa pine zone and threatening to replace cheat grass as the dominant increaser after grazing (Cassidy 1997). Open canopy conifer forest, the defining feature of this zone, covers slightly more than half the area of the zone. The status of ponderosa pine protection in the Okanogan subbasin in relation to other Upper Columbia River subbasins in illustrated.



Source: IBIS 2003

Figure 39. Protection status of ponderosa pine in the Columbia Cascade Ecoprovince, Washington (IBIS 2003).

Desired Future Condition

Recognizing that extant ponderosa pine habitat within the Ecoprovince currently covers a wide range of seral conditions. Ecoprovince planners identified three general ecological/management conditions that, if met, will provide suitable habitat for multiple wildlife species at the Ecoprovince scale within the ponderosa pine habitat type.

These ecological conditions correspond to life requisites represented by a species' assemblage that includes white-headed woodpecker (*Picoides albolarvatus*), flammulated owl (*Otus flammeolus*), pygmy nuthatch (*Sitta pygmaea*), and gray flycatcher (*Empidonax wrightii*). Species information (life requisites, distribution, status and trends) is included in Appendix F of the Columbia Cascade Ecoprovince Wildlife Assessment and Inventory. These species may also serve as a performance measure to monitor and evaluate the results of implementing future management strategies and actions.

Ecoprovince wildlife/land managers will review the conditions described below to plan and, where appropriate, guide future enhancement/protection actions on ponderosa pine habitats. Specific desired future conditions, however, are identified and developed within the context of individual management plans at the subbasin level.

Condition 1a – mature ponderosa pine forest: The white-headed woodpecker represents species that require/prefer large patches (>350 acres) of open mature/old growth ponderosa pine stands with canopy closures between 10 - 50 % and snags (a partially collapsed, dead tree) and stumps for nesting (nesting stumps and snags > 31 inches DBH). Abundant white-headed woodpecker populations can be present on burned or cut forest with residual large diameter live and dead trees and understory vegetation that is usually very sparse. Openness however, is not as important as the presence of mature or veteran cone producing pines within a stand (Milne and Hejl 1989).

Condition 1b – mature ponderosa pine forest: The pygmy nuthatch represents species that require heterogeneous stands of ponderosa pine with a mixture of well-spaced, old pines and vigorous trees of intermediate age and those species that depend on snags for nesting and roosting, high canopy density, and large diameter (greater than 18 inches DBH) trees characteristic of mature undisturbed forests. Connectivity between suitable habitats is important for species, such as pygmy nuthatch, whose movement and dispersal patterns are limited to their natal territories.

Condition 2 – multiple-canopy ponderosa pine mosaic: Flammulated owls represent wildlife species that occupy ponderosa pine sites that are comprised of multiple-canopy, mature ponderosa pine stands or mixed ponderosa pine/Douglas-fir forest interspersed with grassy openings and dense thickets. Flammulated owls nest in habitat types with low to intermediate canopy closure (Zeiner et al. 1990), two layered canopies, tree density of 508 trees/acre (9-foot spacing), basal area of 250 ft.2/acre (McCallum 1994b), and snags >20 inches DBH 3-39 ft. tall (Zeiner et al. 1990). Food requirements are met by the presence of at least one snag >12 inches DBH/10 acres and 8 trees/acre > 21 inches DBH.

3.19.2 Shrubsteppe

Historic

Historically, sage dominated steppe vegetation occurred throughout the majority of the Subbasin. Shrublands were historically co-dominated by shrubs and perennial bunchgrasses with a microbiotic crust of lichens and mosses on the surface of the soil.

Dominant shrubs were sagebrush of several species and subspecies: basin, Wyoming, and mountain big sagebrush; low sagebrush; and early, rigid, and three-tip. Bitterbrush also was important in many shrubsteppe communities. Bunchgrasses were largely dominated by four species: bluebunch wheatgrass, Idaho fescue, needle and thread grass, and Sandberg's bluegrass. Soils, climate and topography acted to separate out distinct plant communities that paired sagebrush species with specific bunchgrasses across the landscape.

Within the shrubsteppe landscape there also were alkaline basins, many of which contained large lakes during wetter pluvial times, where extensive salt desert scrub communities occur. This characteristic Great Basin vegetation contained numerous shrubs in the shadscale group including greasewood which has wide ecological amplitude, being equally at home in seasonally flooded playas and on dunes or dry hillsides.

Current

Today, two shrubsteppe vegetation zones occur in the Okanogan subbasin. The central arid steppe vegetation zone occupies the central portion of the Subbasin (Figure 17 of the Columbia Cascade Ecoprovince Wildlife Assessment and Inventory). The average shrub cover is generally between 5% and 20 %.

In recent years, several exotic plant species have become increasingly widespread. Russian starthistle (*Centaurea repens*) is particularly widespread, especially along and near major watercourses. A 1981 assessment of range conditions rated most of the rangelands in this zone in poor to fair range condition (Cassidy 1987). Agricultural land use dominates the central arid steppe vegetation zone in the subbasin.

The three-tip sage vegetation zone also occupies the central portion of the Okanogan subbasin (Figure 17 of the Columbia Cascade Ecoprovince Wildlife Assessment and Inventory). The average shrub cover is about 12% and ranges from near 0 Percent to greater than 30 %. In recent years, tumble knapweed (*Centaurea diffusa*) has spread through this zone and threatens to replace other exotics as the chief increaser after grazing.

A 1981 assessment of rangelands rated most of this zone in fair range condition, with smaller amounts in good and poor range condition (but ecological condition is generally worse than range condition) (Cassidy 1987). Thirty-nine % of this vegetation zone is in agricultural production statewide.

Livestock grazing practices have led to trampled streambanks, increased bank erosion and sedimentation, and changes in vegetation, including loss of native grasses, impacts to woody vegetation, and establishment of noxious weeds (NPPC 2002e).

A 1970s rangeland evaluation indicated that 25% of rangeland in the Subbasin was in good condition, 34% in fair condition, and 41% was in poor condition (PNRB.C. 1977 in NPPC 2002e). According to NRCS definitions, rangelands in fair to excellent condition provide adequate ground cover to protect the soil resource. Rangeland in poor to fair condition may not protect the soil, depending on the species composition and density. Areas in poor to fair condition may be prone to accelerated erosion. Accelerated erosion will likely degrade water quality. The status of shrubsteppe protection in the Okanogan subbasin in relation to other Upper Columbia River subbasins in illustrated inFigure 40. Protection status of shrubsteppe in the Columbia Cascade Ecoprovince, Washington (IBIS 2003)..

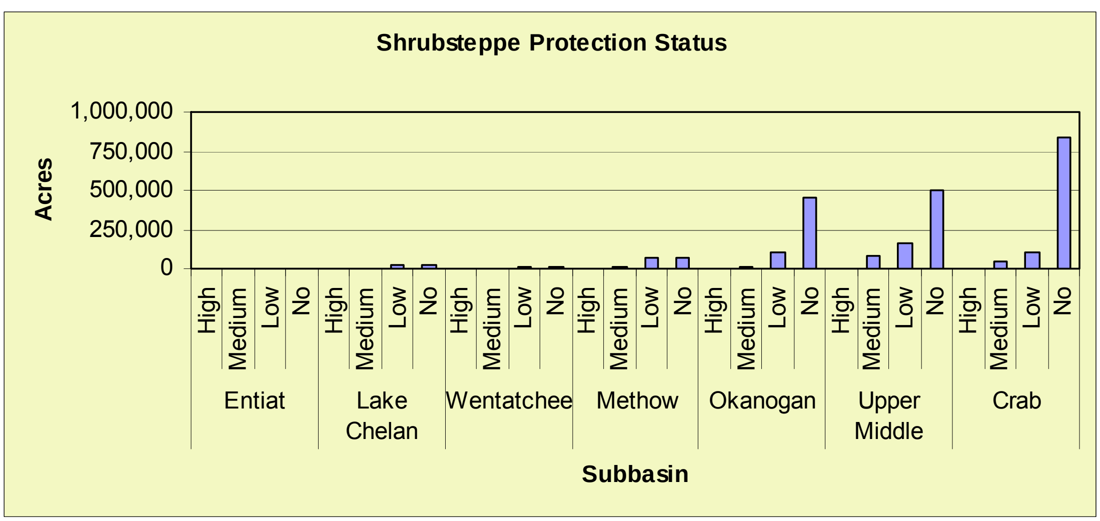


Figure 40. Protection status of shrubsteppe in the Columbia Cascade Ecoprovince, Washington (IBIS 2003).

Desired Future Condition

Shrub dominated shrubsteppe

The general recommended future condition of sagebrush-dominated shrubsteppe habitat includes expansive areas of high quality sagebrush with a diverse understory of native grasses and forbs (non-native herbaceous vegetation less than 10 %). More specific desired conditions include large unfragmented multi-structured patches of sagebrush with shrub cover varying between 10 and 30 %.

Good-condition shrubsteppe habitat has very little exposed bare ground, and supports mosses and lichens (cryptogammic crust) that carpet the area between taller plants. Similarly, subbasin land managers will manage diverse shrubsteppe habitats to protect and enhance desirable shrub species such as bitterbrush while limiting the spread of noxious weeds and increaser native shrub species such as rabbitbrush.

Ecoprovince planners have identified general ecological/management conditions that, if met, will provide suitable habitat for multiple wildlife species at the Ecoprovince scale within the shrubsteppe habitat type. Mule deer (*Odocoileus hemionus hemionus*), sage thrasher (*Oreoscoptes montanus*), sage grouse (*Centrocercus urophasianus*), and pygmy rabbit (*Brachylagus idahoensis*) were selected to represent the range of habitat conditions required by wildlife species that utilize sagebrush dominated shrubsteppe (shrubland) habitat within the Ecoprovince.

Species information (life requisites, distribution, abundance, status and trends) is included in Appendix F of the Columbia Cascade Ecoprovince Wildlife Assessment and Inventory. These wildlife species may also serve as a performance measure to monitor and evaluate the results of implementing future management strategies and actions.

Subbasin wildlife/land managers will review the conditions described below to plan and, where appropriate, guide future enhancement/protection actions on shrubsteppe habitats. Specific desired future conditions, however, are identified and developed within the context of individual management plans at the subbasin level.

Condition 1 – Sagebrush dominated shrubsteppe habitat: Sage thrasher was selected to represent shrubsteppe obligate wildlife species that require sagebrush dominated shrubsteppe habitats and that are dependent upon areas of tall sagebrush within large tracts of shrubsteppe habitat (Knick and Rotenberry 1995; Paige and Ritter 1999; Vander Haegen et al. 2001). Suitable habitat includes 5 to 20 % sagebrush cover greater than 2.5 feet in height, 5 to 20 % native herbaceous cover, and less than 10 % non-native herbaceous cover.

Condition 2 – Diverse shrubsteppe habitat: Mule deer were selected to represent species that require and prefer diverse, dense (30 to 60 % shrub cover less than 5 feet tall) shrubsteppe habitats (Ashley et al. 1999) comprised of bitterbrush, big sagebrush, rabbitbrush, and other shrub species (Leckenby 1969; Kufeld et al. 1973; Sheehy 1975; Jackson 1990) with a palatable herbaceous understory exceeding 30 % cover (Ashley et al. 1999). [Add conditions for pygmy rabbit and sage grouse]

3.19.3 Steppe/Grassland dominated shrubsteppe

The general recommended future condition of steppe/grassland dominated shrubsteppe habitat includes contiguous tracts of native bunchgrass and forb plant communities with less than 5% percent shrub cover and less than 10% exotic vegetation.

In xeric, brittle environments and sites dominated by shallow lithosol soils, areas between bunchgrass culms should support mosses and lichens (cryptogamic crust). In contrast, more mesic (greater than12 inches annual precipitation), deep soiled sites could sustain dense (greater than 75% cover) stands of native grasses and forbs (conclusions drawn from Daubenmire 1970).

Sharp-tailed grouse (*Tympanuchus phasianellus*) was chosen to represent the range of habitat conditions required by steppe/grassland obligate wildlife species. Ecoprovince wildlife/land managers recommend the following range of conditions:

- Greater than 40 % native bunchgrass cover
- Grater than 30 % native forb cover
- Less than 5% non-native herbaceous cover
- Visual obstruction readings (VOR) of at least 6 inches
- Greater than 75% deciduous shrub and tree cover

Multi-structured fruit/bud/catkin-producing deciduous trees and shrubs dispersed throughout the landscape (10 to 40 % of the total area), or within 1 mile of sharp-tailed grouse nesting/broodrearing habitats.

3.19.4 Eastside (Interior) Riparian Wetland

Historic

Historically, riparian wetland habitat was characterized by a mosaic of plant communities occurring at irregular intervals along streams and dominated singularly or in some combination by grass-forbs, shrub thickets, and mature forests with tall deciduous trees. Beaver activity and natural flooding are two ecological processes that affected the quality and distribution of riparian wetlands.

Current

Today, agricultural conversion, altered stream channel morphology, and water withdrawal have played significant roles in changing the character of streams and associated riparian areas. Woody vegetation has been extensively suppressed by grazing in some areas, many of which continue to be grazed. At lower elevations, agricultural conversions have led to altered stream channel morphology, loss of riparian vegetation and water withdrawals for irrigation.

Large areas once dominated by cottonwoods, which contribute considerable structure to riparian habitats, are being lost. The implications of riparian area degradation and alteration are wide ranging for many wildlife populations that utilize these important habitats for breeding, nesting, foraging, and resting activities.

Shallow water habitats typically connected to the mainstem of the river via culverts or small channels, provide special wildlife values. The reduced water fluctuation and protection from wave action is beneficial to wildlife, directly and indirectly, and as a result those conditions promote diverse riparian and wetland vegetative communities.

Natural flooding regimes, which promote important ecological process in riparian areas, were altered by the development of hydropower on the Columbia River. In general, there has been a decline in the diversity of riparian habitats, but an increase in the amount of habitat because of the stability the upstream storage projects provide in periods of high flows. For some species of wildlife such as migrant or wintering waterfowl, suitable habitat has increased because of increased open water associated with the reservoirs. The status of shrubsteppe protection in the Okanogan subbasin in relation to other Upper Columbia River subbasins in illustrated in Figure 41.

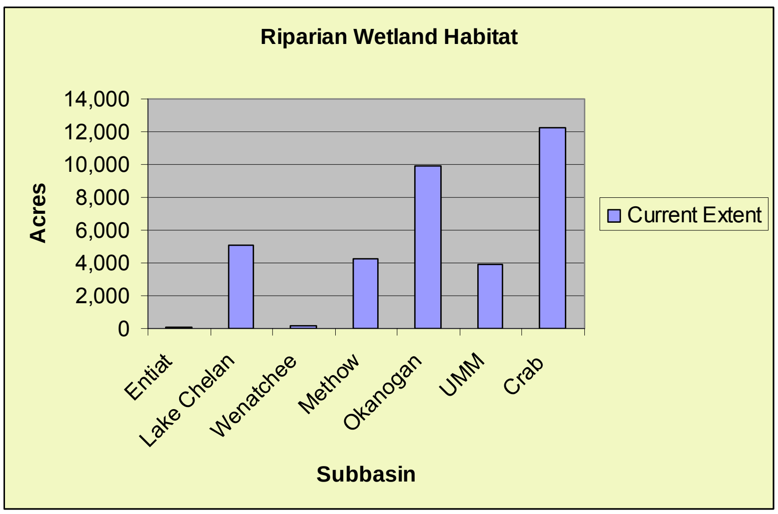


Figure 41. Protection status of riparian wetlands in the Columbia Cascade Ecoprovince, Washington (IBIS 2003).

Desired Future Condition

At the Ecoprovince level, wildlife/land managers focused on riparian (riverine) wetland habitats because of its prevalence throughout the Ecoprovince, close association with salmonid habitat requirements, and relationship to water quality issues. Subbasin level planners have the option to address lacustrine and palustrine wetland habitats at the local level.

Ecoprovince planners have identified general ecological/management conditions that, if met, will provide suitable habitat for multiple wildlife species at the Ecoprovince scale within the riparian wetland habitat type. Ecoprovince and subbasin level planners selected red-eyed vireo (*Vireo olivaceus*), yellow-breasted chat (*Icteria virens*), and beaver (*Castor canadensis*) to represent the range of habitat conditions required by wildlife species that utilize Eastside (Interior) Riparian Wetland habitat within the Ecoprovince.

Species information (life requisites, distribution, abundance, status and trends) is included in Appendix F of the Columbia Cascade Ecoprovince Wildlife Assessment and Inventory. These wildlife species may also serve as a performance measure to monitor and evaluate the results of implementing future management strategies and actions.

Ecoregion wildlife/land managers will review the conditions described below to plan and, where appropriate, guide future enhancement/protection actions on riparian wetland habitats. Specific desired future conditions, however, are identified and developed within the context of individual management plans at the subbasin level.

Wildlife/land managers have a wide array of conditions to consider. Recognizing the variation between existing riparian wetland habitat and the dynamic nature of this habitat type, recommended conditions for riparian wetland habitat focus on the following habitat/ anthropogenic attributes:

- The presence and/or height of native hydrophytic shrubs and trees
- Shrub and/or tree canopy structure, tree species and diameter (DBH)
- Distance between roosting and foraging habitats
- Human disturbance
- Ecoprovince wildlife/land managers recommend the following range of conditions for the specific riparian wetland habitat attributes:
- Greater than 60 % tree canopy closure
- Mature deciduous trees greater than 160 feet in height and 21 inches DBH
- Greater than 10 % young cottonwoods
- Tree cover less than 20 %
- 30 to 80 % native shrub cover
- Multi-structured shrub canopy greater than 3 feet in height
- Snags greater than 16 inches DBH

The status of shrubsteppe protection in the Okanogan subbasin in relation to other Upper Columbia River subbasins is illustrated.

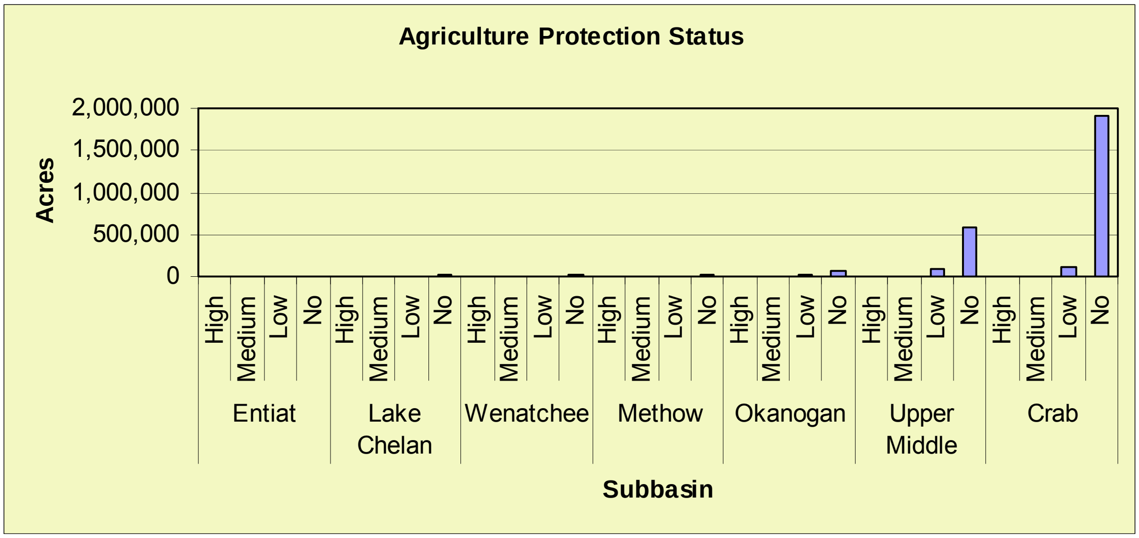


Figure 42. Protection status of agriculture in the Columbia Cascade Ecoprovince, Washington (IBIS 2003).

3.19.5 Rugged Terrains (Cliffs, Caves, and Talus Slopes) – Habitat of Concern

Although not a focal habitat type, cliffs, caves, and talus slopes within the Subbasin are very important and provide unique habitat for many birds and reptile species. Because vast areas of shrubsteppe habitat are virtually treeless, rock outcroppings provide critical nesting habitat for several raptor species.

Rock outcroppings are also used by reptiles for thermoregulation. Barren ground such as steep canyon walls and cliffs can offer protective habitat for numerous species of wildlife. This may include nesting and roosting habitat, perches for hunting, and areas for hibernating in the winter.

The Okanogan River from headwaters to the confluence of the Columbia River has sheer cliffs along much of its length that provide roosts for some bat species and nest sites for some bird species, and refugia for reptiles. Cliff-dwelling bats and birds forage in the adjacent steppe and over the river. The cliffs themselves are in little danger of development, but cliff-dwelling animals may be affected by habitat alteration of the surrounding steppe and the riparian strip (Cassidy 1997).

Species that rely on the combination of sheer cliffs and large rivers have no alternate refuge. An important management consideration is the maintenance of the continuity of riparian areas and protection of the link between cliffs, caves, and talus slopes and adjacent steppe.

3.20 Ecological Relationships in the Aquatic Ecosystem

The biotic communities of aquatic systems in the Upper Columbia Basin are highly complex. Within communities, assemblages and species have varying levels of interaction with one another. Direct interactions may occur in the form of predator-prey, competitor, and disease- or parasite-host relationships. In addition, many indirect interactions may occur between species.

These interactions continually change in response to shifting environmental and biotic conditions. Human activities that change the environment, the frequency and intensity of disturbance, or species composition can shift the competitive balance among species, alter predatory interactions, and change disease susceptibility. All of these changes may result in community reorganization.

3.21 Fish Community Structure and Interactions in the Upper Columbia Basin

Few studies have examined the fish species assemblages within the Upper Columbia Basin. Most information available is from past surveys (e.g., Dell et al. 1975; Dobler et al. 1978; McGee et al. 1983; Burley and Poe 1994; Hillman 2000; Duke Engineering 2001), dam passage studies (e.g., Mullan et al. 1986; Tonseth and Petersen 1999; Chelan PUD unpublished data), and northern pikeminnow studies (e.g., Burley and Poe 1994; West 2000).

The available information indicates that about 41 species of fish occur within the Upper Columbia Basin (from the mouth of the Yakama River upstream to Chief Joseph Dam) (Table 35). This is an underestimate because several species of cottids (sculpins) live there. Of the fishes in the basin, 15 are cold-water species, 18 are cool-water species, and 8 are warm-water species.

Table 35. Fish species of the Upper Columbia

Common name	Species	Native (N) or Exotic (E)	Feeding location in water column			Primary prey				
			Surf	Mid	Bot	Plant	Detrit	Mic	Mac	Fish
Cold-water species:										
White sturgeon	*Acipenser transmontanus*	N			x	x	x	x	X	x
Chinook salmon (juv)	*Oncorhynchus tshawytscha*	N	X	x	x				X	
Coho salmon (juv)	*Oncorhynchus kisutch*	N	X	x	x				X	
Sockeye/kokanee (juv)	*Oncorhynchus nerka*	N	x	X	x			x	X	
Steelhead/rainbow	*Oncorhynchus mykiss*	N	x	X	x				X	x
	Oncorhynchus									

Common name	Species	Native (N) or Exotic (E)	Feeding location in water column			Primary prey				
			Surf	Mid	Bot	Plant	Detrit	Mic	Mac	Fish
Cutthroat trout	*clarki*	N	X	x	x				X	x
Brown trout	*Salmo trutta*	E	x	X	x				X	x
Atlantic salmon	*Salmo salar*	E	x	X	x				X	x
Bull trout	*Salvelinus confluentus*	N	x	x	X				X	x
Brook trout	*Salvelinus fontinalis*	E	x	X	x				X	x
Mountain whitefish	*Prosopium williamsoni*	N	x	x	X				X	
Lake whitefish	*Coregonus clupeaformis*	E		x	X				X	x
Longnose sucker	*Catostomus catostomus*	N			X	x	x	x	x	
Sculpins	*Cottus spp.*	N			X				X	x
Cool-water species:										
Longnose dace	*Rhinichtys cataractae*	N			X				X	
Peamouth	*Mylocheilus caurinus*	N			X				X	x
Chiselmouth	*Acrocheilus alutaceus*	N			X	X			x	
Northern pikeminnow	*Ptychocheilus oregonensis*	N	x	x	X				X	x

Common name	Species	Native (N) or Exotic (E)	Feeding location in water column			Primary prey				
			Surf	Mid	Bot	Plant	Detrit	Mic	Mac	Fish
Redside shiner	*Richardsonius balteatus*	N	x	X	x				X	
Sand roller	*Percopsis transmontana*	N			X				X	
Bridgelip sucker	*Catostomus columbianus*	N			X	X			x	
Mountain sucker	*Catostomus platyrhynchus*	N			X	X	x	x	x	
Largescale sucker	*Catostomus macrocheilus*	N			X	X	x	x	x	
Pacific lamprey (juv)	*Lampetra tridentata*	N			X	x		X	x	
Western brook lamprey (juv)	*Lampetra richardsonii*	N			X	x	X	x		
Threespine stickleback	*Gasterosteus aculeatus*	N	x	X	x				X	
Pumpkinseed	*Lepomis gibbosus*	E		X	x				X	x
Walleye	*Stizostedion vitreum*	E		x	X				x	X
Yellow perch	*Perca flavescens*	E	x	X	x				X	x
Smallmouth bass	*Micropterus dolomieu*	E	x	x	X				X	x

Common name	Species	Native (N) or Exotic (E)	Feeding location in water column			Primary prey				
			Surf	Mid	Bot	Plant	Detrit	Mic	Mac	Fish
Sculpin	*Cottus spp.*	N			X				X	x
Warm-water species:										
Channel catfish	*Ictalurus punctatus*	E			X				X	x
Black bullhead	*Ameiurus melas*	E			X	x			X	
Brown bullhead	*Ameiurus nebulosus*	E			X	x	x	x	X	x
Tench	*Tinca tinca*	E			X	x			X	
Common carp	*Cyprinus carpio*	E			X	x	x	x	X	
Bluegill	*Lepomis macrochirus*	E	x	X	x				X	x
Black crappie	*Pomoxis nigromaculatu s*	E	x	X	x				X	x
Largemouth bass	*Micropterus salmoides*	E	x	X	x				x	X

Most of the cold-water species are native to the area; only four were introduced (brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), lake whitefish (*Coregonus clupeaformis*), and Atlantic salmon (S. salar)). Four of the 18 cool-water species are exotics (pumpkinseed (*Lepomis gibbosus*), walleye (*Stizostedion vitreum*), yellow perch (*Perca flavescens*), and smallmouth bass (*Micropterus dolomieu*)), while all warm-water species are exotics.

Anadromous species within the upper basin include spring and summer/fall Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), sockeye salmon (*O. nerka*), steelhead

(*O. mykiss*), and Pacific lamprey (*Lampetra tridentata*). Atlantic salmon (*Salmo salar*) are also anadromous, but their status in the basin is largely unknown.

White sturgeon (*Acipenser transmontanus*), which may have been anadromous historically, are present as a resident population.

About half of the resident species in the upper basin are piscivorous (eat fish) (Table ?). Ten cold-water species, seven cool-water species, and five warm-water species are known to eat fish. About 59% of these piscivores are exotics (Table ?). Before the introduction of exotics, northern pikeminnow (*Ptychocheilus oregonensis*), sculpin (*Cottus spp*.), white sturgeon, bull trout (*Salvelinus confluentus*), rainbow trout (*O. mykiss*), cutthroat trout (*O. clarki*), and burbot (*Lota lota*) were the primary piscivores in the region (Li et al. 1987; Poe et al. 1994).

Presently, burbot are rare in the upper basin (Dell et al. 1975; Burley and Poe 1994) and probably have little effect on the abundance of juvenile Chinook and steelhead in the region. The status of white sturgeon in the upper basin is mostly unknown, although their numbers appear to be quite low (DeVore et al. 2000).

Introduced species such as walleye, smallmouth bass, and channel catfish (*Ictalurus punctatus*) are important predators of Chinook and steelhead in the Columbia River (Poe et al. 1994). Channel catfish are rare (Dell et al. 1975; Burley and Poe 1994) and likely have little to no effect on abundance of Chinook and steelhead.

Other piscivores, such as largemouth bass (*M. salmoides*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), brown bullhead (*Ameiurus nebulosus*), yellow perch, and pumpkinseed are either rare or not known to prey heavily on juvenile anadromous fish (Dell et al. 1975; Burley and Poe 1994).

What follows is a brief summary of interactions of fish, birds, and mammals with spring Chinook and summer steelhead in the Upper Columbia River Basin.

3.22 Competition

Competition among organisms occurs when two or more individuals use the same resources and when availability of those resources is limited (Pianka 2000). That is, for competition to occur, demand for food or space must be greater than supply (implies high recruitment or that the habitat is fully seeded) and environmental stresses few and predictable.

Two types of competition are generally recognized: (1) interference competition, where one organism directly prevents another from using a resource through aggressive behavior, and (2) exploitation competition, where one species affects another by using a resource more efficiently. Salmonids likely compete for food and space both within species (intra-specific) and between species (inter-specific). Inter-specific interactions are more likely to occur between native and exotic species, rather than between species that coevolved together.

Although coevolved sympatric species should segregate (i.e., partition resources in space or time or both), native species may still interaction along the margins of their spatial and temporal distributions. An example of this may occur between Chinook salmon and steelhead. This interaction was studied in the Wenatchee Basin by Hillman et al (1989a, 1989b) and found to be relatively unimportant in limiting the production of the species.

Interaction between the species was minimized because of disparate times of spawning, which tended to segregate the two species. Both Chinook and steelhead may interact competitively with other natives, such as bull trout, Westslope cutthroat trout, or redside shiners. Currently, there is no evidence that the focal species interact with bull trout or Westslope cutthroat trout. Indeed, Martin et al. (1992) indicated that juvenile bull trout and Chinook have different habitat preferences and thus do not interact competitively.

Significant interaction between redside shiners and Chinook and steelhead may occur as a result of changes or modifications in water quality (e.g., temperature). In both field and laboratory studies, Hillman (1991) found that redside shiners displaced Chinook salmon from rearing areas at temperatures greater than 18°C. In fact, at these warmer temperatures, shiners negatively affected the distribution, behavior, and production of Chinook salmon. Reeves et al. (1987) documented similar results with redside shiners and juvenile steelhead. Thus, if water temperatures increase within the basin, one can expect increased interactions between shiners and Chinook and steelhead.

Exotic species may be more likely to interact with Chinook and steelhead because exotics have not had time to segregate spatially or temporally in their resource use. For example, there is a possibility that brook trout interact with Chinook and steelhead in the upper basin. Welsh (1994), however, found no evidence that brook trout displaced Chinook salmon. On the other hand, Cunjak and Green (1986) found that brook trout were superior competitors to rainbow/steelhead at colder temperatures (9°C), while rainbow/steelhead were superior at warmer temperatures (16°C).

A potentially important source of exploitative competition occurring outside the geographic boundary of the ESUs may be between the exotic American shad (*Alosa sapidissima*) and juvenile Chinook and steelhead. Palmisano et al. (1993a, 1993b) concluded that increased numbers of shad likely compete with juvenile salmon and steelhead.

Although coho salmon were native to the upper basin, they have been absent for many decades. Recently, there have been efforts to re-establish them in the upper basin (Murdoch et al. 2002). Thus, there is the potential that reintroduced coho will interact negatively with Chinook and steelhead. However, studies conducted in the Wenatchee Basin indicate that there is little to no interaction between the species (Spaulding et al. 1989; Murdoch et al. 2002).

3.23 Predation

Fish, mammals, and birds are the primary natural predators of Chinook and steelhead in the Upper Columbia Basin. Although the behavior of Chinook and steelhead precludes any single predator from focusing exclusively on them, predation by certain species can nonetheless be seasonally and locally important.

Recent changes in predator and prey populations along with major changes in the environment, both related and unrelated to development in the Upper Columbia basin, have reshaped the role of predation (Mullan et al. 1986; Li et al. 1987).

Although several fish species can consume Chinook and steelhead in the upper basin, northern pikeminnow, walleyes, and smallmouth bass have the potential for significantly affecting the abundance of juvenile anadromous fish (Gray and Rondorf 1986; Bennett 1991; Poe et al. 1994; Burley and Poe 1994). These are large, opportunistic predators that feed on a variety of prey and switch their feeding patterns when spatially or temporally segregated from a commonly consumed prey.

Channel catfish also have the potential to significantly affect the abundance of juvenile Chinook and steelhead (see e.g., Gray and Rondorf 1986; Poe et al. 1994), but because they are rare in the upper Columbia (Dell et al. 1975; Burley and Poe 1994), they likely have a small effect on survival of juvenile Chinook and steelhead there. Native species such as sculpins and white sturgeon also prey on juvenile anadromous fish (Hunter 1959; Patten 1962, 1971a, 1971b; Mullan 1980; Hillman 1989).

Most adult salmonids within the upper basin are opportunistic feeders and are therefore capable of preying on juvenile Chinook and steelhead. Those likely to have some effect on the survival of Chinook and steelhead include adult bull trout, rainbow/steelhead trout, cutthroat trout, brook trout, and brown trout. Of these, bull trout and rainbow trout are probably the most important. These species occur together with Chinook and steelhead in most tributaries, hence the probability for interaction is high. The presence of both fluvial and adfluvial stocks of bull trout in the region further increases the likelihood for interaction there.

Predation by piscivorous birds on juvenile anadromous fish may represent a large source of mortality. Fish-eating birds that occur in the upper basin include great blue herons (*Ardea herodias*), gulls (*Larus* spp.), osprey (*Pandion haliaetus*), common mergansers (*Mergus merganser*), American dippers (*Cinclus mexicanus*), cormorants (*Phalacrocorax spp*.), Caspian terns (*Sterna caspia*), belted kingfishers (*Ceryle alcyon*), common loons (*Gavia immer*), western grebes (*Aechmophorus occidentalis*), black-crowned night herons (*Nycticorax nycticorax*), and bald eagles (*Haliaeetus leucocephalus*) (T. West, Chelan PUD, pers. comm.).

These birds have high metabolic rates and require large quantities of food relative to their body size. In the Columbia River estuary, avian predators consumed an estimated 16.7 million smolts (range, 10-28.3 million smolts), or 18% (range, 11-30%) of the smolts reaching the estuary in 1998 (Collis et al. 2000). Caspian terns consumed primarily salmonids (74% of diet mass), followed by double-crested cormorants (*P. auritus*) (21% of diet mass) and gulls (8% of diet mass). The NMFS (2000) identified these species as the most important avian predators in the Columbia River basin.

Mammals may be an important agent of mortality to Chinook and steelhead in the upper basin. Predators such as river otters (*Lutra Canadensis*), raccoons (*Procyon lotor*), mink (*Mustela vison*), and black bears (*Ursus americanus*) are common in the upper basin. These animals, especially river otters, are capable of removing large numbers of salmon and trout (Dolloff 1993).

Black bears consume large numbers of salmon, but generally scavenge post-spawned salmon. Pinnipeds, including harbor seals (*Phoca vitulina*), California sea lions (*Zalophus californianus*), and Stellar sea lions (*Eumetopia jubatus*) are the primary marine mammals preying on Chinook and steelhead originating from the Upper Columbia basin (Spence et al. 1996). Pacific striped dolphin (*Lagenorhynchus obliquidens*) and killer whale (*Orcinus orca*) may also prey on adult Chinook and steelhead. Seal and sea lion predation is primarily in saltwater and estuarine environments though they are know to travel well into freshwater after migrating fish. All of these predators are opportunists, searching out locations where juveniles and adults are most vulnerable.

3.24 Disease and Parasitism

Chinook and steelhead can be infected by a variety of bacterial, viral, fungal, and microparasitic pathogens. Numerous diseases may result from pathogens that occur naturally in the wild or that may be transmitted to wild fish via infected hatchery fish.

Among these are bacterial diseases, including bacterial kidney disease (BKD), columnaris, furunculosis, redmouth disease, and coldwater disease; virally induced diseases, including infectious hepatopoietic necrosis (IHN), infectious pancreatic necrosis (IPNV), and erythrocytic inclusion body syndrome (EIBS); protozoan-caused diseases, including ceratomyxosis and dermocystidium; and fungal infections, such as saprolegnia (Bevan et al. 1994).

Chinook in the Columbia River have a high incidence of BKD (Chapman et al. 1995). Incidence appears higher in spring Chinook (Fryer 1984) and can be a major problem in hatchery-reared Chinook in the upper Columbia region (Chapman et al. 1995). Viral infections such as IPNV have been detected in hatchery steelhead in the upper Columbia region (Chapman et al. 1994). Other epizootics, including *Ceratomyxa shasta* and tuberculosis, are endemic to the Columbia River basin, but it is unknown if these affect the production of Chinook and steelhead in the upper Columbia region.

Generally one thinks of epizootics killing fish outright. However, sublethal chronic infections can impair the performance of Chinook and steelhead in the wild, thereby contributing secondarily to mortality or reduced reproductive success. Fish weakened by disease are more sensitive to other environmental stresses. Additionally, they may become more vulnerable to predation (Hoffman and Bauer 1971), or less able to compete with other species. For example, both Hillman (1991) and Reeves et al. (1987) found that water temperature affected interactions between redside shiners and the focal species.

Both researchers noted that outcomes of interactions were, in part, related to infection with *F. columnaris*. In their studies, most Chinook and steelhead were infected at warmer temperatures, whereas shiners showed a higher incidence of infection at cooler temperatures.

3.25 Competition

As noted in the Ecological Interactions section, competition among organisms occurs when two or more individuals use the same resources and when availability of those resources is limited (Pianka 2000). Although competition is difficult to demonstrate, a few studies conducted within the Upper Columbia Basin indicate that competition may affect the production of Chinook salmon and steelhead in the basin.

3.25.1 Chinook/steelhead

It is possible that inter-specific competition may occur between juvenile Chinook and steelhead along the margins of their spatial and temporal distributions. Hillman et al. (1989a, 1989b) investigated the interaction between these species in the Wenatchee River between 1986 and 1989. They reported that Chinook and steelhead used dissimilar daytime and nighttime habitat throughout the year.

During the daytime in summer and autumn, juvenile Chinook selected deeper and faster water than steelhead. Chinook readily selected stations associated with brush and woody debris for cover, while steelhead primarily occupied stations near cobble and boulder cover. During winter days, Chinook and steelhead used similar habitat, but Hillman et al. (1989a) did not find them together. At night during both summer and winter, Hillman et al. (1989b) found that both species occupied similar water velocities, but subyearling Chinook selected deeper water than steelhead.

Within smaller streams, Hillman and Miller (2002) found that Chinook were more often associated with pools and woody debris during the summer, while steelhead occurred more frequently in riffle habitat. Hillman et al. (1989a, 1989b) concluded that interaction between the two species would not strongly negatively affect production of either species, because disparate times of spawning tended to segregate the two species. This conclusion is consistent with the work of Everest and Chapman (1972) in Idaho streams.

3.25.2 Redside shiners

Under appropriate conditions, inter-specific interaction may also occur between redside shiners and juvenile Chinook and steelhead. Hillman (1991) studied the influence of water temperature on the spatial interaction between juvenile Chinook and redside shiners in the field and laboratory. In the Wenatchee River during summer, Hillman (1991) noted that Chinook and shiners clustered together and that shiners were aggressive toward salmon. He reported that the shiners used the more energetically profitable positions, and that they remained closer than Chinook to instream and overhead cover.

In laboratory channels, shiners affected the distribution, activity, and production of Chinook in warm (18-21°C) water, but not in cold (12-15°C) water (Hillman 1991). In contrast, Chinook influenced the distribution, activity, and production of shiners in cold water, but not in warm water. Reeves et al. (1987) documented similar results when they studied the interactions between redside shiners and juvenile steelhead. Although Hillman (1991) conducted his fieldwork in the lower Wenatchee River, shiners are also present in the Entiat, Methow, and Okanogan rivers and are abundant in the mainstem Columbia River. At warmer temperatures, shiners likely negatively affect the production of Chinook salmon and steelhead in the upper basin.

3.25.3 Coho salmon

It is possible that the re-introduction of coho salmon into the Upper Columbia Basin may negatively affect the production of Chinook and steelhead. One of the first studies in the upper basin that addressed effects of coho on Chinook and steelhead production was conducted by Spauling et al. (1989) in the Wenatchee River.

This work demonstrated that the introduction of coho into sites with naturally produced Chinook and steelhead did not affect Chinook or steelhead abundance or growth. However, because Chinook and coho used similar habitat, the introduction of coho caused Chinook to change habitat. After removing coho from the sites, Chinook moved back into the habitat they used prior to the introduction of coho.

Steelhead, on the other hand, remained spatially segregated from Chinook and coho throughout the study. More recent studies conducted by Murdoch et al. (2002) found that juvenile coho, Chinook, and steelhead used different microhabitats in Nason Creek, and at the densities tested, coho did not appear to displace juvenile Chinook or steelhead from preferred microhabitats.

These studies indicate that the re-introduction of coho should have little to no effect on the production of Chinook and steelhead.

3.25.4 Various salmonids

It is possible that juvenile Chinook and steelhead interact with bull trout, brook trout, and cutthroat trout if they occur together. Hillman and Miller (2002) observed Chinook, bull trout, and brook trout together in several tributaries of the Chiwawa River and in the Little Wenatchee River.

In tributaries of the Chiwawa River, Hillman and Miller (2002) observed Chinook and juvenile bull trout in the same habitat. They report seeing bull trout and Chinook nipping each other in Big Meadow, Rock, and Chickamin creeks. Usually the aggressive interactions occurred in pools near undercut banks or in woody debris. In contrast, Martin et al. (1992) investigated the interaction between juvenile bull trout and spring Chinook in the Tucannon River, Washington, and found that the two species have different habitat preferences.

Juvenile spring Chinook occurred more often in open, slow-water habitat without complex hiding cover. Bull trout, on the other hand, more frequently used riffle and cascade habitat. Bull trout numbers inversely correlated with amounts of woody debris and the two species did not compete for food because food was not limiting in the Tucannon River (Martin et al. 1992).

Although Hillman and Miller (2002) observed juvenile Chinook and brook trout together in many tributaries of the Chiwawa River and in the Little Wenatchee River, they did not see aggressive interaction between the two species. Welsh (1994), on the other hand, studied the interaction between the two species in Idaho streams and found that when Chinook were introduced into a stream with brook trout, the latter was displaced into marginal habitat.

Over a six-year period, Welsh (1994) notes that brook trout vanished from his study sites. We can find no studies that address the interaction between Chinook and cutthroat trout. Although Chinook and steelhead may interact with bull trout, brook trout, and cutthroat trout, there is no evidence that they will negatively affect the production of Chinook and steelhead in the Upper Columbia basin.

3.25.5 American shad

A potentially important source of exploitative competition occurring outside the geographic boundary of the ESUs may be between the exotic American shad and juvenile Chinook and steelhead. Changes in stream flow in the Columbia River system have resulted in increased plankton production, which has apparently increased the success of introduced shad.

Shad prey on the most abundant foods (Walburg 1956; Levesque and Reed 1972). Shad in the Columbia River estuary consume amphipods, calanoid copepods (*Neomysis mercedis*), cladocerans (*Daphnia sp.*), and insects (Durkin et al. 1979). Juvenile salmonids eat the same foods (McCabe et al. 1983). Palmisano et al. (1993a, 1993b) concluded that increased numbers of shad likely compete with juvenile salmon and steelhead.

3.26 Predation

Fish, mammals, and birds are the primary natural predators of Chinook and steelhead in the Upper Columbia basin. Although the behavior of Chinook and steelhead precludes any single predator from focusing exclusively on them, predation by certain species can nonetheless be seasonally and locally important. Below is a discussion on the importance of specific predators on the production of Chinook and steelhead in the Upper Columbia basin.

3.26.1 Smallmouth bass

Smallmouth bass were introduced into the Columbia River before 1900 (Poe et al. 1994). Given their behavioral characteristics, it is assumed that they could significantly affect the abundance of juvenile Chinook and steelhead. In spring and early summer they inhabit rocky shoreline areas that are also used by juvenile salmonids (Scott and Crossman 1973; Wydoski and Whitney 1979).

Studies in Columbia basin reservoirs and Lake Sammamish, Washington, showed that smallmouth bass were highly predacious on outmigrating juvenile salmonids (Gray et al. 1984; Gray and Rondorf 1986). In contrast, studies by Bennett et al. (1983) and Zimmerman (1999) found that even though salmonids were present in Snake and Columbia River reservoirs, they were less important in the diets of smallmouth bass than other fish.

Smallmouth bass commonly consumed sculpins, minnows, suckers, and troutperches in impounded and unimpounded reaches of the lower Columbia and lower Snake Rivers during the outmigration of juvenile anadromous salmonids (Zimmerman 1999).

Sampling in the Upper Columbia Basin indicates that smallmouth bass are relatively rare (Dell et al. 1975; Burley and Poe 1994). Burley and Poe (1994) described studies that assessed the relative abundance of northern pikeminnow, walleye, and smallmouth bass in the Rocky Reach project area. Smallmouth bass constituted only 5% of the catch; northern pikeminnow and walleye made up 91% and 4% of the respective catch. Most (63%) smallmouth bass resided in the tailrace.

Very few (3%) were captured mid-reservoir. Mullan (1980), Mullan et al. (1986), and Bennett (1991) suggested that few smallmouth bass occur within the Upper Columbia because of low ambient water temperatures. Optimum growth temperatures for smallmouth bass range from 26-29°C (Armour 1993a).

Because Upper Columbia reservoirs function as a cold-tailwater to the reservoir of Grand Coulee Dam, optimal temperatures for bass occur primarily in warm backwaters (Mullan et al. 1986; Bennett 1991). The typical low water temperatures in the project area result in late spawning times, slow fry and fingerling growth, and small body size of smallmouth bass entering the first winter. This contributes to high over-winter mortality of juvenile smallmouth bass (Bennett 1991).

One could theorize that if sustained removals of northern pikeminnow significantly reduce mortality of juvenile salmonids in the project area, predation by smallmouth bass may be enhanced because of increased availability of juvenile salmonid prey. Studies in the lower Columbia and Snake rivers found that smallmouth bass did not respond to sustained removals of northern pikeminnow (Ward and Zimmerman 1999). Smallmouth bass density, year-class strength, consumption of juvenile salmonids, survival, growth, and relative weight did not increase concurrent with removals of northern pikeminnow. Likewise, it is unlikely that smallmouth bass will respond to sustained removals of northern pikeminnow in the Upper Columbia basin.

Because smallmouth bass are not abundant in the upper Columbia, they probably have a minor influence on the survival of juvenile Chinook and steelhead. Of the anadromous fish in the project area, subyearling summer/fall Chinook may be consumed more readily because their habitats overlap seasonally with smallmouth bass, and the subyearlings are ideal forage size for adult smallmouth bass (Poe et al. 1994).

3.26.2 Walleye

According to Li et al. (1987), walleye recently invaded the Columbia River from the reservoir of Grand Coulee Dam, where they are now very abundant. This fish is a large, schooling predator, unlike the native fauna, and its affect on juvenile Chinook and steelhead could be significant because of the potential for depensatory predatory-prey interactions.

Gray et al. (1984) found a high frequency of occurrence (42%) of juvenile salmonids in the stomachs of walleyes collected in the John Day tailrace during spring. In John Day Reservoir, however, Maule (1982) reported that walleyes ate few juvenile salmonids, and suggested that the probable reason was the spatial and temporal segregation of the species when walleyes were feeding most actively. Perhaps the reason that walleyes eat more juvenile salmonids in the tailrace is because the dam creates habitat that increases potential for spatial overlap, and therefore predation, between the species. This is supported by the high occurrence of juvenile salmonids in walleye stomachs collected between 1800 and 2400 hours (Gray et al. 1984), when the greatest fraction of smolts move through the powerhouse at John Day Dam (Sims et al. 1981), and when walleyes feed most heavily (Maule 1982).

Work by Zimmerman (1999) in impounded and unimpounded reaches of the lower Columbia River indicated that walleyes, like smallmouth bass, more commonly consumed sculpins, suckers, minnows, and troutperches during the outmigration of juvenile salmonids. This comports with the observations of Vigg et al. (1991), who estimated that nonsalmonid consumption rates of walleye were similar to those of smallmouth bass and exceeded those of northern pikeminnow in John Day reservoir.

Walleyes are relatively rare in the upper Columbia (Dell et al. 1975; Burley and Poe 1994). Burley and Poe (1994) reported that walleyes made up only 4% of the catch of the major predators in the Rocky Reach project area; the other two major predators, northern pikeminnow and smallmouth bass, made up 91% and 5% of the respective catch.

Most of the walleyes were captured in the tailrace. Few were captured in the forebay or mid-reservoir. The abundance of walleye appears to be limited by poor recruitment and low turbidity (Bennett 1991). Bennett (1991) reported that the most significant factor limiting abundance of walleyes is the short reservoir retention times (5.5-0.7 days), especially at the time of larvae abundance. High mortality and low food abundance for larvae probably limits recruitment of walleyes in reservoirs. In addition, low water turbidity likely affects the temporal and spatial distribution of feeding and reproduction of walleyes.

Walleyes attain maximum population sizes in shallow, large, turbid waters (Scott and Crossman 1973). They prefer turbid water because their eyes are sensitive to bright light. In clear waters, walleyes retain contact with the substrate during the day (Ryder 1977) and increase activity as light conditions decrease in the evening. Peak periods of activity in clear waters are dusk and dawn (Kelso 1976).

Mullan et al. (1992) believed that low water temperatures might limit recruitment of walleyes in the upper Columbia. Optimal water temperatures for embryo incubation range from 9-15°C (Armour 1993b). Optimal growth temperatures for juveniles and adults range from 22-28°C and 20-28°C, respectively (Armour 1993b). These thermal requirements suggest that water temperatures in the project area may not increase sufficiently fast or high enough for successful incubation, hatching, and rearing (Mullan et al. 1986; Bennett 1991). Successful incubation, hatching, and rearing may occur in backwater areas.

Because walleyes are not abundant in the upper Columbia, they probably do not significantly reduce the abundance of juvenile Chinook or steelhead in the area. Walleye predation on juvenile salmonids is probably greatest on subyearling summer/fall Chinook. Gray et al. (1984) found that about 80% of the juveniles identified in walleye stomachs were subyearlings, probably a result of their smaller size. Subyearling Chinook spend more time in shallower water than yearling spring Chinook, also increasing the likelihood of encountering walleyes.

3.26.3 Northern pikeminnow

The northern pikeminnow is a native cyprinid widely distributed throughout the Columbia River system (Mullan et al. 1986). It is the dominant predator of juvenile salmonids in the system, and predation by this species is clearly important compared to other sources of mortality (Poe et al. 1991; Rieman et al. 1991; Vigg et al. 1991; Ward and Zimmerman 1999; Zimmerman 1999).

Petersen (1994) estimated the annual loss of juvenile salmonids to predation by northern pikeminnow in John Day Reservoir to be 1.4 million, approximately 7.3% of all juvenile salmonids entering the reservoir. Predation varies throughout the system and is often highest near dams (Ward et al. 1995). Although the work by Gadomski and Hall-Griswold (1992) suggests that northern pikeminnow prefer dead juvenile Chinook to live ones, Petersen (1994) found that 78% of juvenile salmonids eaten by northern pikeminnow near a dam were consumed while alive.

Ward et al. (1995) estimated that 48% of predation occurs in mid-reservoir areas away from dams, where juvenile salmonids are presumably alive and uninjured when consumed. Of the estimated 200 million juvenile salmonids that emigrate annually through the Columbia River system, about 16.4 million (8%) are consumed by northern pikeminnow (Beamesderfer et al. 1996).

Northern pikeminnow are abundant in the Upper Columbia Basin (Dell et al. 1975; Mullan 1980; Mullan et al. 1986; Bennett 1991; Burley and Poe 1994) and large numbers pass through the fishways at dams. Of the three major predators in the Rocky Reach project area (northern pikeminnow, smallmouth bass, and walleye), northern pikeminnow made up 91% of the catch (Burley and Poe 1994). These fish were most abundant in the mid-reservoir (45% of the total catch of northern pikeminnow), with the remaining catch of northern pikeminnow split equally between the forebay and tailrace.

At other dams in the Upper Columbia basin, Burley and Poe (1994) found larger numbers of northern pikeminnow in the tailrace areas. Northern pikeminnow in the Rocky Reach project area averaged 296 mm fork length (range, 115-515 mm) (Burley and Poe 1994). Vigg et al. (1991) reported that juvenile salmonids are the major dietary component of northern pikeminnow larger than 250-mm fork length. Therefore, one would assume that northern pikeminnow could significantly affect the abundance of juvenile Chinook and steelhead in the upper basin.

Burley and Poe (1994) summarize studies that assessed the significance of northern pikeminnow predation in the Upper Columbia region. They reported that northern pikeminnow in the Rocky Reach project area consumed primarily fish during the spring and summer; crustaceans, molluscs, insects, and plants were also consumed. Typically, the highest percentage of gut contents consisting of fish occurred in pikeminnows feeding in the tailrace and forebay areas. Juvenile salmonids were a significant component of northern pikeminnow diets, especially in tailrace areas.

The concern that northern pikeminnow could significantly affect the abundance of Chinook and steelhead in the upper basin, resulted in the initiation of a pikeminnow population reduction program. Since its initiation (1994), the program has removed well over 75,000 northern pikeminnow from Rocky Reach and Rock Island project areas (West 2000). At Rocky Reach, the program removed 44,743 (average, 6,400 per year; range, 2,482-9,633) pikeminnow. The number of northern pikeminnow ascending fish ladders at both dams has declined and catch rates have decreased (West 2000).

It is reasonable to assume that the reduction in numbers of northern pikeminnow has increased survival of juvenile Chinook and steelhead in the upper basin. In the lower Columbia and Snake rivers, potential predation on juvenile salmonids by northern pikeminnow decreased 25% after a pikeminnow removal program was implemented there (Friesen and Ward 1999). Friesen and Ward (1999) estimated a reduction in potential predation of 3.8 million juvenile salmon (representing 1.9% of the total population).

Knutsen and Ward (1999) found no evidence that the surviving pikeminnow compensated for removals. That is, estimates of relative weight, growth, and fecundity of pikeminnow were similar to estimates made before pikeminnow removals. Zimmerman and Ward (1999) concluded that consumption of juvenile salmonids by surviving pikeminnow has not increased in response to pikeminnow removal. It is likely that similar results occur within the Upper Columbia basin.

Northern pikeminnow are abundant in the Upper Columbia basin and have the potential to significantly affect the abundance of juvenile Chinook and steelhead. They consume large numbers of juvenile salmonids, primarily those concentrated in the tailrace and forebay areas during the spring outmigration. They also consume large numbers of juvenile salmonids (probably summer/fall Chinook) during summer.

Currently, the factor limiting the abundance of northern pikeminnow in the upper basin is the sustained population reduction program. The program has removed large numbers of northern pikeminnow from the project area. As a result, dam passage counts of pikeminnow have decreased. This has likely resulted in increased survival of juvenile anadromous fish in the project area.

3.26.4 Sculpins

Sculpins are native and relatively common in the upper basin (Dell et al. 1975; Mullan 1980; Burley and Poe 1994). Although sculpins are not considered a major predator of outmigrating anadromous fish, they do prey on small Chinook and steelhead (Hunter 1959; Patten 1962, 1971a, 1971b; Hillman 1989).

In the Wenatchee River, Hillman (1989) noted that large concentrations (20 fish/m2) of juvenile Chinook and steelhead occupied inshore, shallow, quiet-water positions on the streambed during the night. Hillman (1989) found that many sculpins moved into these areas at night and preyed heavily on Chinook and steelhead fry. Predation on fry appeared to be limited to sculpins larger than 85 mm and ceased when prey reached a size larger than 55 mm. The number of fry eaten per night appeared to be related to sculpin size, with the largest sculpins consuming the most fry per individual.

Because sculpins are abundant in Upper Columbia River tributaries, they are likely an important agent of mortality of Chinook and steelhead eggs and fry. As Chinook and steelhead fry grow, they are released from this source of mortality. It is unknown what fraction of the Chinook and steelhead population is removed by sculpins.

3.26.5 White sturgeon

White sturgeon, a native species, are not abundant in the upper basin (Mullan 1980; Mullan et al. 1986; Gray and Rondorf 1986; DeVore et al. 2000). According to Mullan (1980), sturgeon were perhaps the most important predator on young and adult salmon, and other fishes. This is not the case now because of greatly reduced sturgeon abundance.

Using setlines and gill nets, DeVore et al. (2000) found few sturgeon in the Upper Columbia River. In Rock Island Reservoir, a total of 95 overnight setlines captured only four sturgeon. The researchers did not sample in Rocky Reach Reservoir and used only setlines in Rock Island Reservoir. Sturgeon in Rock Island Reservoir ranged in lengths from 144-192 centimetre and in weight from 31-57 kilograms. The researchers aged two fish, one at 17 years and the other at 30 years.

White sturgeon are occasionally captured during the northern pikeminnow reduction program. For example, anglers collected two sturgeon in 1998, one at Rocky Reach Dam and another at Rock Island Dam (West 1999). Angling in 1999 captured three sturgeon at Rock Island Dam (West 2000). No sturgeon were captured at Rocky Reach Dam in 1999. All sturgeon captured during the northern pikeminnow control program were 91 centimetre or larger (T. West, Chelan PUD, pers. comm.).

White sturgeon are opportunistic bottom feeders, as indicated by morphological adaptations that include ventral barbels and a ventral, protrusible, sucker-like mouth (Wydoski and Whitney 1979; Ford et al. 1995). Juveniles predominantly eat chironomids and to a lesser degree, zooplankton, molluscs, and immature mayflies, caddisflies, and stoneflies (Scott and Crossman 1973). In the lower Columbia River, juveniles primarily ate the tube-dwelling amphipod *Corophium salmonis* (McCabe et al. 1993).

Individuals larger than 48 centimetre in length eat primarily fish (Scott and Crossman 1973; Ford et al. 1995). In the Kootenai River, white sturgeon larger than 80 centimetre fed on fish (whitefish, suckers, and other unidentified fish), aquatic insects, snails, clams, leeches, and chironomids (Partridge 1983).

DeVore et al. (2000) concluded that the white sturgeon in the Upper Columbia region are recruitment-limited because spawning habitat appears to be absent and no juveniles were found. Spawning coincides with peak flows during spring and early summer. Mature adults typically spawn in swift water (mean water column velocity, 0.8-2.8 m/s) over large substrate (cobble, boulder, or bedrock) (Parsley et al. 1993; Ford et al. 1995). In the upper basin these conditions likely exist just downstream from Wells Dam and Rocky Reach Dam. It is unknown if white sturgeon spawn in these areas.

Because white sturgeon are rare in the upper basin, they probably do not significantly affect the abundance of juvenile Chinook or steelhead. Small Chinook that rear in the Columbia River may be vulnerable to predation by white sturgeon. Theoretically, this would occur primarily at night when Chinook and steelhead are stationed on the streambed.

3.27 Wildlife/Fish Interactions

3.27.1 Birds

Predation by piscivorous birds on juvenile anadromous fish may represent a large source of mortality. Birds have high metabolic rates and require large quantities of food relative to their body size.

In the Columbia River estuary, avian predators consumed an estimated 16.7 million smolts (range, 10-28.3 million smolts), or 18% (range, 11-30%) of the smolts reaching the estuary in 1998 (Collis et al. 2000). Caspian terns consumed primarily salmonids (74% of diet mass), followed by double-crested cormorants (21% of diet mass) and gulls (8% of diet mass). The NMFS (2000) identified these species as the most important avian predators in the Columbia River basin.

Currently, there is little information on the effects of bird predation on the abundance of juvenile Chinook and steelhead in the upper basin. Fish-eating birds that occur in the region include great blue herons, gulls, osprey, common mergansers, American dippers, cormorants, Caspian terns, belted kingfishers, common loons, western grebes, black-crowned night herons, and bald eagles (T. West, Chelan PUD, pers. comm.).

According to Wood (1987a, 1987b), the common merganser limited salmon production in nursery areas in British Columbia. He found during smolt migrations that mergansers foraged almost exclusively on juvenile salmonids (Wood 1987a). Maximum mortality rate declined as fish abundance increased (i.e., depensatory mortality) and did not exceed 10% for any salmonid species. Wood (1987b) also estimated that young mergansers consumed almost one-half pound of subyearling Chinook per day. Thus, a brood of ten ducklings could consume between four and five pounds of fish daily during the summer.

The loss of juvenile Chinook and steelhead to gulls is potentially significant. Ruggerone (1986) studied the consumption of migrating juvenile salmon and steelhead below Wanapum Dam and found that the foraging success of gulls averaged 65% during bright light conditions and 51% during the evening. The number of salmonids consumed ranged from 50 to 562 fish/h. Ruggerone (1986) estimated that the number of salmonids consumed by gulls foraging downstream from the turbines during 25 days of peak salmonid migration was about 111,750 to 119,250 fish, or 2% of the estimated spring migration. Ruggerone (1986) noted that gulls consumed some salmonids that had been killed when passing through the turbines.

Cormorants may take large numbers of juvenile Chinook and steelhead in the upper basin. Roby et al. (1998) estimated that cormorants in the estuary consumed from 2.6 to 5.4 million smolts in 1997, roughly 24% of their diet, and most were hatchery fish. Although Caspian terns are not common in the upper basin, there is evidence that they consume fish from the area. Bickford (Douglas PUD, pers. comm.) found both PIT-tags and radio tags at a Caspian Tern nesting area near Moses Lake. Tag codes indicated that consumed fish were from the Upper Columbia region.

Although there are no estimates of the losses associated with bird predation in the Upper Columbia basin, it appears that bird predation can significantly affect the survival of juvenile Chinook and steelhead. Accordingly, the PUDs have implemented bird harassment measures and in some cases placed piano wire across tailraces. The degree to which these measures have reduced predation on juvenile anadromous fish is unknown at this time, but they have reduced bird predation on fish in the region (T. West, Chelan PUD, pers. comm.).

3.27.2 Mammals

No one has studied the effects of mammals on numbers of Chinook and steelhead in the Upper Columbia basin. Observations by BioAnalysts (unpublished data) indicate that river otters occur throughout the region. BioAnalysts (unpublished data) found evidence of otters fishing the Wenatchee, Chiwawa, Entiat, and Methow rivers, and Icicle Creek.

Otters typically fished in pools with large woody debris. According to Hillman and Miller (2002), juvenile Chinook are most abundant in these habitat types; thus, the probability for an encounter is high. Dolloff (1993) examined over 8,000 otoliths in scats of two river otters during spring 1985 and found that they ate at least 3,300 juvenile salmonids in the Kadashan River system, Alaska. He notes that the true number of fish eaten was much higher, as it is unlikely that searchers found all the scats deposited by the otters.

Other predators, such as raccoon and mink also occur in tributaries throughout the Upper Columbia basin. Their effects on numbers of Chinook and steelhead are unknown.

Black bears are relatively common in the upper Columbia basin and frequent streams used by spawning salmon during autumn. Studies have shown that salmon are one of the most important meat sources of bears and that the availability of salmon greatly influences habitat quality for bears at both the individual level and the population level (Hilderbrand et al. 1999; Reimchen 2000).

Observations by crews conducting Chinook spawning surveys in the upper basin indicate that bears eat Chinook, but it is unknown if the bears remove pre-spawned fish or are simply scavenging post-spawned fish. Regardless, there is no information on the roll that bears play in limiting survival and production of Chinook and steelhead in the upper basin.

Pinnipeds, including harbor seals, California se lions, and Stellar sea lions are the primary marine mammals preying on Chinook and steelhead originating from the Upper Columbia basin (Spence et al. 1996). Pacific striped dolphin and killer whale may also prey on adult Chinook and steelhead. Seal and sea lion predation is primarily in saltwater and estuarine environments though they are know to travel well into freshwater after migrating fish. All of these predators are opportunists, searching out locations where juveniles and adults are most vulnerable.

Although there are no estimates of the losses associated with mammal predation in the Upper Columbia basin, it appears that mammals can significantly affect the survival of Chinook and steelhead, especially in the estuary and near-shore ocean environments.

3.28 Competition with a Listed species

Bald Eagle (Haliaeetus leucocephalus)

In 1978, the bald eagle was federally listed throughout the lower 48 States as Endangered except in Michigan, Minnesota, Wisconsin, Washington, and Oregon, where it was designated as Threatened (USDI 1978). In July 1995, the USFWS reclassified the bald eagle to Threatened throughout the lower 48 states. In 1999, the bald eagle was proposed for de listing, recovered throughout the lower 48 States. This proposal is currently under review (USFWS July 1999). Eagles are further protected under the Bald and Golden Eagle Protection Act (BGEPA 1940) and the Migratory Bird Treaty Act of 1918 (MBTA 1918). Bald eagle populations have increased in number and expanded their range.

Bald eagles utilize a wide variety of prey items, although they primarily feed on fish, birds and mammals. Diet can vary seasonally, depending on prey availability. Given a choice of food, however, they typically select fish. Many species of fish are eaten, but they tend to be species that are easily captured or available as carrion. In the Pacific Northwest, salmon form an important food supply, particularly in the winter and fall. Birds taken for food are associated with aquatic habitats. Ducks, gulls and seabirds are typically of greatest importance in coastal environments. Mammals are less preferred than birds and fish, but form an important part of the diet in some areas. Deer and elk carcasses are scavenged, and in coastal areas, eagles feed on whale, seal, sea lion and porpoise carcasses (Stalmaster 1987).

3.29 Limiting Factors and Conditions

The presence, distribution, and abundance of fish and wildlife species in the Okanogan subbasin have been affected by habitat change and loss due primarily to:

- Residential development
- Agricultural development
- Livestock grazing
- Exotic species
- Hydropower development and operation
- Fire suppression

For a more in-depth discussion of limiting factors for wildlife at the Ecoprovince scale, see section 4.3 of the Columbia Cascade Ecoprovince Wildlife Assessment and Inventory and the Okanogan Limiting Factors Analysis (Ref?).

3.30 Limiting Factors Overview

Humans have impacted wildlife since before recorded history. Records begin with European exploration and settlement. Activities of the early European settlers that impacted wildlife and wildlife habitat included mining, cattle drives, fur trapping, agriculture, vineyards and orcharding, fire suppression, and forest management activities. Cities, farms and orchards fragmented wildlife habitats and hindered movement of many species.

Forest and cattle range industries have matured and a growing tourism industry leave their seasonal footprints on the upper valley and along water corridors. A growth in rural property owners and crop farmers over the last 100 years has consumed much of the valley bottom and altered riparian ecosystems.

Fur Trade

Fur bearing animals were extensively trapped in the early 1800s and by the turn of the century were practically nonexistent. Reintroduction and protective management has restored harvestable populations of some of these animals (Pacific Northwest River Basins Commission, 1977). Lynx, wolverine, and fisher are currently state and federally listed species. Several of these populations declined dramatically as a result of trapping in the early 1800s. Later, timber harvest and other resource activities further impacted remaining populations.

Mining

United States

The Jessie Moore mine, in the North Fork Salmon Creek drainage, is the only patented claim within the USFS boundary. Several claims have had plans for ground-disturbing activities in the last quarter-century, including the Silversmith Group in 1981, Quimine in 1981, and the Day Star Group in 1981. The Mar-Mac received got approval on its plans for road construction in 1983. That mine was restaked in 1993, and renamed Plata #1 (USDA, 1997).

Existing gravel mines are located well away from stream channels, and are probably not a major contributor of sediments to the streams.

In 1995, Okanogan County Health District conducted site hazard assessments on 25 mine sites in the Okanogan Basin:

6 sites were dropped because they were either active, or judged too insignificant to warrant full investigation.

3 sites were determined to be clean, and no further action was taken

16 sites were tested, and some elements were found at levels recommended for cleanup under the Model Toxics Control Act (MTCA). These elements included lead, arsenic, zinc, cadmium, copper, and antimony.

A number of sites were identified as presenting physical danger to the public because of a variety of causes including rotten or inadequate shoring, or unstable rock masses.

Lead and arsenic in both soil and water were the metals more frequently found above the MTCA's recommended cleanup levels. Lead binds to soil particles and tends to not move significantly in the soil column. Arsenic is more prone to a slow migration through the soil column and into the groundwater.

The WSDOE will conduct site hazard assessments at each of the identified sites, as time and staffing allow, to determine the severity of the problem, rank the sites, and initiate remediation, if required (OWSAC, 2000).

The USEPA recently closed the Texas Kaaba mine, upstream of the Enloe Dam.

Canada

Mining has occurred historically in the Canadian portion of the Okanogan subbasin though specifics regarding location and numbers is not readily available for this document.

Population Growth and Residential Development

Population growth and residential development has resulted in fragmentation and replacement of large areas of habitat and increased the stress on wildlife.

Disturbance by humans in the form of highway traffic, noise and light pollution, and various recreational activities have the potential to displace wildlife or forces them to use less desirable habitat. Most land with development potential (including many areas formerly covered by wetlands) in the basin has now been developed, and urban and agricultural development are now expanding into even marginal land and rough terrain. It is anticipated that urban development will continue to expand at a great rate in the Canadian Okanagan Basin, and to a lesser degree in the US portions of the basin because of the proportionally limited lakeside recreation properties. Seasonal tourist and shoreline residential development will continue to be a major stress on aquatic, terrestrial, and wetland ecosystems of the Okanogan.

While urban areas comprise only a small percentage of the land base within the Okanogan subbasin (0.5%), their habitat impacts are significant. Cities and towns within the Subbasin are largely built along creeks and rivers.

Channelization and development along water courses has eliminated riparian and wetland habitats. Expansion of urban areas affects drainage, and homes built along streams have affected both water quality and the ability of the floodplain to function normally. Removal of woody, overhanging vegetation along stream corridors has increased stream temperatures to the point that they are unable to support coldwater biota.

Hydropower Development and Operation

The development and operation of the hydropower system has resulted in widespread changes in available riparian habitats in the Upper Columbia Biological effects related to hydropower development and operations on fish and wildlife and its habitats may be direct or indirect.

In addition to the direct loss associated with entrainment of area salmon, the cumulative affects include the building of numerous roads and railways, presence of electrical transmissions and lines, the expansion of irrigation, and increased access to and harassment of wildlife.

Water quality

There are some water quality concerns in the US Okanogan Basin. The Okanogan River and several of its tributaries are on the Washington State 303(d) 1998 list (Impaired and Threatened Waterbodies Requiring Additional Pollution Controls) for "failure to meet water quality standards including temperature, dissolved oxygen, pH, and fecal coliform" (WSDOE, 1998) Table 36

Table 36 Okanogan Basin Water bodies on the Washington State 1998 303 (d)

Water Body	Water Quality Issues
Okanogan River	temperature, DO, fecal coliform, PCB-1260, PCB-1254, 4,4'-DDE*, 4,4'-DDD*
Similkameen River	Temperature, arsenic
Salmon Creek	Instream flow
Nine-mile Creek	DDT
Tallant Creek	DDT
Lake Osoyoos	4,4'-DDE*, 4,4'-DDD*

There is a "consistent late summer water temperature criteria violation in the Okanogan (annual violations from 1983 to 1993). Fish within the watershed are subject to poor water quality and low flow conditions, and critically high water temperatures during summer months" (Ecology 1998). Temperature and flow listings pose the most significant problems to salmon recovery in the Okanogan watershed. Washington Department of Ecology (WDOE) has undertaken sampling in the Okanogan watershed to assess Total Maximum Daily Loads (TMDLs) for PCBs and DDT.

The WSDOE establishes TMDLs as the foundation of a basin-specific strategy to improve water quality. The WSDOE may establish statewide TMDLs for temperature-related parameters.

Channelization

The Okanogan and Okanogan mainstem rivers have been channelized from the Osoyoos Lake to its confluence with the Columbia River, and much of the river channel is no longer connected to its floodplain. Low head dams were placed at the outlets of Osoyoos Lake just near Oroville Washington, and in B.C. at the outlets of Vaseux, Skaha, and Okanagan Lakes which have changed migration patters of resident species and limited the upstream extend of anadromous fish migration to McIntrye Dam east of Oliver B.C. A seven-kilometre section of river remains untangled just north of Oliver.

Agricultural Development

Although agriculture is a dominant land use in the Okanogan subbasin, it is not representative of a native wildlife habitat type and is considered to replace preferred habitat types for indigenous species. Agricultural lands therefore are not treated as a focal species in this subbasin plan. However, agricultural lands converted to CRP can significantly contribute toward benefits to wildlife.

Agricultural development in the Okanogan subbasin has altered or replaced significant amounts of native shrubsteppe habitat and fragmented riparian/floodplain habitat. Agricultural operations have increased sediment loads and introduced herbicides and pesticides into streams. Conversion to agriculture has decreased the overall quantity of habitat for many native species, but loss of specific communities may be particularly critical for habitat specialists.

Riparian vegetation such as cottonwood, spruce, alder and a dense shrub layer have been largely removed. Agriculture, residences, and associated roads contribute chemical contaminants and sediments to the streams and rivers.

Conversion of shrubsteppe communities to agricultural purposes throughout the Ecoprovince, and eastern Washington in general, has resulted in a fragmented landscape with few extensive tracts of interior grassland or shrubsteppe remaining (Dobler et al. 1996).

Agricultural land uses in the Ecoprovince include dry land wheat farms, irrigated agricultural row crop production, and irrigated agriculture associated with fruit and livestock production (alfalfa and hay). Agriculture conversions concentrated in low elevation valleys have significantly affected valley bottom grasslands, shrublands, and cottonwood dominated riparian areas.

Agricultural development has altered or replaced vast amounts of native steppe/grassland and shrubsteppe habitat in the lowlands and fragmented riparian wetland habitat within the Ecoprovince. Agricultural operations have also increased sediment loads and introduced herbicides and pesticides into streams.

Livestock Grazing

A federal grazing allotment system began in the early 1900s in response to complaints about the grazing and burning of the forests. Eligible ranchers were granted permits to graze on federal lands at specific times of the year at a fee for each animal per month. In the Toats Coulee area, now DNR and USFS lands, between 1906 and 1925 1,096 cattle grazed the area from June 1 to November 15 each year.

Livestock grazing practices have led to trampled stream banks, increased bank erosion and sedimentation, and changes in vegetation, including loss of native grasses, impacts to woody vegetation, and establishment of noxious weeds.

Most of the native grasses and forbs are poorly adapted to heavy grazing and trampling by livestock (Cassidy 1997). True interior grassland habitat was not likely historically present in the Subbasin and may be more appropriately described as central arid steppe.

A 1970s rangeland evaluation indicated that 25% of rangeland in the basin was in good condition, 34% in fair condition, and 41% was in poor condition (PNRB.C., 1977).

According to NRCS definitions, rangelands in fair to excellent condition provide adequate ground cover to protect the soil resource. Rangeland in poor to fair condition may not protect the soil, depending on the species composition and density. Areas in poor to fair condition may be prone to accelerated erosion. Accelerated erosion will likely degrade water quality.

Habitat conditions in range allotments on National Forest lands are in an upward trend. Most allotments have at least one localized area of overgrazing and trampling, and the Tonasket Ranger District focuses monitoring and restoration efforts on these areas. The District monitors range allotment conditions using a 1960s inventory as a baseline. In 1999 the District began conducting environmental analyses on all allotments. The allotments are assessed in clusters based on geologic features, and are being completed at a rate of one per year (Messerlie, 2001).

The USFS standards used to assess the condition of the riparian zones are contained in the Okanogan Forest Plan (USDA, 1989). On a forest wide basis, 24% of the riparian acreage was monitored in 1997.

Livestock grazing no longer occurs in the Pasayten Wilderness. The existing conservation allotment was created in 2000. The allotment still exists, but it would require an environmental analysis to reestablish grazing, and it is considered extremely unlikely to occur (Messerlie 2001, pers. comm.).

Data gaps exist in the Okanogan National Forest include the lack of baseline monitoring data on water quality for riparian and stream systems. Much of the grazing information for the Canadian sections of the subbasin was unavailable.

Conversion of agricultural lands

Agricultural land use has significantly changed the composition and structure of shrub and steppe vegetation communities from historic conditions. Livestock grazing tends to decrease perennial foragers (i.e., steppe and/or grasslands and increase shrub density).

Conversion of agricultural lands to suburban homesites invites a second new suite of biodiversity onto the Ecoprovince. Suburbanization of agricultural lands does not necessarily favor native species. The brown-headed cowbird (*Molothrus ater*) and European starling (*Sturnus vulgaris*) have taken advantage of the new habitats and moved into the area. The black-tailed jack rabbit (*Lepus californicus*) has largely displaced the white-tailed jack rabbit (Tisdale 1961; Johnson and Cassidy 1997).

Even though the conversion of native habitats to agriculture severely impacted native wildlife species such as the sharp-tailed grouse, agriculture did provide new habitat niches that were quickly filled with introduced species such as the ring-necked pheasant (*Phasianus colchicus*) chukar (*Alectoris chukar*), and the gray partridge (*Perdix perdix*). Native ungulate populations took advantage of new food sources provided by croplands and either expanded their range or increased in number (J. Benson, WDFW, pers. comm., 1999).

Wildlife species/populations that could adapt to and/or thrived on “edge” habitats increased with the introduction of agriculture until the advent of “clean farming” practices and monoculture cropping systems.

Conversion of any wildlife habitat type to agriculture adversely affects wildlife in two ways: native habitat is replaced, and remaining habitat is isolated and embedded in a highly fragmented landscape of multiple land uses.

Species adapted to expansive landscapes of steppe and shrubsteppe communities. When landscapes are fragmented by conversion to land use types different from what occurred naturally, wildlife dependent upon the remnant native habitat may be subjected to adverse population pressures, including:

- isolation of breeding populations;

- competition from similar species associated with other, now adjacent, habitats;
- increased predation by generalist predators;
- increased nest loss through parasitism by brown-headed cowbirds;
- creation of population sinks; and
- increased conflict between wildlife species and economic agricultural crops, i.e., crop depredation.

Fragmentation of previously extensive landscapes can influence the distribution and abundance of birds through redistribution of habitat types and through the pattern of habitat fragmentation, including characteristics such as decreased patch area and increased habitat edge (Ambuel and Temple 1983; Wilcove et al. 1986; Robbins et al. 1989; Bolger et al. 1991, 1997).

Fragmentation also can reduce avian productivity through increased rates of nest predation (Gates and Gysel 1978; Wilcove 1985), increased nest parasitism (Brittingham and Temple 1983; Robinson et al. 1995), and reduced pairing success of males (Gibbs and Faaborg 1990; Villard et al. 1993; Hagan et al. 1996).

It is not known to what extent these population pressures affect birds and other wildlife species in fragmented shrubsteppe environments, although a recent study from Idaho (Knick and Rotenberry 1995) suggests that landscape characteristics influence site selection by some shrubsteppe birds.

Most research on fragmentation effects on birds has occurred in the forests and grasslands of eastern and central North America, where conversion to agriculture and suburban/urban development has created a landscape quite different from that which existed previously. The potential for fragmentation to adversely affect shrubsteppe wildlife in Washington warrants further research.

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Wildlife species/populations that could adapt to and/or thrived on “edge” habitats increased with the introduction of agriculture until the advent of “clean farming” practices and monoculture cropping systems.

Transportation corridors

Federal and Provincial, State, county highways parallel the river at close proximity for its entire length, in Canada from Kelowna to Osoyoos, and the US south to its confluence with the Columbia River, except for a reach from Riverside to Janis, Washington. Riverside to Janis is the only largely undeveloped reach in the US along the Okanogan River floodplain.

During construction of a railroad grade through Omak Creek Canyon near St. Mary's Mission, the crew removed 10,000 cubic yards of rock from the canyon (Lewis, 1980). Much of this was blasted or dropped into Mission Falls directly below. The extra material blocked anadromous fish passage to the waters above the falls until 1999, when the Colville Tribes and NRCS finished removing the material from the channel.

The Biles Colman narrow-gauge railroad was unusual in that it was well maintained throughout its history. The railroad ties were not treated with creosote, as is common still, because of the ready access to timber at the mill (Lewis, 1980).

Roads

There are 4,357 miles of road in the Okanogan Watershed (WDNR, 1996). The Okanogan County road system includes less than 900 miles, with about 33 miles of county road within 200 feet of a stream or river. There is no comprehensive database quantifying the unimproved roads currently within the watershed. Unimproved roads are unpaved, and may or may not be graveled.

Roads are considered to be the greatest contributing source of sediment to streams in the basin. Sedimentation is highest at road crossings over stream channels, along roads in close proximity to streams, along cut and fill slopes, and at roads and ditches that drain to stream channels. Private roads that access multiple parcels often do not have a coordinated maintenance program, leading to increased erosion and sedimentation.

Roads affect streams by accelerating erosion and sediment delivery, altering channel morphology, and changing the runoff characteristics of watersheds (Furniss et al., 1991). In addition, noxious weeds tend to spread along roads, increasing erosion potential. Herbicide treatment of noxious weeds along roadsides can lead to contamination of nearby streams through accidental spills, direct runoff, or infiltration (USDA, 2000).

Road construction is one of the largest impacts in terms of water pollution in the basin. Several thousand acres of land have been devegetated during the initial construction phases and subsequent maintenance operations, leaving the underlying soil exposed to the forces of wind and water.

Water crossing and fill failures have occurred regularly during high water periods, degrading water quality and requiring expensive repairs. In places, erosion of road fills is chronic, because of faulty road drainage or lack of fill protection such as rock armoring or vegetation.

In addition to sediments, runoff from road surfaces carry contaminants such as heavy metals, litter, rubber particles, asphalt materials, herbicides, de-icing compounds, and asphalt sealant.

The Washington State Department of Transportation (WSDOT) maintains almost 175 miles of highway in the watershed and has made significant changes to their maintenance operations in the past several years to provide better protection to the water resource.

These measures include:

Use of vacuum trucks to clean catch basins and bridge drains rather than flushing them out, with the material being recycled or properly disposed of.

Application of liquid de-ices in the fall and spring, in lieu of sanding.

Modification of sand specifications so a "cleaner" sand is being used.

The Endangered Species Act listing of the steelhead trout influenced WSDOT maintenance operations, including weed control operations, culvert cleaning, sanding and deicing practices (OWSAC, 2000). WSDOT has numerous culverts in need of cleaning. A list of all culverts identified by Washington State Department of Fish and Wildlife (WDFW) is available. Many stretches of state highway are in close proximity to streams, and it is difficult for WSDOT to keep the roads safe for travel while protecting the streams from contaminants.

Although Okanogan County Public Works does not have in place written procedures for roadway maintenance practices, the department is in the process of developing guidelines (OWSAC, 2000).

Exotic Species

The spread of non-native plant and wildlife species poses a threat to wildlife habitat quality and to wildlife species themselves. For example, noxious weeds can threaten the abundance of native plant species fed upon by wildlife, and introduced wildlife species can compete with native wildlife for resources, potentially leading to the decline of the native species. Eurasian water milfoil surveys conducted by the Chelan County Public Utility District during the mid 1980s found that milfoil is infiltrating native aquatic weed beds and displacing these native plant species (NPPC 2002e).

Noxious Weed Effects on Water Quality and Riparian and Aquatic Habitat

Noxious weeds alter riparian vegetative cover by reducing the complexity of vegetative layering and diversity, on which indigenous aquatic and semi-aquatic species rely (USDA, 2000). Infestations on stream banks may lead to increased sediment delivery when weeds replace native, fibrous-rooted plants with tap-rooted weeds, such as knapweed. The weeds use available water, but do not provide enough ground cover to prevent erosion. (USDA 2000).

Herbicide treatment of weeds also impacts streams if the herbicide reaches the channel. Herbicides may enter surface or shallow ground water when sprayed directly on running or standing water, or through drift or soil erosion, or in the case of an accidental spill.

Herbicides may indirectly affect surface waters by reducing the riparian zone vegetation, leading to increased water temperatures (USDA, 2000). Herbicides may contaminate water through accidental spills, direct application to water bodies, surface runoff or movement through the soil (USDA, 2000).

Weed treatment under the ONF preferred alternative for the Integrated Weed Management program would use a combination including herbicides and hand pulling, flower head removal, mowing and scraping. In riparian areas, glycophosphate would be sprayed during spring or fall.

Fire

Fire is a natural occurrence in most shrubsteppe ecosystems and has been one of the primary tools humans have used to manage this habitat type. Fire prevents woody vegetation from encroaching, removes dry vegetation, and recycles nutrients. Conversely, fire suppression allows shrubs and trees to encroach/increase on areas once devoid of woody vegetation and/or promotes decadence in undisturbed native steppe/grassland communities.

Although fire can benefit steppe/grassland habitat, it can be harmful too—particularly when fires become much more frequent than is natural. If too frequent, fire can remove plant cover and increase soil erosion (Ehrlich et al. 1997:201) and can promote the spread of annual grasses to the detriment of native plants (Whisenant 1990).

Fires covering large areas of shrubsteppe habitat can eliminate shrubs and their seed sources and create grassland habitat to the detriment of sage dependent wildlife species such as sage grouse. Fires that follow heavy grazing or repeated early season fires can result in annual grasslands of cheatgrass, medusahead, knapweed, and/or yellow starthistle.

In Ecoprovince forest habitats, fire suppression has resulted in the loss of climax forest communities and, in some instances, wildlife species diversity by allowing the spread of shade tolerant species such as Douglas-fir and grand fir. Prior to fire suppression, wildfires kept shade-tolerant species from encroaching on established forest communities. The lack of fire within the ecosystem has resulted in significant changes to the forest community and has negatively impacted wildlife. Changes in forest habitat components have reduced habitat availability, quality, and utilization for wildlife species dependent on timbered habitats.

Long-term fire suppression can lead to changes in forest structure and composition, and result in the accumulation of fuel levels that can lead to severe crown fires that replace entire stands of trees. The higher elevation forests have evolved with high fire severity regimes, and fire suppression effects are not detectable. Thunderstorms bring lightning ignition to forested areas susceptible to fire.

Recreational use accounts for 60 % of fire ignitions in the Chiwawa River watershed (25-year period approximately 1972 to 1997) (NPPC 2002c). As forest stands become more layered, homogenous, and loaded, the potential for catastrophic fire increases. Attempts to restore ponderosa pine forests to their pre- European structure and function (i.e. conditions prior to forest suppression) should have positive impacts on some resident bird species, such as pygmy nuthatch, but too little information is currently available (Ghalambor 2003).

Because fire is an important natural process in ponderosa pine forests and is an important factor in creating snags, the restoration of natural fire regimes has been proposed as a management tool (e.g. Covington and Moore 1994; Arno et al. 1995; Fule and Covington 1995). In particular, the use of prescribed fires to reduce fuel loads has been suggested as being necessary in order to return fire regimes to more “natural” conditions (e.g. Covington and Moore 1994; Arno et al. 1995). Because frequent, low intensity ground fires play an important role in maintaining the character of natural ponderosa woodlands (Moir et al. 1997), prescribed low intensity ground fires are presumed to have beneficial effects on the resident bird species such as pygmy nuthatch.

The current level of information makes it difficult to accurately predict the effects of fire on some species of resident birds. However, it seems reasonable to conclude that low intensity ground fires would have little or no negative effects, whereas high intensity crown fires would have significant negative short-term effects because of the reduction in foraging habitat.

Interactions with Focal Species

The biotic communities of aquatic systems in the Upper Columbia Basin are highly complex. Within communities, assemblages and species have varying levels of interaction with one another. Direct interactions may occur in the form of predator-prey, competitor, and disease- or parasite-host relationships. In addition, many indirect interactions may occur between species. For example, predation of one species upon another may enhance the ability of a third species to persist in the community by releasing it from predatory or competitive constraints (e.g., Mittelbach 1986; Hillman et al. 1989a).

These interactions continually change in response to shifting environmental and biotic conditions. Human activities that change the environment, the frequency and intensity of disturbance, or species composition can shift the competitive balance among species, alter predatory interactions, and change disease susceptibility. All of these changes may result in community reorganization.

3.31 Historical Decline of Focal Species

Human and Natural Factors

Until 7,000 to 10,000 B.P., glacial ice blocked upper reaches of many rivers of the Pacific Northwest (Lackey 1999). Improved ecological conditions for salmon likely developed about 4,000 years ago, and aboriginal fishermen benefited. Lackey (1999) speculated that salmon populations reached their highest levels within the last few centuries.

Humans and salmon colonized and expanded their range in the Columbia River Basin after the most-recent Ice Age (10,000-15,000 years BP). American Indians developed a culture that relied extensively upon anadromous fish for sustenance in some portions of the area (Craig and Hacker 1940). Their catches must have increased as their populations rose and techniques of fishing developed. Particularly at partial obstacles for passage, Indians captured large numbers of fish for both sustenance and trade.

Native Americans had access to an abundant fish resource comprised of spring, summer, and fall runs of Chinook salmon, coho and sockeye salmon, and steelhead, and Pacific lamprey and white sturgeon. Estimates of pre-development (late 1700s) abundance of Columbia River salmon and steelhead ranged from about 8 million (Chapman 1986) to 14 million (NPPC 1986) fish. Estimates of pre-development salmon and steelhead numbers were based on maximum catches in the latter part of the 1800s and assumed catch rates by all fishing gear.

Colville Tribes Historical Use

From a historical perspective Ray (1933:28) reported that the fishing season on the Reservation began around the first of May, overlapping with root digging activities, and that sturgeon and small fish were taken first. The salmon would not start appearing until a month or so later, and the salmon fishing season would last until mid-August with some fish continuing to be taken in September and October. Many of the people chose to use fishing spots near their winter village sites while others traveled some distance to preferred locations such as the mouth of the San Poil or Spokane rivers or Kettle Falls (Ray 1933:28).

An in-depth review of historical fish population and habitat conditions on the Colville Reservation was provided by Hunner and Jones (1997) in the Phase I Hydrology report for the Integrated Resource Management Plan. This report will summarize major conclusions of that document for the purposes of evaluating alternatives presented in this programmatic EIS.

Fish species composition on the Reservation has changed from historical conditions. Formerly dominated by anadromous fish and resident species of native brook trout (bull trout), rainbow trout and cutthroat trout, fish populations are currently dominated (>70%) by eastern brook trout, with some native rainbow and cutthroat trout present. Bull trout presence on the Reservation is currently unknown. Lakes contain mostly warm water and trout species. Over 31 lakes on the Reservation are non-fish bearing because of natural water quality alkalinity levels.

Hunner and Jones (1997) attributed the decline of Reservation fisheries to three activities: over-harvest (off Reservation), water diversions, and habitat degradation. Habitat degradation has occurred from timber harvest, urbanization, conversion of land to agricultural uses, livestock grazing, fire suppression and road building activities.

Estimates of historically (pre-European influence) available anadromous salmonid spawning habitat were used by Hunner and Jones to speculate on historical population density of salmonids on the Reservation. Their calculations estimated an annual run of 20,009 spring Chinook, 13,341 summer and fall Chinook, 22,918 coho and 67,033 steelhead. Currently the Reservation does not have habitat suitable to support populations of that size.

Hunner and Jones also reported past presence of Chinook in Barnaby Creek, Bridge Creek, Gold Creek, Nineteen Mile Creek, the San Poil River, Spring Creek, Thirtymile Creek, Twenty-one Mile Creek and Round Lake. Chinook are not presently known to inhabit any of these areas.

Craig and Hacker (1940) described artisanal fishing methods and Native American utilization of catch for subsistence and trade. Methods often depended upon capturing fish at natural obstacles like waterfalls that concentrated passage points, or upon man-made weirs. As noted in the material on factors for decline, it is very unlikely that catch rates attainable by Native Americans approached those appropriate for maximum sustained yield or populations. Hence escapement rates probably exceeded optima.

Tribal populations declined sharply about 100-500 years ago, attacked by smallpox, measles, sexually-transmitted diseases, cholera, and other pathogens imported from Europe. Fishing rates likely declined in concert.

Inherent in such calculations is the assumption that fish populations in the late 1800s represented a reasonable expression of average effects of cyclic variation in freshwater and ocean habitat conditions. No one currently has determined validity of that assumption. It is, however, quite certain that salmon and steelhead have declined to a small fraction of their former abundance (Figure 3-2 in NRC 1996). Peak catches in the 1800s by all fishers may have included 3-4 million salmon and steelhead (Chapman 1986). Total run size for all salmon and steelhead recently has ranged from 1 to 2 million fish. About three-quarters of recent spring Chinook and summer steelhead runs have consisted of fish cultured to smolt size in hatcheries.

While actual numbers of adult spring Chinook salmon and steelhead produced by the upper Columbia River basin in the pre-development period are not available, one can attempt to estimate them, albeit roughly. From Fulton (1968, his Table 2), one can total formerly used spring Chinook salmon habitat throughout the Columbia River basin as 10,002 kilometres, and upper Columbia habitat (upstream from the Yakima River) as 899 kilometres, or about 9% of the total. Chapman (1986) estimated that about 500,000 spring Chinook returned to the Columbia

River in the latter portion of the 1800s. Nine % of that total would be about 45,000 spring Chinook salmon attributable to the upper Columbia River.

Anadromous fish of the upper Columbia area must have fluctuated because of variable environmental conditions. Certain combinations of freshwater and ocean habitat conditions appear to have caused very low salmon returns in some years well before non-Indians degraded habitat or began fishing intensively (Mullan et al. 1986), and probably "bonus" returns in others (as, recently, in 2002 and 2003).

Numbers of spring Chinook that escaped to the Columbia River at Priest Rapids Dam in the most-recent decade have averaged about 15,800 (adults plus jacks). This escapement would convert to approximately 21,000 fish downstream from Bonneville Dam (adjusting for 4% loss of adults for each dam between the estuary and counting station at Priest Rapids Dam, and a fishing rate of about 5%, mostly upstream from Bonneville Dam). Hatcheries had contributed about 75-80% of these fish. Thus naturally-produced spring Chinook salmon abundance in the upper Columbia area can be estimated to have declined to about 5,000 fish; a decrease of 89%. Estimation of the percentage decline in wild summer steelhead produced in the upper Columbia River would indicate a similar major decline. Salmon and steelhead genetic diversity has also declined as a result of artificial propagation and widespread stock transfers.

Both spring Chinook and summer steelhead in the upper Columbia River have been listed under provisions of the Endangered Species Act (ESA) of 1972. Factors that depressed numbers of wild spring Chinook and steelhead sufficiently to lead to ESA listing include range extirpation, fishing, artificial propagation, and habitat degradation caused by dams, irrigation, channelization, overgrazing, and public policy. Lackey (2001) wrote:

The depressed abundance of wild stocks was caused by a well known but poorly understood combination of factors, including unfavorable ocean or climatic conditions; excessive commercial, recreational, and subsistence fishing; various farming and ranching practices; dams built for electricity generation, flood control, and irrigation, and many other purposes; water diversions for agricultural, municipal, or commercial requirements; hatchery production to supplement diminished runs or produce salmon for the retail market; degraded spawning and rearing habitat; predation by marine mammals, birds, and other fish species; competition, especially with exotic fish species; diseases and parasites; and many others.

Lackey (2001) also wrote that "technocrats" who represent various organizations have developed estimates of the proportions of wild fish declines attributable to one or more of the above-mentioned factors for decline. He pointed out that models that resulted in that work usually ended up supporting the favored policy position of the supporting organization.

Fishing

It seems quite unlikely that aboriginal fishing was responsible for run declines in the Columbia River (Craig and Hacker 1940; Chapman 1986; Lackey 1999). Their artisanal fishing methods (Craig and Hacker 1940) were incapable of harvesting upper Columbia River spring Chinook and summer steelhead at rates that approached or exceeded optima for maximum sustained yield (probably 68% and 69% for spring Chinook and steelhead, respectively, as estimated in Chapman (1986)).

An intense industrial fishery in the lower Columbia River, employing traps, beach seines, gillnets, and fishwheels, developed in the latter half of the 1800s. In the early 1900s, troll fisheries developed to catch salmon even before they reached the Columbia River. The late-spring and early-summer Chinook salmon returns, which constituted the heart of the Columbia River runs, were decimated by the early 1900s (Thompson 1951).

As these run components rapidly declined, fishing shifted earlier, later, and to other species, changes that, for a time, numerically masked the precipitous decline in the sought-after late-spring and early-summer fish.

By the early 1930s, mean escapement of spring Chinook into the upper Columbia River upstream from Rock Island Dam had declined to fewer than 3,000 fish. That escapement would represent perhaps 12,000 fish arriving in the lower Columbia River, inasmuch as fishing rates exceeded 75% in that period. Only Rock Island Dam (1933) lay athwart the Columbia River. Mean returns of summer steelhead to the upper Columbia River were lower than 4,000 fish in the first part of the 1930s. Harvest rates of 70%, and probably higher, were common before the 1940s. If one assumes a 70% rate, returns of upper Columbia summer steelhead to the estuary may have amounted to about 13,000 fish.

By the 1930s and 1940s, restrictions on fishing time and gear had increased. For example, purse seines were outlawed in 1917, whip seines in 1923, fish wheels in 1927 (in Oregon), seines and traps east of Cascade Locks in Oregon in 1927, drag seines, traps, and set nets in 1935 (Washington), and seasons were gradually shortened. Catch rates almost certainly were much higher than those appropriate for maximum sustained yield or populations for several decades before then.

It is important to remember that fishing intensity, unless pursued to stock extinctions, can be relaxed by management action. If habitat remains intact, stocks can rebound. Presently, fishing rates have been reduced well below 10% for spring Chinook and 13% for summer steelhead (see section on harvest), yet wild and natural components of the respective runs in the upper Columbia River have not responded markedly. Currently, factors other than fishing depress these fish of the upper Columbia River.

Fisheries of the late 1800s

The population of humans in the Columbia River Basin developed rapidly with extensive immigration from the eastern US, beginning in the mid-1800s. Efficient fishing techniques, and preservation methods such as canning, set the stage for overexploitation of Columbia River salmon stocks. The onslaught of techniques included gillnets, traps, horse-pulled beach seines, purse seines, and fish wheels.

Intense fishing first targeted the abundant late-spring and summer components of what was a bell-shaped abundance function for Chinook salmon. Spring Chinook entered first, and in relatively small numbers (Chapman 1986). The late-spring and summer runs formed the central bulk of the abundance timing function. Finally, fall Chinook arrived in lesser numbers. Thompson (1951) showed that fishing had all but extirpated the central bulk of the return distribution by 1919. As that fishery disappeared, industry shifted to sockeye, steelhead, coho, and fall Chinook. These shifts partially masked the decline of overfished run components.

Although governmental agencies existed with nominal responsibility for fishery management (e.g., US Bureau of Fisheries, Oregon Fish Commission), demand for fish and gear competition, chiefly among commercial fishermen brooked little interference with seasons and fishing intensity. Washington passed its first gear restriction in 1866, some six years after commercial fishing became an important Columbia River industry. Oregon's first restriction came in 1878. Not until 1899 did Oregon and Washington begin to jointly manage Columbia River fisheries.

There can be little doubt that the relentless fishing intensity in most of the latter half of the 1800s and early 1900s substantially exceeded optimum rates. Chapman (1986) assumed that extant rates were 80-85% on spring and summer Chinook, 88% on fall Chinook, and 85% on steelhead.

The 1900s - decades of change

In 1909, Oregon and Washington instituted joint consistent fishing seasons. About 1910-12, as reasonably dependable internal combustion engines became available, troll fishing for salmon developed, enabling offshore fishing on Columbia River stocks mixed with fish from other rivers. Some inflation of early Columbia River landing statistics likely occurred as a result of troll-caught salmon sales inside the Columbia River mouth.

In 1917, purse seines were prohibited in the Columbia River. These regulations, as several others later, likely resulted in part from gear wars rather than conservation. Whip seines became illegal in 1923, and fish wheels in Oregon were prohibited in 1927. Fish wheels in Washington remained legal until 1935. Washington prohibited drag seines, traps, and set nets in 1935, while Oregon waited until 1949 to so act.

Washington law prohibited commercial take or sale of steelhead from the Columbia River after 1934, while Oregon continued to permit take and sale of steelhead by non-s until 1975.

Meanwhile, upriver dams began to deny salmon access to habitat. Swan Falls Dam on the Snake River was the first mainstem obstacle (1910). On the Columbia River mainstem, Rock Island Dam was completed in 1933, Bonneville Dam in 1938. These facilities provided the first consistent numerical assessments of fish passage (only harvest data were available formerly). Grand Coulee Dam denied fish access to salmon and steelhead that formerly used Canadian tributaries and the Spokane and San Poil rivers. Small irrigation dams also chipped away at fish habitat, beginning in the 1800s.

The year 1957 marked a major change in Native American fisheries. The Dalles Dam, completed in that year, flooded the most important traditional and important fishing dipnetting site in the Columbia River, at Celilo Falls. Catch rates in 1957 in Zone 6 dropped dramatically, and did not increase until the early 1960s afterIndiansshifted to set gillnets.

Commercial fishing, and most Native American subsistence fishing in the latter half of the 1900s, was confined to gillnets. Downstream from Bonneville Dam, in zones 1-5, only drift nets were employed. In Zone 6, set gillnets were used. Gillnets do not facilitate release of gilled fish alive. Hence, the principal means for protecting weak stocks of salmon and steelhead are area and time closures. Large mesh sizes in the 1990s afforded some protection for upper Columbia A-group steelhead (most upper Columbia summer steelhead are in this group of smaller steelhead), although some larger steelhead that spent two years at sea were taken during late summer during the fall Chinook season.

As upriver spring Chinook populations declined sharply in the last quarter of the 1900s, managers reduced commercial fishing seasons in zones 1-5 and tribes reduced harvest rates in Zone 6. Hatchery-produced salmon and steelhead increasingly dominated runs.

Effects of harvest on wild/natural spring Chinook and steelhead of the upper Columbia River are very difficult to control in mixed-stock fisheries of zones 1-5 (Columbia River mouth to Bonneville Dam) and Zone 6 (upstream from Bonneville Dam, concentrated in Bonneville, The Dalles, and John Day pools). Gillnets are the most-utilized fishing technique, indiscriminate in selecting one stock or another or hatchery fish over wild ones. Mixed-stock fisheries are particularly detrimental to naturally small populations or those depressed by human activities (Spence et al. 1996; NRC 1996).

Only through virtual elimination of fishing on weak stocks can managers achieve protection for them. Fisheries in zones 1-6 have been curtailed sharply to protect ESA-listed stocks, chiefly destined for the Snake and upper Columbia rivers. This has led to excess escapements of spring Chinook of hatchery origin, leading to public policy conflicts with respect to management use of the excess returns when they arrive at the hatchery.

Near elimination of harvest on weak stocks can be accomplished by fishery closures, restrictions on area and times of fishing, limitations on gillnet mesh sizes, sometimes combined with net modifications (e.g., trammel nets that entangle rather than gill fish).

Sport and Native American subsistence catches have been confined largely to areas short distances downstream from hatcheries where managers expect sufficient returns (e.g., on Icicle Creek downstream from Leavenworth National Fish Hatchery).

Columbia River fishery management in the last third of the 1900s was based in large measure on the concept of maximum sustained yield (MSY) (NRC 1996). At least two important issues make that concept obsolete for future management. The first is that stock-recruit models, from which MSY was determined, are based on historical adult and progeny adult information obtained under past environmental conditions. Those conditions changed, or re-set, as successive mainstem dams came on line, especially after the early 1950s. They may also change markedly over time with cyclicity of the ocean environment. Furthermore, MSY management does not acknowledge value of “excess” escapement as (1) a means of augmenting nutrient levels by bringing marine nutrients to the infertile streams of the upper Columbia River, or (2) important in fostering competition for mates and spawning sites. The MSY paradigm now does not well serve managers, especially for upriver anadromous stocks.

Current fisheries

Extremely restrictive fisheries are allowed in the lower Columbia River for spring Chinook and steelhead in order to protect listed fish (including upper Columbia River spring Chinook and steelhead). For example, a federally-established limit of 2% incidental kill of wild spring Chinook and wild steelhead was set in 2004 for non-tribal fisheries; of that allowance, a maximum kill of 1.2% was set for the recreational fishery and 0.8% for the commercial fishery in zones 1-5. These conservative impacts were emplaced in spite of an expected spring Chinook run to the Columbia River of 500,000 fish, the second largest run since 1938, when Bonneville Dam counts began. Tribal gillnet fisheries in Zone 6 are likely to harvest an additional 8 to 10%.

Current restrictions also require sport anglers between the Rocky Point/Tongue Point line in the estuary upstream to the I-5 bridge to maintain caught fish that have intact adipose fins in the water as they remove the hook. Commercial fishers must use a combination of tangle net (4.25 inch mesh) and large mesh sizes (9-9.75 inches), not longer than 150 fathoms. Recovery boxes on board must be used for any wild fish captured, and on-board observers determine the number of wild fish caught and released.

ESA-listed upriver stocks, including those in the upper Columbia, prevent directed fisheries, even though substantial numbers of hatchery-produced spring Chinook could be taken. Upriver summer steelhead may not be harvested in the commercial fishery of zones 1-5.

A set-gillnet fishery for spring Chinook and steelhead, classed as "ceremonial and subsistence" is prosecuted byIndiansin Zone 6. Steelhead captured byIndians in Zone 6 can be sold or used as "ceremonial and subsistence" harvest. Mean catch rates in the last half of the 1990s equaled about 10%.

Fishing in the future

Schaller et al. (1999) estimated spawner numbers required for full seeding of spawning areas used by wild Columbia River spring Chinook salmon as 4,808 for the Wenatchee River, 496 for the Entiat River, and 1,379 fish for the Methow River, a total of 6,683. Other estimates have placed the spawner requirement higher. Estimates for the Okanogan have been lacking. The assessment phase of subbasin planning estimates abundance potential in the *hundreds* (adults)for spring Chinook.

Mainstem multipurpose dam projects in the Columbia River kill upper Columbia River spring Chinook and steelhead smolts at cumulative rates that may approach 45-50%. Adult inter-dam loss at 4% per project accumulates to 25% (Wenatchee River fish), and more for fish destined for tributaries upstream from Rocky Reach and Wells dams. Under these pressures from dam-related mortality, wild fish cannot sustain a directed fishery prosecuted with gillnets, and their escapements, even at full seeding, are insufficient to return one progeny spawner for each parent spawner.

Four solutions are theoretically feasible. The first, the approach now employed, is to severely restrict harvest, and to supplement wild fish with hatchery programs aimed at maintaining and fostering genetic adaptiveness peculiar to each upper Columbia River spawning/rearing area. The long-term utility and appropriateness of this approach has yet to be demonstrated.

A second approach is to shift mainstem fisheries to live-catch methods that permit identification and release of wild fish unharmed (NRC 1996). Although live-catch systems would permit substantially greater harvest of hatchery fish, political resistance to this option is strong. Tribal interests regard such proposals as interference with treaty rights.

The third is to confine fisheries aimed at hatchery fish to terminal areas (e.g., Icicle Creek spring Chinook, supported by Leavenworth National Fish Hatchery and by some natural spawners not listed under the ESA, are harvestable in Icicle Creek downstream from the hatchery). Fish quality for spring Chinook destined to spawn in terminal areas of the upper Columbia River declines as fish progress upstream. Quality in the terminal areas cannot compete with quality of pen-reared, or ocean- or estuary-caught salmon. Pen-reared salmon have made up over 50% of marketed salmon in recent years.

The fourth is to stop all fishing other than terminal harvests. NRC (1996) discussed this option, but noted that it is fraught with treaty and international political and legal issues.

Effects of fishing on population characteristics

High fishing rates in the 1800s virtually extirpated some late-spring and summer stocks of Chinook salmon. Past effects of fishing on now-listed spring Chinook and steelhead of the upper Columbia River are unknown. Attempts to sustain fishing by use of hatchery fish influenced genetic composition of at least summer steelhead, as progeny of adults trapped at Priest Rapids and Wells dams were, for several generations, liberated as smolts in the major tributaries of the upper Columbia River without regard to fostering local adaptations. NRC (1996) noted: "The continual erosion of the locally adapted groups that are the basis of salmon reproduction constitutes the pivotal threat to salmon conservation today."

Nelson and Soule (1987) and Thorpe (1993) reviewed effects of fishing on genetic makeup of salmon populations. Intense fishing probably altered genetics of pink salmon in the north Pacific, for example, with the result that adult size declined. Historically, intense gillnetting in the Columbia River may have increased the proportion of smaller fish in escapements, with potential increases in jack fractions and reduced fecundity of females. Three-ocean spring Chinook adults may have been selected against at earlier high fishing rates. At current low fishing rates, genetic selection against large spring Chinook and steelhead by gillnets likely does not occur (Chapman et al. 1995).

Mainstem Columbia River dams

Spring Chinook and steelhead production areas in the pre-development period included the Wenatchee, Entiat, Methow, Okanagan, and limited portions of the Spokane, San Poil, Colville Tribes, Kettle, Pend O'Reille, and Kootenay Rivers. The Grand Coulee Dam project and Chief Joseph Dam eliminated access to the Columbia River upstream. The Grand Coulee Fish Maintenance Project (GCFMP), designed to transfer populations formerly produced upstream into remaining habitat downstream from Grand Coulee, trapped fish at Rock Island from 1939 to 1943. Managers placed some adults in tributaries (e.g., Nason Creek) to spawn naturally, and artificially propagated others. Spring Chinook from outside the upper Columbia were introduced. The extreme changes in population structures permanently transfigured populations of spring Chinook and steelhead of the upper Columbia River (Chapman et al. 1995).

The era of mainstem multi-purpose dams downstream from the Grand Coulee project began with Rock Island Dam in 1933 and culminated with completion of Wells Dam. Seven mainstem dams lie between the Wenatchee River and the sea, eight downstream from the Entiat River, and nine between the Methow/Okanagan systems and the estuary. Dam-related losses are substantial. For example, adult salmon and steelhead mortality in the reaches between projects has been estimated as 4% or more in some years (Chapman et al. 1994 and 1995), and juvenile losses at each project can amount to about 10%.

Some of the losses result from physical effects of adult and smolt passage. Others derive from altered limnological conditions that increase predation by fish and birds, or cause gas-bubble trauma. Whatever the direct causes, losses for Wenatchee adults and juveniles could accumulate to an estimated 25% and 52%, respectively. For Methow River fish, which must pass two additional dams, losses may accumulate to an estimated 31% and 61% for adults and juveniles, respectively. In a very real sense, dam-related mortality appears to have replaced mortality rates once caused by intensive mainstem fishing. The cumulative loss rates also explain why so much mitigative effort has been allocated to project-related mortality rates.

Dams for storage, like Grand Coulee, and mainstem multipurpose dams have had other effects on ecology of salmon and steelhead. Estuarine limnology has shifted from a basis of macrodetritus and benthos to a microdetrital, planktonic trophic structure that favors non-salmonids. Spring freshet flows and turbidity have declined in the river and estuary, and the Columbia River plume has been reduced seasonally (Ebbesmeyer and Tangborn 1993, Chapman et al. 1994 and 1995, NRC 1996) with potential but largely unknown effects on survival of salmon and steelhead in the estuary and nearshore ocean.

Tributary habitat degradation

Perhaps the most important habitat influence on wild spring Chinook and steelhead in the upper Columbia River involves water diversion, withdrawal, and application to crops. The Columbia Basin Project, operated by the US Bureau of Reclamation, constitutes the largest single water diversion and application system in the area. In the Wenatchee, Okanagan, and Entiat River basins, water diversion for orchards is important. In the Methow River system, crops and pasturage divert tributary and mainstem water.

For wild spring Chinook and summer steelhead, diversions on tributaries of the Wenatchee, Entiat, Okanagan, and Methow rivers must be considered a factor for decline. Instream flows have been depleted downstream from irrigation diversion dams, reducing instream habitat and improving predator access to rearing juvenile fish. Diversions were unscreened for many decades, permitting downstream migrants to pass into, and perish in, fields and orchards. Today some fish diversion screens are less than 100% effective. Diversion dams were built in some cases without adequate provision for adult passage.

Cattle pastures adjacent to tributaries can, and have, denuded riparian vegetation and permitted nutrients from fecal material, and fine sediment, to enter salmon and steelhead habitat. Overgrazing by sheep and cattle has locally increased runoff of fine sediments and increased stream flow peaks (Mullan et al. 1992).

Channelization reduces instream habitat by straightening meanders, increasing water velocity, and eliminating or reducing riparian cover and input of large woody debris. It can and has occurred associated with roads and railroad grades, residential encroachment, and protection of agricultural land. Diking and channel-bank riprap prevents stream lateral movements across alluvial floodplains, particularly in the Methow and Okanagan drainages.

Roads for logging access and log skidding can and have locally introduced fine sediments to spring Chinook and summer steelhead habitat. Riparian communities have at times been disrupted, reducing shade and availability of large woody debris. Timber removal alters hydrology of tributaries until regrowth occurs.

Of the foregoing habitat factors, diversions and associated diversion dams probably constitute the most important factors for decline. Mullan et al. (1992) concluded, after reviewing habitat conditions in the tributaries of the upper Columbia River:

Despite some abuse from the recent activities of humans, there appears to be little or no net loss of the functional features of mid-Columbia River tributaries. In large part this is a fortuitous outcome from the lack of human interplay, a result of the formidable topological and climatic barriers that restrict settlement. To be sure, there are problems in sustaining populations of salmonids, but, for the most part, these are minor, localized, and controllable compared to the mainstem Columbia River.

Hatcheries

NRC (1996) and Flagg et al. (2001) discussed at length the risks and problems associated with use of hatcheries to compensate for, or supplement, fish produced in the wild. NRC (1996) noted demographic risk, pointing out that large-scale releases of hatchery fish exacerbate mixed-stock harvest problems. Wild fish cannot sustain harvest rates that would be appropriate for hatchery fish. Demand is essentially unlimited for salmon and steelhead, and advocacy groups for various fisheries often clamor to have access to ever-more harvestable fish from hatcheries.

Solutions to the mixed-stock fishing problem are elusive. Gillnets, for example, have only limited potential for releasing wild spring Chinook and steelhead unharmed. Terminal fisheries, particularly for spring Chinook after they enter waters that contain only hatchery fish, are impractical for commercial fisheries because fish quality there has declined greatly. Steelhead are somewhat easier to manage in sport fisheries, where fish known to be of wild origin (identifiable by an intact adipose fin) can be released with minimal mortality and hatchery fish (with adipose intact) kept.

Genetic and evolutionary risks for hatchery fish and interacting populations include inbreeding depression, loss of population identity and within-population diversity, and domestication selection (NRC 1996). Recognition of these possible factors has increased in recent decades. Unfortunately, measures used in the GCFMP and steelhead management in the upper Columbia (until recently) almost certainly realized some of the listed risks and contributed to decreased genetic diversity of wild fish. Steelhead adults were collected at Priest Rapids, and later at Wells Dam, their progeny reared in hatcheries and released as smolts to the various tributaries without regard to fostering local adaptation in tributaries.

Foraging, social behavior, time of spawning, and predator avoidance can differ for fish reared in the hatchery and in the wild (Flagg et al. 2001). While resulting differences may primarily reduce survival of hatchery-produced salmon and steelhead, negative effects may carry into the wild population where adults of hatchery origin spawn with wild fish. Effects of disease on released hatchery fish and on wild fish are poorly understood, but likely to be negative (Flagg et al. 2001, tables 10-11 summarize these).

Also poorly understood are ecological effects of hatchery programs. NRC (1996) noted that 5.5 billion salmon smolts of all species are released to the wild each year around the Pacific Rim, with potential trophic effects that may lead to altered body size and survival of wild fish. Emphasis on hatchery fish denies marine nutrients to infertile rearing streams used by relatively few wild spring Chinook salmon and steelhead.

Public policy

The Marine Mammals Protection Act of 1976 afforded seals and sea lions complete protection from killing by humans. These animals increased sharply in abundance thereafter (Fresh 1996).

NRC (1996) discussed the potential for effects on salmon and steelhead. They concluded that such predation was "probably not a major factor in the current decline of salmon in general." Chapman et al. (1994 and 1995) suggested a need for adaptive management, including population control through selective harvest and/or sterilization of live-captured seals on haul-out beaches. They pointed out that although pinnipeds and salmon coexisted long before man interfered ecologically, contrary views hold that it is unrealistic for man to manage and prey upon salmon without managing one of their principal predators.

The Corps of Engineers dredges shipping channels in the lower Columbia River and has created artificial islands with the spoils. Caspian terns have exponentially increased in the Columbia River estuary after dredge spoils created near-ideal nesting sites within the boundaries of a U.S Fish and Wildlife Service refuge. Many PIT tags have been found on artificial island sites, demonstrating that terns may be very important predators on smolts that must pass through the estuary to reach the sea.

Public policy clearly has more ubiquitous influences, both direct and indirect, than the foregoing examples (NRC 1996). Mainstem dams are a direct outgrowth of public policy, constructed by the federal government (Chief Joseph, Grand Coulee, and four mainstem Columbia River dams downstream from the Snake River) or by public utilities licensed by the federal Energy Regulatory Commission (Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids dams).

Human population growth in the Pacific Northwest, often fostered by local government boosters, places more pressure every year on salmon and steelhead. Lackey (1999, 2001) eloquently described the ramifications for salmon of human population growth and public policies and decisions. He noted that the Pacific Northwest has a population increase rate that rivals many developing third-world nations. Public policies affect water diversions, instream flows, water temperature, dam operations, manufacturing, urban development, national defense, fishing, hatchery outputs, and transportation of people and goods. All of these factors and more, some of greater influence than others, have depressed salmon and steelhead abundance and potential for restoration of depressed fish populations.

Marsh (1994) may have inadvertently captured an essence of the effects of public policy on salmon when he wrote:

…the process is seriously, significantly, flawed because it is too heavily geared towards a status quo that has allowed all forms of river activity to proceed in a deficit situation – that is, relatively small steps, minor improvements and adjustments – when the situation literally cries out for a major overhaul.

He was referring to salmon restoration and management. But the underlying question was identified by Lackey's papers: Given human population growth and perceived needs, is Pacific Northwest society prepared to make the sacrifices necessary to restore wild listed spring Chinook and steelhead in the upper Columbia River (and elsewhere in the Columbia River basin)? The answer to date appears to be "no."

3.32 Synthesis Of Previous Efforts to Determine Important Factors For Decline of Okanogan Subbasin and Upper River Columbia Fish Populations

3.32.1 Out-of-Subbasin Effects and Mortality Assumptions

Climate change affects

Decadal scale climate-driven fluctuations in marine conditions are a dominant factor influencing salmonid survival in marine waters. This factor appears to account for the greatest amount of change in survival from smolt through return as adults documented over the decades.

NOAA Fisheries (Williams et al. 2003-draft) recently characterized the importance of marine-based processes on the abundance of Columbia River salmon as follows:

Increasing evidence points to dramatic changes in the marine ecosystem of the northern Pacific Ocean resulting from shifts in climate over the past 2000 years (Finney et al. 2002, Moore et al. 2002). Throughout this region, changes in ocean-climate conditions have influenced zooplankton, benthic invertebrate, seabird, and fish populations (McGowan et al. 1998). In particular, analyses of data from the last 100 years demonstrate a strong relationship between ocean conditions and the production of Pacific salmon (*Oncorhynchus spp*.) across a range of spatial and temporal scales (Mantua et al. 1997, Beamish et al. 1999). The varied response of salmon to these past environmental changes likely reflects their complex life history and the wide diversity of freshwater and marine habitats that they occupy (Hilborn et al. 2003).

Recent evidence links Chinook salmon from the Columbia River basin to cyclic changes in ocean-climate conditions. Modeling exercises directed at explaining the negative effects of various anthropogenic activities on the productivity of Snake River spring-summer (SRSS) Chinook salmon identified the estuary and ocean environments as important sources of unexplained variation in stock performance (Kareiva et al. 2000, Wilson 2003). Using catch records from commercial fisheries, Botsford and Lawrence (2002) found reasonable correlations between the inferred survival of Columbia River Chinook salmon and physical attributes of the ocean, such as sea-surface temperature and coastal upwelling.

Building upon these previous studies, Scheuerell and Williams (in review) found that they could actually forecast changes in the smolt-to-adult survival of SRSS Chinook from changes in coastal ocean upwelling over the past 37 years, including the rapid decline in the 1960-70s and the increase in the late 1990s. All of these analyses highlight the important effects of the ocean in determining smolt-to-adult survival, and further support Pearcy's {1992 #307} assertion that the primary influence of the ocean on salmon survival occurs early within the first year that juveniles occupy coastal waters.

Smolt survival through hydro-system

Smolt and adult mortality associated with passage through the hydrosystem is still problematic, but efforts are underway to improve passages conditions and evaluate progress.

System survival studies conducted during the 1980s revealed that the survival of spring-migrating smolts was poor. Skalski and Giorgi (1999) summarized results from seven studies conducted by either the Public Utility Districts or the Fish Passage Center that decade. Four studies used yearling spring Chinook and three used steelhead. The average annual per-project survival across all studies was 86.2% (range = 83.4 to 88.7%). This equates to only 47.6% survival for smolts passing through five hydroelectric projects, from Wells Dam to Priest Rapids Dam. Today the HCP for Douglas and Chelan County PUDs specifies a smolt survival goal of 93% per project for all species of smolts. If this goal can be realized through passage improvements currently being implemented or explored at all five dams, then the smolt survival through that system would equate to 69.6%. If these passage survival goals can be achieved they would provide a substantive contribution to the recovery of ESA-listed spring Chinook and steelhead ESUs in the Upper Columbia.

The existence and magnitude of delayed effects associated with passage through the hydrosystem remains unresolved and constitutes a critical uncertainty in the context of ESU recovery.

It has been hypothesized that cumulative effects may be incurred as smolts migrate through the hydrosystem, which are not expressed until smolts enter saltwater. Such a scenario has proved difficult to test and verify. NOAA Fisheries established the Plan for Analyzing and Testing Hypotheses (PATH) in 1995. For five years this issue was one of many key ones that were investigated. Consensus was never reached. Subsequent to PATH, a number of papers were published, some supporting, and some contesting the hypothesis. The debate still continues today and is a prominent topic treated in a recent draft technical memorandum published by NOAA Fisheries (Williams et al. 2003-draft).

The condition of smolts migrating from a watershed can influence survival in subsequent life stages. Thus, improving habitat conditions may realize benefits beyond those reflected in egg to smolt survival.

Total Mortality Outside The Subbasin

The most comprehensive and instructive index of ESU survival beyond the watershed is smolt-to-adult return rate (SAR). It is a common survival index used to characterize the performance of salmonid populations throughout the Pacific Northwest. This survival index reflects all sources of mortality affecting migrating smolts through returning adults.

These include effects associated with:

- Hydrosystem operations
- Migration conditions in the mainstem, including both natural and anthropogenic causes (e.g., actions associated urbanization and industrialization)
- Fish condition that can vary annually by hatchery or rearing stream
- Marine/estuarine conditions and processes influenced by natural and anthropogenic factors
- Harvest in marine and riverine waters
- Predation

SARs can be calculated in different ways. Juvenile salmonids implanted with either PIT tags or CWT can be used to estimate SAR, if returning adults can be sampled at strategic locations. Alternatively, the survival index can be calculated by estimating smolt abundance passing some site (a dam or the mouth of a tributary), then subsequently estimating adult returns to that location for a specific brood year. Often times SARs are expressed in terms of return rates to the mouth of the Columbia River. This calculation requires additional information such as estimates of inriver harvest and adult passage mortality.

3.33 Upper Columbia Smolt-to-adult Survival

3.33.1 Spring Chinook

Historical estimates of SAR for naturally produced spring Chinook in the upper Columbia River have been reported by Mullan et al. (1992) and Raymond (1988). Mullan et al. estimated the smolt-to-adult return rate for the collective populations produced in the Wenatchee, Entiat, and Methow rivers for the years 1967 to 1987. Over that period SAR ranged from 2.0 to 10.1%. They noted that the estimates reflect corrections for adult passage mortality and marine and inriver harvest.

Raymond (1988) estimated the % returning adults to the uppermost dam on the upper Columbia River for the years 1962 through 1984. Values for wild spring Chinook ranged from 0.7 to 4.9% over those years. One reason Raymond's values are generally lower than those reported by Mullan et al. (1992) may be that his estimates are not adjusted for adult passage mortality and marine harvest, whereas Mullan et al. (1992) were. Also, the reference locations for calculating SARs differed, with Raymond focusing on the upper dam and the other investigators referencing the spawning grounds. This raises an important point. When comparing SAR values among investigators, the locations where smolts and adults are enumerated must be known.

SAR estimates for the most recent decade have not been calculated and published by any other investigators. Thus the historical estimates provide the only guidance on this matter.

3.33.2 Steelhead

Raymond (1988) estimated smolt-to-adult return percentages for the combined wild and hatchery steelhead population (1962-1984). Adult return rates to the upper dam ranged from a low of 0.2% for the smolt migration of 1977 to a high of 6.4% for the 1982 smolt migration. Mullan et al. (1992) reported SARs for only one stock (Well Hatchery steelhead) from 1982 to 1987. The percent return to the mouth of the Columbia River averaged 6.38%, ranging from 1.32 to 14.28%. Survival back to Wells Dam averaged 3.01% and ranged from 0.72 to 7.31. These estimates aligned closely with Raymond's estimates for the overlapping years of 1982 to 1984. Chapman et al. (1994) compiled data from three hatcheries in the upper Columbia (Chelan, Entiat, and Leavenworth) for the years 1961 to 1991. Smolt-to-adult survival averaged 1.7%, with a range from 0.16-7.54%. The foregoing information is shown.

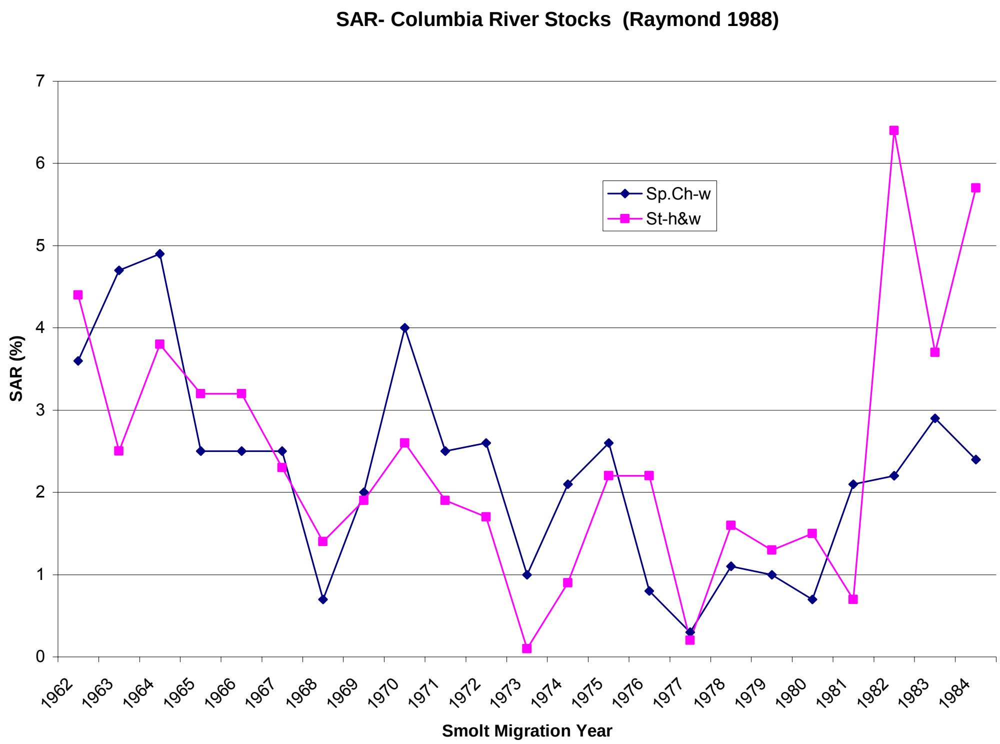


Figure 43Survival from smolt to returning adult for upper Columbia wild spring Chinook and steelhead stocks as estimated by Raymond (1988). The reference point for smolt abundance is the upper dam on the Columbia and estimated return of adults to that location. Years refer to smolt migration years.

Selecting Values for SAR to Use in ESU-Level Habitat Effectiveness Evaluations

Clearly SAR estimates for both spring Chinook and steelhead vary greatly across years. Over the decades changes spanning at least an order of magnitude were commonly observed. Thus, no single survival index value is satisfactory for accurately representing the performance of an ESU beyond the watershed. But accuracy may not be a central requirement for selecting a standard SAR that can be applied universally in habitat evaluations that use models like EDT.

In years when smolt to returning adult survival is low, survival from pre-spawner through parr in the tributaries carries more weight in terms of overall lifecycle survival. Conversely, when SARs are high the contribution of survival during the subbasin residence stages contributes less proportionately to overall gravel-to-gravel survival.

What is the importance in establishing the magnitude of survival expressed outside the boundaries of a subbasin? When resource managers wish to compare the effectiveness of tributary habitat actions among subbasins or across ESUs, then effects beyond the bounds of the subbasin or watershed become an issue. For example, if analysts in Subbasin A assume a high SAR index and they use adult abundance as a performance measure in modeling analyses, then the contribution from tributary-resident life stages is diluted. In contrast if analysts in Subbasin B assume a low SAR index, then the contribution of tributary survival is magnified in importance. One could imagine that funding agencies may prefer to invest in habitat projects where the bang for the buck might be greatest. This will be difficult to determine unless a standard out-of-subbasin survival index is adopted by all parties.

Is it practical to ignore effects outside the subbasin and not incorporate them in quantitative analyses? Not if performance measures like productivity and adult abundance are of interest; these are sensitive to hydro, marine, and harvest effects. Thus a SAR-like component should be incorporated into whatever analytical model is employed. However, it may not be practical to run a series of model analyses over a range of SARs to reflect the sensitivity of every watershed population to variable marine or hydrosystem conditions. Therefore, this is another reason why it is advantageous if a standard SAR value and approach can be selected for application when analyzing various populations emanating from different subbasins.

Out of Subbasin Survival Effects in EDT Analyses

Ecosystem Diagnosis and Treatment (EDT) evaluates habitat across the life history of a focal fish species. For anadromous species, this evaluation addresses conditions within a subbasin as well as conditions outside the subbasin in, for example, the mainstem Columbia River, estuary and ocean. Conditions outside the subbasin are often referred to as "Out-of-subbasin effects" or OOSE. While EDT includes out of subbasin effects, the focus of an EDT evaluation is on the potential of a habitat condition within a subbasin. However, it is of interest to understand how survival conditions outside the subbasin might affect protection and restoration priorities within the subbasin.

In contrast to the situation within a subbasin, in EDT, OOSE survival is not calculated from habitat information, instead a set of survival multipliers are used to achieve reported smolt-to-adult survival rates (SAR). These multipliers result in an SAR value for the focal population, which is reported in the standard EDT output summary.

The SAR, as reported in the EDT output, represents the survival from a juvenile leaving the subbasin to an adult returning. Since EDT accounts for age at emigration and at maturation, the survival value will vary depending on the age composition of a population. However, since age-composition for a given population is stable, a single SAR value can be used for each population. For some populations in some watersheds, significant numbers of juveniles that emigrate from the subbasin are not smolts. In these cases the SAR reported by EDT may be an underestimate.

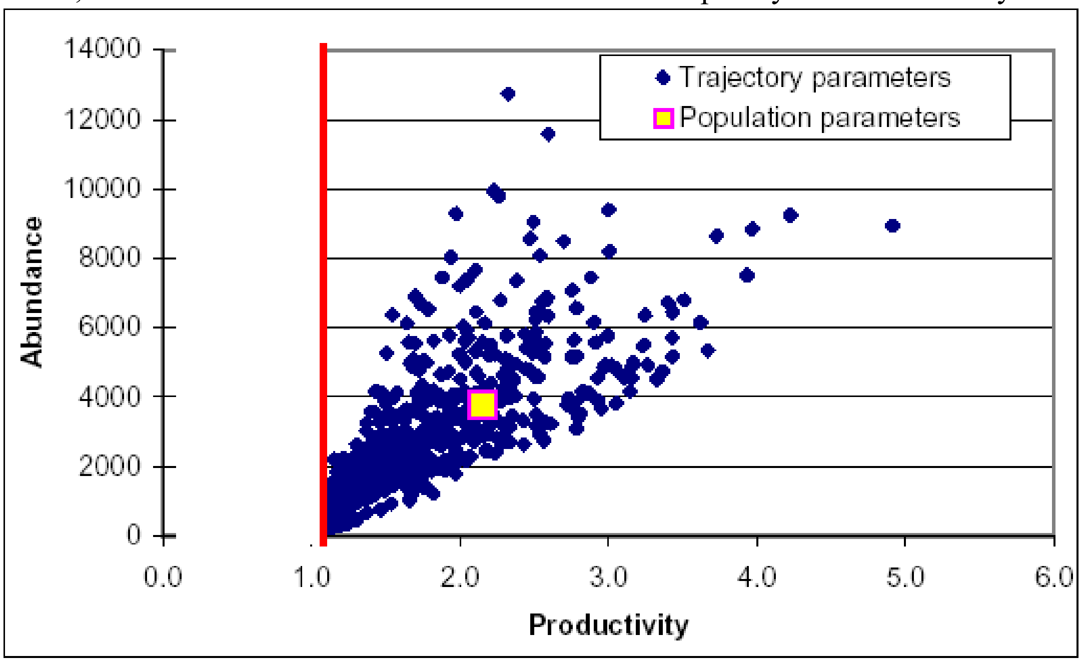
SAR has been estimated from empirical data for some species in a limited number of subbasins (NOAA 2004). Form these estimates it is clear that the SAR is highly variable from year to year and from subbasin to subbasin, and spatial or temporal trends in SAR are difficult to discern. The variability in SAR indicates that the survival rate of smolts leaving a subbasin is highly dependent on conditions both inside and outside the subbasins.

Life History Trajectories in Ecosystem Diagnosis and Treatment

To understand how the SAR affects results in EDT it is necessary to explain the concept of life history trajectories. A life history trajectory is the unbroken sequence of life stages and habitat segments that a fish moves through in completing its full life cycle. Trajectories start and end with spawning at a particular spot (i.e. a stream reach) and at a particular time within a year. At each trajectory segment (defined by a life stage, a location, and a time), the survival conditions are computed from habitat characteristics as they affect the life stage.

Trajectory segments outside the subbasin are greatly simplified by applying constant, population specific survival factors. EDT then computes the cumulative survival of all segments along each trajectory. EDT samples the environment by starting trajectories in a regular pattern along the stream course and at regular time intervals during the spawning season (Figure 44). In a typical stream, EDT generates hundreds of life history trajectories to sample and characterize the habitat conditions within a stream. EDT finally estimates survival parameters for the focal population from this collection of trajectories (Figure ?). Thus the SAR computation is embedded in the trajectory calculations.

To capture the seasonal variations of hydroelectric operations and conditions in the estuary and ocean, survival conditions outside the subbasin are shaped by month within a year.

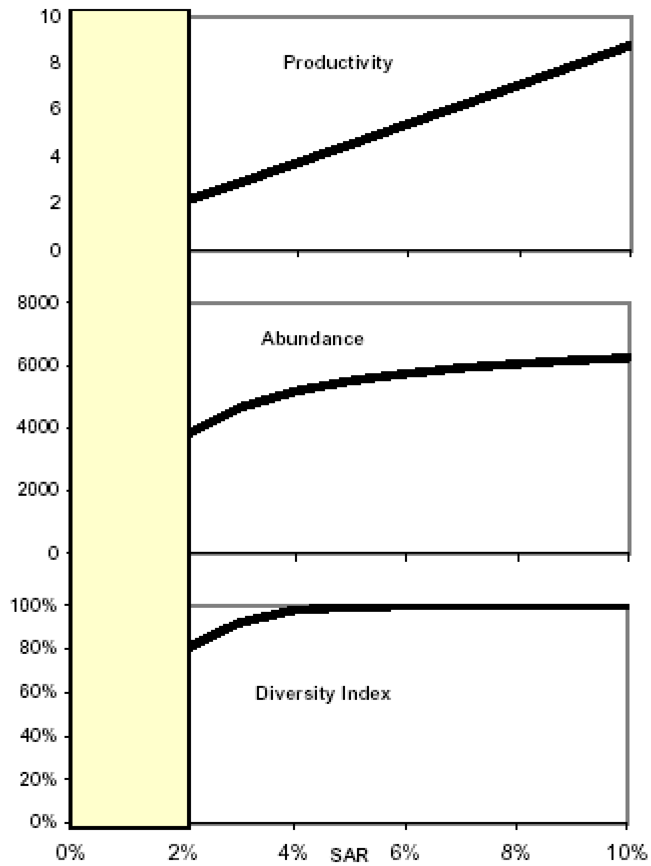


Source: Mobrand Biometrics Inc. 2004

Figure 44 Hypothetical population depicting individual trajectories, the population abundance and productivity parameters EDT derives from the trajectories

Effects of OOSE on population parameters

A hypothetical example might help illustrate how the survival outside the subbasin, the SAR, affects the EDT estimates of the population parameters of the focal population. There is a near linear relationship between productivity and the SAR as might be expected (Figure 3). The deviation from linearity is because of the fact that the SAR affects the population productivity parameter through the individual trajectories described above. For small SARs (< 2% in the example), both equilibrium abundance and the diversity index are very sensitive to changes in SAR (Figure ?). Among the consequences of this are that errors in the estimate of SAR in this range will have a significant effect on the abundance and diversity estimates. It also implies that overall improvements in productivity (e.g. through habitat restoration) will stabilize the population, making it less vulnerable to changes in SAR.



Source: Mobrand Biometrics Inc. 2004

Figure 45 Effects of SAR on EDT estimates of population productivity, abundance and diversity

3.34 Environment/Population Relationships

3.34.1 Most Important Factors For Decline

A number of key documents and reports have addressed factors affecting the decline of wild spring Chinook and steelhead in the upper Columbia. Often the assessments take the form of limiting factor analyses and are reported as such. There is not always clear agreement regarding the importance of various factors. Here we summarize and compare some of the central findings and conclusions offered in a number of key reports.

Chapman et al. (1995) reviewed the status of the spring Chinook salmon ESU of the upper Columbia Basin, including populations in the Wenatchee, Entiat, Methow, and Okanogan rivers. Their key findings and conclusions regarding factors affecting the decline of these wild populations are:

1. The extensive development of mainstem dams and upstream storage reservoirs reduced productivity by 43% from the 1950s through the 1980s.

2. Spawning and rearing habitat has not suffered functional degradation in most areas. However, water withdrawal for irrigation is a serious concern in several key tributaries, particularly in the Methow River Basin.
3. There is no evidence to indicate that inter-specific competition from exotic or native fish species reduced the productivity of this ESU.
4. Inriver harvest rates have been minimal since 1974, but in decades before that, harvest rates ranged from 40-85%. Marine harvest impacts are low, less that 1% for the years 1978 to 1993.

Their report emphasized hydro-passage effects as the primary factor limiting the productivity of this ESU. Risks associated with hatchery programs, and modest degradation in tributary habitat conditions were discussed, but they were not identified as critical factors responsible for the decline in the ESU. Inriver harvest pressures were substantial before 1974, but subsequent to that year harvest rates have been minimal or negligible with the imposition of harvest restrictions.

Chapman et al. (1994) wrote a similar status report for steelhead populations comprising the listed upper Columbia ESU. In their assessment the following factors were identified as the chief causes of the decline of wild steelhead:

- Overfishing prior to the 1950s
- Elimination of access to productive habitat above Grand Coulee Dam with dam emplacement
- Mainstem dams have been the major cause for the depressed runs in recent decades
- Additionally, they suspect two other human activities probably contributed to the decline of wild steelhead:
- Hatchery practices that mixed fish from a variety of sources to seed tributaries
- Mortality (direct and incidental) associated with sport fishing for hatchery-released and resident trout

They did not identify tributary habitat conditions as being important factors in the population decline. In fact they characterize most spawning and rearing areas as being in fair to good condition. However, they noted that irrigation withdrawals in late summer in the Methow, Wenatchee, and Okanogan rivers posed a risk.

Mullan et al. (1992) focused on conditions and processes (including both hatchery influences and habitat factors) within three major watersheds, the Wenatchee, Entiat, and Methow Rivers. In general they concluded that the carrying capacity of those rivers is similar to what it was historically. On page 28 they conclude that natural production of Chinook salmon and steelhead smolts now may be similar to historical production. However, many of Mullen's conclusions have been challenged by more recent analyses' including Shaller et al. and notably, Mullen was silent on the Okanogan as has been the case, inexpicably, with other reviews.

Overall human activities have not badly degraded the tributary habitat, although some localized problem areas were identified. Even so, they note that coho are now extinct in this area. Furthermore, they point to mainstem dams and reservoirs as critical factors impacting stocks emanating from this basin, noting that 62-71% of smolts die while passing through the hydrosystem.

More recently a series of draft subbasin summaries have been published that address limiting factors in the subbasins of the upper Columbia. Electronic copies of these are on the NPCC website. The summaries are supported by a series of limiting factor analyses that were conducted for individual subbasins. Their characterization of tributary habitat conditions as limiting factors contrast with the portrayal by Mullan et al. (1992) and Chapman et al. (1994, 1995).

In general, the limiting factors analyses describe a network of tributaries that has been degraded by assorted human activities, and ecological processes have been compromised. The implication being that some of these areas are important in limiting the productivity of anadromous fish in the basin.

The salmon and steelhead habitat limiting factors assessment for the Okanogan watershed (Entrix & Golder 2002) is the most extensive subbasin evaluation published prior to this subbasin plan. This assessment emphasizes that ongoing hatchery programs have not been able to reestablish salmon and steelhead populations to self-sustaining levels and may not be successful without concomitant improvements in habitat conditions and features across the other "H' sectors. This failure can be attributed to a number of factors including, passage problems and mortality associated with nine hydroelectric facilities on the mainstem Columbia River, unfavorable ocean conditions, harvest pressures, and degradation of ecological processes and habitat within the Okanogan watershed. Importantly, the climatic conditions of the Okanogan naturally restrict habitat use because of thermal and flow barriers that can affect the overall production in the watershed.

These natural environmental conditions limit natural production of salmonids in the Okanogan watershed. In particular, low stream flows in the summer and winter, and high ambient summer temperatures restrict or limit access to habitats. Also, extreme winter conditions can reduce fish growth and activity. In years when moisture availability is limited, dewatered reaches are not uncommon. These conditions restrict salmonid access to habitat, dewater redds, and may strand juveniles, resulting in direct mortality to salmonids.

In some portions of the Okanogan watershed, human activities have perturbed the landscape and exacerbated the degradation of the already naturally limiting habitat. These human activities have primarily occurred in the lower gradient, lower reaches of the tributaries. These impacts are mostly the result of past timber harvest operations, road building and placement, and grazing.

3.35 Synthesis

Collectively, these assessments point to two primary classes of factors associated with anthropogenic activities that have caused the decline and continue to constrain both wild spring Chinook and steelhead production in the Columbia Cascade Province. These principal factors are hydropower development on the mainstem Columbia and degradation of ecological function in important areas within these subbasins.

Although we caution that rigorous quantitative evaluations have yet to be completed. Nevertheless, in order to realize a timely recovery of these ESUs, it appears the prudent strategy is to move forward improving conditions in both sectors simultaneously. Improving access to and condition of spawning and rearing habitat, while fish passage improvements advance, will ensure that the tributaries can offer full advantage to the expected increased escapement associated with implementing the fish passage programs.

To move forward on either front alone, or delay efforts in one sector, may constrain the rate of recovery, or even prevent it. Implementing improvements in hydro and habitat in tandem should maximize productivity by compounding survival improvements across several life stages in lock-step. We think this interaction will maximize the potential for a swifter recovery of these ESUs.

Survival during estuarine and marine residence is recognized as a dominant factor influencing overall returns of adult salmonids. In recent years stocks in the Northwest have benefited from favorable ocean conditions. But climate-driven marine conditions are cyclic, and periods of poorer marine survival are inevitable in the future.

During periods of poor ocean survival, the performance of freshwater life stages takes on increased importance in sustaining robust and resilient populations. Thus, improvements in tributary habitat and hydrosystem passage can increase survival during these critical life stages, and will serve to offset looming periods of poor marine survival.

3.36 Methods and Interpretation

3.36.1 Fisheries Analysis

The Okanogan Subbasin habitat was assessed using the Ecosystem Diagnosis and Treatment (EDT) method for steelhead, spring Chinook and summer /fall Chinook, and contributed to the assessment for sockeye salmon; EDT is an analytical model relating habitat features and biological performance to support conservation and recovery planning for salmonids (Lichatowich et al. 1995; Lestelle et al. 1996; Mobrand et al. 1997; Mobrand et al. 1998). It acts as an analytical framework that brings together information from empirical observation, local experts, and other models and analyses.

Qualitative Habitat Analysis (QHA) was used in the assessment of habitats for bull trout and Westslope cutthroat trout. QHA was modified from its original intent to meet the specific needs of the Methow Subbasin planning process regarding bull trout and Westslope cutthroat trout, and has been a useful tool to organize and summarize a large amount of information into a useable format.

Developing Fisheries Hypothesis, Management Strategies and Priorities

The Information Structure and associated data categories are defined at three levels of organization. Together, these can be thought of as an information pyramid in which each level builds on information from the lower level (Figure 46. Data/information pyramid—information derived from supporting levels for use in the Ecosystem Diagnosis and Treatment model. “Tribes” refers to the Colville Tribes.e . As we move up the through the three levels, we take an increasingly organism-centered view of the ecosystem.

Levels 1 and 2 together characterize the environment, or ecosystem, as it can be described by different types of data. This provides the characterization of the environment needed to analyze biological performance for a species. The Level 3 category is a characterization of that same environment from a different perspective: “through the eyes of the focal species" (Mobrand et al.

1997). This category describes biological performance in relation to the state of the ecosystem described by the Level 2 ecological attributes.

The organization and flow of information begins with a wide range of environmental data (Level 1 data) that describe a watershed, including all of the various types of empirically based data available. These data include reports and unpublished data. Level 1 data exist in a variety of forms and pedigrees. The Level 1 information is then summarized or synthesized into a standardized set of attributes (Level 2 ecological attributes) that refine the basic description of the watershed. The Level 2 attributes are descriptors that specify physical and biological characteristics about the environment relevant to the derivation of the survival and habitat capacity factors for the specific species in Level 3. Definitions for Level 2 and Level 3 attributes can be found at www.edthome.org, together with a matrix showing associations between the two levels and various life stages.

The Level 2 attributes represent conclusions that characterize conditions in the watershed at specific locations, during a particular time of year (season or month), and for an associated management scenario. Hence an attribute value is an assumed conclusion by site, time of year, and scenario. These assumptions become operating hypotheses for these attributes under specific scenarios. Where Level 1 data are sufficient, these Level 2 conclusions can be derived through simple rules. However, in many cases, experts were needed to provide knowledge about geographic areas and attributes where Level 1 data are incomplete. Regardless of the means whereby Level 2 information is obtained, the characterization it provides can be groundtruthed and monitored over time through an adaptive process.

The EDT model measured salmon/steelhead performance using 3 indicators: abundance, productivity, and life history diversity. Abundance (adults and smolts) was based on the capacity of the watershed that was a measure of the habitat quantity. Productivity, or density-independent reproductive rate (returning adults per spawner), was a measure of the habitat quality. Life history diversity was the range of distributions and pathways that can be used successfully by a population. The life history diversity index in EDT output was reported as a % of current life history trajectories that were successful, relative to the template potential. For more detail on EDT output parameters see documentation at www.edthome.org.

Sockeye salmon could not be modeled in EDT because bio-rules do not exist for this species. Therefore, a qualitative assessment of priority areas for restoration and protection was conducted by the Canadian Habitat Workgroup.

For the species where EDT rules do exist, the following life history assumptions were used.

Table 37. Life history assumptions used to model summer steelhead in the Okanogan Subbasin.

Stock Name:	Okanogan River Summer steelhead
Geographic Area (spawning reaches):	Not known; All mapped reaches were assumed to be potential historic spawning habitat.
River Entry Timing (Columbia R):	Wells Pool: April-February

	peak September 15 90 % by November 1
River Entry Timing (Okanogan R.):	August to March; (peak October 15) 90% by November 30 (PUD radio telemetry)
Adult Holding:	Wells Pool: 50% (PUD radio telemetry) Methow R.: 50%
Spawn Timing:	Feb 15-June 15 (mean April 1)
Spawner Ages: **(from Wells Dam 1997-2002)**	1-salt = 49 % 2-salt = 51 % 3-salt = 0 %
Emergence Timing (dates):	May 15-July 15; (mean June 15)
Smolt Ages:	age-1 = 9 % age-2 = 81 % age-3+ = 10 %
Juvenile Overwintering:	Columbia River: 21% Okanogan Basin: 79%
Stock Genetic Fitness:	85%
Harvest:	0%
Fecundity:	5913 eggs/female

Table 38. Life history assumptions used to model spring chinook in the Okanogan Subbasin.

Stock Name:	Okanogan River Spring Chinook
Race:	Spring
Geographic Area (spawning reaches):	Omak Creek (RM 0-6.3)

	McIntyre Creek (RM 0-?)	
River Entry Timing (Columbia R):	March 1-June 1	
River Entry Timing (Okanogan R):	May 1- August 15	
Spawn Timing:	August 1- September 15, (peak August 31)	
Emergence Timing (dates):	February 15 to March 31	
Juvenile Life History: **(No data)**	Ocean type:	0%
	Reservoir type:	10 %
	Stream type:	90 %
Stock Genetic Fitness:	85%	
Harvest	0%	
Spawner ages: [From collections at Wells Dam (1996,1998); Wells Dam and WNFH, MSFH 2000; and Methow tributaries (2003)].	Age 3 (1.1) = 18% Age 4 (1.2) = 70% Age 5 (1.3) = 12%	
Fecundity:	4608 eggs/female	

Table 39. Life history assumptions used to model summer/fall chinook in the Okanogan Subbasin.

Stock Name:	Okanogan River Summer Chinook	
Race:	Summer/Fall	
Geographic Area (spawning reaches):	Malott to McIntyre River (BC); Similkameen (RM 0-4)	
River Entry Timing (Columbia R):	Mid June – early August	
River Entry Timing (Okanogan R):	August 1 –November 1	
Spawn Timing:	September 30 – November 20, (peak October 15).	
Emergence Timing (dates):	March 1 to April 15	
Juvenile Life History:	Ocean type:	70 %
	Reservoir type:	27 %
	Stream type:	3 %
Stock Genetic Fitness:	85%	
Harvest (In Basin):	0%	
Spawner ages: (Based on total age from wild fish 1993-2002; WDFW unpublished data)	Age 2 (1.0; 0.1) = 1 % Age 3 (1.1; 0.2) = 8 % Age 4 (1.2; 0.3) = 57 % Age 5 (1.3; 0.4) = 33 % Age 6+ (1.4; 0.5) = 0 %	
Fecundity:	Mean = 4958 eggs/female	

Prioritization

Reach analysis tables (EDT consumer reports tables) were used to determine primary and secondary limiting factors within each Assessment Unit. The Subbasin Core Team factored in the results of assessments on focal species and across all reaches in each assessment unit. In general, a survival factor was considered a primary limiting factor if there was high or extreme impacts to key life stages. Exceptions included some reaches where sediment load or temperature only had a high impact to spawning or egg incubation. Additionally, a survival factor was considered a primary limiting factor if there was small to moderate impacts across most (9-12) life stages, thereby producing a cumulative impact that could be just as severe as high and extreme impacts to fewer life stages. Secondary limiting factors generally had small to moderate impacts to several (5-8) life stages. An exception occurred with the survival factor "food"; when there was small to moderate impacts to two or three juvenile life stages in most of the reaches of a particular assessment unit then we considered it a secondary limiting factor. In most reaches and assessment units, the break between primary and secondary limiting factors was fairly obvious. In some cases where EDT results were not as obvious, other information, such as the Limiting Factors Reports, RTT Biological Assessment, professional opinion, and local knowledge were factored into the decision.

EDT Model Input

To perform the assessment we first structured the entirety of the relevant geographic areas, including marine waters, into distinct habitat reaches. The Okanogan drainage was subdivided into 221 stream segments (reaches) including obstructions [United States (140) and Canada (81)] within the estimated historic range of each focal species. A stream reach was a segment of river in which environmental, anthropogenic, and biological attributes affecting the focal species were relatively constant.

Some reaches were identified on the basis of similarity of habitat features, drainage connectivity, and land use patterns; some of the primary factors that influenced reach breaks included mainstem inundation, focal species bearing tributaries, obstructions to passage, changes in confinement (valley width), gradient, hydraulic roughness, dewatering reaches, thermal gradients, gross changes in riparian condition or channel form, urban-rural interface, and hatchery release points. Such a detailed reach structure, however, was counterproductive for displaying results and implementing a management plan. Therefore the reaches were grouped into 18 larger geographic areas, or assessment units. Reaches were grouped into assessment units (AU) based on common problems and common solutions such that an AU strategy and plan can be easily described and implemented. A set of standard habitat attributes and reach breaks developed by MBI were used for the mainstem Columbia River, estuarine, nearshore, and deep-water marine areas (Appendix A). We then assembled baseline information on habitat and human-use factors and fish life history patterns for the watersheds of interest. This task required that all reaches be completely characterized by rating the 46 level 2 environmental attributes.

A habitat work group (HWG) was formed for the Okanogan Basin for the purpose of rating the Level 2 habitat attributes for the freshwater stream reaches. The work group drew upon published and unpublished data and information for the basin to complete the task. Expert knowledge about habitat identification, habitat processes, hydrology, water quality, and fish biology was incorporated into the process where data was not available. Protocol for rating attributes was taken from "Attribute Ratings Guidelines (January 2003 revision) and "Attribute ratings Definitions" (January 2003); written and distributed by MBI (www.edthome.org). In addition, MBI personnel were available for consultation and assistance with rating some attributes when local resources were not sufficient.

The sources and methods used for rating the individual attributes are briefly outlined in (Appendix B). The patient current condition attribute ratings represent a variety of sources and levels of proof. Levels of proof (or confidence levels) assigned to ratings are directly from developed rating methods by MBI specifically for the EDT process. The attributes assigned to each reach are assigned a numerical value from 1 to 5 where: 1 is empirical observation; 2 is expansion of empirical observation; 3 is derived information; 4 is expert opinion; 5 is hypothetical. The distribution of the confidence levels assigned to attributes is presented in Appendix B. The template (reference) conditions were either a default, where level of proof was not applicable, or they were determined by expert opinion from the HWG or other contributors to the EDT process that were solicited for participation by the HWG.

Two scenarios were modeled that represent the current and template. Our estimates of a template condition represent an approximation of historic conditions that was intended to calibrate the model to the range of conditions that could naturally occur in the Okanogan basin given the prevailing climatic, geologic, geographic, hydrologic, and biological characteristics. The objective of the diagnosis then became identifying the relative contributions of environmental factors to the reduction of focal species performance. The comparison of these scenarios formed the basis for diagnostic conclusions about how the Okanogan watershed and associated salmonid performance have been altered by human development. To accomplish this, we performed two types of analyses, each at a different scale of overall effect.

Analysis of Model Output

The first analysis considered conditions within individual stream reaches and identified the most important factors contributing to a loss in performance at specific life stages (1-12) corresponding to each reach. This analysis, called the Stream Reach Analysis (www.mobrand.com/edt/NWPCC/index.htm), identified the survival factors (classes of Level 2 environmental attributes) that, if appropriately moderated or corrected, would produce the most significant improvements in overall fish population performance. The stream reach analysis identified the factors that should be considered in planning habitat restoration projects. Reach analysis tables (EDT consumer reports tables) were used to determine primary and secondary limiting factors within each Assessment Unit. Results were factored in from assessments on several species and across all reaches in each assessment unit and reported the results in the Assessment Unit Summary Sheets in Section 2.6 (Synthesis and Interpretation). In general, a survival factor was considered a primary limiting factor if there was high or extreme impacts to two or more life stages. Exceptions included some reaches with a high impact to a single life history stage involving a critical survival factor such as sediment load and egg incubation or temperature and spawning. Additionally, a survival factor was considered a primary limiting factor if there was small to moderate impacts across most (9-12) life stages, thereby producing a cumulative impact that could be just as severe as high and extreme impacts to fewer life stages.

Secondary limiting factors generally had small to moderate impacts to several (4-8) life stages. An exception occurred with the survival factor “food”; when there was small to moderate impacts to two or three juvenile life stages in most or all of the reaches of a particular assessment unit, and then we considered it a secondary limiting factor. In most reaches and assessment units, the break between primary and secondary limiting factors was fairly obvious. In some cases where EDT results were not as obvious, other information, such as the Limiting Factors Reports, RTT Biological Strategy, professional opinion, and local knowledge were factored into the decision.

The second analysis was conducted across geographic areas (assessment units) relevant to populations, where each geographic area typically encompassed many reaches. This analysis, called the Geographic Area Analysis, identified the relative importance of each area for either restoration or protection actions. In this case, we analyzed the effect of either restoring or further degrading of environmental conditions on population performance. The unscaled output estimated the total potential for increase or decrease (because of restoration or protection actions) within an assessment unit, regardless of its length relative to other assessment units. The EDT model normally has the capability to compare unscaled output from in-basin versus Out-of-Subbasin-Effects (OOSE) and compare the potential change in salmon and steelhead performance between these two habitats. However, the web based version available for use in this subbasin plan was set up to only use current conditions in the mainstem; therefore, we could only evaluate the potential benefit and tradeoffs between actions within the watershed. Therefore, the underlying assumption for this analysis was that the majority of impact to abundance, productivity, and life history diversity occurs outside the Okanogan basin, similar to other subbasins of similar distance to the ocean with similar numbers of hydroelectric projects to overcome.

Integrated Priority Assessment Units

The EDT model estimated the potential increase in salmon/steelhead performance because of restoration and protection actions in two ways; 1) unscaled % increase in life history diversity, productivity, and abundance 2) rank of each assessment unit based on the sum of potential increase in each of the categories. However, because of uncertainties of modeling results, we converted ranks to categories (A,B,C,D) which approximate high, moderate, and low priority assessment units for each species.

Sockeye could not be modeled with EDT so we (US and Canada) determined the qualitative importance of each assessment unit for inclusion in the integrated priorities. Results were then integrated for individual species to create a single list of priority assessment units for restoration and protection actions that incorporated results for all anadromous focal fish species. For each focal species-AU combination, categorical ranks (A,B,C) were converted to numerical values (1,2,3) and a value of 4 was assigned to the assessment unit if a particular species was absent. We then summed across all focal species and ordered the list by prioritizing Endangered fish first and non-listed focal species second.

All assessment units with a primary benefit to an Endangered species (steelhead) were in the integrated category “A”, and where then ordered within category “A” based on their score (lowest sum across all focal species). All remaining assessment units with a primary benefit to summer/fall Chinook or sockeye were in the category “B”, and were then ordered within category “B” based on their score (lowest sum across focal species with Endangered fish first, all fish second). Remaining assessment units were considered category “C” and were ordered in the same fashion as previously described. We also integrated the inter-species priority list with the assessment unit limiting habitat attribute summary analysis to provide a matrix of “where” and “what” was highest priority for restoration in the Okanogan Subbasin.

Qualitative Habitat Analysis (QHA)

The QHA relies on the expert knowledge of natural resource professionals with experience in a local area to describe bull trout and Westslope cutthroat trout use in the target stream. From this assessment, planners are able to develop hypotheses about the population and environmental relationships of the bull trout and Westslope cutthroat trout. The ultimate result is an indication of the relative importance for restoration and/or protection management strategies at the sub-watershed scale addressing specific habitat attributes.

The primary strength of the QHA is its ability to conveniently store and summarize a substantial amount of information relating focal species to their habitats. Consequently, planners chose to view the assessment in as a tool for examining three fundamental questions:

1. Where have significant bull trout and Westslope cutthroat trout use changes occurred since the historic reference condition.
2. What changes are thought to have most significantly affected the distribution and abundance of bull trout and Westslope cutthroat trout (sub-populations within the watersheds),
3. Where are the greatest opportunities to protect and/or enhance habitat attributes that will potentially provide the greatest benefits to fish populations within the subbasin?

Current and historic focal species distribution was described by ranking focal species use for each of the stream reaches. The QHA values were compared to existing literature to insure consistency and credibility as well as the EDT habitat analysis.

The technical sub-committee used the subbasin vision, goals and biological objectives as a backdrop for describing a desired future condition. The technical team evaluated where the most affective application of various actions might occur and describe the extent that specific attributes may need to change in order to achieve stated goals and objectives.

Each of these reference conditions were evaluated and compared. Findings from this evaluation are found in the Assessment / Synthesis sub-chapter within this document.

The QHA was used in the Methow subbasin planning process for two fundamental reasons; 1) the tool is a straight forward means to summarize a substantial amount of information associated with bull trout and Westslope cutthroat trout in an accessible manner, and 2) rules of bull trout and Westslope cutthroat trout have not been developed for the EDT model. The subbasin planners have developed various approaches to communicate the findings of the QHA to the general public and scientific community as a basis for the development of management strategy recommendations. Regardless of the shortcomings of the QHA, the methodology was successful in its intent in describing the fundamental changes in bull trout and Westslope cutthroat trout use that have occurred in the Methow subbasin and has served as a catalyst for describing future management direction.

The prioritizations are relative and qualitative in nature. In the Assessment Unit maps and summaries to follow, the priorities are not intended to be prescriptive; rather they focus on a logical series of actions for use and consideration in developing future programs and projects.

The priorities reflect where and when to focus efforts to support the subbasin plan goal and key objectives based on the findings in the EDT analysis. Then the priorities are presented to include the range of possible and reasonable actions.

The prioritization approach was to:

- Estimate status of habitat processes historically and currently;
- Evaluate current and historic fish population use of these habitats;
- Characterize actions and strategies through the use of working hypothesis statements; and,
- Identify a list of measurable objectives (link to M&E), and identify strategies to guide the development of projects, programs and actions for the next 15 years.

The assessment focused on identification of limiting factors, specific habitat and ecosystem attributes relative survival and/or mortality, and location and spatial extent of the habitats themselves. Our analytical method and tool (EDT) allowed us to do this "through the eyes of the fish."

The goals and species objective sections of this plan describe the future desired condition for fish populations in terms of long-term viability, sustainability and opportunities for ceremonial, subsistence and recreational harvest. These are tied directly to the assessment findings and subsequent and derived guidance provided in this section.

In summary, the ecosystem diagnosis method used (the assessment) was intended primarily to address the question: Is there potential to improve anadromous salmonid population status through improvements to habitat conditions in tributary environments.

Central fish habitat hypothesis: Improvements in habitat conditions will have a positive effect on habitat productivity and thus, improve fish population status through increased abundance, diversity, and spatial structure.

3.37 Developing Wildlife Hypothesis, Management Strategies and Priorities

While all habitats are important, focal habitats were selected in part because they are disproportionately vulnerable to anthropogenic impacts, and likely have received the greatest degree of existing impacts within the subbasin. In particular, the majority of shrubsteppe and ponderosa pine habitats fall within the low or no protection status categories defined above. Some of the identified impacts are, for all practical purposes, irreversible (conversion to urban and residential development, primary transportation systems); others are already being mitigated through ongoing management (i.e., USFS adjustments to grazing management).

Emphasis in this management plan is placed on the selected focal habitats and wildlife species described in the inventory and assessment. It is clear from the inventory and assessment that reliable quantification of most subbasin level impacts is lacking, however, many anthropogenic changes have occurred and clearly impact the focal habitats: riparian wetlands, shrubsteppe and ponderosa pine forest habitats.

It is impractical to address goals for future conditions within the subbasin without consideration of existing conditions; not all impacts are reversible. The context within which this plan was drafted recognizes that human uses do occur, and will continue into the future. Recommendations are made within this presumptive framework.

A working hypothesis is a statement that summarizes the subbasin planners' understanding of the subbasin at the time of development of this plan, based on assessment data and analysis. Working hypotheses provide the rationale for the objectives and management strategies.

Subbasin planners have developed a goal for each of the three focal habitat types. Achieving the goal for each focal habitat type should result in functional habitats for the focal species assemblage selected to represent that habitat type, and hence for other species dependent on the habitat type.

The planners have identified both habitat and biological objectives that will advance the goals for each habitat type. Objectives describe the types of changes within the subbasin needed to achieve the goals and, ultimately, the vision for the subbasin. When insufficient data are available, objectives describe the research that will need to be done to identify physical and biological changes needed to achieve goals.

Strategies are sets of actions to accomplish objectives. The strategies in the table below are intended to serve as guidance for development of projects to accomplish the objectives listed above. Each of the strategies is intended to further one of the objectives; the number in the left-hand column shows which one.

Central Wildlife Habitat Hypothesis

Natural habitats exist with sufficient quantity, quality and linkages to perpetuate existing native wildlife populations into the foreseeable future. Where sufficient habitat exists, through a combination of protection and restoration, extirpated wildlife species are restored within the subbasin.

3.38 Synthesis of Key Findings - Okanogan Subbasin Basin EDT Species Results

3.38.1 Sockeye

The highest priority assessment units (Category A) for restoration and protection of sockeye can be seen in Tables 6 and 7. A summary of limiting habitat attributes and survival factors for each assessment unit and species specific life stage generated in the reach analysis of EDT can be found on the assessment unit summary sheets in Section 2.6, Synthesis of Key Findings.

3.38.2 Summer Chinook

The EDT model predicted large increases in summer/fall Chinook performance based on restoration actions in several key assessment units. The unscaled results predicted 5-6 fold increases for productivity and abundance, with a 20 fold increase to life history diversity (Table 4). The majority (61%) of potential performance increase was attainable within the middle and lower Okanogan mainstem assessment units, with an additional 32% in the upper Okanogan and Similkameen (category A)(Table 4). All four assessment units were considered of primary importance to summer/fall Chinook so we did not break the priorities into categories.

The EDT model predicted much smaller benefits to summer/fall Chinook performance based on protection actions, compared to restoration benefits. The unscaled results predicted 1-1.8 fold decreases for life history diversity, productivity, and abundance if habitat conditions were to degrade further (Table 5). The majority of protection benefit (65%) was attainable in the middle

Okanogan assessment unit (category A), with an additional 33% of the cumulative protection benefit in the lower Okanogan, upper Okanogan, and Similkameen assessment units (Table 5). We did not anticipate that the model would predict the Similkameen as the lowest priority of the 4 main assessment units for protection of summer/fall Chinook habitat. The Similkameen River represents a small but critical spawning area and provides important pre-spawn holding habitat. However, juvenile rearing habitat is very limited. The size of the area compared to other assessment units is small so the overall protection ratings may have been lower in the model as it relates to the entire Okanogan subbasin when compared to other main-stem Okanogan assessment units. Future-modeling efforts should re-examine the environmental attribute ratings for current and template conditions in the Okanogan mainstem and Similkameen Rivers and include a scaled model run to help determine if this is a function of model parameters, data input, scale, or true environmental conditions.

A summary of limiting habitat attributes and survival factors for each assessment unit and species specific life stage generated in the reach analysis of EDT can be found on the assessment unit summary sheets in Section 2.6, Synthesis of Key Findings.

3.38.3 Spring Chinook

Quantitative estimates of spring Chinook performance changes because of restoration and protection actions could not be evaluated with the EDT model because of the extremely poor performance of spring Chinook in the Okanogan basin. The model predicted productivity was so low (0.04) that equilibrium abundance was not attainable (Neq =0) under current habitat and mainstem conditions. We were, however, able to evaluate the relative importance of each of the assessment units to spring Chinook based on restoration actions. The majority of potential benefit would come from restoration actions in the Lower Salmon (49%) assessment unit (Table 3). Other important assessment units included the Similkameen (35%) and Omak Creek (11%), for a cumulative total of 94% of the restoration potential that might improve spring Chinook performance Table 3. However, because of the experimental status and uncertainties of historic distribution and abundance of spring Chinook we applied a default benefit category of C to all assessment units. Spring Chinook priority areas overlapped with steelhead and summer/Fall Chinook priorities so this species needs are being addressed in the priority lists, they are just not being given preference over other focal species.

A summary of limiting habitat attributes and survival factors for each assessment unit and species specific life stage generated in the reach analysis of EDT can be found on the assessment unit summary sheets in Section 2.6, Synthesis of Key Findings.

3.38.4 Summer Steelhead

The EDT model predicted large increases in steelhead performance based on restoration actions in several key assessment units. The unscaled results predicted 4-7 fold increases for productivity and abundance, with over 60 fold increases to life history diversity (Table 1). The majority (67%) of potential performance increase was attainable within the Lower Salmon and Omak Creek watersheds, with additional noteworthy potential in the small tributaries (upper and middle basin) and Loup Loup assessment units (24%) (Category A) (Table 1).

The EDT model predicted much smaller benefits to steelhead performance based on protection actions, compared to restoration benefits. The unscaled results predicted 1-1.7 fold decreases for life history diversity, productivity, and abundance if habitat conditions were to degrade further (Table 2). The majority of protection benefit (75%) was attainable in the Lower Salmon assessment unit (category A), with an additional 20% of the cumulative protection benefit in Omak Creek and the small tributaries (upper and middle basins)(category B)(Table 2). The lower Salmon Creek assessment unit was modeled with spring flows that would allow steelhead passage. This assumption was not applied to assessment units with similar water diversion issues such as Loup Loup Creek. If water management scenarios do not provide access to lower Salmon Creek then it would have no preservation value for steelhead. A summary of limiting habitat attributes and survival factors for each assessment unit and species specific life stage generated in the reach analysis of EDT can be found on the assessment unit summary sheets in Section 2.6, Synthesis of Key Findings.

Data Availability and Quality

In general, the data sources available to aid the habitat work group in rating the 46 environmental attributes for EDT were only adequate for a qualitative evaluation of the Okanogan basin. However, when the model was populated with the best available information we received quantitative output, but the accuracy of the output was questionable because of the heavy reliance on qualitative model input. We evaluated 5018 data points entered into the EDT model to determine the % frequency of each level of proof (LOP) category for each environmental attribute that was rated for current conditions (Appendix B). Category one was used for attributes where data was available in a specific reach and was direct measure of the environmental attribute. Category two was used to expand empirical information to adjacent reaches, or to other reaches within the same sub-watershed, if appropriate. Category three was used when data was available to deduce the EDT score, but it was indirectly related to the EDT attribute or expanded from another sub-watershed where applicability was suspect. Category four was for expert opinion and was used for attributes where no data was available, so they had to be rated qualitatively. Category five was hypothetical, and was also based on opinion, but with less confidence and was sometimes used to highlight critical data gaps.

Overall, 43% of the data that populated the model for the Okanogan Basin was based on expert opinion or hypothetical (because of lack of confidence in the educated guess), whereas the remainder consisted of empirical (16%), expanded from empirical (11%), or derived (30%) (Figure 3). In some cases, derived information was adequate for general modeling purposes and as good as we could expect in the near future. For example, the attribute “flow flashy” is a measure of the estimated increase in flashy flows because of anthropogenic influences. Since no data existed regarding pre-development flashiness and no trends were evident in the 20-40 year data sets available from USGS gauging stations we worked with a USFS hydrologist to develop an index of relative increase based on road density. Another example is the attribute “harassment”, which was a relative measure of the proximity to population centers and the potential for disturbance and poaching on a fish population. Empirical data did not exist and will never exist for this attribute as it was defined in the attribute rating guidelines. It was included in EDT for watersheds that might have issues related to major population centers such as in the Puget Sound area. These attributes probably could have been categorized as expert opinion but we had some links to data that warranted a slightly better level of proof rating. Several other attributes that were rated qualitatively using derived information included pathogens and predation.

Conversely, many of the data points in the derived category needed improvement because of their sensitivity within the model and importance to other attributes. For example, to rate the attribute "confinement-hydromodifications" we measured the linear distance of roads that encroached the floodplain (in Terrain Navigator Pro) and added in any known distances of dikes, bank hardening, or other structures that impeded sinuosity, potential channel migration, and off-channel habitat. Although this method provided a decent initial quantification of hydroconfinement, we felt that a formal survey by trained geomorphologists, mapped in GIS (for updating and repeatability) was the correct method to quantify this very important attribute. Although its only a modifying attribute to any one life stage within EDT, it has important repercussions for evaluating template or future desired conditions related to sinuosity, off-channel habitat, bed scour, riparian function, pool riffle ratios, key habitat quantity, channel width, LWD, temperature spatial variation, hyporheic function, peak flow, low flow, and possibly others.

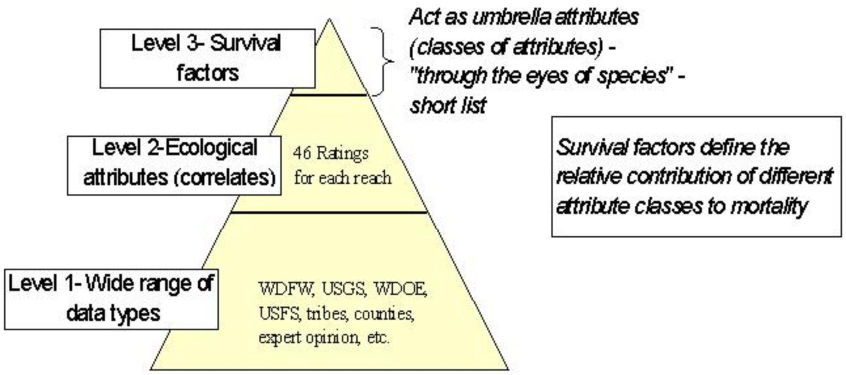
Other key attributes with the majority of their LOP in the "needs improvement" sub-category of "derived," included bed scour and low flow. Bed scour is the primary modifier for the survival factor "channel stability" that was rated as a primary or secondary limiting factor for many of the assessment units thereby increasing the models sensitivity to this environmental attribute. Given the importance of bed scour related to egg incubation and productivity, we were not satisfied with the multiple regression using other attribute ratings to come up with EDT scores for bed scour (see Appendix B). However, until bed scour is measured using empirical studies at multiple locations throughout the watershed, we will have to rely on our initial indirect estimate. For low flow, we had to use outdated relationships between surface flow, irrigation withdrawals and groundwater recharge. Our results indicated that flows were a secondary limiting factor, however, we intend to improve the model input data once the Watershed Plan information is available. Once this attribute is revisited it could increase or decrease in importance as a potential limiting factor.

Uncertainties and Limitations

This assessment used a model as a tool to predict results based on the best available information we could compile and incorporate in the limited timeframe available under the subbasin planning process. We used the EDT model to generate hypotheses about environmental conditions that had the biggest impact to our focal species. The EDT "bio-rules", defined here as "changes in productivity and life stage specific habitat requirements associated with various environmental conditions", were based on a range of information from empirical to expert opinion that we had no control over. The algorithms that define the bio-rules were hard wired into the model and it was beyond the scope of this assessment to test their validity. We were working under the assumption that the bio-rules in EDT were the "best available science"; although we recognize that the algorithms linking environmental conditions to life-stage specific survival may not have universal support of the scientific community. We would have preferred that an exhaustive review of the bio-rules and model sensitivity had been conducted so that we could fully evaluate the potential bias and error in our model estimates. Therefore, uncertainty exists in the accuracy of the results and potential changes to population performance based on restoration or protection actions in specific assessment units. However, we do have confidence in the precision of the EDT model because it systematically applied the same bio-rules throughout the basin, and related the bio-rules to the spatial and temporal dynamics of each focal species in relation to each assessment unit.

In general, we believe that the EDT model runs for steelhead and Chinook in the Okanogan basin were adequate to appropriately guide restoration and protection efforts. However, even where good empirical data existed, the model could not incorporate the measurement error or natural variation associated with the data. Additionally, if we were to model upper and lower error bounds associated with key environmental attributes the benefits would be diluted by the presence of derived and expert opinion ratings with no measurement error for other attributes. We created a table to outline the level of proof (LOP) used to rate each attribute and provide insight as to what data what used and how we expanded or derived ratings in areas with no empirical observations. We felt this was the most effective way to allow reviewers to evaluate the model inputs, without providing a very long and complex methods section (Appendix B). The EDT model uses each attribute multiple times as primary and/or secondary modifiers for various life stage survival factors (for details see www.edthome.org). Therefore, inaccuracies and bias in rating environmental data could be amplified or diminished, depending on the survival factor and life stage being evaluated. This kind of sensitivity analysis is well beyond the scope of this planning document.

High summer temperatures are known to be a natural limiting factor in the Okanogan basin. If natural high temperature conditions were on the edge of salmonid tolerance levels then only slight increases, because of anthropogenic affects, could have large ramifications for salmonid survival. Initial model runs failed to produce viable summer/fall Chinook runs because of warm summer temperatures killing all the prespawn holding adults. However, it is well documented that summer/fall Chinook are able to tolerate the thermal stress and successfully spawn in the upper Okanogan and Similkameen assessment units. Therefore, we concluded that the model was too sensitive to temperature, given all the other degraded habitat conditions, or that we had a locally adapted stock of Chinook with higher thermal tolerance, or that there was patches of thermal refuge that were not captured in the temperature data. Either way, it was beyond the scope of this planning document to change the bio-rules for temperature or collect more temperature data. Therefore, we reduced the EDT scores of current temperatures to allow for appropriate survival of summer/fall Chinook (similar to adult escapement estimates), thereby reducing the models ability to evaluate temperature as a potential limiting factor. However, when filling out limiting factors on the Assessment Unit Summary Sheets we still identified temperature as a primary limiting factor.



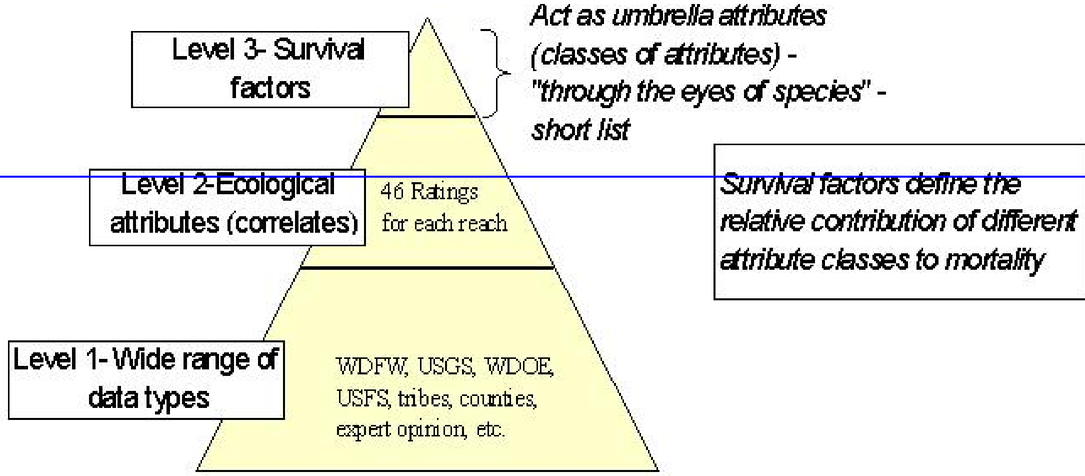

Level 3- Survival factors
Act as umbrella attributes (classes of attributes) - "through the eyes of species" - short list
Level 2-Ecological attributes (correlates)
46 Ratings for each reach
Survival factors define the relative contribution of different attribute classes to mortality
Level 1- Wide range of data types
WDFW, USGS, WDOE, USFS, tribes, counties, expert opinion, etc.

Figure 46. Data/information pyramid—information derived from supporting levels for use in the Ecosystem Diagnosis and Treatment model. "Tribes" refers to the Colville Tribes.

Table 40. Ecosystem Diagnosis and Treatment Model predictions of potential increases in three performance measures due to habitat restoration actions for summer steelhead in Geographic Areas of the Okanogan basin, Washington. N(eq) was the equilibrium abundance of returning adult spawners. The cumulative benefit does not include Out-of Subbasin-Effects on the three performance measures.

			Unscaled			
Geographic Area / Assessment Unit	**Diversity Index**	**Product-ivity**	**N(eq)**	**Sum**	**Cumu-lative**	**Cate-gory**
Omak Creek	2198%	114%	179%	2490%	34%	A
Lower Salmon	2114%	77%	237%	2428%	67%	A
Small Tribs (Middle and Upper Basin)	721%	68%	68%	857%	79%	B
Loup Loup	670%	83%	68%	821%	91%	B
Okanogan Middle	288%	5%	23%	317%	95%	B
Similkameen River	133%	40%	37%	210%	98%	B
Chilliwist/Talent	91%	25%	24%	140%	99.7%	C
Okanogan Lower	0%	4%	9%	13%	99.8%	C
Okanogan Upper	2%	0%	8%	10%	100%	C
Vaseux/McIntyre	0%	0%	0%	0%	100%	D
Canada mainstem middle	0%	0%	0%	0%	100%	D
Vaseux Lake and Mainstem Reaches	0%	0%	0%	0%	100%	D
Canada mainstem Lower	0%	0%	0%	0%	100%	D
Canada mainstem upper	0%	0%	0%	0%	100%	D
Osoyoos Lake South Central	0%	0%	0%	0%	100%	D
Canada mainstem to Okanogan Lake	0%	0%	0%	0%	100%	D
Skaha Lake	0%	0%	0%	0%	100%	D
Upper Salmon	0%	0%	0%	0%	100%	D
Total	6216%	415%	656%	7287%		

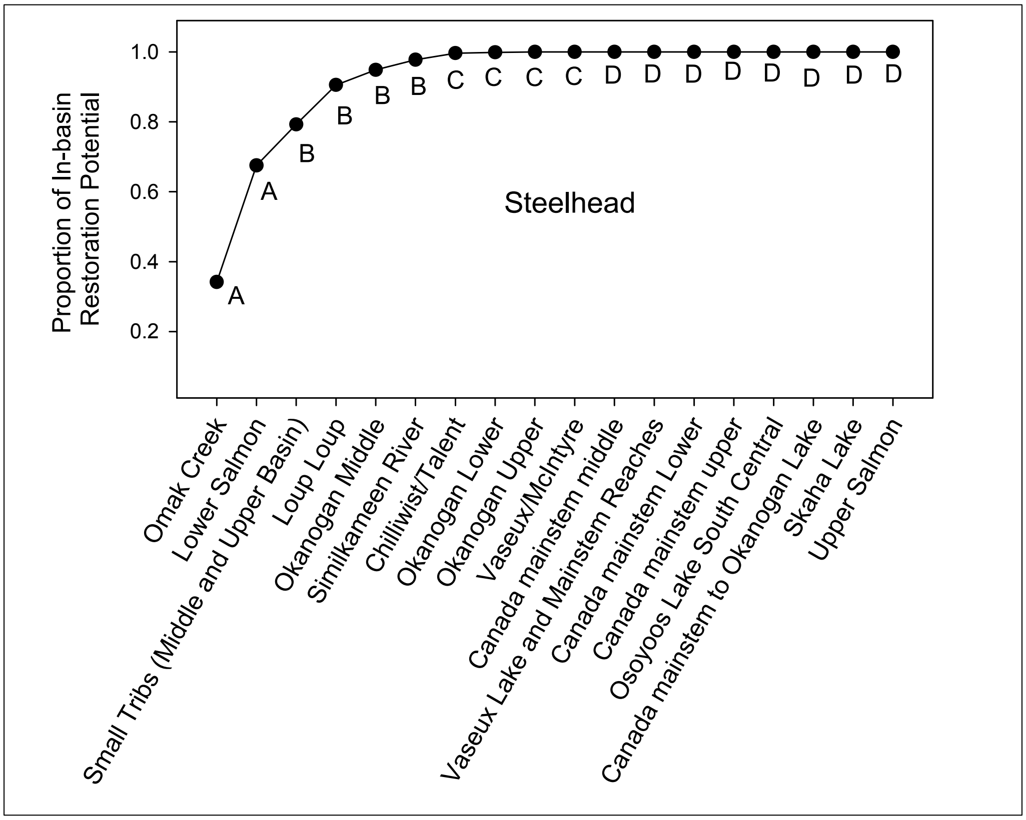


Figure 47. Ecosystem Diagnosis and Treatment Model predictions of potential increased steelhead performance in the Okanogan basin, Washington, due to restoration actions in specific assessment units. Improvements to 3 measures of performance (life history diversity, productivity, and equilibrium abundance) were summed for unscaled output and grouped into 4 categories of high (A), moderate (B), and low (C), and zero (D) potential benefit. Also shown is the cumulative effect of 100 % restoration in each assessment unit for unscaled output, if conducted in the order of highest unscaled rank. Out-of-Subbasin-Effects (OOSE) are not accounted for in the proportion of potential increase.

Table 41. Ecosystem Diagnosis and Treatment Model predictions of potential decreases in three performance measures due to habitat degradation if assessment units are not protected for summer steelhead in Geographic Areas of the Okanogan basin, Washington. N(eq) was the equilibrium abundance of returning adult spawners. The cumulative benefit does not include Out-of Subbasin-Effects on the three performance measures.

		Unscaled				
Geographic Area / Assessment Unit	**Diversity Index**	**Product-ivity**	**N(eq)**	**Sum**	**Cumu-lative**	**Cate-gory**
Lower Salmon	-84%	-94%	-100%	-278%	75%	A
Omak Creek	0%	0%	-45%	-45%	87%	B
Small Tribs (Middle and Upper Basin)	-16%	-6%	-8%	-30%	95%	B
Okanogan Middle	0%	0%	-8%	-8%	97%	C
Okanogan Lower	0%	-2%	-3%	-5%	99%	C
Similkameen River	0%	0%	-4%	-4%	100%	C
Canada mainstem middle	0%	0%	-1%	-1%	100%	C
Okanogan Upper	0%	0%	0%	0%	100%	D
Chilliwist/Talent	0%	0%	0%	0%	100%	D
Vaseux Lake and Mainstem Reaches	0%	0%	0%	0%	100%	D
Loup Loup	0%	0%	0%	0%	100%	D
Vaseux/McIntyre	0%	0%	0%	0%	100%	D
Osoyoos Lake South Central	0%	0%	0%	0%	100%	D
Canada mainstem Lower	0%	0%	0%	0%	100%	D
Canada mainstem to Okanogan Lake	0%	0%	0%	0%	100%	D
Canada mainstem upper	0%	0%	0%	0%	100%	D
Skaha Lake	0%	0%	0%	0%	100%	D
Upper Salmon	0%	0%	0%	0%	100%	D
Total	-100%	-102%	-170%	-372%		

Table 42. Ecosystem Diagnosis and Treatment Model predictions of potential increases in three performance measures due to habitat restoration actions for spring Chinook in Geographic Areas of the Okanogan basin, Washington. N(eq) was the equilibrium abundance of returning adult spawners. Spring Chinook could only be evaluated on a relative scale between assessment units because the model predicted low productivity that could not attain a viable N(eq) at the subbasin scale. The cumulative benefit does not include Out-of Subbasin-Effects on the three performance measures.

	Unscaled Relative EDT Output				
Geographic Area / Assessment Unit	**Diversity Index**	**Product-ivity**	**N(eq)**	**Cumu-lative**	**Cate-gory**
Lower Salmon	65.9%	34.5%	45.4%	49%	A
Similkameen River	14.2%	34.8%	54.6%	83%	A
Omak Creek	17.2%	16.4%	0.0%	94%	B
Small Tribs (Middle and Upper Basin)	2.4%	3.5%	0.0%	96%	C
Okanogan Upper	0.3%	1.8%	0.0%	97%	C
Okanogan Middle	0.0%	1.0%	0.0%	97%	C
Vaseux Lake and Mainstem Reaches	0.0%	0.8%	0.0%	98%	C
Canada mainstem middle	0.0%	0.8%	0.0%	98%	C
Okanogan Lower	0.0%	0.8%	0.0%	98%	C
Canada mainstem Lower	0.0%	0.8%	0.0%	98%	C
Canada mainstem upper	0.0%	0.7%	0.0%	99%	C
Osoyoos Lake South Central	0.0%	0.7%	0.0%	99%	C
Canada mainstem to Okanogan Lake	0.0%	0.7%	0.0%	99%	C
Inkaneep Creek	0.0%	0.7%	0.0%	99%	C
Upper Salmon	0.0%	0.7%	0.0%	100%	C
Skaha Lake	0.0%	0.7%	0.0%	100%	C
Vaseux/McIntyre	0.0%	0.7%	0.0%	100%	C
Total =	100.0%	100.0%	100.0%		

Table 43. Ecosystem Diagnosis and Treatment Model predictions of potential increases in three performance measures due to habitat restoration actions for summer/fall Chinook in Geographic Areas of the Okanogan basin, Washington. N(eq) was the equilibrium abundance of returning adult spawners. The cumulative benefit does not include Out-of Subbasin-Effects on the three performance measures.

				Unscaled		
Geographic Area / Assessment Unit	**Diversity Index**	**Product-ivity**	**N(eq)**	**Sum**	**Cumu-lative**	**Benefit Category**
Okanogan Middle	800%	126%	173%	1099%	36%	A
Okanogan Lower	462%	137%	172%	771%	61%	A
Okanogan Upper	382%	97%	112%	591%	80%	A
Similkameen River	195%	96%	97%	389%	93%	A
Omak Creek	85%	23%	34%	141%	97%	C
Small Tribs (Middle and Upper Basin)	31%	5%	9%	44%	99%	C
Canada mainstem middle	18%	1%	2%	22%	100%	C
Canada mainstem Lower	5%	0%	0%	5%	100%	C
Vaseux Lake and Mainstem Reaches	5%	0%	0%	5%	100%	C
Canada mainstem upper	0%	0%	0%	0%	100%	D
Vaseux/McIntyre	0%	0%	0%	0%	100%	D
Canada mainstem to Okanogan Lake	0%	0%	0%	0%	100%	D
Inkaneep Creek	0%	0%	0%	0%	100%	D
Osoyoos Lake South Central	0%	0%	0%	0%	100%	D
Skaha Lake	0%	0%	0%	0%	100%	D
Total	1982%	485%	601%	3068%		

Table 44. Ecosystem Diagnosis and Treatment Model predictions of potential decreases in three performance measures due to habitat degradation if assessment units are not protected for summer/fall Chinook in Geographic Areas of the Okanogan basin, Washington. N(eq) was the equilibrium abundance of returning adult spawners. The cumulative benefit does not include Out-of Subbasin-Effects on the three performance measures.

				Unscaled		
Geographic Area / Assessment Unit	**Diversity Index**	**Product-ivity**	**N(eq)**	**Sum**	**Cumu-lative**	**Benefit Category**
Okanogan Middle	-85%	-87%	-100%	-272%	65%	A
Okanogan Lower	-28%	-7%	-48%	-83%	84%	B
Okanogan Upper	-13%	-7%	-21%	-41%	94%	B
Similkameen River	-5%	-2%	-10%	-17%	98%	B
Canada mainstem upper	-3%	0%	0%	-3%	99%	C
Omak Creek	-3%	0%	0%	-3%	99%	C
Skaha Lake	-3%	0%	0%	-3%	100%	C
Vaseux Lake and Mainstem Reaches	0%	0%	0%	0%	100%	D
Canada mainstem to Okanogan Lake	0%	0%	0%	0%	100%	D
Vaseux/McIntyre	0%	0%	0%	0%	100%	D
Small Tribs (Middle and Upper Basin)	0%	0%	0%	0%	100%	D
Inkaneep Creek	0%	0%	0%	0%	100%	D
Canada mainstem Lower	0%	0%	0%	0%	100%	D
Canada mainstem middle	0%	0%	0%	0%	100%	D
Osoyoos Lake South Central	0%	0%	0%	0%	100%	D
Total	-138%	-103%	-180%	-421%		

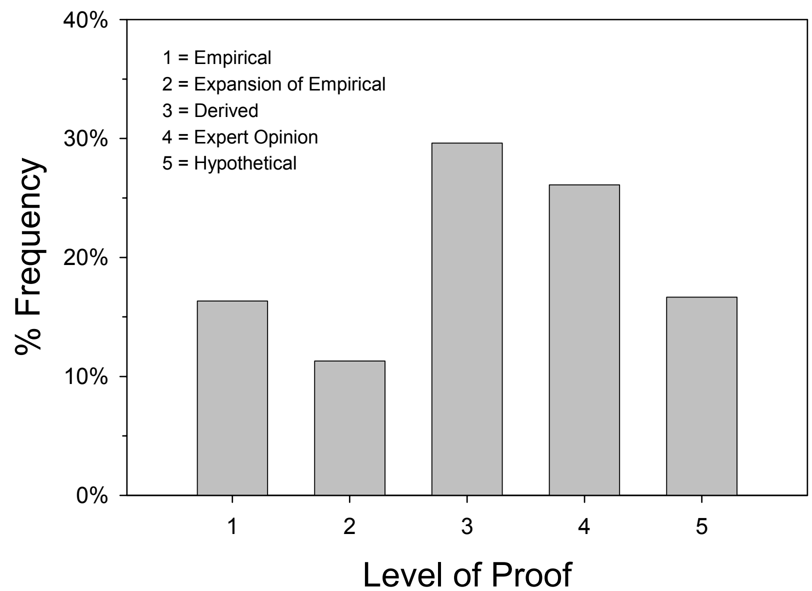


Figure 48. Summary of basin-wide level of proof used to rate EDT input data for current environmental conditions in the Okanogan sub basin, Washington.

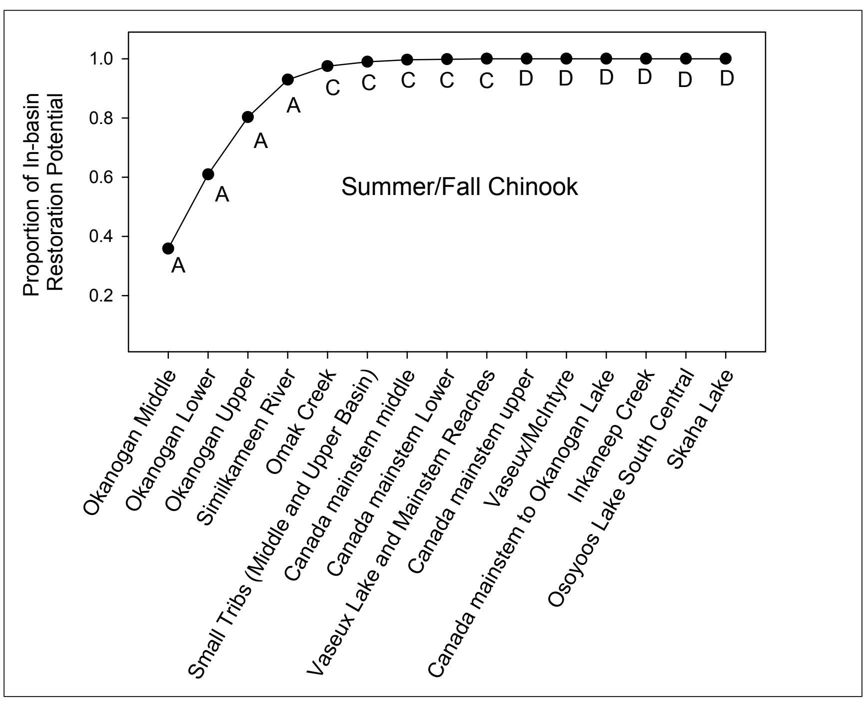


Figure 49. Ecosystem Diagnosis and Treatment Model predictions of potential increased summer/fall Chinook performance in the Okanogan basin, Washington, due to restoration actions in specific assessment units. Improvements to 3 measures of performance (life history diversity, productivity, and equilibrium abundance) were summed for unscaled output and grouped into 4 categories of high (A), moderate (B), and low (C), and zero (D) potential benefit. Also shown is the cumulative effect of 100 % restoration in each assessment unit for unscaled output, if conducted in the order of highest unscaled rank. Out-of-Subbasin-Effects (OOSE) are not accounted for in the proportion of potential increase.

Table 45. Priority assessment units and priority survival factors in the Okanogan subbasin, Washington. Priorities were determined using the EDT model for steelhead and Chinook, and the QHA method for bull trout and cutthroat trout. For survival factors, 1=primary limiting factor, 2= secondary limiting factor, blank cells were minor or not considered limiting factors.

Geographic Area / Assessment Unit	Integrated Priority Restoration Category	Habitat Diversity	Key habitat quantity	Sediment load	Obstructions	Temperature	Channel Stability	Flow	Predation	Chemicals	Pathogens	Harrassment/Poaching	Oxygen	Food	Competition (other species)	Competition (hatchery fish)	Withdrawls
Lower Salmon	A	1	1	2	1	2	1	1					2				
Similkameen River	A	1		1	2	2	2	2	2	1	1	2					
Omak Creek	A	1	2	1	1		1	2	2					2			
Okanogan Middle	B	1		1		1	2		2	2							
Okanogan Lower	B	1	1	1		1			2	2		2					
Okanogan Upper	B	1		1		1			2	2							
Vaseux/McIntyre	B	1					2	1									
Canada mainstem to Okanogan Lake	B	1	1		1		2		2			2		2			
Skaha Lake	B				1						2				2		
Inkaneep Ck	B	2	1	1	1	1	2										
Canada mainstem middle	C	1	1					2	2		2	2					
Vaseux Lake and Mainstem Reaches	C	1	1			2	2		1		2		2		2		
Canada mainstem Lower	C	1	1				1				2	2					
Osoyoos Lake South Central	C					1			2		2		1				
Small Tribs (Middle and Upper Basin)	C	1	1	1	1	2	1	1	2	2		2		2			
Loup Loup	C	1	1		1			1									

Geographic Area / Assessment Unit	Integrated Priority Restoration Category	Habitat Diversity	Key habitat quantity	Sediment load	Obstructions	Temperature	Channel Stability	Flow	Predation	Chemicals	Pathogens	Harrassment/Poaching	Oxygen	Food	Competition (other species)	Competition (hatchery fish)	Withdrawals
Upper Salmon	C	1		2		2		2		2							

Table 46. Integrated priority geographic areas for habitat restoration for summer steelhead (Stlhd), spring Chinook (SprChk), summer/fall Chinook (S/FChk), and sockeye salmon in the Okanogan River Subbasin, Washington. For each focal species-AU combination, categorical ranks (A,B,C) were converted to numerical values (1,2,3) and a value of 4 was assigned to the assessment unit if a particular species was absent. Intra-specific priorities were generated using the Ecosystem Diagnosis and Treatment model unscaled output to estimate potential benefit categories for steelhead and Chinook, whereas a qualitative assessment of potential benefit was made for sockeye. Inter-specific (integrated) priorities were generated by giving preference to assessment units with primary importance to endangered fish first, then all focal species. Categories (A,B,C) represents groups of assessment units with the highest, intermediate, and lowest priority for habitat restoration actions.

	EDT Restoration Priorities							
Geographic Area / Assessment Unit	**Steel-head**	**Spr-Chk**	**Sum-Fal-Chk**		**Sockeye**	**Endangered Fish Sum**	**All Fish Sum**	**Cate-gory**
Lower Salmon	1	1	3		4	2	9	A
Similkameen River	2	1	1		4	3	8	A
Omak Creek	1	2	3		4	3	10	A
Okanogan Middle	2	3	1		2	5	8	B
Okanogan Lower	3	3	1		2	6	9	B
Okanogan Upper	3	3	1		2	6	9	B
Canada mainstem upper	4	3	3		1	7	11	B
Vaseux/McIntyre	4	3	4		1	7	12	B
Canada mainstem to Okanogan Lake	4	3	4		1	7	12	B
Skaha Lake	4	3	4		1	7	12	B
Inkaneep Ck	4	4	4		1	8	13	B
Canada mainstem middle	4	3	3		2	7	12	C
Vaseux Lake and Mainstem Reaches	4	3	3		2	7	12	C
Canada mainstem Lower	4	3	3		2	7	12	C
Osoyoos Lake South Central	4	3	4		3	7	14	C
Small Tribs (Middle and Upper Basin)	2	3	4		4	5	13	C
Loup Loup	2	3	4		4	5	13	C
Upper Salmon	4	3	4		4	7	15	C

Table 47. Integrated priority geographic areas for habitat restoration for summer steelhead (Stlhd), spring Chinook (SprChk), summer/fall Chinook (S/FChk), and sockeye salmon in the Okanogan River Subbasin, Washington. For each focal species-AU combination, categorical ranks (A,B,C) were converted to numerical values (1,2,3) and a value of 4 was assigned to the assessment unit if a particular species was absent. Intra-specific priorities were generated using the Ecosystem Diagnosis and Treatment model unscaled output to estimate potential benefit categories for steelhead and Chinook, whereas a qualitative assessment of potential benefit was made for sockeye. Inter-specific (integrated) priorities were generated by giving preference to assessment units with primary importance to endangered fish first, then all focal species. Categories (A,B,C) represents groups of assessment units with the highest, intermediate, and lowest priority for habitat restoration actions.

	EDT Protection Priorities							
Geographic Area / Assessment Unit	Steel-head	Spr-Chk	Sum-Fal-Chk		Sockeye	Endangered Fish Sum	All Fish Sum	Cate-gory
Lower Salmon	1	1	4		4	2	10	A
Omak Creek	2	1	4		4	3	11	A
Similkameen River	3	1	1		4	4	9	A
Okanogan Middle	3	4	1		4	7	12	B
Vaseux Lake and Mainstem Reaches	4	4	4		1	8	13	B
Canada mainstem Lower	4	4	4		1	8	13	B
Canada mainstem upper	4	4	4		1	8	13	B
Inkaneep Ck.	4	4	4		1	8	13	B
Okanogan Lower	3	4	2		2	7	11	C
Okanogan Upper	4	4	2		2	8	12	C
Osoyoos Lake South Central	4	4	4		2	8	14	C
Skaha Lake	4	4	4		2	8	14	C
Small Tribs (Middle and Upper Basin)	2	4	4		4	6	14	C
Loup Loup	4	4	4		3	8	15	C
Vaseux/McIntyre	4	4	4		3	8	15	C
Canada mainstem to Okanogan Lake	4	4	4		3	8	15	C
Canada mainstem middle	3	4	4		4	7	15	C
Upper Salmon	4	4	4		4	8	16	C

Integrated Priority Assessment Units

We integrated quantitative EDT model output (steelhead & Chinook)] and qualitative (Sockeye) output across multiple focal species and determined that the highest priority assessment units for restoration and in the Okanogan basin were Omak Creek Lower Salmon Creek, small tributaries (upper and middle basin), and Loup Loup (Tables 6). These assessment units ranked the highest on our priority lists because they were in the top category (A) of our EDT model predictions for unscaled steelhead performance (life history diversity, abundance, and productivity)(Tables 1-7) and we gave preference to assessment units that were of primary importance to Endangered species. For protection, Loup Loup was not a high priority because it was modeled with no passage at the irrigation diversion. If the Lower Salmon Creek assessment does not have passage and flow because of restoration actions then it will also fall off the list of priority areas for protection. The Okanogan mainstem and Similkameen assessment units would then become the next highest priority for protection actions (Tables 6,7).

The EDT model predicted that much larger gains in salmon/steelhead performance could be made through restoration actions, rather than protection (Tables 1-7), because of the degraded nature of many critical habitat features in these sub watersheds (see Table 8 for a summary or the Assessment Unit Summary Sheets for details).

Limiting Environmental Attributes

The Okanogan Basin is a naturally harsh environment for fish with high peak flows, low base flows, warm summers, and cold winters. Our assessment was not designed or intended to evaluate the conditions that naturally limit salmonid production. We determined limiting factors from EDT output that identified the survival factors that deviated the most from template conditions. If low base flow and warm summer temperatures are the natural limitations to salmonid production in the Okanogan Basin then our assessment would not identify those factors (we assume a level of local adaptation; unless it was determined that current flow is lower and current temperatures are warmer. This is an important distinction because the goal of this assessment was to identify the greatest opportunities for improvement within the Okanogan basin, not the natural limits of the watershed or to compare and contrast cost-benefit tradeoffs of improving survival inside the Okanogan basin versus in the mainstem Columbia River or other area outside the basin.

Throughout the Okanogan Subbasin, habitat diversity was the most common limiting factor to focal fish species (Table 8). Habitat diversity was a function of gradient, natural confinement, man-made confinement, floodplain connection, off-channel habitat, LWD, and riparian vegetation. The effect of man-made confinement, riparian function, and template LWD were driving these results, but there was no way to validate our assumptions about template conditions. Losses to habitat diversity affected most life stages from moderate to high degrees depending on the assessment unit and species. See the working hypothesis in the Assessment Unit Summary Sheets for predictions of life stages most affected by losses of habitat diversity.

Other critical limiting factors included key habitat quantity (which was primarily a function of reduced quality pools for rearing and holding and reduced pool tailouts for spawning), sediment load (turbidity, embeddedness, and % fines), obstructions, channel stability (bed scour, icing, riparian function, wood, man-made confinement, flashy flow, change in annual peak flow), and temperature. We assumed that man-made confinement, recent and historic removal of LWD, increased bed scour, and degraded riparian zone vegetation had reduced the number of quality pools, pool tailouts, and LWD in most of the lower reaches of the Okanogan River and its tributaries.

The difference between current and template values for these assumptions were driving the results that these survival factors were primary limiting factors in the Okanogan Basin but there was no way to validate our assumptions about template conditions. Channel stability (bed scour) and sediment load (% fines and embeddedness) were particularly problematic for egg incubation and fry colonization life stages, whereas obstructions and key habitat quantity varied by assessment unit depending on localized conditions within the assessment unit. See the working hypothesis in the Assessment Unit Summary Sheets for predictions of life stages and assessment units most affected by these habitat attributes. High summer temperatures are a well-documented problem for salmonids in the mainstem Okanogan, but the EDT model, or the resolution of data that went into the model, were not capable of evaluating this extreme environmental condition (see "Uncertainties and Limitations" for a full explanation of how we handled temperature in the mainstem for modeling purposes.

Common secondary limiting factors included flow (reduced base flow, increased peak flow), predation, and pathogens (Table 8). Although there was a slight increase to peak flow and flashy flow because of road density, the majority of flow related problems in the Okanogan basin were related to water withdrawals affecting summer and winter low flows impacting juvenile rearing life stages for summer steelhead, and prespawn holding and migration for summer/fall Chinook and sockeye salmon. We did not attempt a scientifically defensible analysis of base flow in relation to salmonid performance, however, the EDT model is capable of evaluating the benefit of alteration to flow regimes. This tool could be used in the future to predict benefits and tradeoffs, once options are identified for improving flow conditions in the Okanogan basin.

The assessment identified flow as a secondary limiting factor to salmonid performance, except for in a few key areas such as Lower Salmon Creek and Loup Loup Creek; therefore, opportunities to fill data gaps regarding flow or increase flow during base flow conditions should be pursued, but not at the expense of other primary limiting factors. See the working hypothesis in the Assessment Unit Summary Sheets for predictions of life stages and assessment units most affected by these secondary-limiting attributes. Predation and pathogens were commonly identified as a secondary limiting factor because of increased exotic species, higher temperatures, and hatchery releases, particularly in the mainstem Okanogan in the US and Canada. In reality, the effect of these factors are data gaps in the Okanogan because no one has actually measured the predation rate on the focal species. However, in the EDT model, qualitative ratings were used to estimate an impact to give us an idea of the importance of these attributes relative to other environmental conditions.

3.39 Ecosystem Diagnosis and Treatment - Key Findings

The EDT reports (subbasin, assessment unit, and reach level) of are intended to provide an integrated and step-wise description of findings for use by subbasin planners.

Table 48Provides a subbasin summary list of the Okanogan subbasin's key factors limiting fish habitat productivity—and by extension, characterizes viability concerns associated with low abundance, limited diversity and insufficient spatial structure.

A set of EDT report maps provide an overview by Assessment Unit to aid in spatial understanding.

The Assessment Unit (AU) Summary tables (AU Summaries) provide more exhaustive and detailed information about geographic location, priority factors, working hypotheses, data gaps and objectives. Reach-level habitat attributes information and analysis can be found in Appendix B, EDT Output Tables.

Table 48 List of Key Limiting Factors for the Okanagan Subbasin condensed and derived from the Assessment Unit Summaries.

Key Limiting Factor or Problem	Management Strategies	Applicable AU's
Barriers to Chinook, steelhead and sockeye migration/spawning/rearing	Plan and implement fish passage; inventory barriers. Assess passage conditions. Address thermal blocks and low flow barriers.	2, 3, 9, 15- Mainstem Okanagan River at McIntyre Dam. Many tributaries. McIntyre/Vaseux, Omak Creek, Salmon Creek.
Fish losses in unscreened irrigation canals	Prepare and implement screening plan. Complete survey where lacking information. Assess entrainment.	16 – Mainstem Okanagan River at McIntyre Dam 13 – Inkaneep Creek
Water Temperature & Dissolved Oxygen	Investigate extent of problem. Prepare plan for remedies (e.g. flushing flows, hypolimnetic aeration, etc.)	2, 3, 9, 15, 11 & 12 North, South and Central Basins of Osoyoos Lake
Predation	Investigate extent of losses. Prepare plan for control	01 – 04 Lower reaches of Okanogan River
Predation	Limit range of walleye by constructing selective fishway	11 - Osoyoos Lake
Unknown loss of 50% returning adult sockeye between Wells Dam and spawning grounds	Use mark and recapture or radio tagging to determine where and why losses are taking place	1 – 12 Migratory route between Wells Dam and spawning grounds.
Undetermined numbers and types of Chinook and steelhead in Canadian waters	Inventory Chinook and steelhead and develop a management plan	11 - 15 Osoyoos Lake, Inkaneep Creek, Vaseux Creek and Okanagan River. Applies to Ninemile and Antoine (US) also.
Habitat Diversity	Increase LWD, Reconnect to floodplain areas. Increase side channel habitat. Install habitat boulders and artificial log-jams. Improve riparian habitats with the potential to contribute to future LWD recruitment. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase LWD deposition, channel complexity and riparian areas.	1-8, 13-17, and 19. Lower Salmon, portions of Omak Creek, Small tributary systems. Inkaneep, McIntyre, Shingle, Ellis, Trout et al.
Sediment	Establish baseline for residual pool depths. Monitor residual pool depths annually and evaluate trends. Conduct sediment reduction strategies throughout the Okanogan subbasin especially in the upper portions of the watershed.	1-9, 13-17 and 19. All Mainstem, especially prevalent in Similkameen and those units just below Similkameen/Okanogan Confluence. Also, Tonasket, Bonaparte, Shingle, Ellis, McIntyre and select other small tributary systems.

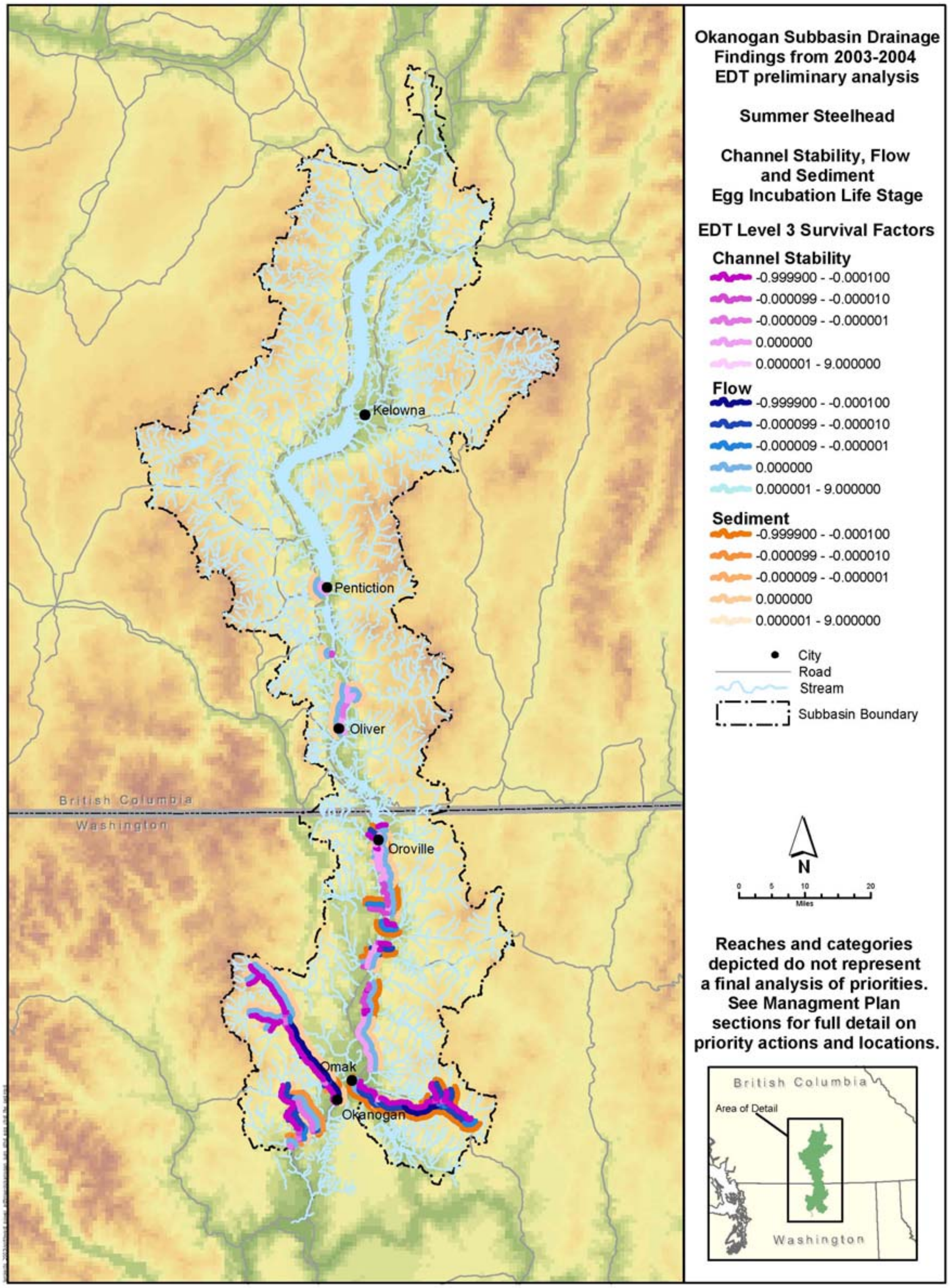
Key Limiting Factor or Problem	Management Strategies	Applicable AU's
Salmon Carcasses (low abundance of salmon/steelhead and their nutrients in general)	Increase or maintain artificial production capacity at levels necessary to meet management needs, maintain new and existing acclimation sites, and support existing and new scatter plantings. Program is intended to support conservation, reestablishment of natural broodstock and interim harvest opportunities.	All tributaries with present or historic anadromous use. Less prevalent in AUs 1-9 and somewhat in 15.
Loss of Floodplain Connectivity	Reestablish back channels, re-slope vertical banks, and establish wetland habitats that allow floodplain inundation to occur approximately every 2 years. Conduct a channel migration corridor study and monitor trends. Protect and re-establish groundwater sources. Protect and re-establish all ground-water sources. Numerous others found in AU summaries.	1-9, 13-17 and 19. All Mainstem, especially prevalent in Similkameen and those units just below Similkameen/Okanogan Confluence. Also, Tonasket, Boneparte, Shingle, Ellis, McIntyre and select other small tributary systems.
Mining and Other Water Quality Issues besides temperature	BMP, enforcement, clean-up of existing land-fill, pesticide dumps etc.	Down stream effects in Similkameen, 2 and some tributary systems.

3.40 EDT Results Illustrated

The following maps depict results from the EDT analysis for three of the focal species; summer/fall and spring Chinook and steelhead. Rule sets do not currently exist for sockeye or for other species, although some inferences about habitat conditions and general patterns of degradation can be inferred.

These maps are a subset of the available data to planners in this format. They outline geographic areas where the analysis found representative differences between the current and the historic habitat conditions and what attributes drove the finding. These results were based upon the initial habitat attribute ratings and categories, and therefore can only in limited instances be viewed as a depiction of priority areas without verification by other information in the plan. Thus, the reader is strongly cautioned against making priority determinations or inferences based on these maps, or the EDT results themselves, alone.

The maps are useful for identifying areas and attributes that limit salmon and steelhead productivity and for viewing attributes and species across the extent of the entire subbasin. In the very near future, a web-based application (available now in beta version) will allow subbasin planners to query any existing EDT data set to produce these maps "on-the-fly." The utility of this kind of interactive query will be an important part of the analytical decision-making and action planning (e.g., projects, programs) phases.



Okanogan Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Summer Steelhead
Channel Stability, Flow
and Sediment
Egg Incubation Life Stage
EDT Level 3 Survival Factors
Channel Stability
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
Flow
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
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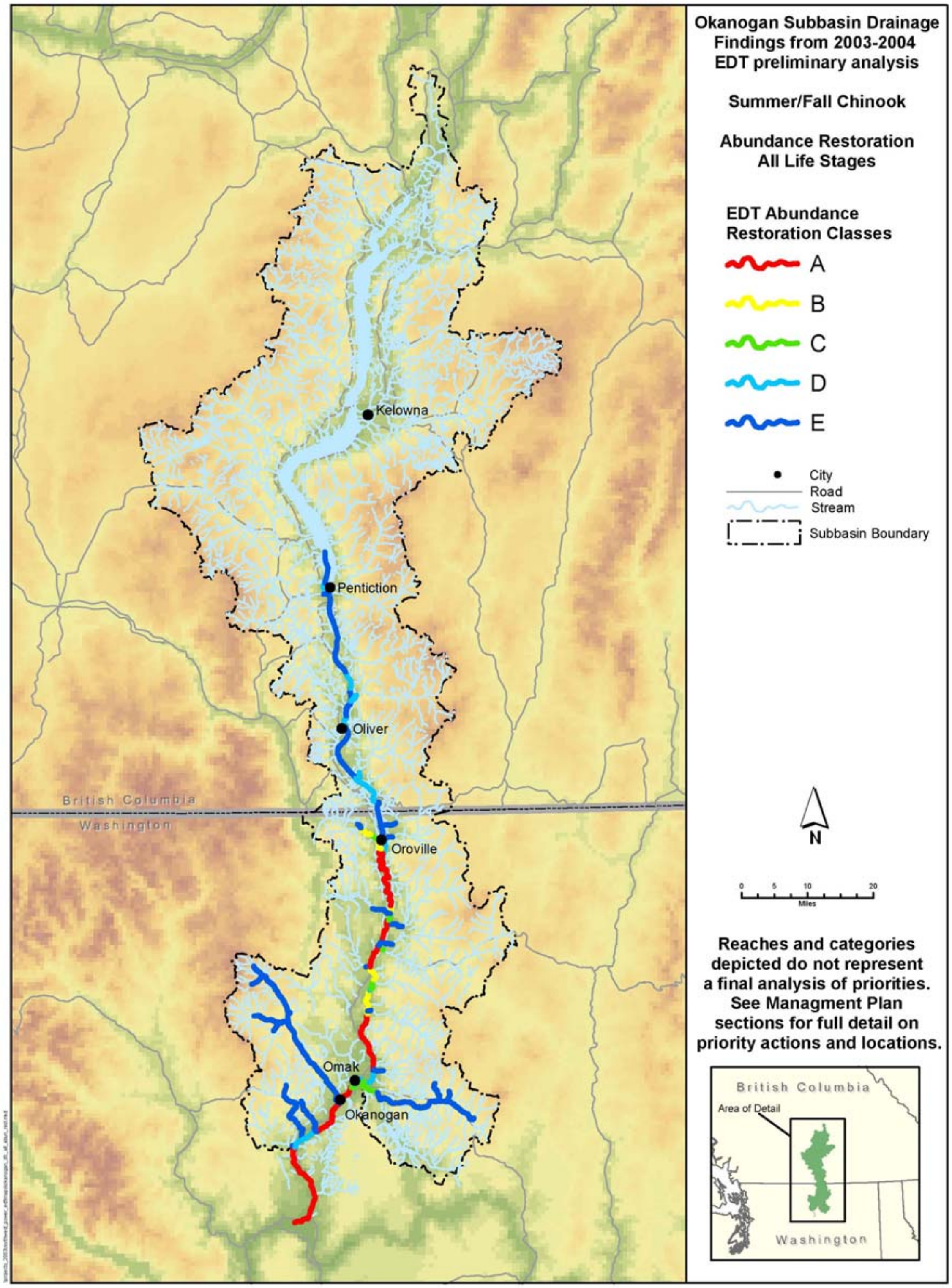
Sediment
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
City
Road
Stream
Subbasin Boundary
N
0 5 10 20
Miles
Reaches and categories depicted do not represent a final analysis of priorities. See Managment Plan sections for full detail on priority actions and locations.
Kelowna
Penticton
Oliver
British Columbia
Washington
Oroville
Omak
Okanogan
Area of Detail


Okanogan Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Summer/Fall Chinook
Abundance Restoration
All Life Stages
EDT Abundance
Restoration Classes
A
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City
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Subbasin Boundary
Kelowna
Penticton
Oliver
British Columbia
Washington
Oroville
Omak
Okanogan
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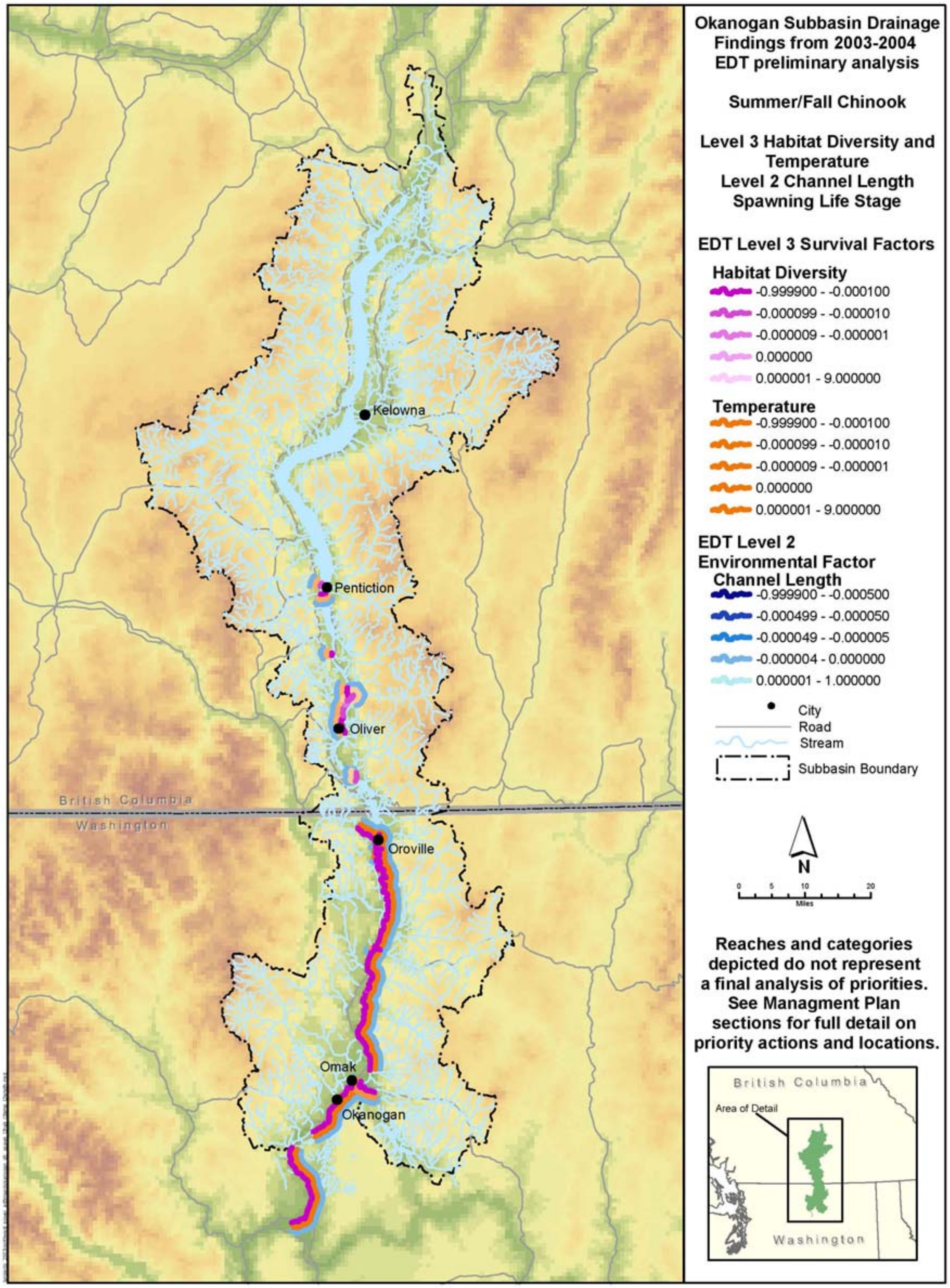
Miles
Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.
British Columbia
Area of Detail
Washington


Okanogan Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Summer/Fall Chinook
Level 3 Habitat Diversity and
Temperature
Level 2 Channel Length
Spawning Life Stage
EDT Level 3 Survival Factors
Habitat Diversity
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
Temperature
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
EDT Level 2
Environmental Factor
Channel Length
-0.999900 - -0.000500
-0.000499 - -0.000050
-0.000049 - -0.000005
-0.000004 - 0.000000
0.000001 - 1.000000
City
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Subbasin Boundary
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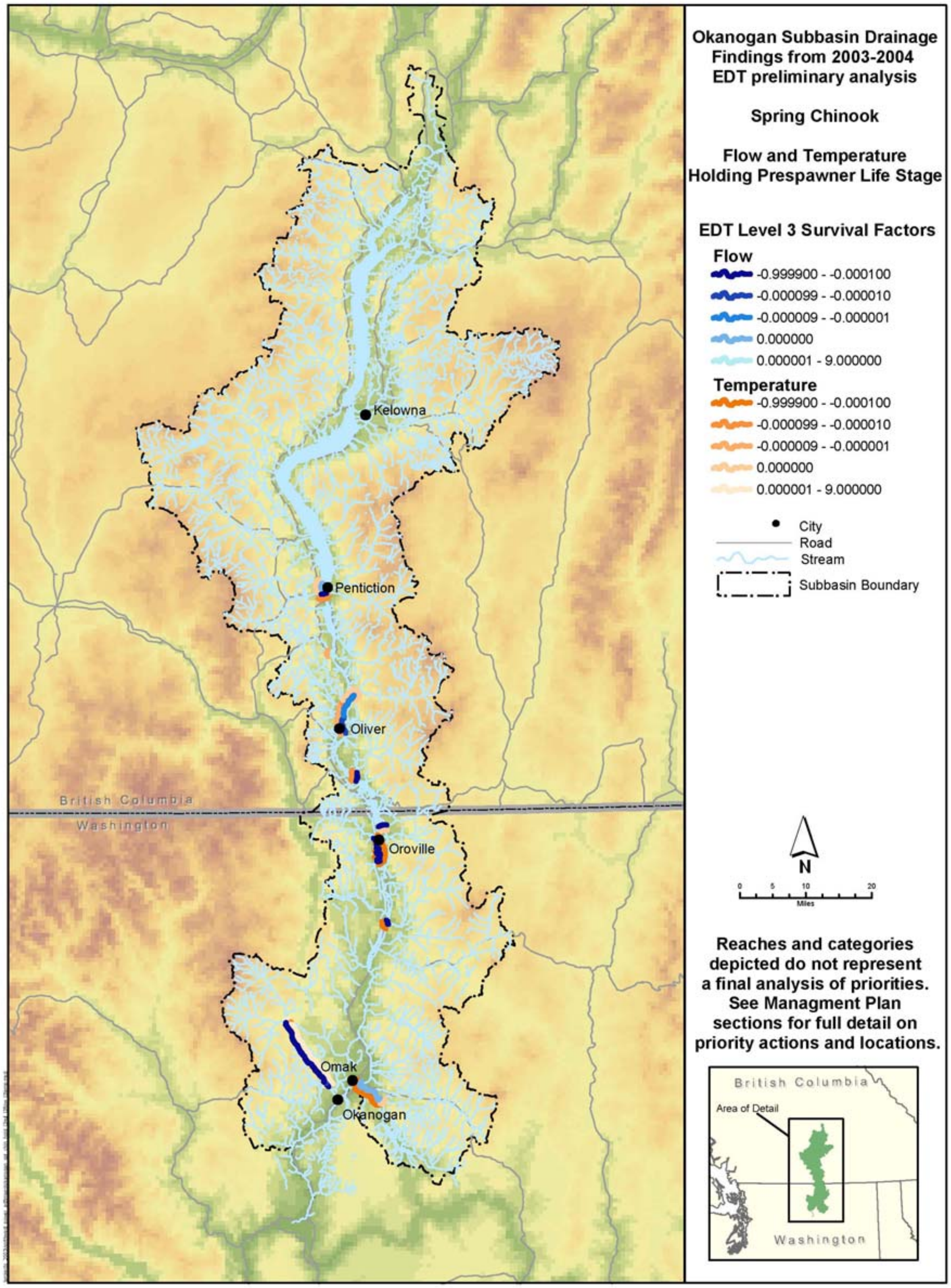
Miles
Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.
Kelowna
Penticton
Oliver
British Columbia
Washington
Oroville
Omak
Okanogan
Area of Detail


Okanogan Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis

Spring Chinook

Flow and Temperature
Holding Prespawner Life Stage

EDT Level 3 Survival Factors
Flow
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-0.000009 - -0.000001
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Temperature
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Subbasin Boundary
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Miles
Reaches and categories depicted do not represent a final analysis of priorities. See Managment Plan sections for full detail on priority actions and locations.
British Columbia
Area of Detail
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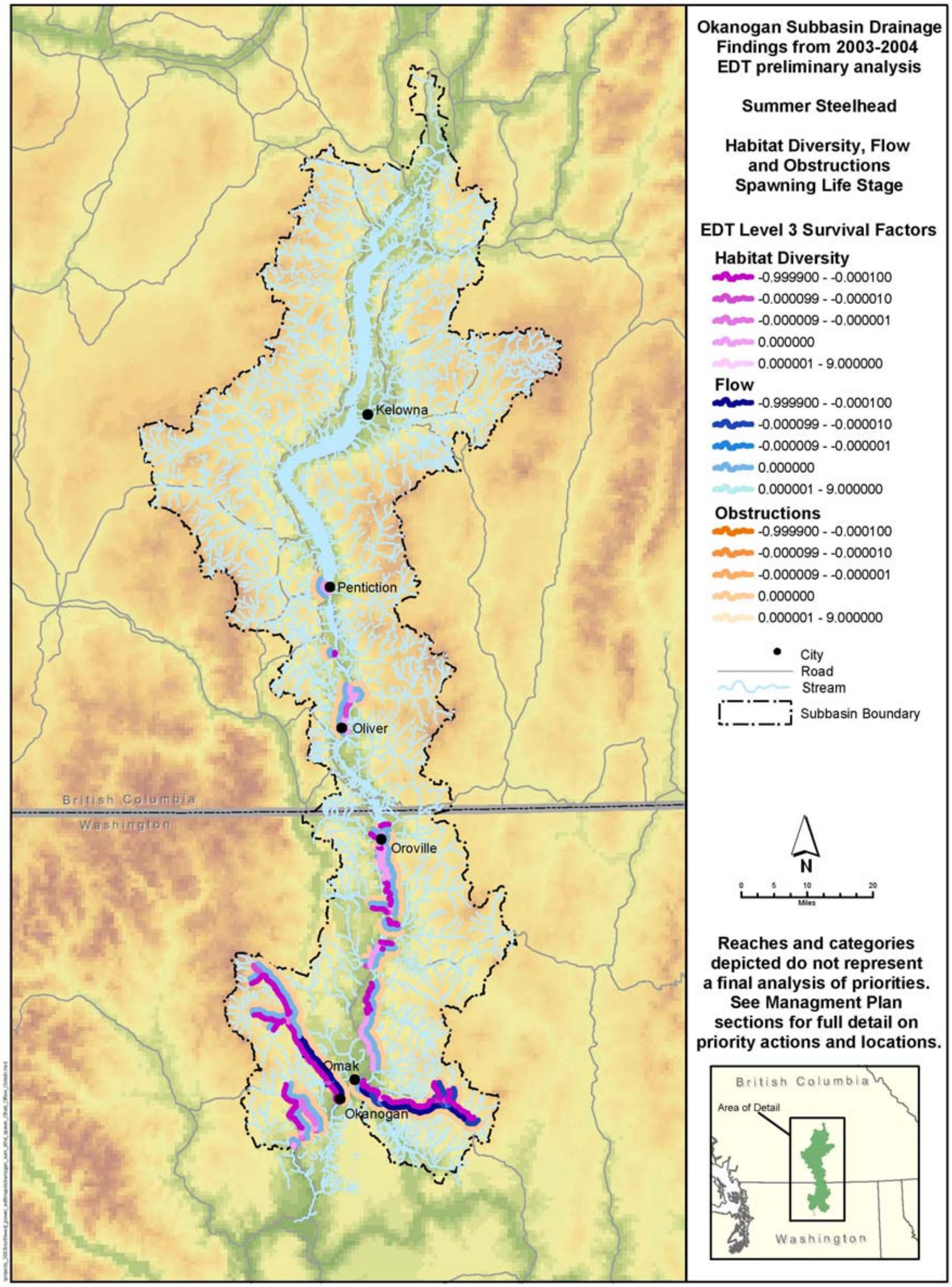
Kelowna
Penticton
Oliver
British Columbia
Washington
Oroville
Omak
Okanogan



Okanogan Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Summer Steelhead
Habitat Diversity, Flow
and Obstructions
Spawning Life Stage
EDT Level 3 Survival Factors
Habitat Diversity
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
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0.000001 - 9.000000
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-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
Obstructions
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-0.000099 - -0.000010
-0.000009 - -0.000001
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0.000001 - 9.000000
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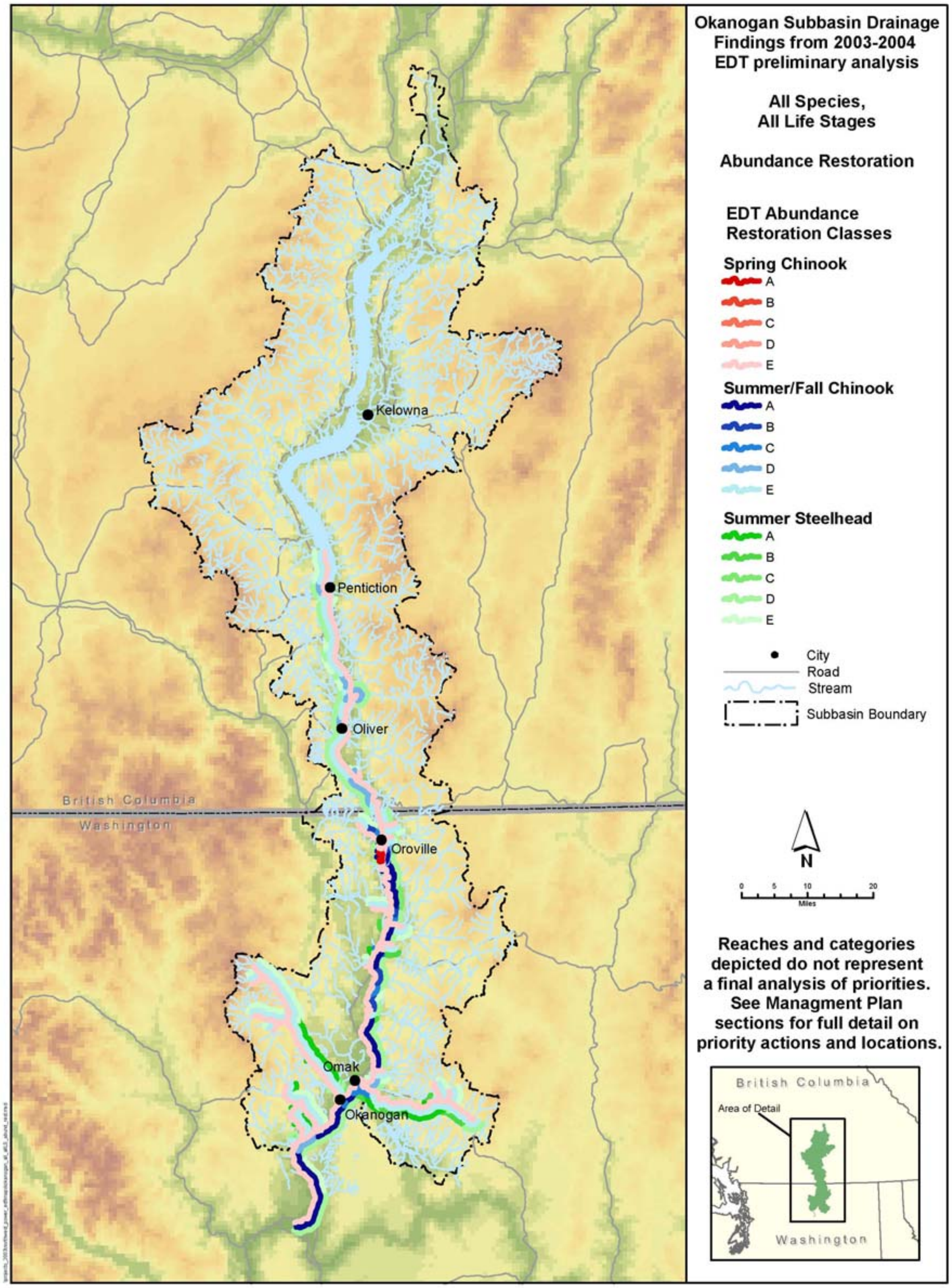
Miles
Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.
British Columbia
Area of Detail
Washington



Okanogan Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
All Species,
All Life Stages
Abundance Restoration
EDT Abundance
Restoration Classes
Spring Chinook
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Summer/Fall Chinook
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Summer Steelhead
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British Columbia
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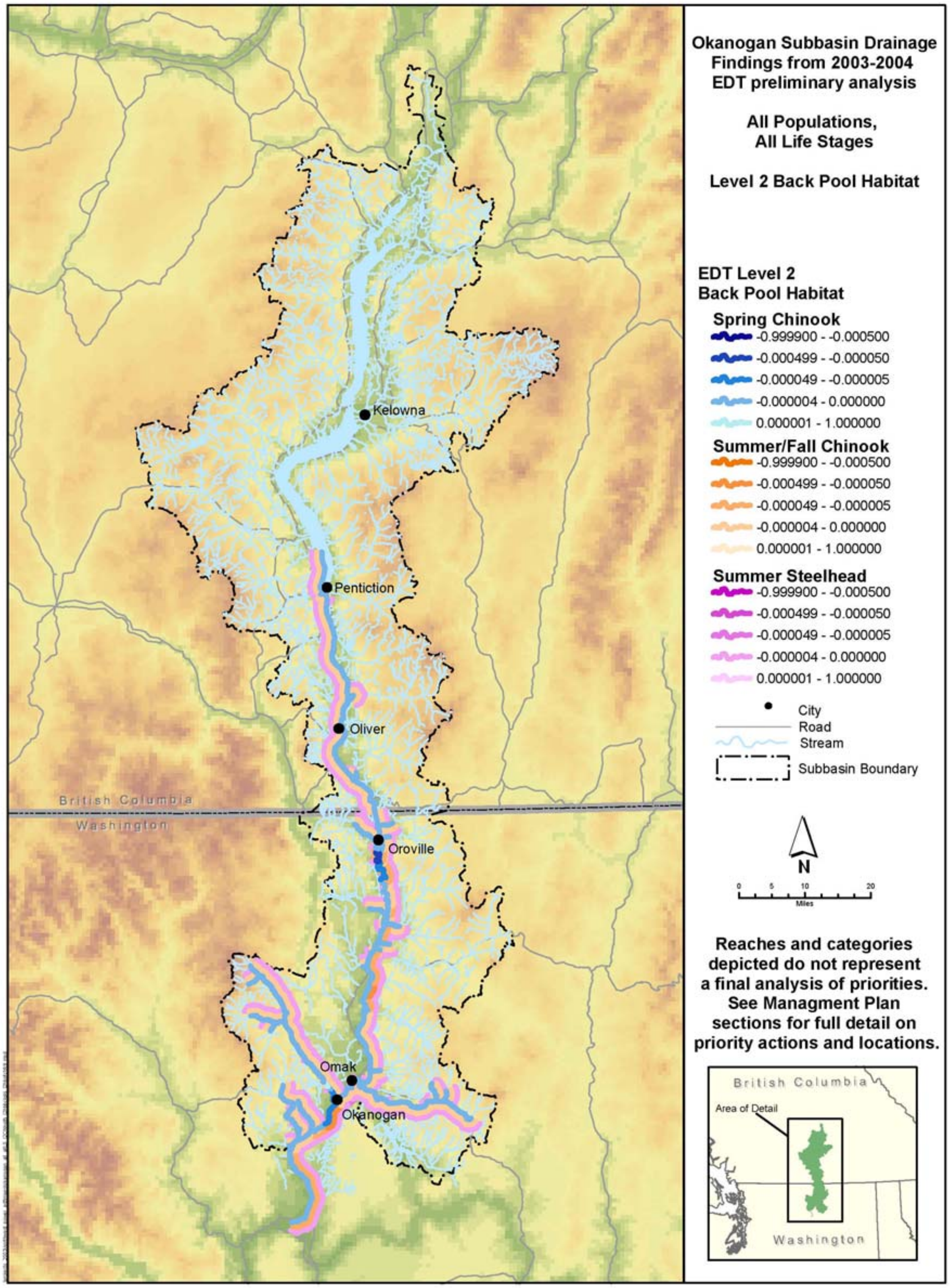
Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.
British Columbia
Area of Detail
Washington


Okanogan Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis

All Populations,
All Life Stages

Level 2 Back Pool Habitat

EDT Level 2
Back Pool Habitat
Spring Chinook
-0.999900 - -0.000500
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Summer/Fall Chinook
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-0.000499 - -0.000050
-0.000049 - -0.000005
-0.000004 - 0.000000
0.000001 - 1.000000
Summer Steelhead
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-0.000499 - -0.000050
-0.000049 - -0.000005
-0.000004 - 0.000000
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Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.

British Columbia
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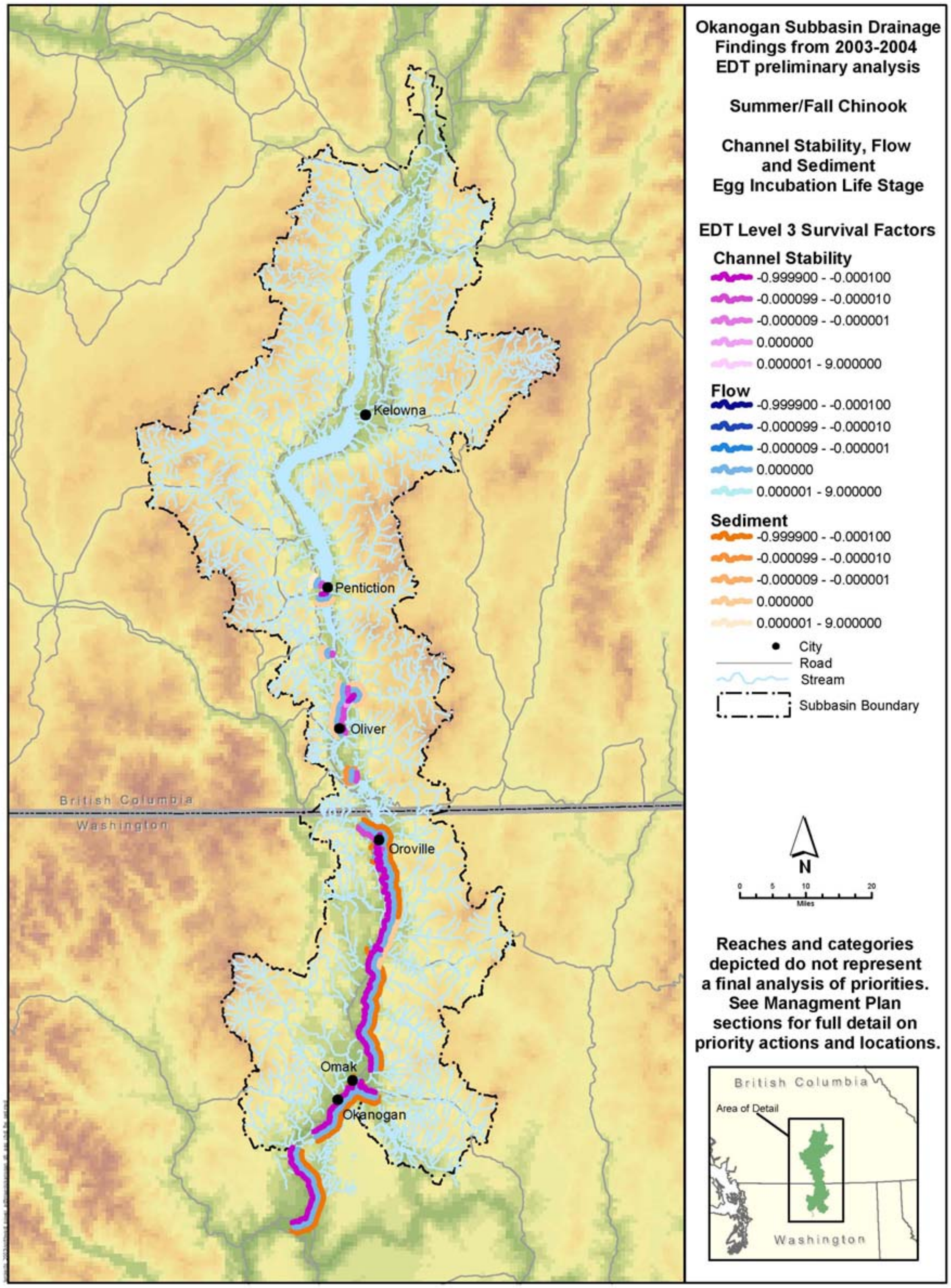
Okanogan


Okanogan Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Summer/Fall Chinook
Channel Stability, Flow and Sediment
Egg Incubation Life Stage
EDT Level 3 Survival Factors
Channel Stability
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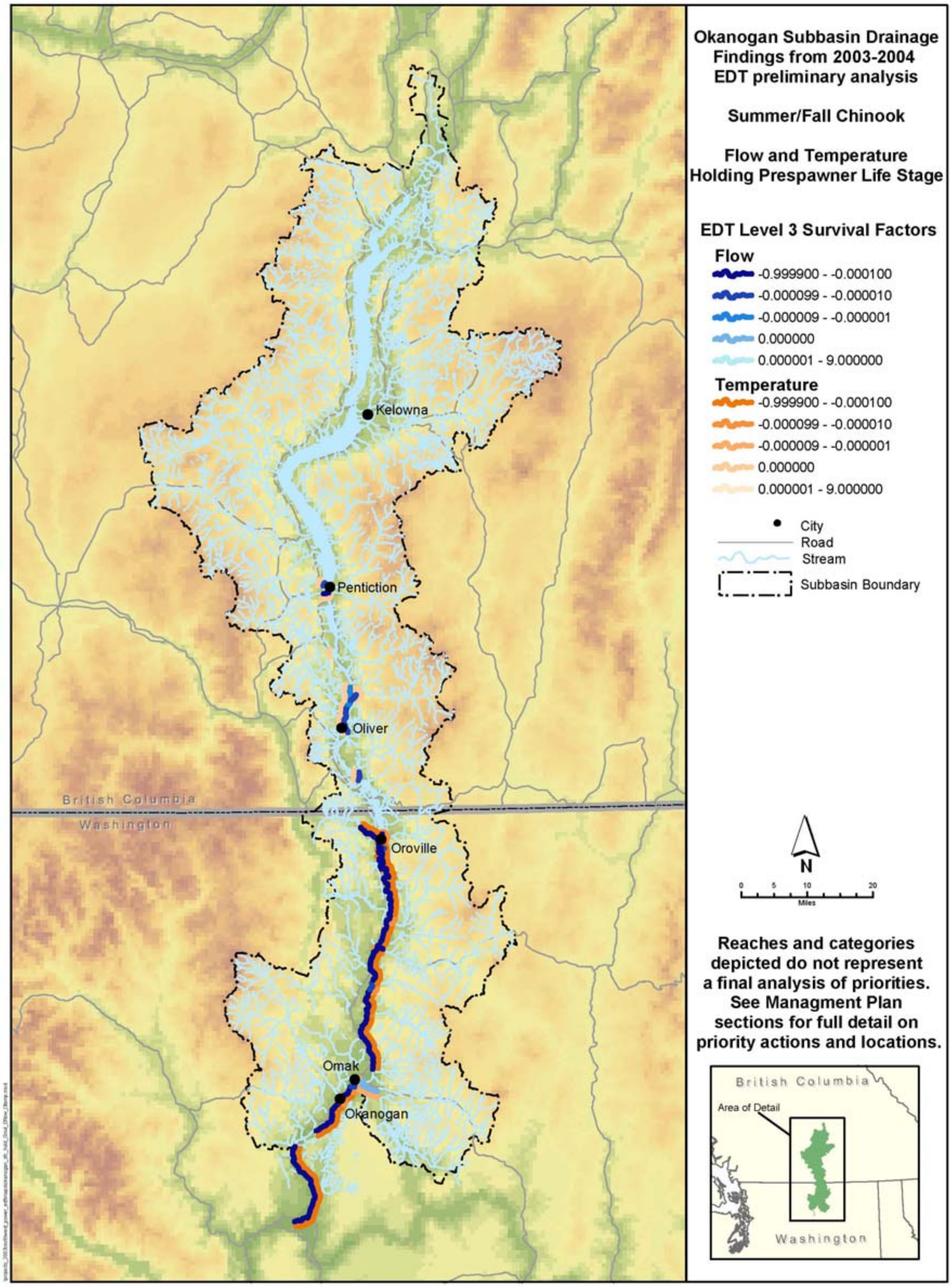
Reaches and categories depicted do not represent a final analysis of priorities. See Managment Plan sections for full detail on priority actions and locations.
British Columbia
Area of Detail
Washington


Okanogan Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Summer/Fall Chinook
Flow and Temperature
Holding Prespawner Life Stage
EDT Level 3 Survival Factors
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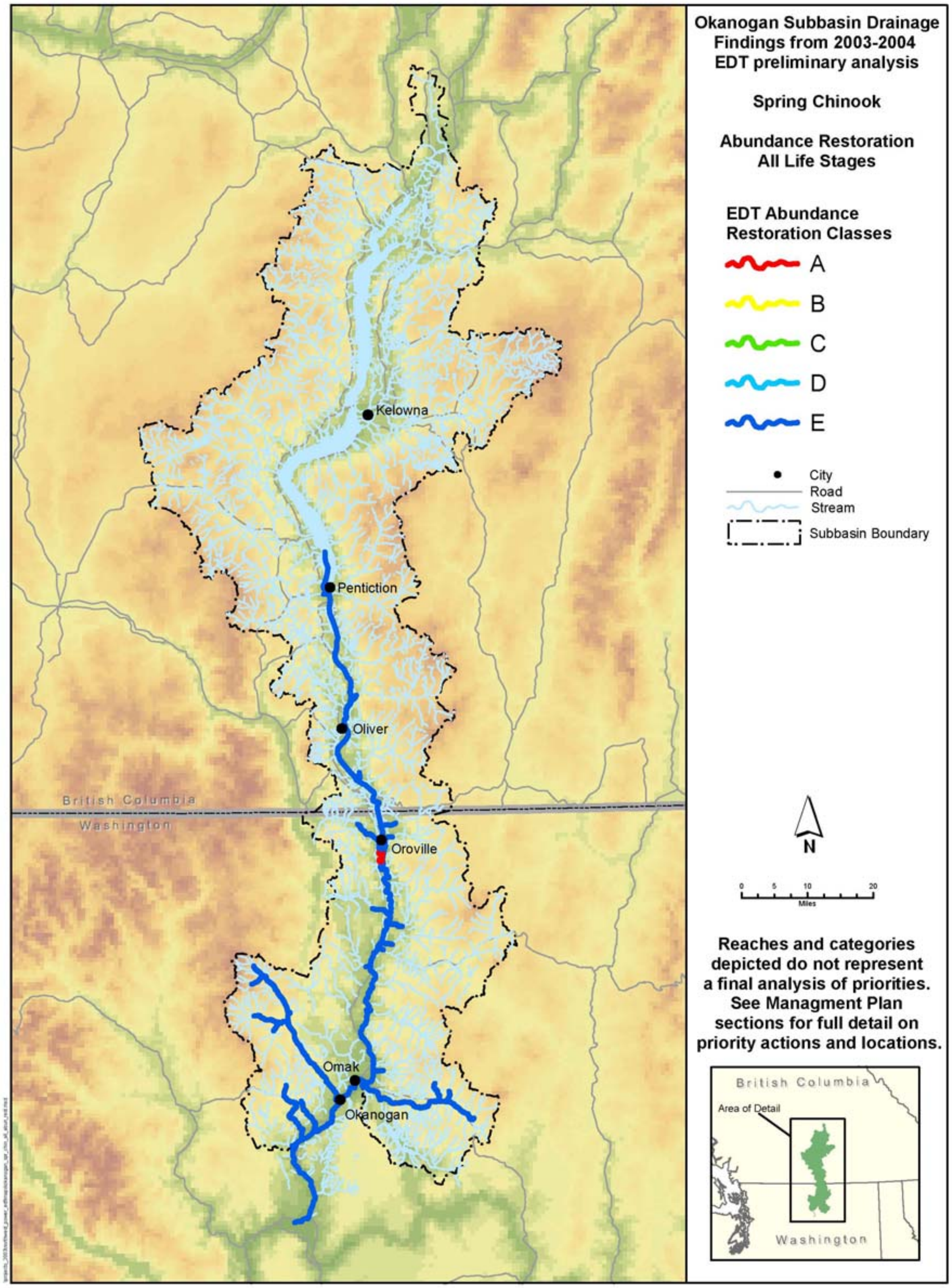
Reaches and categories depicted do not represent a final analysis of priorities. See Managment Plan sections for full detail on priority actions and locations.
British Columbia
Area of Detail
Washington


Okanogan Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Spring Chinook
Abundance Restoration
All Life Stages
EDT Abundance
Restoration Classes
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City
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Subbasin Boundary
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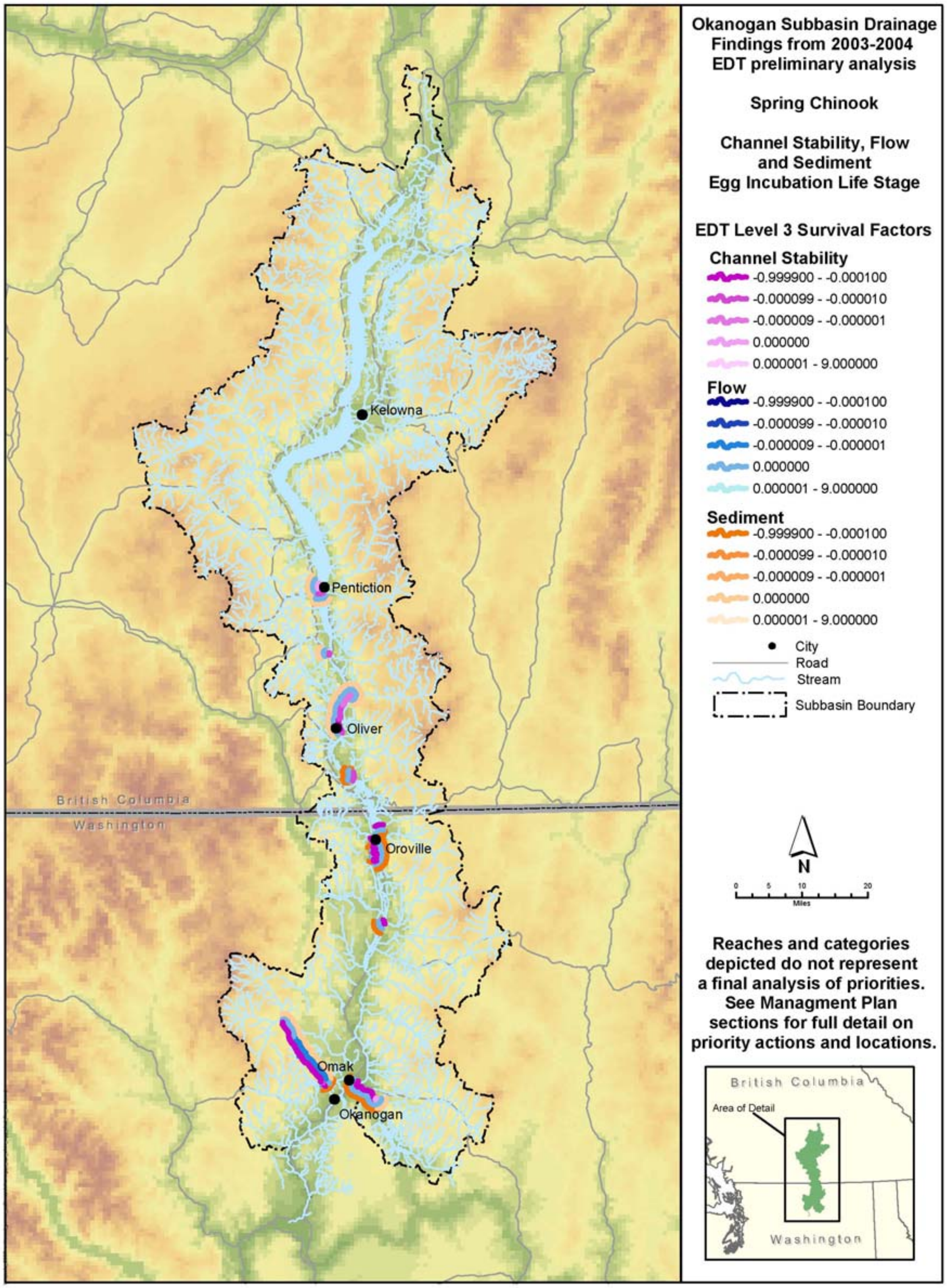
0 5 10 20
Miles
Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.
British Columbia
Area of Detail
Washington
Kelowna
Penticton
Oliver
British Columbia
Washington
Oroville
Omak
Okanogan


Okanogan Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Spring Chinook
Channel Stability, Flow
and Sediment
Egg Incubation Life Stage
EDT Level 3 Survival Factors
Channel Stability
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-0.000009 - -0.000001
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Sediment
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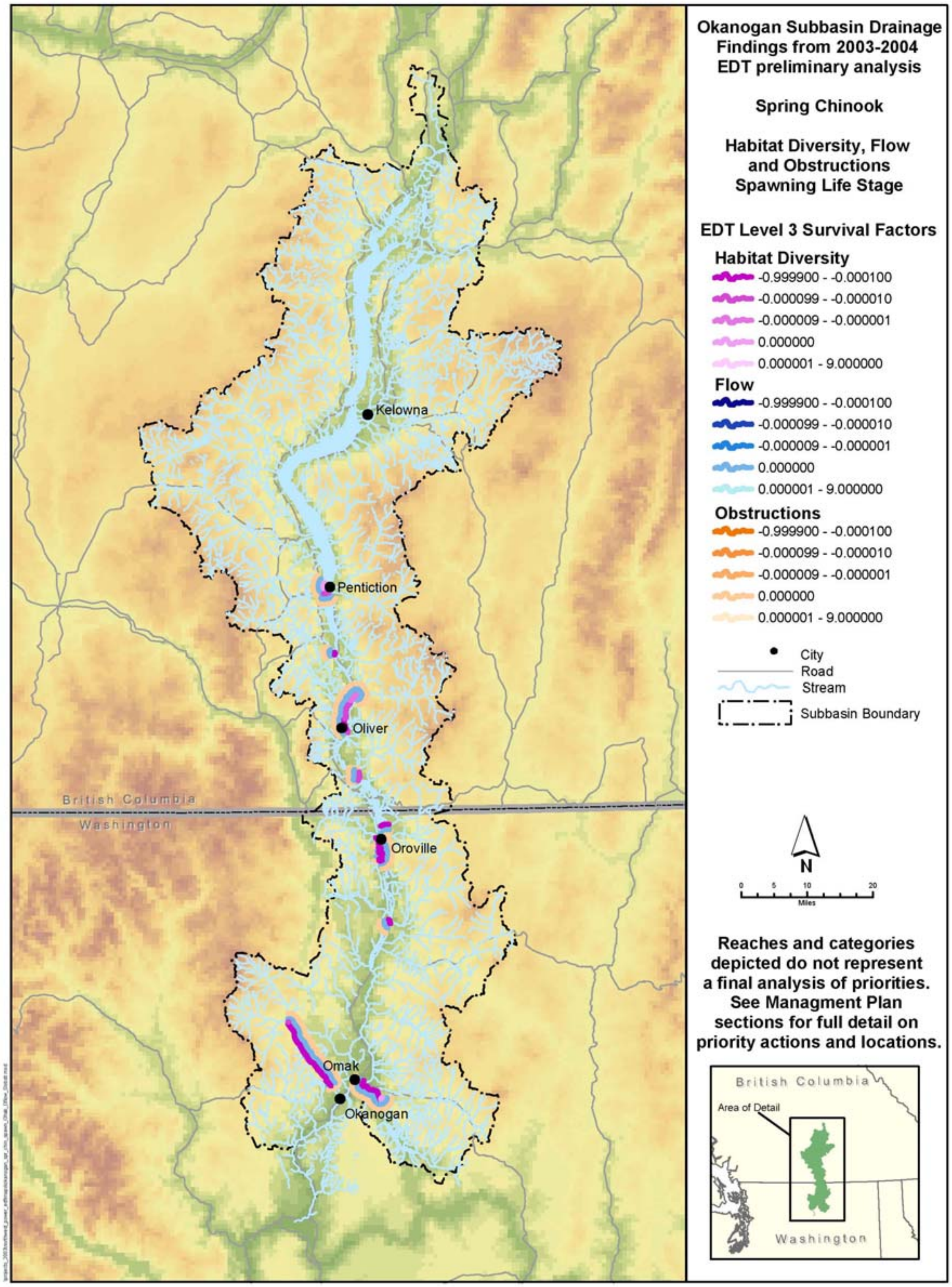
Miles
Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.
British Columbia
Area of Detail
Washington
Kelowna
Penticton
Oliver
British Columbia
Washington
Oroville
Omak
Okanogan



Okanogan Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Spring Chinook
Habitat Diversity, Flow
and Obstructions
Spawning Life Stage
EDT Level 3 Survival Factors
Habitat Diversity
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
Flow
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-0.000099 - -0.000010
-0.000009 - -0.000001
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Obstructions
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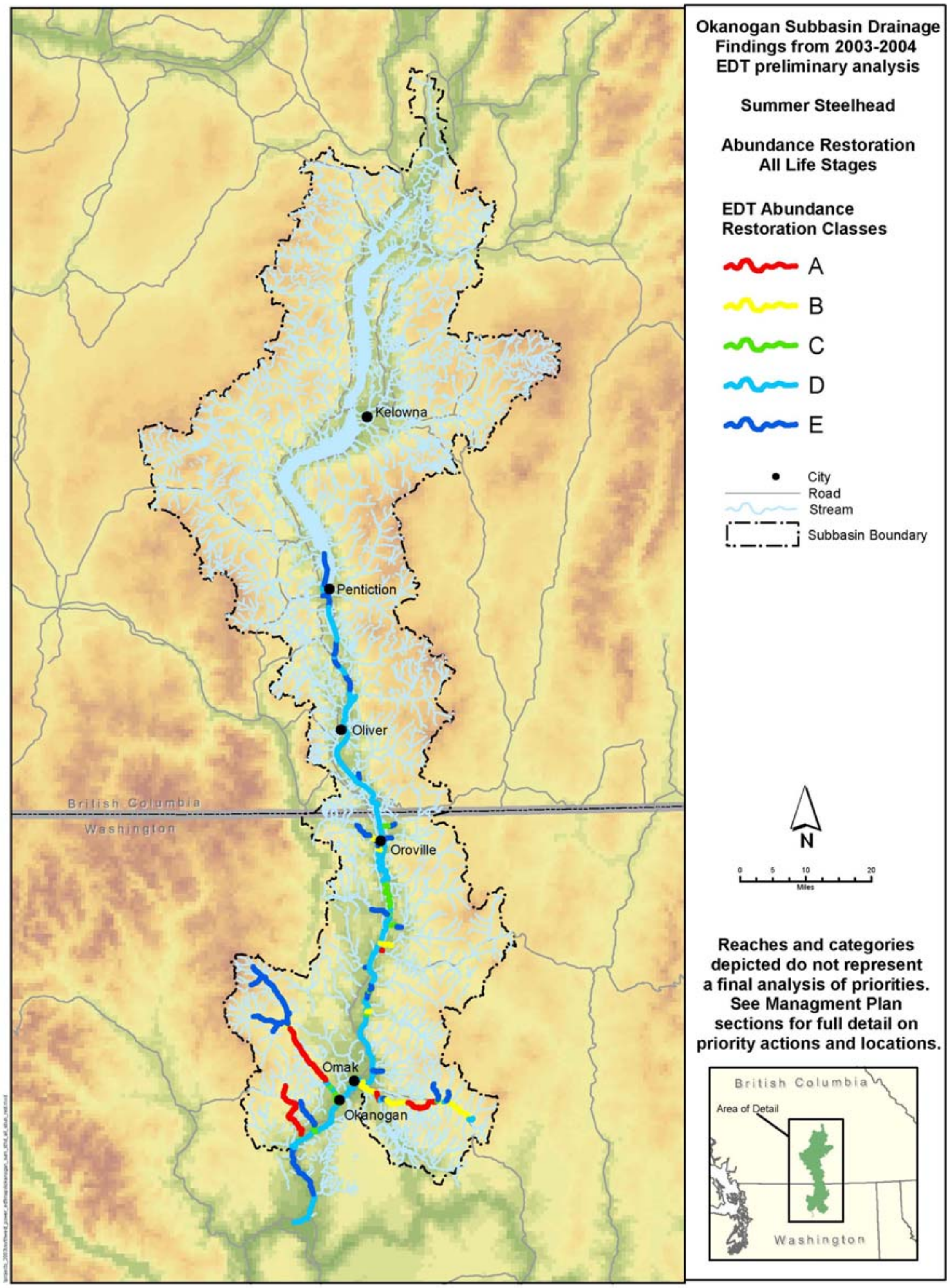
Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.
Kelowna
Penticton
Oliver
British Columbia
Washington
Oroville
Omak
Okanogan
British Columbia
Area of Detail
Washington


Okanogan Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Summer Steelhead
Abundance Restoration
All Life Stages
EDT Abundance
Restoration Classes
A
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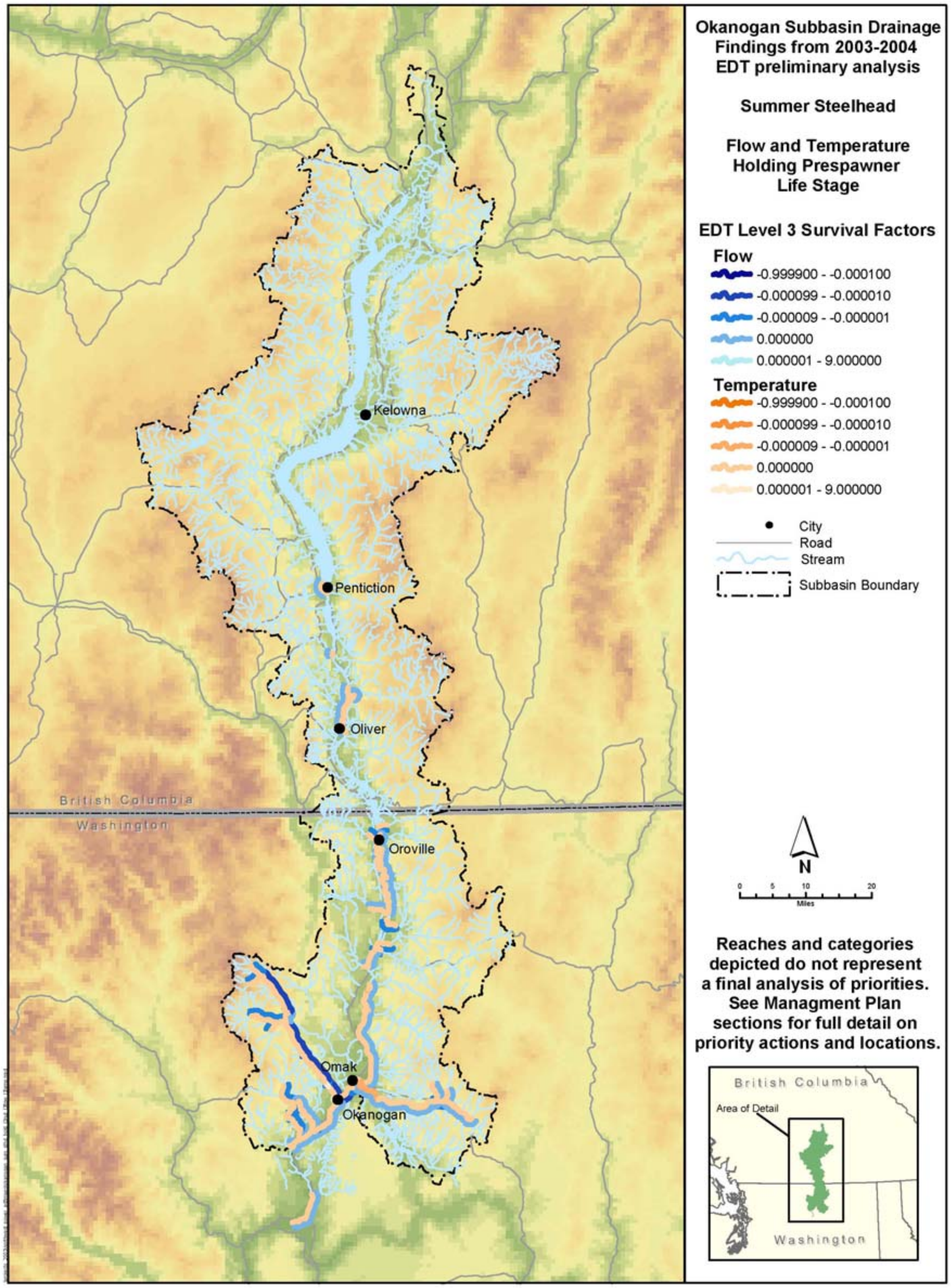
City
Road
Stream
Subbasin Boundary
N
0 5 10 20
Miles
Reaches and categories
depicted do not represent
a final analysis of priorities.
See Managment Plan
sections for full detail on
priority actions and locations.
British Columbia
Area of Detail
Washington
Kelowna
Penticton
Oliver
British Columbia
Washington
Oroville
Omak
Okanogan


Okanogan Subbasin Drainage
Findings from 2003-2004
EDT preliminary analysis
Summer Steelhead
Flow and Temperature
Holding Prespawner
Life Stage
EDT Level 3 Survival Factors
Flow
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
0.000000
0.000001 - 9.000000
Temperature
-0.999900 - -0.000100
-0.000099 - -0.000010
-0.000009 - -0.000001
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0.000001 - 9.000000
City
Road
Stream
Subbasin Boundary
Kelowna
Penticton
Oliver
British Columbia
Washington
Oroville
Omak
Okanogan
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Miles
Reaches and categories depicted do not represent a final analysis of priorities. See Managment Plan sections for full detail on priority actions and locations.
British Columbia
Area of Detail
Washington

4 Inventory of Existing Activities

Introduction

Inventory of existing activities is a key element of the subbasin plans. The following section summarizes agency program, management and regulatory activities, which represents each agencies role in the management of the subbasin. In addition, an inventory of projects follows. This inventory is designed to be compared with the needs for fish and wildlife identified in this plans Assessment.

In both Canada and US, federal, state and provincial agencies, local municipalities, tribal groups, and public interest groups all manage, regulate, or otherwise are involved in land and water usage within their respective jurisdictions. In the Okanogan subbasin this also involves trans-boundary institutions like the International Joint Commission (regulation of water-benefit arrangements and joint management orders) and the BC-Washington Environmental Council (cooperative management of water and air-sheds), and the Georgia Basin/Puget Sound Ecosystem Initiatives (cooperative basin environmental protection).

For the most part, these governing bodies and stakeholders have policies and guidelines to control the demands placed upon the watershed and their mandates include the management of natural resources for society while maintaining a level of protection of water, land, fish, and wildlife resources.

This subbasin plan's inventory of projects includes projects from the last ten years. An extensive effort, through multiple planning processes, has occurred to develop this inventory of projects; however, the list is not all-inclusive. Further, not all other planning processes have required the level of information that is required by NPCC. Given the timeframe and funding level, the subbasin planners could not provide all of the information that was suggested in the Technical Guide for Subbasin Planners (Council Document 2001-20. This included: identifying the limiting factors or ecological processes the activity is designed to address; summarizing accomplishments/failures of the activity; and identifying the relationship to other activities in the subbasin. Further, subbasin planners were not able to accomplish identifying the gaps between actions that have already been taken or are underway and additional actions that are needed.

The information presented in this section is specifically designed to provide context for subbasin planners and to reduce or eliminate duplication of efforts between parties. The tables attempt to categorize project types and geographic areas as well as identify project sponsors. To a degree, this information can be viewed as a snapshot of what is happening on the ground at this time for fish and wildlife protection and restoration. However, it does not depict the full range of actions that have been recommended in the Province even as "high priority actions." This situation is especially prevalent in the Columbia Cascade Province, especially when viewed within the context of population status, past losses and mitigation history, and, when compared to implementation levels in other Provinces.

To provide a regional context for this subbasin plan, Appendix B. provides summarized information for the Columbia Cascade and for the Okanogan (Methow) subbasin. This information details an accounting of what project categories and funding levels have been recommended by the basin technical teams, fish and wildlife managers, the ISRP, the CBFWA and the NPPC.   The results depict what BPA has actually funded in the 2001-2003 period.

Programs and projects in the Okanogan

Programs and projects in the subbasin relating to fish and wildlife are primarily directed at rebuilding or maintaining anadromous and resident fish, wildlife, and habitat result from many of the direct and indirect impacts within the basin; many of these impacts and their resolution have cross-border implications.

Such impacts include hydroelectric facilities and their operations, water consumption, water management, urban development, infrastructure, agriculture, forestry, water quality, ground disturbances, out right habitat loss, and introduced species.

Programmatic Actions

A number of US-based programs are available that provide project resources to address offsite mitigation for salmon entrainment in downstream dams, as well as programs to address endangered species recovery and clean water management. Habitat conservation plans prescribe mitigation for habitat and fish losses associated with development etc.

In Canada, several provincial and federal programs were available over the last decade that provided forestry-based watershed assessments and inventories, multi-agency habitat restoration and stewardship, and public education in the Okanagan-Similkameen Watershed. However, most of these programs were discontinued in 2001/02 due to fiscal and policy changes in government. Some limited provincial habitat restoration remains, however it is dedicated to fish and habitat projects of provincial responsibility associated with resident fisheries.

While cross-border program coordination and collaboration remains in its relative infancy, some successful fish and water management, and pilot habitat projects have been developed in the effort among agencies to mitigate the losses of Canadian sockeye passing through Wells Dam, and have been led by an ad-hoc Okanogan Basin Technical Working Group. Initial funding for the project came through the Wells Committee and Douglas County PUD.

Formalized in Canada, the cross-border information-sharing and collaborative programming forum is a model of future ecosystem-based management for agencies working with trans-boundary stocks in the subbasin. An extension to other fish species, habitats and wildlife promises to generate ecosystem-level benefits.

Existing Protection in the subbasin

Approximately 13 percent (199,143 acres) of the lands in the US Okanogan subbasin have permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events of natural type are allowed to proceed without interference or are mimicked through management (high protection).

An estimated 0.8 percent (12,798 acres) of the Subbasin has permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state (medium protection status) (Figure 50).

Approximately 438,793 acres (29 percent) of the Subbasin has permanent protection from conversion of natural land cover for the majority of the area, but is subjected to uses of either a broad, low intensity type or localized intense type (low protection status). Lands owned by WDFW fall within the medium and low protection status categories and include six wildlife management areas. The majority of the US portions of the subbasin (56 percent; 839,345 acres) have no amount of protection. Many aquatic / fish habitats and functions are in need of protection and restoration.

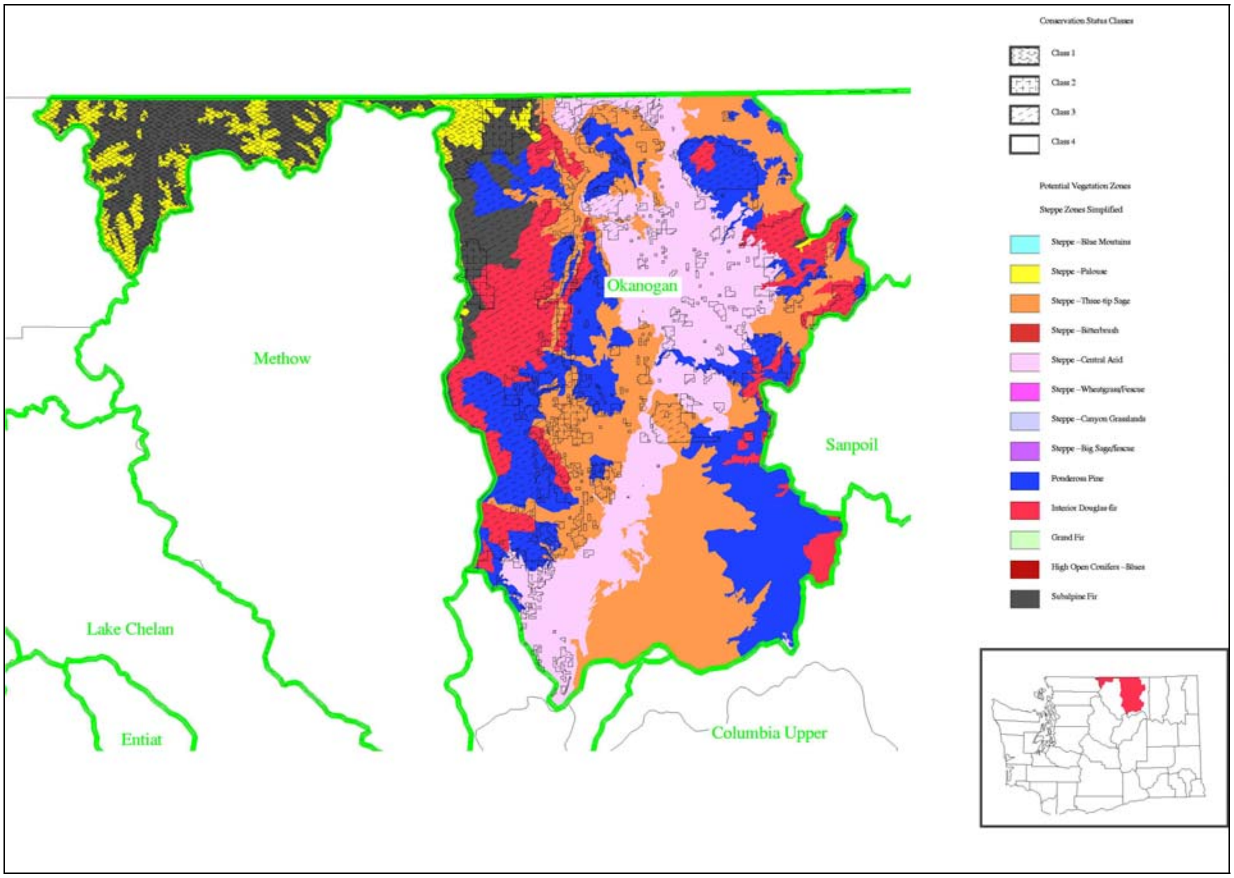

Figure 50 Gap protection status and vegetation zones of the Okanogan subbasin, Washington (Cassidy 1997).

4.1 Fish and Wildlife Programming in the Subbasin (Canada and US)

Programs and projects in the subbasin relating to fish and wildlife are primarily directed at rebuilding or maintaining anadromous and resident fish, wildlife, and habitat result from many of the direct and indirect impacts within the basin; many of these impacts and their resolution have cross-border implications.

Such impacts include hydroelectric facilities and their operations, water consumption, water management, urban development, infrastructure, agriculture, forestry, water quality, ground disturbances, out right habitat loss, and introduced species.

A number of US-based and Canadian programs are available that provide project resources to address regional management priorities.

Offsite mitigation for salmon entrainment in downstream dams, and programs to address Endangered species recovery and clean water management, occupy the primary program priorities in US. The recently published Okanogan Chinook HGMP (Colville Tribes 2003) describes a management plan to aid in the conservation of Upper Columbia Chinook in this ESU.

In Canada, habitat management and conservation plans prescribe mitigation for losses associated with development. Significant program efforts in the last decade include fish-water management modeling to balance sockeye and lake kokanee survival, Okanagan Lake Kokanee restoration, forestry-based watershed restoration, and in the river, reconnecting the floodplane, side channel and wetland habitat restoration, and public stewardship. Recently, a study to explore reintroduction of sockeye to Skaha Lake is underway as part of an Okanagan Nation Alliance program to restore former salmon access to headwater habitats.

While cross-border program coordination and collaboration remains in its relative infancy, some successful fish and water management, and pilot habitat projects have been developed in the effort among agencies to mitigate the losses of Canadian sockeye passing through Wells Dam, and have been led by an ad-hoc Okanogan Basin Technical Working Group. Initial funding for the project came through the Wells Committee and Douglas County PUD.

Formalized in Canada, the cross-border information-sharing and collaborative programming forum is a model of future ecosystem-based management for agencies working with trans-boundary stocks in the subbasin. An extension to other fish species, habitats and wildlife promises to generate ecosystem-level benefits.

Canada

In the Canadian subbasin, the B.C. Government has designated 23 parks. More parks are continuing to be designated as a result of the implementation of the Okanagan-Shuswap Land and Resource Management Plan. This plan led to the protection of an additional 169,000 acres of the Okanogan subbasin in recent years. The Okanagan-Shuswap LRMP has also provided strategic direction for the expansion of the Okanagan Wildlife Management Area associated with the Okanagan River between Vaseaux and Osoyoos Lakes. A new wildlife management area (Direnzy near Skaha Lake is also an outcome of the approved LRMP.

Within the Canadian subbasin, Protected Areas encompass approximately 9% of the land base or 381,000 acres. These areas have permanent protection from conversion of natural land cover and a mandated management plan in operation.

Major protected areas within the subbasin include Manning (subbasin portion of 89,200 acres), Cathedral (81,171 acres), Snowy Protected Area (62,769 acres), Okanagan Mountain (25,448 acres) Greystokes Protected Area (28,866 acres) and Kalamalka (10,160 acres)Various degrees of protection on the public lands outside the Protected Area system is afforded at the strategic level through the Resource Management Zones of the Okanagan-Shuswap Land and Resource Management Plan with the exception of the headwaters of the Similkameen River (much of which is within Provincial Parks). These zones are defined by the presence of resource values and uses and have associated resource management direction in the form of objectives and strategies. The plan is unique in that Resource Management Zones can overlap, depending on the resource values and uses in a specific area. As a result, layers of resource management objectives and strategies apply to operational planning wherever it is proposed on the public land base. Because of the "three dimensional" nature of the Okanagan-Shuswap LRMP it is housed within a web based map browser that provides for the display of resource management zones (and associated objectives and strategies) for any specific site within the public land outside protected areas. The objectives and strategies that apply to the proposed development provide protection to resource values and uses. The Okanagan-Shuswap LRMP is found at http://srmwww.gov.bc.ca/sir/lrmp/okan/ Examples of objectives and strategies appropriate to this plan are found in Appendix E.

4.2 Management and Regulation

US – Canada Treaty

Treaty Between The Government of Government of Canada and the Government of the United States of America Concerning Pacific Salmon

Annex IV Chapter 1 Transboundary Rivers

Recognizing that stocks of salmon originating in Canadian sections of the Columbia River constitute a small portion of the total populations of Columbia River salmon, and that the arrangements for consultation and recommendation of escapement targets and approval of enhancement activities set out in Article VII are not appropriate to the Columbia River system as a whole, the Parties consider it important to ensure effective conservation of up-river stocks which extend into Canada and to explore the development of mutually beneficial enhancement activities.

Therefore, notwithstanding Article VII, paragraphs 2, 3, and 4, the Parties shall consult with a view to developing, for the transboundary sections of the Columbia River, a more practicable arrangement for consultation and setting escapement targets than those specified in Article VII, paragraphs 2 and 3. Such arrangements will seek to,

- ensure effective conservation of the stocks;
- facilitate future enhancement of the stocks on an agreed basis; and
- avoid interference with United States management programs on the salmon stocks existing in the non-transboundary tributaries and the main stem of the Columbia River.

Washington-British Columbia Environmental Cooperation Council (ECC)

The ECC was established by the Environmental Cooperation Agreement entered into by the Governor of Washington State and the Premier of B.C. on May 7, 1992. Its purpose is to ensure coordinated action and information sharing on environmental matters of mutual concern. The ECC has been identified by the Provincial policy makers as the preferred choice for B.C.-Washington coordination on Okanagan subbasin restoration.

US Program Actions

USDA Forest Service

The Tonasket Ranger District, in the Okanogan and Wenatchee National Forest, manages 357,000 acres in the Okanogan Basin. The land is managed according to the Okanogan National Forest System Land and Resource Management Plan (USDA, 1989), as amended by the

Decision Notice for the Interim Strategies for Managing Anadromous Fish- Producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH) (USDA, USDI 1995).

Most of the National Forest land is in mid- to upper elevation forest. The 1989 Forest Plan divides the land into management areas, each with a management prescription based on unique habitat conditions. The majority of National Forest land is managed for multiple uses, including lynx habitat, deer winter range, timber, and livestock grazing.

A small portion of National Forest land in the northeast corner of the district is designated Wilderness, with no motorized equipment allowed. There is also a small parcel of land designated as a Research Area, and another relatively small parcel is managed as semi-primitive, with no motor vehicles allowed. The USFS Tonasket Ranger District maintains 42 cattle allotments on National Forest land.

USDA Bureau of Land Management

The BLM management follows the same legal multiple-use mandate that guides the US Forest Service. Management direction is outlined in the Spokane District Resource Management Plan (USDI, 1987), as amended by PACFISH (USDA, USDI, 1995).

BLM lands in the basin include two large areas in the Similkameen and Salmon watersheds, and numerous small, scattered parcels throughout the basin. Management is centered on the two large areas; the scattered parcels are used primarily in land exchange deals.

US Army Corps of Engineers

Section 10 Permit - Work in Navigable Waters

A Corps permit is required when locating a structure, excavating, or discharging dredged or fill material in waters of the United States or transporting dredged material for the purpose of dumping it into ocean waters. Typical projects requiring these permits include the construction and maintenance of piers, wharfs, dolphins, breakwaters, bulkheads, groins, jetties, mooring buoys, and boat ramps.

However, not every activity requires a separate, individual permit application. Certain activities and work can be authorized by letters-of- permission, nation-wide permits, or regional permits. Some activities authorized by these permits are permitted in advance. Typically, little or no paperwork is required, and consequently permitting time is reduced. So, before submitting an application, contact the District Engineer's office for current information about the type of permit required.

Activity which requires the Permit: Locating a structure, excavating, or discharging dredged or fill material in waters of the United States or transporting dredged material for the purpose of dumping it into ocean waters. Fees are variable.

Statewide Contact:

US Army Corps of Engineers, Seattle District Regulatory Branch, PO Box 3755, Seattle, WA98124-2255. Telephone: (206) 764-3495 Fax: (206) 764-6602

* Permit information last updated 10/1/1998.

401 Water Quality Certification

Applicants receiving a section 404 permit from the Army Corp of Engineers, a Coast Guard permit or license from the federal Energy Regulatory Commission (FERC), are required to obtain a section 401 water quality certification from the Department of Ecology. Issuance of a certification means that the Ecology anticipates that the applicant's project will comply with state water quality standards and other aquatic resource protection requirements under Ecology's authority. The 401 Certification can cover both the construction and operation of the proposed project. Conditions of the 401 Certification become conditions of the federal permit or license.

For 404 permits the Corps has developed Nation-wide permits to streamline the process for specific activities. The Corps reviews a proposed project to determine if an individual 404 permit is required, or if the project can be authorized under a Nation-wide permit. The Nation-wide permits also need 401 Certification from Ecology. Ecology has already approved, denied or partially denied specific Nation-wide permits.

If approved, no further 401 Certification review by Ecology is required. If partially denied without prejudice, an individual certification or Letter of Verification from Ecology is required. If denied without prejudice, an individual certification is required for all activities under that nation-wide permit.

Activity which requires the Permit: Applying for a federal permit or license to conduct any activity that might result in a discharge of dredge or fill material into water or non-isolated wetlands or excavation in water or non-isolated wetlands.

Fees: No fee for certification

Online Application: The application for an individual permit, which is called Joint Aquatic Resources Permit Application Form (JARPA), is online and can be downloaded at http://www.ecy.wa.gov/programs/sea/pac/jarpa.html

Application Requirements: If applicable to the project: Mitigation plans, Operation and maintenance plans, Stormwater site plans and Restoration plans.

Permit Dependencies: In most cases State Environmental Policy Act (SEPA) compliance is needed. If you live within any of Washington's 15 coastal counties then you may need a Coastal Zone Consistency Determination (CZM).

Permit Time Frame: Individual 401's: Minimum twenty-day public notice; up to one year to approve, condition, or deny. Usually less than three months, see notes/comments. Nation-wide permits that have been partially denied may take a few days or weeks, after receipt of the JARPA and a letter from the Corps issuing a LOV. Letter of Verification (LOV): Usually takes 30 days but can take up to 180 days.

Permit Review Process: Review is conducted in Shoreline and Environmental Assistance within each regional office (except dredging and WSDOT projects which are done at Ecology's Headquarters). Regional staff reviewed the applications for completeness and send out a letter or call if additional information is needed. Once the application is considered complete the regional staff starts reviewing the project to recommend approval or denial. Modifications to plans submitted maybe required. Also a site visit maybe required as part of the process.

Permit Duration: 401 Certification becomes part of the federal permit or license. The duration of the 401 Certification would be in effect for same time period as the permit or license, however Ecology issues 401 Certifications as 90.48 administrative orders, so they may have conditions that apply to the project longer than the federal permit or license.

Permit Appeal Information: Appealable to Pollution Control Hearings Board within thirty days of Ecology's decision. P.C.H.B. may not hear case for six or more months.

Notes / Comments: If an applicant receives a nation-wide permit and Ecology issues a LOV, there are no public notice requirements under 401 certification for that specific project. If the applicant receives a nation-wide permit but is required to obtain an individual 401 Certification, public notice is required.

Legal Authority:

Chapter 173-201A State Water Quality Rule WAC

Chapter 173-225 Federal Clean Water Act, Section 401 WAC

Chapter 90.48 State Water Quality Law RCW

Statewide Contact:

Department of Ecology, 300 Desmond Drive, Lacey, WA98503. Telephone: (360) 407-6000

* Permit information last updated 10/23/2003.

Section 404 Permit - Discharge of Dredge and Fill Material

A Corps permit is required when locating a structure, excavating, or discharging dredged or fill material in waters of the United States or transporting dredged material for the purpose of dumping it into ocean waters. Typical projects requiring these permits include the construction and maintenance of piers, wharfs, dolphins, breakwaters, bulkheads, groins, jetties, mooring buoys, and boat ramps.

However, not every activity requires a separate, individual permit application. Certain activities and work can be authorized by letters-of- permission, nation-wide permits, or regional permits. Some activities authorized by these permits are permitted in advance. Typically, little or no paperwork is required, and consequently permitting time is reduced. So, before submitting an application, contact the District Engineer's office for current information about the type of permit required.

Activity which requires the Permit: Locating a structure, excavating, or discharging dredged or fill material in waters of the United States or transporting dredged material for the purpose of dumping it into ocean waters.

Fees: Variable

Statewide Contact: US Army Corps of Engineers, Seattle District Regulatory Branch. PO Box 3755, Seattle, WA98124-2255. Telephone: (206) 764-3495. Fax: (206) 764-6602

* Permit information last updated 10/1/1998.

Tribal Plans

Current management and recovery programs involve harvest management among US co-managers relevant to, but not part of the US v Oregon, and cooperative management efforts involving the US agencies and Colville Tribes and the Canadian agencies and the Okanagan Nation.

The Colville Tribes Natural Resources Department has a vision of restoring all species and stocks of native fish to their historic habitats within their Reservation and Trust Lands. A comprehensive anadromous fish Master Plan – based on an integrated Natural Resources framework – is essential in order to accomplish this Vision.

The Colville Tribes Integrated Resource Management Plan…

The Colville Tribes recently published an Okanogan summer/fall Chinook salmon HGMP (Colville Tribes and Washington Department of Fish and Wildlife April 2003) to guide restoration programs planned from a new hatchery situated below Chief Joseph Dam. The HGMP addresses a comprehensive program for the upper Columbia River summer/fall Chinook ESU in the Okanogan River and the Columbia River from Chief Joseph Dam downstream to the confluence of the Okanogan River. The plan also takes into account the summer/fall Chinook destined for the Methow River in this population. Integrated Recovery Program objectives identify that these populations will be managed to primarily aid in the conservation of this ESU. Objectives include increasing abundance, distribution and diversity of natural-origin summer/fall Chinook in the Columbia, Okanogan and Similkameen Rivers. Acclimation and release sites target historic rearing habitats at Similkameen, Bonaparte and Tonasket ponds.

Yakama Nation leads salmon recovery projects on the Methow Subbasin that may help rebuild depressed coho salmon populations in the upper Columbia River, including the Okanogan Subbasin.

Okanagan Nations Alliance (ONA)

The ONA entered into a Letter of Understanding with the Colville Tribes in March 2001 that addressed the common goal for ecosystem-based recovery of salmon in the Okanagan Subbasin, and refocused plans for salmon introduction plans in the upper Similkameen River on subbasin-wide salmon recovery in the Okanogan.

The Okanagan Nation Alliance has led a trans-boundary effort to restore Okanagan salmon ecosystems and their historic fisheries. Called Tcp'lk'stem (from Syilx – to bring back) the recovery program takes a habitat-based approach to restoring historic salmon stocks and their habitats. Restoring Okanagan sockeye to their former range into the upper watershed is a flagship project drawing agencies from the region and across the border into a science-based collaboration.

Currently, the ONA is leading a Watershed-based Fish Sustainability plan to coordinate Canadian agency and public efforts for recovery of the Okanagan salmon ecosystem. A State of the Okanagan Basin report is pending as one of the first reference documents in this effort (ONA in prep. 2004).

Colville Tribes

On the western third of the Colville Tribes Reservation, 344,146 acres of tribal land fall within the Okanogan Subbasin drainage. This massive tract of land, inclusive of tribal, ceded, and traditional areas, supports viable breeding and/or migratory populations of state and federally listed Species of Concern, Threatened or Endangered.

In 2000, the Colville prepared a Plan for Integrated Resource Management (IRMP) to provide guidance for management of approximately 1.4 million acres of Reservation lands for the next 15 years or more, or until replaced by a revised plan.

The IRMP has been prepared in accordance with the Bureau of Affairs planning regulations found in 43 CFR 1600. The Environmental Impact Statement (EIS) was prepared to disclose action in the IRMP and evaluate the environmental consequences of such action in accordance with the Council of Environmental Quality's (CEQ) regulations for implementing the National Environmental Policy Act (NEPA) of 1969, found in 40 CFR 1500. Federal laws and executive orders affecting management of the Colville Reservation as they relate to preparation of an Integrated Resource Management Plan were reviewed by Hall (1991). In the Colville Tribes Integrated Resource Management Plan (2000 – 2014), the Tribal Vision states that the Colville Tribes will manage the natural resources under its jurisdiction on the Reservation to enhance and maintain the ecological health of the environment and the social well being of Tribal Members and other human populations.

The Colville Tribes is leading an effort to document what species are still or are now occurring in the Upper Columbia River, including the Okanagan Subbasin, to assess after the study period concludes for this area, which species are no longer detected, which are least abundant and thus, potentially at risk, and to manage and partially mitigate with that information.

The Chief Joseph and Grand Coulee Dam hydroelectric projects forced the Colville Tribes to rely largely on resident fish and wildlife resources. The ensuing decline in wildlife resources and native salmonid fish stocks significantly and negatively impacted the traditional subsistence lifestyle of Colville Tribes' Tribal members. The extent of that impact to historical and current native wildlife species must be measured for fair partial mitigation and adequate management of the remaining resource for subsistence, cultural, and ceremonial use. The Bonneville Power Administration has committed to protecting native fish and wildlife habitat on the Colville Tribes Reservation as a mean of partially mitigating the impacts of the Columbia River Hydroelectric System.

Grand Coulee and Chief Joseph hydroelectric projects destroyed, essentially forever, in excess of 88,000 acres of critical low elevation wildlife habitat. This was largely comprised of riverine, island, riparian, shrubsteppe, and mixed and coniferous habitats. This habitat, rich in biodiversity, supported a large number and abundance of wildlife species. Existing conditions throughout the region very likely preclude management entities from ever being able to fully mitigate these losses; however, many projects throughout the region and on this reservation provide some partial mitigation leading toward the fulfillment of full mitigation for losses because of the dams and the subsequent and continuing habitat loss.

The Colville Tribes Fish and Wildlife Department has focused recovery efforts of anadromous salmonids in the Okanogan River Basin. To effectively recover summer steelhead and spring

Chinook salmon in the Okanogan River Basin restoration efforts have been directed toward tributaries. In addition to this project, the Colville Tribes Fish and Wildlife are also sponsors of restoring anadromous salmonids in Okanogan tributaries.

Cold water is an uncommon physical condition in the Okanogan River Basin. During 1998 water temperatures exceeded 80oF in the mainstem of the Okanogan River (Colville Tribes, Fish and Wildlife Dept., unpublished data). The current water temperature regime in the mainstem of the Okanogan River is not conducive to support salmonids that require one or more years in freshwater. To successfully re-establish native salmonids in the Okanogan River, the few cool water sources that exist must be protected and others restored. Therefore the restoration or conservation efforts directed toward key tributaries will begin reducing water temperatures and improve habitat conditions for the recovery of anadromous tributary spawners in the Okanogan River.

Restoration efforts may also be beneficial to anadromous salmonids that use the Okanogan River as a migration corridor. Sockeye (*Oncorhyncus nerka*), which migrate up the Okanogan River, are often delayed by high water temperatures (> 21.5°F or conversion). When water temperatures dip sockeye swim the Okanogan River from the confluence to the north end of Lake Osoyoos (approx. 80 miles).

By re-establishing flows in Salmon Creek, improving riparian habitat and increasing canopy closure along Omak Creek and conserving the water quality in Aeneas Creek, plumes of cold water would be delivered to Okanogan River and provide thermal refuges for migrating sockeye. These cool water refuges may improve the survival of adults to current spawning areas and historical areas such as Skaha Lake, which is currently being evaluated for the feasibility of re-introduction.

The Colville Tribes participates in ongoing cooperative studies of forest carnivores with both WFWD and Forest Service including the lynx tracking study and a proposed marten habitat and prey base diet suitability study for the Okanogan Highland area. All native and desired non-native species are of management interest to the Colville Tribes. Forest carnivores, specifically: Grizzly bear, black bear, wolf, coyote, fox, cougar, lynx, bobcat, wolverine, fisher, marten, badger, mink, and weasel, are all very important in spiritual, cultural, economic, and ecological ways. It is a priority to the tribes that the predators continue to persevere here in a biologically balanced way. These animals are of high regard ceremonially as are the furbearers that include otter, beaver, muskrat, raccoon, and rabbits.

Okanogan County

Lead Entity Strategy

Okanogan County and the Colville Tribes are co-leads and thus co-coordinators for the Okanogan County Lead Entity. Occurring since the creation of the Okanogan County Lead Entity in 1999, this co-coordination effort has proven to be mutually beneficial. A portion of the Colville Tribes reservation lands is within the boundaries of Water Resource Inventory Area 49: Okanogan Basin.

The primary purpose of the Okanogan County Lead Entity Strategy is to provide specific and strategic guidance regarding the development of habitat protection and restoration projects primarily for the Salmon Recovery Funding Board's grant process, and Okanogan County's related contractual work with the Washington State Department of Fish and Wildlife.

The lead entity strategy is a habitat protection and restoration action plan for the watershed(s) within the lead entity area. It provides a stepwise approach to how, where and when to take action to restore and protect habitat and the watershed processes that are necessary to support salmon.

Each participating Lead Entity maintains a separate Citizen Committee and project prioritization process. For the last three years (2nd, 3rd, and 4th Salmon Recovery Funding Board grant rounds) the separate three lead entities have demonstrated the region's cohesiveness by submitted an integrated regional project list.

Many in the Upper Columbia region view the regional salmon recovery plan as the overall plan for salmon recovery with the many other ongoing processes feeding directly into the appropriate sections of the regional recovery plan. In the long-term, the Collaborative Upper Columbia Tri-Lead Entity Strategy will be directly derived from the applicable habitat portions of the regional recovery plan.

The following tools are being used in the Okanogan/Methow Subbasin:

Zoning

Zoning is the most important tool for regulating land use. The basic purpose of zoning is to promote a jurisdiction's public health, safety, and welfare; and to assist in the implementation of the comprehensive plan. In a zoning ordinance the jurisdiction is divided into zoning districts, with types of uses, permit requirements and other land use regulations defined for each district. The most basic regulations pertain to: the height and bulk of buildings; the percentage of a lot which may be occupied and the size of required yards; population density; and the use of buildings and land for residential, commercial, industrial, and other purposes.

Subdivision

Subdivision regulations are intended to regulate the manner in which land may be divided and prepared for development. They apply whenever land is divided for purposes of sale, lease or transfer. State law specifies that any subdivision of land that results in the creation of a parcel of less than five acres in size must comply with state and local subdivision requirements. There are two basic forms of subdivision: long plats, which contain five or more lots; and, short plats, which contain four or fewer lots. Regulations pertaining to both types of subdivisions are adopted and enforced at the local level in accordance with provisions and statutory authority contained in state law. The regulations specify methods of subdivision procedures for the developer and the local government, minimum improvements (streets, utilities, etc.) to be provided by the developer, and design standards for streets, lots, and blocks. Subdivision regulations are intended to encourage the orderly development and redevelopment of large tracts in the planning area.

Planned Development

Planned development regulations are intended to provide an alternative method for land development that:

Encourages flexibility in the design of land use activities so that they are conducive to a more creative approach to development which will result in a more efficient, aesthetic and environmentally responsive use of the land;

Permits creativity in the design and placement of buildings, use of required open spaces, provision of on-site circulation facilities, off-street parking, and other site design elements that better utilize the potential of special features, such as geography, topography, vegetation, drainage, and property size and shape;

Facilitates the provision of economical and adequate public improvements, such as, sewer, water, and streets

Minimizes and/or mitigates the impacts of development on valuable natural resources and unique natural features such as agricultural lands, steep slopes, and floodplain and shoreline areas.

Planned development regulations may be incorporated into a jurisdiction's zoning ordinance or developed as a separate ordinance. It is also possible for the City, County or Tribes to use the planned development process for certain uses that, because of their nature, may be more appropriately reviewed under such regulations.

Binding Site Plan

The binding site plan is a relatively new method for dividing property for commercial and industrial purposes, and in some cases for residential uses such as manufactured home and recreational vehicle parks where the individual parcels are not to be sold. This method for regulating development is intended to provide a flexible alternative to developers and requires that a specific site plan be developed which shows the layout of streets and roads and the location of utilities required to serve the property. The binding site plan is a legally enforceable document which, when required, can be amended to reflect changing conditions. The plan also must be reviewed to ensure that the cost of providing basic services and the maintenance of those services does not represent an unreasonable burden on residents of the planning area.

Shoreline Master Program (SMP)

The SMP is, in effect, a special comprehensive plan and zoning ordinance for those areas falling under shoreline jurisdiction, as defined in the State Shoreline Management Act of 1971.

Uniform Building Code

The Uniform Building Code (UB.C.) is a uniform set of regulations used to regulate and enforce construction activities. The UB.C. may be used in conjunction with other implementation tools to ensure compliance and conformance with the comprehensive plan.

Flood Damage Prevention Ordinance

Flood Damage Prevention ordinances are required for jurisdictions that have areas subject to inundation by 100-year flood events. The purpose of this type of implementation tool is to ensure that new or substantially improved structures and fills are constructed in a manner that not only will minimize flood damage to the structure but also minimize the potential for increasing the flood hazard on adjacent properties.

Watershed Planning

In 1998, the Washington State legislature approved ESHB 2514 to create RCW 90.82. This RCW enables local stakeholders within their watersheds to develop management strategies related to water quantity (required by the bill), water quality (optional), instream flow (optional), and habitat (optional).

There is no RCW 90.82 watershed management plan at this time.

State Programs

Washington Department of Natural Resources (WDNR)

The WDNR manages 134,000 acres in the Loomis Forest. The Chopaka Natural Reserve, in the Loomis Forest, is a 3,000-acre natural preserve area. In the year 2000, two parcels totaling 25,000 acres were designated as Natural Areas, with access for recreation and grazing. The remaining area in the Loomis Forest is managed for multiple uses, including timber harvest and livestock grazing. There are 15 million board feet harvested annually from the Loomis Forest (C. Johnson 2001, pers. comm.).

Washington Department of Fish and Wildlife (WDFW)

The WDFW's mission embodies sound stewardship in fish and wildlife and encourages partnerships with public and international entities, tribal leaders, public volunteers and service groups to share responsibility for fish and wildlife. WDFW maintains five wildlife areas in the Okanogan Basin, and is an active participant in salmon recovery and subbasin planning.

In addition, the WDFW is responsible for the administration of State statute directed at the protection of fish and wildlife habitats.

Programmatic description of Shoreline Management Act: Reference http://www.ecy.wa.gov/programs/sea/SMA/index.html

Washington's Shoreline Management Act (SMA) was passed by the State Legislature in 1971 and adopted by the public in a 1972 referendum. It is codified within RCW 90.58. The SMP is essentially a shoreline comprehensive plan and zoning ordinance with an environmental orientation customized to local circumstances. The SMA emphasizes accommodation of reasonable and appropriate shoreline uses, protection of shoreline environmental resources, and protection of the public's right to access and use shorelines. All allowed uses are required to mitigate for any adverse environmental impacts and preserve the natural character and aesthetics of the shoreline.

The SMA seeks to provide for a balance of authority between local and state government. Cities and counties are the primary regulators. The SMA applies to all 39 counties and more than 200 cities with "shorelines of the state" or "shorelines of statewide significance" within their jurisdictional boundaries. Ecology is the lead state agency, and it provides technical assistance and reviews local programs and permit decisions. The SMA places a strong emphasis on public involvement in developing local shoreline programs, and it provides opportunities for public involvement in individual permits.

In December 2003, new shoreline master program (SMP) guidelines were adopted by the state. These state rules are used by cities and counties as they update plans that regulate development and the use of shorelines of marine waters, rivers and larger streams, lakes and reservoirs over 20 acres, associated wetlands, and portions of flood plains. In addition, the 2003 legislature adopted amendments to the SMA addressing integration with the Growth Management Act.

Fish and Wildlife and the Growth Management Act

The Growth Management Act (GMA) (RCW 36.70A) is intended to avoid the possibility of uncoordinated and unplanned growth inherent in anticipated population increases. It requires county and city governments to adopt locally derived plans and regulations around a basic framework of natural resources issues defined by the state legislature. One of the primary intents of the GMA is to prevent unwise use of natural resource and critical areas in accommodating urban growth.

Each jurisdiction must classify and designate their resource lands and critical areas, and each must adopt development regulations for their critical areas. In addition, some jurisdictions must adopt planning policies and comprehensive plans that address many aspects of urban growth and development that are expected to occur in the county, including land use, housing, utilities, transportation, and others. Subsequent amendments to the GMA require that counties and cities include the best available science in developing policies and development regulations to protect the functions and values of critical areas. In addition, counties and cities must give special consideration to conservation or protection measures necessary to preserve or enhance anadromous fisheries.

The Washington Department of Fish and Wildlife (WDFW) has biologists in 5 of its 6 regions that provide technical assistance to local jurisdictions in complying with the requirements of the GMA regarding fish and wildlife resources. One of the primary goals of WDFW is to integrate its Priority Habitats and Species (PHS) program into the local jurisdictions' GMA planning activities.

Priority Habitat and Species Program

The Priority Habitats and Species (PHS) Program fulfills one of the most fundamental responsibilities of the Washington Department of Fish and Wildlife (WDFW): to provide comprehensive information on important fish, wildlife, and habitat resources in Washington. Initiated in 1989, the PHS Program was identified as the agency's highest priority. Today, the PHS Program serves as the backbone of WDFW's proactive approach to the conservation of fish and wildlife.

PHS is the principal means by which WDFW provides important fish, wildlife, and habitat information to local governments, state and federal agencies, private landowners and consultants, and tribal biologists for land use planning purposes. PHS is the agency's primary means of transferring fish and wildlife information from agency resource experts to those who can protect habitat. PHS information is used:

to screen 12,000 - 15,000 Forest Practice Applications, 10,000 - 18,000 Hydraulic Project Applications, and over 3,000 SEPA reviews annually;

- by a majority of cities and counties to meet the requirements of the Growth Management Act;
- for the development of Habitat Conservation Plans on state, federal, and private lands;

- by state, federal, and tribal governments for landscape-level planning and ecosystem management;
- for statewide oil spill prevention planning and response.

PHS provides the information necessary to incorporate the needs of fish and wildlife in land use planning. The PHS program addresses three central questions:

1. Which species and habitat types are priorities for management and conservation?
2. Where are these habitats and species located?
3. What should be done to protect these resources when land use decisions are made?

To answer those essential questions, the PHS Program:

- identifies habitats and species determined to be priorities based on defensible criteria;
- maps the known locations of priority habitats and species using GIS technology;
- provides information on the conditions required to maintain healthy populations of priority species and viable, functioning priority habitats using best available science;
- provides consultation and guidance on land use issues affecting priority habitats and species;
- distributes this information and makes it easily accessible.

PHS also furnishes products that enable the agency to provide competent and efficient customer service. In this regard, PHS staff annually produce and distribute:

- over 4,000 copies of the Priority Habitats and Species List. The PHS List identifies and defines which species and habitats are priorities, and it outlines criteria used for choosing them.
- over 3,500 copies of Management Recommendations for Washington's Priority Habitats and Species. These detailed documents identify the needs of fish and wildlife based on the best available science. Guidelines for their incorporation in management decisions are provided.
- nearly 2,000 state-of-the-art Geographic Information System (GIS) maps which display locations and extent of priority species and habitats on 29 million acres in Washington State.

Okanogan-Similkameen Conservation Corridor Program

The goal of conservation OSCCP is to maintain the rich biodiversity of the region, including the species at risk, and a viable ecological Corridor between the deserts to the south and the grasslands to the north. This program will protect and restore wildlife habitats on public and private land, with an emphasis on the following priority habitats: shrubsteppe, dry coniferous forest, riparian, and rugged terrain. Program staff will coordinate efforts between state, federal, local, tribal, Canadian, and nonprofit entities, within the Okanogan and Similkameen watersheds, and seek to expand community involvement and promote ecologically sustainable land use.

Road Maintenance/Transportation

RCW 77.55.060 requires that “a dam or other obstruction across or in a stream shall be provided with a durable and efficient fishway approved by the director.” Culverts and other stream crossing structures often create obstructions to upstream or downstream fish passage.

Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual

WDFW has developed the Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual (contact Dave Caudill, Habitat Technical Applications Division, 360-902-2486), which includes protocols for assessing fish passage barrier status at culverts and other instream structures, and juvenile fish screening and bypass status at water diversions.

WDFW conducts fish passage barrier assessments and provides protocol training to other agencies and grant groups interested in conducting fish passage barrier assessments. WDFW also maintains a statewide Fish Passage and Diversion Screening Inventory database (contact Brian Benson, Habitat Science Division, 360-902-2570) that includes information on barrier status of inventoried culverts and other stream crossing structures, and known diversion screening information.

The WDFW Habitat Program Technical Applications Division (TAPPS) also provides technical assistance to fish passage, screening, and habitat restoration project sponsors, to help them develop habitat-related projects. In addition, WDFW in cooperation with other state and federal agencies have developed Aquatic Habitat Guidelines technical guidance documents for certain types of habitat projects.

The two guidance documents currently available include the Fish Passage Design at Road Culverts and Integrated Streambank Protection Guidelines (ISPG); soon to be available will be Salmon Habitat Restoration Guidelines (SHRG). Information on technical assistance opportunities and contacts are available on the WDFW website at http://wdfw.wa.gov/hab/tapps.index.htm

The Hydraulic Code and Hydraulic Code Rules

The Hydraulic Code (Chapter 77.55 RCW) and the associated Hydraulic Code Rules provide WDFW with a regulatory mechanism to protect fish life and their habitat from the impacts of most hydraulic projects.

The Hydraulic Code requires that “in the event that any person or government agency desires to construct any form of hydraulic project or perform other work that will use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state, such person or government agency shall, before commencing construction or work thereon and to ensure the proper protection of fish life, secure the approval of the department as to the adequacy of the means proposed for the protection of fish life.”

WDFW’s authority extends only to the protection of fish life. Fish life is broadly defined to be “all fish species, including but not limited to food fish, shellfish, game fish, and other nonclassified fish species and all stages of development of those species.” Furthermore, "protection of fish life" is defined to mean “prevention of loss or injury to fish or shellfish, and protection of the habitat that supports fish and shellfish populations." Even though other animals such as amphibians, reptiles or birds may be impacted by hydraulic projects, the Hydraulic Code is specific to fish life and HPAs may not be conditioned to protect species other than fish. Measures to protect fish life imposed in HPAs often have multi-species benefits, though, because many species share the same habitat.

Hydraulic project proponents must apply to WDFW for authorization to conduct their projects. With the exception of emergency projects and pamphlet HPAs, which may be applied for verbally, applications must be submitted in writing. Processing time for complete applications is mandated by statute to be no greater than 15-days for expedited projects and 45-days for standard projects. Projects declared to be emergencies by county legislative authorities or by WDFW must be granted approval immediately upon request.

Procedures administering the Hydraulic Code, including mitigation requirements and appeal rights, are specified in Chapter 220-110 WAC. Site-specific requirements and mitigation for unavoidable impacts to fish life are written into the HPA by the local Area Habitat Biologist.

Hatchery and Genetic Management Plans (HGMP)

Upper Columbia Summer Chinook Salmon Mitigation and Supplementation Program-Eastbank (Rocky Reach and Rock Island Settlement Agreements) and Wells (Wells Settlement Agreement) Fish Hatchery Complexes.

The Upper Columbia HGMPs address Upper Columbia River spring and Summer/fall-run ESU Chinook salmon (*Oncorhynchus tshawytscha*) upstream of Priest Rapids Dam. The summer Chinook salmon supplementation project operated and managed by WDFW in the upper Columbia River region are "integrated harvest" programs.

The Colville Tribes have completed drafts for summer/fall, steelhead and spring Chinook HGMP's and are using these plans to plan for integrated recovery, integrated harvest and restoration of natural broodstock programs in the Okanogna and Upper Middle Mainstem subbasins.

WDFW is the lead agency in this summer Chinook salmon run size enhancement program funded by Public Utility District (PUD) No. 1 of Chelan County and PUD No. 1 of Douglas County for the purpose of mitigation for lost fish production as a result of fish mortality at the Rock Island, Rocky Reach, and Wells hydroelectric projects.

The goal of the regional summer Chinook artificial propagation programs is to mitigate for the loss of summer Chinook salmon adults that would have been produced in the region in the absence of Wells, Rocky Reach, and Rock Island hydroelectric projects.

This goal can be met through the use of the artificial environment of fish rearing facilities to increase the number of adults that return to the basin by increasing survival at life-history stages where competitive or environmental bottlenecks occur. Concurrently, a release strategy for artificial production is employed that will not create a new bottleneck in productivity through competition with the naturally produced component of the population and other naturally produced stocks.

The Chief Joseph Dam Hatchery Master Plan

The Master Plan for the Chief Joseph Dam Hatchery Program (CJDHP) describes the rationale, local an regional context, conceptual design of artificial production facilities, conceptual monitoring and evaluation plans, and estimated costs necessary to implement a comprehensive management program for summer/fall Chinook salmon in the Okanogan subbasin and the Columbia River between Wells and Chief Joseph dams. The content of the CJDHP Master Plan was developed to meet the Step 1 requirements of the Council's three-step process for artificial production initiatives. Additionally, in its overall design and through its programmatic objectives and actions, the CJDHP is consistent with recommendations presented in the Independent Science Advisory Board's Review of Salmon and Steelhead Supplementation and the Council's recently completed draft Artificial Production Review and Evaluation. The full Master Plan is available from the NPCC and/or BPA. An electronic appendix to this subbasin plan also provides further information on this program

The Okanagan Conservation District (OCD)

The Okanogan Conservation District strongly endorses the voluntary Coordinated Resource Management planning process for managing natural resources. In the Okanogan Watershed Management Planning Area there are 15 active Coordinated Resource Management planning groups with another eight planning groups starting up in the next five years in the Omak Creek Watershed.

These local planning groups operate within a framework of existing laws and regulations. They can assist and work with, but not over-ride, the decision-making authority of those responsible for public and private lands and resource management. The process provides for a voluntary coordination of activities toward common objectives and solves management problems through plan implementation.

Non-Government Organizations

The Upper Columbia Salmon Recovery Board (UCSRB)

Our proposal to cooperatively provide the analytic foundation complements the high level of policy and technical coordination already occurring. Policy coordination is facilitated by the Upper Columbia Salmon Recovery Board (UCSRB), a partnership among Chelan, Douglas, and Okanogan counties, the Yakama Nation, and the Colville Tribes in cooperation with local, state, and federal partners.

One clear objective is to provide an all-inclusive analytic foundation for the aquatic component of subbasin plans on a timely basis, consistent with the NPPC guide, to maximize the likelihood that defensible subbasin plans are completed on schedule.

Additionally, technical coordination is occurring with the Upper Columbia Regional Technical Team and the Regional Assessment Advisory Committee and well as individual members of BPA, the NWPPC and the CBFWA.

Upper Columbia River Regional Fisheries Enhancement Group (UCRFEG)

The UCRFEG was created to facilitate community stewardship of fish and fish habitats in the Upper Columbia Region, including the Okanogan watershed. The group coordinates delivery of state salmon recovery funding for local community projects and has facilitated some cross border US-Canada community demonstration projects in the Okanogan in partnership with the OSBFP.

North Central Washington Audubon Society (NCWAS)

North Central Washington Audubon Society, a local chapter of the National Audubon Society, is dedicated to furthering the knowledge and the conservation of the environment of North Central Washington, our Nation, and the World.

The status of the yellow-breasted chat population in the Okanagan Valley of B.C. is of significance to the society in the Okanogan as an indicator of riparian ecosystem health. This is of concern in the Okanogan where much riparian habitat has been replaced by other land uses. The Washington population of yellow-breasted chat plays an important role in the persistence of the species in B.C. Current breeding populations of yellow-breasted chats are down to about 40 pairs there. The chapter also sponsors regular field trips, publishes a local newsletter and plays an active role in education events and land conservation issues throughout the Chelan, Douglas, Okanogan and Ferry county region.

Canadian Federal

Fisheries and Oceans Canada (DFO)

Fisheries and Oceans Canada is responsible for policies and programs in support of Canada's economic, ecological, and scientific interests in oceans and inland waters. Its mandate, (based in the Federal Fisheries Act) includes the conservation and sustainable utilization of Canada's fisheries resources in marine and inland waters; leading and facilitating federal policies and program on oceans; and safe, effective, and environmentally sound marine services responsive to the needs of Canadians in a global economy.

DFO is the main agency holding authority under the federal Fisheries Act for the management of fish and fish habitat and has been a lead advocate for the federal government in the restoration of Okanagan salmon populations and their habitat, and the First Nations salmon fisheries in the region.

Environment Canada (EC)

Environment Canada is a federal agency whose mandate is to preserve and enhance the quality of the natural environment, including water, air, and soil quality. In addition, this agency strives to conserve Canada's renewable resources, including migratory birds and other non-domestic flora and fauna, and to protect Canada's water resources.

Environment Canada enforces the rules made by the Canada–United States International Joint Commission relating to boundary waters, and coordinates environmental policies and programs for the federal government related to the joint Georgia Basin-Puget Sound Ecosystem Initiative. There has been come consideration given to the engagement of the Okanogan programs in this trans-boundary partnership with respect to coordinating the recovery of federally listed Endangered species/species at risk in both Canada and US.

Canadian Okanagan Basin Technical Working Group (COBTWG)

This group is a cooperative endeavor between ONA, FOC, and MWALP to coordinate management of salmon and steelhead restoration with the management of resident fish stocks like kokanee within the Okanagan Basin.

Current activities include restoration of sockeye passage in the Skaha Lake system, developing fish-water management tools for balancing lake and river flows to optimize kokanee and salmon management objectives, and Okanagan river habitat restoration.

Canada – B.C. Agreement on the Management of Pacific Salmon Fishery Issues

In 1997 the federal and provincial fisheries agencies in the B.C. Pacific Region created a forum for reviewing policy initiatives and coordinating agreed salmon-related initiatives being pursued by the two governments.

The Agreement established a Council of Fisheries ministers. This agreement gives rise to important guidelines for habitat management coordination between the provincial and federal governments on fish habitat restoration in the trans-boundary Okanogan River.

The Pacific Fisheries Resource Council (PFRCC)

The PFRCC advises the Council of Fisheries Ministers regarding matters of conservation and long-term sustainable use of salmon resources and habitat. The PFRCC released a report in 2002 highlighting the need for trans-border cooperation in salmon ecosystem recovery in the Okanagan River.

Province of B.C.

B.C. Ministry of Water, Land and Air Protection (MWLAP)

MWLAP is a provincial government agency that is responsible for fish and wildlife habitat and species protection and recreational fish and wildlife management.

This agency also includes management of air, land and water pollution, environmental emergencies, parks, recreation and protected areas, and flood plain management.

The province also exercises delegated authority under the federal Fisheries Act for the management of the non-salmon freshwater fisheries. A significant body of knowledge has been generated by this ministry on the status of fish stocks and habitats in the Okanagan subbasin.

The Okanagan Lake Action Plan

The Okanagan Lake Action Plan is a significant provincial fisheries program of the MWLAP in the Okanagan valley, initiated in 1996 after the closure of the kokanee sport fishery the previous year.

The goal of the plan is to identify biological relationships within Okanagan Lake to determine limiting factors to kokanee production. In addition, the plan will determine remedial measures that will result in the recovery of the lake’s kokanee population.

B.C. Ministry of Sustainable Resource Management (MSRM)

The B.C. Ministry of Sustainable Resource Management is responsible for Crown land policy and protected areas establishment, and sustainable resource planning including the coordination of implementation of Land and Resource Management Plans (LRMPs). In addition, MSRM is responsible for coordinating resource inventories, archaeology, surveying and mapping and data base development, and environmental assessment.

The MSRM is participating in a planning partnership with the Regional Development of Central Okanagan to develop a Water Use Plan for the Trepanier Creek Watershed, a tributary of Okanagan Lake. In response to the Growth Management Strategy of the regional district, this planning initiative is to allocate water (if any) at the strategic level with proposed land use designations on private land to accommodate future settlement while maintaining instream flows to support aquatic ecosystems

The MSRM is working collaboratively with the Okanagan Basin Technical Working Group on the development of a Watershed-based Fish Sustainability Plan that is being developed to dovetail with the Okanogan Subbasin Plan and the Okanagan-Shuswap LRMP.

Land and Water B.C. (LWB.C.)

LWBC is a crown corporation (owned by government, but operated as a semi-autonomous corporation) responsible for water management and licensing under the direction of lead provincial agencies for planning, fish and wildlife.

LWBC is responsible for managing lake levels at water flow control structures on Okanagan Lake, Skaha Lake and Vaseux Lake, and is a partner in the fish-water management tools project associated with the COBTWG. As a provincial agency, LWBC administers Crown land and water consistent with the Okanagan-Shuswap LRMP

B.C. Ministry of Forests (MoF)

B.C. MoF is a provincial government agency that strives to encourage maximum timber resource productivity. Its mandate is to manage timber resources responsibly to achieve the greatest short- and long-term social benefits; practice integrated resource management; encourage a globally competitive forest industry; and assert the financial interests of the Crown. As a provincial ministry, all operational planning approved by MoF is to be consistent with the Okanagan-Shuswap LRMP.

Significant watershed and fish habitat assessment, inventory and restoration activities were funded over the last decade through Forest Renewal B.C. in cooperation with MWLAP. That program was discontinued in 2002.

Watersheds B.C.

The Watershed B.C. project is hosted by the B.C. MWLAP with the objective to supply decision-makers with information on land and water resources throughout B.C. This assessment project consists of a users guide, a map of 18,000 provincial watersheds, and a database with 436 attribute measurements for each watershed. It may be found at http://home.gdbc.gov.bc.ca/watershedsB.C.

B.C. Watershed Ranking Tool

Hosted by MWALP, the B.C. Watershed Ranking Tool summarizes province-wide data sets from Watershed B.C., and consists of three complementary products:

- a spreadsheet containing 150 attributes for each watershed
- an associated GIS data set

- a Watershed Ranking Atlas which maps watershed boundaries

More information on the Watershed Ranking Tool, including data sets may be viewed at www.env.gov.bc.cz/gdbc/watershed_ranking.

Interior Watershed Assessment Procedures

Under the B.C. Forest Practices Code, numerous interior watersheds assessments (IWAP) were required for watersheds with high value fisheries potential were conducted in the Okanagan in collaboration between the B.C. Ministry of Forests (MOF) and MWLAP in association with local forest industry and local partners.

The IWAP results were used in the Thompson Okanagan Resource Management Plan. For further information on IWAPs, refer to the Interior Watershed Assessment Procedure Guidebook from the MOF or refer to www.for.gov.bc.ca/tasb/legsregs/fpc/fcguide/iwap/

Thompson-Okanagan Resource Management Plan

The Thompson-Okanagan Resource Management Plan was funded by Forest Renewal B.C. in 1998/99 to develop a guide to restore fish habitat and water quality in key watersheds damaged by past forest practices. Watersheds were ranked according to fish use, domestic water consumption, logging impacts and restoration potential. For further information on this plan, refer to the Thompson-Okanagan Regional Plan 1998-2005, or go to www.for.gov.bc.ca/cpp/rmp/wrp/

Okanagan Land and Resource Management Plan (LRMP)

The Okanagan- Shuswap LRMP, approved by the BC Cabinet in 2001, provides strategic resource management direction to the use of land and resources over the public land (outside Protected Areas) in the subbasin. Because of the high area of Provincial Crown land, the Okanagan-Shuswap LRMP applies to approximately 65% of the sub-basin area..

Some Okanagan LRMP recommendations applicable to Okanagan watershed restoration include:

Inventory and identify environmentally sensitive and critical fish habitats

Restore depressed salmon and freshwater fish populations to the capacity of the system

Restore salmon and freshwater fish habitat where it is not functioning at, or near capacity

Restore habitats on private lands through voluntary stewardship agreements

For further information on the Okanagan LRMP, refer to For further information on the Okanagan LRMP, refer to Appendix E or website:http://srmwww.gov.bc.ca/sir/lrmp/okan/.

A summary of objectives and strategies pertaining to the enhancement and restoration of fish and wildlife habitats and populations that apply within the subbasin is in appendix ?.

Watershed-based Fish Sustainability Planning (WFSP)

WFSP was designed as a standard planning framework designed by the provincial and federal government with input from First Nations and key stakeholders. The objective is to make fish planning more consistent throughout B.C. and to enable coordinated government involvement with local partners.

The WFSP is designed to accommodate any number of common objectives and to integrate existing or new information in planning for fish and habitat restoration on public and private lands.

The WFSP is the preferred model for use in the Okanagan by the COBTWG to incorporate past government efforts and existing data sets, and new information as required. The tool is very similar to the subbasin plan, and is considered suitable to adapt the Canadian agency participation in the subbasin planning effort.

For further information about the WFSP process e-mail wfsp.info@pac.dfo-mpo.gc.ca

B.C. Conservation Data Center (CDC)

The British Columbia Conservation Data Center (CDC) systematically collects and disseminates information on the rare and Endangered plants, animals and plant communities of British Columbia.

This information is compiled and maintained in a computerized database that provides a centralized and scientific source of information on the status, locations and level of protection of these rare organisms and ecosystems.

The CDC is part of the Registries and Resource Information Division in the B.C. Ministry of Sustainable Resource Management. It is also part of NatureServe, an international organization of cooperating Conservation Data Centers and Natural Heritage Programs all using the same methodology to gather and exchange information on the Threatened elements of biodiversity. Several freshwater resident fish stocks indigenous to the Okanagan-Similkameen Watershed are contained in the data center listings as Endangered, Threatened or of special concern.

Further information on the CDC can be found at http://srmwww.gov.bc.ca/cdc/index.htm

Sensitive Ecosystems Inventory (SEI)

The purpose of the SEI project is to identify remnants of rare and fragile terrestrial ecosystems and to encourage land-use decisions that will ensure the continued integrity of these ecosystems. It is intended for use in a variety of land-use planning processes. A Conservation Manual provides guidance on the protection of sensitive ecosystems.

Because the information was mapped at a 1:20,000 scale, the boundaries of an identified sensitive ecosystem will have to be verified through a field check.

The Regional District of Central Okanagan in partnership with the Ministry of Environment, Lands and Parks (Resources Inventory Branch, Wildlife Inventory Section and the B.C. Conservation Data Centre) and with the support of the Habitat Conservation Trust Fund is now completing a Sensitive Ecosystems Inventory. The inventory will provide a baseline of information for conservation planning and voluntary land stewardship activities in the region. The Terrestrial Ecosystems Mapping (TEM) approach

The study area for the Central Okanagan SEI includes the low and mid-elevation lands within the electoral areas of the Regional District. These are areas that are under strong pressure to urbanize as growth in the region pushes out well beyond the City of Kelowna's municipal boundaries.

The inventory work complements the exhaustive habitat inventory work completed in the South Okanagan (see Habitat Atlas for Wildlife at Risk, South Okanagan and Similkameen) and provides another key building block for an Okanagan-wide conservation strategy.

For more information visit http://srmwww.gov.bc.ca/cdc/sei/seiprojects.htm or contact Ken Arcuri, Director of Planning Services, Regional District of Central Okanagan (250) 868-5246.

Canadian Non-Government Organizations

Okanagan-Similkameen-Boundary Fisheries Partnership (OSBFP)

The OSBFP is a Canadian-based partnership of community and government organizations whose priority it is to protect and restore regional wild indigenous fish stocks and their habitat for present and future generations.

Created in 1999, the OSBFP functioned as a delivery partner with the B.C. Government program called Fisheries Renewal B.C. (discontinued in 2001). This group is hosted by the ONA and remains committed to coordinating community participation in fisheries planning in the Okanagan valley.

South Okanagan Similkameen Conservation Program (SOSCP)

A partnership of over 40 conservation groups, agencies, universities, First Nations organization, and other Non-government organizations, the South Okanagan-Similkameen Conservation Program facilitates collaboration on conservation efforts to address species at risk in the South Okanagan region.

SOSCP is a key non-government agency in facilitating wildlife stewardship across the border in the Okanagan Subbasin.

Partners in Flight B.C./Yukon and the Canadian Intermountain Joint Venture (CIJV)

Partners in Flight B.C./Yukon and the CIJV support advancement of transboundary conservation efforts in the Okanagan/Okanogan-Similkameen region in partnership with existing programs and initiatives including the South Okanagan - Similkameen Conservation Program (SOSCP), the Okanagan - Similkameen Conservation Corridor Project (OSCCP) and the Intermountain West Joint Venture (IWJV).

The Intermountain West Joint Venture (IWJV) has been working with the State of Washington to identify key habitat focus areas for conservation work important to birds and have identified priorities areas for collaborative work. These areas are being identified in an All-Bird Implementation Plan.

Collaborative development of a regional resolution to address fish passage issues at Enloe Dam

On March 29, 2001, The Colville Tribes Business Council and the Okanagan Nation Alliance signed a joint letter of commitment, quoted here:

In this joint letter of commitment, the Colville Tribes Business Council and the Okanagan Nation Alliance commit to the collaborative development of a regional resolution to fish passage issues at Enloe Dam, and working with the Upper and Lower Similkameen Bands in particular to protect related fishing rights and interests. The collaborative activities will include working together on common fisheries interests to facilitate a broader ecosystem approach to fisheries, focusing on common restoration programming in the Okanagan-Similkameen sub-basin.

Collaborative fisheries programming will address long-term ecosystem perspectives in the restoration of the subbasin and the region's tribal/First Nation's fisheries. Restoration programming may consider subbasin fisheries as part of broader collaborative fisheries programming in the Columbia watershed, and in the Upper Columbia Watershed in particular. Key elements of the collaborative programming will address, although are not limited to the following:

- protection of fishing rights and interests;
- rehabilitation of the watershed's aquatic environments;
- cooperative conservation and management of common fisheries interests; and
- development of the regions' tribal/First Nation's fisheries.
- The Council confirms its respect for the spiritual prohibitions against salmon passage at Enloe Dam, and the need to involve the Upper and Lower Similkameen Bands in related policy and program planning.

4.3 Artificial Production

In 1937 the Grand Coulee Fish Maintenance Project (GCFMP) was launched to mitigate for the loss of anadromous fish anticipated because of the impending completion of Grand Coulee Dam. Under the GCFMP, between 1939 and 1943 all adult salmon and steelhead were intercepted at Rock Island Dam for brood stock (Fish and Hanavan 1948; Chapman et al. 1995). Some adults were released in enclosed areas of each river to spawn naturally, while others were brought into the hatcheries for artificial production.

The various tributary stocks of each species were mixed in the hatchery program with the resultant young released throughout the Wenatchee, Entiat, Methow and Okanogan River drainages. After 1943 the hatchery depended on eggs from previous hatchery stock, augmented with eggs from non-indigenous populations from other Columbia River Basin locations (BAMP 1998).

The construction of the Mid-Columbia hydroelectric projects (Rocky Reach and Priest Rapids dams in 1961, Wanapum Dam in 1964 and Wells Dam in 1967) contributed to further declines in naturally occurring anadromous fish production in the Mid-Columbia River Basin. The hatchery programs developed to mitigate for losses associated with the Mid-Columbia hydroelectric projects relied historically (and at present) on locally returning populations of anadromous fish (spring Chinook, summer Chinook, summer steelhead and sockeye).

Initially, Mid-Columbia anadromous fish production, like much hatchery production throughout the basin, was designed to replace lost productivity with little emphasis placed on recovery of locally adapted populations. Today's hatchery programs seek to address mitigation obligations in addition to preserving and enhancing indigenous fish populations.

There are four hatcheries that supply/supplied salmonids to the Okanogan Basin lakes and streams in recent history. Salmon supplementation programs are addressed by two HGMPs: Upper Columbia fall (summer) Chinook and Mid-Columbia Coho Reintroduction. Details outlining production objectives are contained in Management of Focal Species.

Although no coho reintroduction programs are considered at this time to the Okanogan subbasin as part of the Mid-Columbia River Coho Reintroduction HGMP, the Winthrop National Fish Hatchery may be considered in the future for rearing juvenile coho from broodstock returning to the Methow basin.

Okanagan hatchery supplementation programs are currently designed to operate in a manner consistent with the Mid-Columbia River Biological Assessment and Management Plan (NMFS, 1998b). The first objective of outplanting of salmon is in response to the Endangered Species Act (ESA 1973 and amendment 16 USC. 1531 et seq.) to support the conservation of Threatened and Endangered species in their natural habitats to self-sustaining levels without further legal protection.

Upper Columbia Fall Chinook supplementation has been planned as a result of fish mortality at the Rock Island, Rocky Reach, and Wells hydroelectric projects.

Various processes are underway within the Columbia Basin that direct hatchery program implementation. The listing of certain populations of fish under the ESA has also dictated hatchery program modifications and reform. The principal processes are described in the following overview.

Federal

Hatchery and Genetic Management Plans

The Hatchery and Genetic Management Plan (HGMP) process was initiated to identify offsite mitigation opportunities associated with operation of the federal Columbia River Power System. The HGMP process is designed to describe existing propagation programs, identify necessary or recommended modifications of those programs, and help achieve consistency of those programs with the Endangered Species Act. The HGMP process only addresses anadromous salmon and steelhead programs.

Hatchery and Genetic Management Plans are described in the final salmon and steelhead 4(d) rule (July 10, 2000; 65 FR 42422) as a mechanism for addressing the take of certain listed species that may occur as a result of artificial propagation activities. NOAA Fisheries will use the information provided by HGMPs in evaluating impacts on anadromous salmon and steelhead listed under the ESA. In certain situations, the HGMPs will apply to the evaluation and issuance of section 10 take permits. Completed HGMPs may also be used for regional fish production and management planning by federal, state, and tribal resource managers.

The primary goal of the HGMP process is to devise biologically-based artificial propagation management strategies that ensure the conservation and recovery of listed Evolutionarily Significant Units (ESUs). The HGMP process also seeks to document and implement hatchery reform in the Columbia Basin. Much of the initial work on the HGMP process was coordinated and combined with efforts to complete the Artificial Production Review and Evaluation (APRE – see below)) analysis, which looked at the same sorts of information.

4.3.1 Artificial Production Review and Evaluation (APRE)

The APRE process seeks to document progress toward hatchery reform in the Columbia Basin. The NPCC used consultants and representatives of the Columbia Basin fishery managers to analyze existing programs and recommend reforms; a draft report that will go to the Council and the region has been prepared. The APRE process includes both anadromous and non-anadromous fish in its analysis.

Pacific Coastal Salmon Recovery Fund

The Pacific Coastal Salmon Recovery Fund (PCSRF) was established in FY2000 to provide grants to the states and tribes to assist state, tribal and local salmon conservation and recovery efforts. The PCSRF was requested by the governors of the states of Washington, Oregon, California and Alaska in response to Endangered Species Act (ESA) listings of West Coast salmon and steelhead populations. The PCSRF supplements existing state, tribal and federal programs to foster development of federal-state-tribal-local partnerships in salmon recovery and conservation; promotes efficiencies and effectiveness in recovery efforts through enhanced sharing and pooling of capabilities, expertise and information. The goal of the Pacific Coastal Salmon Recovery Fund is to make significant contributions to the conservation, restoration, and sustainability of Pacific salmon and their habitat.

The PCSRF's enhancement objective is: To conduct activities that enhance depressed stocks of wild anadromous salmonids through hatchery supplementation, reduction in fishing effort on depressed wild stocks, or enhancement of Pacific salmon fisheries on healthy stocks in Alaska. This includes supplementation and salmon fishery enhancements.

US v. OR

United States v Oregon, originally a combination of two cases, Sohappy v. Smith and US v. Oregon, legally upheld the Columbia River treaty tribes reserved fishing rights. Specifically the decision acknowledged the treaty tribes reserved rights to fish at "all usual and accustomed" places whether on or off the reservation, and were furthermore entitled to a "fair and equitable share" of the resource. Although the Sohappy case was closed in 1978, US v. Oregon remains under the federal court's continuing jurisdiction serving to protect the tribes' treaty reserved fishing rights. This case is tied closely to US v. Washington, which among other things defined "fair and equitable share" as 50 % of all the harvestable fish destined for the tribes' traditional fishing places, and established the tribes as co-managers of the resource.

In 1988, under the authority of US v. Oregon, the states of Washington, Oregon and Idaho, federal fishery agencies, and the treaty tribes agreed to the Columbia River Fish Management Plan (CRFMP), which was a detailed harvest and fish production process. There are no financial encumbrances tied to the process. Rather, the fish production section reflects current production levels for harvest management and recovery purposes, since up to 90% of the Columbia River harvest occurs on artificially produced fish. This Plan expired in 1998, and has had subsequent annual rollover of portions in which agreement has been reached. However, a newly negotiated CRFMP is forthcoming.

Hatchery production programs in the upper Columbia sub-basins are included in the management plans created by the fishery co-managers identified in the treaty fishing rights case United States v Oregon. The parties to US v Oregon include the four Columbia River Treaty Tribes –

Yakama Nation, Warm Springs, Umatilla, and Nez Perce tribes, NOAA-Fisheries, US Fish and Wildlife Service, and the states of Oregon, Washington, and Idaho. The Shoshone-Bannock Tribe is admitted as a party for purposes of production and harvest in the upper Snake River only. These parties jointly develop harvest sharing and hatchery management plans that are entered as orders of the court that are binding on the parties. The "relevant co-managers" described in the US v Oregon management plans are, for the mid-Columbia sub-basins, the federal parties, Yakama Nation, and Washington Department of Fish and Wildlife.

Hatchery programs are viewed by some tribes as partial compensation for voluntary restrictions to treaty fisheries imposed by the tribe to assist in rebuilding upriver populations of naturally spawning salmonids. Because treaty and non-treaty fisheries are restricted on the basis of natural stock abundance, the tribal priority is to use hatcheries in a manner that supplements natural spawning and increases average population productivity. Perspectives on the appropriate use of hatchery-origin fish for supplementation vary between federal, state, and tribal fish co-managers. Federal, and, to a lesser degree, state co-managers place a higher priority on managing the genetic risks of hatchery supplementation of natural populations, while the tribe sees the demographic threats of habitat loss and degradation as the greater risk to natural populations. In general, however, all parties agree that hatcheries can and should be operated as integral components of natural populations where the survival benefits of the hatchery can result in a significant increase in net population productivity.

ESA Permits

Section 7

The Endangered Species Act (ESA) has a broader mandate than simply directing the USFWS and NOAA Fisheries to protect listed fish, animals and plants. It directs all federal agencies to participate in Endangered species conservation. Under section 7 of the ESA, federal agencies are required to consult with USFWS and NOAA-Fisheries to ensure that actions they fund, authorize, permit or otherwise carry out will not jeopardize the continued existence of any listed species or adversely modify designated critical habitats. For further information regarding consultation see http://Endangered.fws.gov/consultation.

USFWS, Central Washington Field Office 215 Melody Lane. Suite 119, Wenatchee WA 98801. Telephone: (509) 665-3508.

NOAA Fisheries, 304 S. Water Street, #201, Ellensgurg, WA 98926. Telephone (509) 962-8911

Section 10 : Habitat Conservation Plans

In 1982, the US congress amended section10 of the ESA to authorize "incidental take" through the development and implementation of Habitat Conservation Plans (HCP). An incidental take permit allows property owners, state or county entities to conduct otherwise lawful activities in the presence of listed species. A non-federal entity develops an HCP in order to apply for an incidental take permit under section 10(a)(1)(B) of the ESA. The HCP integrates the applicant's proposed project or activity with the needs of the species. It describes, among other things, the anticipated effect of a proposed taking on the affected species and how that take will be minimized and mitigated. Such information must be submitted with any incidental take permit.

In 2002, habitat conservation plans (HCPs) were signed by Douglas and Chelan PUDs, WDFW, USFWS, NOAA Fisheries, and the Colville Tribes. The overriding goal of the HCPs is to achieve No Net Impact on anadromous salmonids as they pass Wells (Douglas PUD), Rocky Reach, and Rock Island (Chelan PUD) dams. One of the main objectives of the hatchery component of NNI is to provide species specific hatchery programs that may include contributing to the rebuilding and recovery of naturally reproducing populations in their native habitats, while maintaining genetic and ecologic integrity, and supporting harvest. For more information regarding HCPs, see http://Endangered.fws.gov/hcp/.

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Natural Resource Conservation Service

One of the purposes of the NRCS is to provide consistent technical assistance to private land users, tribes, communities, government agencies, and conservation districts. The NRCS assists in developing conservation plans, provides technical field-based assistance including project design, and encourages the implementation of conservation practices to improve water quality and fisheries habitat. Programs include the CRP, River Basin Studies, Forestry Incentive Program, Wildlife Habitat Improvement Program, the Environmental Quality Incentives Program, and Wetlands Reserve Program. The USDA Farm Services Administration (FSA) and the NRCS administer and implement the federal CRP and Continuous CRP.

Conservation Reserve Program (CRP)

The enrollment of agricultural land with a previous cropping history into CRP has removed highly erodible land from commodity production. The land is converted into permanent herbaceous or woody vegetation to reduce soil and water erosion. Conservation Reserve Program contracts are for a maximum of 10 years per sign-up period (the contracts may be extended) and have resulted in an increase in wildlife habitat. Cover Practices (CP) that occur under CRP include planting introduced or native grasses, wildlife cover, conifers, filter strips, grassed waterways, riparian forest buffers, and field windbreaks.

Conservation Reserve Program contract approval is based, in part, on the types of vegetation landowners are willing to plant. Cover Practice planting combinations are assigned points based on the potential value to wildlife. For example, cover types more beneficial to wildlife are awarded higher scores. Seed mixes containing diverse native species generally receive the highest scores (FSA 2003).

There are currently an estimated 4,064 acres enrolled in CRP in Okanogan County. Conservation Reserve Program and associated cover practices that emphasize wildlife habitat increase the extent of shrubsteppe habitat, provide connectivity/corridors between extant native shrubsteppe and other habitat types, reduce habitat fragmentation, contribute towards control of noxious weeds, increase landscape habitat diversity and edge effect, reduce soil erosion and stream sedimentation, and provide habitat for a myriad of wildlife species.

Continuous Conservation Reserve Program (CCRP)

The CCRP focuses on the improvement of water quality and riparian areas. Practices include shallow water areas with associated wetland and upland wildlife habitat, riparian forest buffers, filter strips, grassed waterways and field windbreaks. Enrollment for these practices is not limited to highly erodible land, as is required for the CRP, and carries a longer contract period (10 - 15 years), higher installation reimbursement rate, and higher annual annuity rate.

Conservation Reserve Enhancement Program (CREP)

The CREP, established in 1998, is a partnership between USDA and the State of Washington, and is administered by FSA and the WCC. The CREP provides incentives to restore and improve salmon and steelhead habitat on private land. Program participation is voluntary. Under 10 or 15-year contracts, landowners remove fields from production, remove grazing, and plant trees and shrubs to stabilize stream banks.

This also provides wildlife habitat, reduces sedimentation, shades stream corridors, and improves riparian wetland function. Landowners receive annual rent, incentive and maintenance payments, and cost share for practice installations. Payments made by FSA and WCC can result in no cost to the landowner for participation. Both the CRP and CREP utilize herbaceous seedings, shrubs, and trees to accomplish conservation measures that provide short-term high protection for wildlife habitats. It is unknown how many acres in the Subbasin are protected by CREP.

Wildlife Habitat Incentive Program (WHIP)

The WHIP is administered and implemented by NRCS and provides financial incentives to develop wildlife habitat on private lands. Participants agree to implement a wildlife habitat development plan and NRCS agrees to provide cost-share assistance for the initial implementation of wildlife habitat development practices. The NRCS and program participants enter into a cost-share agreement for wildlife habitat development. This agreement generally lasts a minimum of 10 years. It is unknown how many acres in the Subbasin are protected by WHIP.

Environmental Quality Incentives Program (EQIP)

The EQIP is administered and implemented by the NRCS and provides technical, educational, and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program assists farmers and ranchers with federal, state, and tribal environmental compliance, and encourages environmental stewardship. The program is funded through the Commodity Credit Corporation.

Program goals and objectives are achieved through the implementation of a conservation plan that incorporates structural, vegetative, and land management practices on eligible land. Eligible producers commit to 5 to 10-year contracts. Cost-share payments are paid for implementation of one or more eligible structural or vegetative practices such as animal waste management facilities, terraces, filter strips, tree planting, and permanent wildlife habitat. Furthermore, incentive payments are made for implementation of one or more land management practices such as nutrient management, pest management, and grazing land management. It is unknown how many acres in the Subbasin are protected by EQIP.

Wetlands Reserve Program (WRP)

The WRP is also administered and implemented by the NRCS. This voluntary program is designed to restore wetlands. Participating landowners can establish permanent or 30-year conservation easements, or they can enter into restoration cost-share agreements where no easement is involved. In exchange for establishing a permanent easement, the landowner receives payment up to the agricultural value of the land and 100 % of the restoration costs for restoring the wetlands. The 30-year easement payment is 75% of what would be provided for a permanent easement on the same site and 75% of the restoration cost. The voluntary agreements are a minimum of 10 years in duration and provide for 75% of the cost of restoring the involved wetlands. Easements and restoration cost-share agreements establish wetland protection and restoration as the primary land use for the duration of the easement or agreement. It is unknown how many acres in the Subbasin are protected by WRP.

The Public Law 566 Small Watershed Program (PL 566)

The Public Law 566 Small Watershed Program can be leveraged with other federal, state, or local program funds to provide wildlife and fisheries protection. Soil and water conservation districts using other project funding sources leverage NRCS program resources in combination to concentrate conservation within watersheds of concern.

Agricultural Community

Private landowners manage the vast majority of ponderosa pine, shrubsteppe, and riparian wetland habitats in the Subbasin. Many landowners protect, enhance, and maintain privately owned/controlled steppe communities and riparian habitats through active participation in the USDA’s CRP and CREP programs.

Agriculturalists apply Best Management Practices (BMPs) to croplands to reduce the amount of soil leaving these areas. The BMPs include: upland sediment basins designed to catch sediment; terraces to direct runoff to sediment basins or grassed waterways and filter strips; strip cropping; and direct seeding of crops reducing summer-fallow acres and reducing erosion by 95% on those acres. Landowners also control noxious weeds, which severely affect wildlife habitats and populations.

4.3.2 State

The state, along with the federal government have various forums in which they are active. All have some role in determining or balancing artificial production programs, as well as the ones that follow under “other”. Essentially no specific action would occur until the action is determined to be warranted in the already established processes.

4.3.3 Other

FERC processes

The federal Energy Regulatory Commission (FERC): Under current settlement agreements and stipulations, the three mid-Columbia PUDs pay for the operation of hatchery programs within the Columbia Cascade Province. These programs determine the levels of hatchery production needed to mitigate for the construction and continued operation of the PUD dams.

Biological Assessment and Management Plan

The biological assessment and management plan (BAMP) was developed by parties negotiating the HCPs in the late 1990s. The BAMP was developed to document guidelines and recommendations on methods to determine hatchery production levels and evaluation programs. It is used within the HCP as a guiding document for the hatchery programs.

All of these processes affect the hatchery programs within the Upper Columbia Basin in one way or another.

Historic programs

Other than two releases of sockeye as part of the Grand Coulee Fish Maintenance Project, anadromous fish releases began in the Okanogan Basin in the early 1960s, when steelhead were released into the Similkameen River as part of a state program (Chapman et al. 1994). Periodic releases of steelhead have been made since the 1960s (and regularly since the early 1990s) into Omak Creek, and regularly since 1966 into the mainstem Okanogan River as mitigation for the operation of Wells Dam, which is funded by Douglas PUD. A small number of “catchable” trout were also released into the Okanogan, once in the 1940s, and then three more times in the 1970s. Since the early 1990s, summer/fall Chinook have been released in the Similkameen River.

Current program overview

Currently, there are releases of summer/fall Chinook, steelhead, and experimental programs for spring Chinook and sockeye (in Canada).

Table ?. Current artificial anadromous fish production in the Okanogan Subbasin

Fish Species	Facility	Funding Source	Production level goals
Spring Chinook	Omak Creek, Ellisford Pond	BPA, COLVILLE TRIBES	30,000-150,000 (current production is dependent on availability of Carson-stock eggs)
Steelhead	Wells hatchery, Omak Cr.	DPUD	100,000
Summer Chinook	CPUD	Similkameen rearing pond	576,000
Sockeye	none	Douglas PUD	To compensate for impacts to smolts, DPUD has funded a cooperative water flow effort in the Okanogan River upstream from Lake Osoyoos, which has increased survival of incubating sockeye.
Coho	n/a	n/a	n/a

NNI refers to achieving a virtual 100% survival of anadromous salmonids as they pass the mainstem projects. This is achieved through 91% survival of adults and juveniles (or 93% for juveniles) passing the projects, and 7% compensation through hatchery programs and 2% contribution through a tributary fund, which will fund projects to improve salmonid habitat in the tributaries.

State and other programs

Summer/Fall Chinook: Artificial propagation of summer Chinook was initiated in 1989 through a mitigation agreement with Chelan and Douglas PUDs. The program is intended to mitigate for the loss of summer Chinook from the operations of Wells, Rocky Reach, and Rock Island dams (WDFW 1999). This program also provides surplus fish for recreational and tribal ceremonial and subsistence fisheries.

Spring Chinook: Spring Chinook were extirpated from the Okanogan River before the 1930s because of excessive harvest in the lower Columbia River, and habitat destruction in Canadian waters and tributaries of the Okanogan River in the US (Craig and Suomela 1931; Fish and Hanavan 1948). There has never been a formal mitigation program for spring Chinook in the Okanogan River.

Currently, spring Chinook are artificially propagated and released in the Okanogan subbasin through a cooperative agreement between NOAA Fisheries, USFWS, COLVILLE TRIBES, and WDFW, as an interim, segregated harvest program to support tribal ceremonial and subsistence fishing and provide information for a proposed, long-term integrated recovery program.

Steelhead: Wells Hatchery is funded by Douglas PUD and operated by WDFW as mitigation for passage mortalities at Wells Dam. Steelhead are artificially propagated and released in the Okanogan subbasin as an integrated harvest program. The Colville Tribes have also initiated a local broodstock program and will be starting a kelt reconditioning program to create a comprehensive integrated recovery program through funding by BPA.

Release numbers and locations of Wells Hatchery stock steelhead have varied considerably over the past 12 years. In the lower Similkameen River, releases have varied from 37,500 to 82,415 since 1992 (APRE 2003b). Releases elsewhere in the Okanogan subbasin, primarily Omak and Salmon Creeks, has varied from 30,000 to 160,756 since 1992 (APRE 2003a). Current releases of Wells Hatchery stock steelhead are planned at 50,000 into the lower Similkameen River and 50,000 at other locations in the Okanogan subbasin.

Coho: There never has been an artificial propagation program for coho salmon in the Okanogan subbasin, and none are proposed at this time, but may the Yakama are currently piloting a coho restoration plan in the Methow, which if successful includes future extension into the Okanogan River.

Sockeye: Sockeye salmon were to be propagated in the subbasin as part of the authorized mitigation program for Grand Coulee Dam. However, while there were two releases of sockeye into Lake Osoyoos during the GCFMP, the sockeye hatchery was not constructed. A short-term sockeye propagation program was initiated in the 1990s at Cassimer Bar Hatchery, but suspended after only a few years as success was questionable and the direction of mitigation was shifted to habitat improvement in Canadian waters.

Currently, a program funded by Douglas PUD for compensation of sockeye passage losses at Wells Dam, coordinates water releases in the upper Okanogan River, which has increased egg and fry survival of sockeye.

Facilities Description

Summer/fall Chinook

This propagation program is operated as an integrated harvest program to mitigate for the effects of the three PUD dams. Adult summer Chinook are collected at the Wells Dam trap, held at Eastbank Hatchery located on the Columbia River at Rocky Reach Dam, north of Wenatchee. All spawning, incubation and early rearing occur at Eastbank Hatchery. In October, the fingerling Chinook are transported to Similkameen Pond, located at river mile 3.1 on the Similkameen River. Here the fish are acclimated through the winter until their release in April of the following year. In 2004, 100,000 of the program's 576,000 smolt release were reared at the Bonaparte Pond, located at river mile 56 on the Okanogan River, with the intent of dispersing subsequent spawning of returning adults in historical habitats. This program may continue in the future if facility modifications are made to reduce over-winter mortality.

Spring Chinook

Two spring Chinook programs have been initiated in the Okanogan subbasin on an interim, informal basis. In Omak Creek, an integrated recovery program is underway to reintroduce spring Chinook in this historical habitat. The program was initiated in 2001 with scatter planting of 40,000 yearling spring Chinook in Omak Creek, below Mission Falls. These fish were of Carson stock origin reared at Winthrop NFH. These releases continued in 2002 with a scatter planting of 48,000 Carson stock Chinook from Leavenworth NFH. In 2003, 35,000 spring Chinook from Leavenworth NFH were again released in Omak Creek, but were first acclimated at the newly constructed St. Mary's Mission Acclimation Pond. All 45,000 Chinook scheduled for release in 2004 were lost when the new acclimation pond's pump failed. These releases are intended to test the capability of Omak Creek and the Okanogan River to again support spring Chinook.

In the Okanogan River, a segregated harvest program was initiated in 2001 with the acclimation of 254,000 Carson stock spring Chinook in Ellisforde Pond for release in April 2002. These fish were from Winthrop NFH and were surplus to management needs in the Methow subbasin. Releases of 100,000 spring Chinook from Leavenworth NFH were made in 2003 (from Bonaparte Pond) and 2004 (again from Ellisforde Pond). The first returns from these fish are expected in 2005 as four-year-olds. The objective of these fish is to test the capability of the Okanogan River to support spring Chinook migration and to provide a tribal ceremonial and subsistence fishery. No spawning of these fish in the Okanogan River is desired.

Steelhead

Wells Hatchery is located adjacent to Wells Dam at river mile 535 of the Columbia River. The hatchery production destined for the Okanogan is currently operated as an integrated recovery program, contributing to the conservation of the population, but also providing some harvest opportunity. Broodstock is collected from the west bank fish ladder at Wells Dam and from volunteer returns to the Hatchery, held to maturity and spawned at the Hatchery. Two mating categories are used, wild x hatchery crosses and hatchery x hatchery crosses (APRE 2003a). The latter crosses have been released in the Okanogan subbasin, however, plans are now to release H x W crosses in the Okanogan whenever possible. Juvenile steelhead are reared to yearlings, then transported to the Okanogan subbasin where they are scatter planted in the Similkameen River

(50,000), Omak Creek, Salmon Creek, and the Okanogan River (50,000) in late April to mid May.

In 2003, the Colville Tribes initiated a local broodstock program, collecting steelhead returning to Omak Creek. Eggs are incubated and subsequent fingerlings and pre-smolts reared at Colville Trout Hatchery, river mile 542 of the Columbia River. The integrated recovery program is planned to release 20,000 smolts in April or May of each year (NMFS 2003).

Genetic Integrity of Populations

Summer/fall Chinook

The Okanogan subbasin population of summer/fall Chinook is a fully integrated between the natural and hatchery origin fish. "There are no known genotypic, phenotypic, or behavior differences between the hatchery stocks and natural stocks in the target area" (WDFW 1999). The Okanogan and Methow populations have been managed as a single entity with a common hatchery broodstock.

The later-arriving component of the Okanogan summer/fall Chinook population has been severely depressed because of mortalities imposed by passage through nine mainstem dams, higher harvest rates on these fish in lower river fall Chinook fisheries, and the lack of artificial propagation. This component of the run is proposed by intensive propagation to restore its abundance (COLVILLE TRIBES 2004a).

Spring Chinook

There currently is no natural spring Chinook population although the Colville tribes have begun a program to reestablish and restore natural broodstock and populations.in the Okanogan subbasin.

Steelhead

Current steelhead populations originated from a mix of indigenous upper Columbia Basin stocks intercepted during the GCFMP of the 1930s and 1940s, and potential resident fish. The Wells Hatchery stock was initiated in the 1960s from naturally spawning populations migrating past Priest Rapids Dam. The genetic background of the stock is therefore from a mix of populations. The stock is considered highly domesticated from years of broodstock collection at the hatchery and the low level of natural-origin fish available for inclusion in the broodstock. With about 81% of the natural spawning escapement consisting of hatchery-origin fish and the Okanogan subbasin receiving progeny of H x H crosses, the natural populations have been substantially affected by the Wells Hatchery program.

The new conservation programs initiated by the Colville Tribes and further efforts of WDFW at the hatchery to incorporate different matings (HxW, etc.) are intended to improve the viability and adaptability of steelhead in the Okanogan (and other) subbasin.

Program Goals and Objectives

Summer/fall Chinook

The goal of the Similkameen Pond program is "…to mitigate for the loss of summer Chinook salmon adults that would have been produced in the region in the absence of Wells, Rocky

Reach, and Rock Island hydroelectric projects" (WDFW 1999). To this end, the mitigation agreement requires the production and release of 576,000 yearling summer Chinook in the Okanogan subbasin. Performance objectives and performance indicators have been established for the program (WDFW 1999) that addresses program benefits and risks.

Spring Chinook

The goal of the integrated recovery program in Omak Creek is to restore a natural spawning population of spring Chinook in historical habitats that contributed to the fisheries of the Tribes of the Colville Reservation. This program would also assist, longer-term in the recovery of Endangered Upper Columbia River Spring Chinook when Carson stock is replaced with Methow Composite stock. Phase I of this program is intended to return 200- 700 adults to the subbasin to allow assessment of survival parameters and suitability of habitat.

The goal of the segregated harvest program is to mitigate for the loss of spring Chinook because of the construction of Grand Coulee, Chief Joseph, Wells, Rocky Reach, Rock Island, Wanapum, Priest Rapids, McNary, John Day, The Dalles, and Bonneville Dams. The fish will be managed for tribal ceremonial and subsistence fisheries and recreational angling. The Phase I of this program is intended to return 400 – 1,400 adults to the Okanogan River for tribal and recreational harvest. These fish will also be used to test the feasibility of live-capture, selective fishing gears the Colville Tribes intend to deploy for subsistence fishing.

Steelhead

The goal of the Wells Hatchery program in the Okanogan subbasin is to contribute to the conservation and recovery of steelhead while providing for recreational and tribal harvest when compatible with recovery.

From brood year 1981 through brood year 1996, smolt-to-adult survival for Wells Hatchery stock has ranged from 0.29% to 7.54%, with a median survival of 0.92% and a mean survival of 1.63% (WDFW 2002).

Proposed programs

Summer/fall Chinook

The Colville Tribes are proposing the construction of Chief Joseph Dam Hatchery and the use of 2 new acclimation ponds on the Okanogan River to increase the abundance, distribution and diversity of the propagation program for summer/fall Chinook in the Okanogan subbasin.

The Colville Tribes (2004a,) have proposed to increase production levels of summer/fall Chinook to increase the abundance, diversity, and distribution of the naturally spawning population and provide a more stable base for tribal ceremonial and subsistence fishing and recreational angling. The proposed program would initially release an additional 400,000 yearling summer/fall Chinook from a new acclimation site proposed near river mile 49, and 700,000 yearling and sub-yearling Chinook from a new acclimation pond at the mouth of Omak Creek (river mile 32). The broodstock for these releases would constitute the later-arriving Chinook that are not included in the current propagation program.

This subbasin plan supports the premise that salmon (bull trout and steelhead) recovery is a race between the time a population or group of populations will be extirpated and the time habitat to support those populations can be recovered. Whether supplementation is appropriate for a population depends on the anticipated time to extirpation compared to the time required for habitat recovery. Supplementation should be considered appropriate if a population would be extirpated before habitat could be recovered, and, if the habitat could be recovered in the extended period, that supplementation could provide. Given this line of reason, and a vision reflective of the unmitigated history of losses caused by hydropower, agricultural and industrial development in the main stem, valley bottom, and tributary areas across our trust lands, the Colville Tribes conclude that the current state-of-affairs for fish populations and their ecosystems in the Okanogan unequivocally corresponds to this fundamental premise.

It is reasonable to argue that no other region in the Columbia Basin exemplifies the need for strategic, comprehensive, and substantive actions more poignantly or literally than the combined territory of the Okanogan River Basin, the Columbia Cascade Province, and the Upper Columbia ESU. The effort to reestablish viable native fish populations and sustainable natural production habitats in this region will fail without cumulative (positive) effects derived from habitat improvement and protection, implementation of appropriate harvest rates, reductions in mortality associated with hydropower operations and facilities, and (in combination with), the effective and judicious use of artificial production.

The Chief Joseph Hatchery Conceptual Plan and its monitoring components will provide guidance for performance standards in the following categories:

- Legal Standards
- Conservation Standards
- Life History Characteristics
- Genetic Characteristics
- Research Activities
- Operation of Artificial Production facilities
- Socio-economic effectiveness
- Harvest Standards
- Non-target population impacts
- Target population production
- Target population long-term fitness

Also, in 2001, the Colville Tribes submitted a monitoring plan to the Northwest (then the Power Planning Council) Power and Conservation Council and Bonneville that included the US/Canada Okanogan/Okanagan and the Similkameen River basins. This plan has been strongly endorsed in 2001 by the ISRP as a “model” for the entire Columbia Basin and is used extensively by reference in the Pacific Northwest Aquatic Monitoring Partnership’s “Guidance to Subbasin Planners.” The Baseline Monitoring and Evaluation Program (the Baseline M&E), is now collecting data on many, but not all, of the performance indicators for this program. Consequently, and as part of the Master Planning process, the Colville Tribes have prepared a complementary monitoring plan to describe, in general, the scope of efforts and range of supplementary information needed to detect and report overall production program performance as described in HGMPs.

These integrated efforts will begin to provide essential information on habitat conditions, capacity and fish populations, beginning in 2004. The information derived will then be used to detect the effectiveness (or lack thereof) of the hatchery production and supplementation and the integrated harvest and recovery programs as each element comes on line. This will allow the co-managers to operate all facilities in a manner consistent with efforts to detect the trends and effectiveness between and among other subbasins, ESUs, and across a broader group of "H's" and planning processes. Previously unattained levels of cost-effectiveness, standardization of performance metrics and crosscut data and communications management, represent the by-products and benefits of this coordinated approach.

The current escapement goal for summer/fall Chinook in the Okanogan and Methow rivers is 3,500 fish past Wells Dam. The Colville Tribes have proposed to expand this escapement initially by 1,200 later-arriving summer/fall Chinook in the Okanogan subbasin. The Colville Tribes, in their draft Okanogan River Summer/Fall Chinook HGMP, are proposing an expanded management program to increase the escapement of summer/fall Chinook throughout their historical range in the Okanogan River by employing habitat enhancement and an expanded and diversified propagation program. The ultimate management goal will need to be derived from monitoring and evaluating the significant new program. The goal will need to include both increased escapement and stable harvestable surpluses for tribal and recreational fisheries.

Spring Chinook

The Colville Tribes are seeking an extension of the interim programs described above until a larger and more formal program can be initiated. The Colville Tribes are seeking a program that would initially release 200,000 Carson stock spring Chinook from Ellisforde Pond and 50,000 from St. Mary's Mission Pond. Eggs for this program would be collected at Leavenworth NFH then incubated and reared at Willard NFH prior to transfer to the two acclimation ponds in October (COLVILLE TRIBES, 2004b). The current HGMP and the integrated hatchery program described in detail above for summer/fall Chinook also applies to spring Chinook, and is envisioned as a future program by the Colville Tribes.

Thus, the Colville Tribes have proposed in their Okanogan River Spring Chinook HGMP to initiate a significant reintroduction effort. This would begin using Carson stock in an integrated recovery program followed by a transition to Endangered Upper Columbia River Spring Chinook from the Methow subbasin upon its availability. The Colville Tribes are also proposing an initial isolated harvest program using Carson stock Chinook to be converted later to an integrated harvest program upon the availability of Methow subbasin fish. The HGMP's recovery goal is to restore spring Chinook in their historical tributary habitats, including eventually in Canadian waters. Enumerating a recovery goal at this time is premature until the Colville proposals are approved.

Steelhead

The Colville Tribes have initiated preparation of an Okanogan River Steelhead HGMP. The goal of the program will be to restore Endangered steelhead in their historical habitats and create harvestable surpluses for tribal ceremonial and subsistence fisheries and for recreational harvest. Recovery of steelhead will require a mix of habitat restoration actions in tributary streams and artificial propagation. The later will include initiating a local Okanogan River broodstock to replace the homogenized, domesticated stock at Wells Hatchery and a kelt reconditioning program. Enumerating a recovery goal at this time is premature until the Colville Tribes' HGMP has been completed and implementation approved.

The objective of the new local broodstock project is to release 20,000 yearlings in Omak Creek starting in 2004. At that time, Wells Hatchery steelhead will no longer be released in Omak Creek.

The Colville Tribes will also soon be initiating a kelt recondition project in Omak Creek as part of a research experiment to compare the relative reproductive success of natural-origin, hatchery-origin, and reconditioned kelts in producing offspring.

The Colville Tribes are initiating development of a comprehensive HGMP for future management of steelhead in the Okanogan subbasin, working directly with WDFW and other fishery co-managers. Objectives for future management will include recovery of the population and provisions for tribal ceremonial and subsistence harvest and recreational angling that is consistent with recovery

Sockeye & Coho

There have never been nor are there any longer artificial propagation programs for sockeye or coho salmon in the Okanogan subbasin. Rehabilitation of the sockeye population in the Okanogan subbasin is currently being pursued through habitat rehabilitation efforts largely in Canada. First Nations in Canada, in coordination with the Colville Tribes, have also initiated an artificial propagation program to increase fry production in lake waters and a reintroduction of sockeye into Skaha Lake. This program is now progressing into the implementation and monitoring phase. The Colville Tribes may soon propose a coho salmon reintroduction program for the Okanogan River. At that time, an HGMP will be prepared.

Relationship Between Artificial and Natural Populations

Summer/fall Chinook

The current propagation program uses broodstock collected at Wells Dam from mid July through August 28th, a combination of Chinook destined for the Okanogan and Methow rivers (and perhaps Columbia River). The Similkameen Pond program has successfully increased the abundance of the naturally spawning Chinook as evidenced by the high proportion of hatchery fish in the spawning population. The resulting population of hatchery-origin and natural-origin fish is fully integrated.

It appears that the Similkameen program has been essential in maintaining at least the short-term health of the summer/fall Chinook population in the Okanogan subbasin. [note – this is speculative, and if it is just dam based – then why has the Wenatchee late-run population been increasing over the last 40 years?] As with almost all supplemented populations of salmon, however, what is not known is the relative reproductive success of these hatchery-origin fish compared to the natural-origin Chinook in producing offspring.

Historically, natural Okanogan summer/fall Chinook have displayed a dominant sub-yearling or ocean-type life history strategy with juvenile fish entering the ocean in their first year. More recently, biologists have been documenting that many natural-origin adults are the result of a yearling or reservoir reared life history, apparently over-wintering in the Columbia River reservoirs prior to entering the ocean (J. Sneak, WDFW, pers. comm.). However, the presence of the reservoir-reared pattern became apparent well before demographic changes could have taken place through the summer Chinook supplementation yearling programs. And in fact, the reservoir rearing could be an environmental adaptation for summer Chinook in the impounded Columbia River system. The Similkameen Pond propagation program releases yearling smolts that have been shown in other summer/fall Chinook programs to survive at much higher rates than sub-yearling releases. The effect of yearling releases on the long-term health of the population is not known.

A second variation of the artificial propagation program relative to the natural population is the timing of broodstock collection. All broodstock collected for the hatchery program is done from mid-July through August 28th, although summer/fall Chinook continue to migrate past Wells Dam into November. This truncated collection period was initiated to avoid including stray fall Chinook from lower river programs in the broodstock. This straying problem has since been eliminated, because Turtle Rock no longer uses Priest Rapids Hatchery fall Chinook, but rather uses summer Chinook collected at Wells Hatchery.

The expanded propagation program proposed by the Colville Tribes (2004) has been designed to enhance the qualities of the current Similkameen Pond program. Adult Chinook would be collected in or near the Okanogan River to create a fully localized broodstock of fish adapted to the Okanogan River. Broodstock would include the later-arriving population component (September to early November) that is believed to spawn in the lower river reaches, later in the fall. The added numbers of juvenile fish would be acclimated at two new sites in the mid and lower Okanogan River (Riverside and Omak) to seed these underutilized, historical habitats. And also, about 40% of the juvenile releases at Omak would be sub-yearling fish, the natural life history, to monitor their success relative to the yearling hatchery releases and the natural-origin migrants.

Spring Chinook

Spring Chinook salmon were extirpated from the Okanogan subbasin so there is no natural population. Carson stock spring Chinook have been used as eggs and are readily available from the Wenatchee subbasin and the stock has performed relatively successfully in the Columbia Cascade Province when artificially propagated. The Colville Tribes have proposed to use Carson stock until a surplus of ESA-listed Methow Composite stock is available from Winthrop NFH and Methow State Hatchery that can be introduced into the Okanogan subbasin as an experimental population under the terms of the ESA (COLVILLE TRIBES 2004b).

Steelhead

Steelhead populations are currently listed as Endangered in the Columbia Cascade Province with natural cohort replacement rates prior to 1995 thought to be 0.3 or less for the various populations. The Okanogan subbasin has been a low priority for steelhead recovery efforts. At one time, NOAA Fisheries concluded that, “Current habitat conditions are not conducive to steelhead in the Okanogan River subbasin.” Further, the Wells Hatchery releases destined for the Okanogan subbasin are from hatchery x hatchery crosses that would be expected to have the least success in natural reproduction. WDFW's spawning ground objective for the listed ESU has been 6,000. However, the Okanogan subbasin was not included in this objective.

With recent habitat improvements in Omak and Salmon creeks, natural reproduction of steelhead in the Okanogan subbasin has been increasing. In 2002, 39 steelhead redds were observed in 2 miles of reference reaches and natural-origin steelhead fry were abundant (Fisher 2003a). In 2003, 21 steelhead redds were observed in the same reaches. Fry were again abundant in some reaches, but not others because of a kill resulting from an accidental dumping of fire retardant (Fisher 2003b). Also in 2003, six steelhead redds were observed in Salmon Creek following an experimental release of water by the Okanogan Irrigation District. Subsequently, fry production was observed (Fisher 2003c). Further demonstrating the improved status of natural-origin steelhead in the Okanogan subbasin, with issuance of Section 10 (a)(1)(A) Permit 1395 to WDFW in October of 2003, NOAA Fisheries designated mortality limitations to natural-origin steelhead in the Okanogan River with runs up to 600 natural-origin fish.

Internal and External Consistency of Program to Purpose

Summer/fall Chinook

The Similkameen Pond program has been operated consistently with the planned objective of managing the Okanogan and Methow summer/fall Chinook as a single population. Actions that need to be undertaken in the Okanogan subbasin to improve the consistency of the existing program include:

1. Develop a local Okanogan broodstock, separate from the Methow population.
2. Propagate the entire summer/fall Chinook run, including fish arriving in September, October, and November.
3. Propagate and evaluate the benefits and costs of releasing the natural sub-yearling type juvenile in addition to the yearling smolts.
4. Continue to disperse acclimated hatchery releases throughout the full range of historical habitat.
5. Develop harvest strategies that manage for the proportion of hatchery-origin fish in the spawning population to optimize the population's viability.

Spring Chinook

The programs are too new to evaluate internal or external consistency. A key external risk that must be evaluated is the extent, if any, to which the Carson-stock spring Chinook stray to the Methow subbasin and spawn with ESA-listed Chinook of the Upper Columbia River Spring Chinook ESU or survive through the summer in the Okanogan River and spawn with summer/fall Chinook. Management actions will be taken to minimize these risks.

Steelhead

The current steelhead program in the Okanogan subbasin is going through a substantial change. Additional planning and execution via a new HGMP will be required to direct a holistic and consistent program. Actions that need to be undertaken in the Okanogan subbasin to improve the consistency of the existing program include:

1. Implement new acclimation sites for Wells Hatchery stock steelhead in the Okanogan subbasin that will provide ongoing conservation and fishery benefits, but not conflict with the new local broodstock and kelt reconditioning programs being developed in Omak Creek.
2. Transition from the aggregate, domesticated Wells Hatchery stock to an entire Okanogan subbasin program supported by local broodstock.
3. Implement a steelhead marking program that will support, yet differentiate the Wells Hatchery stock and Omak Creek programs.
4. Expand the local broodstock and kelt reconditioning programs from a base of Omak Creek to programs appropriate for the entire Okanogan subbasin.
5. Adjust proposed programs based on results of planned research in Omak Creek to evaluate the relative reproductive success of hatchery-origin, natural-origin, and reconditioned kelt steelhead.

Program Operations

Summer/fall Chinook

To implement the current Similkameen Pond program, broodstock are collected at the Wells Dam east ladder trap from mid-July through August 28th then immediately transported to Eastbank Hatchery for holding and maturing. For both the Okanogan and Methow programs, 556 Chinook are taken with equal numbers of males and females. In taking broodstock, there is no protocol for selecting for or against any particular trait. The program has specific protocols that ensure broodstock collection does not adversely affect natural spawning goals (WDFW 1999).

Adults are primarily spawned from late September through late October. A 1:1 mating scheme is employed. Eggs are placed in Heath stack incubators. Ponding of swim-up fry occurs after accumulation of about 1,700 temperature units from early May through June. About 85% of fertilized eggs survive to fry ponding. Rearing of juveniles is performed in raceways following loading densities of 6 lbs./gpm and 0.75 lbs./cu. ft. (WDFW 1999).

Fish health and disease are continuously monitored (10-15 times) by professionals in compliance with standard fish health policy standards. BKD is the primary disease of concern.

In October, fingerlings are transferred from Eastbank Hatchery to Similkameen Pond where they are reared for 6 months through the winter until release in early April. The objective for smolts is 576,000 at 10 fpp. All smolts are adipose fin clipped and coded wire tagged for identification.

Okanogan summer/fall Chinook contribute in various amounts to fisheries along the West Coast from S.E. Alaska to the Columbia River. Prior to recent harvest restrictions implemented because of widespread listings of salmon species pursuant to the Endangered Species Act, summer Chinook were harvested at high rates in ocean fisheries of Alaska and British Columbia. With the increased runs of the past three years, recreational fishing and tribal treaty fisheries in the Columbia River have enjoyed increased harvests. In the past two years, recreational fishing in the Okanogan River has resumed. The Okanogan summer/fall Chinook provide the Colville

Tribes' with their last remaining ceremonial and subsistence fishery of any magnitude. Average Tribal harvests have been consistently below 1,000 fish until the past few years when harvest has exceeded 3,000 Chinook.

Spring Chinook

Broodstock collection, mating, egg incubation, and early rearing of the spring Chinook released in the Okanogan subbasin is performed at Leavenworth NFH, the operations of which can be viewed in the appended Okanogan River Spring Chinook HGMP (Colville Tribes 2004b) or sought in that facility's HGMP or the Wenatchee Subbasin Plan.

In October of each year the fingerling spring Chinook are transported to St. Mary's Mission Pond on Omak Creek and Ellisforde Pond on the Okanogan River. Ellisforde Pond is an open-air pond, is 225' x 90' x 6' deep, and has 121,500 cubic feet of useable rearing volume. The Pond's water is supplied by six pumps, each delivering 5 cfs from the Okanogan River. The pond is located on the left bank of the Okanogan River at river mile 62, near the community of Ellisforde. St Mary's Mission Pond is 72' x 12'x 4' and served with gravity flow from Omak Creek and from a well. Either water source can provide the necessary 550 gpm water supply. The Chinook are fed a restricted diet through the winter months followed by increased feeding and accelerated growth prior to their April release. The size objective for these Chinook is 15 fpp.

Steelhead

Steelhead broodstock for the Wells Hatchery stock program are collected in the west ladder of Wells Dam and from volunteer returns to the Hatchery. Fish are collected from throughout the run starting in August and into the following spring. To supply sufficient steelhead for all subbasins in the upper Columbia, 420 steelhead are collected for broodstock. Wild-origin fish have made up 5-12% of the broodstock. Fish are spawned in the spring as they ripen.

Steelhead matings for the program are W x W, H x W, and H x H, with the latter destined for the Okanogan subbasin.

For the new local broodstock program, the 10 - 16 adult fish required for broodstock are collected at a weir and trap located at approximately river mile 0.5 in Omak Creek near its confluence with the Okanogan River. The trap is operated from March until early May. Collected steelhead are transported to Cassimer Bar Hatchery for holding. Hatchery-origin broodstock may be returned to Omak Creek if natural-origin steelhead are later trapped in order to meet broodstock protocols. Broodstock are examined weekly for ripeness and accordingly spawned. The mating preference is W x W crosses and secondarily H x W crosses.

At Cassimer Bar Hatchery, eggs are incubated in vertical Heath trays. Green egg to eyed egg survival is expected to be about 80%. Upon hatching and button-up, fry are transferred to modified Capillano troughs (63 cu. ft). Steelhead are reared in the troughs until July or when they reach 400/lb, when they are transferred to outside raceways (Golder 2002). Fingerlings are marked using elastomer-type tags. Due to water and space limitations at Cassimer Bar Hatchery, final rearing of the steelhead occurs at Colville Trout Hatchery.

Steelhead are reared to a size of 10 to 15 fish per pound and then scatter-planted in Omak Creek prior to mid-April. Any production above the 20,000 smolt objective will be planted into other Okanogan River tributaries (e.g. Tunk or Bonaparte creeks).

Program Success

Summer/fall Chinook

The Similkameen Pond program has been operated consistently with the planned objective of managing the Okanogan and Methow summer/fall Chinook as a single population. The program has been successful in maintaining at least minimum numbers of spawning fish through years of poor freshwater and marine survival. In more recent years, the program has supported revitalized recreational and tribal fisheries throughout the Columbia River. Recent dispersal of production to Bonaparte Pond should improve the program contribution to population diversity in the Okanogan Basin.

The propagation of summer Chinook in the Okanogan subbasin was initiated with the 1989 brood year and a subsequent release of 352,600 yearling smolts in 1991. Since that time, releases have varied about the 576,000 program objective (WDFW 1999). Through 2003, all releases were made from Similkameen Pond. However, this has resulted in excessive use of the spawning habitat in the Similkameen and upper Okanogan rivers while other historical habitats are under utilized. In 2004, 100,000 of the Chinook historically released from Similkameen Pond may be released from Bonaparte Pond. If successful, this release may be increased to 200,000 yearlings (depending on modifications to the pond – see above).

The summer/fall Chinook destined for the Okanogan River has recently experienced a substantial increase. From runs of fewer than 5,000 fish passing Wells Dam, returns since 2001 have ranged from about 40,000 to 69,000 adults. The proportion of hatchery-origin fish in the naturally spawning population is substantial ranging from just under 50% in the lower runs of recent years to over 70% in the last few larger runs.

The smolt-to-adult return rate for the Similkameen rearing pond has averaged 0.74 for brood years 1989 through 1997, ranging from 0.001-2.11.

Spring Chinook

Adults are not expected to start returning until May or June of 2005. Therefore no measurements of program success are available. Performance standards and indictors have been developed for the program and will be the basis for a monitoring and evaluation program.

Rearing in the new acclimation ponds has not been without mishap, however. At St Mary’s Mission Pond, 10,000 fish were lost just prior to release. In 2004, all 45,000 fish were lost when the gravity water supply iced up and the auxiliary pump failed.

Steelhead

From brood year 1981 through brood year 1996, smolt-to-adult survival for Wells Hatchery stock has ranged from 0.29% to 7.54%, with a median survival of 0.92% and a mean survival of 1.63% (WDFW 2002).

4.4 Restoration and Conservation Projects

The information presented in this section is specifically designed to provide context for subbasin planners and to reduce or eliminate duplication of efforts between parties. The tables attempt to categorize project types and geographic areas as well as identify project sponsors. To a degree, this information can be viewed as a snapshot of what is happening on the ground at this time for fish and wildlife protection and restoration. However, it does not depict the full range of actions that have been recommended in the Province even as "high priority actions." This situation is especially prevalent in the Columbia Cascade Province, especially when viewed within the context of population status, past losses and mitigation history, and, when compared to implementation levels in other Provinces.

To provide a Columbia Cascade Eco-province context for this subbasin plan, Appendix D provides summary project information (2001 – 2003) that details project categories and BPA funding levels recommended by the basin technical teams, fish and wildlife managers, the ISRP, the CBFWA and the NPPC. To review a summary of projects in the Okanogan subbasin (US and Canada, organized by Assessment Unit) for the last 10 years, see Appendix D.

4.4.1 Assessment of Projects

This subbasin plan's inventory of projects includes projects from the last ten years. An extensive effort, through multiple planning processes, has occurred to develop this inventory of projects; however, the list is not all-inclusive. Further, not all other planning processes have required the level of information that is required by NPCC. Given the timeframe and funding level, the subbasin planners could not provide all of the information that was suggested in the Technical Guide for Subbasin Planners (Council Document 2001-2002). Future work is required for subbasin planners to identify the gaps between actions that have already been taken or are underway and additional actions that are needed.

Project efforts in the Okanogan subbasin over the past 10 years span a broad range of habitat restoration work, education and awareness, improvements to irrigation systems, etc. These represent largely cooperative efforts of various combinations of local government, private organizations, private citizens, tribes and state agencies. In addition, an inventory of projects follows. This inventory is designed to be compared with the needs for fish and wildlife identified in this plans Assessment.

5 Management Plan

The management plan described in this section is a culmination of extraordinary efforts by the subbasin planners, the public and stakeholder input. Its development came as a laborious result of carrying out the assessment and inventory work and formation of the vision, goals and principles sections of the subbasin plan. Additional guidance and direction was derived from the conscientious integration of socio-economics, harvest, hydropower and artificial production information and synthesis into the final construct.

As a result, this management plan depends upon an assimilation of this information and careful review and full use of all sections of the subbasin plan and its key findings.

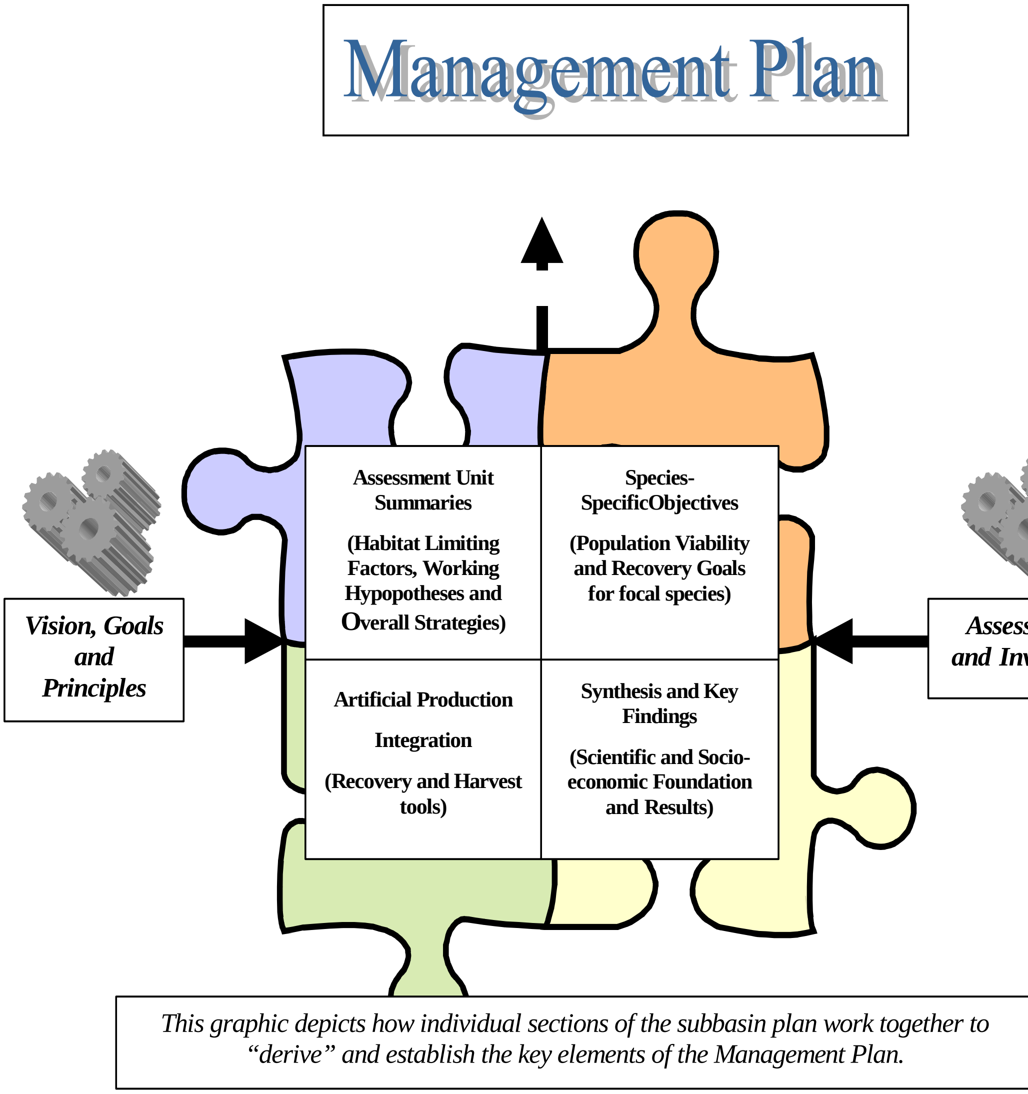


Figure 51. Logic Path for the Development of the Subbasin Plan

5.1 Management and Our Vision for the Okanagan subbasin

The management plan to follow is designed to be consistent with, and guided by our Vision. The Vision for the Methow subbasin is consistent with the 2000 Columbia Basin Fish and Wildlife Program's Vision, yet tailored specifically to the geographic region of the Methow subbasin and its citizenry. Within 15 years, it is envisioned that:

The Methow subbasin supports self-sustaining, harvestable, and diverse populations of fish and wildlife and their habitats, and supports the economies, customs, cultures, subsistence, and recreational opportunities within the basin. Decisions to improve and protect fish and wildlife populations, their habitats, and ecological functions are made using open and cooperative processes that respect different points of view and statutory responsibilities, and that are made for the benefit of current and future generations.

Specific planning assumptions and principles are provided at the beginning of this subbasin plan.

Decisions as to which management strategies will be implemented should be a part of a public process that takes into account economics, public policy, community values and tradeoffs of several different kinds. Strategies may be rejected during the public review process because they are too expensive, conflict with policy, or are inconsistent with community values. When this occurs, it will be necessary to look for appropriate alternative strategies or re-examine the goals, and to assess the effect on the plan goals. (NPPC 1997).

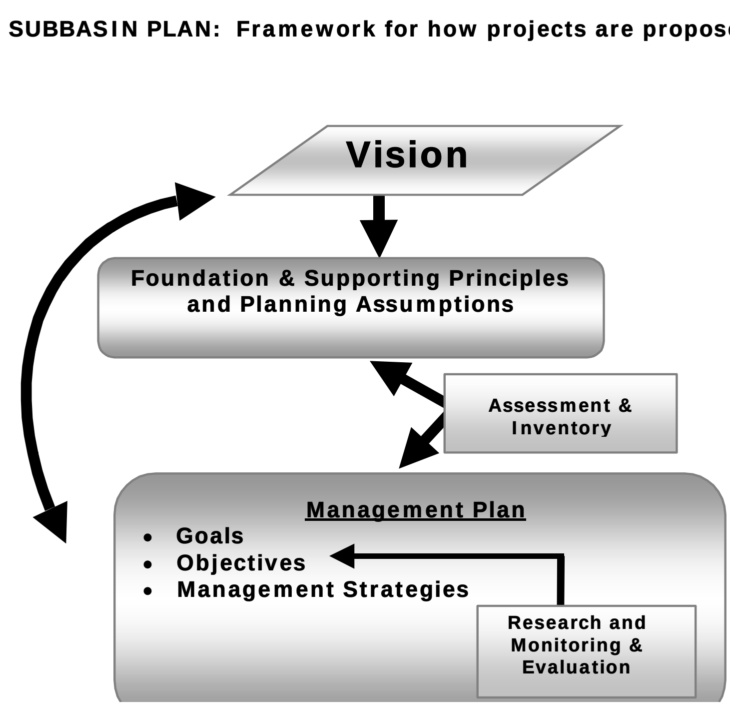


Figure 52 Subbasin Plan: Framework for how projects wll be derived using the subbasin plan

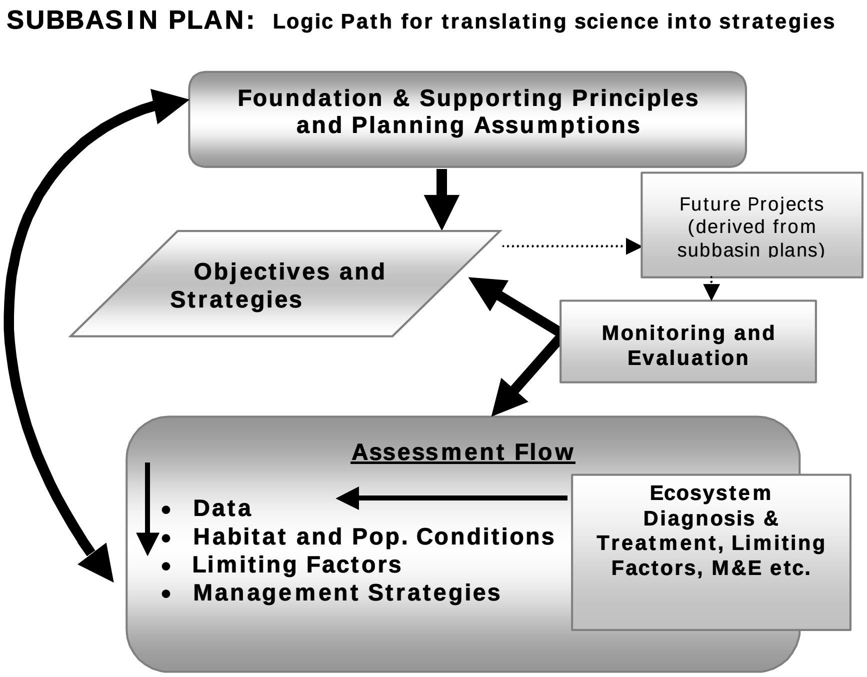


Figure 53 Subbasin Plan: Logic Path for translating science into strategies (*deriviving* the subbasin plan)

5.2 Assessment Unit Summaries

The following Assessment Unit Summary Sheets are intended to be used as a *guide* for developing future strategies, projects and direct actions as they relate to salmon habitat. They support and form the basis for the Management Plan, and are in turn supported by the subbasin plan sections: Goals and Vision, Species Objectives, Hatchery Integration and the Monitoring and Evaluation Framework. Taken together, these form our scientific and socio-economic foundation, and ultimately, the core of the Management Plan itself.

Four course-scale filters were used to guide us in developing the specific strategies found in the AU summary sheets. These were used ensure that actions are balanced and rationale. Ultimately them were used to gauge if the actions would be (will be) implementable. In taking this step, we found that trade-off analysis and multiple iterations of planning was reduced by focusing actions in areas and on habitat attributes that fell within the “realm of the doable and effectual.”

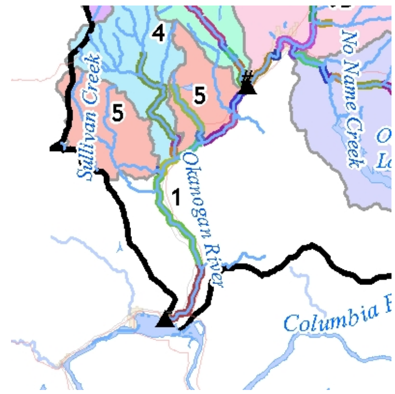
1. Is the strategy supported by science and by the assessment findings?
2. Is the strategy effective relative to the cost?
3. Does the strategy have (or is it likely to win) public support?

4. Are resources available to implement the strategy and monitor the outcomes—including enforcement where relevant?

The working hypotheses in these summaries are the "testable" part of the management plan equation. The strategies themselves provide the metrics for testing and form the most appropriate foundation for the monitoring and evaluation program priorities.

5.3 Assessment Units: 01 - 021

U.S. AU Summaries

<table>
<tr><td>ASSESSMENT UNIT: O1—Okanogan Lower
REACHES: 8
1 | 2 | 3 | 4 | 5 | 6 | 7 | 8</td><td>
</td></tr>
<tr><td>FOCAL species: Sockeye salmon, summer/fall Chinook salmon, and steelhead.</td><td>Drainage area: Approximately 134 acres of mainstem or 36 river miles</td></tr>
<tr><td colspan="2">SUBWATERSHEDS Chilliwist, Talent, Davis Canyon, Dan Canyon, Loup Loup (also connectivity to mainstem Col. R which is important rearing and prespawning holding area)</td></tr>
<tr><td colspan="2">ASSESSMENT UNIT DESCRIPTION: : This AU begins at the mouth of Okanogan river and terminates at the Mouth of Salmon Creek near the town of Okanogan. This is 1 of 11 in the US of 1 of 21 combining the US and Canadian portions of the Okanogan subbasin. Reaches from the historic channel (reach 1 especially and 2-4 significantly) are now inundated by the Wells dam reservoir. Effects of inundation can be traced up to the mouth of Salmon Creek. Width to depth ratio is very high in the lower reaches and the channel is moderately constricted by road (Hwy 97) and railroad beds in the middle and upper reaches. Land use is dominated by agriculture (soft fruits and hay operations). Zero age active rearing, prespawn migrant and prespawn holding for summer/fall, spring Chinook, steelhead and sockeye are the predominating life history stages in this AU. In Okanogan 1, 2 and 3 habitat quantity was gained as a consequence of Wells dam pool inundation. In the Okanogan, spck likely outmigrate as zero-age fish to avoid the effects of high temperatures in tributaries. Fall Chinook production has been lost in this AU due to hatchery practices which have concentrated all production in the upper AU's and selected against the late arriving, or fall, component in broodstock programs. The eastern and western boundaries of the mainstem Okanogan basin are steep, jagged ridgelines at elevations ranging from 1,500 feet to more than 6,000 feet above the basin floor (WDOE 1995). The average width of the drainage area for the mainstem is approximately 35 miles, and the floodplain of the Okanogan River valley averages about a mile in width. The mainstem's elevation and descends from an elevation of about 920 feet at the international boundary to about 780 feet at the river's confluence with the Columbia River. Osoyoos Lake occupies the northernmost 4 miles of the valley floor and extends several miles into Canada. Multiple natural terraces formed mostly of glacially deposited gravel rise locally as much as 500 feet above the valley floor to the foot of, and between, the lateral ridges.</td></tr>
<tr><td colspan="2">LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.</td></tr>
<tr><td colspan="2">FACTORS LIMITING PRODUCTION:
S-Predation (avian and some exotic fish)
P-Loss of Habitat Diversity in many reaches and at multiple life stages.
P-Sediment
S-Some harassment.</td></tr>
</table>

P-Loss of habitat quantity.

P-Prespawn holding habitat loss.

S-Winter temp for sthd

S-High summer temp for spck (if tributary habitat is still in poor condition)\

S-Chemicals

Additional LFA comments:

(all related to flow) Impervious surface, floodplain connectivity, reservoir operations and withdrawals. Generally the influences from changes to the hydrograph in tributaries are captured in EDT. Mainstem areas are affected, but it is unknown to what degree (data gap for mainstem).

Refer to Appendix B for reference and specific detail by reach and species

Working Hypotheses and Focal Species Conservation and Rehabilitation Alternatives:

Hypothesis 1: Artificial production (supplementation) provides an increase in fish population numbers and is required to meet tribal trust responsibilities, provide harvestable surplus for people of this region, and to aid in salmon and steelhead recovery efforts because of population decreases caused by habitat loss, main-stem Columbia River dams, and downriver harvest activities. (Hatchery activities should be consistent with approved Hatchery Genetic Management Plans and the artificial production section of this plan)

Objective 1-1. Provide tribal and selective recreational harvest opportunities for summer/fall Chinook, summer steelhead, sockeye salmon, and spring Chinook were feasible.

Strategy 1-1A. Build summer/fall Chinook acclimation ponds at strategic locations and release artificial production from these sites annually.

Strategy 1-1B. Increase or maintain artificial production capacity at levels necessary to meet management needs, maintain new and existing acclimation sites, and support existing and new scatter plantings.

Strategy 1-1C. Monitor adult salmonid returns annually, determine a baseline, and evaluate trends.

Objective 1-2. Increase the number of spawning summer/fall Chinook in this AU by 50%

Strategy 1-2A. Build summer/fall Chinook acclimation ponds at strategic locations and release artificial production from these sites annually.

Strategy 1-2B. Develop in-stream structures to sort gravel and reduce fine sediment accumulation.

Strategy 1-2C. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase channel complexity.

Strategy 1-2D. Determine baseline redd counts for summer/fall Chinook in the assessment unit.

Strategy 1-1E. Monitor redd counts in assessment unit annually and compare trends to baseline.

Hypothesis 2: Increasing habitat diversity (i.e. providing resting and rearing cover)in the middle and upper reaches of the AU will increase survival for summer/fall Chinook, steelhead and sockeye in the 0-age active rearing, prespawn migrant, and prespawn holding life stages.

Objective 2-1. Protect and enhance rearing and per-spawn holding habitat by 5% for steelhead, adult sockeye and Chinook using in-stream structures.

Strategy 2-1A. Install habitat boulders and artificial log-jams that provide large interstitial spaces providing juvenile hiding cover and current breaks for per-spawn migrant holding areas.

Strategy 2-1B. Improve riparian habitats with the potential to contribute to future LWD recruitment.

Strategy 2-1C. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase LWD deposition, channel complexity and riparian areas.

Objective 2-2. Control poaching and unauthorized take of adult steelhead and salmon.

Strategy 2-2A. Increased enforcement emphasis, fisheries and river use regulations.

Strategy 2-2B. Use sportsman shows and community events to educate anglers on regulations, ethics, and how they can assist in management efforts.

Hypothesis 3: Reducing fine sediment input throughout the Okanogan subbasin will increase residual pool depths in this assessment unit. (Direct activities in this assessment unit are unlikely to product tangible results).

Objective 3-1. Increase residual pool depth by 10% in this assessment unit to evaluate subbasin wide fine sediment reduction strategies.

Strategy 3-1A. Establish baseline for residual pool depths.

Strategy 3-1B. Monitor residual pool depths annually and evaluate trends.

Strategy 3-1C. Conduct sediment reduction strategies throughout the Okanogan subbasin especially in the upper portions of the watershed.

Objective 3-2. Increase floodplain connectivity along an additional 10% of the assessment unit where feasible to establish aquatic/terrestrial nutrient exchange processes allowing floodplain inundation every 2-years on average.

Strategy 3-2A. Remove diking, reestablish back channels, reslope vertical banks, and establish wetland habitats that allow floodplain inundation to occur approximately every 2 years.

Strategy 3-2B. Determine pre-settlement riparian corridor.

Strategy 3-2C. Restore and conserve historic riparian corridor.

Strategy 3-2D. Protect and re-establish all ground-water sources.

Strategy 3-2E. Address non-point source and point source pollution.

Hypothesis 4: Predation on juvenile salmonids is a limiting factor and removal of predators will increase survival of steelhead, sockeye and Chinook in the subyearling, yearling, and age 1 and 2 prespawn migrants.

Objective 4-1. Reduce the overall abundance of aquatic predator species by 10% that are known to consume juvenile salmonids (i.e. walleye, smallmouth bass, northern pike minnow) from reaches 1-4 to increase juvenile salmon and steelhead survival.

Strategy 4-1A. Determine baseline predator abundance and consumption rates.

Strategy 4-1B. Eradicate aquatic predators targeting those that have the highest salmonid consumption rates using selective harvest techniques.

Strategy 4-1C. Monitor predator abundance annually and evaluate trends.

Objective 4-2. Determine avian and terrestrial predation rates.

Strategy 4-2A. Determine if non-aquatic predators are consuming significant numbers of salmonid juveniles, determine species, and effective control methods.

Objective 4-3. Determine economic and recreation impacts to salmon and steelhead populations.

Strategy 4-3A. Determine the economic benefits and cost associated with recreational angling along the Okanogan River.

Strategy 4-3B. Conduct creel census of salmon and steelhead caught on the Okanogan River.

Strategy 4-3C. Determine impacts to salmonid populations from recreational activities other than angling that occur along the Okanogan River.

Hypothesis 5: Adult enumeration of salmon and steelhead is critical in this AU will determine the proportion of adults returning to the Okanogan subbasin verses other subbasins located above Wells Dam. (Note: This has been an acknowledged data gap for many years).

Objective 5-1.Evaluate and monitor the trend in adult returns to the Okanogan subbasin as a method to determine the cumulative success or failure of proposed actions.

Strategy 5-1A. Establish a counting station to monitor migrating adult salmonids.

Strategy 5-1B. Monitor adult salmonid returns annually, determine a baseline, and evaluate trends.

Strategy 5-1C. Coordinate data sharing with all agencies with management authority to provide information for adaptive management.

Hypothesis 6: Survival for all life stages of Chinook, steelhead, and sockeye will increase by restoring proper passage conditions at human made barriers and irrigation withdrawals.

Objective 6-1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Strategy 6-1A. Prevent new passage problems by restricting the placement of new roads or providing adequate mitigation for unavoidable impacts.

Strategy 6-1B. Design and construct road culverts and screens consistent with standards and guidelines.

Strategy 6-1C. Prevent the placement of dikes and other structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 6-1D. Use permits or other local, state and federal approval mechanisms to impose design and construction restrictions on activities that may impede fish passage and access.

Strategy 6-1E. Remove, modify or replace culverts and or screens that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity.

Strategy 6-1F. Remove, replace or modify diversion dams identified as major limiting factors affecting fish passage and habitat connectivity.

Strategy 6-1G. Use cost-sharing programs to help landowners screen diversions.

Note: Some of the documented Limiting Factors probably cannot logistically or cost effectively be addressed (sediment for instance) in reaches 1-2 due to significant and insurmountable inundation effects from the Wells Pool. Temperature is a limiting factor in the lower reaches of this AU, however, as with sediments, it is unlikely that any management strategies can logistically or cost effectively be implemented. Some improvements for both temperature and sediment will be realized through increases in habitat diversity (e.g. riparian function, instream structure and land use practices) in upper reaches and AU area..

DATA GAPS AND M&E NEEDS:

Stream reach corridor data.

Juvenile outmigration and use.

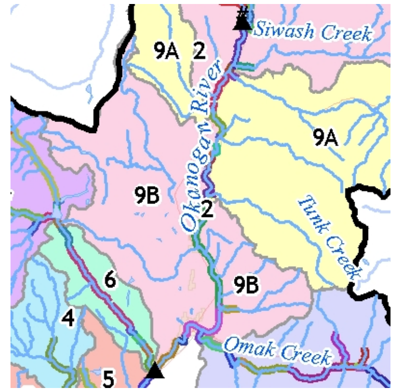
Adult emigration data.

Predation levels and consumption rates.

ASSESSMENT UNIT: O2—Okanogan Middle

REACHES: 18

9	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**



FOCAL species: Sockeye salmon, summer/fall chinook salmon, and steelhead.

Drainage area: Approximately 62 river miles.

SUBWATERSHEDS: Salmon, Omak, Antoine, Wanacut, Tunk, Bonaparte, Siwash, Tonasket, Whitestone, Aeneas, Johnson

ASSESSMENT UNIT DESCRIPTION: This AU begins at the mouth of Salmon Creek in the Town of Okanogan and ends just North of the City of Tonasket at the mouth of Antoine Creek. The AU is dominated by both meandering and confined mainstem channel condition. The section beginning at Riverside contains a high proportion of sand and silts due to input from Canada and US and low gradient and velocity in these reaches. The eastern and western boundaries of the mainstem Okanogan basin are steep, jagged ridgelines at elevations ranging from 1,500 feet to more than 6,000 feet above the basin floor (WDOE 1995). The average width of the drainage area for the mainstem is approximately 35 miles, and the floodplain of the Okanogan River valley averages about a mile in width. The mainstem's elevation and descends from an elevation of about 920 feet at the international boundary to about 780 feet at the river's confluence with the Columbia River. Osoyoos Lake occupies the northernmost 4 miles of the valley floor and extends several miles into Canada. Multiple natural terraces formed mostly of glacially deposited gravel rise locally as much as 500 feet above the valley floor to the foot of, and between, the lateral ridges.

LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.

FACTORS LIMITING PRODUCTION:

P-Reduced natural population numbers

P-Habitat Diversity

S-Predation

P-Sediment

S-Channel stability

S-Chemicals

S-Temp (winter

P-Temp (summer)

P-Prevent future artificial barrier and irrigation diversion impacts

Additional LFA comments:

(all related to flow) Impervious surface, floodplain connectivity, reservoir operations and withdrawals. Generally the influences from changes to the hydrograph in tributaries are captured in EDT. Mainstem areas are affected, but it is unknown to what degree (data gap for mainstem).

Refer to Appendix B; for reference and specific detail by reach and species

Working Hypotheses and Focal Species Conservation and Rehabilitation Alternatives:

Hypothesis 1: Artificial production (supplementation) provides an increase in fish population numbers and is required to meet tribal trust responsibilities, provide harvestable surplus for people of this region, and to aid in salmon and steelhead recovery efforts because of population decreases caused by habitat loss, main-stem Columbia River dams, and downriver harvest activities. (Hatchery activities should be consistent with approved Hatchery Genetic Management Plans and the artificial production section of this plan)

Objective 1-1. Provide tribal and selective recreational harvest opportunities for summer/fall Chinook, summer steelhead, sockeye salmon, and spring Chinook were feasible.

Strategy 1-1A. Build summer/fall and spring Chinook acclimation ponds at strategic locations and release artificial production from these sites annually.

Strategy 1-1B. Increase or maintain artificial production capacity at levels necessary to meet management needs, maintain new and existing acclimation sites, and support existing and new scatter plantings.

Strategy 1-1C. Enhance traditional tribal harvest opportunities at traditional sites.

Strategy 1-1D. Monitor adult salmonid returns annually, determine a baseline, and evaluate trends.

Objective 1-2. Increase the number of spawning summer/fall Chinook in this AU by 50%

Strategy 1-2A. Build summer/fall Chinook acclimation ponds at strategic locations and release artificial production from these sites annually.

Strategy 1-2B. Develop in-stream structures to sort gravel and reduce fine sediment accumulation.

Strategy 1-2C. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase channel complexity.

Strategy 1-2D. Determine baseline redd counts for summer/fall Chinook in the assessment unit.

Strategy 1-2E. Monitor redd counts in assessment unit annually and compare trends to baseline.

Hypothesis 2: Increasing water quality will increase survival for Chinook, steelhead and sockeye in the following life stages:

Juvenile rearing, prespawn holding and active migration. Some spawning for Chinook.

Objective 2-1. Reduce chemical impacts for all species to remove this reach of the from 303(d) listing.

Strategy 2-1A. Address non-point source and point source pollution.

Strategy 2-1B. Remove and properly dispose of contaminated sediments.

Objective 2-2. Reduce summer water temperatures for all species to remove this reach of the Okanogan River from 303(d) listing.

Strategy 2-2A. Remove diking, reestablish back channels, reslope vertical banks, and establish wetland habitats that allow floodplain inundation to occur approximately every 2 years.

Strategy 2-2B. Protect existing shading and plant additional trees and shrubs in areas of exposed rock.

Strategy 2-2C. Protect and re-establish all ground-water sources.

Hypothesis 3: Increasing habitat diversity throughout the AU will increase survival for Chinook, steelhead and sockeye in the following life stages: Zero age active rearing, prespawn migrant and prespawn holding for summer/fall, spring Chinook, steelhead and sockeye plus increase spawning distribution for summer/fall Chinook.

Objective 3-1. Protect and enhance rearing and per-spawn holding and rearing habitat by 5% for steelhead, sockeye, and Chinook using in-stream structures.

Strategy 3-1A. Install habitat boulders and artificial log-jams that provide large interstitial spaces providing juvenile hiding cover and current breaks for per-spawn migrant holding areas.

Strategy 3-1B. Improve riparian habitats with the potential to contribute to future LWD recruitment.

Strategy 3-1C. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase LWD deposition, channel complexity and riparian areas.

Objective 3-2. Increase spawning habitats for summer/fall Chinook by 5% to increase egg-fry survival.

Strategy 3-2A. Install Newberry riffles or rock vortex structures to increase water velocities and gravel recruitment in select areas.

Strategy 3-2B. Create side-channel habitats, islands, spawning channels, and reconnect back channels to create spawning areas away from the main channel.

Hypothesis 4: Fine sediment reduction throughout the Okanogan subbasin and increased bank stability will increase residual pool depth and reduce width to depth ratios. (Direct activities in this assessment unit are likely to produce only limited benefits) The following life stages would benefit from these actives: incubation, rearing, prespawn holding and rearing mainly for Chinook and steelhead, but possibly migration for sockeye.

Objective 4-1. Reestablish normative width to depth ratios of 10:1.

Strategy 4-1A. Establish baseline for existing width to depth ratio.

Strategy 4-1B. Monitor width to depth ratios annually and evaluate trends.

Strategy 4-1C. Reslope vertical banks and reestablish riparian plant communities

Strategy 4-1D. Stabilize sloughing banks using soft techniques wherever possible and armoring when necessary.

Strategy 4-1E. Use barb and bail techniques to manage sediment loads and move channel away from sensitive banks and reestablish plant communities.

Strategy 4-1F. Limit grazing access to the riparian corridor and minimize the time that these areas can be used.

Objective 4-2. Increase residual pool depth by 10% in this assessment unit to evaluate subbasin wide fine sediment reduction strategies.

Strategy 4-2A. Establish baseline for residual pool depths.

Strategy 4-2B. Monitor residual pool depths annually and evaluate trends.

Strategy 4-2C. Conduct sediment reduction strategies throughout the Okanogan subbasin especially in the upper portions of the watershed.

Objective 4-3. Increase floodplain connectivity along an additional 10% of the assessment unit where feasible to establish aquatic/terrestrial nutrient exchange processes allowing floodplain inundation every 2-years on average.

Strategy 4-3A. Remove diking, reestablish back channels, reslope vertical banks, and establish wetland habitats that allow floodplain inundation to occur approximately every 2 years.

Strategy 4-3B. Determine pre-settlement riparian corridor.

Strategy 4-3C. Restore and conserve historic riparian corridor.

Strategy 4-3D. Monitor the proportion of riparian area that currently exists verses historic and function.

Hypothesis 5: Survival for all life stages of Chinook, steelhead, and sockeye will increase by restoring proper passage conditions at human made barriers and irrigation withdrawals.

Objective 5-1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Strategy 5-1A. Prevent new passage problems by restricting the placement of new roads or providing adequate mitigation for unavoidable impacts.

Strategy 5-1B. Design and construct road culverts and screens consistent with standards and guidelines.

Strategy 5-1C. Prevent the placement of dikes and other structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 5-1D. Use permits or other local, state and federal approval mechanisms to impose design and construction restrictions on activities that may impede fish passage and access.

Strategy 5-1E. Remove, modify or replace culverts and or screens that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity.

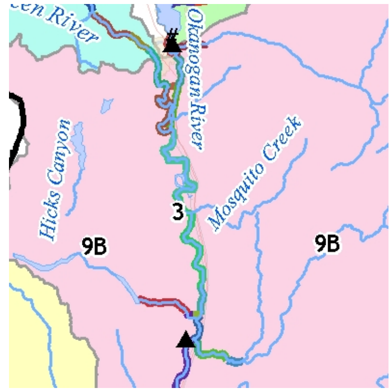
Strategy 5-1F. Remove, replace or modify diversion dams identified as major limiting factors affecting fish passage and habitat connectivity. Strategy 5-1G. Use cost-sharing programs to help landowners screen diversions.
DATA GAPS AND M&E NEEDS: Monitor ongoing TMDL for toxics (DOE, EPA) Embeddedness Mainstem effects from changes to hydrograph Acquire targeted empirical habitat data through coordinated, subbasin-wide M&E effort. Increase fish monitoring for abundance and habitat use

ASSESSMENT UNIT: O3—Okanogan Upper

REACHES: 9

(US reaches only. See Canadian AU's for additional reaches in upper watershed)

25	26a	26b	27	28	Bf1	29	30	31



FOCAL species: Sockeye salmon, summer/fall Chinook salmon, and steelhead.

Drainage area: Approximately 17 river miles.

SUBWATERSHEDS Antoine, Whitestone, Similkameen, Ninemile, Tonasket, Lake Osoyoos.

ASSESSMENT UNIT DESCRIPTION: This AU begins at the mouth of Antoine Creek and ends at Lake Osoyoos. The Lake is divided up into three basins, the South, Central and North. The South basin is a shared US/Canada AU and is characterized by shallow, silted and marsh lands. Human impacts along the shoreline and as non-point source pollution are high. The lake is controlled by Zosel dam. The state of Washington (DOE) owns the dam and the Oroville Tonasket Irrigation District manages the water plan and the releases out of Osoyoos Lake. High thermal input, with relatively low sediment transport and load, is documented from the Lake and the effects are seen 9-10 miles downstream into this AU. The Similkameen river joins the Okanogan mainstem in this AU and is characterized by cool water input, but with high sediment, transport and load. A distinct mixing zone can be delineated by the recent TIR/LIDAR data collected by the Colville Tribes. The lower and middle sections of the AU (moving south to north) are characterized by confined channels caused by: 1. HWY 97, 2. RR beds, and 3. diking.

LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.

FACTORS LIMITING PRODUCTION:

P-Natural reproduction in this AU is threatened by abundant hatchery production returns

P-Habitat Diversity (loss of sinuosity, length etc.). Middle reaches

P-Sediment where influence of Similkameen input dictates.

P-Channel simplification is pervasive in middle AU and in lower reaches of this AU

P-Loss of connectivity to floodplain in middle reaches

S-Temperature (major source is upper basin)

S-Predation (model artifact in many cases, but large predator populations do exist)

S-Chemical (from Osoyoos?)

Refer to Appendix B for reference and specific detail by reach and species

Working Hypotheses and Focal Species Conservation and Rehabilitation Alternatives:

Hypothesis 1: Protecting existing spawning habitats from degradation and hatchery super-imposition will ensure continued recruitment of native summer/fall Chinook in the Okanogan River.

Objective 1-1: Increase and monitor natural production of summer/fall Chinook above existing levels.

Strategy 1-1A. Monitor redd counts in assessment unit annually and compare trends to established baseline.

Strategy 1-1B. Develop tribal and recreational harvest opportunities that selectively harvest excess hatchery production of summer/fall Chinook.

Strategy 1-1C. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase channel complexity and expand suitable spawning habitats.

Objective 1-2: Protect all existing spawning areas for summer/fall Chinook.

Strategy 1-2A. Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat salmon.

Strategy 1-2B. Establish and protect riparian buffers using regulatory and incentive mechanisms provided in Critical Area Ordinances, shoreline master programs, forest practices regulations, farm conservation plans and other programs to protect spawning habitat for summer/fall Chinook.

Strategy 1-2C. Regulate or restrict shoreline uses, forest practices, land conversion, rural and urban development and other activities within riparian zones;

Strategy 1-2D. Acquire priority riparian areas through purchase; conservation easements; and transfer of timber, farm, grazing or land development rights

Strategy 1-2E. Provide incentives and compensation to landowners to retain buffers.

Hypothesis 2: Increasing habitat diversity (riparian function, LWD, man-made confinement) will increase survival of summer Chinook in the following life stages a) spawning b) prespawn holding c) fry colonization. Summer steelhead survival will increase in the following life stages a) spawning b) fry colonization c) age 0-2 juvenile rearing.

Objective 2-1: Protect and restore floodplain connectivity along an additional 10% of the assessment unit where feasible to establish aquatic/terrestrial nutrient exchange processes allowing floodplain inundation every 2-years on average.

Strategy 2-1A. Remove diking, reestablish back channels, reslope vertical banks, and establish wetland habitats that allow floodplain inundation to occur approximately every 2 years.

Strategy 2-1B. Conduct a channel migration corridor study and monitor trends.

Strategy 2-1C. Protect and re-establish ground-water sources.

Strategy 2-1D. Protect and re-establish all ground-water sources.

Strategy 2-1E. Measures and actions designed to address flows, hydrology, sediment loading and riparian zones (e.g., forest practices regulations, protection of agricultural, rural and urban riparian zones, minimizing road constructions, etc.) are likely to result in improved channel complexity and habitat connectivity.

Strategy 2-1F. Restrict or condition new development to be consistent with shoreline management guidelines, local Critical Area Ordinances and development regulations, hydraulic project approval and other state and/or local regulations or permits.

Strategy 2-1G. Establish and protect riparian buffers using regulatory and incentive mechanisms provided in Critical Area Ordinances, shoreline master programs, forest practices regulations, farm conservation plans and other programs to avoid or minimize removal of native vegetation

Strategy 2-1H. Acquire priority riparian areas through purchase; conservation easements; and transfer of timber, farm, grazing or land development rights

Strategy 2-1I. Provide incentives and compensation to landowners to retain buffers.

Hypothesis 3: Fine sediment reduction throughout the Okanogan subbasin and increased bank stability will increase residual pool depth and reduce width to depth ratios. (Direct activities in this assessment unit are likely to produce only limited benefits) The following life stages would benefit from these actives: incubation, rearing, prespawn holding and rearing mainly for Chinook and steelhead, but possibly migration for sockeye.

Objective 3-1. Reestablish normative width to depth ratios of 10:1.

Strategy 3-1A. Establish baseline for existing width to depth ratio.

Strategy 3-1B. Monitor width to depth ratios annually and evaluate trends.

Strategy 3-1C. Reslope vertical banks and reestablish riparian plant communities

Strategy 3-1D. Stabilize sloughing banks using soft techniques wherever possible and armoring when necessary.

Strategy 3-1E. Use barb and bail techniques to manage sediment loads and move channel away from sensitive banks and reestablish plant communities.

Strategy 3-1F. Limit grazing access to the riparian corridor and minimize the time that these areas can be used.

Strategy 3-1G. Increase the amount of flood prone areas to reduce lateral scour and flow volume in main channel.

Objective 3-2. Increase residual pool depth by 10% in this assessment unit to evaluate subbasin wide fine sediment reduction strategies.

Strategy 3-2A. Establish baseline for residual pool depths.

Strategy 3-2B. Monitor residual pool depths annually and evaluate trends.

Strategy 3-2C. Conduct sediment reduction strategies throughout the Okanogan subbasin especially in the upper portions of the watershed and the Similkameen River watershed specifically.

Strategy 3-2D. Install habitat boulders and artificial log-jams that provide large interstitial spaces providing juvenile hiding cover and current breaks for per-spawn migrant holding areas.

Strategy 3-2E. Improve riparian habitats with the potential to contribute to future LWD recruitment.

Strategy 3-2F. Install Newberry riffles or rock vortex structures to increase water velocities and gravel recruitment in select areas.

Hypothesis 4: Adult enumeration of salmon and steelhead is critical in this AU will determine the proportion of adults returning to the Okanogan subbasin verses other subbasins located above Wells Dam. *(Note: This has been an acknowledged data gap for many years).*

Objective 4-1.Evaluate and monitor the trend in adult returns to the Okanogan subbasin as a method to determine the cumulative success or failure of proposed actions.

Strategy 4-1A. Establish a counting station to monitor migrating adult salmonids (e.g., Zosel dam).

Strategy 4-1B. Monitor adult salmonid returns annually, determine a baseline, and evaluate trends.

Strategy 4-1C. Coordinate data sharing with all agencies with management authority to provide information for adaptive management.

Hypothesis 5: Survival for all life stages of Chinook, steelhead, and sockeye will increase by restoring proper passage conditions at human made barriers and irrigation withdrawals.

Objective 5-1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Strategy 5-1A. Prevent new passage problems by restricting the placement of new roads or providing adequate mitigation for unavoidable impacts.

Strategy 5-1B. Design and construct road culverts and screens consistent with standards and guidelines.

Strategy 5-1C. Prevent the placement of dikes and other structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries.

Strategy 5-1D. Use permits or other local, state and federal approval mechanisms to impose design and construction restrictions on activities that may impede fish passage and access.

Strategy 5-1E. Remove, modify or replace culverts and or screens that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity.

Strategy 5-1F. Remove, replace or modify diversion dams identified as major limiting factors affecting fish passage and habitat connectivity.

Strategy 5-1G. Use cost-sharing programs to help landowners screen diversions.

DATA GAPS AND M&E NEEDS:

Predation and pathogen information is lacking and the EDT models' assumptions are course scale at best

Predator population and consumption rates

Water quality

Heat budget from Osoyoos

Sediment budget from Similkameen

Invasive species (aquatic and terrestrial plant. Exotic fish species also

Water quality in Osoyoos (septic)

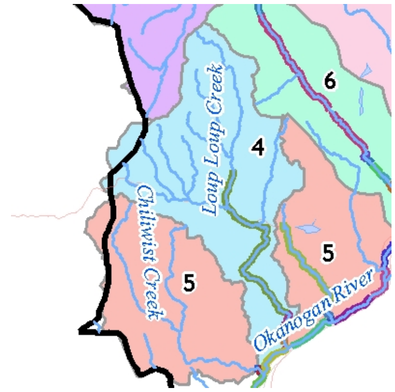
Abundance and distribution run timing etc.

Adult salmonid enumeration to establish a count of fish destined for Canada.

ASSESSMENT UNIT: O4—Loup Loup

REACHES: 10

1	2	3	4	5	6	7	8	9



FOCAL species: Sockeye salmon, summer/fall chinook salmon, and steelhead.

Drainage area: 40,868 acres

SUBWATERSHEDS: Little Loup Loup

ASSESSMENT UNIT DESCRIPTION: Loup Loup Creek is a tributary of the Okanogan River and enters the river at RM 16.9, in the small community of Malott, WA. Nearly the entire watershed (40,868 acres) is categorized as forested (86.5%). Peak elevation is approximately 1,700 feet. Land ownership includes the Bureau of Land Management (BLM), Washington Department of Natural Resources (WDNR), United States Forest Service (USFS) and private owners, with WDNR responsible for managing 31,506 acres. Approximately 3,500 acre-feet of Loup Loup Creek is annually diverted into Leader Lake, a storage reservoir used for irrigation. Another irrigation diversion is located at ~ RM 2.0. Typically, due to water withdrawals, the lower reach of Loup Loup Creek is dry by mid-summer. The lower reaches extend from the confluence to the base of a pair of falls approximately 12 feet high at ~ RM 2.5. These falls were likely the extent of the historical range of steelhead in Loup Loup Creek. The upper reach extends from the falls to the headwaters of Loup Loup Creek. Barriers include a road culvert at Hwy 97, the Ralston diversion dam and the falls.

LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.

FACTORS LIMITING PRODUCTION:

P-Habitat Quantity

P-Flow

P-Habitat Diversity

P-Obstructions

Refer to Appendix B for reference and specific detail by reach and species

Working Hypotheses and Focal Species Conservation and Rehabilitation Alternatives:

Hypothesis 1: Removing obstructions and enhancing flows in this tributary will increase habitat quantity and survival for steelhead in the following life history stages: a. spawning, b. rearing, and c: active migration for both juveniles and adults.

Objective 1-1. Monitor, protect and increase stream discharge during April and May to a minimum of 14 cfs for migration and spawning of adult fish and protect and increase flows all months other than April and May to a minimum of 1-2 cfs for juvenile rearing.

Strategy 1-1A Protect and maintain established in-stream flows by monitoring water use and enforcing laws and regulations.

Strategy 1-1B Administer groundwater and surface water right permits and changes consistent with the established in-stream flow.

Strategy 1-1C Protect groundwater recharge areas from impacts of land development by designating and protecting agricultural, forest and other resource lands and critical areas.

Strategy 1-1D Conduct comprehensive in-stream flow study.

Strategy 1-1E Pursue methods to acquire permanent water rights for in-stream use (i.e. water banking, lease, purchase and trust water donations).

Strategy 1-1F Develop programs that assist water users and promotes the efficient use of water.

Strategy 1-1G Develop programs that assist water users and promotes the efficient use of water.

Strategy 1-1H Implement activities that promote water storage and groundwater recharge that collective add to existing in-stream flows.

Strategy 1-1I Develop, operate, and maintain and monitor real-time monitoring station to monitor stream discharge and other water quality parameters.

Objective 1-2. Remove all identified fish passage barriers below the natural falls by 2015.

Strategy 1-2A. Remove, modify or replace culverts and or screens that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity.

Strategy 1-2B. Remove, replace or modify diversion dams identified as major limiting factors affecting fish passage and habitat connectivity.

Strategy 1-2C. Use cost-sharing programs to help landowners screen diversions.

Strategy 1-2D. Address fish passage and screening concerns, as much as possible, in other restoration and protection efforts. Ensure effective operation and maintenance of culverts and other in-stream structures

Strategy 1-2E. New stream crossing structure designs should meet or exceed design criteria provided through WDFW in the Aquatic Habitat Guidelines guidance documents.

Strategy 1-2F. Monitor and evaluate passage project effectiveness.

Hypothesis 2: Increasing habitat diversity throughout the AU will increase survival for Chinook, steelhead and sockeye in the following life stages: Zero age active rearing, prespawn migrant and prespawn holding for summer/fall, spring Chinook, steelhead and sockeye plus increase spawning distribution for summer/fall Chinook.

Objective 2-1. Protect and enhance rearing and spawning habitat by 10% for steelhead using in-stream structures and riparian area restoration.

Strategy 2-1A. Install habitat boulders and artificial log-jams that provide large interstitial spaces providing juvenile hiding cover and current breaks for per-spawn migrant holding areas.

Strategy 2-1B. Restore riparian habitats with the potential to contribute to future LWD recruitment and promote stream channel shading.

Strategy 2-1C. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase, channel complexity, gravel recruitment, and pool formation processes.

Strategy 2-1D. Install Newberry riffles or rock vortex structures to increase water velocities and gravel recruitment in select areas.

Strategy 2-1E. Develop watershed plan to enhance water quantity, quality, and fish habitat.

Hypothesis 3: Artificial production (supplementation) provides an increase in fish population numbers and is required to meet tribal trust responsibilities, provide harvestable surplus for people of this region, and to aid in salmon and steelhead recovery efforts because of population decreases caused by habitat loss, main-stem Columbia River dams, and downriver harvest activities. (Hatchery activities should be consistent with approved Hatchery Genetic Management Plans and the artificial production section of this plan)

Objective 3-1. Improve population numbers of summer steelhead by 50% above current levels.

Strategy 3-1A. Use scatter plants of summer steelhead to enhance returns to Loup-loup Creek and improve selective harvest opportunities along the main-stem Okanogan River.

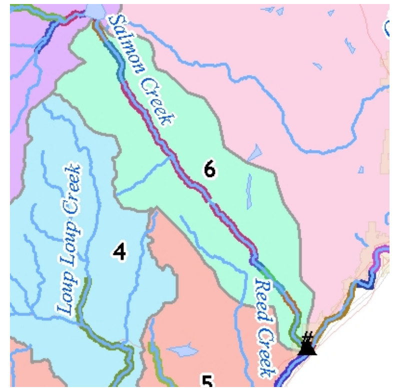
Strategy 3-1B. Expand, operate, and maintain artificial production capacity at levels necessary to meet management needs for

locally adapted summer steelhead. Strategy 3-1C. Operate and maintain weir sites to collect locally adapted broodstock and Monitor adult salmonid returns annually, determine a baseline, and evaluate trends. Strategy 3-1D. Determine baseline redd counts for summer steelhead and evaluate trends over time to aid in management decisions and evaluate changes in habitat utilization.
DATA GAPS AND M&E NEEDS: Habitat Surveys Water rights survey and enforcement Adult summer steelhead return enumeration and juvenile production estimates

ASSESSMENT UNIT: O6—Lower Salmon Creek

REACHES: 10

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**



FOCAL species: Summer/fall, spring Chinook salmon, and steelhead.

Drainage area: 17,920 acres

SUBWATERSHEDS Watercress Springs (groundwater input)

ASSESSMENT UNIT DESCRIPTION: Salmon Creek is a perennial tributary of the Okanogan River with a total watershed area of about 167 square miles. It enters the Okanogan River at the town of Okanogan. Mountains surround Salmon Creek forming its hydrologic divides. The basin is generally oriented on a northwest-southeast axis, with a broad upper watershed about 8 to 10 miles wide and 12 to 15 miles long. The North Fork, West Fork, and South Fork of Salmon Creek converge at Conconully draining the 119 square-mile upper Salmon watershed. This portion of watershed is inaccessible to anadromous fish because of Conconully Dam and Reservoir. Conconully Dam is approximately 15 miles upstream from the mouth of Salmon Creek. Although data or written references are unavailable to define historic use of the upper watershed by anadromous salmonids, professional opinion is that it was probably limited to less than three miles above the damsite.

The Okanogan Irrigation District (OID) manages Conconully Reservoir to serve District lands east of the watershed. Controlled releases for irrigation deliveries are made from Conconully Reservoir between April and October. These releases are conveyed through 11 miles of natural and modified stream channel (referred to as the middle reach of Salmon Creek) to the OID diversion dam, located 4.3 stream miles above the mouth of Salmon Creek. For more than eighty years, the 4.3 miles of Salmon Creek downstream of the OID diversion dam (referred to as lower Salmon Creek), have been dewatered, except during snowmelt events that result in uncontrolled spill at the OID diversion dam.

LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.

FACTORS LIMITING PRODUCTION:

NOTE: Most apply to reaches below Watercress Springs

P-Obstructions

P-Channel Stability

P-Flow

P-Habitat Quantity

P-Habitat Diversity

S-Temperature

S-Oxygen (general water quality issues including low DO etc for trapped fish)

NOTE: Apply to reaches above OID diversion

S-Sediment

P-Habitat Quantity P-Flow (overwintering) P-Habitat Diversity Refer to Appendix B; for reference and specific detail by reach and species
Working Hypotheses and Focal Species Conservation and Rehabilitation Alternatives: Hypothesis 1: Removal or modification of the fish passage barriers will increase habitat quantity available and survival of spring Chinook and steelhead in the adult spawning, migration, and juvenile rearing life stages. Objective 1-1: Increase the linear distance available for salmon production (spawning areas and juvenile rearing areas) as measured by the passage design criteria. Strategy 1-1A. Provide water for adult fish passage, over-winter rearing, and juvenile out-migration (below OID) Strategy 1-1B. Channel rehabilitation from Watercress to mouth Strategy 1-1C. Stabilize landfill areas below Watercress Objective 1-2: Increasing the overall abundance of salmon upstream of the OID diversion by 20 percent or more (e.g., "the number of Chinook per mile and the number of redds per mile will increase relative to the control sites downstream.") Strategy 1-2A. Reconnect reaches to floodplain Strategy 1-2B. Grade control structures where high energy is eroding bank Strategy 1-2C. Design for unimpeded passage at mouth Strategy 1-2D. Protect high quality habitats including areas of groundwater input Strategy 1-2E. Reestablish and/or improve existing riparian areas Hypothesis 2: Implementing a set of rehabilitative treatments will provide access to higher quality habitats above the OID diversion for all life stages of steelhead and spring Chinook. Objective 2-1. Provide fish passage through the degraded reach below the OID diversion dam, to access the higher quality habitat between the diversion dam and Conconully Lake Level 1. Effective if design criteria are met for 80 percent of the removal action on Year 5 (i.e., no statistical test), and; Level 2. Effective if a change of 20 percent or more is detected for salmon abundance of either adults, redds, or juveniles between the calculated difference between the paired impact and control areas by Year 5 at the Alpha =0.05 level. Strategy 2-1A. Implement EIS recommended rehabilitation flows for steelhead and spring Chinook in the lower and middle reaches of Salmon Creek as defined by the EIS Appendix B. Strategy 2-1B. Steam Rehabilitation Treatments/Strategies Strategy 2-1C. Channel preservation-No direct action. Preservation of existing channel alignment, bank conditions, in-channel habitat, and floodplain areas. Hypothesis 3: Protecting and improving habitat diversity, especially in the reaches above the OID diversion dam of this AU, will maintain survival for spring, Chinook and steelhead for all life stages and for rearing summer/fall Chinook near the mouth.

Objective 3-1. Protect intact riparian and flood plain function

Strategy 3-1A. Implement BMPs for land use and development

Strategy 3-1B. Create full-scale coordinated resource management plans (irrigation needs, fish needs, human population needs, recovery needs under ESA and other management plans).

Strategy 3-1C. Top of bank/levee recontouring-Locally remove artificially raised top of banks/levees to reestablish the channel's floodplain connection where consistent with adjacent landowner needs. No change to channel alignment or in-channel habitat. Assumes no net impact or export of material.

Objective 3-2. Increase riparian and flood plain function to at least 80 percent of normative in those areas (~50 percent of the total area) in the first five years to reach LWD 20 pieces/mi, pool frequency ratios of 56-96/mile, etc.

Strategy 3-2A. Bank protection-Use geo-technical and/or bio-stabilization materials to protect banks from erosive high flows. No change to channel alignment, in-channel habitat, or floodplain connection.

Strategy 3-2B. Bank protection and bed improvements-Use geo-technical and/or bio-stabilization materials to protect banks from erosive high flows and constrict low flow channel width. Use excavator to reconfigure bed geometry to create a low-flow channel for fish passage. No change to channel alignment or floodplain connection.

Strategy 3-2C. Bank, bed, and floodplain modification-Use geo-technical and/or bio-stabilization materials to protect banks from erosive high flows and constrict low flow channel width. Use excavator to reconfigure bed geometry to create a low-flow channel for fish passage. Use local cut and fill to contour portions of leveed or terraced banks to reestablish the channel's floodplain connection. No change to channel alignment.

Strategy 3-2D. Full channel reconstruction-Use geo-technical and/or bio-stabilization materials to protect banks from erosive high flows and constrict low flow channel width. Use excavator to construct a new channel along a new alignment, reduce channel width, and define a low-flow channel for fish passage. Use local cut and fill to contour leveed or terraced banks and construct a connected floodplain. Note: 1) Geo-technical includes actions such as placement of large, angular rock at the toe of banks, construction of rock walls, and geo-textiles. 2) Bio-stabilization includes re-vegetating with treatments such as plant stakings and vegetation mats.

Note: additional information and alternatives will be available and reviewed in 2004 from ongoing EIS process in Salmon Creek.

DATA GAPS AND M&E NEEDS:

Basin hydrology

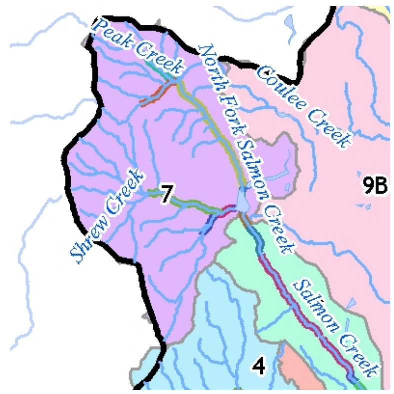
Habitat use for all species

Fish Population monitoring (applies to all other tributaries and mainstem)

ASSESSMENT UNIT: O7—Upper Salmon Creek and Tributaries

REACHES: 12

40	**41**	**42**	**43**	**44**	**45**
46	**47**	**48**	**49**	**50**	**51**



FOCAL species: Summer/fall Chinook salmon, sockeye, and steelhead. Kokanee are present in Conconully Reservoir (not stocked on an annual basis). West Slope cutthroat are present and bull trout have been known to occur).

Drainage area: 97,808 acres

SUBWATERSHEDS: West Fork, South Fork, North Fork and Pelican Creek

ASSESSMENT UNIT DESCRIPTION:

Salmon Creek is a perennial tributary of the Okanogan River with a total watershed area of about 167 square miles. It enters the Okanogan River at the town of Okanogan. Mountains surround Salmon Creek forming its hydrologic divides. The basin is generally oriented on a northwest-southeast axis, with a broad upper watershed about 8 to 10 miles wide and 12 to 15 miles long. The North Fork, West Fork, and South Fork of Salmon Creek converge at Conconully draining the 119 square-mile upper Salmon watershed. This portion of watershed is inaccessible to anadromous fish because of Conconully Dam and Reservoir. Conconully Dam is approximately 15 miles upstream from the mouth of Salmon Creek. Although data or written references are unavailable to define historic use of the upper watershed by anadromous salmonids, professional opinion is that it was probably limited to less than three miles above the damsite.

The Okanogan Irrigation District (OID) manages Conconully Reservoir to serve District lands east of the watershed. Controlled releases for irrigation deliveries are made from Conconully Reservoir between April and October. These releases are conveyed through 11 miles of natural and modified stream channel (referred to as the middle reach of Salmon Creek) to the OID diversion dam, located 4.3 stream miles above the mouth of Salmon Creek. For more than eighty years, the 4.3 miles of Salmon Creek downstream of the OID diversion dam (referred to as lower Salmon Creek), have been dewatered, except during snowmelt events that result in uncontrolled spill at the OID diversion dam.

LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.

FACTORS LIMITING PRODUCTION:

P-Habitat Diversity

S-Temperature

S-Sediment

S-Flow (some minor diversions, but on naturally nominal flows)

Extensive mining in area, but no data to identify effects (implication for “chemical” as a possible LF)

Refer to Appendix B for reference and specific detail by reach and species

Working Hypotheses and Focal Species Conservation and Rehabilitation Alternatives:

Hypothesis 1: Increasing habitat diversity throughout the AU will increase survival for Chinook, steelhead, Kokanee and cutthroat in the following life stages: Zero age active rearing, prespawn migrant and prespawn holding for Chinook, steelhead and Kokanee. (Bull trout may have historically occurred here)

Objective 2-1. Protect and enhance rearing and spawning habitat by 10% for salmonids by using in-stream structures, disconnected floodplain and riparian area restoration.

Strategy 2-1A. Install habitat boulders and artificial log-jams that provide large interstitial spaces providing juvenile hiding cover and current breaks for per-spawn migrant holding areas.

Strategy 2-1B. Restore riparian habitats with the potential to contribute to future LWD recruitment and promote stream channel shading.

Strategy 2-1C. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase, channel complexity, gravel recruitment, and pool formation processes.

Strategy 2-1D. Install Newberry riffles or rock vortex structures to increase water velocities and gravel recruitment in select areas.

Strategy 2-1E. Develop watershed plan to enhance water quantity, quality, and fish habitat

Hypothesis 2: Implementing livestock exclusion structures and strategies will increase bank stabilization, riparian function and water quality for all life history stages for steelhead, bull trout and other resident fish species.

Objective 2-1. Expand current efforts to exclude livestock from the stream and riparian areas in this AU or relocate and harden livestock crossings to reduce impacts and achieve PFC for all habitat conditions.

Strategy 2-A. Install and maintain fencing or fish friendly stream crossing structures to prevent livestock access to riparian zones and streams

Hypothesis 3: Reducing overall road density will decrease sediment input into the stream and increase survival at incubation and rearing life stages. Lowered sediment input will also reduce the occurrence of culvert failures in the watershed while culvert replacement programs are fully implemented.

Objective 3-1. Achieve an overall road density of 2-3 miles/sq. mile with roads located in valley bottoms only were other options do not exist.

Strategy 3-A. Implement a road maintenance schedule to prevent and mitigate sediment impacts

Strategy 3-B. Remove, reconstruct or upgrade roads that are vulnerable to failure due to design or location

Strategy 3-C. Implement road maintenance and abandonment or decommissioning plans approved under forest practices regulations;

Strategy 3-C. Upgrade stream crossing, culverts and road drainage systems;

Strategy 3-D. Reconnect floodplains through dike removal or breaching;

Strategy 3-E. Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides

Strategy 3-F. Construct detention and infiltration ponds to capture runoff from roads, development, farms and irrigation return flows

Strategy 3-G. Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

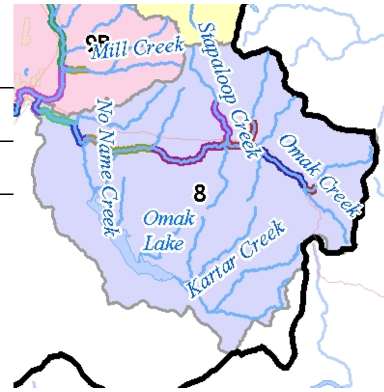
Hypothesis 4: Improve development and water and recreational use programs around and adjacent to both Conconully Reservoir and Salmon Lake will protect possible sockeye and Kokanee spawning and rearing habitat and protect resident fish species habitats.

Objective 4-1. Manage development and recreational use, implement water use strategies, and improve water quality to PFC levels for salmonid species. Strategy 4-A. Restrict or condition new development to be consistent with shoreline management guidelines, local Critical Area Ordinances and development regulations, hydraulic project approval and other state and/or local regulations or permits Strategy 4-B. Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat salmon Strategy 4-C. Avoid or mitigate adverse impacts of upland development where it has the potential to adversely impact channel conditions, such as when the removal of vegetation and improper drainage result in erosion and the need for shoreline stabilization structures. Strategy 4-D. Establish and protect riparian buffers using regulatory and incentive mechanisms provided in Critical Area Ordinances, shoreline master programs, forest practices regulations, farm conservation plans and other programs to avoid or minimize removal of native vegetation Strategy 4- E. Rehabilitate areas where mining activities are found to have altered chemistry and/or channel structure.
DATA GAPS AND M&E NEEDS: Extensive mining in area, but no data to identify effects Fish distribution, abundance and use for Westslope Effects of SF, NF roads on channels

ASSESSMENT UNIT: O8—Omak Creek and Tributaries

REACHES: 24

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
12	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
23										



FOCAL species: Sockeye salmon, summer/fall chinook salmon, and steelhead.

Drainage area: 90,683 acres

SUBWATERSHEDS: Trail, Swimpkin, Stapaloop.

ASSESSMENT UNIT DESCRIPTION:

Omak Creek is a fourth order tributary of the Okanogan River that flows into the mainstem at RM 31. Of the 90,683 acres in this watershed, 73,029 acres are owned and managed by the Colville Tribes (NRCS 1995). Elevations within the sub-basin range from 860 feet above sea level at the Omak confluence with the Okanogan River, to 6,774 feet at Moses Mountain. The climate of the sub-basin varies from arid to montaine, with an average annual precipitation of 12 inches in the lower elevations to over 45 inches at Moses Mountain. Average daily temperatures range from 23^{o} F in winter to 70^{o} F in the summer. The average growing-season in the watershed lasts 120 days.

LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.

FACTORS LIMITING PRODUCTION:

P-Population supplementation to aid in recovery (Summer steelhead and spck)

P-Sediment (road density). Good studies.

P-Channel stability

S-Habitat Diversity, P-spck

S-Predation in some reaches

P-Obstructions (especially at Mission Falls), others at culverts

P-Habitat Quantity (Primary in Stappaloop, Swimptkin, first reach of Trail. NOTE: Some "quantity" gain as a result of increased width from sediment input—therefore gain in quantity should not always be considered good)

S-Flow, but cumulative, P-spck in summer (prespawn migrants)

S-Food (generally low in tributaries, also noting low carcass)

Refer to Appendix *B* for reference and specific detail by reach and species

See Table X for list Priority Ranking

Working Hypotheses and Focal Species Conservation and Rehabilitation Alternatives:

Hypothesis 1: Increase habitat diversity (riparian function, LWD, confinement will increase survival of steelhead and spring Chinook in the following life stages: a) spawning , b) egg incubation, c) fry colonization , and d) rearing.

Objective 1-1: Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation, large woody debris, and connectivity to the floodplain, and off channel habitat).

Strategy 1-1A. Improve riparian habitats with the potential to contribute to future LWD recruitment.

Strategy 1-1B. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase LWD deposition, channel complexity and riparian areas.

Strategy 1-1C. Implement BMPs for general land use and development (e.g., timber and range lands)

Strategy 1-1D. Restrict or condition new development to be consistent with shoreline management guidelines, local Critical Area Ordinances and development regulations, hydraulic project approval and other Tribal and/or local regulations or permits

Strategy 1-1E. Replace invasive or non-native vegetation with native vegetation

Strategy 1-1F. Replant degraded riparian zones by reestablishing native vegetation

Strategy 1-1G. Install and maintain fencing or fish friendly stream crossing structures to prevent livestock access to riparian zones and streams

Strategy 1-1H. Acquire priority riparian areas through purchase; conservation easements; and transfer of timber, farm, grazing or land development rights

Objective 1-2: For large woody debris, reach or exceed 20 pieces/mi (12” dia. And 35’ long) with adequate recruitment potential. This represents properly functioning condition for large woody debris in Eastern Washington (Bjorn and Reiser 1995).

Strategy 1-2A. Establish and protect riparian buffers using regulatory and incentive mechanisms provided in Critical Area Ordinances, shoreline master programs, forest practices regulations, farm conservation plans and other programs to avoid or minimize removal of native vegetation

Strategy 1-2B. Regulate or restrict shoreline uses, forest practices, land conversion, rural and urban development and other activities within riparian zones;

Strategy 1-2C. Acquire priority riparian areas through purchase; conservation easements; and transfer of timber, farm, grazing or land development rights

Strategy 1-2D. Provide incentives and compensation to landowners to retain buffers.

Strategy 1-2E. Measures and actions designed to restore stream flows, sediment loading and riparian zones – such as removing or breaching dikes and levees, managing stormwater and runoff, maintaining or abandoning roads, restoring wetlands, floodplain processes and functions, restoring fish passage, etc. – are likely to result in improved channel complexity and habitat connectivity.

Strategy 1-2F. Add large woody debris and place in-channel engineered log jams

Strategy 1-2G. Restore and reconnect wetlands and floodplains to the riverine system.

Strategy 1-2H. Restore nutrients lost to the food chain because of decline in salmon populations; for instance, placement of salmon carcasses or otherwise returning adult salmon to the watershed.

Hypothesis 2: Survival for all life stages of steelhead will increase and habitat quantity will expand by restoring proper passage conditions at human made barriers (i.e. Mission Falls, HWY 155 crossings).

Objective 2-1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Strategy 2-1A. Prevent new passage problems by restricting the placement of new roads or providing adequate mitigation for unavoidable impacts.

Strategy 2-1B. Design and construct road culverts consistent with established standards and guidelines.

Strategy 2-1C. Prevent the placement of dikes and other structures that may confine or restrict side channels and disconnect habitat in floodplains.

Strategy 2-1D. Use permits or other local, tribal and federal approval mechanisms to impose design and construction restrictions on activities that may impede fish passage and access.

Strategy 2-1E. Remove, modify or replace culverts that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity.

Strategy 2-1F. Continue to improve passage at Mission Falls and address culverts in priority order (likely Stapaloop first since this is the largest Sub watershed. Trail next and then Swimptkin)

Hypothesis 3: Fine sediment reduction and increased bank stability will reduce width to depth ratios and increase residual pool depth. The following life stages would benefit from these actives: incubation, rearing, prespawn holding and rearing for Chinook and steelhead.

Objective 3-1. Increase residual pool depth by 10% in this assessment unit to evaluate subbasin wide fine sediment reduction strategies.

Strategy 3-1A. Establish baseline for residual pool depths.

Strategy 3-1B. Monitor residual pool depths annually and evaluate trends.

Strategy 3-1D. Install habitat boulders and artificial log-jams that provide large interstitial spaces providing juvenile hiding cover and current breaks for per-spawn migrant holding areas.

Strategy 3-1E. Improve riparian habitats with the potential to contribute to future LWD recruitment.

Strategy 3-1F. Install Newberry riffles or rock vortex structures to increase water velocities and gravel recruitment in select areas.

Strategy 3-1G. Implement a road maintenance schedule to prevent and mitigate sediment impacts

Strategy 3-1H. Remove, reconstruct or upgrade roads that are vulnerable to failure due to design or location

Strategy 3-1I. Implement road maintenance and abandonment or decommissioning plans approved under forest practices regulations.

Strategy 3-1J. Educate timber harvesters, transportation engineers, political officials, planners, and others on the needs to reduce fine sediments in the Omak Creek watershed.

Strategy 3-1K. Monitor changes in sediment recruitment in the Omak Creek watershed using embeddedness indices, V-star analysis.

Strategy 3-1L. Decrease sediment delivery from upland practices through expanded use of conservation tillage, sediment basins, CRP participation, mowing of road shoulders in place of herbicide use, vegetative buffers on road shoulders, and other practices.

Strategy 3-1M. Conduct road survey and sediment source survey throughout the watershed to determine priority action areas and establish a GIS layer for future land use activity planning.

Objective 3-2. Reestablish normative width to depth ratios of 10:1.

Strategy 3-2A. Restrict development, road construction, logging and intensive farming in areas with high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 3-2B. Minimize total road density to less than 3 miles/square mile within the watershed and provide adequate drainage control for new roads.

Strategy 3-2C. Protect geologically hazardous areas, such as unstable slopes, and riparian zones through critical areas ordinances and zoning regulations.

Strategy 3-2D. Implement best management farm practices, and nonpoint source control techniques for urban areas.

Strategy 3-2E. Avoid road construction and soil disturbance in proximity to riparian areas, wetlands, unstable slopes, and areas where sediment related degradation has been identified

Strategy 3-2F. Maintain drainage ditches, culverts and other drainage structures to prevent clogging with debris and sediments.

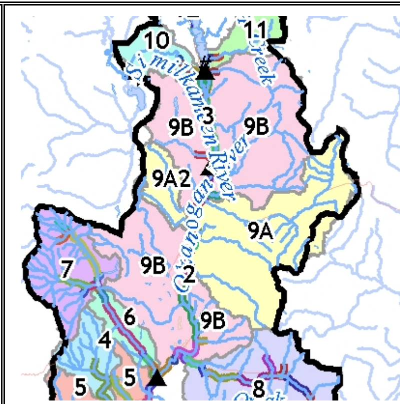
Strategy 3-2G. Reslope vertical banks and reestablish riparian plant communities

Strategy 3-2H. Stabilize sloughing banks using soft techniques wherever possible and armoring when necessary. Strategy 3-2I. Use barb and bail techniques to manage sediment loads and move channel away from sensitive banks and reestablish plant communities. Strategy 3-2J. Limit grazing access to the riparian corridor and minimize the time that these areas can be used. Strategy 3-2K. Increase the amount of flood prone areas to reduce lateral scour and flow volume in main channel. Hypothesis 4: Artificial production (supplementation) provides an increase in fish population numbers and is required to meet tribal trust responsibilities, provide harvestable surplus for people of this region, and to aid in salmon and steelhead recovery efforts because of population decreases caused by habitat loss, main-stem Columbia River dams, and downriver harvest activities. (Hatchery activities should be consistent with approved Hatchery Genetic Management Plans and the artificial production section of this plan) Objective 4-1. Improve population numbers of summer steelhead and Chinook by 50% above current levels. Strategy 4-1A. Operate and maintain the Saint Mary Mission spring Chinook acclimation site and continue efforts to reintroduce spring Chinook back into Omak Creek. Strategy 4-1B. Expand, operate, and maintain artificial production capacity (Cassimar Bar Hatchery) at levels necessary to meet management needs for locally adapted summer steelhead. Strategy 4-1C. Operate and maintain a weir site on Omak Creek to collect locally adapted broodstock and Monitor adult salmonid returns annually, determine a baseline, and evaluate trends. Strategy 4-1D. Expand locally adapted broodstock program to include other Okanogan River tributaries if results indicate enhanced survival and returns compared to other stocks of summer steelhead as evaluated through pit-tag studies. Strategy 4-1E. Determine baseline redd counts for spring Chinook and summer steelhead and evaluate trends over time to aid in management decisions and evaluate changes in habitat utilization. Strategy 4-1F. Build, operate, and maintain summer/fall Chinook acclimation ponds at Mouth of Omak Creek and release artificial production from this site annually to expand habitat usage in the Okanogan River.
DATA GAPS AND M&E NEEDS: Predation studies overall Adult returns enumeration Better basin wide obstruction rating and ranking is needed (not just this AU). Habitat utilization of Omak Creek spring Chinook. Pit-tag studies to determine survival differences in Wells hatchery stocks and locally adapted Okanogan summer steelhead. Genetic studies of parental origin and hatchery/wild production differences in Omak Creek

ASSESSMENT UNIT: 09a, 9b, 9c and 09d—Small Tributary Systems

REACHES: 26 combined

1	3	5	1	3	4	1	3	1	1	3	1	1	2	1
2	3	1	1	2	1	3	5	1	3	5				



FOCAL species: Sockeye salmon, summer/fall chinook salmon, and steelhead.

Drainage area: Variable but >125 sq. mi. combined. (80,000 acres)

SUBWATERSHEDS:

9a. Chilliwist, Talent, Aeneas, Johnson,

9b. Tunk and Bonaparte,

9c. Ninemile, Antoine, Tonasket

9d. Siwash, Wanacut and Whitestone

ASSESSMENT UNIT DESCRIPTION:

The Chiliwist/ Talent Creek sub-basin comprises approximately 27,842 acres, representing approximately 1.7% of the Okanogan watershed (OCD 2000). It is located in the southwestern corner of the Okanogan watershed, and is the lowest Okanogan sub-basin upstream of the Okanogan River's confluence with the Columbia River (Figure B-1). Chiliwist Creek enters the Okanogan River on its western side at approximately RM 15.1 (WDNR 1982). The sub-basin includes all the habitat along the southeast border of the sub-basin (i.e., the western shore of the mainstem Okanogan) for approximately 27 km (before entering the Columbia. The principal tributary within this sub-basin is Chiliwist Creek, however, the sub-basin also includes Sullivan Creek, Smith Lake, and Starzman Lake. None of these other waters within the sub-basin regularly convey surface waters to the Okanogan. Over half of the sub-basin is within the Okanogan National Forest, found in the northwestern and part of the northeastern portions of the sub-basin watershed.

Aeneas Creek enters the Okanogan River along the west side at approximately river mile 50. The subwatershed comprises approximately 0.41% percent of the total Okanogan watershed (OCD 2000). Aeneas Creek flows in a southeasterly direction from the slopes of Aeneas Mountain (950 ft el.) to the Okanogan River (xx ft el.). It has a total stream length of XXX, and flows through an area referred to as the "lime belt region." The affect of this lime belt land-type region is evident by the accumulation of calcium carbonate along the streambed channel.

The Johnson Creek sub-basin encompasses 77.5 mi2 of the Lower Okanogan Watershed (Ecology Draft, 1995). It is located on the western portion of the Okanogan Watershed with the Okanogan River as its eastern boundary, Sinlahekin State Wildlife Recreation Area as its northwest boundary, and Salmon Creek sub-basin to southwest. Johnson Creek enters the Okanogan River on the west side at approximately RM 35, just south of Riverside. The Johnson Creek sub-basin runs parallel to the Okanogan River for about 11 miles. The majority of the basin is in the Okanogan River Valley, with patches of mountainous regions to the western, northern and central areas. There is a series of 21 lakes found in the central mountainous region of the sub-basin (USGS 1984).

Tunk Creek is a perennial tributary of the Okanogan River with a total watershed area of approximately 45,585.7 acres (OK CO Watershed WQ MP). It enters the Okanogan River approximately 5 miles north of the town of Riverside. The basin is generally oriented on an east-west axis. The watershed consists primarily of forest (40%) and rangeland (59.1%). Resource information regarding this sub-basin is very limited. (Okanogan County Watershed Water Quality Management Plan)

The Bonaparte Creek watershed encompasses 102,120 acres of mixed ownership. The acres are a mixed ownership as follows:

Private ownership, 59,000 acres (58%); Washington Department of Natural Resources, 9000 acres (9%); Bureau of Land Management managed lands, 1000 acres (1%); and the remaining 33,000 acres (32%) are managed by the US Forest Service (USFS). Bonaparte Creek enters the Okanogan River in the city of Tonasket, Washington, at River Mile (RM) 56.7 of the Okanogan River. The watershed at its longest axis is approximately 20 miles long; its widest point is approximately 17 miles wide.

Ninemile Creek Subbasin is in the Northeast corner of the Washington-Canada border of the Okanogan Watershed. The main tributary that forms the subbasin generates from Osoyoos Lake on its western border. The majority of the Ninemile Creek subbasin is in Canada, to the northeast of Osoyoos Lake. The land ranges from arid desert to coniferous forest. No other major bodies of water are found on the Canadian side besides Ninemile Creek.

A recent survey of the lower 2+ miles that included the entire stream from the mouth at the southern basin of Osoyoos Lake to the eastern edge of property owned by Junior Eder. The remaining portion of the watershed is located on lands owned by Junior Eder and permission to be on this property could not be obtained prior to the survey. No barriers were identified and flow appeared sufficient to provide passage for summer steelhead even during a low water year. One adult steelhead was observed about 600 years up stream of the mouth and several small fish were also observed. The lower 2 miles for stream were channelized and diked over 20 years ago and remain that way today. No flood plain connection exists and down-cutting of the channel has occurred. The channel provided a suitable passage corridor but substrates are cemented and little macro-invertebrate life was observed. Vary sparse areas of unconsolidated gravels exist but it appeared that at least one small redd had been excavated in one of these areas. Riparian cover was relatively thick between the dikes but little riparian cover existed outside of the dikes. Stream width varied between 5 feet in the lower portion to 7 feet near the top. Above the property line is a small shale canyon that did not appear to have any significant barrier and the channel was much more natural (Not artificially confined) above this constriction. Above the canyon it appeared riparian condition and channel stability were degraded by grazing activity. Road culverts exist that could be potential barriers and it is believed that some water withdrawal occurs in this area, however, no access could be gained to this private property. Nine-mile Creek has potential for steelhead production and this is the second time recently that steelhead have been positively identified in Nine-mile Creek. The lack of spawning habitat below the canyon and lack of artificial confinement above leads us to hypothesize that spawning and rearing currently occurs on private lands and the lower section is mainly utilized as a passage corridor. Considerable data gaps regarding fish populations, habitat, water use/ownership, and historic information exist for this stream. Orchards line the entire lower section of creek on both sides so chemicals could limit fish production. Harassment is known to occur as local orchard owners have attested that migrant workers have fished for and taken steelhead from the creek.

The Antoine Creek watershed encompasses 46,695 acres of mixed ownership. The acres are a mixed ownership as follows: Private ownership, 30,000 acres (72%); Washington Department of Natural Resources, 2800 acres (6%); Bureau of Land Management managed lands, 459 acres (<1%); and the remaining 9806 acres (21%) are managed by the US Forest Service (USFS). Antoine Creek enters the Okanogan River 4 miles north of the city of Tonasket, Washington, at River Mile (RM) 61.2 of the Okanogan River. The watershed at its longest axis is approximately 14 miles long and its widest point is approximately 10 miles wide. Antoine Creek is dammed at approximately RM 12 by Fancher Dam. Approximately 40% of the watershed acres drain to Antoine Creek above Fancher Dam, with the remaining 60% of the watershed draining to Antoine Creek below Fancher Dam. The water in Fancher Dam reservoir is used for irrigation of croplands.

A recent survey of Antoine Creek identified a natural barrier that exists are approximately river mile 3. Antoine creek is mainly limited by the amount of discharge resulting in a barrier to fish migration from low flows and limited habitat quantity. This stream averages less than 5 feet wide with a depth of less than 0.5 feet deep. Conditions along the creek are in fair condition but an increase in flow of 50% would be needed to provide sufficient water for adult steelhead passage and spawning to occur. Until this problem is rectified other work to increase habitat quality will have very limited benefits. Riparian area improvements and reducing fine sediment loads would benefit fish in the Mainstem Okanogan River but not to the extent that increased flows would. A dam located in the headwaters of this watershed could be utilized to improve downstream flows during migration and spawning. A number of possible alternatives to increase discharge in Antoine Creek do exist but it will take time to work out all the details.

The Tonasket Creek watershed encompasses 35,460 acres of mixed ownership. The acres are a mixed ownership as follows: Private ownership, 20,000 acres (56%); Washington Department of Natural Resources, 5700 acres (16%); Bureau of Land Management managed lands, 960 acres (3%); and the remaining 8,800 acres (25%) are managed by the US Forest Service (USFS). Tonasket Creek enters the Okanogan River east of the city of Oroville, Washington, at River Mile (RM) 77.8 of the Okanogan River. The watershed at its longest axis is approximately 12 miles long and its widest point is approximately 8 miles wide.

The Siwash Watershed is 30,946 acres. Of these acres, 10,567 (34%) acres are managed by the USFS, the remaining 20,379 (66%) acres are a combination of ownership that includes private owners (60%), Washington Department of Natural Resources (5.5%), and Bureau of Land Management managed lands (<1%).

Wanacut Creek is an intermittent tributary to the Okanogan River located on the Colville Reservation immediately north of the Omak Creek sub-basin. The total watershed area is 12,595 acres, representing 0.76% of the total Okanogan watershed (OCD 2000). Wanacut Creek is 8 miles long, and the total of 38.7 miles of stream channel in the sub-basin. Wanacut Creek flows westward, entering the eastern side of the Okanogan River at approximately RM 30, (COLVILLE TRIBES 2001).

The Whitestone Creek Watershed encompasses six main bodies of water (from north to south): Blue Lake, Wanacut Lake, Spectacle Lake, Whitestone Creek, Whitestone Lake, and Stevens Lake (DOI 1976). The Okanogan River flows along its eastern border, running 33.1 km along the subbasin from Oroville to Tonasket (Murdoch and Miller 1999). The Whitestone Creek subbasin is an island surrounded by larger subbasins of the Okanogan watershed. To the west is the Similkameen River subbasin, to the southwest is the Aeneas Creek, to the southeast is the Siwash Creek, to the east is the Antoine Creek and to the northeast is the Tonasket Creek.

LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.

FACTORS LIMITING PRODUCTION:

Chiliwist/Talent: Flow, passage

Aeneas: Food, flow, Sediment, channel stability, habitat diversity and quantity, harassment

Johnson: Water quality, channel habitat, passage, riparian function, bank stability and floodplain connectivity (from LFA)

Tunk: Sediment, habitat quantity and diversity, channel stability and flow

Bonaparte: MIA for now on Sthd. (Core says) Harassment, channel stability, sediment, diversity and quantity, chemicals.

Nine Mile: Sediment, habitat quantity and diversity, channel stability, flow and chemicals

Antoine: Flow, diversity, sediment, P-quantity, predation, stability

P-Low Flow

P-Habitat Quantity

s-Fine sediments

s-riparian function

s-habitat diversity

Tonasket: Flow, diversity, sediment, P-quantity, predation

Siwash: Diversity and quantity, flow, sediment, winter temp, predation and channel stability

Wanacut: Channel stability, Flow, food, diversity, predation, sediment and quantity

Whitestone: Channel stability, Flow, food, diversity, predation, sediment and quantity (increased by Toats Coulee diverted into WS

Refer to Appendix *B* for reference and specific detail by reach and species

Working Hypotheses and Focal Species Conservation and Rehabilitation Alternatives:

9a: Chilliwist/Talent, Aeneas, and Johnson Creeks (9 reaches combined—good water quality benefits, low production potential)

Hypothesis 1: Protecting water quality (cool) flows in these tributaries will continue to provide input in the mainstem Okanogan River and provide thermal refugia and rearing habitat for steelhead, sockeye and summer/fall Chinook at the following life history stages: a. rearing, and b. active migration.

Objective 1-1. Monitor, protect and increase stream discharge year round so that a minimum of 1 cfs remains in all stream channels and that Johnson Creek has a minimum of 6 cfs during the months of April and May.

Strategy 1-1A Protect and maintain established in-stream flows by monitoring water use and enforcing laws and regulations.

Strategy 1-1B Administer groundwater and surface water right permits and changes consistent with the established in-stream flow.

Strategy 1-1C Protect groundwater recharge areas from impacts of land development by designating and protecting agricultural, forest and other resource lands and critical areas.

Strategy 1-1D Conduct comprehensive in-stream flow study.

Strategy 1-1E Pursue methods to acquire permanent water rights for in-stream use (i.e. water banking, lease, purchase and trust water donations).

Strategy 1-1F Develop programs that assist water users and promotes the efficient use of water.

Strategy 1-1G Enhance riparian canopy cover especially in areas with exposed rocks.

Strategy 1-1H Implement activities that promote water storage and groundwater recharge that collective add to existing in-stream flows.

Strategy 1-1I Develop, operate, and maintain and monitor real-time monitoring station to monitor stream discharge and other water quality parameters.

Hypothesis 2: Survival for all life stages of steelhead will increase and habitat quantity will expand by restoring proper passage conditions at human made barriers.

Objective 2-1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Strategy 2-1A. Prevent new passage problems by restricting the placement of new roads or providing adequate mitigation for unavoidable impacts.

Strategy 2-1B. Design and construct road culverts consistent with established standards and guidelines.

Strategy 2-1C. Prevent the placement of dikes and other structures that may confine or restrict side channels and disconnect habitat in floodplains.

Strategy 2-1D. Use permits or other local, tribal and federal approval mechanisms to impose design and construction restrictions on activities that may impede fish passage and access.

Strategy 2-1E. Remove, modify or replace culverts that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity.

Strategy 2-1F. Continue to improve passage were know blockages occur and remove artificial confinement to restore floodplain function were possible.

Hypothesis 3: Fine sediment reduction and increased bank stability will increase residual pool depth and contribute to reducing sediment loads throughout the Okanogan subbasin. The following life stages would benefit from these actives: incubation, rearing, prespawn holding and rearing for Chinook and steelhead.

Objective 3-1. Increase residual pool depth by 10% in this assessment unit to evaluate subbasin wide fine sediment reduction strategies.

Strategy 3-1A. Restrict development, road construction, logging and intensive farming in areas with high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 3-1B. Establish baseline for residual pool depths and monitor and evaluate trends.

Strategy 3-1C. Protect geologically hazardous areas, such as unstable slopes, and riparian zones through critical areas ordinances and zoning regulations.

Strategy 3-1D. Implement best management farm practices, and nonpoint source control techniques for urban areas.

Strategy 3-1E. Avoid road construction and soil disturbance in proximity to riparian areas, wetlands, unstable slopes, and areas where sediment related degradation has been identified

Strategy 3-1F. Maintain drainage ditches, culverts and other drainage structures to prevent clogging with debris and sediments.

Strategy 3-1G. Limit grazing access to the riparian corridor and minimize the time that these areas can be used.

Strategy 3-1H. Increase the amount of flood prone areas to reduce lateral scour and flow volume in main channel.

Strategy 3-1I. Remove, reconstruct or upgrade roads that are vulnerable to failure due to design or location

Strategy 3-1J. Implement road maintenance and abandonment or decommissioning plans approved under forest practices regulations.

Strategy 3-1K. Decrease sediment delivery from upland practices through expanded use of conservation tillage, sediment basins, CRP participation, mowing of road shoulders in place of herbicide use, vegetative buffers on road shoulders, and other practices.

Strategy 3-1L. Develop watershed management plans to enhance water quantity, quality, and fish habitat.

Hypothesis 4: Artificial production (supplementation) provides an increase in fish population numbers and is required to meet tribal trust responsibilities, provide harvestable surplus for people of this region, and to aid in salmon and steelhead recovery efforts because of population decreases caused by habitat loss, main-stem Columbia River dams, and downriver harvest activities. (Hatchery activities should be consistent with approved Hatchery Genetic Management Plans and the artificial production section of this plan)

Objective 4-1. Improve population numbers of summer steelhead by 50% above current levels.

Strategy 4-1A. Use scatter plants of summer steelhead to enhance returns to small tributaries and improve selective harvest opportunities along the main-stem Okanogan River.

Strategy 4-1B. Expand, operate, and maintain artificial production capacity at levels necessary to meet management needs for locally adapted summer steelhead.

Strategy 4-1C. Operate and maintain weir sites to collect locally adapted broodstock and Monitor adult salmonid returns annually, determine a baseline, and evaluate trends.

Strategy 4-1D.Determine baseline redd counts for summer steelhead and evaluate trends over time to aid in management decisions and evaluate changes in habitat utilization.

9b: Tunk and Bonaparte Creeks (3 reaches combined—good water quality benefits, some production potential)

Hypothesis 5: Protecting water quality (cool) flows in these tributaries will continue to provide input in the mainstem Okanogan River and provide thermal refugia and rearing habitat for steelhead, sockeye and summer/fall Chinook at the following life history stages: a. rearing, and b. active migration. These streams also support spawning and rearing habitat for summer steelhead.

Objective 5-1. Monitor, protect and increase stream discharge year round so that a minimum of 1 cfs remains in all stream channels and that during the months of April and May minimum flows of 14 cfs exist for migration and spawning of summer steelhead.

Strategy 5-1A Protect and maintain established in-stream flows by monitoring water use and enforcing laws and regulations.

Strategy 5-1B Administer groundwater and surface water right permits and changes consistent with the established in-stream flow.

Strategy 5-1C Protect groundwater recharge areas from impacts of land development by designating and protecting agricultural, forest and other resource lands and critical areas.

Strategy 5-1D Conduct comprehensive in-stream flow study.

Strategy 5-1E Pursue methods to acquire permanent water rights for in-stream use (i.e. water banking, lease, purchase and trust water donations).

Strategy 5-1F Develop programs that assist water users and promotes the efficient use of water.

Strategy 5-1G Enhance riparian canopy cover especially in areas with exposed rocks.

Strategy 5-1H Implement activities that promote water storage and groundwater recharge that collective add to existing in-stream flows.

Strategy 5-1I Develop, operate, and maintain and monitor real-time monitoring station to monitor stream discharge and other water quality parameters.

Strategy 5-1J Restrict new development within the floodplain and protect 300 foot riparian buffer zones.

Hypothesis 6: Survival for all life stages of steelhead will increase and habitat quantity will expand by restoring proper passage conditions at human made barriers.

Objective 6-1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Strategy 6-1A. Prevent new passage problems by restricting the placement of new roads or providing adequate mitigation for unavoidable impacts.

Strategy 6-1B. Design and construct road culverts consistent with established standards and guidelines.

Strategy 6-1C. Prevent the placement of dikes and other structures that may confine or restrict side channels and disconnect habitat in floodplains.

Strategy 6-1D. Use permits or other local, tribal, state, and federal approval mechanisms to impose design and construction restrictions on activities that may impede fish passage and access or impact riparian areas or flood plain function.

Strategy 6-1E. Remove, modify or replace culverts that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity.

Strategy 6-1F. Continue to improve passage were know blockages occur and remove artificial confinement to restore floodplain function were possible.

Hypothesis 7: Fine sediment reduction and increased bank stability will increase residual pool depth and contribute to reducing sediment loads throughout the Okanogan subbasin. The following life stages would benefit from these actives: incubation, rearing, prespawn holding and rearing for Chinook and steelhead.

Objective 7-1. Increase residual pool depth by 10% in this assessment unit to evaluate subbasin wide fine sediment reduction strategies.

Strategy 7-1A. Restrict development, road construction, logging and intensive farming in areas with high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 7-1B. Establish baseline for residual pool depths and monitor and evaluate trends.

Strategy 7-1C. Protect geologically hazardous areas, such as unstable slopes, and riparian zones through critical areas ordinances and zoning regulations.

Strategy 7-1D. Implement best management farm practices, and nonpoint source control techniques for urban areas.

Strategy 7-1E. Avoid road construction and soil disturbance in proximity to riparian areas, wetlands, unstable slopes, and areas where sediment related degradation has been identified

Strategy 7-1F. Maintain drainage ditches, culverts and other drainage structures to prevent clogging with debris and sediments.

Strategy 7-1G. Limit grazing access to the riparian corridor and minimize the time that these areas can be used.

Strategy 7-1H. Increase the amount of flood prone areas to reduce lateral scour and flow volume in main channel.

Strategy 7-1I. Remove, reconstruct or upgrade roads that are vulnerable to failure due to design or location

Strategy 7-1J. Implement road maintenance and abandonment or decommissioning plans approved under forest practices regulations.

Strategy 7-1K.Decrease sediment delivery from upland practices through expanded use of conservation tillage, sediment basins, CRP participation, mowing of road shoulders in place of herbicide use, vegetative buffers on road shoulders, and other practices.

Hypothesis 8: Artificial production (supplementation) provides an increase in fish population numbers and is required to meet tribal trust responsibilities, provide harvestable surplus for people of this region, and to aid in salmon and steelhead recovery efforts because of population decreases caused by habitat loss, main-stem Columbia River dams, and downriver harvest activities. (Hatchery activities should be consistent with approved Hatchery Genetic Management Plans and the artificial production section of this plan)

Objective 8-1. Improve population numbers of summer steelhead by 50% above current levels.

Strategy 8-1A. Use scatter plants of summer steelhead to enhance returns to small tributaries and improve selective harvest opportunities along the main-stem Okanogan River.

Strategy 8-1B. Expand, operate, and maintain artificial production capacity at levels necessary to meet management needs for locally adapted summer steelhead.

Strategy 8-1C. Operate and maintain a weir sites to collect locally adapted broodstock and Monitor adult salmonid returns annually, determine a baseline, and evaluate trends.

Strategy 8-1D.Determine baseline redd counts for summer steelhead and evaluate trends over time to aid in management decisions and evaluate changes in habitat utilization.

9c: Ninemile, Antoine and Tonasket Creeks (6 reaches combined—high production potential, flow limiting)

Hypothesis 9: Protecting water quality (cool) flows in these tributaries will continue to provide input in the mainstem Okanogan River and provide thermal refugia and rearing habitat for steelhead, sockeye and summer/fall Chinook at the following life history stages: a. rearing, and b. active migration. These streams also support spawning and rearing habitat for summer steelhead.

Objective 9-1. Monitor, protect and increase stream discharge year round so that a minimum of 1 cfs remains in all stream channels and that during the months of April and May minimum flows of 10 cfs exist for migration and spawning of summer steelhead.

Strategy 9-1A Protect and maintain established in-stream flows by monitoring water use and enforcing laws and regulations.

Strategy 9-1B Administer groundwater and surface water right permits and changes consistent with the established in-stream flow.

Strategy 9-1C Protect groundwater recharge areas from impacts of land development by designating and protecting agricultural, forest and other resource lands and critical areas.

Strategy 9-1D Conduct comprehensive in-stream flow study.

Strategy 9-1E Pursue methods to acquire permanent water rights for in-stream use (i.e. water banking, lease, purchase and trust water donations).

Strategy 9-1F Develop programs that assist water users and promotes the efficient use of water.

Strategy 9-1G Enhance riparian canopy cover especially in areas with exposed rocks.

Strategy 9-1H Implement activities that promote water storage and groundwater recharge that collective add to existing in-stream flows.

Strategy 9-1I Develop, operate, and maintain and monitor real-time monitoring station to monitor stream discharge and other water quality parameters.

Strategy 9-1J Restrict new development within the floodplain and protect 300 foot riparian buffer zones.

Objective 9-2. Reduce chemical impacts for all species to remove this reach of the Okanogan River from 303(d) listing.

Strategy 9-2A. Address non-point source and point source pollution for arsenic.

Strategy 9-2B. Remove and properly dispose of contaminated sediments.

Objective 9-3. Decrease summer daily maximum temperatures to no more than 4 days greater than 72 ^{O}F (24 ^{O}C) and show progress toward meeting Washington State temperature standards and TMDL goals

Strategy 9-3A. Remove diking, increase channel sinuosity, reestablish back channels, reslope vertical banks, and establish wetland habitats that allow floodplain inundation to occur approximately every 2 years.

Strategy 9-3B. Protect existing shading and plant additional trees and shrubs in areas of exposed rock.

Strategy 9-3C. Protect and re-establish all ground-water sources.

Hypothesis 10: Survival for all life stages of steelhead will increase and habitat quantity will expand by restoring proper passage conditions at human made barriers.

Objective 10-1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e. broodstock collection, monitoring and evaluation) are permissible.

Strategy 10-1A. Prevent new passage problems by restricting the placement of new roads or providing adequate mitigation for unavoidable impacts.

Strategy 10-1B. Design and construct road culverts consistent with established standards and guidelines.

Strategy 10-1C. Prevent the placement of dikes and other structures that may confine or restrict side channels and disconnect habitat in floodplains.

Strategy 10-1D. Use permits or other local, tribal, state, and federal approval mechanisms to impose design and construction restrictions on activities that may impede fish passage and access or impact riparian areas or flood plain function.

Strategy 10-1E. Remove, modify or replace culverts that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity.

Strategy 10-1F. Continue to improve passage were know blockages occur and remove artificial confinement to restore floodplain function were possible.

Hypothesis 11: Fine sediment reduction and increased bank stability will increase residual pool depth and contribute to reducing sediment loads throughout the Okanogan subbasin. The following life stages would benefit from these actives: incubation, rearing, prespawn holding and rearing for Chinook and steelhead.

Objective 11-1. Increase residual pool depth by 10% in this assessment unit to evaluate subbasin wide fine sediment reduction strategies.

Strategy 11-1A. Restrict development, road construction, logging and intensive farming in areas with high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 11-1B. Establish baseline for residual pool depths and monitor and evaluate trends.

Strategy 11-1C. Protect geologically hazardous areas, such as unstable slopes, and riparian zones through critical areas ordinances and zoning regulations.

Strategy 11-1D. Implement best management farm practices, and nonpoint source control techniques for urban areas.

Strategy 11-1E. Avoid road construction and soil disturbance in proximity to riparian areas, wetlands, unstable slopes, and areas where sediment related degradation has been identified

Strategy 11-1F. Maintain drainage ditches, culverts and other drainage structures to prevent clogging with debris and sediments.

Strategy 11-1G. Limit grazing access to the riparian corridor and minimize the time that these areas can be used.

Strategy 11-1H. Increase the amount of flood prone areas to reduce lateral scour and flow volume in main channel.

Strategy 11-1I. Remove, reconstruct or upgrade roads that are vulnerable to failure due to design or location

Strategy 11-1J. Implement road maintenance and abandonment or decommissioning plans approved under forest practices regulations.

Strategy 11-1K.Decrease sediment delivery from upland practices through expanded use of conservation tillage, sediment basins, CRP participation, mowing of road shoulders in place of herbicide use, vegetative buffers on road shoulders, and other practices.

Hypothesis 12: Artificial production (supplementation) provides an increase in fish population numbers and is required to meet tribal trust responsibilities, provide harvestable surplus for people of this region, and to aid in salmon and steelhead recovery efforts because of population decreases caused by habitat loss, main-stem Columbia River dams, and downriver harvest activities. (Hatchery activities should be consistent with approved Hatchery Genetic Management Plans and the artificial production section of this plan)

Objective 12-1. Improve population numbers of summer steelhead by 50% above current levels.

Strategy 12-1A. Use scatter plants of summer steelhead to enhance returns to small tributaries and improve selective harvest opportunities along the main-stem Okanogan River.

Strategy 12-1B. Expand, operate, and maintain artificial production capacity at levels necessary to meet management needs for locally adapted summer steelhead.

Strategy 12-1C. Operate and maintain a weir sites to collect locally adapted broodstock and Monitor adult salmonid returns annually, determine a baseline, and evaluate trends.

Strategy 12-1D.Determine baseline redd counts for summer steelhead and evaluate trends over time to aid in management decisions and evaluate changes in habitat utilization.

9d: Siwash, Wanacut and Whitestone Creeks (8 reaches combined—low production potential, “do no more harm” is the sole objective for these tributary systems)

Hypothesis 13: Summer water temperatures in the Okanogan River exceed levels that are known to be stressful to salmonid therefore reducing inputs from small warm tributaries during summer months will benefit water quality in the Okanogan main-stem but could enhance water quality in winter months.

Objective 13-1. Monitor discharge volume and temperatures to insure water with temperature greater than the Okanogan River Main-stem do not flow during summer months.

Strategy 13-1A. Develop water retention and use plans to ensure that warm water releases do not contribute to Okanogan River flows.

Strategy 13-1B. Study water injection strategies to determine if groundwater flows from these watersheds to the Okanogan River can be enhanced or increased.

Strategy 13-1C. Develop real time monitoring station to monitor discharge and temperature.

DATA GAPS AND M&E NEEDS:

Sediment transport analysis

Develop infrastructure to monitor discharge where not gauged

Habitat quantity and quality data for all tributaries with emphasis in gaining access to upper Nine Mile Creek watershed located on land owned by Junior Eder.

Fish species presence/absence, run timing, abundance, and habitat utilization

Water quality, flow, use, ownership, and withdrawals.

Monitor the presence, abundance, run-timing, and habitat utilization of fish species.

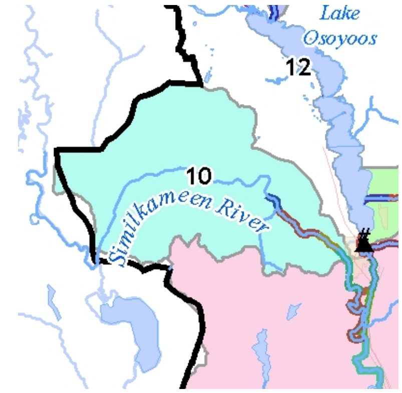
Quantify habitat quality and quantity.

Determine water ownership and use.

ASSESSMENT UNIT: O10—Similkameen

REACHES: 9

1	2	3	4	5	6	7	8	9



FOCAL species: Sockeye salmon, summer/fall chinook salmon, and steelhead.

Drainage area: 19 sq. mi.

SUBWATERSHEDS Tulameen, Sinlahekin Creek, Toats Coulee, Palmer Lake

ASSESSMENT UNIT DESCRIPTION:

Beaver populations high (relative to historic—unknown). Historic information about fish and human development, tribal culture exist for this area. Many tribal legends describe fish passage barriers at Enloe Falls. Impacts of the dam itself are however poorly understood and/or described. Because of anthropomorphic change to the Similkameen river system, most notably by Enloe dam, upstream bank destabilization, rip rapping, and loss of wetland habitat near Palmer lake, the natural hydrograph in this AU has likely been altered. No empirical data exist to estimate the effects of these activities.

LEVEL OF CERTAINTY: See Okanogan Level of Proof (LOP) Appendix F for details on ratings for each attribute. Also see the Master Attribute Rating Table for additional comments associated with LOP for individual reaches.

FACTORS LIMITING PRODUCTION:

P-Sediment

P-Habitat Diversity

P-Pathogens (adjacent to large scale summer/fall ck hatchery releases, some sthd releases)

S-Predation

P-Chemicals (primary likely due to spill from Enloe. WDFW has some gas level measurements. Some GBT reported at the Hatchery. May-June

S-Temperature

P-Obstructions (Falls are natural, Enloe is a dam)

S-Channel stability

S-Harassment (Core group reports anecdotally). High level of uncertainty as to scale.

S-Flow

Refer to Appendix B for reference and specific detail by reach and species

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1: Fine sediment reduction and increased bank stability will reduce width to depth ratios. The following life stages would benefit from these actives: incubation, rearing, prespawn holding and rearing for Chinook, steelhead, and sockeye.

Objective 1-1. Reestablish normative width to depth ratios of 10:1.

Protection strategies*:*

Strategy 1-A. Restrict development, road construction, logging and intensive farming in areas with high likelihood of occurrence of mass wasting (unstable slopes) and/or erosion.

Strategy 1-B. Minimize total road density within the watershed and provide adequate drainage control for new roads.

Strategy 1-C. Protect geologically hazardous areas, such as unstable slopes, and riparian zones through critical areas ordinances and zoning regulations.

Strategy 1-D. Implement best management farm practices, and nonpoint source control techniques for urban areas.

Strategy 1-E. Avoid road construction and soil disturbance in proximity to riparian areas, wetlands, unstable slopes, and areas where sediment related degradation has been identified

Strategy 1-F. Maintain drainage ditches, culverts and other drainage structures to prevent clogging with debris and sediments.

Restoration strategies:

Strategy 1-G. Implement a road maintenance schedule to prevent and mitigate sediment impacts

Strategy 1-H. Remove, reconstruct or upgrade roads that are vulnerable to failure due to design or location

Strategy 1-I. Implement road maintenance and abandonment or decommissioning plans approved under forest practices regulations;

Strategy 1-J. Upgrade stream crossing, culverts and road drainage systems;

Strategy 1-K. Reconnect floodplains through dike removal or breaching;

Strategy 1-L. Implement in-channel projects that address geologic processes such as deep-seated slope failure, toe erosion, or landslides

Strategy 1-M. Construct detention and infiltration ponds to capture runoff from roads, development, farms and irrigation return flows

Strategy 1-N. Reestablish natural riparian vegetation to restore a more natural delivery and routing of sediment.

Strategy 1-O. Remove and properly dispose of contaminated sediments.

Hypothesis 2: Increase habitat diversity (riparian function, LWD, man-made confinement will increase survival of summer Chinook, steelhead, in the following life stages: a) spawning, b) egg incubation, c) fry colonization, and d) rearing Chinook, steelhead

Objective 2-1. Achieve properly functioning riparian conditions (at least 75% of normative for riparian vegetation, large woody debris, and connectivity to the floodplain, and off channel habitat). Restore 10% of the disconnected floodplain.

Strategy 2-A. Measures and actions designed to address flows, hydrology, sediment loading and riparian zones (e.g., forest practices regulations, protection of agricultural, rural and urban riparian zones, minimizing road constructions, etc.) are likely to result in improved channel complexity and habitat connectivity.

Strategy 2-B. Restrict or condition new development to be consistent with shoreline management guidelines, local Critical Area Ordinances and development regulations, hydraulic project approval and other state and/or local regulations or permits

Strategy 2-C. Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat salmon

Strategy 2-D. Avoid or mitigate adverse impacts of upland development where it has the potential to adversely impact channel conditions, such as when the removal of vegetation and improper drainage result in erosion and the need for shoreline stabilization structures.

Strategy 2-E. Establish and protect riparian buffers using regulatory and incentive mechanisms provided in Critical Area Ordinances, shoreline master programs, forest practices regulations, farm conservation plans and other programs to avoid or minimize removal of native vegetation

Strategy 2-F. Establish appropriate environmental designations according to local shoreline master programs that are consistent with the state shoreline management guidelines

Strategy 2-G. Establish salmon friendly land use patterns and design standards

Strategy 2-H. Regulate or restrict shoreline uses, forest practices, land conversion, rural and urban development and other activities within riparian zones;

Strategy 2-I. Acquire priority riparian areas through purchase; conservation easements; and transfer of timber, farm, grazing or land development rights

Strategy 2-J. Provide incentives and compensation to landowners to retain buffers.

Restoration strategies:

Strategy 2-K. Measures and actions designed to restore stream flows, sediment loading and riparian zones – such as removing or breaching dikes and levees, managing stormwater and runoff, maintaining or abandoning roads, restoring wetlands, floodplain processes and functions, restoring fish passage, etc. are likely to result in improved channel complexity and habitat connectivity.

Strategy 2-L. Restore and reconnect wetlands and floodplains to the riverine system.

Strategy 2-M. Remove or replace bank stabilization structures

Strategy 2-N. Replace invasive or non-native vegetation with native vegetation

Strategy 2-O. Create or redesign pools, spawning habitat, etc.;

Strategy 2-P. Influence or redirect stream flows to reduce erosive forces on stream banks or stream-beds (includes installation of deflectors, barbs and vanes)

Strategy 2-Q. Add large woody debris and place in-channel engineered log jams

Strategy 2-R. Introduce appropriate spawning gravel to the channel.

Strategy 2-S. Replant degraded riparian zones by reestablishing native vegetation

Strategy 2-T. Install and maintain fencing or fish friendly stream crossing structures to prevent livestock access to riparian zones and streams. Provide alternative sites for stock watering.

Strategy 2-U. Selectively thin, remove and prune non-native and invasive vegetation; and

Strategy 2-V. Restore nutrients lost to the food chain because of decline in salmon populations; for instance, placement of salmon carcasses or otherwise returning adult salmon to the watershed.

Hypothesis 3: Increasing water quality will increase survival for Chinook, steelhead and sockeye in the following life stages:

Juvenile rearing, prespawn holding and active migration. Some spawning for Chinook.

Objective 3-1. Reduce chemical impacts for all species to remove this reach of the Okanogan River from 303(d) listing.

Strategy 3-1A. Address non-point source and point source pollution for arsenic.

Strategy 3-1B. Remove and properly dispose of arsenic contaminated sediments.

Objective 3-2. Reduce summer water temperatures for all species to remove this reach of the Okanogan River from 303(d) listing.

Strategy 3-2A. Remove diking, reestablish back channels, reslope vertical banks, and establish wetland habitats that allow floodplain inundation to occur approximately every 2 years.

Strategy 3-2B. Protect existing shading and plant additional trees and shrubs in areas of exposed rock.

Strategy 3-2C. Protect and re-establish all ground-water sources.

Objective 3-3. Maintain TDG levels below 110 percent and manage flows to eliminate bed load movement.

Strategy 3-3A. Implement Total Maximum Daily Loads (TMDLs) that address temperature and TDG

Strategy 3-3B. Install flip-lips at Enloe Dam.

Strategy 3-3C. Monitor and evaluate TDG levels and other water quality criteria below Enloe Dam.

Hypothesis 4: Protecting existing spawning habitats from degradation and hatchery super-imposition will ensure continued recruitment of native summer/fall Chinook in the Okanogan River.

Objective 4-1: Increase and monitor natural production of summer/fall Chinook above existing levels.

Strategy 4-1A. Monitor redd counts in assessment unit annually and compare trends to established baseline.

Strategy 4-1B. Develop tribal and recreational harvest opportunities that selectively harvest excess hatchery production of summer/fall Chinook.

Strategy 4-1C. Create side-channel habitats, islands, spawning channels, and reconnect back channels to increase channel complexity and expand suitable spawning habitats.

Objective 4-2: Protect all existing spawning areas for summer/fall Chinook.

Strategy 4-2A. Prohibit sand and gravel removal where such activities have the potential to alter the natural processes of gravel transportation in the river system and to degrade salmon habitat salmon.

Strategy 4-2B. Establish and protect riparian buffers using regulatory and incentive mechanisms provided in Critical Area Ordinances, shoreline master programs, forest practices regulations, farm conservation plans and other programs to protect spawning habitat for summer/fall Chinook.

Strategy 4-2C. Regulate or restrict shoreline uses, forest practices, land conversion, rural and urban development and other activities within riparian zones;

Strategy 4-2D. Acquire priority riparian areas through purchase; conservation easements; and transfer of timber, farm, grazing or land development rights

Strategy 4-2E. Provide incentives and compensation to landowners to retain buffers.

Hypothesis 5: Survival for all life stages of Chinook, steelhead, and sockeye will increase by restoring proper passage conditions at human made barriers and irrigation withdrawals.

Objective 5-1: Ensure that useable or restorable habitat is accessible to resident and anadromous fishes. Obtain no impact to upstream or downstream movement (100% passage). Obstructions that meet NOAA standards and aid in fish management (i.e.

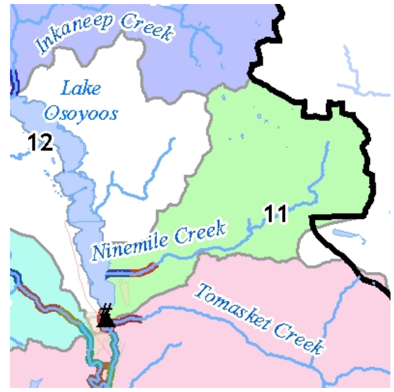
broodstock collection, monitoring and evaluation) are permissible. Strategy 5-1A. Prevent new passage problems by restricting the placement of new roads or providing adequate mitigation for unavoidable impacts. Strategy 5-1B. Design and construct road culverts and screens consistent with standards and guidelines. Strategy 5-1C. Prevent the placement of dikes and other structures that may confine or restrict side channels and disconnect habitat in floodplains and estuaries. Strategy 5-1D. Use permits or other local, state and federal approval mechanisms to impose design and construction restrictions on activities that may impede fish passage and access. Strategy 5-1E. Remove, modify or replace culverts and or screens that prevent or restrict access to salmon habitat and/or cause loss of habitat connectivity. Strategy 5-1F. Remove, replace or modify diversion dams identified as major limiting factors affecting fish passage and habitat connectivity. Strategy 5-1G. Use cost-sharing programs to help landowners screen diversions.
DATA GAPS AND M&E NEEDS: Information on overall basin hydrology, especially relative to the influence of Enloe dam and changes to the natural hydrograph, is lacking. Harassment level and source unknown Hatchery/wild fish interaction to better manage production programs Spring Chinook life history Summer/Fall vs. summer and/or fall Chinook Distribution and habitat utilization above Enloe dam (Similkameen watershed both US and Canada) Passage at Enloe falls Scale of effects from mineral mining (recreational mainly) Historical beaver population size v. current. Effects on fluvial geomorphology and hyporehic (groundwater surface water interaction) function.

5.3.1 Canadian AU Summaries

Assessment Unit (AU): 011—Osoyoos Lake South/Central

Priority Rank Restoration: **Reaches: 3**

1	**2**	**3**					



FOCAL species: Sockeye salmon, spring/summer/fall Chinook salmon, and steelhead.

Drainage area:

SUBWATERSHEDS:

Nine Mile Creek

ASSESSMENT UNIT DESCRIPTION:

This AU includes the central and south basins of Osoyoos Lake. The south basin spans the Canada/U.S. Border, and includes the 6 kilometre (4 mile) portion from Haynes Point south to the lake outlet. The central basin is just over 1 kilometre in length, and spans the portion of lake from Highway 3 in the Town of Osoyoos to Haynes Point.

Fisheries habitat throughout Osoyoos Lake is limited in mid to late summer by anoxic conditions in the hypolimnion and intolerably high water temperatures in the epilimnion. In the north basin, there is usually a metalimnetic zone between the epilimnion and hypolimnion which offers a refuge for fish. However, in the present AU, which is comprised of the south and central basins, there, generally, is no metalimnetic refuge; mid to late summer conditions become intolerable for the focal species.

As a general rule, counts of sockeye salmon on the spawning grounds are only about half the counts at Wells Dam. This may be due to differences in counting methods, but it may also be due to losses en route. Installation of counting fences at the inlet and outlet of Osoyoos Dam would help to determine where losses were occurring, and, thus, may reveal the causative factors for the loss.

LEVEL OF CERTAINTY:

Sufficient limnological work has been conducted throughout Osoyoos Lake to provide a high level of certainty in regard to the limiting factors.

FACTORS LIMITING PRODUCTION:

P-Oxygen

P-Temperature

S-Pathogens

S-Predation

Refer to Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Moderating high water temperatures in the epilimnion and anoxic conditions in the hypolimnion will increase the size of the rearing and holding area available for sockeye and Chinook.

Objective 1- Investigate the timing of the occurrence of intolerable conditions to ascertain the effects on various life history stages of focal species.

Strategy 1 - Measure vertical water temperature and oxygen profiles from bottom to surface from July to September. Compare results with tolerable limits for each focal species and life history stage.

Objective 2 - Investigate the feasibility, costs, benefits, and risks of reducing both the length of time the effects occur, and the severity of those effects.

Strategy 1- Investigate possibilities for BOD sources and possibilities for reduction, water inflow management, and hypolimnetic aeration. Hypothesis 2 - Preventing walleye from entering Osoyoos Lake will increase survival of sockeye and Chinook fry by removing that source of predation. Objective 1 - Use a species selective fishway to exclude walleye from Osoyoos Lake. Strategy 1 - Confirm the presence or absence of walleye north of Zosel Dam. Strategy 2 - Examine the literature to determine the cost and efficacy of selective fishways. Strategy 3 - Based on findings, prepare a management plan for excluding walleye. Hypothesis 3 - Sockeye that hold in the central and south basins do not contribute to the spawning population, and account for the approximately 50% discrepancy between Wells Dam and spawning ground counts. Objective 1 - Determine survival-to-spawning of sockeye that hold in south/central basin prior to spawning, and compare to other sockeye holding areas. Strategy 1- Mark/recapture, trap and transport, and/or radio tagging could be used to determine survival throughout the migratory route.
DATA GAPS AND M&E NEEDS: Resident Chinook in lake have been documented, but nothing is known about stock. Chinook are believed to rear in Osoyoos Lake (H. Wright, ONA, pers. comm.). It is not known if they spring, summer/fall or both. The effects of water flow releases on temperature and dissolved oxygen levels are not known. Although walleye have not been found in Osoyoos Lake, there are reports of their presence from knowledgeable sources. Given their predatory tendencies and the possibility of preventing their entry if they have not yet become established, it is important to confirm their presence. Adult sockeye survival in south and central basin over summer period and contribution to the spawning population.
MANAGEMENT STRATEGIES: Investigate methods for creating tolerable rearing and adult holding conditions in the south and central portions of Osoyoos Lake. Prevent walleye from entering Osoyoos Lake. Determine if adults that hold in south and central basin of Osoyoos Lake contribute to the unaccounted 50% loss of sockeye between Wells Dam counts and spawning ground escapement counts.

Assessment Unit (AU): O12—Osoyoos North

Reaches: 1

1																	

FOCAL species: Sockeye salmon, spring and summer/fall Chinook salmon, and steelhead.

Drainage area:

SUBWATERSHEDS:

Inkaneep Creek (see AU Summary)

Mica Creek

ASSESSMENT UNIT DESCRIPTION:

This AU includes the north basin of Osoyoos Lake. It is about 7 kilometres (4 miles) in length and stretches from the lake inlet to the Highway 3 crossing in the Town of Osoyoos. It has a maximum depth of 60 metres (200 feet) and a flushing time of 1 year.

Fisheries habitat in Osoyoos Lake is limited in mid to late summer by anoxic conditions in the hypolimnion and intolerably high water temperatures in the epilimnion. In the north basin, there is usually a metalimnetic zone between the epilimnion and hypolimnion that offers a refuge for fish; however, the extent of the metalimnetic zone varies and in some years is virtually non-existent (K. Hyatt, Fisheries and Oceans Canada, pers. comm.).

Mysis relicta have worked their way downstream from Okanagan Lake and were first found in Osoyoos Lake about 5 years ago. Numbers are thought to be increasing and managers are concerned that competition for food and space might adversely impact sockeye salmon.

LEVEL OF CERTAINTY:

Sufficient limnological work has been conducted throughout Osoyoos Lake to provide a high level of certainty in regard to the limiting factors.

FACTORS LIMITING PRODUCTION:

P-Oxygen

P-Temperature

S-Predation

S-Pathogens

Refer to Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Additional rearing areas for juvenile sockeye and Chinook salmon, and a larger holding area for adult sockeye and Chinook can be created by moderating epilimnetic water temperature and hypolimnetic oxygen levels in the North Basin of Osoyoos Lake during August and September.

Objective 1 - Record the extent of rearing and holding habitat in August and September.

Strategy 1 - Record water temperature and oxygen level from bottom to surface throughout the north basin in August and September. Compare results with requirements of the focal species.

Objective 2 - Determine possibility of moderating temperature and oxygen level.

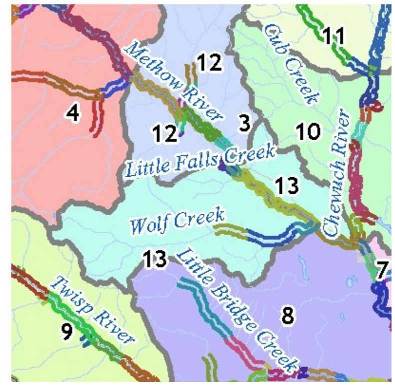
Strategy 1 - Measure and model the effect of water releases on temperature and oxygen level. Run a computer model to predict the benefits of various levels of water release. Link the model outputs with the Fish Water Management Tool to determine the costs

and risks of water release. Strategy 2 - Review methods of hypolimnetic aeration. Estimate costs, benefits and risks. Hypothesis 2 - Chinook depend upon habitat in the north basin of Osoyoos Lake for juvenile rearing and adult holding. Objective 1 - Develop a plan for Chinook investigations in Canadian portion of the Okanagan Basin. Strategy 1 - Form an investigative (recovery) team to guide investigations. Objective 2 - Record the abundance and timing of Chinook in this AU. Strategy 1 - Enumerate Chinook migrating into the north basin; collect lake Chinook by using trawls, beach seining (0+), and gillnets at predetermined locations and times. Objective 3 - Determine life history strategies of Chinook in this AU (one theory exists that a resident population within the lake may be a remnant of a wild population found in the system prior to the Grand Coulee Fish Management Project). Strategy 1 - Collect Chinook at various times and locations in the north basin and record distribution, age/growth, life history stage, and genetics; assess degree of anadromy or residency. Hypothesis 4 - Survival of sockeye salmon underyearlings will increase if competition with *Mysis relicta* is reduced. Objective 1 - Determine the biomass and population trend of *Mysis relicta*. Strategy 1 - Use vertical trawls to determine biomass, abundance and distribution of mysids. Monitor over time. Objective 2 - Determine whether mysid control programs being used on Okanagan Lake would be effective in Osoyoos Lake. Strategy 1 - Use OLAP results to determine efficacy of mysid harvesting. Compare lake areas and populations to determine whether harvesting would have an effect in Osoyoos Lake. Hypothesis 5 - There are significant losses of salmon fry during their sojourn in the littoral areas of Osoyoos Lake's north basin due to predation by exotic species. Objective 1 - Determine salmon fry usage of littoral areas. Strategy 1 - Conduct seasonal beach seining and boat shocking at predetermined locations and times. Objective 2 - Determine loss of sockeye production from predation during littoral utilization. Strategy 1 - Sample predators to determine predation loss.
DATA GAPS AND M&E NEEDS: Holding patterns and timing of sockeye in Osoyoos Lake The effects of water releases on summer water temperatures and oxygen levels The extent of shoal spawning by sockeye salmon is unknown (objectives to determine extent and utilization) The level of competition between *Mysis relicta* and rearing sockeye Competition for food and rearing space between sockeye and kokanee Adult sockeye survival in the north basin over the summer period and contribution to the spawning population Resident Chinook have been reported, but little is known about their stock status No protocol has been established for sampling of Canadian Chinook
MANAGEMENT STRATEGIES: Determine the extent of use of Osoyoos Lake by Chinook salmon; establish management plans. Investigate methods for protecting and expanding sockeye rearing habitat in this AU. Determine the extent of sockeye shoal spawning. Determine contribution of adult sockeye holding in the north basin of Osoyoos Lake to spawning population relative to other sockeye holding areas. Determine sockeye/kokanee/*mysis relicta* interactions and the benefits of Mysid control.

Assessment Unit (AU): O13 - Inkaneep Creek

Reaches: 1

1								



FOCAL species: Sockeye salmon, summer/fall Chinook salmon, and steelhead

Drainage area: 18,764 hectares (46,367 acres)

SUBWATERSHEDS:

None

ASSESSMENT UNIT DESCRIPTION:

Inkaneep Creek flows through the centre of the Osoyoos Reserve and drains the west side of Mount Baldy before empting into the northern basin of Osoyoos Lake. The watershed is 80% forested and 20% burned. According to the BC Watershed Ranking Atlas (1998), agriculture uses 1.8% of the watershed.

Surveys conducted by Colville Tribes and Okanagan Nation Alliance (ONA) in 2004 indicate that habitat is largely intact and could support summer steelhead and, perhaps, other anadromous species. Substrate is mainly large cobble and fines; therefore, it is not optimal for steelhead that prefer 1 to 3 inch size gravels. Substrate conditions would be more conducive to Chinook production; however, pockets of good gravels do exist.

Summer temperatures are known to reach 24 degrees Celsius; therefore, temperature will limit salmonid rearing to areas near groundwater inputs unless fish migrate to the north basin of Osoyoos Lake. Flow and passage appear adequate and riparian areas are in fair condition.

Cattle grazing threatens riparian function and groundwater inputs; however, new management practices implemented 2 years ago appear to be having a positive effect.

A natural falls (11 feet high and 12 feet long) at approximately river kilometre 5 (3 miles) is a barrier to anadromous fish. The origin of O. mykiss caught by anglers below this falls is unknown and could be either adfluvial rainbow trout from Osoyoos Lake or Okanogan River steelhead.

Some diking and riprapping has artificially confined some of the lower reaches. Two surface diversions were observed; both are entirely unscreened with placement in-line with main flow, and are possibly resulting in considerable juvenile entrainment. Water withdrawal quantity is unknown but believed to be minor.

Although surveys were conducted during the time steelhead were present in streams further south, no fish were observed; water clarity, however, limited visual observation. Fine sediment in lower reaches is being conveyed from upstream areas; no major sediment recruitment areas were observed below the falls. An area of mass wasting is known to exist along the highway to Mount Baldy Ski Area and high in the watershed. Large woody debris (LWD) was largely non-existent.

LEVEL OF CERTAINTY:

A survey and some restoration work have been carried out by Okanagan Nation Alliance (ONA) (see literature cited). ONA and COLVILLE TRIBES fisheries personnel carried out a visual survey in 2004.

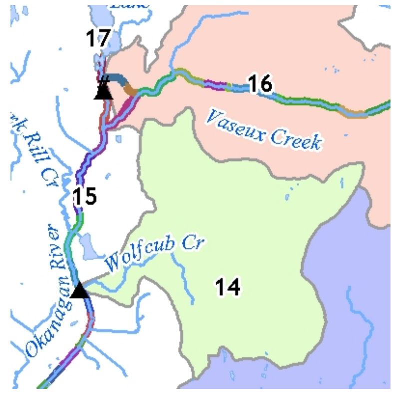
FACTORS LIMITING PRODUCTION: P-High summer water temperature P-Fine sediments P-Unscreened water diversions P-Habitat quantity S-Bank stability and artificial confinement S-Riparian condition S-Habitat diversity Refer to Appendix B for reference and specific detail by reach and species.
AU WORKING HYPOTHESIS STATEMENT: Hypothesis 1 - Inkaneep Creek is an important spawning area for sockeye, and an important spawning and rearing area for rainbow trout/steelhead. Objective 1- Determine numbers of sockeye, rainbow trout, and steelhead. Strategy 1 - Count steelhead spawners, and electrofish fry. Strategy 2- Count sockeye spawners and estimate fry production. Objective 2 - Determine whether *Onchorhynchus mykiss* spawning in Inkaneep Creek are adfluvial rainbow from Osoyoos Lake or steelhead. Strategy 1 - Use genetic markers, observation of scales, and measures of body morphometry to identify. Hypothesis 2 - Sockeye and steelhead egg-to-fry survival will increase when loading of fine sediments in Inkaneep Creek is reduced. Objective 1 - Control erosion resulting from road construction and maintenance. Strategy 1 - Refer to erosion control methods documented by ONA. Hypothesis 3 - Screening irrigation diversions on Inkaneep Creek will increase sockeye and steelhead fry survival. Objective 1 – Screen intakes. Strategy 1 - Determine practical screening methods. Prepare, negotiate, and implement plan. Hypothesis 4 - Increasing the limit of migration of adult steelheads will provide access to more spawning and rearing habitat. Objective 1 - Determine feasibility of laddering falls. Strategy 1 - Prepare a plan that provides costs, benefit, and risks of laddering options; implement. Hypothesis 5 - Streamside vegetation and stream bank stability will increase as a result of improved range management. Objective 1 - Monitor changes in streamside vegetation and bank stability improvements, and determine the extent of improvement due to range management changes. Objective 2 - Negotiate further improvements in range management if indicated by monitoring results.
DATA GAPS AND M&E NEEDS: Sediment loads in Inkaneep Creek (expected to be high) Species and numbers of fry being diverted into unscreened irrigation canals Presence, absence, and run timing of focal fish species It is not known whether *O. mykiss* are adfluvial or anadromous Degree of habitat utilization by anadromous species Flow, temperature, and water quality
MANAGEMENT STRATEGIES: Screen water withdrawals to NOAA or DFO specifications. Inventory the degree of use by steelhead and sockeye and other focal species. Investigate methods for protecting ground water quality. Improve riparian habitats and bank stability in upper watershed.

Reconnect floodplains that were artificially confined.
Increase LWD and install Newberry riffles to help with gravel sorting and pool formation processes.
Develop anadromous fish monitoring program to complement activities in U.S. (i.e. Upper Columbia monitoring efforts).

Assessment Unit (AU): O14—Canada Lower Mainstem

reaches: 10

1	2	3	4	5	6	7	8	9	10
11	12								



FOCAL species: Sockeye salmon, spring and summer/fall Chinook salmon, and steelhead.	Drainage area:

SUBWATERSHEDS:

Testalinden Creek

Hester Creek

Wolfcub Creek

ASSESSMENT UNIT DESCRIPTION:

This AU includes the Okanagan mainstem from Osoyoos Lake upstream to Vertical Drop Structure 12 in the middle of the Town of Oliver. The entire 15 kilometre (9 mile) stretch has been channellized. Habitat diversity is very low within the channel, with no LWD, no cover and few pools and riffles. The channel is not connected to the floodplain and riparian vegetation has been removed. The river in this area includes some riffles, most of which are associated with drop structures.

The tributaries in this section of the river (Testalinden, Hester and Wolfcub Creeks) remain dry for most of the year and are not considered a high priority for protection nor restoration at this point in time.

This section of the river supports sockeye, Chinook and steelhead. The major use is as a migratory pathway, but some spawning has been documented. This occurs on the occasional pockets of gravel associated with riffles. Elsewhere, the substrate is mostly sand and silt.

Productivity for focal fish species is presently limited by the low gradient (design grade between drop structures is 0.05%), silty substrates, a lack of habitat diversity within the channel, denuded banks, and lack of a floodplain. There are, however, opportunities for restoring pool/riffle habitats and creating greater habitat diversity, particularly in the vicinity of Vertical Drop Structures where there is sufficient drop to provide a design grade compatible with good fish habitat.

Water quality is unknown, but fertilizers and herbicides are widely used on surrounding vineyards.

Dyke roads parallel the river on both sides for the entire length of the river, but traffic is minimal.

LEVEL OF CERTAINTY:

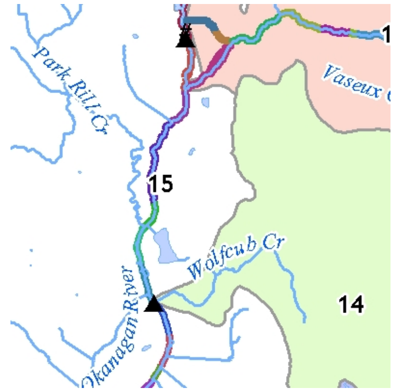
The level of certainty is high. This section of the river is highly accessible and has been thoroughly examined.

FACTORS LIMITING PRODUCTION: P-Habitat diversity P-Habitat quantity P- Fish Passage P-Spawning habitat S-Harrassment S-Channel stability Refer to Appendix B for reference and specific detail by reach and species.
AU WORKING HYPOTHESIS STATEMENT: Hypothesis 1 - Increasing the number of pool/riffle complexes in this AU will increase the spawning area used by sockeye, Chinook, and rainbow trout/steelhead, and will increase rearing habitat for Chinook and steelhead. Objective 1- Increase the number of pool/riffle complexes in the system. Strategy 1 - Replace the gradient drops at vertical drop structures with a series of rock riffles; where possible, restore channel sinuosity and braiding. Hypothesis 2 - Egg-to-fry survival for all the focal species can be increased by restoring a functional floodplain that provides an area for silt deposition and for dispersal of floodwaters. Objective 1 - Restore connectivity of channel and floodplain at selected locations (particularly in association with drop structures and groundwater sources). Strategy 1 - Purchase key riparian areas, set back dykes, and revegetate the floodplain. Hypothesis 3 - Sockeye, Chinook, and steelhead fry production can be increased by replacing the vertical drop structures that disorient migrating fry and increase their vulnerability to predation. Objective 1 - Replace drop structures with natural rock riffles. Strategy 1 - Design a plan in cooperation with provincial water managers. Hypothesis 3 - Moderating summer and autumn water temperatures will mitigate delays of migrating adults, and will increase the amount of available fry rearing habitat. Objective 1 - Locate and protect sources of incoming groundwater that form temperature refugia. Objective 2 - Shade the river by restoring riparian vegetation.
DATA GAPS AND M&E NEEDS: Spawning usage by sockeye, steelhead and Chinook Location and extent of temperature refugia, both current and potential (in dyked-off oxbows) Degree of predation of fry downstream of Vertical Drop Structures Water quality
MANAGEMENT STRATEGIES: Increase production of focal species by restoring selected portions of this AU, ensuing in a fully functional river with a wide diversity of habitats and connectivity with the floodplain. Replace vertical drop structures by more fish-friendly natural rock riffles. Locate and protect groundwater sources and temperature refugia. Increase knowledge of current focal species utilization.

Assessment Unit (AU): O15—Canada Middle Mainstem

Reaches: 6

1	2	3	4	5	6



FOCAL species: Sockeye salmon, spring and summer/fall Chinook salmon, and steelhead.	Drainage area:

SUBWATERSHEDS:

Vaseux Creek

Park Rill Creek

ASSESSMENT UNIT DESCRIPTION:

AU WORKING HYPOTHESIS STATEMENT:

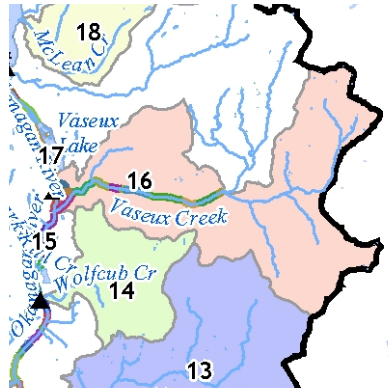
DATA GAPS AND M&E NEEDS:

MANAGEMENT STRATEGIES:

Assessment Unit (AU): O16—Vaseux/McIntyre

Reaches: 1

1										



FOCAL species: Sockeye salmon, spring Chinook salmon, and steelhead/rainbow trout.

Drainage area: 26,850 hectares (66,348 acres)

SUBWATERSHEDS:

Solco Creek

ASSESSMENT UNIT DESCRIPTION:

The watershed of Vaseux Creek is 80% forested and 0.7% agricultural. There is negligible urban development.

This AU includes the first reach of Vaseux Creek from its confluence with Okanagan River upstream to the canyon and falls (an impassable barrier). Although Vaseux Creek presently runs intermittently in the lower reach, there is good continuous flow further upstream.

Local residents report that the creek used to run continuously and supported sockeye and steelhead. Sockeye were reportedly so numerous that they plugged irrigation canals; their carcasses were spread on adjacent fields as fertilizer. In addition, Okanagan elders also remember Chinook returning to the system. Some say that channellization in the 1950s scoured the riverbed and opened up filtration galleries that now allow the stream to percolate underground during the summer.

Members of Colville Tribes and Okanagan Nation Alliance (ONA) visited the stream recently and wrote “This stream could be key to salmon recovery effort in the Okanogan River basin, but little information exists. A recent survey … indicate(d) that a huge potential for anadromous fish production exists. Substrate is mainly gravels and small cobble, ideal for steelhead production and other salmonids. Substrates are unconsolidated and little fine sediment is present …The lack of knowledge about this stream is a major limiting factor for the entire Okanogan subbasin.…”

Chinook reportedly enter this stream (Howie Wright, ONA, pers. comm..) as do large *Oncorhynchus mykiss* which may be adfluvial rainbow trout from Osoyoos Lake, steelhead, or both. In summer, the portion below the canyon percolates to the sub-surface and, thus far, there has been little effort to collect data on this stream. The large volume of water that exists in the spring still provides abundant spawning areas, and when flows are present in the fall, spawning sockeye have been observed.

LEVEL OF CERTAINTY:

Level of certainty is fair at best. Most of the information is expert opinion; no formal inventories have been conducted.

FACTORS LIMITING PRODUCTION:

Insufficient data information exists.

P-Habitat diversity

P-Flow

S-Channel Stability

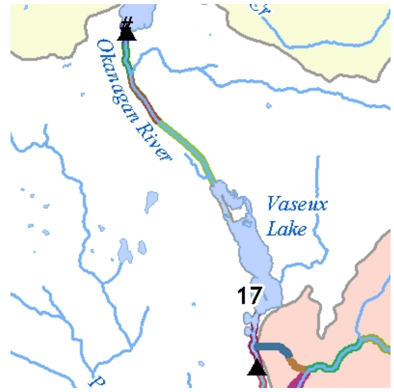
Refer to Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT: Hypothesis 1 - Man-made disturbances caused this formerly very productive stream to percolate underground. Restoration will provide spawning and rearing areas for all focal species. Objective 1 - Investigate the percolation problem and determine if restoration is feasible. Objective 2 - Investigate options for improved water flow in the lower portion of the creek. Hypothesis 2 - The large *O. mykiss* that use Vaseux Lake include both adfluvial rainbow trout and anadromous steelhead. Objective 1 - Determine the origin of Vaseux Creek's *O. mykiss*, and the interrelationship between resident and anadromous forms. Strategy 1 - Use morphometrics, genetics, marine origin cues (scales, stable isotopes), and run timing to ascertain whether these fish are anadromous or adfluvial. Prepare a management plan. Hypothesis 3 - Vaseux Creek is used for spawning and rearing by Chinook, steelhead, and sockeye. Objective 1 - Inventory fish populations during all life histories and prepare a management plan.
DATA GAPS AND M&E NEEDS: Fish presence, absence, distribution, abundance, and habitat utilization Water discharge, withdrawals, and quality data Natural barrier surveys Historical information COLVILLE TRIBES and ONA state that "…this Creek will require major efforts to collect, analyze data and develop a watershed recovery plan. This should be one of the highest priorities in the entire Okanogan River subbasin for both the U.S. and Canada."
MANAGEMENT STRATEGIES: Collect data to fill major data gaps. Investigate possibilities for restoring flows, and write up a management plan.

Assessment Unit (AU): O17—Vaseux Lake and some Mainstem reaches

reaches: 7

19a	**19b**	**20**	**21**	**22**	**23**	**24**					



FOCAL species: Sockeye salmon, spring and summer/fall Chinook salmon, and steelhead.

Drainage area:

SUBWATERSHEDS:

Shuttleworth Creek

ASSESSMENT UNIT DESCRIPTION:

This AU includes the Okanagan River mainstem from McIntyre Dam north (upstream) to the outlet of Skaha Lake at the Town of Okanagan Falls. Vaseux Lake is included within the AU.

McIntyre Dam is a low head dam approximately 3 metres high. Its purpose is to divert water into a very large irrigation ditch which serves the southern Okanagan Valley. It also serves as a balancing reservoir to stabilize the height of water in Vaseux Lake. Many years ago, large mouth bass moved into the Okanagan from the U.S., and in an attempt to contain them, fisheries officers decided that McIntyre Dam should not be allowed to pass fish. McIntyre Dam has blocked migration for all anadromous species since then.

The irrigation canal immediately upstream from McIntyre Dam remains unscreened; if anadromous fish are allowed to pass McIntyre, the canal would destroy many fry.

Vaseux Lake lies within this AU. It supports populations of both large and small mouth bass, and may present a predation problem for out-migrating salmon fry. Kokanee and rainbow trout populations are depressed, indicating that the lake does not have much potential for rearing salmonids, possibly due to unsuitable limnological conditions (high epilimnial temperature, low hypolimnetic oxygen levels).

The mainstem is channellized in this AU, and for the most part, is too low in gradient to be used by focal species. The exception is the northern reach which runs from the outlet of Skaha Lake downstream to the confluence with Shuttleworth Creek. This reach has not been channeled and has a good gradient and mixture of cobble and gravel substrate. A modest fishery for rainbow trout occurs in this reach; the area may be suitable for steelhead if they are able to get by McIntyre Dam.

Shuttleworth Creek has huge problems with mass wasting and unstable banks. It introduces vast quantities of silt into Okanagan River between its confluence and Vaseux Lake. A sediment-catching basin has been constructed at the mouth of Shuttleworth Creek, but appears ineffective.

LEVEL OF CERTAINTY:

The level of certainty for this AU can be described as fair to good. Effects of low gradients, siltation, and channellization are obvious.

FACTORS LIMITING PRODUCTION:

P-Habitat diversity

P-Habitat quantity

P-Predation

S-Channel Stability

S-Pathogens

Vaseux Lake

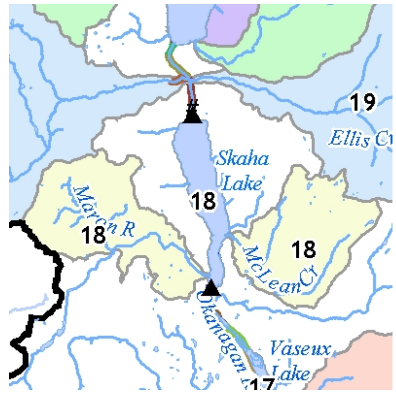
Temp/DO limitations

Predation *Mysis relicta* competition uncertainty Kokanee competition uncertainty Refer to Appendix B for reference and specific detail by reach and species.
AU WORKING HYPOTHESIS STATEMENT: Hypothesis 1 - The habitat between McIntyre Dam and Shuttleworth Creek is unsuitable for focal species to use other than as a migratory pathway. Attempts to change the nature of this reach are premature at this time. Objective 1 - Provide migratory access through this AU. Strategy 1 - Design a system for laddering, bypassing or changing the operation of McIntyre Dam. Strategy 2 - Design a plan for restoring the fishway at Okanagan Falls Dam. Strategy 3 - Design a plan for screening the irrigation canal at McIntyre Dam. Hypothesis 2 - Predation by warm water species in Vaseux Lake will limit production of anadromous focal species. Strategy 1 - Assess the potential predation of warm water species in Vaseux Lake on out-migrating salmon fry. Hypothesis 2 - The Okanagan River Reach between Shuttleworth Creek and Skaha Lake is suitable habitat for Chinook/steelhead/sockeye spawning and Chinook/steelhead rearing. Objective 1 - Determine the extent of quality spawning and rearing habitat. Strategy 1 - Survey this reach and compare with steelhead and Chinook spawning and rearing habitat requirements. Prepare management plan.
DATA GAPS AND M&E NEEDS: Habitat suitability studies Inventory of present use by salmonids (rainbow trout) Potential predation problems in Vaseux Lake
MANAGEMENT STRATEGIES : Plan migratory access through this AU for anadromous fish, and evaluate. Investigate suitability of habitat in upper reach of AU.

Assessment Unit (AU): O18—Skaha Lake

Reaches: 2

1	**2**						



FOCAL species: Sockeye salmon, spring and summer/fall Chinook salmon, and steelhead

Drainage area:

SUBWATERSHEDS:

McLean Creek

Marron River

ASSESSMENT UNIT DESCRIPTION:

This AU is comprised of the north and south basins of Skaha Lake. The lake is oligotrophic/mesotrophic with a maximum depth of 53 metres (175 feet) and a flushing rate of 1 year. In the late 1960s, Skaha was bordering on eutrophic, but tertiary sewage treatment has lowered the trophic status.

Limitations for rearing sockeye fry and holding sockeye adults in Osoyoos Lake have prompted recommendations for reintroduction of sockeye to Okanagan Lake, a cooler and more well oxygenated water body. Provincial fisheries' authorities expressed concerns about competition between sockeye and kokanee, and as a result, a decision was made to use Skaha Lake for an experimental introduction. If funded, the experiment will begin in 2004, and will prompt an active research program into the costs, benefits and risks of extending the present range of focal species, beginning with sockeye.

LEVEL OF CERTAINTY:

High. A number of basic limnology studies and fish inventories have been carried out on Skaha Lake.

FACTORS LIMITING PRODUCTION:

Passage of McIntyre Dam and Okanagan Falls outlet dam

Competition with *Mysis relicta* and kokanee

Predation from small mouth bass and other exotic species

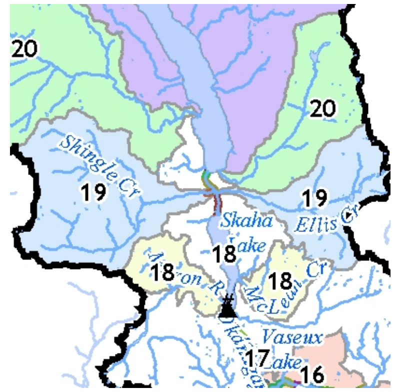
Refer to Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT: Hypothesis 1 - There will be no difference in sockeye salmon fry-to-smolt and smolt-to-adult survival in Skaha Lake compared to Osoyoos Lake. Objective 1 - Determine if sockeye production in Skaha Lake is equal to or greater than in Osoyoos Lake. Strategy 1 - Identify funding sources, and implement an experimental sockeye fry reintroduction program into Skaha Lake; monitor and evaluate program. Follow the assessment program outlined in detail by ONA. Hypothesis 2 - *Mysis relicta* will compete with sockeye salmon fry for available food. Objective 1 **-** Determine if *Mysis relicta* limit sockeye fry survival in Skaha Lake. Strategy 1 - Investigate the standing stock and diet of *Mysis relicta* and compare with the diet of sockeye and kokanee; determine interrelationships. Hypothesis 3 - There will be no difference in sockeye adult over-summer survival-to-spawning in Skaha Lake compared to Osoyoos Lake. Objective 1 - Determine if adult sockeye over-summer survival-to-spawning in Skaha Lake is greater compared to sockeye in Osoyoos Lake basins. Strategy 1- Trap and transport adult sockeye into both lakes (and basins), and monitor over-summer survival to spawning. Hypothesis 4 - *O. nerka* fry production is limited by exotic species predation (e.g. small mouth bass). Objective 1 - Determine if exotic species limit *O. nerka* (sockeye and kokanee) fry-to-smolt (1.0) survival. Hypothesis 5 - Historically, there were spring and summer/fall Chinook, steelhead and other salmon returning above Okanagan Falls and into Skaha Lake. Objective 1- Determine salmon recovery goals for stock and habitat restoration of upper Okanagan Strategy 1 - Use a combination of traditional knowledge with western science to develop recovery goals and restore ecosystem.
DATA GAPS AND M&E NEEDS: Mysid standing stocks Kokanee standing stocks and biomass Level of competition between sockeye, kokanee and mysids Historical information on salmon species in the upper Okanagan
MANAGEMENT STRATEGIES: Investigate the costs, benefits, and risks of reintroducing sockeye salmon to Skaha Lake. Initiate collection of Traditional Ecological Knowledge based on protocols to be developed.

Assessment Unit (AU): O19—Canada Main Stem to Okanagan Lake

Reaches: 3

1	**2**	**3**	**4**							



FOCAL species: Sockeye salmon, spring summer/fall Chinook salmon, and steelhead.

Drainage area:

SUBWATERSHEDS:

Ellis Creek - not included in EDT and may not be on maps.

Shingle Creek

ASSESSMENT UNIT DESCRIPTION:

This AU includes the 6 kilometre (4 mile) stretch of Okanagan River located between Okanagan and Skaha Lakes. It has been completely channellized, and the grade of the lower portion is too low to be useful to the focal species except as a migration path. The middle and upper portions of the AU, however, do have a suitable gradient, and are presently used by spawning kokanee, some of which are as large as sockeye.

This AU is lake-headed. That, plus riprapped dikes, preclude the recruitment of any spawning gravel. As a result, gravel has been added in the past, and has been a successful improvement for spawning kokanee. Similar steps will be needed to accommodate sockeye.

Two tributaries enter this AU: Ellis Creek and Shingle Creek. Ellis Creek runs through the industrial section of Penticton, and drains a watershed of 12,182 hectares. It is intermittent, steep, and has a substrate of large boulders and cobbles. In freshet, it carries heavy loads of silt, and in mid-summer, dries completely. A few kokanee spawn in the lowest reach of Ellis Creek, but they soon encounter an impassable concrete dam. Costs of laddering the dam would outweigh benefits as the upstream habitat is too steep and confined to be useful.

Shingle Creek is described in a separate AU summary.

LEVEL OF CERTAINTY:

The level of certainty is good. This AU has been under close surveillance for many decades.

FACTORS LIMITING PRODUCTION:

P-Habitat diversity

P-Habitat quantity

S-Predation

S-Harassment

Obstruction in Ellis Creek

Shingle Creek has an obstruction about 1kilometre above, with passage provisions, but not operative.

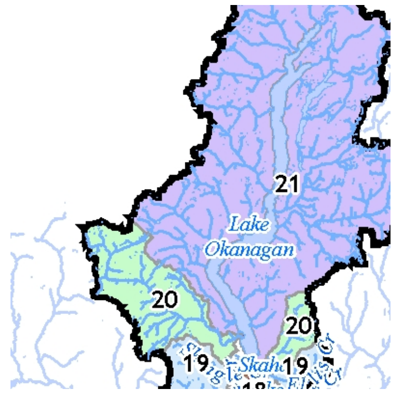
Refer to Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT: Hypothesis 1 - Adult sockeye salmon that are reintroduced to Skaha Lake will compete with kokanee for spawning habitat in this AU due to limited spawning habitat. Objective 1 - Determine if sockeye and Skaha kokanee spawning habitat overlaps. Strategy 1 - Trap and transport adult sockeye into Skaha Lake; monitor and evaluate. Hypothesis 2 - Eggs and fry of all focal species (starting with sockeye) will survive better when a functional floodplain is available to provide cover and shade, a settling area for fines, a filter for runoff, stabilization for banks, and a diversification of habitat. Objective 1 - Restore a natural floodplain and riparian zone where possible. Strategy 1 - Acquire key riverfront properties which will allow removal or setting back of dykes. Strategy 2 - Conduct stream restoration on acquired riverfront properties. Hypothesis 2 - Sockeye egg-to-fry survival is limited by lack of gravel recruitment. Objective 1 - Compensate for the lack of gravel recruitment. Strategy 1 - Construct gravel spawning beds in conjunction with habitat restoration; monitor and evaluate.
DATA GAPS AND M&E NEEDS: Water quality criteria
MANAGEMENT STRATEGIES: Improve spawning conditions to accommodate reintroduced sockeye salmon. Restore river floodplain function where feasible.

Assessment Unit (AU): O20—Okanagan Lake

Reaches: 1

1										



FOCAL species: Sockeye salmon, kokanee and rainbow trout

Drainage area:

SUBWATERSHEDS:

Penticton Creek

Trout Creek

ASSESSMENT UNIT DESCRIPTION:

This AU includes a 7 kilometre (4½ mile) portion of Okanagan Lake from the lake outlet at Penticton north to Trout Creek. This small portion of Okanagan Lake was included in the Subbasin Plan to mark a placeholder for Okanagan Lake. Limited resources precluded the inclusion of a larger section of the lake.

Of all the lakes in the drainage basin, Okanagan Lake stands out as having the greatest potential for rearing sockeye.- It is 35,000 hectares (88,000 acres) in surface area and up to 240 metres (800 feet) in depth. It is more oligotrophic than the downstream lakes and has an unlimited zone of tolerable conditions. Furthermore, it has many tributary streams that offer suitable spawning.

The decision to reintroduce sockeye to Okanagan Lake will not be made until monitoring and evaluation of results from the experimental reintroduction at Skaha Lake. In the meantime, Okanagan Lake will be included in planning exercises because of its tremendous potential. Salmon focal species other than sockeye will not be discussed at this time.

LEVEL OF CERTAINTY:

Good. Okanagan has been the centre of scientific attention since the Okanagan Basin Study in the early 1970s. More recently, a major scientific program called Okanagan Lake Action Plan (OLAP) has been deployed to address the reasons and solutions for the collapse of the kokanee population.

FACTORS LIMITING PRODUCTION:

Passage at Okanagan Lake outlet dam (fish ladder available but not operated)

Competition with *Mysis relicta*

Destruction of stream spawning areas

Tributary flows

Nutrient imbalances

Kokanee fry to 1.0 survival (overwinter survival)

Refer to Appendix B for reference and specific detail by reach and species

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1- Benefits of reintroducing sockeye salmon to Okanagan Lake will outweigh the costs and risks.

Objective - Determine costs, benefits and risks of sockeye reintroduction.

Strategy 1 - Use information gained in the Skaha Lake experiment to model Okanagan Lake. Use strategy outlined in detail by ONA.

Hypothesis 2 - Kokanee fry to 1.0 survival is reduced due to overwinter mortality.

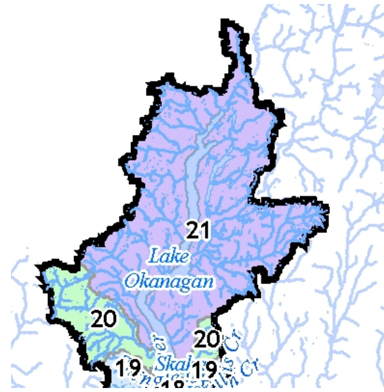
Objective - Determine if overwinter mortality is a significant factor in reduced kokanee fry to 1.0 survival.

Strategy 1 - Conduct seasonal acoustic and trawl surveys to verify overwinter mortality. Strategy 2- If significant overwinter mortality, determine causes and evaluate costs/benefits/risks of remediation. Hypothesis 3 - *Mysis relicta* limit kokanee production in Okanagan Lake. Objective - Determine if *M. relicta* limit kokanee production. Strategy 1 - Conduct mysid harvesting to increase kokanee rearing capacity; monitor and evaluate. Hypothesis 4 - A nutrient imbalance of reduced dissolved nitrogen levels during the late summer fall in Okanagan Lake provides conditions more favourable for cyanobacteria (blue-green algae) and; therefore, limits kokanee production through the food chain (less desirable food for desired zooplankton species; less desired zooplankton species for kokanee). Objective - To determine if improving nutrient imbalance will increase kokanee production. Strategy 1 - Evaluate costs/benefits/risks of nutrient addition to improve nutrient conditions. Strategy 2 - Implement small scale experiments to evaluate benefits of nutrient addition. Strategy 3 - Conduct community consultations, evaluate costs/benefits and risks, implement, monitor and evaluate. Hypothesis 5 - Channelization and water flow limit rainbow trout and kokanee production in Trout Creek. Objective - Improve flow conditions and restore habitat functions to improve rainbow trout and kokanee production. Strategy 1 - Set back dike where possible, increase water flows (license buy backs, water planning, alternate water sources).
DATA GAPS AND M&E NEEDS: Sockeye/kokanee interactions Effect of *Mysis relicta* on *Onchorhynchus nerka* stocks Benefits of re-introducing sockeye to Okanagan Lake Overwinter mortality of kokanee fry to 1.0.
MANAGEMENT STRATEGIES: Investigate the costs, benefits and risks of sockeye reintroduction. Continued implementation of Okanagan Lake Action Plan.

Assessment Unit (AU): O21—Shingle Creek

Reaches: 1

1										



FOCAL species: Sockeye salmon and steelhead

Drainage area:

SUBWATERSHEDS:

Shatford Creek

ASSESSMENT UNIT DESCRIPTION:

This AU includes a 1kilometre (0.6 mile) portion of Shingle Creek from its confluence with Okanagan River to a fishway and low-head dam located on Penticton Reserve.

Shingle Creek was, historically, a major fishing area for First Nations; the name for this creek translates to “place of the steelhead.” Additional information on salmon, however, is lacking (H. Wright, ONA, pers. comm.). McIntyre Dam has cut off access to this stream, but the stream continues to be an important producer of rainbow trout and kokanee.

Shingle Creek and its tributary, Shatford Creek, drain a watershed of 22,040 hectares (54,460 acres). The watershed is 80-90% forested with 3% agricultural use.

The AU is wholly within the Penticton Reserve, and the Band is keenly interested in restoring anadromous salmonids to the upper Okanagan.

LEVEL OF CERTAINTY:

Fair. As a part of the Okanagan System, Shingle Creek has been of considerable interest; however, its location on Reserve has limited access.

FACTORS LIMITING PRODUCTION:

Water withdrawal

Limited natural flow

Bank instability (natural but worsened by cattle and horses)

Access to upper reaches

Refer to Appendix B for reference and specific detail by reach and species.

AU WORKING HYPOTHESIS STATEMENT:

Hypothesis 1 - Habitat degradation and water flow limit rainbow trout and kokanee (and in the future, sockeye) production in Shingle Creek.

Objective 1 - Improve flow conditions and restore habitat functions to improve rainbow trout and kokanee (and in the future, sockeye) production.

Strategy 1 - Set back diking and habitat restoration where possible; increase water flows (license buy backs, water planning, alternate water sources).

Hypothesis 2 – Historically, there were steelhead and other salmon returning above Okanagan Falls and into Shingle Creek.

Objective 1 - Determine salmon recovery goals for stock and habitat restoration of Shingle Creek as information is lacking

Strategy 1 - Use a combination of traditional knowledge with western science to develop recovery goals and restore creek.

DATA GAPS AND M&E NEEDS: Benefits, costs, and risks of steelhead reintroduction Methods of steelhead reintroduction Quantity and quality of spawning and rearing habitat Traditional knowledge of the historic fishery (species, numbers, and timing)
MANAGEMENT STRATEGIES: Investigate the benefits and methods of steelhead reintroduction. Investigate and implement restoration options for Shingle Creek.

5.4 Fish and Wildlife Biological Goals and Objectives

Description of Values and Priorities

Prioritizing across all levels of actions in this subbasin plan is beyond the scope of this effort and the current precision of the assessment. The intricate linkages between artificial production actions and habitat-based strategies require a much more in-depth examination of trade-offs, legal responsibilities, cause-and-effect relationships, and most importantly, a systematic analysis of the implied effects of individual actions and the synergistic effect(s) of combined actions. To do this with a defensible quality of precision, the level of confidence in the habitat rating inputs and current fish use and life history patterns must be improved over time. Notably, this plan lays a logical foundation and rational strategy to do this.

Therefore, prioritization in this plan is limited to the following schema: a close examination of the habitat limiting factors and use of the course-scale filtering approach described above. We used this approach to develop strategies (habitat and artificial production) that 1.) Operate directly upon the limiting factors, including out-of-basin effects in the case of artificial production, 2.) Are rationale, implementable and cost-effective, 3.) Support the biological objectives, and, 4.) Sustain the goals and vision of the subbasin plan. Use of testable hypotheses statements and measurable objectives, coupled with the M&E framework and current baseline efforts for the subbasin, will allow planners to more credibly and accurately assess the effects of the strategies and the overall progress towards reaching the goals of the subbasin plan over the life of the management plan.

5.5 Fisheries Management Plan

5.5.1 Sockeye

Goal: Run size and spawning escapement level of sockeye salmon in the Okanogan/Okanagan Subbasin that:

- provide for long term viable population(s)
- contribute to spatial diversity;
- help mitigate hydrosystem losses;
- lead to a harvestable surplus.

Objective 1 – Re-introduce sockeye into Skaha Lake to:

- improve fry survival during rearing
- improve adult survival during pre-spawn holding and
- serve as an experimental pilot program for re-introduction into Okanagan Lake.

Strategy 1-1 – Maintain a close liaison with Canadian fisheries authorities (COPTWG) through ONA and Colville Tribes

Strategy 1-2 - Collect eggs from locally adapted Okanagan stocks, incubate, mark fry and release into Skaha Lake.

Strategy 1-3 - Monitor and evaluate results of sockeye introduction into Skaha Lake using methods consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

Strategy 1-4 - Investigate options for sockeye passage at McIntyre Dam.

Strategy 1-5 – Determine competitive relationships between sockeye fry, kokanee fry and Mysis. Use meristic and genetic data to separate Okanogan sockeye and Skaha kokanee

Strategy 1-6 – Determine benefits, costs and risks of sockeye re-introduction into both Skaha and Okanagan lakes

Strategy 1-7 – Provide annual reports on progress of sockeye re-introduction program

Objective 2 – Improve survival of sockeye in the mainstem migration corridor

Strategy 2-1 – Determine where, when and why 50% of the sockeye run is disappearing between Wells Dam and the spawning grounds.

Strategy 2-2. Expand access to off-channel and in-channel thermal refugia,.

Objective 3– Monitor and evaluate level of survival of Okanagan sockeye salmon at various stages of their fresh water life history (egg to fry, fry to smolt, and smolt to spawner) to fill data gaps (necessary for stock conservation and management planning)

Strategy 3-1. Quantify egg to fry survival

Strategy 3-2. Monitor fry abundance and distribution in Osoyoos and Skaha Lakes; spawner timing, distribution and abundance throughout the mainstem and tributaries,

Strategy 3-3. Determine amount of habitat available for all life stages of sockeye and estimate carrying capacity .

Strategy 3-4 Determine adult to adult and smolt-to-adult return rates (construct a permanent counting facility at Zosel Dam).

Strategy 3-5. Determine extent and carrying capacity of viable holding area for prespawning adult sockeye in Osoyoos Lake, Skaha Lake and Okanagan LakeSpring Chinook

Goal: Run size and spawning escapement level that provides for viable population(s) of spring Chinook salmon in the Okanogan Subbasin; contributes to spatial diversity for the Upper Columbia ESU; effectively mitigates for hydrosystem losses, and supports a harvestable surplus.

Objective 1: Determine current and future natural smolt production capabilities within the Okanogan Subbasin.

Strategy 1-1. Determine adult to adult and smolt-to-adult return rates and quantify spawner success rates for naturally produced and hatchery produced fish.

Strategy 1-2. Operate a smolt trap or weir in the lower Okanogan River and at least one tributary to the Okanogan River to monitor migration pattern, timing, as well as determine smolt production.

Strategy 1-3. Design and implement an over-winter (and possible over-summer) ecology study to examine use and survival of stream type fish. This may also include investigations into possible lake rearing life history patterns.

Strategy 1-4. Determine appropriate broodstock source for rebuilding and recovery efforts and initiate efforts to enhance this broodstock for use in the basin.

Strategy 1-5. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

Objective 2.Quantify natural and artificial limitations to natural production.

Strategy 2-1. Design and implement a study to quantify use and survival of stream type fish through the summer and winter months of their first year.

Strategy 2-2.Conduct annual spawning ground surveys as run sizes increase (track colonization through variety of means including telemetry).

Strategy 2-3. Determine fry production, parr production and spring smolt production and correlate to spawner abundance, human and natural changes over time.

Strategy 2-4. Find fish in summer, early fall, and winter and characterize the habitat they utilize. Follow this protocol through a series of years and abundance trends.

Strategy 2-5. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

Objective 3. Achieve a natural cohort replacement rate of 1 or greater and a minimum of 500 naturally produced spawners for at least eight consecutive years. EDT analysis does not currently support this abundance level, thus, new and additional areas for production must be investigated.

Strategy 3-1. Use artificial production to aid in the conservation of natural-origin anadromous fish populations by increasing their abundance, distribution and diversity, and to enhance tribal C&S and recreational angling opportunities.

Strategy 3-2. Develop locally adapted stocks by use of best surrogate in supplementation programs.

Strategy 3-3.Eliminate exogenous stocks from the artificial production programs once natural broodstock or a surrogate broodstock source is identified and put into use.

Strategy 3-4. Manage consumptive fisheries consistent with adult escapement objectives.

Strategy 3-5. Reduce predatory consumption of smolts during seaward migration.

Strategy 3-6. Enlarge existing hatchery facilities and/or construct additional facilities to increase effectiveness, not through quantity but through quality of the hatchery programs to supplement the natural production.

Strategy 3-7. Improve smolt and adult bypass systems at mainstem hydropower facilities.

Strategy 3-8. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

Strategy 3-9. Develop new and modify existing acclimation facilities to improve distribution of spawners at return and reduce point source impact of direct plants.

Strategy 3-10.Achieve habitat objectives identified in the AU summaries.

Strategy 3-11. Reconnect side channels and floodplain areas to increase late summer and over winter rearing habitat and subsequently survival for stream type fish, and/or enhance lake-rearing habitats where applicable.

Objective 4: Maintain artificial production programs using locally adapted brood fish or interim surrogates to meet recovery, conservation and harvest needs, while mitigating for fish losses from the Columbia River hydropower system.

Strategy 4-1.Use locally adapted stocks only.

Strategy 4-2. Determine egg to smolt survival.

Strategy 4-3. Use natural rear to determine if a better smolt (smolt-to-adult survival) can be produced from competition, predator avoidance, temperature, flow, and cover than a traditional production facility.

Strategy 4-4. Quantify naturally produced spawners with CWT marked spawners.

Strategy 4-5. Maintain and reacquire distinct population attributes of the Okanogan Subbasin.

Strategy 4-6. Reduce predatory consumption of migrating smolts in the mainstem hydropower system.

Strategy 4-7. Manage and monitor consumptive fisheries consistent with adult escapement objectives.

Strategy 4-8. Perform annual spawning ground surveys.

Strategy 4-9. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

Strategy 4-10. Develop new and modify existing acclimation facilities to improve distribution of spawners at return and reduce point source impact of direct plants

Strategy 4-11. Achieve habitat objectives identified in the AU summaries.

Objective 5. Maintain the genetic diversity/ integrity and population structure of the locally adapted stocks (natural and artificially propagated stocks), consistent with VSP criteria developed through the TRT for recovery planning.

Strategy 5-1. Improve existing or create adult collection facilities on the tributary streams to promote local stock production.

Strategy 5-2. Collect DNA or genetic tissue to monitor and evaluate artificial production programs.

Strategy 5-3. Quantify naturally produced and hatchery spawners on the spawning grounds to determine success adult to adult for both.

Strategy 5-4. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

Strategy 5-5. Develop new and modify existing acclimation facilities to improve distribution of spawners at return and reduce point source impact of direct plants

Strategy 5-6. Achieve habitat objectives identified in the AU summaries.

Objective 6. Minimize impacts of artificial propagation on resident and naturally produced anadromous fish through genetic and fish health monitoring, juvenile rearing and release strategies, and brood collection.

Strategy 6-1. Improve existing or create adult collection facilities on the tributary streams to promote local stock production.

Strategy 6-2. Collect DNA or genetic tissue to monitor and evaluate artificial production programs.

Strategy 6-3. Monitor smolt migration development using external visual observation within the hatchery and coincide release to peak smoltification.

Strategy 6-4. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

Strategy 6-5. Develop new and modify existing acclimation facilities to improve distribution of spawners at return and reduce point source impact of direct plants.

Strategy 6-6. Achieve habitat objectives identified in the AU summaries.

Objective 7. Improve smolt-to-adult survival in the mainstem migration corridor.

Strategy 7-1. Increase and require spring flow augmentation.

Strategy 7-2. Reduce predatory consumption of migrating smolts in the mainstem hydropower system.

Strategy 7-3. Manage and monitor consumptive fisheries consistent with adult escapement objectives.

Strategy 7-4. Improve juvenile bypass systems within the Columbia River hydrosystem.

Objective 8: Provide species status report every five years to evaluate effectiveness of vision, with adoption of changes as necessary every ten years.

Strategy 8-1. Document life history strategy.

Strategy 8-2. Operate smolt traps and/or weirs to determine migration pattern and timing.

Strategy 8-3. Correlate abundance (status and trend) with human and natural environmental changes and track progress of habitat-oriented protection and restoration programs for effectiveness.

Strategy 8-4. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

5.5.2 Summer/fall Chinook

Goal: Run size and spawning escapement levels that provide for viable self-sustaining naturalized population of upper Columbia summer/fall Chinook salmon in the Okanogan Subbasin; effectively mitigate for hydrosystem losses and supports a harvestable surplus.

Objective 9. Increase the natural spawning escapement to match production levels sought in the HGMPs, HCP and to fully seed the Okanogan River system (including portions of the Upper Middle Mainstem subbasin).

Strategy 9-1. Implement the most successful rearing strategy for artificial production to ensure demographic success of the natural production. Monitor and adaptively manage.

Strategy 9-2. Expand the number of acclimation facilities to better distribute releases of artificial production.

Strategy 9-3. Increase and require spring/summer flow augmentation.

Strategy 9-4. Reduce predatory consumption of summer Chinook subyearlings and yearling migrants.

Strategy 9-5. Manage consumptive fisheries consistent with adult escapement objectives.

Objective 10. Maintain and/enhance sport and tribal fisheries, consistent with the protection of endemic naturally produced stocks.

Strategy 10-1. Improve juvenile bypass facilities at Columbia River hydropower facilities.

Strategy 10-2. Identify and evaluate most successful rearing strategy for artificial production to ensure demographic success of the natural production.

Strategy 10-3. Reduce predatory consumption of summer Chinook subyearlings and yearling migrants.

Strategy 10-4. Identify, conserve and monitor natural production demographics.

Strategy 10-5. Manage consumptive fisheries consistent with adult escapement objectives.

Objective 11: Maintain artificial production programs that supplement natural production using locally adapted stocks.

Strategy 11-1. Implement and evaluate the most successful rearing strategy for artificial production to ensure demographic success of the natural production.

Strategy 11-2. Quantify naturally produced spawners with CWT marked spawners.

Strategy 11-3. Implement supplementation programs consistent with Mid Columbia HCPs, HGMP, future hatchery program proposals etc.

Strategy 11-4. Provide adult collection facilities on Columbia River tributaries for management of locally adapted stock(s).

Objective 12. Determine natural production smolt capabilities within the Okanogan Subbasin.

Strategy 12-1. Determine egg to smolt survival.

Strategy 12-2. Operate a smolt trap and/or weir(s) in the lower Okanogan River to monitor migration pattern and timing as well as determine natural production capabilities.

Strategy 12-3. Identify, conserve and monitor natural production demographics.

Strategy 12-4.Conduct annual spawning ground surveys.

Strategy 12-5. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

Objective 13. Determine and quantify natural and artificial limitations to natural production.

Strategy 13-1. Evaluate long-term trends with human and natural events.

Strategy 13-2. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

Objective 14. Minimize impacts of artificial propagation on resident and naturally produced anadromous fish through juvenile rearing and release strategies, brood collection and genetic monitoring.

Strategy 14-1. Rear and release high quality smolts determined through size, fish health, smoltification and imprinting.

Strategy 14-2. Collect DNA or genetic tissue from natural spawners and hatchery spawners every three years to ensure consistency between the two and with baseline.

Strategy 14-3. Determine early life history strategy most successful to adult return for natural production and hatchery production. Ensure artificial production does not change demographics.

Strategy 14-4.Monitor fish health monthly, and ensure disease occurrence mirrors natural production.

Strategy 14-5. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

Objective 15: Improve smolt-to-adult survival in the mainstem migration corridor.

Strategy 15-1. Improve juvenile bypass facilities at Columbia River hydropower facilities.

Strategy 15-2. Reduce predatory consumption of summer Chinook subyearlings and yearling migrants.

Strategy 15-3. Identify, conserve and monitor natural production demographics.

Objective 16. Provide species status report every five years to evaluate effectiveness of vision, with adoption of changes as necessary every ten years.

Strategy 16-1. Document natural production demographics.

Strategy 16-2. Correlate historical and current abundance with human and natural occurrences.

Strategy 16-3. Provide spawner recruit analysis.

Strategy 16-4. Determine natural production carrying capacity.

Strategy 16-5. Determine what proportion of the annual return is naturally and artificially produced. Report on how well is artificial production is contributing to meeting overall goals and objectives for the subbasin.

Strategy 16-6. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

Strategy 16-7. Operate smolt trap and/or weir(s)in the lower Okanogan River.

Strategy 16-8. PIT tag naturally produced and artificially produced smolts to determine if migration patterns are similar and to examine relative survival differences.

Objective 17. Maintain and expand evaluation of the artificial production program.

Strategy 17-1.Operate a smolt trap in the lower Okanogan River to assess naturally production and smolt migration timing and pattern.

Strategy 17-2. Implement complete life history study to monitoring survival through Columbia River hydropower system, estuary and marine environment.

Strategy 17-3. Provide query of PSMFC database for CWT recoveries to determine escapement, fishery contributions and general marine survival.

Strategy 17-4. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

5.5.3 Steelhead

Goal: Run size and spawning escapement levels that provide for the recovery of ESA listed upper Columbia River steelhead in the Okanogan Subbasin; effectively mitigates for hydrosystem losses and supports a harvestable surplus.

Objective 18: Determine natural smolt production capabilities within the Okanogan Subbasin.

Strategy 18-1. Determine adult to adult and smolt-to-adult return rates and quantify spawner success rates for naturally produced and hatchery produced fish.

Strategy 18-2. Operate a smolt trap and/or weir(s) in the lower Okanogan River and at least one tributary to the Okanogan River to monitor migration pattern, timing, as well as determine smolt production.

Strategy 18-3. Design and implement an over-winter ecology study to examine use and survival through the winter.

Strategy 18-4. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

Objective 19. Determine and quantify natural and artificial limitations to natural production.

Strategy 19-1. Design and implement a study to quantify use and survival of through the summer and winter months of their first and second year.

Strategy 19-2. Conduct annual spawning ground surveys.

Strategy 19-3. Determine fry production, parr production and spring smolt production and correlate to spawner abundance, human and natural changes over time.

Strategy 19-4. Find fish in summer, early fall, and winter and characterize the habitat they utilize. Follow this protocol through a series of years and abundance trends.

Strategy 19-5. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

Objective 20. Achieve a natural cohort replacement rate of 1 or greater and a minimum of 2,500 naturally produced spawners for at least eight consecutive years (adapted from

NOAA Fisheries interim recovery abundance and productivity targets for Methow since no numbers for the Okanogan have been developed).

Strategy 20-1. Maintain artificial production programs.

Strategy 20-2.Use locally adapted stocks in supplementation programs.

Strategy 20-3. Use kelt reconditioning to support recovery and subbasin plan goals for abundance and diversity.

Strategy 20-3. Manage consumptive fisheries consistent with adult escapement objectives.

Strategy 20-4. Reduce predatory consumption of smolts during seaward migration.

Strategy 20-5. Enlarge existing hatchery facilities and construct additional facilities to increase effectiveness, not through quantity but through quality of the hatchery programs to supplement the natural production.

Strategy 20-6. Reduce predatory consumption in mainstem migration corridor.

Strategy 20-7. Increase and require spring flow augmentation on the Columbia mainstem.

Strategy 20-8. Improve smolt bypass systems at mainstem hydropower facilities.

Strategy 20-9. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

Strategy 20-10. Develop new and modify existing acclimation facilities to improve distribution of spawners at return and reduce point source impact of direct plants.

Strategy 20-11. Achieve habitat objectives identified in the AU summaries.

Strategy 20-12. Reconnect side channels and floodplains, as well as reduce alluvial fan barriers to **increase late summer and winter rearing habitat, thus increasing survival for stream type fish.**

Objective 21. Maintain artificial production programs using locally adapted brood fish to meet recovery, conservation and harvest needs, while mitigating for fish losses from the Columbia River hydropower system.

Strategy 21-1. Use locally adapted stocks only.

Strategy 21-2. Determine egg to smolt survival.

Strategy 21-3. Use natural rear to determine if a better smolt (smolt-to-adult survival) can be produced from competition, predator avoidance, temperature, flow, and cover than a traditional production facility.

Strategy 21-4. Radio tag adult steelhead migrants in upper Columbia River to monitor location of winter holding and spawning.

Strategy 21-5. Quantify naturally produced spawners with CWT marked spawners.

Strategy 21-6. Maintain/develop distinct population attributes of the Okanogan Subbasin.

Strategy 21-7. Develop tributary adult collection facilities so all brood stock requirements are met from these locations.

Strategy 21-8. Reduce predatory consumption of migrating smolts in the mainstem hydropower system.

Strategy 21-9. Manage and monitor consumptive fisheries consistent with adult escapement objectives.

Strategy 21-10. Perform annual spawning ground surveys.

Strategy 21-11. Collect DNA or genetic tissue from adult spawners within the hatchery and on the spawning ground to ensure artificial production is not altering the genetic composition of the populations.

Strategy 21-12. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

Strategy 21-13. Develop new and modify existing acclimation facilities to improve distribution of spawners at return and reduce point source impact of direct plants

Strategy 21-14. Achieve habitat objectives identified in the AU summaries.

Objective 22. Maintain the genetic diversity/ integrity and population structure of the locally adapted stocks (natural and artificially propagated stocks), consistent with VSP criteria developed through the TRT for recovery planning.

Strategy 22-1. Improve existing or create adult collection facilities on the tributary streams to promote local stock production.

Strategy 22-2. Collect DNA or genetic tissue to monitor and evaluate artificial production programs.

Strategy 22-3. Quantify naturally produced and hatchery spawners on the spawning grounds to determine success adult to adult for both.

Strategy 22-4. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

Strategy 22-5. Develop new and modify existing acclimation facilities to improve distribution of spawners at return and reduce point source impact of direct plants.

Strategy 22-6. Achieve habitat objectives identified in the AU summaries.

Objective 23. Minimize impacts of artificial propagation on resident and naturally produced anadromous fish through genetic and fish health monitoring, juvenile rearing and release strategies, and brood collection.

Strategy 23-1. Improve existing or create adult collection facilities on the tributary streams to promote local stock production.

Strategy 23-2. Collect DNA or genetic tissue to monitor and evaluate artificial production programs.

Strategy23-3. Monitor smolt migration development using external visual observation within the hatchery and coincide release to peak smoltification.

Strategy 23-4. Design Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

Strategy 23-5. Develop new and modify existing acclimation facilities to improve distribution of spawners at return and reduce point source impact of direct plants.

Strategy 23-6. Achieve habitat objectives identified in the AU summaries.

Objective 24. Improve smolt-to-adult survival in the mainstem migration corridor.

Strategy 1.Increase and require spring flow augmentation.

Strategy 24-1. Reduce predatory consumption of migrating smolts in the mainstem hydropower system.

Strategy 24-2. Manage and monitor consumptive fisheries consistent with adult escapement objectives.

Strategy 24-3. Improve juvenile bypass systems within the Columbia River hydrosystem.

Objective 25. Provide species status report every five years to evaluate effectiveness of objective attaining/direction toward goal, with adoption of changes as necessary every ten years.

Strategy 25-1. Document life history strategy.

Strategy 25-2. Operate smolt trap and/or weir(s) to determine migration pattern and timing.

Strategy 25-3. Correlate abundance with human and natural environmental changes.

Strategy 25-4. Implement shared monitoring and evaluation goals and objectives consistent with the Okanogan Baseline Program, Hatchery M&E programs, HCPs, and the M&E guidance section of this subbasin plan.

5.5.4 Pacific Lamprey

Goal: Provide conditions for viable and sustainable Pacific Lamprey populations.

Objective 28. Improve information base for overall life history, distribution and abundance.

Strategy 28-1. Estimate total amount of habitat available for all life stages and carrying capacity.

Strategy 28-2. Estimate location, condition and extent of spawning and rearing habitats in the Okanogan/Okanagan subbasin.

Strategy 28-3. Collect genetic data.

5.5.5 Bull trout

Currently, it is unknown to what degree bull trout utilize the Okanogan Watershed. If studies show bull trout are present, then the following apply.

Goal 1: Ensure the long-term persistence of self-sustaining, complex interacting groups (or multiple local populations that may have overlapping spawning and rearing areas) of bull trout distribution across the species' native range, so that the species can eventually be delisted.

Objectives:

Maintain current distribution of bull trout and restore distribution in previously occupied areas within the Okanogan Core Area.

Maintain stable or increasing trends in abundance of bull trout.

Restore and maintain suitable habitat conditions for all bull trout life stages and strategies

Conserve genetic diversity and provide opportunity for genetic exchange.

Goal 2: Reduce threats to the long-term persistence of bull trout populations and their habitat, ensuring the security of multiple interacting groups of bull trout, and providing habitat and access to conditions that allow for the expression of various life history forms.

Objectives:

Restore passage of specific man-made migrational barriers within the Okanogan Watershed, providing the barriers are not providing protection from invasive species such as brook trout.

Reduce impacts to stream corridor through improved road management throughout the Okanogan Watershed.

Reduce impacts to the stream corridor through improved land use practices such as increased riparian buffer widths, decrease livestock grazing and improved irrigation efficiencies.

Reduce or eliminate impacts from past, present and future mining activities.

Reduce impacts from residential and recreational development.

Reduce or eliminate effect from non-native species. This includes brook trout eradication and elimination of non-native species stocking programs.

Maintain and restore floodplain connectivity throughout the watershed.

Goal 3: Improve current knowledge base on bull trout throughout the Okanogan Watershed.

Objectives:

Complete a bull trout fish use study in the mainstem Okanogan.

Complete a population distribution and abundance study, where bull trout might be present in the Okanogan watershed.

If bull trout are found in the Okanogan, complete a life history study throughout the watershed.

5.5.6 Westslope cutthroat trout

Goal 1: Ensure the long-term persistence of self-sustaining, complex interacting groups (or multiple local populations that may have overlapping spawning and rearing areas) of Westslope Cutthroat Trout distribution across the species' native range.

Objectives:

Maintain current distribution of Westslope Cutthroat Trout and restore distribution in previously occupied areas within the Okanogan Core Area.

Maintain stable or increasing trends in abundance of Westslope Cutthroat Trout.

Restore and maintain suitable habitat conditions for all Westslope Cutthroat Trout life stages and strategies

Conserve genetic diversity and provide opportunity for genetic exchange.

Goal 2: Reduce threats to the long-term persistence of Westslope Cutthroat Trout populations and their habitat, ensuring the security of multiple interacting groups of Westslope Cutthroat Trout, and providing habitat and access to conditions that allow for the expression of various life history forms.

Objectives:

Restore passage of specific man-made migrational barriers within the Okanogan Watershed, providing the barriers are not providing protection from invasive species such as brook trout and lake trout.

Reduce or eliminate impacts from past, present and future mining activities.

Reduce impacts from residential and recreational development.

Reduce or eliminate effect from non-native species.

Restore connectivity from the tributaries to the lake during drawdown.

Goal 3: Improve current knowledge base on Westslope Cutthroat Trout throughout the Okanogan Watershed.

Objectives:

Complete a Westslope Cutthroat Trout fish use study in the tributaries to Okanogan.

Complete a population distribution and abundance study, where Westslope Cutthroat Trout might be present in the Okanogan watershed.

Complete a life history study throughout the watershed.

5.6 Wildlife and Terrestrial Biological Goals, Objectives and Strategies

Emphasis in this Subbasin Plan is placed on the selected focal habitats and wildlife species described in the assessment ("Methods and Interpretation", Section 2.6). It is clear from the assessment that reliable quantification of most subbasin-level impacts is lacking; however, many anthropogenic changes have occurred and clearly impact the focal habitats: riparian wetlands, shrubsteppe and ponderosa pine forest habitats.

While all habitats are important, focal habitats were selected in part because they are disproportionately vulnerable to anthropogenic impacts, and likely have received the highest level of impacts within the subbasin. In particular, the majority of shrubsteppe, ponderosa pine, and low elevation riparian habitats fall within the low or no protection status categories defined above. Some of the identified impacts are, for all practical purposes, irreversible (conversion to urban and residential development, primary transportation systems); others are already being mitigated through ongoing management (e.g., USFS adjustments to grazing management).

It is impractical to address goals for future conditions within the subbasin without consideration of existing conditions; not all impacts are reversible. The context within which this plan was drafted recognizes that human uses do occur, and will continue into the future. Recommendations are made within this presumptive framework.

The Okanogan Subbasin Management Plan directs conservation efforts towards three focal habitats: Ponderosa pine, shrubsteppe, and Eastside (Interior) Riparian Wetlands.

Focal species selected to represent the three Focal Habitats include: 1) Ponderosa pine: White-headed woodpecker, Pygmy nuthatch, Gray flycatcher, and Flammulated owl; 2) Shrubsteppe: Sharp-tailed grouse, Mule deer, Brewer's Sparrow, and Grasshopper sparrow; and 3) Eastside Riparian Wetlands: Red-eyed Vireo, Yellow-breasted chat, and beaver.

5.7 Wildlife Management Plan

5.7.1 Ponderosa Pine

Goal: Provide sufficient quantity and quality ponderosa pine habitats to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing ponderosa pine toward conditions 1a, 1b, 2 and 3 identified in 3.1.7.1.3 (Inventory and Assessment).

Habitat Objective 1: Determine the necessary amount, quality, and juxtaposition of ponderosa pine habitat to sustain focal species populations.

Identify and distinguish ecologically functioning and non-functioning ponderosa pine habitats, corridors, and linkages.

Identify sites that are currently not in ponderosa pine habitat that have the potential to be of high ecological value, if restored.

Habitat Objective 2: Based on findings of Objective 1, identify and provide biological and social conservation measures to sustain focal species populations and habitats by 2010.

Strategies:

Enter into cooperative projects and management agreements with federal, state, tribal, local government, and private landowners to restore and conserve habitat function.

Use easements, leases, cooperative agreements, and acquisitions to achieve permanent protection of habitat (long-term protection strategies are preferred over short term).

Emphasize conservation of large blocks and connectivity of functional, high quality ponderosa pine habitat.

Uphold existing land use and environmental regulations that protect habitats.

Identify inadequate land use regulations. Work to strengthen existing regulations or pass new regulations to improve protection of habitats.

Habitat Objective 3: Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving silviculture practices, fire management, weed control, livestock grazing practices, and road management on existing and restored ponderosa pine habitats.

Strategies:

Provide information, outreach, and coordination with public and private land managers to improve the use of prescribed fire, fire protection, and silviculture practices to restore and conserve habitat functionality.

Implement habitat stewardship projects with private landowners.

Assist in long-term development and implementation of a Comprehensive Weed Control Management Plan in cooperation with local weed boards.

Work with county, state, and federal agencies and private landowners to develop livestock grazing programs on federal and private lands that do not contribute to the invasion of noxious weeds or negatively alter under-story vegetation.

Develop and implement a coordinated, cross-jurisdictional road management plan.

Biological Objective 1: Show an increase in distribution and population status of white-headed woodpecker, flammulated owl, gray flycatcher, and pygmy nuthatch.

Strategies:

Select survey protocol and determine current distribution and population status of each ponderosa pine focal species.

Identify current and potential areas of high quality habitat for each of the ponderosa pine focal species.

Work with state, federal, tribal, county, and private entities to maintain and improve structural stand conditions of ponderosa pine habitat.

Biological Objective 2: Within the framework of the focal species population status determinations, inventory other ponderosa pine obligate populations to test assumption of the umbrella species concept for conservation of other ponderosa pine obligates.

Strategies:

Implement federal, state, tribal management and recovery plans.

5.7.2 Shrubsteppe

Goal: Provide sufficient quantity and quality shrubsteppe habitat to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing sagebrush-dominated shrubsteppe toward conditions 1, 2 and 3 identified in 3.1.7.2.3 (Inventory and Assessment).

Habitat Objective 1: Determine the necessary amount, quality, and juxtaposition of shrubsteppe habitat to sustain focal species populations.

Strategies:

Identify and distinguish ecologically functioning and non-functioning shrubsteppe habitats, corridors, and linkages.

Identify sites that are currently not in Shrubsteppe habitat that have the potential to be of high ecological value, if restored.

Habitat Objective 2: Based on findings of Objective 1, identify and provide biological and social conservation measures to sustain focal species populations and habitats by 2010.

Strategies:

Enter into cooperative projects and management agreements with federal, state, tribal, local government, and private landowners to restore and conserve habitat function.

Use easements, leases, cooperative agreements, and acquisitions to achieve permanent protection of habitat (long-term protection strategies are preferred over short term).

Emphasize conservation of large blocks and connectivity of functional, high quality shrubsteppe habitat.

Uphold existing land use and environmental regulations that protect habitats.

Identify inadequate land use regulations. Work to strengthen existing regulations or pass new regulations to improve protection of habitats.

Habitat Objective 3: Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving agricultural practices, fire management, weed control, livestock grazing practices, and road management on existing and restored shrubsteppe.

Strategies:

Provide information, outreach, and coordination with public and private land managers on the use of fire (protection and prescribed) to restore and conserve habitat functionality.

Implement habitat stewardship projects with private landowners.

Assist in long-term development and implementation of a Comprehensive Weed Control Management Plan in cooperation with local weed boards.

Work with county, state, and federal agencies and private landowners to develop livestock grazing programs on federal and private lands that do not contribute to the invasion of noxious weeds or negatively alter under-story vegetation.

Develop and implement a coordinated, cross-jurisdictional road management plan.

Biological Objective 1: Determine population status of the grasshopper sparrow, Brewer's sparrow, Sharp-tailed grouse, and mule deer by 2008.

Strategies:

Select survey protocol and measure populations status of focal species.

Complete a more detailed assessment of focal species, focal species assemblages, and obligate species needs to determine their habitat requirements (quantity and quality).

Biological Objective 2: Re-introduce sharp-tailed grouse to at least desired minimum viable population levels by 2024.

Strategies:

Implement state and tribal management recovery plans.

Re-introduce Sharp-tailed grouse into the sub-basin.

Ensure Sharp-tailed grouse habitat needs are met on federal, state, and tribal managed lands during land use planning.

Biological Objective 3: Maintain and enhance mule deer populations consistent with state/tribal herd management objectives.

Strategies:

Implement state and tribal management plans.

Ensure mule deer habitat needs are met on federal, state, and tribal managed lands during land use planning.

Maintain mule deer populations within landowner tolerances.

Protect and enhance important winter range and areas of sensitive habitat.

Work with state, federal, tribal, and private entities to improve habitat quality within ponderosa pine habitat (road closures, weed management, improved forage, etc)

5.7.3 Riparian Wetlands

Goal: Provide sufficient quantity and quality riparian wetlands to support the diversity of wildlife as represented by sustainable focal species populations. Emphasis should be placed on managing riparian wetland habitats toward conditions Okanogan Wildlife Inventory and Assessment 1a, 1b, and 2 identified in 3.1.7.3.3

Habitat Objective 1: Determine the necessary amount, quality, and juxtaposition of riparian wetland habitat to sustain focal species populations.

Strategies:

Identify and distinguish ecologically functioning and non-functioning riparian wetland habitats, corridors, and linkages.

Identify sites that are currently not in riparian wetland habitat that have the potential to be of high ecological value, if restored.

Habitat Objective 2: Based on findings of Habitat Objective 1, identify and provide biological and social conservation measures to sustain focal species populations and habitats by 2010.

Strategies:

Enter into cooperative projects and management agreements with federal, state, tribal, local government, and private landowners to restore and conserve habitat function.

Use easements, leases, cooperative agreements, and acquisitions to achieve permanent protection of habitat (long-term protection strategies are preferred over short term).

Emphasize conservation of large blocks and connectivity of functional, high quality riparian wetland habitat.

Uphold existing land use and environmental regulations that protect habitats.

Identify inadequate land use regulations. Work to strengthen existing regulations or pass new regulations to improve protection of habitats.

Habitat Objective 3: Maintain and/or enhance habitat function (i.e., focal habitat attributes) by improving silviculture, agricultural practices, fire management, weed control, livestock grazing practices, and road construction and maintenance on and adjacent to existing riparian wetlands.

Strategies:

Provide information, outreach, and coordination with public and private land managers on the use of fire (protection and prescribed) to produce desired riparian wetland habitat conditions.

Implement habitat stewardship projects with private landowners.

Assist in long-term development and implementation of a Comprehensive Weed Control Management Plan in cooperation with local weed boards.

Work with county, state, and federal agencies and private landowners to develop livestock grazing programs on federal and private lands that do not contribute to the invasion of noxious weeds or negatively alter under-story vegetation.

Develop and implement a coordinated, cross-jurisdictional road management plan.

Biological Objective 1: Determine population status of beaver, red-eyed vireo, and, yellow-breasted chat by 2008.

Strategies:

Select survey protocol and measure populations status of focal species.

Complete a more detailed assessment of focal species, focal species assemblages, and obligate species needs to determine their habitat requirements (quantity and quality).

Biological Objective 2: Within the framework of the focal species population status determinations, inventory other riparian wetlands obligate populations to test assumption of the umbrella species concept for conservation of other riparian wetlands obligates.

Strategies:

Implement federal, state, tribal management and recovery plans.

Biological Objective 3: Based on findings of Biological Objective 1, maintain and enhance beaver populations where appropriate and consistent with state/tribal management objectives.

Strategies:

Protect, and where necessary restore, habitat to support beaver.

Reintroduce beaver into suitable habitat where natural re-colonization may not occur.

Through state harvest restrictions, protect beaver populations at a level sufficient to allow natural and reintroduced beaver populations to perpetuate at levels that will meet Habitat Objective 2.

5.8 Consistency with ESA/CWA Requirements

Clean Water Act (CWA)

The Technical Guide for Subbasin Planners says that "the management plan should describe how the objectives and strategies are reflective of, and integrated with, the recovery goals for listed species within the subbasin, and the water quality management plan within that particular state. Coordination with NMFS's Technical Review Teams and the state agency charges with implementing the CWA will be an important step in ensuring consistency with ESA and CWA requirements."

In the Okanogan subbasin, there are potentially three federally listed fish species, spring Chinook, which are considered extirpated, and bull trout and steelhead populations, whose occupancy is currently unknown within the basin. Objectives and strategies outlined in this plan are likely to benefit these species through improved habitat but specific actions to recover these species were not considered feasible within the Okanogan Subbasin by the core team or habitat working group. However, collecting information to fill data gaps will provide better opportunities for possible management actions.

Summer Steelhead were listed as Endangered in the upper Columbia ESU in August of 1997 and are therefore considered a focal species within the Okanogan subbasin and this plan outlines specific actions that if implemented would result in increased survival, abundance, and habitat therefore complementing recovery efforts for these fish. federally listed wildlife species are recognized in the management plans with objectives that call for protection of these species and their habitats. Therefore, the management plan is consistent with ESA requirements. Additional species specific detail considered throughout the development of this plan is included below for each ESA listed species.

5.8.1 Columbia River Bull Trout ESU

The distinct population segment for bull trout, incorporating the entire Columbia (i.e., upper and lower), was listed as Threatened under the ESA on June 10, 1998. The Okanogan River may not provide suitable habitat for bull trout because of their requirement for very cold, clean waters with clean gravel/cobble substrate for successful spawning and rearing. However, it is thought that bull trout may use the mainstem Okanogan for foraging, rearing and overwintering during certain part of the year. FWS currently, identifies bull trout in the Okanogan as occupancy unknown. In the Okanogan basin, bull trout are documented to have used Salmon Creek and Loup Loup Creek. Bull Trout were reported in creel census records from the 1940s and 1950s in the North Fork of Salmon Creek (Fisher 2002). The introduction of Brook Trout and resulting hybridization of the two species are considered primary factor in the decline of bull trout in the Okanogan River basin (FWS 2000). Scott and Crossman (1973) reported that bull trout were/are not present within the Canadian portion of the Okanogan River system.

5.8.2 Upper Columbia River spring-run ESU

Myers et al. (1998) defined the Upper Columbia River spring-run ESU as stream-type Chinook that spawn in the Wenatchee, Entiat, and Methow rivers. They explain that the biological review team (BRT) felt that in spite of the tremendous amount of hatchery influence on these fish, they still represented an important genetic resource, partially because it was presumed it still contained the last remnants of the gene pools for populations from the headwaters of the Columbia River.

Ford et al. (2001) concluded that there were currently three independent populations of spring Chinook within the Upper Columbia spring Chinook ESU; Wenatchee, Entiat, and Methow basins. The Okanogan spring Chinook are believed to be extinct, possibly since the 1930s (see below).

Brannon et al. (2002) separated the Methow spring Chinook first-order metapopulation from the Wenatchee and Entiat populations, which were linked together.

Within these populations there are other sub-populations that Ford et al. (2001) suggested should be considered when reviewing management actions within these geographic areas to maintain potential adaptive advantages of these sub-populations.

The Interior Columbia Basin Technical Recovery Team (TRT), in its draft report (TRT 2003) agrees with the initial designation of independent populations by Ford et al. (2001).

In conclusion, for the purposes of sub-basin planning, we assume that there are three independent populations (Wenatchee, Entiat, and Methow) within the large groups of populations that spawn naturally upstream from Rock Island Dam. Within these independent populations, there are sub-populations that should be considered during management processes, but overall, the spring Chinook from one of the three drainages is considered as a whole.

5.8.3 Upper Columbia summer steelhead ESU

Buby et al. (1996) determined that the ESU for Upper Columbia summer steelhead comprised the populations that currently spawn in the Wenatchee, Entiat, Methow, and possibly Okanogan rivers. The BRT felt that because of past hatchery practices (see below) there has been substantial homogenization of the gene pool. However, there is probably remnant genetic material from ancestral populations that could have been "stored" in resident populations (Mullan et al. 1992CPa). Ford et al. (2001) agreed with the delineation described by Busby et al.

(1996), but described each subbasin, with the possible exception of the Okanogan, as an independent population (see definition above).

Brannon et al. (2002) combined all of the first-order metapopulations of summer steelhead upstream of the Yakima River into one metapopulation.

The TRT recently listed the Okanogan Basin steelhead as an independent population: "The current status of steelhead endemic to the Okanogan is unknown. Currently, low numbers of natural steelhead return to this system, but may be offspring from hatchery returns.

However, the Okanogan appears to have supported an independent population of steelhead historically. Although habitat conditions for rearing are highly degraded in the system, the Okanogan and its tributaries in the US and Canada appear to have contained sufficient habitat to have supported an independent population of steelhead. In addition, the Okanogan is found in a substantially different habitat than other populations in this ESU, further supporting delineation of this population" (TRT 2003).

In conclusion, for the purposes of sub-basin planning, we assume that there are four independent populations (Wenatchee, Entiat, Methow, and Okanogan) within the large groups of populations that spawn naturally upstream from Rock Island Dam.

The Okanogan Subbasin Core Team and Habitat Working Group developed objectives and strategies that will lead to improvements in water quality. This is particularly emphasized where water quality does not currently meet water quality standards. In some cases, the subbasin plan specifically acknowledges the work being done by other entities to improve water quality and recommends consistency with other management plans, such as total maximum daily load (TMDL). Therefore, the subbasin management plan is consistent with CWA requirements.

5.9 Relationship to Other Planning Efforts

In the Okanogan, an open dialogue existed throughout this process to included state, federal, tribal, and other stakeholder interest and to coordinate with other planning efforts through the Habitat Working Group, and Subbasin Core Group. Both groups included members who were working on watershed planning, State Salmon Recovery Planning, The federal BIOP, Bull Trout Recovery Planning, Mid-Columbia Habitat Conservation Planning, TMDL, water quality planning, Growth Management Planning, Land Use Planning, and FERC hydropower re-licensing. Participation of these members assures that the subbasin plan is compatible with other planning efforts.

A primary strategy was to coordinate with, and have the plan reviewed by the Technical Recovery Teams developed by the Upper Columbia Salmon Recovery Board. The Upper Columbia Salmon Recovery Board has established technical, policy, and stakeholder groups that meet regularly to coordinate, evaluate, and implement mitigation measures within this subbasin. Coordination with Canadian interests was developed by creating the Canadian Okanogan Basin Technical Working Group and through coordination with SERA activities. Many documents were utilized to develop the subbasin plan including but not limited to:

- Habitat Conservation Plans
- Hatchery Genetic Management Plans

- The Clean Water Act
- The Powers Act
- The Northwest Power and Conservation Councils 2000 Fish and Wildlife Program (and the Technical Guide to Subbasin Planning)
- Assorted Watershed Management Plans
- The 2001 Federal BIOP
- Pacific Salmon Treaty
- Colville Tribes Integrated Resource Management Plan
- Washington State Wild Salmonid Policy
- Watershed based Fish sustainability Planning
- SARA
- The Endangered Species Act
- FWS Draft: Bull trout Recovery Plan
- FWS Proposed Critical Habitat Designation for Bull Trout
- FWS Draft: Bull trout Recovery Plan
- FWS Proposed Critical Habitat Designation for Bull Trout

5.10 Research

Generally, the M&E section of this plan will be used to guide reseach activities only where appropriate and where significant unknown restrict the planners and managers ability to make decisions.   Until baseline information is obtained sufficient to identify these uncertainties, M&E will play a greater role that pure research activities in the Okanogan subbasin.

Examples questions forming a research framework include:

- What is Known/Unknown (about each proposed hypothesis)
- Anticipated Results and Possible Interpretations
- Potential Management Application (of the anticipated research results)
- Experimental Design/Approach (for hypothesis testing)
- Statistical Analyses/Evaluation
- Spatial Scale (where will the research take place? what is the geographic scope of the study?)
- Temporal Scale (when will research start and end? at what intervals will research occur?)
- Application of Research Results (to specific species or conditions)

- Budget Considerations
- End Products (or data formats)
- Data Storage, Access, and Distribution

5.11 Monitoring and Evaluation (M&E)

The first sections of this M&E plan addresses fish exclusively and are derived from a variety of sources including the PNAMP guidance to follow. Following M&E plan for fish in the Okanogan subbasin we provide a general framework for terrestrial (wildlife) monitoring. The wildlife section is adapted from Paquet, Marcot and Powell 2004.

To allow the subbasin plan authors to track the progress of specific objectives and goals over time, a disciplined and well-coordinated monitoring and evaluation (M&E) program is proposed. This program is designed to help confirm our scientific assumptions, resolve key scientific uncertainties, and provide the basis for performance tracking and adaptive management. The goals for this coordinated program are to maximize efficiencies; avoid duplication, and improve experiments to minimize confounding factors or actions.

This effort will begin to provide essential information on habitat conditions and fish populations beginning in 2004. This will also allow state, federal and tribal programs to operate in a manner consistent with efforts to detect the trends and effectiveness between and among other subbasins, ESUs, programs and across a broader group of "H's" and planning efforts.

The monitoring plan described in this document is not another regional monitoring strategy. Rather, this plan draws from the existing strategies and outlines an approach specific to the Okanogan subbasin and the Upper Columbia region.

The plan described here addresses the following five basic questions:

1. What are the current habitat conditions and abundance, distribution, life-stage survival, and age-composition of anadromous fish in the Okanogan subbasin (status monitoring)?
2. How do these factors change over time (trend monitoring)?
3. What effects do tributary habitat actions have on fish populations and habitat conditions (effectiveness monitoring)?
4. What effects do fishery management actions have on fish populations (effectiveness monitoring)?
5. Are the goals, vision and objectives of the subbasin plan being met?

Assumptions

Monitoring and evaluation coordination and implementation will be an ongoing activity at the reach, subbasin, and regional levels. The subbasin planners assume these iterative, concurrent processes at different scales will be coordinated to optimize when and where implementation occurs to increase learning from broader scale monitoring both within and across subbasins.

Monitoring that is proposed will be more effective if it fits within a broader programmatic network of status monitoring programs and intensively monitored watersheds. The subbasin planners assume that M&E efforts will be able to rely on broader monitoring frameworks and programmatic activities (where they exist) to meet some of their needs.

The subbasin planners assume that local, bottom-up approaches developed within subbasins will have a higher likelihood for successful funding and meaningful results if they reflect the approaches being developed within the comprehensive state, tribal initiatives, and federal pilot projects (Wenatchee, John Day, and Upper Salmon), and the top-down framework and considerations being developed by PNAMP.

Approach

A coordinated and comprehensive approach to the monitoring and evaluation of status and trends in anadromous and resident salmonid populations and their habitats is needed to support restoration efforts in the Columbia Cascade Province, and in the Okanogan subbasin in particular. Currently, independent research projects and some monitoring activities are conducted by various state and federal agencies, tribes, and to some extent by watershed councils or landowners, but to date there has been no overall framework for coordination of efforts or for interpretation and synthesis of results.

Guidance for this M&E Program

Four primary documents make up this framework plan for the Okanogan. They are:

1. The Okanogan Baseline M&E Program (BPA project 200302200)
2. The Upper Columbia Monitoring Strategy (Hillman, et al. 2004)
3. Considerations for Monitoring in Subbasin Plan (PNAMP 2004)
4. Considerations for Monitoring Wildlife in Subbasin Plan (NPCC, 2004)

The authors also used a variety of programs and plans to help construct the Okanogan Monitoring Framework. Examples used include:

- The M&E Program for the Chief Joseph Hatchery (Conceptual Master Plan)
- The Pacific Northwest Aquatic Monitoring Partnership (PNAMP)—Draft Guidance to the State, Feds and Tribes for Monitoring (2004)
- The Coordinated System Wide Monitoring and Evaluation Project (CSMEP) Work Plan.
- 2001 ISRP (review of the Okanogan Baseline Program, 2001)
- 2003 ISAB Review of Supplementation
- Federal Research Evaluation and Monitoring (RME) Plan
- The Pacific Coastal Salmon Recovery Fund (PCSRF) Performance Standards
- The Pacific Coastal Salmon Recovery Fund Data Definitions
- A Data Management Protocol (Wolf, Jordan, Toshach et al.—in press)

- BPA Pilot Studies in Wenatchee and John Day (data dictionary and geospatial database structure)
- The Washington Coordinated Monitoring Strategy
- The Oregon Monitoring Plan
- The Skaha Lake Sockeye Reintroduction Program
- The subbasin authors/planners also suggest use of the following resources in implementing the M&E plan:
- The Yakima Klickitat Fisheries Project: http://www.ykfp.org
- The Northeast Oregon Hatchery: http://www.cbfwa.org/2001/projects/198805301.htm
- The Columbia Basin Fish and Wildlife Authority (M&E): http://www.cbfwa.org/rme.htm
- The State of Washington: Outline for Salmon Regional Recovery Plans. http://www.wdfw.wa.gov/recovery/recovery_model.htm
- Coordinated Management Strategy. http://www.iac.wa.gov/srfb/monitoring.htm

5.11.1 Principles, Goals and Objectives

The following principles will guide M&E in the Okanogan Subbasin:

- Resource Policy and Management: The purpose of monitoring efforts is to provide the most important scientific information needed to inform public policy and resource management decisions.
- Acknowledge each party's mandates, objectives, and management milestones.
- Construct a monitoring program that meets each party's milestones and objectives through coordinating and sharing monitoring resources.
- Develop a monitoring program that is sufficiently robust to meet public policy needs; demonstrate the links between public policy needs and monitoring efforts.
- Develop a monitoring program that demonstrates compliance.
- Commit to resolving scientifically the most important policy and management questions using an adaptive management approach.
- Efficiency and Effectiveness: Cooperative monitoring will enhance efficiencies and effectiveness of our respective and collective efforts.
- Participate fully in the PNAMP, including the identification of contact(s) for monitoring issues.
- Identify and coordinate goals, objectives, and budgets, and demonstrate resource savings over short and longer time frames.
- Cooperatively adapt programs and budgets to address monitoring gaps.

- State and federal agencies and the tribes commit to long-term inter- and intra-agency monitoring programs.
- Encourage staff exchanges and shared training to learn what each other are doing (e.g., new innovations) and ensure consistency across programs.
- Develop common monitoring approaches, including quality control/quality assurance programs; shared evaluation tools; integrated status and trend monitoring efforts; land use, land cover, and riparian vegetation categorization; core data for representative subset of watersheds in all represented states.
- Perform all monitoring activities in a timely manner.
- Scientifically Based: Environmental monitoring must be scientifically sound.
- Develop an integrated monitoring program (e.g., issues, disciplines, and values).
- Monitoring program is based on shared goals and objectives (e.g., census level, regional status and trends, cause and effect questions, effectiveness of regional efforts, identification of trouble spots).
- Address multiple spatial and temporal scales.
- Develop and use compatible data collection and analysis protocols.
- Recognize inherent diversity and variability and dynamic inter-relationships or resource conditions in monitoring design, analysis and interpretation.
- All environmental data should have a known level of precision.
- All baseline data on ecosystems are known and compiled between agencies.
- Shared Information: Monitoring data should be accessible to all on a timely basis.
- Make strategic investments in information systems needed to make data useful.
- Monitoring databases would integrate a number of issues, disciplines and values.
- Data management systems and protocols provide a linkage for sharing data between agencies.
- Adopt and use common data sharing protocols.
- Adopt and use common database/s of core metadata, data, and electronically connected distribution systems.

The primary goal of this M&E framework is:

To combine, coordinate, and standardize the activities of multiple agencies working on fisheries related issues in the Okanogan basin and establish a measure of success or failure of habitat and hatchery practices directed towards rehabilitation of fish and wildlife populations.

Specific goals of the Okanogan subbasin M&E plan include:

- Assess status and trends of watershed conditions and salmon populations regionally.
- Monitor habitat, water quality, biotic health, and salmon in select watersheds.
- Analyze habitat, water quality and population trends at the landscape scale.
- Document conservation and restoration projects, activities and programs.
- Evaluate effectiveness of restoration and management efforts locally.
- Evaluation the combined effectiveness of restoration and conservation efforts in select watersheds.
- Standardize monitoring, collection, management and analysis efforts.
- Coordinate and support public-private monitoring partnerships.
- Integrate information and product data products and reports.

Specific Questions to be asked by the M&E Plan include:

1. How are the annual abundance and productivity of salmon by species, ESU, and life stage changing over time?
2. What improvements are occurring in restoring the geographic distribution of salmon by ESU, species, and life stage to their historic range?
3. Are the unique life history characteristics of salmon within a Salmon Recovery Region changing over time because of human activities?
4. What are the trends in the climate of the Pacific Northwest that will allow the State to anticipate and account for such conditions in initiating and monitoring management actions for watershed health and salmon recovery? What trends in climate may mask or expose the status of freshwater habitat and its role in salmon recovery?
5. What are the trends in effects of hatchery production on the survival and productivity of wild salmon populations within each ESU?
6. How are surface water quality conditions changing over time?
7. How effective are clean water programs at meeting water quality criteria?
8. What are the trends in water quantity and flow characteristics?
9. What are the status and trends in habitat-forming landscape processes in riverine ecosystems as they relate to watershed health and salmon recovery?
10. Are habitat improvement projects effective?
11. What is the condition of salmon populations at the ESU, Subbasin and watershed scale?
12. What is the status and what are the trends in aquatic habitats, water quality, and stream flow?
13. What are the critical factors that limit watershed function and salmon productivity?
14. What constitutes detectable and meaningful change in habitat condition and populations?

15. What changes are occurring in watersheds that improve stream habitat quality?
16. What are the management practices and programs that enhance or restore watershed functions and salmon populations?
17. What habitat changes and biotic responses result from these projects, practices, and programs?
18. What are the abundances, productivity, and distributions of Columbia River? Basin (CRB) fish populations relative to performance standards or objectives?
19. What is the biological, chemical, and physical status of CRB fish habitat relative to performance standards or objectives?
20. What are the relationships between fish populations and freshwater and estuary/ocean habitat conditions that determine population-limiting factors?
21. What is the effect of a specific mitigation or management action on the habitat and/or population performance of CRB fish?
22. What is the combined effect of multiple watershed level mitigation on management actions on the habitat and/or population performance of CRB fish?
23. Are federal and state mitigation actions achieving the necessary survival changes identified in the All H federal Caucus Program and the FCRPS BO for each ESU?

Measurable M&E Objectives

The M&E plan is developed to capture the variables and indicators necessary to determine whether progress is being made to achieve this list of habitat and artificial production objectives. Individual Assessment Unit summaries provide a long list of relevant detailed habitat objectives by geographic area. Production objectives are outlined in this subbasin plan's biological objectives. The monitoring plan proposed requires a long-term commitment, as most outcomes will not be realized for 7 to 20+ years.

This project is designed to address the following priority objectives:

An efficient monitoring plan reduces "error" to the maximum extent possible. One can think of error as unexplained variability, which can reduce monitoring efficiency through the use of invalid statistical designs, biased sampling designs, poorly selected indicators, biased measurement protocols, and non-standardized reporting methods.

1. Determine if there is a statistically significant difference in the abundance, survival, and timing and life history characteristics of summer/fall, spring Chinook, sockeye, and steelhead (7-20+ year time frame).

2. Determine if there is a statistically significant difference in selected physical habitat parameters and characteristics for summer/fall, spring Chinook, sockeye, and steelhead in the Okanogan basin resulting from the cumulative benefits of habitat actions (7-20+ year time frame).

3. Estimate in-basin and out-of-basin harvest and stock-specific harvest of hatchery and wild anadromous salmonids within the Okanogan subbasin (ongoing).

4. Conduct a baseline Okanogan Basin inventory & analysis: a. Collect data, to raise physical habitat data to an empirical level for use in EDT and other analytical models or methods. b.) Collect data on historical and current fish population distributions, and c.) Collect passage conditions throughout the basin for use in EDT modeling runs to assist in future enhancement-planning processes (1-20+ year time frame).

For artificial production objectives, the following performance standards will be monitored:

- Legal Standards
- Conservation Standards
- Life History Characteristics
- Genetic Characteristics
- Research Activities
- Operation of Artificial Production facilities
- Socio-economic effectiveness
- Harvest Standards
- Non-target population impacts
- Target population production
- Target population long-term fitness

The plan is designed to address these questions and at the same time eliminate duplication of work, reduce costs, and increase monitoring efficiency. The implementation of valid statistical designs, probabilistic sampling designs, standardized data collection protocols, consistent data reporting methods, and selection of sensitive indicators will increase monitoring efficiency?

An efficient monitoring plan reduces "error" to the maximum extent possible. One can think of error as unexplained variability, which can reduce monitoring efficiency through the use of invalid statistical designs, biased sampling designs, poorly selected indicators, biased measurement protocols, and non-standardized reporting methods.

For this plan to be successful, all organizations involved must be willing to cooperate and freely share information. Cooperation includes sharing monitoring responsibilities, adjusting or changing sampling methods to comport with standardized protocols, and adhering to statistical design criteria. In those cases where the standardized method for measuring an indicator is different from what was used in the past, it may be necessary to measure the indicator with both methods for a few years so that a relationship can be developed between the two methods. Scores generated with a former method could then be adjusted to correct for any bias.

Specific Elements of the M&E Plan

Program Setup

In order to setup a monitoring program, it will be important to follow a logical sequence of steps. By proceeding through each step, the planner will better understand the goals of monitoring and its strengths and limitations. These steps will aid the implementation of a valid monitoring program that reduces duplication of sampling efforts, and thus overall costs, but still meets the needs of the different entities. The plan assumes that all entities involved with implementing the plan will cooperate and freely share information. Setup steps are:

1. Identify the populations and/or subpopulations of interest (e.g., spring Chinook steelhead, sockeye).
2. Identify the geographic boundaries (areas) of the populations or subpopulations of interest.
3. Describe the purpose for selecting these populations or subpopulations (i.e., what are the concerns?).
4. Identify the objectives for monitoring.
5. Select the appropriate monitoring approach (status/trend or effectiveness monitoring or both) for addressing the objectives.
6. Identify and review existing monitoring and research programs in the area of interest.
7. Determine if those programs satisfy the objectives of the proposed program.
8. If monitoring and evaluation data gaps exist, implement the appropriate monitoring approach by following the criteria outlined in 9-13.
9. Classify the landscape and streams in the area of interest.
10. Complete a data management needs assessment. Describe how data collection and management needs will be met and shared among the different entities.
11. Identify an existing database for storing biological and physical/environmental data.
12. Estimate costs of implementing the program.
13. Identify cost-sharing opportunities.

Suggested Table of Contents (for any entity implementing an M&E element)

- Statement of Need and Program Outline
- Summary of Indicators and Program Elements
- Summary of Monitoring and Evaluation Priorities
- Program Set Up
- Statistical Design

- Sampling Design
- Sample Size
- Measurement Error
- Fish Population Monitoring Overview
- Habitat Monitoring Overview
- Biological Variables
- Physical/Environmental Variables
- Spatial Scales
- Performance Standards
- Classification
- Indicators to be used
- Measuring Protocols to be used
- Status Trend Monitoring
- Effectiveness Monitoring
- Data Management Needs Assessment and Data Management Plan
- Peer Review and Annual Reporting
- Adaptive Management
- References
- Appendices as needed

Basic Statistical Considerations

This document defines "statistical design" as the logical structure of a monitoring study. It does not necessarily mean that all studies require rigorous statistical analysis. Rather, it implies that all studies, regardless of the objectives, be designed with a logical structure that reduces bias and the likelihood that rival hypotheses are correct. The purpose of this section is two-fold. First, it identifies the minimum requirements of valid statistical designs and second it identifies the appropriate designs for status/trend and effectiveness monitoring. The following discussions draw heavily on the work of Hairston (1989), Hicks et al. (1999), Krebs (1999), Manly (1992, 2001), and Hillman and Giorgi (2002). (See: Hillman et al. 2004) section 3, pages 9-13.)

The Okanogan Baseline Program currently employs this statistical design that is an EMAP-derived approach although additional guidance is used and adapted to fit the needs of the individual subbasins.

Sampling Design Considerations

Once the investigator has selected a valid statistical design, the next step is to select "sampling" sites. Sampling is a process of selecting a number of units for a study in such a way that the units represent the larger group from which they were selected. The units selected comprise a sample and the larger group is referred to as a population. All the possible sampling units available within the area (population) constitute the sampling frame. The sampling frame is a "list" of all the available units or elements from which the sample can be selected. The sampling frame should have the property that every unit or element in the list has some chance of being selected in the sample. A sampling frame does not have to list all units or elements in the population. This definition makes it clear that a "population" is not limited to a group of organisms. In statistics, it is the total set of elements or units that are the target of our curiosity. For example, habitat parameters will be monitored at sites selected from the population of all possible stream sites in the watershed.

The purpose of sampling is to gain information about a population. If the sample is well selected, results based on the sample can be generalized to the population. Statistical theory assists in the process of drawing conclusions about the population using information from a sample of units.

Defining the population and the sample units may not always be straightforward because the extent of the population may be unknown, and natural sample units may not exist. For example, a researcher may exclude livestock grazing from sensitive riparian areas in a watershed where grazing impacts are widespread. In this case the management action may affect aquatic habitat conditions well downstream from the area of grazing. Thus, the extent of the area (population) that might be affected by the management action may be unclear, and it may not be obvious which sections of streams to use as sampling units.

When the population and/or sample units cannot be clearly defined, the investigator should subjectively choose the potentially affected area and impose some type of sampling structure. For example, sampling units could be stream habitat types (e.g., pools, riffles, or glides), fixed lengths of stream (e.g., 150-m long stream reaches), or reach lengths that vary according to stream widths (e.g., see Simonson et al. 1994). Before selecting a sampling method, the investigator should define the population, size and number of sample units, and the sampling frame. (See: Hillman et al. 2004) section 4, pages 9-13).

Spatial Scale

Because monitoring will occur at a range of spatial scales, there may be some confusion between the roles of status/trend monitoring and effectiveness monitoring. Generally, one thinks of status/trend monitoring as monitoring that occurs at coarser scales and effectiveness monitoring at finer scales. In reality, both occur across different spatial scales, and the integration of both is needed to develop a valid monitoring program (ISAB 2003; AA/NOAA Fisheries 2003; WSRFB 2003).

The scale at which status/trend and effectiveness monitoring occurs depends on the objectives of the study, the size or distribution of the target population, and the indicators that will be measured. In status/trend monitoring, for example, the objective may be to measure egg-parr survival of spring Chinook salmon in the Okanogan Basin, but because the Okanogan subbasin likely consisted of multiple sub populations of Chinook (lake rearing and stream rearing), status/trend monitoring can occur at various scales depending on the distribution of the population of interest.

In the same way, effectiveness monitoring can occur at different spatial scales. That is, one can assess the effect of a tributary action on a specific Recovery Unit or ESU (which may encompass several populations), a specific population (may include several sub-populations), at the sub-population level (may encompass a watershed within a basin), or at the reach scale. Clearly, the objectives and hence the indicators measured dictate the spatial scale at which effectiveness monitoring is conducted. For example, if the objective is to assess the effects of nutrient enhancement on egg-smolt survival of spring Chinook in the Chiwawa Basin (a sub-population of the Wenatchee spring Chinook population), then the spatial scale covered by the study should include the entire area inhabited by the eggs, fry, parr, and smolts. If, on the other hand, the objective is to assess the effects of a sediment reduction project on egg-fry survival of a local group of spring Chinook (i.e., Chinook within a specific reach of stream), then the study area would only encompass the reach of stream used by spawners of that local group.

In theory there might be no limit to the scale at which effectiveness monitoring can be applied, but in practice there is a limit. This is because as the spatial scale increases, the tendency for multiple treatments (several habitat actions) affecting the same population increases. That is, at the spatial scale representing a Recovery Unit, ESU, or population, there may be many habitat actions within that area. Multiple treatment effects make it very difficult to assess the effects of specific actions on an ESU. Even though it may be impossible to assess specific treatment effects at larger spatial scales, it does not preclude one from conducting effectiveness monitoring at this scale. Indeed, one can assess the combined or cumulative effects of tributary actions on the Recovery Unit, ESU, or population. However, additional effectiveness monitoring may be needed at finer scales to assess the effects of individual actions on the ESU or population. (See: Hillman et al. 2004, section 5, pages 31-33.)

Classification

Both status/trend and effectiveness monitoring require landscape classification. The purpose of classification is to describe the "setting" in which monitoring occurs. This is necessary because biological and physical/environmental indicators may respond differently to tributary actions depending on landscape characteristics. A hierarchical classification system that captures a range of landscape characteristics should adequately describe the setting in which monitoring occurs. The idea advanced by hierarchical theory is that ecosystem processes and functions operating at different scales form a nested, interdependent system where one level influences other levels. Thus, an understanding of one level in a system is greatly informed by those levels above and below it.

A defensible classification system should include both ultimate and proximate control factors (Naiman et al. 1992). Ultimate controls include factors such as climate, geology, and vegetation that operate over large areas, are stable over long time periods, and act to shape the overall character and attainable conditions within a watershed or basin. Proximate controls are a function of ultimate factors and refer to local conditions of geology, landform, and biotic processes that operate over smaller areas and over shorter time periods. These factors include processes such as discharge, temperature, sediment input, and channel migration. Ultimate and proximate control characteristics help define flow (water and sediment) characteristics, which in turn help shape channel characteristics within broadly predictable ranges (Rosgen, 1996).

The UCMS plan proposes a classification system that incorporates the entire spectrum of processes influencing stream features and recognizes the tiered/nested nature of landscape and aquatic features. This system captures physical/environmental differences spanning from the largest scale (regional setting) down to the channel segment. The Action Agencies/NOAA Fisheries RME plan proposes a similar classification system. By recording these descriptive characteristics, the investigator will be able to assess differential responses of indicator variables to proposed actions within different classes of streams and watersheds. Importantly, the classification work described here fits well with Level 1 monitoring under the ISAB (2003) recommend strategies for restoring tributary habitat. Classification variables and recommend methods for measuring each variable are defined below. (See: Hillman et al. 2004) section 6, pages 33-45.).

The Okanogan Baseline Program is currently collecting information (GIS-based) to include this element. However, the current effort does not include those portions of the subbasin in Canada. This is a data gap that must be bridged in the near term.

Indicators

The Okanogan subbasin planners have identified the following as a subset of key indicators: bank-full width, reach length, bank-full depth, sediment, wood, gradient, pools, residual pool depth, bank stability, temperature, invertebrates, shade, and riparian characteristics.

Additional indicators that provide information for use in assessing fish population structure and distribution and habitat conditions as described generally in the EDT analytical model and method are also targeted in the Okanogan Baseline Program.

Theses indicators represent a subset of variables that should be measured. Investigators can measure additional variables depending on their objectives and past activities. For example, reclamation of mining-impact areas may require the monitoring of pollutants, toxicants, or metals. Some management actions may require the measurement of thalweg profile, placement of artificial instream structures, or livestock presence. Adding other needed indicators will supplement the core list.

Indicator variables identified in the UCMS template are consistent with those identified in the Action Agencies/NOAA Fisheries RME Plan and with most of the indicators identified in the WSRFB (2003) monitoring strategy. The Action Agencies/NOAA Fisheries selected indicators based on their review of the literature (e.g., Bjornn and Reiser 1991; Spence et al. 1996; and Gregory and Bisson 1997) and several regional monitoring programs (e.g., PIBO, AREMP, EMAP, WSRFB, and the Oregon Plan). They selected variables that met various purposes including assessment of fish production and survival, identifying limiting factors, assessing effects of various land uses, and evaluating habitat actions. Their criteria for selecting variables were based on the following characteristics:

- Indicators should be sensitive to land-use activities or stresses.
- They should be consistent with other regional monitoring programs.

- They should lend themselves to reliable measurement.
- Physical/environmental indicators would relate quantitatively with fish production.

Table 49. Biological indicator variables (with conceptual protocols) to be monitored in the Okanogan Baseline M&E Program and Chief Joseph Hatchery M&E Program

General characteristics	Specific indicators	Recommended protocol	Sampling frequency	HGMP Performance Indicator
Adults	Escapement/ Number	Dolloff et al. (1996); Reynolds (1996); Van Deventer and Platts (1989)	Annual	Total number of fish harvested in Colville Tribes summer/fall fisheries. Annual number of summer/fall Chinook spawners in each spawning area, by age (Similkameen River, Okanogan River, Columbia River above Wells Dam).
	Age structure	Borgerson (1992)	Annual	To be completed as above
	Size	Anderson and Neumann (1996)	Annual	To be completed as above
	Sex ratio	Strange (1996)	Annual	To be completed as above
	Origin (hatchery or wild)	Borgerson (1992)	Annual	To be completed as above
	Genetics	WDFW Genetics Lab	Annual	To be completed as above
	Fecundity	Cailliet et al. (1986)	Annual	To be completed as above
Redds	Number	Mosey and Murphy (2002)	Annual	To be completed as above
	Distribution	Mosey and Murphy (2002)	Annual	To be completed as above
Parr/Juveniles	Abundance/Distribution	Dolloff et al. (1996); Reynolds (1996); Van Deventer and Platts (1989)	Annual	To be completed as above
	Size	Anderson and Neumann (1996)	Annual	To be completed as above
Smolts	Number	Murdoch et al. (2000)	Annual	To be completed as above
	Size	Anderson and Neumann (1996)	Annual	To be completed as above
	Genetics	WDFW Genetics Lab	Annual	To be completed as above
Macroinvertebrates	Transport	Wipfli and Gregovich (2002)	Annual/Monthly	To be completed as above
	Composition	Peck et al. (2001)[1]	Annual	To be completed as above

Measuring Protocols

An important component of all regional monitoring strategies (ISAB, Action Agencies/NOAA Fisheries, and WSRFB) is that the same measurement method be used to measure a given indicator. The reason for this is to allow comparisons of biological and physical/environmental conditions within and among watersheds and basins. Bonar and Hubert (2002) and Hayes et al. (2003) review the benefits, challenges, and the need for standardized sampling. This section identifies methods to be used to measure biological and physical/environmental indicators. The methods identified in this plan are consistent with those described in the Action Agencies/NOAA Fisheries RME Plan and, for the most part, consistent with EMAP and WSRFB protocols.

PNAMP is supporting an initiative to coordinate a side-by-side comparison of protocols and will communicate to subbasin planners which protocols will be included in the test. This comparison, which is proposed to take place in 2005, will be done to identify which protocols are best for determining watershed condition status and trend. Its possible a pilot study in the John Day basin will take place in 2004 if funding and logistical constraints are resolved.

The Action Agencies/NOAA Fisheries monitoring group reviewed several publications, including the work of Johnson et al. (2001) that describe methods for measuring indicators. Not surprisingly, there can be several different methods for measuring the same variable. For example, channel substrate can be described using surface visual analysis, pebble counts, or substrate core samples (either McNeil core samples or freeze-core samples). These techniques range from the easiest and fastest to the most involved and informative. As a result, one can define two levels of sampling methods. Level 1 (extensive methods) involves fast and easy methods that can be completed at multiple sites, while Level 2 (intensive methods) includes methods that increase accuracy and precision but require more sampling time. The Action Agencies/NOAA Fisheries monitoring group selected primarily Level 2 methods, which minimize sampling error, but maximizes cost.

Before identifying measuring protocols, it is important to define a few terms. These terms are consistent with the Action Agencies/NOAA Fisheries RME Plan.

Reach (effectiveness monitoring) – for effectiveness monitoring, a stream reach is defined as a relatively homogeneous stretch of a stream having similar regional, drainage basin, valley segment, and channel segment characteristics and a repetitious sequence of habitat types. Reaches are identified by using a list of classification (stratification) variables. Reaches may contain one or more sites. The starting point and ending point of reaches will be measured with Global Positioning System (GPS) and recorded as Universal Transverse Mercator (UTM).

Although the level of accuracy expected from GPS reporting of stream locations may not be sufficient for all subbasin monitoring and evaluation purposes, the researchers for the John day and Upper Columbia projects are planning to use it for the subbasin pilot efforts.

Reach (status/trend monitoring) – For status/trend monitoring, this section refers only to a “sampling reach” as defined by the EMAP design and referenced in the UC Strategy document. This is one method to consider using to initially locate a reach, with the “X” point being the place where bankfull width is determined. From this location the extent of the upstream and downstream boundaries (total reach length) are determined according to the protocol used. Data collected in the sampling reach should be linked to the best available hydrography layers to facilitate mapping and use in a GIS. Typically the 1:100,000 scale has been used, but a routed 1:24,000 scale hydrography may soon become available.

Note: Standardized GIS and post processing of spatial data will require a standardized protocol that does not currently exist. In the interim PNAMP recommends the following:

All GIS data should be provided with federal Geographic Data Committee compliant metadata, including information on projection used;

data should be linked to a standardized stream each identification system to facilitate mapping and use in GIS; and, 3. use existing 1:100,000 and 1:24,000 hydrography layers where they have been cleaned and routed, and if not, use the best available information.

Site (effectiveness monitoring) – a site is an area of the effectiveness monitoring stream reach that forms the smallest sampling unit with a defined boundary. Site length depends on the width of the stream channel. Sites will be 20 times the average bankfull width with a minimum length of 150 m and a maximum length of 500 m. Site lengths are measured along the thalweg. The upstream and downstream boundaries of the site will be measured with GPS and recorded as UTM. For purposes of re-measurements, these points will also be photographed, marked with permanent markers (e.g., orange plastic survey stakes), and carefully identified on maps and site diagrams. Site lengths and boundaries will be "fixed" the first time they are surveyed and they will not change over time even if future conditions change.

Transect – a transect is a straight line across a stream channel, perpendicular to the flow, along which habitat features such as width, depth, and substrate are measured at pre-determined intervals. Effectiveness monitoring sites and status/trend monitoring reaches will be divided into 11 evenly spaced transects by dividing the site into 10 equidistant intervals with "transect 1" at the downstream end of the site or reach and "transect 11" at the upstream end of the site or reach. The number of transects varies for different attributes.

Habitat Type – Habitat types, or channel geomorphic units, are discrete, relatively homogenous areas of a channel that differ in depth, velocity, and substrate characteristics from adjoining areas. This plan recommends that the investigator identify the habitat type under each transect within a site or reach following the Level II classification system in Hawkins et al. (1993). That is, habitat will be classified as turbulent fast water, non-turbulent fast water, scour pool, or dammed pool (see definitions in Hawkins et al. 1993). By definition, for a habitat unit to be classified, it should be longer than it is wide. Plunge pools, a type of scour pool, are the exception, because they can be shorter than they are wide. (See: Hillman et al. 2004) section 8, pages 59-76)

Status/Trend Monitoring

If the objective of the monitoring program is to assess the current status of populations and/or environmental conditions, or to assess long-term trends in these parameters, then the following steps will help the investigator design a valid status/trend monitoring program.

- Problem Statement and Overarching Issues:
- Identify and describe the problem to be addressed.
- Identify boundaries of the study area.

- Describe the goal or purpose of the study.
- List hypotheses to be tested.

Statistical Design (see Section 3 of UCMS Strategy)

- Describe the statistical design to be used (e.g., EMAP design).
- List and describe potential threats to external validity and how these threats will be addressed.
- If this is a pilot test, explain why it is needed.
- Describe descriptive and inferential statistics to be used and how precision of statistical estimates will be calculated.

Sampling Design (see Sections 4 & 5 of UCMS Strategy)

- Describe the statistical population(s) to be sampled.
- Define and describe sampling units.
- Identify the number of sampling units that make up the sampling frame.
- Describe how sampling units will be selected (e.g., random, stratified-random, systematic, etc.).
- Describe variability or estimated variability of the statistical population(s).
- Define Type I and II errors to be used in statistical tests (the plan recommends no less than 0.80 power).

Measurements (see Sections 7 & 8 of UCMS Strategy):

- Identify indicator variables to be measured.
- Describe methods and instruments to be used to measure indicators.
- Describe precision of measuring instruments.
- Describe possible effects of measuring instruments on sampling units (e.g., core sampling for sediment may affect local sediment conditions). If such effects are expected, describe how the study will deal with them.
- Describe steps to be taken to minimize systematic errors.
- Describe QA/QC plan, if any.
- Describe sampling frequency for field measurements.

Presenting M&E Results

Explain how the results of this study will yield information relevant to management decisions. Subbasin planners should include a section regarding how the data from the study (with metadata) will be stored, managed and made available to others. A starting point for some subbasin data collection efforts, could be the data definitions document for the Upper Columbia and John Day pilot projects once it has been reviewed. Proponents for the Upper Columbia and John Day projects are reviewing the final data dictionary on which their data system will be developed. The mechanics of data management in the Upper Columbia and John Day systems are being developed by the respective project teams and need significant additional work.

Data Management

Several forms of analysis will be required as data are gathered. Statistical tests, design components, database management architecture, and various reporting format requirements are things the sponsor will take into consideration.

A data management protocol will be established following the general outline:

1. Develop Data Dictionary

1.1 Other Documentation

1.1.1 Develop Data Flow Diagram

1.1.2 Process Flow Diagram

1.1.3 Prepare Data Management Plan (who, what when how)

2. **Develop Forms**

2.1 Develop Field Forms

2.1.1 Create list of useful existing forms

2.1.3 Create Rough Drafts of needed Forms

2.1.4 Edit Forms to coincide with Finalized Data Dictionary (when complete)

2.1.5 Finalize Field Forms

2.2 Develop PDA Forms

2.3 Develop Data Loggers

3. **Establish Data Collection and Reporting Standards**

3.1 Establish appropriate level of granularity

3.2 Create/Adopt Chain of Custody Protocols

3.3 Create/Adopt QA/QC Protocols

3.4 Create/Adopt All Methods, Indicators, Metrics and Protocols (sampling and statistical design)

4.**Create/Adopt Field Manuals**

4.1 Field Forms

4.2 PDAs

4.3 Data Loggers

4.4 Test Field manuals and equipment

5. **Training of all field crews and outside contractors**

6. **Collect Data**

6.1 Field Forms

6.2 PDAs

6.3 Data Loggers

7**. Data Reporting Timelines, Protocols and Formats**

8. **QA/QC**

9. **Data Transition**

9.1 Develop data transition methods (including 10.0 Below)

9.1.1 Field Forms to Electronic Entry Form

9.2.1 Data Loggers to Individual PCs

9.2.1.1 Individual PCs to Central Server

9.3.1 PDAs to Individual PCs

9.3.1.1 Individual PCs to Central Server

9.4 Test data transitions

10. **All data to single repository**

10.1 Develop Repository capability

10.2 Test Repository capability

11. **Final Testing Check off**

12. **Documentation** From steps above to derive a program Data Management Protocol

1. **Develop Data Dictionary**

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Some additional considerations

All M&E data will be held within the data archive system developed for the Baseline M&E Plan. This system will consist of standardized Access/Excel database (Geospatial data base structure and data dictionary being developed for the John Day will be used in the Upper Columbia) formats and will be compatible with other industry and BPA structures. Data will be unrestricted and available to all resource management agencies and subbasin planners. It will remain in this data archive system until delivered to BPA, the Upper Columbia RTT, CBFWA, and other basin database systems such as StreamNet, IBIS, and SSHIAP etc.

Finally, data should follow a common form for definitions. The Pacific Costal Salmon Recovery Fund project has a set of draft definitions that are currently under review by PNAMP and others, and could be used.

Wildlife

Following is a suggested template and outline for considering a terrestrial Monitoring and Evaluation section in subbasin plans:

- Overview of Monitoring and Evaluation – Background and Concepts
- Why is Monitoring and Evaluation important in subbasin planning?
- Direction from Technical Guide for Subbasin Planners (Council Document 2001-20)
- "Each subbasin plan must have a monitoring plan component that describes how strategies to be implemented are achieving the stated biological objectives…"
- "The measures are the improvement in conditions of habitat or population overall – the trends within the subbasin"
- Address if the strategies selected and implemented address the "limiting factors" as anticipated
- Verify that the "limiting factors" are elements that limit the environmental expression and biological performance desired
- Not to be project-specific (that follows later)

Four fundamental questions for M&E design:

- What indicator variables will actually be monitored?
- Who collects the information and how?
- How is the information evaluated and used?
- How much will it cost?

1. To answer the four fundamental questions listed above, five steps to consider during the design of M&E plans for subbasin implementation strategies:

- adopt elements of an ecological management framework;
- define monitoring objectives (address indicators, address management needs, resolve scale issues, conduct early planning of the evaluation component);
- establish monitoring needs (address sampling design, indicators, performance standards, and pilot studies);

- develop a data and information archive (address QA/QC, data management and analysis, and report preparation); and
- evaluation (conduct a scientific evaluation, a decision-making evaluation, and a public evaluation)

1. Guidance in "A Technical Guide for Developing Wildlife Elements of a Subbasin Plan" (Scheeler et al. 2003)
2. Merely mentions section 5.6 Research, Monitoring and Evaluation as part of the Outline for Subbasin Plan
3. Existing direction and protocols for aquatic monitoring and evaluation
4. Pacific Northwest Aquatic Monitoring Partnership (PNAMP) draft "Recommendations for Monitoring in Subbasin Plans"
5. Involved aquatic monitoring, including resident and anadromous fish
6. Will describe how to monitor, not what or why
7. Was reviewed by ISRP/ISAB: needs to address multi-scale benefits (subbasin, province, state, and region) of a collaborative approach
8. Other aquatic monitoring protocols, for information:

- Aquatic Ecological Unit Inventory draft technical guide (http://www.fs.fed.us/emc/rig/includes/aeui_draft_april04.pdf)
- Pacfish/Infish Biological Opinion monitoring (http://www.fs.fed.us/biology/resources/pubs/feu/rmrs_gtr_121.pdf)

1. Need to coordinate and integrate terrestrial monitoring and evaluation with aquatic monitoring and evaluation
2. Efficiencies of effort by coordinating monitoring of parameters, sites conditions, etc.
3. Both should use top-down and bottom-up approaches, collaborative development of monitoring priorities, etc.
4. Other attributes of a successful monitoring program (Reid ca. 1994, with our additions):

- Statisticians and regulatory staff are involved in planning the program from the earliest stages
- There is an institutional commitment to completing the program
- The overall program has a well-defined objective
- The monitoring strategy is designed to achieve the objectives of the program
- The study is designed using prior knowledge of: a) what will change; b) where it will change; c) how much it will change; and d) when it will change
- A detailed plan for collecting baseline conditions is developed before monitoring begins

- Monitoring parameters are appropriately sensitive to expected change
- Methods other than monitoring may be used if they are more efficient for answering question
- Monitoring methods for each study are designed specifically to answer the question proposed
- Monitoring protocols are consistent through the duration of a study
- A detailed plan for analyzing the data is developed and tested before monitoring begins
- All aspects of the monitoring plan are tested during an initial pilot study
- There is a clear tie between results and user needs; results will provide useful information
- A mechanism is included for communicating and applying the results

Also with good advice on monitoring are:

- Convention on Biological Diversity, with guidelines on designing national-level monitoring programs (http://www.biodiv.org/doc/meetings/sbstta/sbstta-09/official/sbstta-09-10-en.doc)
- Other federal guidance on monitoring, such as internal USDA Forest Service guidance on forest plan monitoring and evaluation.
-

Table 50 General objectives for monitoring. Examples from Reid (ca. 1994):

Objective	Comments	Examples
Early warning:		
Of large events	Long-term; accuracy more important than consistency, so improved methods are incorporated as developed	National Weather Service rainfall records used in flood forecasting
Of detrimental trends	Long-term; consistency as important as accuracy	Atmospheric CO_2; Christmas bird counts
Evaluate effectiveness of a practice or method	Timing and attributes keyed to knowledge of response mechanism; may be short-term; usually is effectiveness or validation monitoring	USFS BMPEP
Test hypotheses of associative or causal relations	Timing and attributes keyed to hypothesis and knowledge of response mechanism; may be short-term	Many research experiments
Regulatory oversight:		
Was action carried out?	Implementation monitoring; timing keyed to timing of activity, attributes to wording of regulations; long-term. If standards defined by implementation, may be same as compliance monitoring.	County building permit inspections

Objective	Comments	Examples
Early warning:		
Was goal attained?	Compliance monitoring; attributes keyed to wording of regulations, timing to knowledge of response mechanism and timing of activity; long-term	EPA water quality
Define resource to facilitate planning:		
Through time	Baseline monitoring, usually short term	Stream gauging for reservoir planning
Through space	Inventory, usually carried out once	Forest stand inventory
Describe something	Not a valid objective; for what purpose is it to be described?	Many inventories
Compare areas	Not a valid objective; for what purpose are they to be compared?	Many inventories

Examples of specific objectives of natural resource planning monitoring

Examples of specific objectives can be found on http://www.fs.fed.us/oonf/reports/det2.html (source: USDA Forest Service), which include monitoring parameters of (1) ecosystem condition, health, and sustainability; (2) sustainable multiple forest and range benefits; and (3) organizational effectiveness.

Many other examples are available in the literature and on the Web. Specific to monitoring within the Columbia River basin is the publication by Bisbal (2001):

Abstract (Bisbal 2001)

> A logical sequence of seven steps is proposed as a generic template to design plans for monitoring and evaluating fish and wildlife in the Columbia River ecosystem. Management programs for these resources fail to include coordinated monitoring and evaluation plans. This shortcoming is indicative of pervasive management conflicts detected from regional to local geographic scales.
>
> In the absence of a cohesive ecological management framework, monitoring and evaluation activities proceed without a clear understanding of what uncertainty they are intended to address, nor is there a clear description of the process to utilize the information gained. As a result, the accountability for the investment of public funds for fish and wildlife restoration is poor, information collected from the environment is not included in decision-making, and the ability to gain knowledge while taking management actions is compromised.

The sequence of steps discussed here does not identify or describe distinct monitoring activities or methodologies at any particular location or listed under any specific monitoring plan. Instead, it concentrates on the generic elements necessary for the design and implementation of coordinated fish and wildlife monitoring plans. It is proposed that at least four major issues demand considerable attention in order to improve regional monitoring and evaluation capabilities: The first is adoption of an ecological framework for the management of fish and wildlife at relevant geographic scales within the ecosystem. Such a framework must include an explicit identification of goals, objectives, and actions to steer coordinated decisions across the boundaries of technical disciplines, management jurisdictions, and institutional responsibilities.

The second is that the identification of these management goals for the geographic location of interest must precede the design of monitoring and evaluation plans from the top down. Third, the evaluation component must be considered early on in the planning process, so that it blends smoothly with monitoring at the time of implementation. Fourth, decision-makers and scientists engaged in the planning of fish and wildlife monitoring and evaluation efforts in the region must have a close collaborative relationship.

Monitoring and evaluation plans designed under these premises may enhance our collective observational capabilities, promote cost-effectiveness and adequate evaluation, and provide a useful tool to adjust our management practices to the challenges of complex ecosystems.

Types of monitoring and evaluation

The following terminology on "tiers" derives from the Independent Scientific Review Panel, with additional terminology from federal agency usage (viz., USDA Forest Service and USDI Bureau of Land Management):

1. Tier 1 Trend (Change) Monitoring (generally similar to "implementation monitoring") – Did the agencies, landowners, and managers implement the management guidelines? Implementation monitoring is sometimes viewed as an administrative accounting of actions.

2. Tier 2 Statistical Monitoring (generally similar to "effectiveness monitoring") – Did the management guidelines have the expected results? Effectiveness monitoring is viewed as tracking results as a specific outcome of management activities.

3. Tier 3 Research Monitoring (generally similar to "validation monitoring") – Are the scientific assumptions underlying the management guidelines correct? Validation monitoring is viewed as testing the scientific basis for the management guidelines, and may entail research.

4. Evaluation – should be integrated into the cycle of objective-setting, planning, monitoring, evaluation of results, and revising objectives; to be part of the adaptive management cycle and as a feedback loop back into the monitoring plan.

Prioritizing and Selecting What to Monitor (a proposed list)

Criteria for selecting parameters to monitor

1. Identify and list the key assumptions underlying the management guidelines. For wildlife, examples include such concepts as functional redundancy imparting greater resilience of ecosystems to perturbations; and use of focal species as "umbrella species" that represent the habitat needs and ecological roles of other species. Validating some key assumptions may extend into the realm of research, although some may be tested with Tier 2 Statistical Monitoring (or effectiveness monitoring) activities.
2. Identify and list habitats, species, and key ecological functions most at risk. These form the basis from which specific parameters (habitat area, habitat patch size, species presence, population density and trend, inferred redundancy of key ecological functions, etc.) are determined and tracked through Tier 2 Statistical Monitoring (or effectiveness monitoring) activities.
3. List the management activities resulting from the subbasin plan, which would be instituted to meet the plan objectives. An example of such management activities is controlling pollution or re-establishing the channel complexity of the Willamette River. Management activities can be identified at scales broader than the individual project scale. Tier 1 Trend (Change) Monitoring (or implementation monitoring) would track whether the management activities are being carried out as stated in the plan.
4. Identify and list limiting factors that most guide the outcome and form of the subbasin plan and associated management guidelines. An example may be the need to quickly slow or reverse the spread of noxious weeds or exotic species. Tier 2 Statistical Monitoring (or effectiveness monitoring) could track such parameters.
5. Identify and list which habitats, species, and key ecological functions are most effectively (and positively) influenced by management activities and guidelines for conservation or restoration. That is, Tier 2 Statistical Monitoring (or effectiveness monitoring), especially, is best aimed at parameters that management can influence, rather than other system conditions for which management may have little to no direct influence.
6. Identify and list parameters most directly and severely affecting desired ecosystem services. Such parameters may include specific wildlife-habitat types, and categories of key ecological functions, key environmental correlates, and other factors. A combination of Tier 2 Statistical Monitoring (or effectiveness monitoring) (to track trends in parameters) and Tier 3 Research Monitoring (or validation monitoring) activities could be used to test the underlying causal links to amounts and patterns of ecosystem services.
7. Identify parameters by spatial scale. Some parameters may need to be determined at the scale of a subbasin, others finer than a subbasin, and others broader than a subbasin (e.g., Ecoprovince). For the last of these, each subbasin would contribute their share of sampling that, collectively across the appropriate set of subbasins, would provide sample sizes and locations by which to judge conditions and trends of specified parameters at the desired level of statistical confidence.

8. Parameters would be identified from both bottom-up (local issues and needs) and top-down (Basin, Ecoprovince, and other broader issues and needs) priorities and procedures
9. Integrate terrestrial with aquatic, and wildlife with fish, monitoring activities and needs assessments. This will help address ecosystem more as a whole, and provide efficiencies in monitoring budgets and operations.

Specific Examples for Subbasin Planning

An example of monitoring and evaluation at the subbasin planning level within the Columbia River basin:

Draft Walla Walla Subbasin Wildlife Assessment and Inventory (Paul R. Ashley, Stacey H. Stovall, 2004; "Originally Appendix J of the Southeast Wildlife Ecoregion Wildlife Assessment and Inventory [WDFW 2004]): "Draft Subbasin Management Plan Terrestrial Research, Monitoring and Evaluation"

Lists 4 major assumptions used to focus subbasin planning (use of focal habitats; use of umbrella species as focal species; managing for focal species' "recommended management conditions" would provide for functional focal habitats; focal species assemblages adequately represent focal habitats)

Presents an "Ecoregion Assessment and Inventory Synthesis Cycle", an adaptive management process

Presents a Research, Monitoring and Evaluation Plan, which lists research needs, data gaps, and methods for monitoring focal habitats and focal species

Presents focal habitat and species monitoring methodology, including general methods for vegetation and wildlife, and specific parameters to monitor for each focal habitat and species.

The Role of Research

The "R" component of "RM&E" may come later – research.

Subbasin plans can be used to help list key uncertainties and assumptions to test.

Monitoring can be designed to answer some research questions, in the sense of adaptive management. Implementing the subbasin plans can be done as management experiments to track and test.

As an example, the main hypotheses and key assumptions pertaining to the "key ecological functions" part of the IBIS database can be listed (see http://www.spiritone.com/~brucem/kef1.htm#Hypotheses) as a basis for selected research studies.

A Skaha Lake Monitoring and Assessment Plan – a model for range restoration above Okanagan Falls

Okanagan River sockeye salmon, which spawn near the town of Oliver, B.C., have their farther upstream migration limited by several water control and diversion dams. Stock numbers have been declining for many years and the Okanagan Native Alliance Fisheries Department (ONAFD) has been the principal advocate of a program to restore their numbers and range by reintroducing them into upstream waters where they may once have occurred in substantial numbers

Some investigators have warned that without effective intervention Okanagan sockeye are at considerable risk of extinction. Among a host of threats, the quality of water in the single nursery areas in Osoyoos Lake is deteriorating and a sanctuary such as that afforded in larger lakes higher in the system could be essential.

Because the proposed reintroduction upstream has implications for other fish species, (particularly kokanee, the so-called "landlocked sockeye" which reside in many Okanagan lakes), the proponents undertook a three-year investigation, with funding from the Bonneville Power Administration and the Confederated Tribes of the Colville Tribes Reservation, to identify possible problem areas, and they committed to an interim experimental reintroduction to Skaha Lake where any problems could be worked out before a more ambitious reintroduction, (e.g. to Okanagan Lake) could be formally considered.

The three-year investigation was completed in the spring of 2003. It included an assessment of risks from disease or the possible introduction of unwanted exotic species. It also considered the present quality and quantity of sockeye habitat, and opportunities for expanding or improving it. Finally ecological complexity encouraged the development of a life history model to examine interactions of sockeye with other fishes and their food organisms.

While some problem areas were exposed in the course of these studies, they appeared to be manageable and the concept of an experimental reintroduction was largely supported but with the proviso that there should be a thorough evaluation and reporting of progress and results. A 2004 start on implementation and monitoring has now been proposed.

The Canadian Okanagan Basin Technical Working Group (COBTWG), with research and other expertise from participating agencies has, since 1997, provided guidance in moving toward a comprehensive implementation and monitoring program. (Much of the technical input from COBTWG is by a sub-committee of fisheries experts from federal, provincial and Okanagan Nation member agencies.)

Participants reviewed several introduction options and concluded that capture of mature adults on the spawning grounds, and extraction and fertilization of eggs gave the least risk, and offered the greatest learning opportunities - for instance for studies of sockeye-kokanee interactions at various life stages. Eggs would be incubated in a local hatchery and known numbers of fry would be planted in the river from which point they would be expected to move downstream and into Skaha Lake.

Planned studies are also expected to expand knowledge of sockeye and kokanee interactions with food organisms, particularly the ubiquitous shrimp *Mysis relicta* which represents a food supply for growing sockeye and kokanee, and at the same time competes with them for planktonic forage organisms. While there is uncertainty about the weight that should be assigned to each of these disparate roles, modeling results suggest that mysids may be a greater hazard for lake-dwelling kokanee than sockeye.

As the program moves forward, conservation measures for the existing stock are being built in. For instance yearly escapement records from Wells Dam on the Columbia River permit a forecast of corresponding run sizes on the spawning grounds, and investigators have proposed that no fish should be removed for brood stock purposes, when runs are smaller than 10,000 sockeye at Wells.

Modeling results were instructive when considering levels for fry plants: Simulated fry introductions ranging from 200-7500 fry/ha suggested that numbers as high as 1000 fry/ha would have little effect on survival of either kokanee or mysids, and that stepped increases as high as 5000 fry/ha would generate increases in sockeye fry survivals, but that survival would begin to decline above that level.

Fry cultured for the Skaha Lake reintroduction will be distinctively marked so their behavior, growth and survival can be measured at successive life stages. Marking will also help in distinguishing them from kokanee fry of similar size and appearance. Unique marks will be selected so as to readily identify the bearers if mixed with fish from any other marking programs in the Columbia Basin.

The central question in this investigation relates to the performance of the resident kokanee population during the reintroduction of their anadromous counterparts. Investigators must decide how great a change in growth and survival of kokanee (particularly juveniles), and over how long, should be accepted as clear evidence of success or failure of the reintroduction experiment.

To get at this question a series of hypotheses will be tested and suitable performance measures are now being developed. There will be several levels of fry introduction over the years, and a comparison of both sockeye and kokanee population responses, such as growth rates, will be measured. Kokanee response data will be compared with like data from years when there were no sockeye in Skaha L.

The ONAFD seeks efficiency, and year-to-year consistency in the critical task of obtaining brood stock and to this end it is developing a detailed Procedures Manual for fieldwork. This draws upon the extensive experience of government agency culturists and others and can be upgraded after each year's work experience.

A detailed work plan has been developed, featuring essential tasks, and setting down procedures and processes designed to maximize both performance and efficiency. In appendix ? is information on the Monitoring and Evaluation Plan proposed for this project consisting of: the role of COBTWG, key features, performance measures, hypothesis to be tested, model refinement needs and a work plan for the first four years of the program.

Canadian Science Coordination for Monitoring and evaluation in the Okanogan subbasin

The Canadian Okanagan Basin Technical Working Group (COBTWG) is a tripartite working group consisting of federal Fisheries and Oceans Canada (DFO), the Okanagan Nation Alliance (ONA), and the provincial Ministry of Water, Land and Air Protection (WLAP). COBTWG deals with salmon and resident fish population issues in the Canadian portion of the Okanagan basin (www.obtwg.ca). The members of COBTWG have been involved with this initiative since the first workshop in 1997 (Peters et al. 1998). They participated in the review, development, and recommendations for the evaluation phase of the project from 2000-2003, and, jointly with the ONAFD, in planning and developing essential features of the Year 1 incubation and fry rearing phases.

A workshop was called by COBTWG on November 24, 2003 to discuss the Implementation, Monitoring and Evaluation plans. It was decided that technical input to plan development would thereafter be by a sub-committee of members from DFO, WLAP and ONAFD.

The COBTWG sub-committee will provide historical data input, an initial program review monitoring and evaluation parameters, and recommend to the parent committee. It will act as a technical advisory body on the implementation strategy and arrange for annual, and other reports to be provided to both COBTWG representatives and funding agencies. The sub-committee will be provided with technical assistance as required

At a meeting of the sub-committee on November 25, 2003 and during a teleconference on December 22, 2003 members developed the monitoring and evaluation plan and the year one work plan. In addition, a subsequent discussion at the January 15, 2004 COBTWG meeting was held prior to development of this report to be sent out for final comment.

Evaluation limitations

Large scale experiments such as the Reintroduction of Sockeye Salmon to Skaha L. outlined here will always have some monitoring and evaluation limitations and generate uncertainty about the quality of certain baseline information. (In the present case the historic data were sometimes collected under uncertain circumstances and by many different investigators working with several resource agencies over several decades).

Program success or failure from a sockeye stock perspective can be measured simply in terms of the number of successful anadromous returns to Skaha L. However, the sockeye reintroduction could also affect the well being of other Okanagan fish species with possible negative impacts on kokanee being the most significant. A critical question to be answered is:

What rates of growth and survival of kokanee juveniles, relative to their historic or “baseline” performance will be convincing evidence of either program success or program failure?

The difficulty in setting a satisfactory level for statistical tests, and accumulating test values over a satisfactory number of years may be reduced through the expertise of agencies who have participated and learned from similar large scale experiments concerned with British Columbia *O. nerka* populations such as those in the Great Central L., Okanagan L., and in Kootenay L. (Andrusak et al. 2001; Ashley & Thompson 1993; O'Neill & Hyatt 1987; Stockner 1987). Examination of performance measures used in those studies, and the level of success enjoyed in those and other similar ventures should be instructive when evaluating the approach taken here.

Performance Measures

Performance measures will need to address production, growth and survival of key organisms, and at least four such measures are considered:

1. Failure in Biological Persistence: i.e. when kokanee are unable to maintain themselves in the presence of increasing numbers of sockeye.

2. Impacts on Existing Utilization: i.e. when there is a persistent decrease in CPUE in kokanee, or indirectly on predators such as rainbow trout (for the latter a change in size at age may also be apparent).

3. Statistically significant change in kokanee stock performance (in response to successive sockeye introductions) relative to some base period for which acceptable data exists.

4. Changes in kokanee and other stock performance as sockeye fry are introduced in varying numbers in successive years.

In the present investigation a hypothesis similar to that suggested by Parnell et al (2003) may be tested: Hypothesis: "failure in biological persistence of Skaha L. kokanee can be attributed to reintroduction of sockeye salmon"

The main thrust of the investigation is to quantify variations in kokanee stock performance caused by introduction of sockeye. However demonstrating cause and effect will be challenging, and the problem will be exacerbated by variations in numbers of mysids interacting with the fish populations. For each of these 3 taxa, (sockeye, kokanee, mysids) a baseline, a range of values and a mean and variance will be needed. Both the nature and magnitude of variations in abundance, and what drives them, will be researched as will variations in zooplankton food organisms.

The effects on the existing sockeye population of the reintroduction to Skaha will be watched with great interest. It will be required to track a known number of marked sockeye fry to at least the smolt stage, to monitor kokanee population trends and to partition the mysid stock into a) an energy source;(i.e. as food for organisms higher in the food chain), and b) an energy sink;(by consuming food sought by other species).

Comparative measures of sockeye production in Osoyoos and Skaha lakes will be required as reintroduction to Skaha takes hold, and because tertiary waste water treatments began to affect Skaha L. trophic levels about 20 years ago lacustrine baseline data should not begin earlier than about 1980.

Indicators of production variation in kokanee include the following:

- numbers of spawners on the spawning grounds
- biomass in Skaha L.
- change in density dependent growth
- change in survival rate (only in a modeling sense as needed baseline data are not available)

There is a curvilinear relationship between kokanee size at age 1.0, and the pelagic biomass. Using this as a baseline it will be possible to measure changes in yearly performance beginning with the year of sockeye introductions. Confidence in assessing relative success or failure can be expected to improve as data are gathered.

It is apparent that a great deal of careful monitoring of both physical and biological features of the aquatic ecosystem will be needed during the next dozen years. A period of uninterrupted work will be required initially, but it is expected that there should be a thorough review of progress at the end of (for instance) each 4-year period when any required re-alignment of effort can be undertaken.

Skaha L. was selected as an experimental environment in which to evaluate the long-term goal of reintroducing sockeye back into Okanagan L. (Peters et al. 1998). While the experiment should proceed, there is also need to establish an acceptable level of risk for both sockeye and kokanee. With risk in mind strict conservation measures have already been set for broodstock collection. In the more difficult case of fry reintroduction, there is a need to balance the risk to kokanee against anticipated important learning benefits. A question arises as to the size and duration of an observed negative impact (for example reduced growth rate) before deciding that sockeye reintroduction is detrimental to Skaha kokanee? This question should be reviewed on both a technical and general public level at the conclusion of each 4-year period.

Hypotheses to be Tested

Concerns implicit in the hypotheses given below, and in the information needed to test them comprised the rationale for the work plan presented in Appendix C. The list of information needs serves as a check against requirements of the work plan, ensuring that no essentials are missed and that no unnecessary expenditures of human or material resources occur. The hypotheses are similar in intent to those proposed by Parnell et al (2003).

Although the sub-committee of the COBTWG has had input into the development of the work plan, the formal review by COBTWG of both the work plan and this report will not be in time for present reporting purposes.

Kokanee Related Hypotheses

Hypothesis 1: There is no difference between brood year-return ratios in adult Skaha L. kokanee in the 1989-2003 base period and the experimental reintroduction period.

Information needs: Standardized adult escapements in the baseline period; yearly escapement numbers during the experimental period; kokanee biosamples.

Hypothesis 2: There is no difference between predicted and observed density related growth of age 0+ Skaha L kokanee at various levels of sockeye fry introductions during the experimental reintroduction period.

Information needs: Results of four-season Acoustic and Trawl Survey (ATS); general chemical and limnological conditions; zooplankton (including *Mysis*) abundance: numbers of sockeye fry introduced.

Hypothesis 3: There is no difference between predicted and observed survival rates of age 0-1.0 Skaha L. kokanee at various levels of sockeye fry introduction during the experimental period.

Information needs: Calibration of spring ATS surveys by estimated numbers of emerging fry; four-season ATS results; biosamples; numbers of sockeye fry introduced.

Sockeye Related Hypothesis

Hypothesis 4: There is no difference between Osoyoos L. and Skaha L. Smolt to Adult Return (SAR) ratios during the sockeye fry reintroduction period.

Information Needs: Annual Okanagan R. sockeye escapement; and for both Osoyoos and Skaha lakes, ATS data; smolt timing and age composition; general chemical and physical limnological conditions; zooplankton (including *Mysis*) abundance.

Model Refinement Needs

A model developed by Peters and Marmorek (2003) will be used to generate predictions for comparison with observed variations in kokanee production. As with most models, there are limitations. Most notable here are assumptions respecting density-dependent in-lake carrying capacity. Our phosphorus to fish biomass estimates are based on lakes where the major limnetic fish are juvenile sockeye (Hyatt & Rankin 1999) whereas in Skaha L. there are kokanee and *Mysis relicta* populations and both are pelagic feeders. To overcome this limitation the model uses ‘ 0+ equivalents’ for other than 0+ age classes of kokanee and for *M. relicta* (Peters & Marmorek 2003). The concern is whether these really are equivalents. For instance do sockeye out-compete kokanee, or do kokanee out-compete sockeye and are mysids primarily an energy sink or primarily a source of food? More information is needed as to interactions between these taxa and their food sources.

As an added complication, there are two whitefish species (Lake Whitefish - *Coregonus clupeaformis* and Mountain Whitefish – *Prosopium williamsoni*), which are also limnetic in Skaha L. and which utilize the same general food source to some degree as the three animals identified above.

To improve our understanding of the various species interactions, an analysis similar to that provided by the ‘Wisconsin’ bioenergetics model by Stockwell and Johnson (1997) and developed by Fisheries and Oceans Canada for another British Columbia lake will be conducted (Hyatt et al. 2004). It is expected that at the end of the 12- year experimental period, our knowledge of these interactions will be much improved and will enable us in a future project to develop a refined model to evaluate reintroduction of sockeye into Okanagan L.

6 References

During the Quality Control/Quality Assurance phase of document review, several references were found to be improperly cited or improperly used (i.e., secondary references or missing information). Thus, an exhaustive review of the subbasin plan and the following reference section will turn up a small number of missing citations. These are available upon request from the subbasin coordinators, but have not been reconciled for accuracy.

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During the Quality Control/Quality Assurance phase of document review, several references were found to be improperly cited or improperly used (i.e., secondary references or missing information). Thus, an exhaustive review of the subbasin plan and the following reference section will turn up a small number of missing citations. These are available upon request from the subbasin coordinators, but have not been reconciled for accuracy.

7 Technical Appendices

8 Appendix A: Wildlife Species of the Okanogan Subbasin

Table 51 Wildlife Species of the Okanogan subbasin

Shrub-steppe	Eastside (Interior) Riparian Wetlands	Herbaceous Wetlands
American Avocet	American Badger	American Avocet
American Badger	American Beaver	American Beaver
American Crow	American Crow	American Bittern
American Goldfinch	American Dipper	American Coot
American Kestrel	American Goldfinch	American Crow
American Robin	American Kestrel	American Dipper
Bank Swallow	American Marten	American Goldfinch
Barn Owl	American Redstart	American Kestrel
Barn Swallow	American Robin	American Pipit
Barrow's Goldeneye	American Tree Sparrow	American Robin
Big Brown Bat	American Wigeon	American Wigeon
Black Bear	Bank Swallow	Baird's Sandpiper
Black-billed Magpie	Barn Owl	Bank Swallow
Black-chinned Hummingbird	Barn Swallow	Barn Owl
Black-necked Stilt	Barred Owl	Barn Swallow
Black-tailed Jackrabbit	Belted Kingfisher	Barrow's Goldeneye
Black-throated Sparrow	Big Brown Bat	Big Brown Bat
Blue Grouse	Black Bear	Black Bear
Bobcat	Black Swift	Black Swift
Brewer's Blackbird	Black-backed Woodpecker	Black Tern
Brewer's Sparrow	Black-billed Magpie	Black-billed Magpie
Brown-headed Cowbird	Black-capped Chickadee	Black-capped Chickadee
Bullfrog	Black-chinned Hummingbird	Black-chinned Hummingbird
Burrowing Owl	Black-crowned Night-heron	Black-crowned Night-heron
Bushy-tailed Woodrat	Black-headed Grosbeak	Black-necked Stilt
California Myotis	Black-tailed Deer	Black-tailed Deer
California Quail	Black-throated Gray Warbler	Blue-winged Teal

Shrub-steppe	Eastside (Interior) Riparian Wetlands	Herbaceous Wetlands
Canada Goose	Blue Grouse	Bobcat
Canyon Wren	Bobcat	Bobolink
Chipping Sparrow	Bobolink	Brewer's Blackbird
Chukar	Bohemian Waxwing	Brown-headed Cowbird
Cliff Swallow	Brewer's Blackbird	Bullfrog
Columbia Spotted Frog	Brown Creeper	Burrowing Owl
Columbian Ground Squirrel	Brown-headed Cowbird	California Gull
Common Garter Snake	Bullfrog	California Myotis
Common Nighthawk	Bullock's Oriole	Calliope Hummingbird
Common Poorwill	Bushy-tailed Woodrat	Canada Goose
Common Porcupine	California Myotis	Canvasback
Common Raven	California Quail	Cascade Frog
Cooper's Hawk	Calliope Hummingbird	Caspian Tern
Coyote	Canada Goose	Cedar Waxwing
Deer Mouse	Canyon Wren	Cinnamon Teal
Eastern Kingbird	Cascade Frog	Clark's Grebe
European Starling	Cassin's Finch	Cliff Swallow
Ferruginous Hawk	Cassin's Vireo	Columbia Spotted Frog
Fringed Myotis	Cedar Waxwing	Columbian White-tailed Deer
Golden Eagle	Chipping Sparrow	Common Garter Snake
Golden-mantled Ground Squirrel	Chukar	Common Loon
Gopher Snake	Cliff Swallow	Common Nighthawk
Grasshopper Sparrow	Coast Mole	Common Porcupine
Gray Flycatcher	Columbia Spotted Frog	Common Raven
Gray Partridge	Columbian Ground Squirrel	Common Yellowthroat
Great Basin Pocket Mouse	Columbian Mouse	Cooper's Hawk
Great Basin Spadefoot	Common Garter Snake	Coyote
Great Horned Owl	Common Merganser	Deer Mouse
Greater Yellowlegs	Common Nighthawk	Double-crested Cormorant
Hoary Bat	Common Porcupine	Eared Grebe
Horned Lark	Common Raven	Eastern Kingbird
Killdeer	Common Redpoll	European Starling

Shrub-steppe	Eastside (Interior) Riparian Wetlands	Herbaceous Wetlands
Lark Sparrow	Common Yellowthroat	Forster's Tern
Least Chipmunk	Cooper's Hawk	Fringed Myotis
Lesser Yellowlegs	Cordilleran Flycatcher	Gadwall
Little Brown Myotis	Coyote	Glaucous Gull
Loggerhead Shrike	Creeping Vole	Golden Eagle
Long-billed Curlew	Dark-eyed Junco	Great Basin Spadefoot
Long-eared Myotis	Deer Mouse	Great Blue Heron
Long-eared Owl	Double-crested Cormorant	Great Egret
Long-legged Myotis	Downy Woodpecker	Great Gray Owl
Long-tailed Vole	Dusky Flycatcher	Great Horned Owl
Long-tailed Weasel	Eastern Cottontail	Greater Yellowlegs
Long-toed Salamander	Eastern Fox Squirrel	Green-winged Teal
Mallard	Eastern Kingbird	Grizzly Bear
Merriam's Shrew	Ermine	Gyrfalcon
Mink	European Starling	Herring Gull
Montane Vole	Evening Grosbeak	Hoary Bat
Mountain Bluebird	Fisher	Hooded Merganser
Mourning Dove	Flammulated Owl	House Finch
Nashville Warbler	Fox Sparrow	Killdeer
Night Snake	Fringed Myotis	Lapland Longspur
Northern Flicker	Golden Eagle	Least Sandpiper
Northern Goshawk	Golden-crowned Kinglet	Lesser Yellowlegs
Northern Grasshopper Mouse	Golden-mantled Ground Squirrel	Lincoln's Sparrow
Northern Harrier	Gopher Snake	Little Brown Myotis
Northern Leopard Frog	Gray Catbird	Loggerhead Shrike
Northern Pocket Gopher	Gray Jay	Long-billed Curlew
Northern Rough-winged Swallow	Great Basin Spadefoot	Long-billed Dowitcher
Northern Shrike	Great Blue Heron	Long-eared Myotis
Nuttall's (Mountain) Cottontail	Great Egret	Long-eared Owl
Orange-crowned Warbler	Great Horned Owl	Long-legged Myotis
Osprey	Greater Yellowlegs	Long-tailed Vole
Pacific Chorus (Tree) Frog	Green-winged Teal	Long-tailed Weasel

Shrub-steppe	Eastside (Interior) Riparian Wetlands	Herbaceous Wetlands
Painted Turtle	Grizzly Bear	Long-toed Salamander
Pallid Bat	Hairy Woodpecker	Mallard
Prairie Falcon	Harlequin Duck	Marsh Wren
Pygmy Rabbit	Heather Vole	Meadow Vole
Racer	Hermit Thrush	Mink
Red-tailed Hawk	Hoary Bat	Montane Vole
Ringneck Snake	Hooded Merganser	Moose
Ring-necked Pheasant	House Finch	Mountain Lion
Rock Dove	House Wren	Muskrat
Rock Wren	Killdeer	Northern Bog Lemming
Rough-legged Hawk	Lazuli Bunting	Northern Goshawk
Rough-skinned Newt	Least Chipmunk	Northern Harrier
Rubber Boa	Lesser Yellowlegs	Northern Leopard Frog
Sage Grouse	Lewis's Woodpecker	Northern Pintail
Sage Sparrow	Lincoln's Sparrow	Northern Pygmy-owl
Sage Thrasher	Little Brown Myotis	Northern River Otter
Sagebrush Lizard	Long-eared Myotis	Northern Rough-winged Swallow
Sagebrush Vole	Long-eared Owl	Northern Shoveler
Savannah Sparrow	Long-legged Myotis	Northern Shrike
Say's Phoebe	Long-tailed Vole	Northwestern Salamander
Sharp-shinned Hawk	Long-tailed Weasel	Nutria
Sharp-tailed Grouse	Long-toed Salamander	Pacific Chorus (Tree) Frog
Short-eared Owl	Macgillivray's Warbler	Pacific Jumping Mouse
Short-horned Lizard	Mallard	Pacific Water Shrew
Side-blotched Lizard	Masked Shrew	Painted Turtle
Snow Bunting	Meadow Vole	Pallid Bat
Solitary Sandpiper	Mink	Pectoral Sandpiper
Spotted Bat	Montane Shrew	Pied-billed Grebe
Spotted Sandpiper	Montane Vole	Pine Siskin
Striped Whipsnake	Moose	Raccoon
Swainson's Hawk	Mountain Bluebird	Redhead

Shrub-steppe	Eastside (Interior) Riparian Wetlands	Herbaceous Wetlands
Tiger Salamander	Mountain Chickadee	Red-necked Grebe
Townsend's Big-eared Bat	Mountain Lion	Red-tailed Hawk
Townsend's Ground Squirrel	Mourning Dove	Red-winged Blackbird
Townsend's Solitaire	Muskrat	Ring-billed Gull
Turkey Vulture	Nashville Warbler	Ring-necked Duck
Vagrant Shrew	Northern Alligator Lizard	Ring-necked Pheasant
Vesper Sparrow	Northern Flicker	Roosevelt Elk
Washington Ground Squirrel	Northern Flying Squirrel	Rough-legged Hawk
Western Fence Lizard	Northern Goshawk	Rough-skinned Newt
Western Harvest Mouse	Northern Harrier	Ruby-crowned Kinglet
Western Kingbird	Northern Leopard Frog	Ruddy Duck
Western Meadowlark	Northern Pocket Gopher	Rufous Hummingbird
Western Pipistrelle	Northern Pygmy-owl	Savannah Sparrow
Western Rattlesnake	Northern River Otter	Sharp-shinned Hawk
Western Skink	Northern Rough-winged Swallow	Short-eared Owl
Western Small-footed Myotis	Northern Saw-whet Owl	Shrew-mole
Western Terrestrial Garter Snake	Northern Waterthrush	Silver-haired Bat
Western Toad	Northwestern Salamander	Snowy Owl
White-crowned Sparrow	Olive-sided Flycatcher	Solitary Sandpiper
White-tailed Jackrabbit	Orange-crowned Warbler	Song Sparrow
White-throated Swift	Osprey	Sora
Woodhouse's Toad	Pacific Chorus (Tree) Frog	Spotted Bat
Yellow-bellied Marmot	Pacific Jumping Mouse	Spotted Sandpiper
Yuma Myotis	Pacific Water Shrew	Striped Skunk
	Painted Turtle	Swainson's Hawk
	Pallid Bat	Thayer's Gull
	Pied-billed Grebe	Tiger Salamander
	Pileated Woodpecker	Townsend's Big-eared Bat
	Pine Siskin	Tree Swallow
	Prairie Falcon	Tundra Swan
	Pygmy Nuthatch	Turkey Vulture
	Raccoon	Vagrant Shrew

Shrub-steppe	Eastside (Interior) Riparian Wetlands	Herbaceous Wetlands
	Racer	Vaux's Swift
	Red Crossbill	Violet-green Swallow
	Red Fox	Virginia Rail
	Red-breasted Nuthatch	Western Grebe
	Red-breasted Sapsucker	Western Harvest Mouse
	Red-eyed Vireo	Western Jumping Mouse
	Red-naped Sapsucker	Western Meadowlark
	Red-tailed Hawk	Western Sandpiper
	Red-winged Blackbird	Western Screech-owl
	Ring-necked Duck	Western Small-footed Myotis
	Ring-necked Pheasant	Western Terrestrial Garter Snake
	Rough-legged Hawk	Western Toad
	Rough-skinned Newt	White-crowned Sparrow
	Rubber Boa	White-throated Swift
	Ruby-crowned Kinglet	Wilson's Phalarope
	Ruffed Grouse	Wilson's Snipe
	Rufous Hummingbird	Wood Duck
	Savannah Sparrow	Woodhouse's Toad
	Say's Phoebe	Yellow-bellied Marmot
	Sharptail Snake	Yellow-headed Blackbird
	Sharp-tailed Grouse	Yellow-rumped Warbler
	Shrew-mole	Yuma Myotis
	Silver-haired Bat	
	Snowshoe Hare	
	Solitary Sandpiper	
	Song Sparrow	
	Southern Alligator Lizard	
	Southern Red-backed Vole	
	Spotted Bat	
	Spotted Sandpiper	
	Spotted Towhee	

Shrub-steppe	Eastside (Interior) Riparian Wetlands	Herbaceous Wetlands
	Steller's Jay	
	Striped Skunk	
	Swainson's Hawk	
	Swainson's Thrush	
	Tailed Frog	
	Three-toed Woodpecker	
	Tiger Salamander	
	Townsend's Big-eared Bat	
	Townsend's Solitaire	
	Townsend's Warbler	
	Tree Swallow	
	Trowbridge's Shrew	
	Turkey Vulture	
	Vagrant Shrew	
	Vaux's Swift	
	Veery	
	Violet-green Swallow	
	Virginia Opossum	
	Warbling Vireo	
	Water Shrew	
	Water Vole	
	Western Bluebird	
	Western Harvest Mouse	
	Western Jumping Mouse	
	Western Pipistrelle	
	Western Rattlesnake	
	Western Screech-owl	
	Western Small-footed Myotis	
	Western Tanager	
	Western Terrestrial Garter Snake	
	Western Toad	
	Western Wood-pewee	

Shrub-steppe	Eastside (Interior) Riparian Wetlands	Herbaceous Wetlands
	White-breasted Nuthatch	
	White-crowned Sparrow	
	White-headed Woodpecker	
	White-tailed Jackrabbit	
	White-throated Swift	
	Wild Turkey	
	Williamson's Sapsucker	
	Willow Flycatcher	
	Wilson's Warbler	
	Winter Wren	
	Wood Duck	
	Woodhouse's Toad	
	Yellow Warbler	
	Yellow-bellied Marmot	
	Yellow-breasted Chat	
	Yellow-pine Chipmunk	
	Yellow-rumped Warbler	
	Yuma Myotis	

9 Appendix B: Wildlife-Salmonid Habitat Associations in the Okanogan Subbasin

Table 52 Wildlife-Salmonid Habitat Associations in the Okanogan Subbasin

	Common Name	Scientific Name	Salmonid Relationship	Closely Associated with Riparian Wetlands	Closely Associated with Other Wetlands
Amphibians					
	Tiger Salamander	*Ambystoma tigrinum*		Yes	
	Long-toed Salamander	*Ambystoma macrodactylum*		Yes	
	Tailed Frog	*Ascaphus truei*		Yes	
	Great Basin Spadefoot	*Scaphiopus intermontanus*		Yes	
	Western Toad	*Bufo boreas*		Yes	
	Pacific Chorus (Tree) Frog	*Pseudacris regilla*		Yes	
	Cascades Frog	*Rana cascadae*			
	Columbia Spotted Frog	*Rana luteiventris*		Yes	
	Bullfrog	*Rana catesbeiana*		Yes	
	Total Amphibians:	**9** **Total:**	**0**	**8**	**0**
Birds					
	Common Loon	*Gavia immer*	Yes		Yes
	Pied-billed Grebe	*Podilymbus podiceps*	Yes		Yes
	Red-necked Grebe	*Podiceps grisegena*	Yes		Yes
	Eared Grebe	*Podiceps nigricollis*			Yes
	American Bittern	*Botaurus lentiginosus*			Yes
	Great Blue Heron	*Ardea herodias*	Yes	Yes	
	Black-crowned Night-heron	*Nycticorax nycticorax*	Yes	Yes	
	Turkey Vulture	*Cathartes aura*	Yes		
	Canada Goose	*Branta canadensis*			Yes

Birds					
	Tundra Swan	*Cygnus columbianus*			
	Wood Duck	*Aix sponsa*		Yes	
	Gadwall	*Anas strepera*			Yes
	American Wigeon	*Anas americana*			Yes
	Mallard	*Anas platyrhynchos*	Yes	Yes	
	Blue-winged Teal	*Anas discors*			Yes
	Cinnamon Teal	*Anas cyanoptera*			Yes
	Northern Shoveler	*Anas clypeata*			Yes
	Northern Pintail	*Anas acuta*			Yes
	Green-winged Teal	*Anas crecca*	Yes		Yes
	Canvasback	*Aythya valisineria*	Yes		Yes
	Redhead	*Aythya americana*			Yes
	Ring-necked Duck	*Aythya collaris*			
	Greater Scaup	*Aythya marila*	Yes		
	Harlequin Duck	*Histrionicus histrionicus*	Yes	Yes	
	Barrow's Goldeneye	*Bucephala islandica*	Yes		
	Hooded Merganser	*Lophodytes cucullatus*	Yes	Yes	
	Common Merganser	*Mergus merganser*	Yes	Yes	
	Ruddy Duck	*Oxyura jamaicensis*			Yes
	Osprey	*Pandion haliaetus*	Yes		
	Northern Harrier	*Circus cyaneus*			
	Sharp-shinned Hawk	*Accipiter striatus*			
	Cooper's Hawk	*Accipiter cooperii*			
	Northern Goshawk	*Accipiter gentilis*			
	Swainson's Hawk	*Buteo swainsoni*			
	Red-tailed Hawk	*Buteo jamaicensis*	Yes		
	Rough-legged Hawk	*Buteo lagopus*			
	Golden Eagle	*Aquila chrysaetos*	Yes		
	American Kestrel	*Falco sparverius*			
	Gyrfalcon	*Falco rusticolus*	Yes		

Birds					
	Prairie Falcon	*Falco mexicanus*			
	Chukar	*Alectoris chukar*			
	Gray Partridge	*Perdix perdix*			
	Ring-necked Pheasant	*Phasianus colchicus*		Yes	
	Ruffed Grouse	*Bonasa umbellus*		Yes	
	Spruce Grouse	*Falcipennis canadensis*			
	White-tailed Ptarmigan	*Lagopus leucurus*			
	Blue Grouse	*Dendragapus obscurus*		Yes	
	Sharp-tailed Grouse	*Tympanuchus phasianellus*		yes	
	Wild Turkey	*Meleagris gallopavo*			
	California Quail	*Callipepla californica*			
	Virginia Rail	*Rallus limicola*			Yes
	Sora	*Porzana carolina*			Yes
	American Coot	*Fulica americana*			Yes
	Killdeer	*Charadrius vociferus*	Yes		
	American Avocet	*Recurvirostra americana*			Yes
	Greater Yellowlegs	*Tringa melanoleuca*	Yes		
	Lesser Yellowlegs	*Tringa flavipes*			
	Solitary Sandpiper	*Tringa solitaria*		Yes	
	Spotted Sandpiper	*Actitis macularia*	Yes		
	Long-billed Curlew	*Numenius americanus*			
	Semipalmated Sandpiper	*Calidris pusilla*			
	Western Sandpiper	*Calidris mauri*			
	Least Sandpiper	*Calidris minutilla*			
	Baird's Sandpiper	*Calidris bairdii*			
	Pectoral Sandpiper	*Calidris melanotos*			
	Stilt Sandpiper	*Calidris himantopus*			
	Long-billed Dowitcher	*Limnodromus*			

Birds					
		scolopaceus			
	Common Snipe	*Gallinago gallinago*			Yes
	Wilson's Phalarope	*Phalaropus tricolor*			Yes
	Red-necked Phalarope	*Phalaropus lobatus*			
	Ring-billed Gull	*Larus delawarensis*	Yes		
	California Gull	*Larus californicus*	Yes		
	Herring Gull	*Larus argentatus*	Yes		
	Thayer's Gull	*Larus thayeri*	Yes		
	Glaucous Gull	*Larus hyperboreus*	Yes		
	Black Tern	*Chlidonias niger*			Yes
	Rock Dove	*Columba livia*			
	Mourning Dove	*Zenaida macroura*		Yes	
	Barn Owl	*Tyto alba*			
	Flammulated Owl	*Otus flammeolus*			
	Western Screech-owl	*Otus kennicottii*		Yes	
	Great Horned Owl	*Bubo virginianus*			
	Snowy Owl	*Nyctea scandiaca*	Yes		
	Northern Pygmy-owl	*Glaucidium gnoma*			
	Burrowing Owl	*Athene cunicularia*			
	Spotted Owl	*Strix occidentalis*			
	Barred Owl	*Strix varia*			
	Great Gray Owl	*Strix nebulosa*			
	Long-eared Owl	*Asio otus*		Yes	
	Short-eared Owl	*Asio flammeus*			Yes
	Boreal Owl	*Aegolius funereus*			
	Northern Saw-whet Owl	*Aegolius acadicus*			
	Common Nighthawk	*Chordeiles minor*			
	Common Poorwill	*Phalaenoptilus nuttallii*			
	Black Swift	*Cypseloides niger*			
	Vaux's Swift	*Chaetura vauxi*			

Birds					
	White-throated Swift	*Aeronautes saxatalis*			
	Black-chinned Hummingbird	*Archilochus alexandri*			
	Calliope Hummingbird	*Stellula calliope*			
	Rufous Hummingbird	*Selasphorus rufus*			
	Belted Kingfisher	*Ceryle alcyon*	Yes	Yes	
	Lewis's Woodpecker	*Melanerpes lewis*			
	Williamson's Sapsucker	*Sphyrapicus thyroideus*			
	Red-naped Sapsucker	*Sphyrapicus nuchalis*		Yes	
	Red-breasted Sapsucker	*Sphyrapicus ruber*			
	Downy Woodpecker	*Picoides pubescens*			
	Hairy Woodpecker	*Picoides villosus*			
	White-headed Woodpecker	*Picoides albolarvatus*			
	Three-toed Woodpecker	*Picoides tridactylus*			
	Black-backed Woodpecker	*Picoides arcticus*			
	Northern Flicker	*Colaptes auratus*			
	Pileated Woodpecker	*Dryocopus pileatus*			
	Olive-sided Flycatcher	*Contopus cooperi*			
	Western Wood-pewee	*Contopus sordidulus*			
	Willow Flycatcher	*Empidonax traillii*	Yes	Yes	
	Hammond's Flycatcher	*Empidonax hammondii*			
	Gray Flycatcher	*Empidonax wrightii*			
	Dusky Flycatcher	*Empidonax oberholseri*			
	Pacific-slope Flycatcher	*Empidonax difficilis*			
	Cordilleran Flycatcher	*Empidonax occidentalis*		Yes	

Birds					
	Say's Phoebe	*Sayornis saya*			
	Western Kingbird	*Tyrannus verticalis*			
	Eastern Kingbird	*Tyrannus tyrannus*			
	Loggerhead Shrike	*Lanius ludovicianus*			
	Northern Shrike	*Lanius excubitor*			
	Cassin's Vireo	*Vireo cassinii*			
	Warbling Vireo	*Vireo gilvus*		Yes	
	Red-eyed Vireo	*Vireo olivaceus*		Yes	
	Gray Jay	*Perisoreus canadensis*	Yes		
	Steller's Jay	*Cyanocitta stelleri*	Yes		
	Clark's Nutcracker	*Nucifraga columbiana*			
	Black-billed Magpie	*Pica pica*	Yes	Yes	
	American Crow	*Corvus brachyrhynchos*	Yes		
	Northwestern Crow	*Corvus caurinus*	Yes		
	Common Raven	*Corvus corax*	Yes		
	Horned Lark	*Eremophila alpestris*			
	Tree Swallow	*Tachycineta bicolor*	Yes	Yes	
	Violet-green Swallow	*Tachycineta thalassina*	Yes		
	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Yes	Yes	
	Bank Swallow	*Riparia riparia*	Yes	Yes	
	Cliff Swallow	*Petrochelidon pyrrhonota*	Yes	Yes	
	Barn Swallow	*Hirundo rustica*	Yes	Yes	
	Black-capped Chickadee	*Poecile atricapillus*			
	Mountain Chickadee	*Poecile gambeli*			
	Chestnut-backed Chickadee	*Poecile rufescens*			
	Boreal Chickadee	*Poecile hudsonicus*			
	Red-breasted Nuthatch	*Sitta canadensis*			

Birds					
	White-breasted Nuthatch	*Sitta carolinensis*			
	Pygmy Nuthatch	*Sitta pygmaea*		Yes	
	Brown Creeper	*Certhia americana*			
	Rock Wren	*Salpinctes obsoletus*			
	Canyon Wren	*Catherpes mexicanus*			
	House Wren	*Troglodytes aedon*			
	Winter Wren	*Troglodytes troglodytes*	Yes		
	Marsh Wren	*Cistothorus palustris*			Yes
	American Dipper	*Cinclus mexicanus*	Yes	Yes	
	Golden-crowned Kinglet	*Regulus satrapa*			
	Ruby-crowned Kinglet	*Regulus calendula*			
	Western Bluebird	*Sialia mexicana*			
	Mountain Bluebird	*Sialia currucoides*			
	Townsend's Solitaire	*Myadestes townsendi*			
	Veery	*Catharus fuscescens*		Yes	
	Swainson's Thrush	*Catharus ustulatus*			
	Hermit Thrush	*Catharus guttatus*			
	American Robin	*Turdus migratorius*	Yes		
	Varied Thrush	*Ixoreus naevius*	Yes		
	Gray Catbird	*Dumetella carolinensis*		Yes	
	Sage Thrasher	*Oreoscoptes montanus*			
	European Starling	*Sturnus vulgaris*		Yes	
	American Pipit	*Anthus rubescens*			
	Bohemian Waxwing	*Bombycilla garrulus*			
	Cedar Waxwing	*Bombycilla cedrorum*		Yes	
	Orange-crowned Warbler	*Vermivora celata*			
	Nashville Warbler	*Vermivora ruficapilla*			
	Yellow Warbler	*Dendroica petechia*		Yes	

Birds					
	Yellow-rumped Warbler	*Dendroica coronata*			
	Townsend's Warbler	*Dendroica townsendi*			
	American Redstart	*Setophaga ruticilla*		Yes	
	Northern Waterthrush	*Seiurus noveboracensis*		Yes	
	Macgillivray's Warbler	*Oporornis tolmiei*			
	Common Yellowthroat	*Geothlypis trichas*		Yes	
	Wilson's Warbler	*Wilsonia pusilla*			
	Yellow-breasted Chat	*Icteria virens*		Yes	
	Western Tanager	*Piranga ludoviciana*			
	Spotted Towhee	*Pipilo maculatus*	Yes		
	American Tree Sparrow	*Spizella arborea*			
	Chipping Sparrow	*Spizella passerina*			
	Brewer's Sparrow	*Spizella breweri*			
	Vesper Sparrow	*Pooecetes gramineus*			
	Lark Sparrow	*Chondestes grammacus*			
	Sage Sparrow	*Amphispiza belli*			
	Savannah Sparrow	*Passerculus sandwichensis*			
	Grasshopper Sparrow	*Ammodramus savannarum*			
	Fox Sparrow	*Passerella iliaca*		Yes	
	Song Sparrow	*Melospiza melodia*	Yes		
	Lincoln's Sparrow	*Melospiza lincolnii*		Yes	
	White-crowned Sparrow	*Zonotrichia leucophrys*			
	Dark-eyed Junco	*Junco hyemalis*			
	Lapland Longspur	*Calcarius lapponicus*			
	Snow Bunting	*Plectrophenax nivalis*			
	Black-headed Grosbeak	*Pheucticus melanocephalus*			
	Lazuli Bunting	*Passerina amoena*		Yes	

Birds					
	Bobolink	*Dolichonyx oryzivorus*			
	Red-winged Blackbird	*Agelaius phoeniceus*			Yes
	Western Meadowlark	*Sturnella neglecta*			
	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*			Yes
	Brewer's Blackbird	*Euphagus cyanocephalus*			
	Brown-headed Cowbird	*Molothrus ater*			
	Bullock's Oriole	*Icterus bullockii*		Yes	
	Gray-crowned Rosy-Finch	*Leucosticte tephrocotis*			
	Pine Grosbeak	*Pinicola enucleator*			
	Cassin's Finch	*Carpodacus cassinii*			
	House Finch	*Carpodacus mexicanus*			
	Red Crossbill	*Loxia curvirostra*			
	White-winged Crossbill	*Loxia leucoptera*			
	Common Redpoll	*Carduelis flammea*			
	Pine Siskin	*Carduelis pinus*			
	American Goldfinch	*Carduelis tristis*			
	Evening Grosbeak	*Coccothraustes vespertinus*			Yes
	House Sparrow	*Passer domesticus*			
	Total Birds:	***220*** ***Total:***	**47**	**42**	**28**

Mammals					
	Masked Shrew	*Sorex cinereus*	Yes		
	Vagrant Shrew	*Sorex vagrans*	Yes		
	Montane Shrew	*Sorex monticolus*	Yes		
	Water Shrew	*Sorex palustris*	Yes	Yes	
	Trowbridge's Shrew	*Sorex trowbridgii*	Yes		
	Merriam's Shrew	*Sorex merriami*			

Mammals					
	Coast Mole	*Scapanus orarius*			
	California Myotis	*Myotis californicus*			
	Western Small-footed Myotis	*Myotis ciliolabrum*		Yes	
	Yuma Myotis	*Myotis yumanensis*		Yes	
	Little Brown Myotis	*Myotis lucifugus*			
	Long-legged Myotis	*Myotis volans*		Yes	
	Fringed Myotis	*Myotis thysanodes*			
	Long-eared Myotis	*Myotis evotis*			
	Silver-haired Bat	*Lasionycteris noctivagans*			
	Western Pipistrelle	*Pipistrellus hesperus*		Yes	
	Big Brown Bat	*Eptesicus fuscus*		Yes	
	Hoary Bat	*Lasiurus cinereus*			
	Spotted Bat	*Euderma maculatum*			
	Townsend's Big-eared Bat	*Corynorhinus townsendii*			
	Pallid Bat	*Antrozous pallidus*		Yes	
	American Pika	*Ochotona princeps*			
	Nuttall's (Mountain) Cottontail	*Sylvilagus nuttallii*			
	Snowshoe Hare	*Lepus americanus*		Yes	
	White-tailed Jackrabbit	*Lepus townsendii*			
	Black-tailed Jackrabbit	*Lepus californicus*			
	Least Chipmunk	*Tamias minimus*			
	Yellow-pine Chipmunk	*Tamias amoenus*			
	Townsend's Chipmunk	*Tamias townsendii*			
	Yellow-bellied Marmot	*Marmota flaviventris*			
	Hoary Marmot	*Marmota caligata*			
	Columbian Ground Squirrel	*Spermophilus columbianus*			

Mammals					
	Golden-mantled Ground Squirrel	*Spermophilus lateralis*			
	Cascade Golden-mantled Ground Squirrel	*Spermophilus saturatus*			
	Eastern Fox Squirrel	*Sciurus niger*			
	Western Gray Squirrel	*Sciurus griseus*			
	Red Squirrel	*Tamiasciurus hudsonicus*			
	Northern Flying Squirrel	*Glaucomys sabrinus*	Yes		
	Northern Pocket Gopher	*Thomomys talpoides*			
	Great Basin Pocket Mouse	*Perognathus parvus*			
	American Beaver	*Castor canadensis*		Yes	
	Western Harvest Mouse	*Reithrodontomys megalotis*		Yes	
	Deer Mouse	*Peromyscus maniculatus*	Yes	Yes	
	Columbian Mouse	*Peromyscus keeni*			
	Northern Grasshopper Mouse	*Onychomys leucogaster*			
	Bushy-tailed Woodrat	*Neotoma cinerea*		Yes	
	Southern Red-backed Vole	*Clethrionomys gapperi*		Yes	
	Heather Vole	*Phenacomys intermedius*			
	Meadow Vole	*Microtus pennsylvanicus*		Yes	
	Montane Vole	*Microtus montanus*			Yes
	Long-tailed Vole	*Microtus longicaudus*		Yes	
	Creeping Vole	*Microtus oregoni*			
	Water Vole	*Microtus richardsoni*		Yes	
	Sagebrush Vole	*Lemmiscus curtatus*			
	Muskrat	*Ondatra zibethicus*		Yes	
	Northern Bog Lemming	*Synaptomys borealis*			Yes

Mammals					
	Norway Rat	*Rattus norvegicus*			
	House Mouse	*Mus musculus*			
	Western Jumping Mouse	*Zapus princeps*		Yes	
	Pacific Jumping Mouse	*Zapus trinotatus*		Yes	
	Common Porcupine	*Erethizon dorsatum*			
	Nutria	*Myocastor coypus*			Yes
	Coyote	*Canis latrans*	Yes		
	Gray Wolf	*Canis lupus*	Yes		
	Red Fox	*Vulpes vulpes*	Yes		
	Black Bear	*Ursus americanus*	Yes		
	Grizzly Bear	*Ursus arctos*	Yes		
	Raccoon	*Procyon lotor*	Yes	Yes	
	American Marten	*Martes americana*	Yes		
	Fisher	*Martes pennanti*	Yes		
	Ermine	*Mustela erminea*			
	Long-tailed Weasel	*Mustela frenata*	Yes		
	Mink	*Mustela vison*	Yes	Yes	
	Wolverine	*Gulo gulo*	Yes		
	American Badger	*Taxidea taxus*			
	Striped Skunk	*Mephitis mephitis*	Yes		
	Northern River Otter	*Lutra canadensis*	Yes	Yes	
	Mountain Lion	*Puma concolor*	Yes		
	Lynx	*Lynx canadensis*			
	Bobcat	*Lynx rufus*	Yes		
	Elk	*Cervus elaphus*			
	Mule Deer	*Odocoileus hemionus*			
	White-tailed Deer	*Odocoileus virginianus*			
	Moose	*Alces alces*			
	Mountain Goat	*Oreamnos americanus*			

Mammals						
	Bighorn Sheep	*Ovis canadensis*				
	Total Mammals:	**86**	**Total:**	**22**	**22**	**3**

Reptiles						
	Painted Turtle	*Chrysemys picta*				
	Northern Alligator Lizard	*Elgaria coerulea*				
	Short-horned Lizard	*Phrynosoma douglassii*				
	Sagebrush Lizard	*Sceloporus graciosus*				
	Western Fence Lizard	*Sceloporus occidentalis*				
	Western Skink	*Eumeces skiltonianus*				
	Rubber Boa	*Charina bottae*				
	Racer	*Coluber constrictor*				
	Night Snake	*Hypsiglena torquata*				
	Gopher Snake	*Pituophis catenifer*				
	Western Terrestrial Garter Snake	*Thamnophis elegans*		Yes		
	Common Garter Snake	*Thamnophis sirtalis*		Yes	Yes	
	Western Rattlesnake	*Crotalus viridis*				
	Total Reptiles:	**13**	**Total:**	**2**	**1**	**0**
	Total Species:	**328**	**Total:**	**71**	**73**	**31**

10 Appendix C: Relevant Species Ranking, Status and Management Lists

US Federal and State Fish Species Rankings

Table 53 US Federal and State listed fish species present or potentially present in the Okanogan Basin

(Source: Washington State Salmon and Steelhead Stock Inventory, 1992 and ESA list.)

Species and Subbasin	SASSI Stock Status	Stock Origin	ESA Status	Maximum Upriver Distribution	Mean Escapement
Spring Chinook	Depressed	Native	Endangered, 1999	Considered Extirpated	NA
Summer Chinook	Depressed		Not listed	RM 26-77	363-2,300 (1977-1991)
Sockeye	Healthy	Native	Not listed	RM 90-106	65,000-64,700 (1977-1991)
Steelhead	Depressed	Mixed	Endangered, 1997	Not definitively established	114-837 (1982-1991)
Bull trout	Threatened	Native	Threatened 1998	Not definitively established	N/A

State and Federal Wildlife Species Status in Okanogan Subbasin

Table 54 State and Federal Wildlife Species Status in Okanogan Subbasin

	Common Name	Scientific Name	State Status		Federal Status
Amphibians					
	Dunn's Salamander	*Plethodon dunni*	WA	Candidate Species	
	Western Toad	*Bufo boreas*	WA	Candidate Species	
	Columbia Spotted Frog	*Rana luteiventris*	WA	Candidate Species	
	Northern Leopard Frog	*Rana pipiens*	WA	Endangered	
Total Listed Amphibians:		**4**			

Birds					
	Common Loon	*Gavia immer*	WA	Sensitive	
	Western Grebe	*Aechmophorus occidentalis*	WA	Candidate Species	
	Northern Goshawk	*Accipiter gentilis*	WA	Candidate Species	
	Ferruginous Hawk	*Buteo regalis*	WA	Threatened	
	Golden Eagle	*Aquila chrysaetos*	WA	Candidate Species	
	Sage Grouse	*Centrocercus urophasianus*	WA	Threatened	Anticipated Candidate
	Sharp-tailed Grouse	*Tympanuchus phasianellus*	WA	Threatened	
	Marbled Murrelet	*Brachyramphus marmoratus*	WA	Threatened	Threatened
	Flammulated Owl	*Otus flammeolus*	WA	Candidate Species	
	Burrowing Owl	*Athene cunicularia*	WA	Candidate Species	
	Spotted Owl	*Strix occidentalis*	WA	Endangered	Threatened
	Vaux's Swift	*Chaetura vauxi*	WA	Candidate Species	
	Lewis's Woodpecker	*Melanerpes lewis*	WA	Candidate Species	
	White-headed Woodpecker	*Picoides albolarvatus*	WA	Candidate Species	
	Black-backed Woodpecker	*Picoides arcticus*	WA	Candidate Species	
	Pileated Woodpecker	*Dryocopus pileatus*	WA	Candidate Species	
	Loggerhead Shrike	*Lanius ludovicianus*	WA	Candidate Species	
	Horned Lark	*Eremophila alpestris*	WA	Candidate Species	Candidate
	White-breasted Nuthatch	*Sitta carolinensis*	WA	Candidate Species	
	Sage Thrasher	*Oreoscoptes montanus*	WA	Candidate Species	
	Vesper Sparrow	*Pooecetes gramineus*	WA	Candidate Species	
	Sage Sparrow	*Amphispiza belli*	WA	Candidate Species	

Birds					
Total Listed Birds:		**22**			

Mammals					
	Merriam's Shrew	*Sorex merriami*	WA	Candidate Species	
	Townsend's Big-eared Bat	*Corynorhinus townsendii*	WA	Candidate Species	
	Pygmy Rabbit	*Brachylagus idahoensis*	WA	Endangered	Endangered
	White-tailed Jackrabbit	*Lepus townsendii*	WA	Candidate Species	
	Black-tailed Jackrabbit	*Lepus californicus*	WA	Candidate Species	
	Washington Ground Squirrel	*Spermophilus washingtoni*	WA	Candidate Species	Anticipated Candidate
	Western Gray Squirrel	*Sciurus griseus*	WA	Threatened	
	Northern Pocket Gopher	*Thomomys talpoides*	WA	Candidate Species	
	Gray Wolf	*Canis lupus*	WA	Endangered	Endangered
	Grizzly Bear	*Ursus arctos*	WA	Endangered	Threatened
	Fisher	*Martes pennanti*	WA	Endangered	
	Wolverine	*Gulo gulo*	WA	Candidate Species	
	Lynx	*Lynx canadensis*	WA	Threatened	Threatened
	White-tailed Deer	*Odocoileus virginianus*	WA	Endangered	Endangered
Total Listed Mammals:		**14**			

Reptiles					
	Sharptail Snake	*Contia tenuis*	WA	Candidate Species	
	Striped Whipsnake	*Masticophis taeniatus*	WA	Candidate Species	
Total Listed Reptiles:		**2**			
Total Listed Species:		**42**			

US listing of known high-quality or rare plant communities and wetland ecosystems of the Okanogan subbasin (Washington Natural Heritage Information System 2003)

Partners in Flight species of the Okanogan subbasin (IBIS 2003)

Table 55 Partners in Flight species of the Okanogan subbasin (IBIS 2003)

Common Name	Scientific Name	PIF 1998-1999 Continental	PIF Ranking by Super Region Draft 2002	WA PIF Priority & Focal Species
Northern Harrier	*Circus cyaneus*			Yes
Swainson's Hawk	*Buteo swainsoni*		MO (Intermountain West, Prairies)	Yes
Ferruginous Hawk	*Buteo regalis*			Yes
Rough-legged Hawk	*Buteo lagopus*		PR (Arctic)	
American Kestrel	*Falco sparverius*			Yes
Gyrfalcon	*Falco rusticolus*		PR (Arctic)	
Sage Grouse	*Centrocercus urophasianus*		MA (Intermountain West, Prairies)	
Spruce Grouse	*Falcipennis canadensis*		PR (Northern Forests)	
White-tailed Ptarmigan	*Lagopus leucurus*		MO (Arctic)	
Blue Grouse	*Dendragapus obscurus*		MA (Pacific, Intermountain West)	
Sharp-tailed Grouse	*Tympanuchus phasianellus*		MO (Prairies)	Yes
Long-billed Curlew	*Numenius americanus*	Yes		
Stilt Sandpiper	*Calidris himantopus*	Yes		
Flammulated Owl	*Otus flammeolus*		MO (Pacific, Intermountain West, Southwest)	Yes
Snowy Owl	*Nyctea scandiaca*		PR (Arctic)	
Northern Pygmy-owl	*Glaucidium gnoma*		PR (Pacific)	
Burrowing Owl	*Athene cunicularia*			Yes
Spotted Owl	*Strix occidentalis*		IM (Pacific, Intermountain West, Southwest)	
Great Gray Owl	*Strix nebulosa*			Yes
Short-eared Owl	*Asio flammeus*	Yes	MA (Arctic, Northern Forests, Intermountain	Yes

Common Name	Scientific Name	PIF 1998-1999 Continental	PIF Ranking by Super Region Draft 2002	WA PIF Priority & Focal Species
			West, Prairies)	
Common Poorwill	*Phalaenoptilus nuttallii*			Yes
Black Swift	*Cypseloides niger*	Yes	IM (Pacific, Intermountain West)	Yes
Vaux's Swift	*Chaetura vauxi*			Yes
White-throated Swift	*Aeronautes saxatalis*		MA (Intermountain West, Southwest)	Yes
Calliope Hummingbird	*Stellula calliope*		MO (Intermountain West)	Yes
Rufous Hummingbird	*Selasphorus rufus*	Yes	MA (Pacific, Intermountain West)	Yes
Lewis's Woodpecker	*Melanerpes lewis*	Yes	MO (Intermountain West, Prairies)	Yes
Williamson's Sapsucker	*Sphyrapicus thyroideus*		MO (Intermountain West)	Yes
Red-naped Sapsucker	*Sphyrapicus nuchalis*		MO (Intermountain West)	Yes
Red-breasted Sapsucker	*Sphyrapicus ruber*		MO (Pacific)	Yes
Downy Woodpecker	*Picoides pubescens*			Yes
White-headed Woodpecker	*Picoides albolarvatus*	Yes	PR (Pacific, Intermountain West)	Yes
Three-toed Woodpecker	*Picoides tridactylus*		PR (Northern Forests)	
Black-backed Woodpecker	*Picoides arcticus*		PR (Northern Forests)	Yes
Pileated Woodpecker	*Dryocopus pileatus*			Yes
Olive-sided Flycatcher	*Contopus cooperi*		MA (Pacific, Northern Forests, Intermountain West)	Yes
Western Wood-pewee	*Contopus sordidulus*			Yes
Willow Flycatcher	*Empidonax traillii*		MA (Prairies, East)	Yes
Hammond's Flycatcher	*Empidonax hammondii*			Yes
Gray Flycatcher	*Empidonax wrightii*		PR (Intermountain West)	Yes
Dusky Flycatcher	*Empidonax*		MA (Intermountain West)	Yes

Common Name	Scientific Name	PIF 1998-1999 Continental	PIF Ranking by Super Region Draft 2002	WA PIF Priority & Focal Species
	oberholseri			
Pacific-slope Flycatcher	*Empidonax difficilis*		PR (Pacific)	Yes
Loggerhead Shrike	*Lanius ludovicianus*			Yes
Northern Shrike	*Lanius excubitor*		PR (Northern Forests)	
Warbling Vireo	*Vireo gilvus*			Yes
Red-eyed Vireo	*Vireo olivaceus*			Yes
Gray Jay	*Perisoreus canadensis*		PR (Northern Forests)	
Clark's Nutcracker	*Nucifraga columbiana*		PR (Intermountain West)	Yes
Horned Lark	*Eremophila alpestris*			Yes
Bank Swallow	*Riparia riparia*			Yes
Chestnut-backed Chickadee	*Poecile rufescens*		PR (Pacific)	
Boreal Chickadee	*Poecile hudsonicus*		MA (Northern Forests)	
White-breasted Nuthatch	*Sitta carolinensis*			Yes
Brown Creeper	*Certhia americana*			Yes
House Wren	*Troglodytes aedon*			Yes
Winter Wren	*Troglodytes troglodytes*			Yes
American Dipper	*Cinclus mexicanus*			Yes
Western Bluebird	*Sialia mexicana*			Yes
Mountain Bluebird	*Sialia currucoides*		PR (Intermountain West)	
Townsend's Solitaire	*Myadestes townsendi*			Yes
Veery	*Catharus fuscescens*			Yes
Swainson's Thrush	*Catharus ustulatus*			Yes
Hermit Thrush	*Catharus guttatus*			Yes
Varied Thrush	*Ixoreus naevius*			Yes
Sage Thrasher	*Oreoscoptes montanus*		PR (Intermountain West)	Yes

Common Name	Scientific Name	PIF 1998-1999 Continental	PIF Ranking by Super Region Draft 2002	WA PIF Priority & Focal Species
American Pipit	*Anthus rubescens*		PR (Arctic)	Yes
Bohemian Waxwing	*Bombycilla garrulus*		MA (Northern Forests)	
Orange-crowned Warbler	*Vermivora celata*			Yes
Nashville Warbler	*Vermivora ruficapilla*		PR (Northern Forests)	Yes
Yellow Warbler	*Dendroica petechia*			Yes
Yellow-rumped Warbler	*Dendroica coronata*			Yes
Black-throated Gray Warbler	*Dendroica nigrescens*		MO (Pacific)	Yes
Townsend's Warbler	*Dendroica townsendi*			Yes
Hermit Warbler	*Dendroica occidentalis*	Yes	MO (Pacific)	Yes
Macgillivray's Warbler	*Oporornis tolmiei*			Yes
Wilson's Warbler	*Wilsonia pusilla*			Yes
Yellow-breasted Chat	*Icteria virens*			Yes
Western Tanager	*Piranga ludoviciana*			Yes
Chipping Sparrow	*Spizella passerina*			Yes
Brewer's Sparrow	*Spizella breweri*	Yes	MA (Intermountain West)	Yes
Vesper Sparrow	*Pooecetes gramineus*			Yes
Lark Sparrow	*Chondestes grammacus*			Yes
Black-throated Sparrow	*Amphispiza bilineata*			Yes
Sage Sparrow	*Amphispiza belli*	Yes	PR (Intermountain West)	Yes
Grasshopper Sparrow	*Ammodramus savannarum*		MA (Prairies)	Yes
Fox Sparrow	*Passerella iliaca*			Yes
Lincoln's Sparrow	*Melospiza lincolnii*		PR (Northern Forests)	Yes
Lapland Longspur	*Calcarius lapponicus*		PR (Arctic)	
Snow Bunting	*Plectrophenax*		PR (Arctic)	

Common Name	Scientific Name	PIF 1998-1999 Continental	PIF Ranking by Super Region Draft 2002	WA PIF Priority & Focal Species
	nivalis			
Black-headed Grosbeak	*Pheucticus melanocephalus*			Yes
Bobolink	*Dolichonyx oryzivorus*	Yes		
Western Meadowlark	*Sturnella neglecta*			Yes
Bullock's Oriole	*Icterus bullockii*			Yes
Pine Grosbeak	*Pinicola enucleator*		MO (Northern Forests)	
Purple Finch	*Carpodacus purpureus*			Yes
Cassin's Finch	*Carpodacus cassinii*		MA (Intermountain West)	
Red Crossbill	*Loxia curvirostra*			Yes
White-winged Crossbill	*Loxia leucoptera*		PR (Northern Forests)	
Total Species:	**98**			

Canadian Wildlife Status

The BC Conservation Data Centre list of both globally and provincially threatened and endangered species in the Okanagan Basin provided below.

Global and Provincial Status of "At Risk" Wildlife Species in the Okanagan Basin

Table 56 Global and Provincial Status of "At Risk" Wildlife Species in the Okanagan Basin

Common Name	Global Ranka	Provincial Rankb	Provincial Listc
Amphibians			
Tailed Frog – Coastal	G4T4Q	S3S4	Blue
Tiger Salamander	G5	S2	Red
Great Basin Spadefoot	G5	S3	Blue
Northern Leopard Frog	G5	S1	Red
Reptiles			
Painted Turtle	G5	S3S4	Blue

Common Name	Global Ranka	Provincial Rankb	Provincial Listc
Pigmy Short-Horned Lizard	G5	SH	Red
Rubber Boa	G5	S3S4	Blue
Racer	G5	S3S4	Blue
Gopher Snake, deserticola subspecies	G5T5	S3	Blue
Western Rattlesnake	G5	S3	Blue
Birds			
Western Grebe	G5	S1B,S3N	Red
American Bittern	G4	S3B,SZN	Blue
Great Blue Heron, herodias subspecies	G5T5	S3B, S5N	Blue
Tundra Swan	G5	S3N	Yellow
Redhead	G5	S3N, S4B	Yellow
Bald Eagle	G4	S4	Yellow
Swainson's Hawk	G5	S2B, SZN	Red
Ferruginous Hawk	G4	S1B	Red
Rough-Legged Hawk	G5	S2S3N	Yellow
Peregrine Falcon, anatum subspecies	G4T3	S2B, SZN	Red
Prairie Falcon	G5	S2B, SZN	Red
Sage Grouse	G5	SX	Red
Sharp-Tailed Grouse, columbianus subspecies	G4T3	S3	Blue
Sandhill Crane	G5	S3B, SZN	Blue
American Avocet	G5	S2S3B, SZN	Blue
Upland Sandpiper	G5	S1S3B, SZN	Red
Long-Billed Curlew	G5	S3B,SZN	Blue
Ring-Billed Gull	G5	S4B, SZN	Yellow
California Gull	G5	S3B,SZN	Blue
Barn Owl	G5	S3	Blue
Flammulated Owl	G4	S3S4B, SZN	Blue
Western Screech-Owl, macfarlanei subspecies	G5T?	S2	Red
Burrowing Owl	G4	S1B, SZN	Red
Short-Eared Owl	G5	S2N, S3B	Blue
White-Throated Swift	G5	S3S4B, SZN	Blue
Lewis's Woodpecker	G5	S3B, SZN	Blue

Common Name	Global Ranka	Provincial Rankb	Provincial Listc
Williamson's Sapsucker, thyroideus subspecies	G5TU	S3B, SZN	Blue
White-Headed Woodpecker	G4	S1S2	Red
Gray Flycatcher	G5	S3	Blue
Canyon Wren	G5	S3	Blue
Sage Thrasher	G5	S1B	Red
Yellow-Breasted Chat	G5	S1B	Red
Brewer's Sparrow, breweri subspecies	G5T4	S2B	Red
Lark Sparrow	G5	S2B, SZN	Red
Grasshopper Sparrow	G5	S2B	Red
Bobolink	G5	S3B,SZN	Blue
Mammals			
Preble's Shrew	G4	S1	Red
Merriam's Shrew	G5	S1	Red
Fringed Myotis	G4G5	S2S3	Blue
Western Small-Footed Myotis	G5	S2S3	Blue
Northern Long-Eared Myotis	G4	S2S3	Blue
Spotted Bat	G4	S3	Blue
Townsend's Big-Eared Bat	G4	S2S3	Blue
Pallid Bat	G5	S1	Red
Nuttall's Cottontail	G5	S3	Blue
Mountain Beaver, rainieri subspecies	G5T4	S3	Blue
Cascade Golden-Mantled Ground Squirrel	G5	S3S4	Blue
Great Basin Pocket Mouse	G5	S3	Blue
Western Harvest Mouse	G5	S2S3	Blue
Fisher	G5	S3	Blue
Northern Bog Lemming, artemisiae subspecies	G4T2T3	S2S3	Blue
Grizzly Bear	G4	S3	Blue
Fisher	G5	S3	Blue
Wolverine, luscus subspecies	G4T4	S3	Blue
Badger	G5	S2	Red
Caribou, Southern population	G5T2T3Q	S2	Red
California Bighorn Sheep	G4G5T4	S2S3	Blue

a Basic Global Ranks include the following: GX – Presumed Extinct throughout its range, GH – Possibly Extinct and G1 through G5 where G1 is Critically Imperiled and G5 is Secure. Additional Ranking codes include G#G# which is used to indicate uncertainty regarding the exact status of a taxon; Q denotes questionable taxonomic status; T reflects the status of infraspecific taxa (subspecies or varieties) and follows the species' global rank; U indicates a lack of available information about status or trends and the species is therefore unrankable; and a ? which indicates that the global rank of a species has not yet been assessed.

b Basic Provincial Ranks are similar to that of the Global Ranking system but are based upon provincial species populations and are coded with an S (such as SX, SH, S1 through S5). Provincial ranks are sometimes followed by rank qualifiers which include B which refers to the breeding occurrences of mobile animals; N which refers to the non-breeding occurrences of mobile animals; and Z which refers to species that occurs within the province but as a diffuse, usually moving population (for which it is difficult or impossible to map static occurrences).

c Red List candidates include any indigenous species or subspecies (taxa) considered to be Extirpated, Endangered, or Threatened in British Columbia. Extirpated taxa no longer exist in the wild in British Columbia, but do occur elsewhere. Endangered taxa are facing imminent extirpation or extinction. Threatened taxa are those that have been, or are being, evaluated for these designations.

Blue List species are any indigenous species or subspecies (taxa) considered to be Vulnerable in British Columbia. Vulnerable taxa are of special concern because of characteristics that make them particularly sensitive to human activities or natural events. Blue listed taxa are at risk, but are not Extirpated, Endangered, or Threatened.

Yellow List candidates include any indigenous species or subspecies (taxa) which is not at risk in British Columbia. The CDC tracks some Yellow listed taxa which are vulnerable during times of seasonal concentration (for example, breeding colonies).

Classified Aquatic Species

Fish populations in the Okanogan Subbasin are the subject of various agency classifications, and generally represent geographically "tiered" conservation designations. These include national designations according to lists created for the Endangered Species Act (US) and the Species at Risk Act (Canada), Provincial Conservation Center ranking (BC) and State Salmon and Steelhead Stock Inventory ranking (Washington), and global ranking (IUCN).

Canadian Species at Risk Act

The status assessment of Okanagan sockeye, Chinook and steelhead salmon stocks of Canadian origin are currently under review.

Sockeye may be a subject of management concern as a response to decreased stock productivity (K. Hyatt pers. com.).

Stock status reports for Canadian origin Okanagan chinook and steelhead are under preparation by members of the COBTWG for review by Canada's assessment agency COSEWIC. Reports with recommendations on status rating to the Minister can usually be anticipated within 6 months of submission, for response by the Canadian Minister of Fisheries and Oceans within 9 months.

There are no current records of the presence of any other Canadian origin salmon stocks, white sturgeon, bull trout, cutthroat trout or Pacific lamprey.

Provincial Conservation Data Center

The Umatilla dace is Provincially Red Listed or considered rare. Mottled sculpin and the chiselmouth minnow are Blue Listed, or considered threatened (BC Conservation Data Center **http://srmwww.gov.bc.ca/cdc/index.htm**.).

The B.C. Conservation Data Centre (CDC) maintains a list of both globally and provincially threatened and endangered species in the Okanagan Basin. For fish, this list is provided in **Table 9**.

Table 57 Global and Provincial Status of "At Risk" Fish Species in the Okanagan Basin

Common Name	Global Ranka	Provincial Rankb	Provincial Listc
Freshwater Fish			
Mottled Sculpin	G5	S3	Blue
Bull Trout	G3	S3	Blue
Chiselmouth	G5	S3	Blue
Umatilla Dace	G4	S2	Red
Mountain Sucker	G5	S3	Blue

a Global Ranks: G1 through G5 where G1 is Critically Imperiled and G5 is Secure.

b Provincial Ranks: S1 through S5 as in Global Ranks

c Red List: species or subspecies (taxa) considered to be Extirpated, Endangered, or Threatened in British Columbia.

The presence of rare fish in the Okanagan Basin means that special care must be taken when planning land use, including the operating and building of any dams or water diversions. It is also an indicator of a more wide spread problem with fish habitats. It is also important that care be taken to not introduce fish species to non-indigenous habitats in order that the native species present are not threatened by competition.

Global Ranking (Source: BC Conservation Center)

The IUCN (World Conservation Union) assesses the conservation status of species, subspecies, varieties and even selected sub-populations on a global scale in order to highlight taxa threatened with extinction, and therefore promote their conservation. Global Ranking of fish stocks indigenous to the Okanogan Subbasin can be found in the Provincial Ranking and Listing above.

The 2000 IUCN Red List of Threatened Species highlights those taxa that are facing a higher risk of global extinction (i.e. those listed as Critically Endangered, Endangered and Vulnerable) and provides taxonomic, conservation status and distribution information on these taxa.

11 Appendix D: Okanogan Subbasin Projects Inventory

Table 58 Okanogan subbasin Projects list (US and Canada)

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
Unknown	NA	?	Okanogan River Sockeye population				
Weyerhaeuser Canada Limited	Forest Renewal BC	Apr 97	Okanagan Falls Reconnaissance Stream Inventory	1:20K Reconnaissance Fish and Fish Habitat Inventory, performed according to Resource Inventory Committee (RIC) standards (Main Stem + Tributaries; Unnamed Creek (alias Angel Creek), WS Code: 310-444700-66300, tributary to Vaseux Creek, Okanagan/Columbia Rivers, near Oliver; Dutton Creek, tributary to Vaseux Creek, Okanagan/Columbia Rivers, near Oliver; McIntyre Creek, tributary to Vaseux Creek, Okanagan/Columbia Rivers, near Oliver; Solco Creek, tributary to Vaseux Creek, Okanagan/Columbia Rivers, near Oliver; Underdown Creek, tributary to Vaseux Creek, Okanagan/Columbia Rivers, near Oliver.)	Canadian AU's		Habitat Diversity

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
PUD # 1 Douglas County	NA	???? – ongoing	Okanogan River Bank restoration and maintenance	All Species – Gordon Brett 509.884.7191 gbrett@dcpud.org	Lower, Middle Okanogan	O1	Channel Stability, Sediment
COLVILLE TRIBES	199506700	1995 ?	Hellsgate winter range land purchase	Procure habitat area between Whitmore Mtn and Columbia River (Performance Contract)	Okanogan Lower	O1	Sediment
COLVILLE TRIBES	199506700	1995 ?	Hellsgate winter range land purchase	Procure habitat area between Whitmore Mtn and Columbia River	Okanogan Lower	O1	Sediment
IEC Beak Consultants	198347700	1983 ?	Similkameen River - Enloe Dam passage opportunities	Study of fish passage issues at Enloe Dam and potential salmonid habitat upstream and in tributaries	Similkameen	O10	Obstructions
Gorman Brothers Lumber Limited	Forest Renewal BC	Apr 96 –99	Nicola/Similkameen/Okanagan River Reconnaissance (1:20 000) Fish and Fish Habitat Inventory	A sample based survey covering whole watersheds, providing information regarding fish species distributions, characteristics and relative abundance, and stream reach and lake biophysical characteristics (Main Stem + Tributaries; Chute Creek (including tributaries Nuttall/Ratnip Creeks), tributary to Okanagan Lake/Okanagan/Columbia Rivers, near Naramata)	Similkameen	O10	Habitat Diversity

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
BLM	NA	2000 -2000	Mine Tailing Removal on the Similkameen River	All Species – Joe Kelly $ 1,200,000	Similkameen	O10	Habitat Diversity, Pathogens
UCRFEG	01-1436	2002 – ongoing	Assess/feasibility/ prelim design Similkameen confluence	Chinook, Steelhead, sockeye – Larry Bailey $ 282,000	Similkameen	O10	Habitat Diversity, Sediment, Channel Stability
OCD	NA	2000 - 2003	Basin-wide Water Quality Assessment	Craig Nelson $ 333,000	All US AU's	O1-10	Flow, Pathogens
COLVILLE TRIBES	199604200	2000 - ongoing	Okanogan Basin - focus watershed project feasibility	Initiate coordination of a watershed planning project	All US AU's	O1-10	Flow, Habitat Diversity, Pathogens, Temperature
BLM	NA	Ongoing	Inventory on BLM Lands	Steelhead - Joe Kelly $ 2,000	All US AU's	O1-10	
BOR	NA	Ongoing	Okanogan Project operations	Upper Columbia Area Office Manager – PO Box 1749 – Yakima, WA 509.575.5848 – Fax 509.454.5611	All US AU's	O1-10	
COLVILLE TRIBES	200399916	NA	Design and Conduct Monitoring and Evaluation Associated with Reestablishment of Okanogan	Steelhead, Spring/Summer and Fall Chinook – Joe Peone $ 480,152	All US AU's	O1-10	

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
			Basin Natural Production				
COLVILLE TRIBES	200399917	NA	Develop and Propagate Local Okanogan River Summer/Fall Chinook	Summer/Fall Chinook – Joe Peone $ 393,500 est	All US AU's	O1-10	
COLVILLE TRIBES	01-1390	2002-2002	Okanogan River System Thermal Imaging	All Species – Joe Peone $ 109,568	All US AU's	O1-10	Temperature
OCD	00-1680	2000 – ongoing	Okanogan County Fish Passage Barrier Study	Craig Nelson 509.422.0855 $ 249,898	All US AU's	O1-10	Obstructions
COLVILLE TRIBES	198503800	1986 - ongoing	Upper Columbia/Okanogan - construction of resident fish hatchery	Produce 22,679 kg (50,000 lbs) of resident fish – brook trout, rainbow trout, lahontan cutthroat trout - to be released into reservation waters	Okanogan AU's	O1-10	
COLVILLE TRIBES	198503800	Jul 88 – Oct 89	Upper Columbia/Okanogan - construction of resident fish hatchery	Produce 22,679 kg (50,000 lbs) of resident fish – brook trout, rainbow trout, lahontan cutthroat trout - to be released into reservation waters	Canadian AU's	O11-20	
COLVILLE TRIBES	198508301	Jul 89	Fish Culture Training	Training of 6 members of the CCT to operate trout hatchery	Canadian AU's	O11-20	
COLVILLE TRIBES	199404100	1994 ?	Wildlife Mitigation Coordination	Develop and implement a public involvement program to review wildlife mitigation proposals of	Canadian AU's	O11-20	

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
				the CCT			
District of Summerland	Forest Renewal BC	Apr 96 – Mar 98	Trout & Eneas Creek Watershed Restoration	This watershed will be assessed to determine what work will need to be completed in order to restore the areas that were damaged by past activities, such as logging	Canadian AU's	O11-20	Sediment
Okanagan Nation Fisheries Commission	?	Nov 99 - Mar 00	Equesis/Naswhito /Whiteman Creek Fish Habitat and Passage Assessments	Habitat assessment for approx. 8km	Canadian AU's	O11-20	Habitat Diversity
Glenmore-Ellison Improvement District	In Vernon it is FRBC project #KA34-96-006. Also includes FRBC project #TOM98242.	Mar 96 – Jun 96	Kelowna Creek Watershed Restoration	Assessments, rehabilitation plan and management plan	Canadian AU's	O11-20	
Glenmore-Ellison Improvement District	Forest Renewal BC	Apr 95 – Dec 98	Kelowna (Mill) Creek Watershed Restoration	Propose management strategies for existing and proposed roads within the entire watershed, stream channel assessment, gully assessment, water quality monitoring (WSC: 310-808200)	Canadian AU's	O11-20	Sediment, Channel Stability
Riverside Forest Products Limited	Forest Renewal BC	Apr 98 – Dec 98	Kelowna Creek Watershed Restoration Plan (WRP)	Rehabilitate and restore the watershed from disturbances. Produce a report containing current watershed conditions,	Canadian AU's	O11-20	Sediment

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
				risks of future development, conclusions, and recommendations (WSC: 310-808200)			
City of Kelowna	?	Aug 99 – Oct 99	Lower Mill Creek Watershed Restoration Project	Habitat Restoration; 450 m of streambank stabilized, 450 m of instream complexing and 1400 m of riparian planting. Education; project open houses for public and senior staff and two newspaper articles published	Canadian AU's	O11-20	Sediment, Habitat Diversity, Channel Stabiltiy
Lower Similkameen Indian Band	?	Aug 99 – Jan 00	Snehumption Creek- Fish Absence/Presence Inventory and Preliminary Habitat Assessment	Completion of a fish absence/presence site reconnaissance inventory in the lower reaches of Snehumption Creek for purposes of gathering baseline data	Canadian AU's	O11-20	
City of Kelowna	?	Oct 99 – Mar 00	Mill Creek Interpretive Signage	Education/public awareness; installation of four interpretive signs	Canadian AU's	O11-20	
Penticton Indian Band/ Columbia Environmental Consulting	?	Feb 99 – Mar 00	Kelowna/McDougall/Vernon Creeks Urban Referral Compliance Evaluation	Review of Water Act compliance and applications for 4 urban creeks	Canadian AU's	O11-20	
BC Ministry of	?	Apr 88	Okanagan Storm	Implementation of a Storm Drain	Canadian AU's	O11-20	

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
Environment Lands and Parks			Drain Marking	Marking program in the Okanagan: Coordination of school groups and volunteers, marking of storm drains, and distribution of pamphlets			
BC Ministry of Environment Lands and Parks	?	Apr 88	Kelowna (Mill) Creek Enhancement	Planning and identification of potential enhancement projects for spawning habitat with public involvement, following the construction of a flood control project	Canadian AU's	O11-20	Habitat Diversity
Riverside Forest Products Limited	Forest Renewal BC	Oct 96 – Nov 98	Lambly Creek Watershed Restoration	An Integrated Watershed Restoration Plan (IWRP), Access Management Strategy, Fish Habitat Assessment Procedure, Sediment Source Survey, and final Watershed Assessment Committee (WAC) recommendations (Lambly WSC: 310-822600)	Canadian AU's	O11-20	Sediment
BC Ministry of Environment Lands and Parks	?	Apr 88	Tadpole Lake Water Storage	Collection of information and development of a plan for sharing water storage in Tadpole Lake with Westbank Irrigation District to secure minimum flow for Powers Creek	Canadian AU's	O11-20	Flow
BC Ministry of Environment Lands and Parks	Forest Renewal BC	Mar 97 – Apr 97	Mission Creek Watershed Restoration	Integrated Watershed Restoration Plan (IWRP), Access Management Strategy (AMS), and Interior Watershed	Canadian AU's	O11-20	

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
				Assessment			
City of Kelowna	?	Jan 96	Kelowna Education, Streamkeeper, and Habitat Project Coordination	Coordination of school classroom incubation, Streamkeepers, bank stabilization, interpretive fieldtrips	Canadian AU's	O11-20	Channel Stability, Sediment
BC Ministry of Environment Lands and Parks	Forest Renewal BC	Apr 98	Okanagan Timber Supply Area (TSA) Small Lakes Inventory	1:20K reconnaissance lake inventory	Canadian AU's	O11-20	
Okanagan University College	?	Feb 99 – Mar 00	Mission Creek Kokanee Habitat Enhancement	Planning phase for water management and fish enhancement goals	Canadian AU's	O11-20	
BC Ministry of Environment Lands and Parks	?	Apr 88	Mission Creek Spawning Channel Improvements	Improvements to the existing 1000 m long diversion channel for spawning kokanee: existing intake structures realigned, gravel placed, and channel regarded	Canadian AU's	O11-20	Habitat Diversity, Key Habitat Quantity
BC Ministry of Environment Lands and Parks	?	Apr 88 - 89	Kelowna/Nelson Spawning Gravel Cleaning Equipment Tests	Testing and evaluations of gravel cleaning equipment	Canadian AU's	O11-20	Sediment
BC Ministry of Environment Lands and Parks	?	Apr 89	Okanagan Storm Drain Marking Program	Implementation of a Storm Drain Marking program in the Okanagan: coordination of school groups and volunteers, marking of storm drains, and	Canadian AU's	O11-20	Pathogens

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
				distribution of pamphlets			
BC Ministry of Environment Lands and Parks	?	Apr 90	Mission Creek Spawning Channel Evaluation	Evaluation of spawning channel enhancements with estimates of kokanee egg to fry survival rates. (Main Stem of Stream; Mission Creek, tributary to Okanagan Lake, Okanagan/Columbia Rivers, near Kelowna)	Canadian AU's	O11-20	Habitat Diversity
BC Ministry of Environment Lands and Parks	?	Apr 91	Mission Creek Spawning Channel Evaluation	Enumeration of fry and adult kokanee to assess effectiveness of the spawning channel (Main Stem of Stream; Mission Creek, tributary to Okanagan Lake, Okanagan/Columbia Rivers, near Kelowna)	Canadian AU's	O11-20	
BC Ministry of Environment Lands and Parks	?	Apr 92	Mission Creek Spawning Channel Evaluation	Enumeration of fry and adult kokanee to assess effectiveness of the spawning channel (Main Stem of Stream; Mission Creek, tributary to Okanagan Lake, Okanagan/Columbia Rivers, near Kelowna)	Canadian AU's	O11-20	
BC Ministry of Environment Lands and Parks	?	Apr 93	Mission Creek Spawning Channel Evaluation	Final year of fry output studies. Required to firm up egg-fry survival estimator for Okanagan spawning channels (Main Stem of Stream; Mission Creek, tributary to Okanagan Lake, Okanagan/Columbia Rivers,	Canadian AU's	O11-20	

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
				near Kelowna)			
BC Ministry of Environment Lands and Parks	?	Apr 89	Mission Creek Awareness	Construct a 12-panel information kiosk, and prepare a brochure to promote fisheries awareness	Canadian AU's	O11-20	
Gorman Brothers Lumber Limited	Forest Renewal BC #DPE-WRP-98-GORMANS-1	Dec 95 – Sept 98	Naramata Creek Watershed Restoration	Summarizes the results of a surface and ground water hydrology assessments, conducted an Integrated Watershed Restoration Plan including a Sediment Source Survey (SSS) and Access Management Plan, prepared activity and channel assessment reports, conducted Geotechnical Evaluation of landslides, and geological engineering assessment of possible landslides (WSC: 310-660700)	Canadian AU's	O11-20	Flow, Sediment
Gorman Brothers Lumber Limited	Forest Renewal BC	Apr 96 – Apr 99	Nicola/Similkameen/Okanagan River Reconnaissance Fish and Fish Habitat Inventory	1:20K Reconnaissance Fish and Fish Habitat Inventory, performed according to the Resource Inventory Committee (RIC) standards	Canadian AU's	O11-20	
Okanagan Nation Fisheries Commission	Forest Renewal BC	Nov 99 – Mar 00	Equesis/Naswhito/Whiteman Creek Fish Habitat and Passage	Habitat assessment for approx. 8km	Canadian AU's	O11-20	Habitat Diversity

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
			Assessments				
Riverside Forest Products Limited	Forest Renewal BC	Apr 96 – Dec 98	Naswhito Creek Watershed Restoration	Activity reports – 1) summary of implemented work at a failure on Browns Creek Forest Service Road, a summary report of road deactivation prescriptions in the watershed, and a summary report for road relocation and road upgrade for the Browns Creek Forest Service Road (WSC: 310-958000) 2) fish habitat assessment procedure conducted for the Equesis, Naswhito, Whiteman and Shorts watersheds (WSC: 310-946900 WSC: 310-905500) 3) results of the interior watershed assessment procedure conducted on the Naswhito Creek Watershed (WSC: 310-958000)	Canadian AU's	O11-20	Sediment, Channel Stability
BC Ministry of Environment Lands and Parks	?	Sep 99 – Mar 00	Okanagan Lake - Mysis Beam Trawl Harvesting Feasibility	In-lake population estimate for mysis shrimp, development of more efficient harvesting techniques, harvest product acceptability, and harvest technique cost benefits	Canadian AU's	O11-20	
Gorman Brothers Lumber Limited	Forest Renewal BC	Apr 96 – Apr 99	Nicola/Similkameen/Okanagan River Reconnaissance	1:20K Reconnaissance Fish and Fish Habitat Inventory, performed according to Resource Inventory Committee	Canadian AU's	O11-20	

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
			Fish and Fish Habitat Inventory	(RIC) standards			
Okanagan Nation Fisheries Commission	?	Jul 99 – Jan 00	Okanagan Basin-Fish Species Presence and Distribution	Review of existing materials/reports within the Ministry of the Environment, Lands and Parks regional office compiled into one report	Canadian AU's	O11-20	
BC Ministry of Environment Lands and Parks	?	Apr 83	Okanagan Lake Spawning Habitat Construction	Beach gravel moved to below high water mark from above to create kokanee spawning habitat. Identification of spawning sites during the first year	Canadian AU's	O11-20	Habitat Diversity
BC Ministry of Environment Lands and Parks	?	Apr 86	Okanagan River Habitat Enhancement	Creation of spawning habitat for kokanee in the Okanagan River channel by scarifying 160 m and excavating and replacing gravel throughout 400 m of the channel	Canadian AU's	O11-20	Habitat Diversity, Key Habitat Quantity
BC Ministry of Environment Lands and Parks	?	?	Okanagan Lake fisheries awareness	Video, information pamphlet, and slide show to increase public awareness of the importance of Okanagan lake fisheries and to facilitate habitat protection	Canadian AU's	O11-20	
BC Ministry of Environment Lands and Parks	?	Apr 88	Okanagan Storm Drain Marking	Implementation of a Storm Drain Marking program in the Okanagan: Coordination of school groups and volunteers,	Canadian AU's	O11-20	Pathogens

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
				marking of storm drains, and distribution of pamphlets			
BC Ministry of Environment Lands and Parks	?	Apr 89	Okanagan Storm Drain Marking Program	Implementation of a Storm Drain Marking program in the Okanagan: Coordination of school groups and volunteers, marking of storm drains, and distribution of pamphlets	Canadian AU's	O11-20	Pathogens
District of Peachland	Forest Renewal BC	Apr 96 – Jan 99	Peachland Creek and Trepanier Creek Watershed Restoration	Access Management Plan, Fish Habitat Assessment, Level 1 Coastal or Interior Watershed Assessment Procedure (CWAP or IWAP), Terrain Stability	Canadian AU's	O11-20	Habitat Diversity
BC Ministry of Environment Lands and Parks	?	Apr 86	Peachland Creek Kokanee Spawning Enhancement	Enhancement of kokanee spawning habitat by constructing 300 sq. m of gravel platforms upstream from previous enhancement activities	Canadian AU's	O11-20	Habitat Diversity, Key Habitat Quantity
BC Ministry of Environment Lands and Parks	?	Apr 87	Peachland Creek Kokanee Spawning Enhancement	Enhancement of kokanee spawning habitat by constructing more gravel platforms, cleaning sediment basins, and removing excess debris. Also, eggs collected and kokanee spawners enumerated	Canadian AU's	O11-20	Habitat Diversity, Key Habitat Quantity
BC Ministry of Environment Lands and Parks	?	Apr 88	Peachland Creek Tours	Educational tours of kokanee spawning ecology prepared and conducted for school groups and the public	Canadian AU's	O11-20	

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
BC Ministry of Environment Lands and Parks	?	Apr 88	Peachland Creek Kokanee Spawning Enhancement	Maintenance and evaluation of previous projects: gravel platforms, siltation control measures, incubation boxes. Construction of an enumeration fence and collection of kokanee eggs	Canadian AU's	O11-20	Sediment, Habitat Diversity, Key Habitat Quantity
BC Ministry of Environment Lands and Parks	?	Apr 89	Peachland Creek Kokanee Spawning Enhancement	Maintenance of gravel platforms, siltation control measures, and incubation boxes. Evaluations of previous projects by assessing kokanee fry	Canadian AU's	O11-20	Sediment, Habitat Diversity, Key Habitat Quantity
BC Ministry of Environment Lands and Parks	?	Apr 90	Peachland Creek Kokanee Spawning Enhancement	Maintenance of gravel platforms, and incubation boxes, and control of siltation. Previous projects evaluated by assessing kokanee fry	Canadian AU's	O11-20	Sediment, Habitat Diversity, Key Habitat Quantity
BC Ministry of Environment Lands and Parks	?	Apr 91	Peachland Creek Kokanee Spawning Enhancement	Gravel platforms maintained, siltation controlled, and rock weirs repaired. Previous projects evaluated by assessing kokanee fry	Canadian AU's	O11-20	Sediment, Habitat Diversity, Key Habitat Quantity
BC Ministry of Environment Lands and Parks	?	Apr 89	Peachland Creek Tours	Preparation and follow through of educational tours of kokanee spawning ecology for school groups and the public	Canadian AU's	O11-20	
BC Ministry of Environment Lands	?	Apr 89	Peachland Creek Erosion Control	Construct a series of check dams to minimize siltation in the	Canadian AU's	O11-20	Sediment

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
and Parks				creek and to stabilize the entire gully that is used by kokanee			
BC Ministry of Environment Lands and Parks	?	Apr 90	Peachland Creek Erosion Control	Construct a series of check dams to minimize siltation in the creek and to stabilize the entire gully that is used by kokanee	Canadian AU's	O11-20	Sediment
Weyerhaeuser Canada Limited	Forest Renwal BC: Contract #98-WRP	Apr 95 – Sep 98	Hedley / McNulty / Cahill / Winters Creek Watershed Restoration	Integrate results from the Sediment Source Survey (SSS), Access Management Strategy (AMS), Fish Habitat Assessment Procedure (FHAP), and Interior Watershed Assessment Procedure (IWAP). Also terrain stability mapping. Prescriptions for the Penticton, Shuttleworth, and Vaseux Watersheds.	Canadian AU's	O11-20	Sediment
Penticton Flyfishers	?	Nov 99 – Mar 00	Penticton Creek Interpretive Signage Project	4 interpretive signs designed and developed pertaining to Okanagan Lake kokanee and Penticton Creek habitat	Canadian AU's	O11-20	
Penticton Flyfishers	?	Nov 99 – Mar 00	Penticton Creek Resting and Leaping Pool	Improvement of fish ladder to provide access to an additional 0.6 km of stream	Canadian AU's	O11-20	Obstructions
BC Ministry of Environment Lands	?	Apr 86	Powers Creek	Replacement of an existing unscreened diversion with a	Canadian AU's	O11-20	Obstructions

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
and Parks			Screening	screened irrigation diversion to prevent migrating Rainbow trout fry from becoming trapped in an irrigation canal			
BC Ministry of Environment Lands and Parks	?	Apr 86	Powers Creek Fishway Construction	Construction of a fishway to assist kokanee in bypassing a rock obstruction and reaching their spawning habitat	Canadian AU's	O11-20	Obstructions
BC Ministry of Environment Lands and Parks	?	Apr 88	Tadpole Lake Water Storage	Collection of information and development of a plan for sharing water storage in Tadpole Lake with Westbank Irrigation District to secure minimum flow for Powers Creek	Canadian AU's	O11-20	Flow
Naramata Citizens Association	?	Apr 99	Robinson Creek Riparian Fencing	Fencing construction was completed for 2 km	Canadian AU's	O11-20	Habitat Diversity
Gorman Brothers Lumber Limited	?	Dec 95 – Apr 96	Naramata Creek Watershed Restoration	Activity report includes introduction, methods, report format and project deliverables, description of watersheds, conclusions and recommendations. Report on Channel Assessment (WSC: 310-665200)	Canadian AU's	O11-20	Habitat Diversity
Tolko Industries Limited	?	Apr 96 – Feb 99	Tulameen Main Line Watershed Restoration	Channel Assessment report (draft)	Canadian AU's	O11-20	Channel Stability, Habitat Diversity
Gorman Brothers	Forest Renewal BC	Apr 96 –	Nicola/Similkameen/Okanagan	1:20K Reconnaissance Fish and Fish Habitat Inventory,	Canadian AU's	O11-20	Habitat Diversity

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
Lumber Limited		Apr 99	River Reconnaissance Fish and Fish Habitat Inventory	according to Resource Inventory Committee (RIC) standards (Main Stem + Tributaries; South Keremeos Creek (tributary to Keremeos Creek), Snehumption Creek, Shoudy Creek, Robert Creek, Red Bridge Creek (tributary to Ashnola River), Duruisseau Creek (tributary to Ashnola River), Easygoing Creek (tributary to Ashnola River), tributaries to Similkameen/Okanagan/Columbia Rivers)			
Weyerhaeuser Canada Limited	Forest Renewal BC	Apr 96	Merritt Timber Supply Area (TSA) Enhanced Forestry	1:20K Reconnaissance Fish and Fish Habitat Inventory, according to Resource Inventory Committee (RIC) standards (Main Stem + Tributaries; Dillard Creek, tributary to Summers/Allison Creeks, Summers Creek tributary to Allison Creek, Spukunee Creek tributary to Hayes Creek, Siwash Creek tributary to Hayes Creek, Rampart Creek tributary to Summers Creek – tributaries to Similkameen/Okanagan/Columbia River)	Canadian AU's	O11-20	Habitat Diversity
Tolko Industries Limited	Forest Renewal BC	Apr 96	Tolko Multi Activity Land-	1:20K Reconnaissance Fish and Fish Habitat Inventory,	Canadian AU's	O11-20	Habitat Diversity

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
			Based	according to Resource Inventory Committee (RIC) standards (Main Stem and tributaries of Tulameen River, Holmes Creek, tributary to Granite Creek, Fraser Gulch, Collins Creek, Otter Creek, Spearing Creek tributary to Otter Creek, Blakeburn Creek tributary to Granite Creek, Newton Creek tributary to Granite Creek, Manion Creek, tributaries to Tulameen/Similkameen/Okanagan/Columbia River)			
BC Ministry of Environment Lands and Parks	Forest Renewal BC	Apr 96 – Apr 99	Tulameen River Watershed Restoration	Channel Assessment, stream assessment, stream restoration works, surveys, assessments and prescriptions, fish habitat rehabilitation prescriptions	Canadian AU's	O11-20	Habitat Diversity
Lower Similkameen Indian Band	Forest Renewal BC	Apr 96 – Apr 98	Ashnola River Watershed Restoration	Level 1 Coastal or Interior Watershed Assessment Procedure (CWAP or IWAP), and Sediment Source Survey	Canadian AU's	O11-20	Sediment
First Nations of Okanagan-Similkameen Environmental Protection Society	Forest Renewal BC	Apr 94 – Nov 98	Arrastra Creek Watershed Restoration	In Stream & Off Channel Rehabilitation report contains executive summary, background, watershed characteristics, project design, implementation summary and recommendation for future work.	Canadian AU's	O11-20	Habitat Diversity

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
Ardew Wood Products Ltd	Forest Renewal BC	Apr 98 – Feb 99	Granite Creek Watershed Restoration	Work Summary report contains introduction, methods, detailed work plan, results, recommendations and budget summary	Canadian AU's	O11-20	
First Nations of Okanagan-Similkameen Environmental Protection Society	Forest Renewal BC	Apr 95 – Mar 98	Wolfe Creek Watershed Restoration	Integrated Watershed Restoration Plan to develop a strategy to adequately protect natural resources (fisheries, water, timber) while maintaining access to, and use of these resources by stakeholders in the watershed and a report to identify potential watershed impacts in the Wolfe Creek drainage due to forest harvest practice	Canadian AU's	O11-20	
?	Forest Renewal BC	Apr 95 – Mar 98	Hedley / McNulty / Cahill / Winters Creek Watershed Restoration	Integrated Watershed Restoration Plan (IWRP), Sediment Source Survey	Canadian AU's	O11-20	Sediment
?	Forest Renewal BC	Apr 96 – Sept 98	Willis Creek Watershed Restoration	Restore the watershed to some level of pre harvest activity	Canadian AU's	O11-20	Sediment
Tolko Industries Limited	Forest Renewal BC	Apr 95 – Mar 98	Northwest Tulameen River Watershed Restoration	The Integrated Watershed Restoration Plan (IWRP) includes descriptions of the project's Sediment Source Survey, Stream Channel and Fish Habitat Assessment, and	Canadian AU's	O11-20	Sediment

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
				Access Management Plan, as well as a determination of Watershed Level Objectives			
BC Ministry of Forests	Forest Renewal BC	Oct 96 – Apr 97	Old Arrastra Creek Watershed Restoration	Road deactivation prescriptions conducted, equipment supervision and remedial works for slump on Arrastra Creek FSR	Canadian AU's	O11-20	Sediment
Tolko Industries Limited	Forest Renewal BC	Apr 98	Tolko Multi-Year Plan	1:20K Reconnaissance Fish and Fish Habitat Inventory, performed according to Resource Inventory Committee (RIC) standards (Main Stem + Tributaries; Britton Creek, Lawless Creek, Coates Creek tributary to Holding Creek, Blackeye Creek, Podunk Creek (including Chisholm and Cunningham Creek tribs), Packer Creek, Squakin Creek, Gellatly Creek, Otter Creek (including Manning, Myren, and Gulliford Creeks and other un-named tribs), tributary to Tulameen River, Allison Creek, tributary to Similkameen/Okanagan/Columbia Rivers, near Tulameen)	Canadian AU's	O11-20	Habitat Diversity
Weyerhaeuser Canada Limited	Forest Renewal BC	Apr 99	Whipsaw, Smith and Willis Creek Watersheds	1:20K Reconnaissance Fish and Fish Habitat Inventory, performed according to	Canadian AU's	O11-20	Habitat Diversity

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
			Reconnaissance Fish and Fish Habitat Inventory	Resource Inventory Committee (RIC) standards (Main Stem + Tributaries; Willis Creek, tributary to Wolfe Creek, Whipsaw Creek, tributary to Similkameen/Okanagan/Columbia Rivers, near Tulameen; Smith Creek, tributary to Tulameen river, tributary to Similkameen/Okanagan/Columbia Rivers, near Coalmont)			
Okanagan Region Wildlife Heritage Fund Society	Fisheries Renewa BC	Oct 99 – Mar 00	Okanagan/Boundary/Similkameen Rivers-Barriers to Fish Passage (Phase 1)	Identification of 186 potential obstructions to fish passage	Canadian AU's	O11-20	Obstructions
Okanagan Region Wildlife Heritage Fund Society	Fisheries Renewal BC	Oct 99 – Mar 00	Okanagan Region Inventory of Non-natural Barriers to Fish Passage	186 potential fish passage obstructions identified to date	Canadian AU's	O11-20	Obstructions
BC Ministry of Environment Lands and Parks	?	Apr 81	Chain Lake Chemical Rehabilitation	Chemical rehabilitation of Chain Lake to eradicate Finescale suckers and Peamouth Chub, which will enhance the Rainbow trout fishery	Canadian AU's	O11-20	
BC Ministry of Environment Lands and Parks	?	Apr 84	Allison Creek Fish Barrier Construction	Construction of a coarse fish barrier to prevent the invasion of Bridgelip suckers, Longnose dace, and Torrent Sculpin in order to protect the productive	Canadian AU's	O11-20	Obstructions

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
				Rainbow trout population			
BC Ministry of Environment Lands and Parks	?	Apr 89	Rampart Dam Construction	Construct an earth-fill dam with overflow spillway to increase Rainbow trout production. Also, provide access into the lake to adult trout	Canadian AU's	O11-20	
Gorman Brothers Lumber Limited	Forest Renewal BC: Activity # 105256	Apr 98	Trepanier Creek Watershed Restoration Project	Final watershed assessment committee recommendations and current watershed conditions, a risk assessment of proposed forest development, and conclusions regarding future watershed activity.	Canadian AU's	O11-20	
District of Peachland	Forest Renewal BC	Apr 96 – Jan 99	Peachland Creek and Trepanier Creek Watershed Restoration	The purpose of the Integrated Watershed Restoration Plan (IWRP) activity is to integrate the results of the Sediment Source Survey, Access Management Strategy, Fish Habitat Assessment Procedure and Interior Watershed Assessment Procedure (IWAP) to recommend an action plan for the prescription phase.	Canadian AU's	O11-20	Sediment
Gorman Brothers Lumber Limited	Activity # 105256	Apr 98 – Dec 98	Trout Creek Watershed Restoration Project	Level 1 Coastal or Interior Watershed Assessment Procedure (CWAP or IWAP) contains the final watershed assessment committee recommendations	Canadian AU's	O11-20	

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
Gorman Brothers Lumber Limited	Forest Renewal BC	Apr 96	Nicola/Similkameen/Okanagan River Reconnaissance Fish and Fish Habitat Inventory	1:20K Reconnaissance Fish and Fish Habitat Inventory, performed according to Resource Inventory Committee (RIC) standards	Canadian AU's	O11-20	Habitat Diversity
Trepanier Creek Linear Park Society	?	Feb 99 – Mar 00	Trepanier Creek Watershed Stewardship Action Plan	Stewardship/community planning; partnerships built with 11 groups/organizations	Canadian AU's	O11-20	
Trepanier Creek Linear Park Society	?	Sep 99 – Dec 99	Trepanier Creek Spawning Channel: Watershed Concerns	Preliminary evaluation of a proposed spawning channel. Developed recommendations for four issues (low flows; sedimentation from the Macdonald Creek landslide; municipal issues and public/input stewardship) that may have an impact on the proposed spawning channel and fish habitat	Canadian AU's	O11-20	Flows, Sediment, Channel Stability
BC Ministry of Environment Lands and Parks	?	Apr 88	Trepanier Ditch Upgrade	The Trepanier ditch water system upgraded to a pressurized system to contribute to upgrading the multi-user ditch system	Canadian AU's	O11-20	Flow
District of Summerland	Forest Renewal BC	Apr 96 – Mar 98	Trout & Eneas Creek Watershed Restoration	Interior Watershed Assessment Procedure (IWAP) was conducted, assessing the entire watershed including roads,	Canadian AU's	O11-20	Habitat Diversity, Sediment

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
				gullies and streams - contains a Fish Habitat Assessment Procedure, Sediment Source Survey and Access Management Map			
Gorman Brothers Lumber Limited	Forest Renewal BC contract # DPE-WRP-98-GORMANS-1	Oct 96 – Dec 98	Trout Creek Watershed Restoration Project	An Interior Watershed Assessment Procedure for Trout Creek Watershed was conducted. The activity report includes: Introduction, key watershed assessment issues, watershed characteristics, methods, results of office analysis, results of past assessments and reports, risk of future forest development, conclusions and recommendations	Canadian AU's	O11-20	Habitat Diversity
Gorman Brothers Lumber Limited	Forest Renewal BC	Apr 96	Nicola/Similkameen/Okanagan River Reconnaissance Fish and Fish Habitat Inventory	1:20K Reconnaissance Fish and Fish Habitat Inventory, performed according to Resource Inventory Committee (RIC) standards	Canadian AU's	O11-20	Habitat Diversity
District of Summerland	?	Aug 99 – May 00	Trout Creek Intake Fish Screen	Design, construction, installation and maintenance of a self cleaning fish screen, located immediately downstream of the diversion intake into the	Canadian AU's	O11-20	Obstructions

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
				municipal water system			
Weyerhaeuser Canada Limited	Contract #98-WRP-Prescriptions for the Penticton, Shuttleworth, and Vaseux Watersheds	Apr 95 – Mar 99	Hedley / McNulty / Cahill / Winters Creek Watershed Restoration	Access Management Strategies (AMS), Interior Watershed Restoration Plan (IWRP), terrain stability mapping, and Sediment Source Survey (SSS)	Canadian AU's	O11-20	Sediment
Weyerhaeuser Canada Limited	Forest Renewal BC	Apr 98	Weyerhaeuser-OK Falls Div.-Multi-Year Plan Reconnaissance Fish and Fish Habitat Inventory	1:20K Reconnaissance Fish and Fish Habitat Inventory, performed according to Resource Inventory Committee (RIC) standards (Main Stem + Tributaries; Un-named creek (alias Angel Creek), WS Code: 310-522400-66300, tributary to Vaseux Creek, tributary to Okanagan/Columbia Rivers, near Okanagan Falls; Dutton Creek, tributary to Vaseux Creek, tributary to Okanagan/Columbia Rivers, near Okanagan Falls; McIntyre Creek, tributary to Vaseux Creek, tributary to Okanagan/Columbia Rivers, near Okanagan Falls; Solco Creek, tributary to Vaseux Creek, tributary to Okanagan/Columbia Rivers, near Okanagan Falls; Underdown Creek, tributary to Vaseux Creek, tributary to	Canadian AU's	O11-20	Habitat Diversity

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
				Okanagan/Columbia Rivers, near Okanagan Falls.)			
Oceola Fish and Game Club	?	Feb 99 – Mar 00	Vernon/Winfield Creeks Stewardship Action Plan	Habitat assessment, inventory and mapping for 6km	Canadian AU's	O11-20	Habitat Diversity
Wood Lake Improvement District	Forest Renewal BC	Mar 96 – Mar 98	Oyama Creek Watershed Restoration	Access management strategy, integrated watershed restoration plan, Upslope Restoration / Rehabilitation, Interior Watershed Assessment, Water Quality Monitoring, and Road Design (WSC: 310-939400-34700)	Canadian AU's	O11-20	
Winfield and Okanagan Centre Irrigation District	Forest Renewal BC	Apr 95 – Mar 99	Vernon Creek Watershed Restoration	Upslope Restoration / Rehabilitation, landslide rehabilitation assessment procedure, Stream Channel Assessment and Sediment Source Survey, access management strategy, Water Quality Monitoring (WSC: 310-939400)	Canadian AU's	O11-20	Habitat Diversity, Key Habitat Quantity, Sediment, Channel Stability
Tolko Industries Limited	Forest Renewal BC	Apr 96 – Mar 98	King Edward Lake Watershed Restoration	Integrated watershed restoration plan - integrate the results of the sediment source survey, access management strategy, fish habitat assessment procedure, channel assessment procedure and interior watershed	Canadian AU's	O11-20	Habitat Diversity, Key Habitat Quantity

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
				assessment procedure			
BC Ministry of Forests	Forest Renewal BC	Apr 96 – Dec 98	Coldstream Creek Watershed Restoration	The objectives of this activity were to: 1) define the potential negative cumulative or site-specific effects of past forest practices, and other land uses, on the watershed's hydrology, slope and channel geomorphology, and water quality and; 2) provide guidance on continued forest operations	Canadian AU's	O11-20	Sediment, Flow
BC Ministry of Environment Lands and Parks	Forest Renewal BC	Apr 98	Okanagan Timber Supply Area (TSA) Small Lakes Inventory	1:20K reconnaissance lake inventory	Canadian AU's	O11-20	
Oceola Fish and Game Club	?	Mar 00 – Jun 00	Wood Lake Angler Survey / Creel Census	Estimation of angler pressure/effort on the lake, estimation of number of kokanee and other species harvested, education of anglers towards kokanee conservation	Canadian AU's	O11-20	
Penticton Indian Band/Columbia Environmental Consulting	?	Feb 99 – Mar 00	Kelowna/McDougall/Vernon Creeks Urban Referral Compliance Evaluation	Review of Water Act compliance and applications for 4 urban creeks	Canadian AU's	O11-20	Flow
BC Ministry of Environment Lands and Parks	?	Apr 86	Echo Lake Dam Restoration	Reconstruction of an earth-fill dam with an outlet flow control device and an overflow spillway	Canadian AU's	O11-20	Obstructions

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
				to increase storage capability and increase the quality and quantity of rainbow trout production			
BC Ministry of Environment Lands and Parks	?	Apr 86	Vernon Creek Improvement Inventory	A stream inventory conducted. Identification of the methods (e.g. channelization, culvert reconstruction, rip-rap and gravel placement), locations, timing and costs for stream improvements which would benefit kokanee	Canadian AU's	O11-20	Obstructions
BC Ministry of Environment Lands and Parks	?	Apr 87	Echo Lake Dam Restoration	Reconstruction of an earth-fill dam with an overflow spillway at the outlet to improve the quality and quantity of Rainbow trout production	Canadian AU's	O11-20	Obstructions
BC Ministry of Environment Lands and Parks	?	Apr 87	Vernon Creek Passage Improvement	Improvement of passage for kokanee through construction of baffles within a culvert and weir, removing a concrete weir, and placing another weir to decrease water velocity. Volunteers coordinated to remove man-made debris	Canadian AU's	O11-20	Obstructions
BC Ministry of Environment Lands and Parks	?	Apr 88	Vernon Creek Habitat Improvement	Various stream enhancement activities for kokanee performed: boulder weirs placed, gravel spawning platforms constructed, stream clearance conducted,	Canadian AU's	O11-20	Habitat Diversity, Key Habitat Quantity

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
				and 100 m of streambank excavated and stabilized.			
BC Ministry of Environment Lands and Parks	?	Apr 88	Okanagan Drainage Warmwater Fish Enhancement	Enhancement of a Smallmouth bass fishery by controlling weeds, establishing riparian vegetation, transplanting bass, constructing refuge holes, and placing brush piles in lakes for rearing habitats.	Canadian AU's	O11-20	Habitat Diversity
BC Ministry of Environment Lands and Parks	?	Apr 89	Vernon Creek Habitat Improvement	Various stream enhancement activities preformed to enhance kokanee spawning habitat: stream clearance, gravel placement, and installation of a fish barrier at the creek junction	Canadian AU's	O11-20	Habitat Diversity
BC Ministry of Environment Lands and Parks	?	Apr 90	Vernon Creek Habitat Improvement	Various stream enhancement activities performed to enhance kokanee spawning habitat: stream clearance, and gravel placement	Canadian AU's	O11-20	Habitat Diversity
Oceola Fish and Game Club	?	Apr 89	Winfield Creek Enhancement	Improve kokanee spawning habitat by excavating and replacing spawning substrate, excavating settling ponds to control silt and sand deposition, and re-aligning the stream course	Canadian AU's	O11-20	Sediment, Channel Stability, Habitat Diversity
North Okanagan Naturalist Club	?	Feb 99 – Mar 00	Coldstream Creek Renewal Project	Land use mapping, hydrology assessment, design of water	Canadian AU's	O11-20	Flow, Channel Stability

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
				quality and streambed mapping, and research into previous work on Coldstream Creek			
COLVILLE TRIBES	199604200	1996 ?	Okanogan Basin - focus watershed project feasibility	Initiate coordination of a watershed planning project	All AU's	O1-20	Flow
Okanogan County	NA	2002 – ongoing	Okanogan Stream Gaging	All listed Species – Julie Dagnon	Okanogan AU's	O1-3	Flow
COLVILLE TRIBES	20001300	2000 - 2003	Skaha Lake experimental sockeye reintroduction	Examine feasibility of sockeye reintroduction upstream of Skaha Lake Dam	Skaha Lake	O18	Obstructions
COLVILLE TRIBES	20001300	2000 ?	Skaha Lake experimental sockeye reintroduction	Examine feasibility of sockeye reintroduction upstream of Skaha Lake Dam	Skaha Lake	O18	Obstructions
PUD # 1 Douglas County	NA	???? – ongoing	Okanogan River Bank restoration and maintenance	All Species – Gordon Brett 509.884.7191 gbrett@dcpud.org	Lower, Middle Okanogan	O2	Channel Stability, Sediment
BLM	NA	2001 - 2000	Whistler Canyon	Spring Chinook, Steelhead – Joe Kelly $ 10,000	Middle Okanogan	O2	
WDFW	199506800	1995 ?	Scotch Creek wildlife area enhancement	Purchase and initiate enhancement activities on site: Scotch Creek, Pogue Mtn, Chesaw and Tunk Valley Units	Okanogan Middle	O2	Sediment

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
COLVILLE TRIBES	200200100	2002 -2003	Ellisforde Acclimation Pond	Spring Chinook – Chris Fisher $ 130,000	Okanogan Middle	O2	
NRCS	NA	???? - 1995	Okanogan River Streambank restoration	Randy Kelley	Okanogan Middle	O2	Channel Stability, Sediment
WA DNR	NA	1995	Loomis Forest water quality monitoring		Okanogan Middle	O2	Flow, Sediment
BLM	NA	1997-2001	Salmon Creek Land Acquistions	Steelhead/Rainbow – Joe Kelly 503.665.2118 – Joe_Kelly@or.blm.gov $ 364,000	Salmon Creek	O6,7	Sediment, Habitat Diversity
DNR	NA	2003 - unknown	Salmon Creek Confluence Land Acquisition	Anadromous fish – Chris Fisher $ 150,000	Salmon Creek	O6,7	Habitat Diversity, Sediment
City of Okanogan	99-1308	2000 - 2000	Salmon Creek Riparian Restoration	Anadromous fish – Chris Johnson $ 41,932	Salmon Creek	O6,7	Sediment, Channel Stability, Habitat Diversity
Okanogan Irrigation District	00-1144	???? - ongoing	Salmon Creek Instream Flows	Steelhead, Chinook – Tom Sullivan $ 300,000	Salmon Creek	O6,7	Flows
COLVILLE TRIBES	99-1610	2000-2000	Salmon Creek	Anadromous Fish – Hilary Lyman $ 192,000	Salmon Creek	O6-7	

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
COLVILLE TRIBES	200000100	2000 - ongoing	Omak Creek anadromous fish habitat and passage improvement	Anadromous fish habitat and passage improvement (Summer Steelhead)	Omak	O8	Obstructions, Habitat Diversity
COLVILLE TRIBES	99-1611	2000 – ongoing	Omak Creek Restoration	Summer Steelhead – Chris Fisher $ 602,010	Omak Creek	O8	Habitat Diversity, Sediment
COLVILLE TRIBES	00-1683	2001 - ongoing	Omak Creek Watershed Restoration	Summer Steelhead – Chris Fisher $ 189,621	Omak Creek	O8	Habitat Diversity, Sediment
COLVILLE TRIBES	01-1420	2002 - ongoing	Omak Creek Road Decommission	Summer Steelhead – Chris Fisher $ 59,413	Omak Creek	O8	Sediment
COLVILLE TRIBES	WA-COA-01-140	2001 - 2004	Burned Area Emergency Rehab	Summer Steelhead – Chris Fisher $ 456,030	Omak Creek	O8	Sediment, Habitat Diversity, Pathogens
COLVILLE TRIBES	NA	2002-2002	Omak Creek Acclimation Pond	Spring Chinook – Chris Fisher $ 100,000	Omak Creek	O8	
OCD	NA	1994 - 1997	Omak Creek Restoration	Craig Nelson $ 1,000,000+	Omak Creek	O8	Habitat Diversity, Sediment
COLVILLE TRIBES	200000100	2000 ?	Omak Creek anadromous fish habitat and passage	Anadromous fish habitat and passage improvement	Omak Creek AU's	O8	Obstructions

Responsible Agency	BPA Project # or Other Funder	Project Duration	Project Title	Project Description, Rationale, and Results	Assessment Unit	A.U. #	Survival Factor Assessed/Restored/ Protected (maintained)
			improvement				
Riverside Forest Products Limited	Forest Renewal BC	Apr 96 – Apr 97	Naswhito Creek Watershed Assessment and Restoration	Restore the watershed to some level of pre harvest condition, to restore natural hydrology to the area, and to enhance and rehabilitate riparian habitat. Specific actions undertaken may be road deactivation, gully and landslide rehabilitation and sediment source detection.	Omak Creek AU's	O8	Sediment, Flow
UCRFEG	NA	2002 - 2002	Bonaparte Creek clean up	Larry Bailey	O9 Small Tributaries	O9	Habitat Diversity, Pathogens
UCRFEG	NA	2001 - 2002	Aeneas Creek riparian fencing	Larry Bailey	Small Tributaries	O9	Sediment, Habitat Diversity

12 Appendix E: Okanagan-Shuswap LRMP - Direction on the enhancement or restoration of fish habitat and populations in Okanagan Subbasin

Objectives: "A concise, measurable statement of a desired future condition for a resource or resource use which is attainable through management action"

Strategy: " A means of achieving a resource objective"

Restore depressed salmon and freshwater fish population to the capability of the system.

Identify depressed stocks, and root causes of population declines.

Develop and implement site-specific measures to reverse such declines.

Restore salmon and freshwater fish habitat where it is not functioning at, or near, natural capacity.

Identify fish habitats that would benefit from enhancement works.

Develop and implement site-specific habitat enhancement projects to restore riparian areas and instream fish habitats in watersheds impacted by past activities.

Through stewardship programs and agreements, the Watershed Restoration Program, Fisheries Renewal Fund or other funding sources, rehabilitate and stabilize streambanks that have been impacted by urban development activities such as agriculture and timber harvesting

Where mitigation strategies significantly impact timber values, range, agriculture and other values they need to be brought to the attention of the LRMP Implementation and Monitoring Committee (implementation).

Evaluate the effectiveness of fish habitat restoration and rehabilitative measures (implementation).

Restore channel stability in streams where assessments (e.g. IWAP) indicate a concern, or where there are known problems.

Identify stream channels with stability concerns and the cause of instability.

Avoid unmitigated development activities that could result in further instability concerns.

Restore channel stability in streams where assessments (e.g. IWAP) indicate a concern, or where there are known problems.

Develop and implement site-specific channel stability restoration measures to accelerate natural recovery processes.

Restore the structural and functional integrity of steam riparian areas on private lands.

All levels of government that work with private land owners should be encouraging the use of stream riparian buffers where riparian integrity is compromised.

Restore riparian areas that are not properly functioning as a result of improper grazing.

Utilize the "Provincial Range and Riparian Remedial Measures Procedures" as a guide when restoring non-functioning riparian areas.

Retain, or where possible, restore or enhance Crown wetlands not located within the provincial forest.

Identify and maintain a publicly accessible inventory of wetlands.

Manage development to limit negative impacts to wetlands.

Utilize the restoration and enhancement of alternate sites as part of mitigation/compensation resulting from development.

Provide stewardship information to adjacent landowners, conservation groups, the public and local governments and sub-dividing authorities.

Encourage partnership and stewardship agreements (e.g. conservation covenants) between all levels of government, private landowners, and other stakeholders (e.g. local naturalist clubs, community associations) to protect wetlands.

Provide sufficient quantity and quality of habitat to secure long-term viability and distribution of rare elements and high value habitats.

Where appropriate, restore important habitat attributes and special features (implementation).

Minimize, where practical, conflicts between agriculture and fish and wildlife interests.

Evaluate fish and wildlife population and habitat enhancement projects as to their potential impact to the agricultural sector, and develop measures to mitigate those impacts.

Achieve and maintain properly functioning conditions of streams including the timing and magnitude of flows.

Mitigate and compensate for the impacts from new development activities that may alter the hydrologic regime to the detriment of the fish.

Minimize, where practical, conflicts between agriculture and fish and wildlife interests.

Evaluate fish and wildlife population and habitat enhancement projects as to their potential impact to the agricultural sector, and develop measures to mitigate those impacts.

Enhance the non-consumptive values of fishery resources (e.g. viewing opportunities).

Allow for the development of fish education and appreciation opportunities provided they do not impact fish and their habitat.

Enhance salmon and freshwater fish populations where appropriate

Identify opportunities to enhance fish populations

Enhance salmon and freshwater fish populations where appropriate

Develop and implement site-specific measures to enhance salmon and freshwater fish populations.

Restore salmon and freshwater fish habitat where it is not functioning at, or near, natural capacity.

Identify fish habitats that would benefit from enhancement works.

Restore salmon and freshwater fish habitat where it is not functioning at, or near, natural capacity.

Develop and implement site-specific habitat enhancement projects to restore riparian areas and instream fish habitats in watersheds impacted by past activities.

Restore channel stability in streams where assessments (e.g. IWAP) indicate a concern, or where there are known problems.

Develop and implement site-specific channel stability restoration measures to accelerate natural recovery processes.

Maintain stream temperature conditions necessary to sustain and protect fish and fish habitat.

Avoid activities that could result in increases to stream temperature.

Provide adequate riparian habitat to sustain healthy aquatic ecosystems, fish and wildlife populations.

Establish 10,000 hectares of "enhanced riparian reserves" within the timber harvesting land base (THLB).

Provide adequate riparian habitat to sustain healthy aquatic ecosystems, fish and wildlife populations.

For a S5 stream establish a 10-metre reserve and retain approximately 25% of the basal area within the adjacent 20-metre riparian management zone (RMZ) by cut block.

Provide adequate riparian habitat to sustain healthy aquatic ecosystems, fish and wildlife populations.

For a larger S6 stream establish either a 10-metre reserve or retain approximately the equivalent in basal area within the RMZ by cutblock.

Provide adequate riparian habitat to sustain healthy aquatic ecosystems, fish and wildlife populations.

Variation from the strategies for S1 and S6 streams can be done pursuant to a riparian management plan, or a prescription as recommended by a qualified professional.

Provide adequate riparian habitat to sustain healthy aquatic ecosystems, fish and wildlife populations.

The 10,000 hectares of "enhanced riparian reserves" will be allocated within the plan area within five years.

Provide adequate riparian habitat to sustain healthy aquatic ecosystems, fish and wildlife populations.

Harvesting within the LRMP imposed riparian reserves is regulated in the same manner as that described for FPC riparian reserve zones in Section 4(1) of the Silviculture Practices Regulation, and Section 10(3) of the Timber Harvesting Practices Regulation

Provide adequate riparian habitat to sustain healthy aquatic ecosystems, fish and wildlife populations.

For S1 streams with a stream width greater than 20-metres and less than 100 metres, establish a riparian reserve zone (RRZ) 50 metres wide, and a riparian management zone (RMZ) 20-metres wide on each side, with an average 50% basal area retention. (The to

Provide adequate riparian habitat to sustain healthy aquatic ecosystems, fish and wildlife populations.

For S4 fish streams establish a 10-metre reserve in low windthrow areas.

Retain, or where possible, restore or enhance Crown wetlands not located within the provincial forest.

Identify and maintain a publicly accessible inventory of wetlands.

Retain, or where possible, restore or enhance Crown wetlands not located within the provincial forest.

Manage development to limit negative impacts to wetlands.

Retain, or where possible, restore or enhance Crown wetlands not located within the provincial forest.

Utilize the restoration and enhancement of alternate sites as part of mitigation/compensation resulting from development.

Retain, or where possible, restore or enhance Crown wetlands not located within the provincial forest.

Provide stewardship information to adjacent landowners, conservation groups, the public and local governments and sub-dividing authorities.

Retain, or where possible, restore or enhance Crown wetlands not located within the provincial forest.

Encourage partnership and stewardship agreements (e.g. conservation covenants) between all levels of government, private landowners, and other stakeholders (e.g. local naturalist clubs, community associations) to protect wetlands.

Restore and maintain properly functioning conditions of streams, including timing and magnitude of flows.

When recommended by a Watershed Advisory Committee, proponents are to consider undertaking long term plans to address quantity and timing of flow issues identified in the IWAP.

Okanagan-Shuswap LRMP direction on the enhancement or restoration of wildlife habitat and populations in Okanagan Subbasin

Provide sufficient quantity and quality of habitat to secure long-term viability and distribution of rare elements and high value habitats.

Recommend to the District Manager and Designated Environment
Official that the following be recognized as "wildlife habitat features"
under Section 1 of the FPC Operational Planning Regulations (OPR):
a) red- and blue-listed plants and plant community locations.
b) sedentary features of red- and blue-listed wildlife, such as dens, nests
and hibernacula.
c) historic red-Listed species occurrences, including nests and dens.
d) Conservation Data Centre (CDC) "record trees".
e) raptor nests that are currently used.
f) mountain goat and bighorn sheep natal areas.
g) bighorn sheep ram rutting areas.

Maintain fisher habitat and provide landscape connectivity (for fisher dispersion) within the biodiversity old seral and "enhanced" riparian budget.

Manage the riparian management zone for structure and suitability along S1, S2 and S3 fish bearing streams by undertaking the following management activities: retaining all deciduous, especially cottonwood, where practicable; retaining large diameter snag

Maintain or enhance food and forage sources, cover and connectivity for marten.

Within two years of ratification, develop and initiate an operational inventory and monitoring program that will examine the effectiveness of managing various forest attributes on the maintenance and enhancement of pine marten populations

Maintain or enhance food and forage sources, cover and connectivity for marten.

Plan for connectivity during landscape unit planning, utilizing temporal and spatial distribution of cut and leave areas, old growth management areas, wildlife tree patches, and enhanced riparian protection.

Maintain or enhance food and forage sources, cover and connectivity for marten.

Consider placing WTPs to complement the retention levels along these riparian corridors.

Maintain or enhance food and forage sources, cover and connectivity for marten.

The location of WTPs should be well distributed over two broad habitats: a) drier sites that are important for denning, resting, and whelping; and b) adjacent to riparian areas to compliment structure retained for movement opportunities.

Maintain or enhance food and forage sources, cover and connectivity for marten.

In high capability marten habitats as per the "High Capability Marten Habitat" map retain "enhanced" levels of coarse woody debris along riparian management areas (RMA) that do not have a reserve. This is only required on one RMA per 40 hectares of harvest area.

Provide opportunities for the movement of bighorn sheep in the sheep habitat areas shown on the "Wildlife-Bighorn Sheep Habitat" map.

Within the bighorn sheep habitat, apply forest management prescriptions that restore, maintain or enhance sheep use of corridors linking seasonal ranges and linking fragmented sheep populations.

Improve information regarding the location and use of bighorn sheep habitat.

Where practicable, restore sheep to areas where the species has been extirpated, or reduced to critical levels, as identified by the "Wildlife-Bighorn Sheep Habitat" map (implementation).

Manage for early of mid-seral understory vegetation in lambing areas in order to promote a higher forb content in sheep forage.

Where practicable, develop and implement prescribed burn plans to enhance forage availability or improve habitat suitability on winter ranges.

Manage for early of mid-seral understory vegetation in lambing areas in order to promote a higher forb content in sheep forage.

Assess the capacity of the forage habitat in terms of the number or density of sheep that the habitat could support. Mitigate negative factors and enhance positive factors to allow sheep to reach sustainable levels (implementation).

Manage for early of mid-seral understory vegetation in lambing areas in order to promote a higher forb content in sheep forage.

Develop a strategy to enhance forage productivity by actively managing forest ingrowth into grasslands, and open forest sites. Where practical, develop prescribed burn plans or utilize other methods to enhance forage production. (Implementation).

Manage for early of mid-seral understory vegetation in lambing areas in order to promote a higher forb content in sheep forage.

Where external funding is secured, intensive silviculture of habitat enhancement activities are to enhance important habitat features in mule deer winter ranges.

Provide opportunities for the movement of bighorn sheep in the sheep habitat areas shown on the "Wildlife-Bighorn Sheep Habitat" map.

Within the bighorn sheep habitat, apply forest management prescriptions that restore, maintain or enhance sheep use of corridors linking seasonal ranges and linking fragmented sheep populations.

Manage activities within Zone 1 and 2, as identified on the "Wildlife-Derenzy Bighorn Sheep Habitat" map, to protect, maintain and/or enhance habitat for bighorn sheep or other wildlife.

Establish Zone 1, as identified on the "Wildlife - Derenzy Bighorn Sheep Habitat" map, as a wildlife management area (WMA).

Manage activities within Zone 1 and 2, as identified on the "Wildlife-Derenzy Bighorn Sheep Habitat" map, to protect, maintain and/or enhance habitat for bighorn sheep or other wildlife.

The existing local stakeholder group will be involved in Zone 1 WMA and Zone 2 development, as well as the development of access management objectives.

Manage activities within Zone 1 and 2, as identified on the "Wildlife-Derenzy Bighorn Sheep Habitat" map, to protect, maintain and/or enhance habitat for bighorn sheep or other wildlife.

Within Zone 1, habitat enhancement work may be undertaken for the benefit of the sheep.

Manage activities within Zone 1 and 2, as identified on the "Wildlife-Derenzy Bighorn Sheep Habitat" map, to protect, maintain and/or enhance habitat for bighorn sheep or other wildlife.

Within Zone 2, as identified on the "Wildlife-Derenzy Bighorn Sheep Habitat" map, maintain 33% of the stand to a height of 16 metres or greater, and a crown closure class of 3 or greater.

Manage activities within Zone 1 and 2, as identified on the "Wildlife-Derenzy Bighorn Sheep Habitat" map, to protect, maintain and/or enhance habitat for bighorn sheep or other wildlife.

Within Zone 2, develop a "Total Chance Plan" to manage access.

Manage activities within Zone 1 and 2, as identified on the "Wildlife-Derenzy Bighorn Sheep Habitat" map, to protect, maintain and/or enhance habitat for bighorn sheep or other wildlife.

Avoid Crown land alienation within Zones 1 and 2.

Manage activities within Zone 1 and 2, as identified on the "Wildlife-Derenzy Bighorn Sheep Habitat" map, to protect, maintain and/or enhance habitat for bighorn sheep or other wildlife.

Rock climbing should be discouraged within Zone 1.

Manage activities within Zone 1 and 2, as identified on the "Wildlife-Derenzy Bighorn Sheep Habitat" map, to protect, maintain and/or enhance habitat for bighorn sheep or other wildlife.

If disease or parasites of sheep become an unacceptable mortality factor MELP will consider all available management options.

Manage activities within Zone 1 and 2, as identified on the "Wildlife-Derenzy Bighorn Sheep Habitat" map, to protect, maintain and/or enhance habitat for bighorn sheep or other wildlife.

MELP will encourage the natural re-occupation and, if needed, transplants of suitable ranges historically used by California bighorn sheep.

Manage activities within Zone 1 and 2, as identified on the "Wildlife-Derenzy Bighorn Sheep Habitat" map, to protect, maintain and/or enhance habitat for bighorn sheep or other wildlife.

Should it be determined that predator control (particularly for coyote) may result in increased lamb recruitment and benefit the sheep population, MELP should consider this as a management tool.

Maintain and enhance opportunities for the public to appreciate, study and view wildlife in their natural habitat, and to maintain and enhance public use of the wildlife resources of the RMZ (Zone 1 WMA and Zone 2) for hunting.

Within Zone 1, ensure that wilderness-type outdoor experiences and high value scenic opportunities are available for recreational users.

Maintain the NDT4a (as defined by the Regional NDT4 Committee) as grasslands.

Initiate a feasibility study to determine area specific appropriateness of using prescribed fire as a management tool to maintain ecosystem integrity - e.g. to enhance *Ceanothus* (yellow stemmed buck brush) for deer forage (implementation).

Manage the NDT4b for the stand structure and understory attributes described by the Regional NDT4 Committee.

Initiate a feasibility study to determine area specific appropriateness of using prescribed fire as a management tool to maintain ecosystem integrity - e.g. to enhance *Ceanothus* (yellow stemmed buck brush) for deer forage (Implementation).

Restore and enhance ecosystem connectivity in NDT4a and b.

Avoid resource use and/or development activities that would have major implications to maintaining connectivity within this RMZ.

Maintain or enhance habitat opportunities for rare elements dependent on NDT4 ecosystems.

Any resource use activities occurring on NDT4 ecosystems must take into account habitat requirements of rare elements.

Maintain or enhance habitat opportunities for rare elements dependent on NDT4 ecosystems.

Protect rare plant communities by planning management activities so that those communities persist.

Maintain or enhance habitat opportunities for rare elements dependent on NDT4 ecosystems.

Develop and implement management prescriptions for rare plants and plant communities.

Maintain or enhance habitat opportunities for rare elements dependent on NDT4 ecosystems.

Assess habitats in the BG, PP and IDFxh zones capable of supporting rare elements prior to approving resource use and development.

Restore and/or rehabilitate NDT4 ecosystems.

Develop and implement management plans for both noxious weeds and weed species of concern. The intent is to minimize the spread and proliferation of weed species.

Restore and/or rehabilitate NDT4 ecosystems.

Utilize native seed species mixes wherever practical.

Restore and/or rehabilitate NDT4 ecosystems.

A committee will be structured to promote and review enhancement projects. Approved projects will have priority for funding from the Grazing Enhancement Fund (GEF).

Provide suitable habitat attributes for bull trout, geographically isolated populations, high value spawning areas, cutthroat trout, and salmon as shown on the "Fish RMZ" map.

Identify spawning areas, and assess the potential for enhancement.

Maintain the productivity of these provincially important broodstock collection sites as shown on the "Broodstock Collection Sites" map.

For all other fish-bearing streams within the Pennask Creek drainage not included the protected area, any proposed activities will be addressed through the management direction found in the Riparian & Wetlands section.

Within goat habitat identified in the "Wildlife-Mountain Goat Habitat RMZ" map, provide forage for goats.

Where other resource values are not threatened, enhance early seral foraging opportunities by implementing a "let burn" policy for high elevation wild fires in inoperable areas that are on, or adjacent to, goat winter ranges.

Enhance food and forage sources, cover and connectivity for grizzly bear as per the "Wildlife - Grizzly Bear Habitat RMZ" map.

Manage for "enhanced" leveled of coarse woody debris (CWD) within moderately-high and high grizzly bear habitat.

Enhance food and forage sources, cover and connectivity for grizzly bear as per the "Wildlife - Grizzly Bear Habitat RMZ" map.

Through ongoing inventories and research, identify and assess the amount and quality of habitat and the ecological processes that are required to ensure effective management of the grizzly bear (implementation).

Enhance food and forage sources, cover and connectivity for grizzly bear as per the "Wildlife - Grizzly Bear Habitat RMZ" map.

Review the recovery plans for the North Cascades and Kettle/Granny grizzly bear units as they apply to the plan area (implementation).

Enhance food and forage sources, cover and connectivity for grizzly bear as per the "Wildlife - Grizzly Bear Habitat RMZ" map.

On a trial basis, for those subzone variants defined in Table 1, manage to minimum stocking rates as targets and look at planning for 10% voids in other areas (implementation).

Enhance food and forage sources, cover and connectivity for grizzly bear as per the "Wildlife - Grizzly Bear Habitat RMZ" map.

Maintain naturally occurring non-forested features (avalanche tracks, non-productive brush sites, berry sites in the non-timber harvesting land base).

Enhance food and forage sources, cover and connectivity for grizzly bear as per the "Wildlife - Grizzly Bear Habitat RMZ" map.

Plan development in watersheds so that at a minimum approximately 20% of the area is in early seral condition.

Enhance food and forage sources, cover and connectivity for grizzly bear as per the "Wildlife - Grizzly Bear Habitat RMZ" map.

Where possible, prime berry producing sites will be incorporated into wildlife tree patches (WTPs), provided they have WTP characteristics.

Enhance food and forage sources, cover and connectivity for grizzly bear as per the "Wildlife - Grizzly Bear Habitat RMZ" map.

Maintain areas for berry production by promoting variable inter-tree spacing and/or cluster planting.

Enhance food and forage sources, cover and connectivity for grizzly bear as per the "Wildlife - Grizzly Bear Habitat RMZ" map.

In important berry producing areas, as defined in Table 1, minimize, where practicable, the adverse impacts of site preparation and timber harvesting on *Vaccinium*.

Enhance food and forage sources, cover and connectivity for grizzly bear as per the "Wildlife - Grizzly Bear Habitat RMZ" map.

In forested riparian site series (I.e. no distinct water feature) manage to the stocking standards outlined in Table 2.

Enhance food and forage sources, cover and connectivity for grizzly bear as per the "Wildlife - Grizzly Bear Habitat RMZ" map.

For site series associated with water features (I.e. streams, lakes or wetlands - see Table 2), manage riparian site series for bear forage, cover and connectivity by: a) avoiding road construction in these areas, except for crossings or where no other pr

Enhance food and forage sources, cover and connectivity for grizzly bear as per the "Wildlife - Grizzly Bear Habitat RMZ" map.

For riparian, inundated and forested site series adjacent to the main stem floodplains of the Seymour, Anstey, Perry, Upper Eagle, and Upper Shuswap River systems, and the Ratchford and Wap Creek systems, manage riparian site series as defined by Table 2

Provide forest cover that is adequate to meet mule deer thermal, snow interception and security requirements in the mule deer winter range habitats shown on the "Wildlife - Mule Deer Winter Range RMZ" map.

Where external funding is secured, intensive silviculture or habitat enhancement activities are to enhance important habitat features in mule deer winter ranges.

Maintain and/or enhance forage for mule deer.

Promote ground forage productivity.

Maintain and/or enhance forage for mule deer.

Range use plans (RUPs) in mule deer winter range areas (see the "Wildlife - Mule Deer Winter Range RMZ" map) will identify and manage for desired plant communities (DPC) that favor mule deer winter browse species.

Maintain and/or enhance forage for mule deer.

Re-vegetation of permanent grassland range within mule deer winter range will, wherever practicable, be done using available native species mixes.

Maintain and/or enhance forage for mule deer.

Where practicable, utilize prescribed burns under specific conditions or mechanical treatment to enhance winter range forage values.

Maintain and/or enhance forage for mule deer.

Forest harvesting is to be distributed across the planning cells to maintain sufficient early seral areas for forage.

Maintain and/or enhance forage for mule deer.

Specific forage objectives will be developed as part of the implementation strategy so as to co-ordinate the relationship between forage and cover and incorporate proposed research trials (see Appendix IX). (Implementation).

Maintain and/or enhance forage for mule deer.

Manage for tree stocking densities as outlined in Table 2.

Manage Mission Creek watershed for sustainability of both consumptive and instream uses in an integrated manner for both Crown land (industrial, commercial and recreational) activities and private land activities.

The Regional District of Central Okanagan (RDCO), in partnership with MELP and MoF is to create and support Enhanced Watershed Advisory Committee (EWAC) that will provide advice on the management of land use activities (resource extraction, urban development

13 Appendix F: Level of Proof (LOP) percent frequency for each EDT habitat attribute and associated data sources and comments for the Okanogan basin.

Table 59 Definitions for key headings in the Reach Analysis Reports.

Ecological Attribute	Level of Proof	Data Sources and Comments
Alkalinity	1) 1% 2) 31% 3) 68% 4) 5)	Used USGS/WDOE monitoring sites for the mainstem In or near the rating high range, Palmer Lake et., al naturally alkaline Based upon CCT Environmental Trust data Extrapolated from similar streams from CCT Environmental Trust data In or near the rating high range, Palmer Lake et., al naturally alkaline
Bed Scour	1) 2) 3) 4)100% 5)	Based on field observations of largest material moved down channel Chris Fisher, John Arterburn expert opinion based on largest sizes of material mobile in channel, determined as influenced by gradient and flow. Omak Creek highly variable and flashy,
Benthic Community Richness	1)7% 2)6% 3) 4)16% 5)71%	Used the 4 WDOE watershed sites and expanded to the rest of the basin. Lowered the level of proof to 4 or 5 in most cases to highlight the uncertainty of this expansion and identify as a data gap.
Channel Length	1)100% 2) 3) 4) 5)	Used Terrain Navigator to measure reach lengths (HWG 2003)
Channel Width Maximum	1)25% 2)13% 3) 4% 4)58% 5)	Remote sensing using aerial and Terrain Nav. OCD 2003 Dames and Moore 1999 measurements taken in lower river Assumed based on Dames and Moore 1999 measurements taken in lower river CCT Fish and Wildlife stream surveys
Channel Width Minimum	1)26% 2)14% 3) 60% 4) 5)	OCD 2003 Derived from series of maximum ratio calc demonstrating an avg. reduction of max channel width percent change from max to min at .61

Ecological Attribute	Level of Proof	Data Sources and Comments
Confinement Man-Caused	1) 2) 3)100% 4) 5)	% confinement by reach, multiplied by 2 for both stream banks. Confinement by riprap, roads, railroad beds, etc. HWG 2003. Terrain Navigator used to measure distances of confinement/total reach bank length
Confinement Natural	1)1% 2) 3) 99% 4) 5)	% confinement by reach, multiplied by 2 for both stream banks. Confinement by riprap, roads, railroad beds, etc. HWG 2003. Terrain Navajo used to measure distances of confinement/total reach bank length Derived from DOE WQ data for WRIA 49, and HWG 2003
Dissolved Oxygen	1)12% 2)88% 3) 4) 5)	WDOE Gauging Station OID 2003
Embedded-ness	1)16% 2)3% 3) 5% 4)76% 5)	V-star sediment analysis CCT 2000 CCT Fish and Wildlife stream Surveys
% Fines	1) 2) 3) 4)100% 5)	no data exist assume up rate one category and additional in AG reaches Field observations of CCT biologists, high gradient. V-star sediment analysis CCT 2000 CCT fish and wildlife department stream surveys
Fish Community Richness	1) 2) 3) 27% 4)73% 5)	HWG using spreadsheet workbook exercise to populate matrix of presence/absence. Data from WDFW surveys. HWG 2003
Pathogens	1) 2) 3) 100% 4) 5)	Rated qualitatively using proximity to hatchery release sites.
Fish Species Exotic	1) 2) 3) 100% 4) 5)	HWG 2003 using species present/absent matrix Only Brook Trout are known to exist based on CCT fisheries data when channel has water

Ecological Attribute	Level of Proof	Data Sources and Comments
Flow High	1) 2) 3) 100% 4) 5)	Gauging station showed no trends, no high flow measurements are available for pre-development. Used Road density as an indicator to scale the score between a 2 and 3. derived from road density (if < 2.5 then no impact)(2.5-6 mi/mi^2= EDT score 2.25-3.25)--Mel Bennett USFS data no data; assume its similar to Loup Loup and Chilowist derived from road density (if < 2.5 then no impact)(2.5-6 mi/mi^2= EDT score 2.25-3.25) Although road density was low, Runoff from impervious surfaces in Okanogan and Omak would increase flashiness. It also has higher road density upstream which will effect down stream. Although road density was low, Runoff from impervious surfaces in Okanogan and Omak would increase flashiness. It also has higher road density upstream which will effect down stream. No data: assume its similar to Tunk and Aeneas Ck. No data: assume its similar to Antoine and Siwash buffered peak flows due to runoff storage by Zosel Dam
Flow Low	1) 2) 3) 4) 100% 5)	Rated qualitatively by the Habitat Work group 2003
Flow Diel Variation	1) 2) 3) 4)100% 5)	Wells pool effect; no data was available to evaluate daily fluctuations Assume no diel effect of irrigation diversions, dams, etc. USGS gage at Oroville based on Osoyoos operations --need to check capacity Lake to determine if 60 days of flow is stored. May be affected by Boohoos Lake mgmt.
Flow Flashy	1) 2) 3) 100% 4) 5)	Gauging station showed no trends, no high flow measurements are available for pre-development. Used Road density as an indicator to scale the score between a 2 and 3. derived from road density (if < 2.5 then no impact)(2.5-6 mi/mi^2= EDT score 2.25-3.25) no data; assume its similar to Loup Loup and Chilowist Although road density was low, Runoff from impervious surfaces in Okanogan and Omak would increase flashiness. It also has higher road density upstream which will effect down stream. No data: assume its similar to Tunk and Aeneas Ck. No data: assume its similar to Antoine and Siwas
Gradient	1) 100% 2) 3) 4) 5)	Measured in Terrain Navigator

Ecological Attribute	Level of Proof	Data Sources and Comments
Habitat: Backwater- Pools; Large Cobble Riffles; Pool- Tailouts; Small Cobble-Riffles; Glides; Beaver Ponds; Primary-Pools;	1)25% 2) 3) 75% 4) 5)	Hanson 1995, Dames and Moore 1999, Fisher and Federsen 1998 Exptrapolated from CCT Fish and Wildlife Department Stream Surveys based on the description describing the primary pool habitat for Omak Creek Difficult to determine based on survey data but expert opinion determined that 5% was appropriate unless constrained by hydraulic conditions
Offchannel Habitat	1)24% 2) 3) 76% 4) 5)	Hanson 1995, Dames and Moore 1999, Fisher and Federsen 1998 Gradient, defined channel, and small drainage area made this habitat minimal, CCT Fish and Wildlife Stream Surveys
Harassment	1) 2) 3) 100% 4) 5)	Rated qualitatively based on proximity to roads and population centers
Hatchery Fish Outplants	1)100% 2) 3) 4) 5)	Stocking records and locations provided by WDFW and CCT.
Hydrologic Regime Natural	1)100% 2) 3) 4) 5)	Based on USGS Flow patterns
Hydrologic Regime Regulated	1)35% 2) 3) 4)65% 5)	Data needs to analyzed to compare the storage in Osoyoos to the flow of the Okanogan above and below the Similkameen. No water storage projects Need to confirm storage capacity of Lieder Lake relative to stream flow. Need to confirm the storage capacity of Conconelly relative to the flow of Salmon Ck. Enloe is run of the River; need to confirm with documentation
Icing	1) 2)	Based on elevation. Likely not persistent nor frequent occurrences of anchor ice. HWG 2003

Ecological Attribute	Level of Proof	Data Sources and Comments
	3) 4)100% 5)	
Metals in Water Column	1) 2)100% 3) 4) 5)	Based on the 303 d list, assuming that the USGS/WDOE sites are representative.
Metals in Soils/ Sediment	1) 2)100% 3) 4) 5)	A few points in the basin were monitored and this was expanded to everywhere else. Probably should be a data gap and have much less confidence in the Level of Proof because there could be high impact areas in between survey sites.
Miscellaneous Toxins	1) 2) 3) 48% 4)52% 5)	1998 303 d list DDD, DDE, PCB 1254, PCB1260 agricultural area has some toxins 1998 303 d list DDT not on 303 d list and limited agriculture so minimal toxic effects 1998 303 d list, Arsenic 1998 303 d list DDD, DDE 1998 303 d list DDT,
Nutrients	1) 2) 3) 100% 4) 5)	Wolf and Terrel, 2003 using WRIA 49 WQ data from DOE
Obstructions	1) 2) 3) 50% 4) 50% 5)	Some were surveyed and some were not.
Predation Risk	1) 2) 3) 4) 100% 5)	based upon census of non native fish. HWG 2003
Riparian Function	1) 2) 3) 4)100% 5)	Remote sensing using Terrain Navigator. HWG 2003 Heavy grazing damage, channel alterations, and timber harvest reduce functional riparian areas vegetation mostly composed of young plants Bedrock canyon provides no riparian area

Ecological Attribute	Level of Proof	Data Sources and Comments
Salmon Carcasses	1)10% 2) 3) 72% 4)18% 5)	Assessment of Adult Steelhead Migration through the Mid-Columbia River using Radio-Telemetry Techniques, 1999-2000 Karl K. English, Cezary Sliwinski, Bryan Nass, and John R. Stevenson. Used dist. From SSHIAP work group 2003.
Temperature Maximum	1)4% 2)92% 3) 4% 4) 5)	extrapolated from WDOE Okan. @ Brewster gauge WDOE Okan. @ Brewster gauge WDOE Okan. @ Malott gauge OCD 2003, 1 sample/ mo 2000-2003 OCD 2003, only one measurement in July and no flow Aug-Oct.; used chilowist values. OCD WQ survey 2000-2003 no data for this stream; took the average of all other small tribs with OCD temperature data WDOE Okan. @ Oroville gauge OCD 2003; no flow after June so used Bonaparte as surrogate No data so used Antoine as surrogate WDFW temp logger at the Similkameen pond intake
Temperature Minimum	1)4% 2)92% 3) 4% 4) 5)	extrapolated from WDOE Okan. @ Brewster gauge WDOE Okan. @ Brewster gauge WDOE Okan. @ Malott gauge OCD 2003, 1 sample/ mo 2000-2003 OCD 2003, only one measurement in July and no flow Aug-Oct.; used chilowist values. OCD WQ survey 2000-2003 no data for this stream; took the average of all other small tribs with OCD temperature data WDOE Okan. @ Oroville gauge OCD 2003; no flow after June so used Bonaparte as surrogate No data so used Antoine as surrogate WDFW temp logger at the Similkameen pond intake
Temperature Spatial Variation	1) 2) 3) 100% 4) 5)	Due to low average summer temps groundwater and springs must be major contributors in this hot dry area. Bonaparte had higher avg. temps than other small tribs, so presumeably less groundwater input.
Turbidity	1)1% 2)91% 3) 7% 4)1% 5)	Extrapolated from Okan @ Malott WDOE gauge, used 2 month duration OCD 2003 No OCD data so we used the average of all the small tribs Averaged Sililkameen and Okanogan together, but weighted it towards Similk because of more flow during runoff Extrapolated from Similkameen @ Oroville WDOE gauge, used 2 month duration

Ecological Attribute	Level of Proof	Data Sources and Comments
		Extrapolated from Okan. @ Oroville gauge Okan. @ Oroville gauge
Withdrawals	1) 2) 3) 4)100% 5)	Rated qualitatively due to no comprehensive survey of all water withdrawals.
Woody Debris	1) 2) 3) 4)100% 5)	Remote sensing data. Terrain Nav. Satellite and HWG 2003 Current loadings are rear and recruitment is minimal due to lack of riparian area. Current loadings are mostly from willow and alder large wood likely will increase due to recent fires . Current loadings are mostly from willow and alder.

Rationale for Rating Environmental Attributes in the Canadian Portion of the Okanagan River Basin

Background

As outlined in the Okanogan/Similkameen Subbasin Summary (Talayco, 2001), subbasin planning will assist in the allocation of funding for fisheries work throughout the Columbia Basin.

The Okanagan is the largest single subwatershed in the entire Columbia Basin. Since most of it is situated within Canada, a cooperative trans-boundary approach is required. Canadian Fisheries Authorities, working cooperatively through the Canadian Okanagan Basin Technical Working Group (COBTWG), have agreed that the Okanagan Nation Alliance Fisheries Department should provide Canadian content for the Okanogan Subbasin Plan. However, COBTWG approval of the specific ratings would be valuable before the ratings are finally adopted into the plan.

It is valuable to be aware that COBTWG has begun work on a separate “made in Canada” planning exercise known as Watershed-based Fish Sustainability Planning. Methodology is outlined in Anon. (2001). Stage 1 of the 4 stage process is being implemented in 2004.

Limitations

Subbasin Planning is a US initiative and only a token limit of funding has been allocated to the Canadian Section of the Okanogan. As a result, planning has had to be minimized wherever possible. Instead of covering the entire Okanagan/Similkameen Watershed up to the height of land, we include only those areas that anadromous salmonids can presently access (border to McIntyre Dam) or may soon be able to access if re-introduction plans are implemented (McIntyre Dam to Okanagan Lake).

To further reduce the quantity of work we have included only the most significant tributaries in terms of anadromous fisheries potential (Inkaneep Creek, Vaseux alias McIntyre Creek, and Shingle Creek. We do not include minor tributaries such as Hester, Testalinden, and Wolfcub. Neither do we include Park Rill, McLean, Shuttleworth or Ellis since these are unlikely to be important to anadromous fish in the short term. Proposals which consider non-anadromous salmonids should consider including at least Park Rill, and McLean Creeks.

We cover only the lower portions of each of the tributaries. In the case of Inkaneep up to an impassable falls, for Vaseux up to the canyon and for Shingle up to the fishway.

The southern portion of Okanagan Lake (from Okanagan Lake Dam to Trout Creek) has been included to provide a comparison with the other lakes that are being considered.

When resources become available for a future iteration of this planning exercise a wider geographic range should be considered.

Focal Species

The focal species for the US Sub-basin Plan will be andromous fish which are of concern to managers in the US and that spend part of their life history in Canadian waters. These will include sockeye, Chinook and coho salmon.

COBTWG has determined that the focal species for the Canadian Watershed-based Fish Sustainability Planning exercise will include sockeye and kokanee.

Scoring

Ecosystem Diagnosis and Treatment (EDT) has been chosen as the method for describing fisheries habitats within each of the Subbasins. EDT divides the watersheds into reaches and rates 48 channel and habitat attributes within each reach. General guidelines on how to apply ratings have been provided by Mobrand Biometrics Inc. (2003), but the explanation for the choice of specific ratings with the Canadian portion of the subbasin is the purpose of this report.

Authors

This process was directed by Howie Wright, Fisheries Biologist with Okanagan Nation Fisheries Department with help from Keith Wolf of KWA Consultants. Rating was carried out by C. Bull of Glenfir Resources, a fisheries biologist who has worked on the Okanagan River since 1974 and has written several scientific reports on the river (Bull 1999a, 1999b, 2000, 2002, 2003). Brent Phillips, a biologist with Summit Environmental Consultants Ltd., rated attributes pertaining to substrates in the Okanagan River. Brent has several years of experience working directly with salmon redds, bed scour and sediments in the Okanagan River.Jim Bryan, rated attributes relating to water quality and water withdrawal in Okanagan River. Dr. Bryan was head of the Water Quality Section of Ministry of Environment, Lands and Parks for many years. Kari Long, Habitat Biologist with Okanagan Nation Fisheries Department, rated habitat attributes for both the Okanagan River and tributaries.

Confidence Ratings

Confidence ratings reflect the certainty of the data. The following rating scales were used:

Empirical observation – 1

Expansion of empirical observation - 2

Derived information – 3

Expert opinion – 4

Hypothetical – 5

The financial resources available to complete the Subbasin planning exercise in the Canadian portion of the Okanagan Basin were very limited. The time to research background information was limited and expert opinion had to be used in many instances.

Ratings

Attribute #1 - Alkalinity

Alkalinity can be used as a measure of the primary and secondary productivity of a stream. Hence it is a general indicator of the streams capacity to produce fish food organisms and ultimately fish. Dr. J. Bryan rated Okanagan River and the lakes. H. Wright and C. Bull rated the tributary streams. J. Bryan and C. Bull rated the lakes.

<u>Rating Okanagan River Reaches</u>

EDT Rating Guidelines state that when an average alkalinity value is 100-300, that reach falls into Index 4. Consequently a Current Index rating of 4 was assigned in all reaches of the Okanagan River because the average alkalinity exceeded 100 mg/L at all of the sites for which data sets were available.

Reaches which included one of the sites with published data were given a Confidence Rating of 1 whereas those without data were given a Confidence Rating of 2 by extension The data for OKR4 are from Whipperman and Webber (1996) and data for all other sites can be found in Haughton, Giles, and Feddes (1974).

The historical rating was also assumed to be fairly high since this system lies east of the Cascades in a dry, lake-headed, low elevation area that was probably productive even in historical times.

<u>Rating the Tributary Stream Reaches</u>

No empirical data is available for the tributary streams. However, because they are not lake headed and are fed by flows from higher elevations it is assumed that they would be slightly less productive than the mainstem rivers. Therefore they were rated 3.

Rating the Lakes

Alkalinity ratings for the lakes averaged 109 mg/l (SE = 0.37) (Bryan, 1990) and so these reaches fell into category 4.

The effects of cultural eutrophication were becoming evident in Skaha Lake in the 1970s when occasional algae blooms occurred. Since then, however, nutrient levels in the lakes have been reduced as a result of tertiary sewage treatment plants installations in all the major centres.

Provincial fishery managers have recently expressed concern that fish production may have been adversely affected by altering the nitrogen to phosphorus ratios.

Attribute #2 - Bed Scour

Bed scour is a measure of the depth at which substrate materials are moved during high flows. It is an important factor in the survival of fish eggs, incubating fry, juvenile fish (which at times hide in the interstitial spaces), and aquatic insects. Scour increases when land use practices such as clear-cutting increase freshet flows.

Brent Phillips rated the Okanagan River. C. Bull and H. Wright estimated values for the tributary streams. This attribute does not apply to lakes.

Rating Okanagan River

In general, bed scour in the Okanagan River is relatively low. Firstly, peak flows in the river are dampened by the presence of large lakes upstream. Secondly, in addition to natural flow dampening by the lakes, water storage typically reduces peak river flows and increases flows at other times of year (Summit, 2002a). Under current water management practices there is little bed scour during the period when sockeye and kokanee eggs and alevins are in the gravel. Finally scour occurs in the redd mound at lower water velocity than in the bed proper. Summit Environmental determined the depth of egg deposition to figue out egg losses at various scour levels. Their findings show that scour begins in the Okanagan River when discharges reach 25 cubic meters per second and gets really critical when velocities hit 40 cms. The ratings used in this section are based on expert opinion derived from hydrologic and bed scour analyses completed in recent years.

Rating the Tributary Streams

No empirical information is available for the tributary streams. The rating was expert opinion based upon the stream gradients and substrates. All the tributaries are steeper than the mainstem and the presence of cobbles indicates a higher degree of scour than the mainstem. Hence the rating was increased in comparison to Okanagan River. Vaseux Creek has much larger cobbles than Inkaneep and Shingle Creeks, hence it was rated higher than them.

Rating the Lakes

The bed scour attribute does not apply to lakes.

Attribute #3 - Benthos Diversity and Production (Benthic Community Richness)

Benthic insects are both a critical component of the food web and a readily measurable indicator of system health. Inventories are underway in the Okanagan Basin but results are preliminary and most of the work has so far been limited to tributaries of Okanagan and Kalamalka Lake (personal communication, Vic Jensen, BC Ministry of Water Land and Air Protection).

River ratings were carried out by J. Bryan. C. Bull rated the tributaries. Since this metric was meant to be applied to flowing systems it was not applicable to lake reaches.

<u>Rating Okanagan River</u>

The only known data set for benthic invertebrates in the Okanagan River was obtained by Truscott and Kelso (1979). Invertebrates were collected in two reaches of the river and showed a wide variety of taxa and substantial numbers of individuals despite a discharge of domestic wastewater with tertiary treatment between the two sites. Using this data and the simple EDT Index, Index 2 seems the most appropriate rating. Although Ephemeroptera, Tricoptera, and Plecopetera were found, the taxa were fewer than might have been expected, so these reaches fall into the category of Index 2. These reaches were assigned Confidence Level 1 and the reach upstream (OKR28) Confidence Level 2. For most other reaches, the confidence levels are lower because of the spatial variability typical of benthos. The reaches which have not been channelized (OKR 16 & 17) were assigned Index 1 since more natural reaches generally have more diverse benthic communities, and the slow-flowing reaches were assigned Index 3 as such reaches generally have less diversity and production.

The historical ratings were also indicative of a rich benthic community because the area was low elevation and lake-headed so water temperatures and flows were moderated.

<u>Rating the Tributary Streams</u>

No information is available for the tributary streams. However they are neither unusually productive, nor unproductive and there are no effluent discharges. Consequently invertebrate production would likely be indicative of a normal stream. An index rating of 1 has been assigned and it is consistent with the unchannellized portions of the mainstem.

<u>Rating the Lakes</u>

This attribute was not meant to be applied to lake reaches.

Attribute #4 - Channel Length

Channel length is a measure of the quantity of habitat available. All values are given in meters to fit with standard scientific practice rather than feet or miles as is sometimes found in US documents.

Rating Okanagan River

Current channel lengths for Okanagan River were taken from post-channelization river surveys by Schubert (1980) and are shown in Table 60. Although this information is nearly 25 years old it remains accurate because the vast majority of the river is confined between armoured dikes and has not changed length. The few reaches which remain unconfined are fairly short and some were naturally confined so once again the Schubert surveys will still be fairly accurate.

Table 60 Current Reach lengths (measurements from Schubert, 1980)

Reach	Start Point	End Point	Distance (m)
Ok R 1	390 m upstream from Osoyoos Lake	1795	1405
OK R 2	1795	4605	2810
OK R 3	4605	5932	1327
OK R 4	5932	6418	486
OK R 5	6418	7197	779
OK R 6	7197	9419	2222
OK R 7	9419	9803	384
OK R 8	9803	10858	1055
OK R 9	10858	11952	1094
OK R 10	11952	12747	795
OK R 11	12747	13815	1068
OK R 12	13815	14928	1113
OK R 13	14928	16248	1320
OK R 14	16248	17347	1099
OK R 15	17347	18251	904
OK R 16	18251	20548	2297
OK R 17	20548	22588	2040
OK R 18	22588	24196	1608
OK R 19	24196	26038	1842
Vaseux Lk	26038	30692	4654
OK R 20	30692	33435	2743
OK R 21	33435	34402	967
OK R 22	34402	34934	532
OK R 23	34934	35286	352
OK R 24	35286	35922	636

Reach	Start Point	End Point	Distance (m)
OK R 25	250 upstream from Skaha Lake	2956	2706
OK R 26	2956	3300	344
OK R 27	3300	5623	2323
OK R 28	5623	6287	664

Historic river lengths were obtained by preparing a collage of aerial photos from before the river was channelled (the river was channelled between 1952 and 1955 and the photos were taken in 1938). Reaches were marked on the collage and a meilograph (map wheel) was used to follow the old channels and record lengths. Aerial photograph numbers are shown in **Table 4**.

Table 61 Numbering system for pre-channellization (1938) aerial photographs of Okanagan River

General Area of River	River Reach Numbers	Photograph Numbers
Okanagan Lake to Skaha Lake	OK R 25-28	BC 105.2
		BC 104.65
		BC 104.16
Okanagan Falls to Vaseaux Lake	Ok R 20 -24	BC 101.85
		BC 101.32
		BC 101.11
Vaseaux Lake to OKR 4	OK R 4 - 19	BC 101.20
		BC 99.14
		BC 99.86
		BC 98.13
		BC 97.40
		BC 99.46

<u>Rating the Tributary Streams</u>

The length of the tributary stream reaches was taken from Long, 2000 for Inkaneep Creek. For the other tributaries the approximate distance was taken from aerial photographs using a meilograph (map wheel). All lengths are approximate.

<u>Rating the Lakes</u>

The length of Vaseaux Lake was taken from engineering diagrams (Shubert, 1980). Other lake reaches corresponded to lake basins and their approximate lengths were measured from bathymetric maps provided in Okanagan Basin Agreement, Tech. Supp. V, 1974. For the purposes of this study the southern limit of the south basin of Osoyoos Lake was assumed to coincide with the Canada/US border. The Okanagan Reach covered the distance from the Lake outlet at Penticton to Trout Creek Point.

Attributes #5 - Channel Width Max

Rating Okanagan River

This attribute is meant to provide an estimate of relative size of the river. Survey information by Schubert (1980) provides maps of channel cross sections in late June 1980. These should suffice to provide a close enough estimation of maximum width for the purposes of this exercise (i.e. to place the river into a size category). Since these are actual measurements but span only a limited time-frame the confidence rating is reduced to 2 for the current ratings.

Historic measurements are not available but it is probable that maximum sizes were somewhat greater than current because freshets would be higher prior to storage and because the flood plain was not confined. The increase in maximum size would likely have put the river into a 3 rating but it would not have likely reached a 4. Since there is no empirical evidence a level of confidence of 4 is assigned for the historic ratings.

Rating the Tributary Streams

Time and financial resources precluded actual surveys of the widths of the tributary streams. The values given are guesses based upon memory of the appearance of the stream or quick inspections and in the case of Inkaneep from photographs provided in Long, 2000. This will probably suffice to put the streams into the correct rating categories but the assigned values should be reconsidered as soon as the opportunity to do measurements arises.

Due to percolation and water use, reach 1 of Vaseux Creek goes dry nearly every summer. This probably did not happen historically since there was no water use, no logging in the head waters and less percolation (the current percolation problems are said to have originated due to disturbance of the river bed for flood control [Barisoff – long time resident – personal communication]).

Rating the Lakes

This attribute does not apply to lakes because it is a river rating rather than an actual measure of width.

Attributes #6 – Channel Width Minimum

Rating Okanagan River

Throughout most of the river current maximum and minimum widths are identical because channelling keeps the river bounded by armoured banks. Within the U shaped channel water velocities and depths change but widths do not.

Historical estimates are not available but it is likely that low flows were often significantly lower than current because of the lack of storage and planned releases.

However, it is unlikely that the river got down to a minimum channel width of less than 15 ft (i.e. index value 1), therefore a historic value of 2 is derived by conjecture.

Rating the Tributary Streams

Time and financial resources precluded actual measurements of the widths of the tributary streams. The values given are guesses based upon memory of the appearance of the stream or quick field inspections and in the case of Inkaneep Creek on photographs from Long, 2000. This will probably suffice to put the streams into the correct rating categories but the assigned values should be reconsidered as soon as the opportunity to do measurements arises.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #7 - Confinement – Hydromodifications (Confinement – man caused)

Rating Okanagan River

Every reach of the Okanagan River has been modified by man to some extent and nearly every reach has been completely channelled. Exceptions are portions of Reach 17 (over 50% pristine) and portions of Reaches 18 and 24 which are naturally confined. The only completely untouched portion is 1128 meters of river located within Reach 17 and situated completely on Osoyoos Indian Reservation (river distance 21,159 – 22287 m from Osoyoos Lake).

Below this pristine portion is a 2,908 meter semi-natural strip with setback and meandering dikes. It is located within Reaches 16 and 17 between river distances 18,251 and 21,159 m.

Information for rating this attribute was taken from pre and post channelling aerial photographs and maps and post channelling engineering surveys (Schubert, 1980).

Rating the Tributary Streams

All the tributaries have been modified to some degree for flood control (Vaseux Creek and Inkaneep Creek) or road construction (Shingle Creek). Estimates are based upon memory.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #8 - Confinement Natural

Rating Okanagan River

Historic photographs from 1938 (prior to channelization) show the system in its nearly natural state. The valley floor is (and was) fairly flat with sands and silts allowing the river to meander tortuously throughout most of its length. However, there was some natural channel confinement in reaches 17-19 and 24 as shown by single thread straight channels.

Rating the Tributary Streams

Inkaneep Creek rating was based upon memory and pictures in Long, 2000. Vaseux Creek was rated from memory. Shingle Creek was based upon field observation.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #9 - Dissolved Oxygen

Rating Okanagan River

Jim Bryan rated the river reaches. He used unpublished BC Environment data collected between June and September 1972 and 1983. YSI dissolved oxygen meters were used to obtain 55 values from 8 sites. DO saturation levels were determined with the nomogram of Rawson (1944).

The average DO value was 9.07 and DO levels were near saturation; even at sites downstream from treated wastewater. There were a few DO measurements less than 8, but the median value was 9 and the average 9.07, therefore for all reaches of the river, Index Level 0 is the appropriate value. As the DO data set is unpublished but considered reasonably reliable, the Confidence Level 4 seems appropriate.

Historically, river oxygen levels were probably at or near saturation since the flows originated in steep valley draws or in the surface waters of large windy lakes.

Rating the tributaries reaches

No empirical data was available for the tributaries, but the systems are well known to the raters and they knew of no oxygen deficit problems nor any substance which would contribute to a biochemical oxygen demand. For this reason there was not assumed to be a problem with oxygen readings in the tributaries at this time.

Rating the lake reaches

H. Wright and C. Bull rated the lake reaches. The area of the lake that was rated was the preferred habitat range for salmonids where oxygen levels were at least 4mg/L and water temperatures were less than 17 degrees C. This area was based on work by Fisheries and Oceans Canada and 2001-2003 sampling by ONAFD (Wright 2002; Wright & Lawrence 2003) (ONAFD unpublished data from 2003).

The south and central basins of Osoyoos lake were rated index 4 based on 2001 data (Wright 2002). In these basins the preferred zone for salmonids disappears completely during some months of the year. The ratings show that there is still a small zone of preferred habitat remains throughout the summer months in the north Basin of Osoyoos Lake (warranting a rating of 3) and a much bigger area is available in Skaha Lake. Okanagan is even less of a concern because of its large volume, and deep morphometry and frequent wind circulation. Research into the frequency and extent of the temperature/oxygen "squeeze" is presently being pursued as part of the Fish Water Management Tool Project (explained elsewhere in this text). Fish Water Management Tools is working out the river discharge required to provide sufficient turnover within the lake to avoid density dependent mortalities of salmonids.

Okanagan lake has been found to have oxygen levels at or near saturation except for certain eutrophic sites within Armstrong Arm at the north end of the lake (Okanagan Basin Agreement, Tech. Supp V, 1974 and Andrusak et. al., 2001).

Attribute #10 - Embededness

Rating Okanagan River

Embededness measures the extent to which cobbles or gravel are surrounded or covered by fine sediments. This has a direct bearing on the survival of fish and fish food organisms.

Mobrand Biometrics (2003) points out that embededness is only a meaningful measurement where the substrates are cobble and gravel. They recommend that embededness ratings of 0 be assigned where embeddedness is not a suitable measure of channel characteristics. Reaches 1-16; 19-23; and 25 are all low gradient and so the 0 rating could be applied. However every reach has some gravel substrate that adds to the fisheries production potential of the river. Consequently each reach was rated based upon the gravel areas within it regardless of the fact that many of the reaches are low gradient and heavily weighted toward sand and silt substrates.

Ratings reaches were scored by Brent Phillips, a biologist with Summit Environmental Consultants Ltd.. Brent referred to scientific studies listed on the tables and also relied upon his experience of working on Okanagan River substrates for four years. During that time, Brent collected sediment composition samples and excavated sockeye salmon redds. Results are found in ONAFD and Summit (2003b) and Wright (2003).

The scoring of current embeddedness is based on a combination of substrate objective and subjective observations during four yeas of sockeye habitat assessments (two reports cited), sediment composition measurements (Wolman samples) taken for Summit 2002b, and recent sockeye redd excavation work in the dyked and natural sections of river downstream of McIntyre Dam (ONAFD and Summit, 2003). Historical embeddedness is based on substrate notes in Anonymous (1909) for the river through Penticton and channel and substrate descriptions/samples in Hourston et al. (1954) for the river downstream of Vaseux Lake.

Historical information was gleaned from Anon (1909) and Hourston et. al., 1954.

Rating the Tributary Streams

Inkaneep Creek was assigned a value of 2 based upon the fact that mass wasting has been a significant problem in this watershed (Long, 200: Alex & Long, 2002: Davies, 1999). Vaseux Creek was rated 0 because although it is the main source of gravel recruitment for the Okanagan River fine sediments are thought to flush through this high gradient system.

Shingle Creek was rated 1. There are unstable banks throughout the fields which have been cleared of riparian vegetation in the areas upstream from Reach 1. However, Reach 1 is fairly high gradient so much of the fines pass through to the Okanagan River channel.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #11 - Fine Sediment

Rating Okanagan River

Fine sediment (less than 0.85 mm) can smother the eggs and alevins of salmonids as well as benthic invertebrates. Levels in untouched salmonid spawning areas generally range between 6% and 11% (Mobrand Biometrics Inc., 2003). Levels quite often increase due to land disturbances such as agriculture, forestry, mining and urban development. Low slope areas of river (therefore most of the Okanagan River) are particularly sensitive to sediment loading.

To rate this attribute, historic information was gleaned from detailed surveys of the Okanagan river between Okanagan and Skaha Lakes (Anon., 1909). For these Reaches (25 – 28) substrate descriptions and sketches were available with notations of clay, mud, sand , fine gravel medium gravel, gravel, coarse gravel and small boulders. For Reaches 1 -18 information was taken from Hourston et al.(1954) that described habitat conditions existing prior to river channelization.

Information for rating current conditions came from ONAFD and Summit (2003) and Wright (2003). These studies provided sediment core analyses from sockeye redds downstream from McIntyre Dam (Reaches 1 – 24).

Rating the Tributary Streams

Inkaneep Creek was assigned a value of 2 based upon the fact that mass wasting has been a significant problem in this watershed (Long, 200: Alex & Long, 2002: Davies, 1999). Vaseux Creek was rated 0 because although it is the main source of gravel recruitment for the Okanagan River fine sediments are thought to flush through this high gradient system.

Shingle Creek was rated 1. There are unstable banks throughout the fields which have been cleared of riparian vegetation in the areas upstream from Reach 1. However, Reach 1 is fairly high gradient so much of the fines pass through to the Okanagan River channel.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #12 - Fish Community Richness

The fish community richness rating is based upon the number of taxa (species) found in the Okanagan Basin (i.e. the river and the lakes).

A number of intensive inventory projects have been carried out and results are easily located in FISS (Fisheries Information Summary System) found online at www.bcfisheries.gov.bc.ca/fishinv/fiss.html . Table 62 shows that thirty (30) species are found currently in the Okanagan but only 19 are indigenous.

Rating Okanagan River

Several of these species do not frequent the river so that ratings have been lowered to 2. Note that below McIntyre 3 anadromous species are found (sockeye, Chinook and steelhead) whereas they have been extirpated from the waters above McIntyre. Additional species such as coho and chum salmon are also reported to have been extirpated from the system (Howie Wright, fisheries scientist, Okanagan Nation Alliance Fisheries Dept., personal communication).

Native salmonids are considered a focal group for reasons set out in Bull (2002 b). However another species that has been found in the Okanagan River which is important because is rare is the Chiselmouth (*Acrocheilus alutaceus*). According to Cannings & Ptolemy (1998) this species is being tracked by the BC Conservation Data Centre and is considered vulnerable or sensitive because of its restricted distribution and occurrence.

Rating the Tributary Streams

The tributary streams tend to be higher gradient, lower temperature, and lower productivity than the mainstem. Therefore warmwater species are rare or absent. FISS reports that Shingle Creek supports sculpin, long nose sucker, brook trout, kokanee, rainbow trout, longnose dace, and peamouth chub. Vaseux Creek has been found to contain sculpin rainbow trout, longnose dace, and mountain whitefish. Inkaneep Creek supports sockeye salmon, bridgelip sucker, rainbow trout and kokanee.

Rating the Lakes

A lot of inventory is available for the lakes. Thirty species are present in the lower part of the system and 25 in the upper (Table 51). Anadromous salmonids have disappeared from Okanagan, Skaha and Vaseux Lakes but 11 species of exotics have entered.

Table 62 Species of fish found in the Okanagan Basin (Alexis, Alex and Lawrence, 2003 and Pinsent, Koshinsky, Willcocks and O'Riordan, 1974). Non-indigenous species are listed in italics.

Genus & Species	Common Name	Historic Presence	Current Presence
Lota lota	Burbot	Present	Present[1 2 3]
Mylocheilus caurinus	Chub - Peamouth	Present	Present[1 2 3]
Acrocheilus alutaceus	Chiselmouth	Present	Present[1 2 3]
Oncorhynchus nerka	Salmon - Sockeye	Present	Present[1 2]
O. nerka	Salmon - Kokanee	Present	Present[1 2]
O. tschawytscha	Salmon - Chinook	Present	Occasional[1 2]
O. mykiss	Steelhead	Present	Occasional [2]
O. mykiss	Rainbow (fluvival)	Present	Present[1 2]
O. mykiss	Rainbow (adfluvial)	Present	Present[1 2]

Genus & Species	Common Name	Historic Presence	Current Presence
Entosphenus tridentatus	Pacific Lamprey	Present	Extirpated
Catostomus macrocheilus	Largescale sucker	Present	Present [2]
Catostomus catostomus	Longnose sucker	Present	Present [2]
Pytlocheilus oregonensis	Northern pikeminnow	Present	Present[1 2]
Prosopium coulteri	Whitefish - Pygmy	Present	Present [2 3]
Prosopium williamsoni	Whitefish - Mountain	Present	Present [2]
Richardsonius baleatus	Shiner - Redside	Present	Present[1 2]
Rhinichthys cataractae	Dace - Longnose	Present	Present[1 2]
Rhinichthys falcatus	Dace - Leopard	Present	Present [2]
Cottus asper	Sculpin Prickly	Present	Present[1 2]
Cottus cognatus	Sculpin Slimy	Present	Present[1 2]
Micropterus dolomieui	*Bass - Smallmouth*	*Absent*	*Present*[1 2]
Micropterus salmoides	*Bass - Largemouth*	*Absent*	*Present*[1 2]
Ictalurus melas	*Bullhead Black*	*Absent*	*Present*[1 2]
Lepomis microchirus	*Bluegill sunfish*	*Absent*	*Present*[1 3]
Cyprinus carpio	*Carp*	*Absent*	*Present*[1 2]
Pomoxis nigromaculatus	*Crappie - Black*	*Absent*	*Present*[1 2]
Salvelinus fontinalis	*Eastern brook trout*	*Absent*	*Present*[1]
Lepomis gibbosus	*Pumpkinseed*	*Absent*	*Present*[1 2]
Tinca tinca	*Tench*	*Absent*	*Present*[1 3]
Perca fluviatilis	*Yellow perch*	*Absent*	*Present*[1 2]
Coregonus clupeaformis	*Whitefish - Lake*	*Absent*	*Present* [2 3]

[1] Source = Alexis et. al., 2003

[2] Source = Pinsent et. al., 1974.

[3] Found in Basin but seldom found in river

Attribute #13 - Fish Pathogens

Rating Okanagan River

A comprehensive study of pathogens in Okanagan River fish was carried out in 2000, 2001 and 2003. The work was done in response to a proposal to extend the present range of sockeye salmon (Evelyn and Lawrence, 2003).

Over 700 fish were tested including 3 species of salmonids and 11 species of non-salmonids. The key findings were:

- IHNV (infectious haematopoietic necrosis virus) Type 1 and Erythrocytic Inclusion Body Syndrome (EIBSV) were found routinely throughout the system
- IHNV Type 2, IPNV (infectious pancreatic necrosis virus) and *Myxobolus cerebralis* (whirling disease) were not found
- *Ceratomyxa shasta* (ceratomyxosis) was found infrequently throughout the system.
- *Parvicapsula minibicornis* was found in the lower part of the system.

The authors conclude that pathogens do not constitute an unusual risk to fish populations in the system. The possible exception is the recently discovered parasite *Parvicapsula minibicornis* which requires further research.

This information would indicate a rating of 2, however, the rating guidelines indicate a value of 4 should be assigned if C. Shasta is known to occur in the watershed. Hence all waterways have been assigned a value of 4. With no indication of what the base case (historic case) may have been the value of 4 is repeated.

<u>Rating the Tributary Streams</u>

There is no information on the tributary streams. Since we are dealing only with the lowest reach (ie accessible to anadromous salmonids) the default value is 4.

<u>Rating the Lakes</u>

Die-offs of kokanee occur in Okanagan Lake every few years. These always occur in June or July and affect only 2 year old kokanee. The cause has not been determined. Similar die-offs have occurred in other large B C lakes (eg Shuswap, Quesnel, Kootenay) but have not been reported in Skaha or Osoyoos.

Given the information available we have chosen to rate the lakes 1 since viruses are known to occur but no disease related incidents have been noted.

A large provincial fish hatchery is located at Summerland on Okanagan Lake and a small one is located adjacent to the south basin of Skaha Lake.

Attribute #14 - Exotic Fish Species

<u>Rating Okanagan River</u>

As with fish pathogens, a comprehensive study of exotic fish in the Okanagan Basin was carried out in 2000, 2001 and 2003 in response to a proposal to extend the present range of sockeye salmon (Alexis, Alex and Lawrence, 2003).

The exhaustive study captured fish throughout the basin using electro-fishing gear, gill nets, minnow traps, beach seines, trap nets, angling and the by-catch from a weed harvester. Twenty two (22) fish species were captured. These are included in Table 3.

Table 51 shows that eleven (11) species of fish in the Basin are exotics. While most of these are lake dwellers some (e.g. carp, brook trout and smallmouth bass) have become some of the most frequently observed river species.

Rating the Tributary Streams

The tributary streams are colder, more flashy, higher gradient and less productive than the mainstem and the lakes. Consequently they support fewer species. However some exotics such as brook trout use the tributaries at certain life history stages. Thus we rated the tributaries as 1.

Rating the Lakes

The lakes contain the full gamut of exotic species. Since there are 11 exotic species listed in Table 51 the lakes are rated at 3.

Attribute #15 - Changes in inter-annual variability of high flows

This metric is designed to note the relative change in average peak annual discharge compared to an undisturbed watershed. It is meant to describe both short-term and long-term changes in flow size and timing due to man made changes such as urbanization, channelization, timber harvest and water storage. In the Okanagan a noticeable change in flows has resulted from construction and operation of dams on both the headwater lakes and on Okanagan Lake. Further changes have resulted from logging.

Rating Okanagan River

Okanagan Dam retains the vast majority of flow passing through the Okanagan River and Skaha, Vaseux and Osoyoos Lakes. Summit Environmental Consultants Ltd. (2002d) used a model to reconstruct the natural hydrograph of the river and compare it with the hydrograph that has resulted since the construction of storage. The model shows that high flows are less than would have occurred historically in the months of June to September. These results are statistically significant ($\alpha = 0.01$) and show that the June peak is reduced about 35% by regulation. As a consequence this attribute was assigned a rating of zero. All reaches are given the same rating because the vast majority of the flow originates in Okanagan Lake and passes through all of the river reaches.

Rating the Tributary Streams

Generally Okanagan tributary streams nearly all support storage reservoirs which fill in the spring lowering the freshet. However, Okanagan watersheds are also generally heavily logged which causes higher and earlier freshets. The two factors tend to offset one another and therefore the change in peak flows over historical is buffered.

As a consequence the tributary streams have been rated 2 – typical of relatively undisturbed watershed.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #16 – Changes in inter-annual variability of low flows

Rating Okanagan River

Changes in low flow due to land use such as timber harvest and urbanization are very evident in most of the tributary streams to Okanagan Lake. However, storage on Okanagan Lake stabilizes river flows and is thought to mask the low flow problem which would have occurred had storage not been developed. As a consequence the model developed by Summit (see text under attribute 15) shows that there is no statistical difference in the low flows that have been happening since regulation versus what would have been expected if the river ran naturally. This is only the case for the low flow months of September and October. There are statistical differences in regulated versus natural flows in all other months of the year.

The lack of perceptible differences in low flows resulted in a rating of 2. As mentioned earlier, all reaches are given the same rating because the vast majority of the flow originates in Okanagan Lake and passes through all of the river reaches.

Rating the Tributary Streams

As mentioned earlier, changes in low flow due to land use such as timber harvest and urbanization are very evident in most of the tributary streams. Since water is such a sought after commodity low flows in the late summer and fall months are a major problem. Vaseux Creek runs dry every year. Inkaneep and Shingle Creeks do not but they still suffer from low flow problems. As a consequence Inkaneep and Shingle are assigned a rating of 3 while Vaseux gets a 4.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #17 - Flow - Intra-daily (diel) variation

This attribute describes the daily changes in flow that occur throughout a season. . It reflects such things as ramping for hydro-electric generation or spiky flows resulting from urbanization. Pristine basins are rated 0 indicating slight daily fluctuations over the month when the greatest variation would be noticed.

Rating Okanagan River

Some ramping up or down of flows from Okanagan Lake must be conducted to meet flow regulation guidelines but attempt to avoid rapid diel changes (Brian Symonds, Water Manager – personal communication). Since there is some departure from the pristine situation but it is done carefully the rating for this attribute was chosen as 1.

Rating the Tributary Streams

Although there is some storage on the three tributary streams it is not generally thought to be a major cause of intra-daily change. A value of 2 was assigned but it is purely speculative.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #18 Flow Flashy - Changes in intra-annual flow pattern

This attribute describes the variations which occur in the primary runoff season (i.e. the "flashiness" of the system). It is meant to identify changes caused by such factors as storm runoff or flow regulation which might result in desiccation of fry on the low flow end or bed scouring on the high flow end.

Rating Okanagan River

The pristine rate is 2. Regulation and storage results in flows that are less flashy than would have been experienced historically and so the assigned rating is 1.

Rating the Tributary Streams

It seems obvious that with all the changes that have taken place on the tributary streams flow patterns are no longer identical to the historic patterns. Logging and other forms of land clearing will have made flows more flashy in the spring and it is unlikely that the small storage impoundments on these systems would offset that substantially. In the summer and fall it is likely that high water consumption would also increase the variability by quickly lowering the available volume of water from time to time.

Although some "flashiness" may result from land use, the dominant factor seems to be meteorological events (Geostream Consulting, 2001 and Hawthorn and Karanka, 1982 [in Geostream Consulting, 2001]).

Given all the factors mentioned, a value of 3 has been assigned.

Rating the Lakes

This attribute does not apply to lakes.

Additional Note in regard to Okanagan River Flows

Fisheries authorities have recognized the critical importance of flows in the production of salmonids in the Okanagan River. Thus a multi-disciplinary team has recently constructed a state-of-the-art computer model that uses real-time data to assist with water balance decisions. The tool, known as the Fish Water Management Tool, has been developed by ESSA Technologies for Canada Fisheries and Oceans, B. C. Ministry of Water, Land and Air Protection, Okanagan Nation Alliance and Public Utility District No. 1 of Douglas County, Washington.

Attribute #19 – Gradient

Rating Okanagan River

A survey of the Okanagan River with cross sections and profile was completed in 1980 (Schubert, 1980). Some changes will have taken place since that time but the system is fairly stable because it is confined by dykes, and the gradient is controlled by 17 drop structures. Flows are regulated by dams and the stability prevents excessive scouring and material transport. Tributary streams are few and extremely small.

The few steeper sections of Okanagan River have not been channelled and ratings for these reaches will not have changed substantially as compared with the historic situation. In the channelled sections which make up most of the river, however, gradients were, and still are, low and so all reaches are in the zero index category.

Historically the elevation change which now occurs at the 17 Vertical Drop Structures would have been spread out through the river. This would provide a greater rating if the river was the same length. However, aerial photographs show that the river was much longer before it was channelled (see channel length). The extra length that the river once had would offset the greater elevation change, therefore the historic gradients were, in the opinion of the rater, similar to the present gradient.

Rating the Tributary Streams

The gradient for Inkaneep Creek was taken from Long 2000 (page 5). The approximate gradients for Vaseux and Shingle Creeks were calculated by dividing the drop (ascertained from topographical maps) by the channel lengths (see Channel Length Attribute). Calculations are given in Table 63.

Rating the Lakes

This attribute does not apply to lakes.

Table 63 Calculation of gradients for rating the tributary reaches (approximate).

Tributary	Elevation Drop (m) (from topo maps)	Reach Length (m) (from aerial photos)	Approximate Gradient (%)
Shingle Creek	3220	62	1.9
Vaseux Creek	2730	81	2.9

Attribute #20 - Habitat - back water pools

Backwater pools are alcoves connected to the main channel. They are one of the main channel slow water habitats (along with primary pools, backwater pools, pool tailouts/glides, and beaver ponds) and can provide key habitat for some species of juvenile salmonids.

Rating Okanagan River

The current ratings within the channelled reaches are easily estimated with a good deal of accuracy (there are few if any backwater pools). These are rated zero. Most of the unchannelled reaches are steeper sections and again there are few backwater pools. These have been assigned a rating of 1 (though they are probably on the low end of the 1 range). No quantification of the habitat has been carried out so the confidence level of the rating slips from 1 to 4.

In historic times the reaches which are now channelled ran slowly and meandered through many oxbow turns so the backwater pools were probably found extensively. These are conjecturally rated at 2.

Rating the Tributary Streams

Rating of the tributary reaches was based on the memories of the raters (K. Long and C. Bull) and on the knowledge that the number of pools varies inversely with the gradient.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #21 Habitat - beaver ponds

Beaver ponds are one of the main channel slow water habitats (along with primary pools, backwater pools, and pool tailouts/glides). They are considered important because of their ecological functions (e.g. nutrient retention and sediment trapping) and their importance as rearing and overwintering areas for some salmonids.

Rating Okanagan River

The current rating of the Okanagan river is easy. There are very few beaver dams and water managers actively exclude them from the engineered channel. Thus the rating is zero throughout the mainstem. Historically there were undoubtedly a number of beaver dams since the system was slow and meandering.

Rating the Tributary Streams

Rating of the tributary reaches was based on knowledge of the system by the raters (K. Long and C. Bull). The steep gradients encountered in the tributaries would no doubt discourage a lot of potential beaver activity.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #22 - Habitat – glides

Glides are one of the main channel slow water habitats (along with primary pools, backwater pools, pool tailouts, and beaver ponds) and serve as rearing areas for some life history stages of salmonids.

Rating Okanagan River

Much of the mainstem is currently glide habitat resulting from the construction of a uniform straight channel with little habitat diversity. Historically it was likely similar due to the low gradient and extensive meanders. The higher gradient sections between McIntyre Dam and Vertical Drop Structure 13 and between Skaha Lake Dam and Shuttleworth Creek are exceptions.

Rating the Tributary Streams

The tributary streams are higher gradient than the mainstem and support extensive riffle habitat Thus they are rated lower than the mainstem reaches. Inkaneep Creek has more glide habitat than the other two tributaries which is to be expected since it is lower gradient.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #23 - Habitat - large cobble/boulder riffles

This metric is a measure of one type of habitat used by salmonids at certain life history stages.

Rating Okanagan River

Since the river is channellized and low gradient throughout much of its length cobble riffles are rare. Ratings are minimal except in the higher gradient areas which have been left unchannellized.

Rating the Tributary Streams

Riffle habitat is common in the tributaries. The extent of this habitat varies directly with the gradient so that the highest concentration is found in Vaseux Creek followed by Shingle and finally Inkaneep.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #24 - Habitat - small cobble/gravel riffles

Riffles support high densities of benthic invertebrates and are significant food producing areas. They are also good rearing areas for some juvenile salmonids

Rating Okanagan River

Since the river is channellized and has a relatively low gradient throughout much of its length, riffles are rare. Ratings are minimal except in the higher gradient areas which have been left unchannellized.

Rating the Tributary Streams

Riffle habitat is common in the tributaries. The Cobble riffles are most extensive in the highest gradient tributaries such as Vaseux Creek. In lower velocities creeks such as Inkaneep small cobble and gravel riffles predominate.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #25 – Habitat - off channel habitat

Oxbows, ponds and marshes and other off channel habitats store water, nutrients and sediments; slow water during floods and provide refugia for aquatic animals. They are also important for some salmonids at certain life history stages.

Rating Okanagan River

Historic pictures of the Okanagan River show that it was one a magnificent example of habitat diversity. However, in the 1950s channellization separated the river from the flood plain cutting off nearly all of the off channel habitat. Hence ratings are high historically and very low currently.

Rating the Tributary Streams

The higher gradient, linear tributary streams appear to always have been devoid of off channel habitat.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #26 – Habitat - primary pools

Primary pools are one of the main channel slow water habitats (along with backwater pools, pool tailouts/glides, and beaver ponds).

Rating Okanagan River

The current ratings within the channelled reaches of the mainstem are easily estimated with a good deal of accuracy because there are few, if any, backwater pools. These are rated zero.

Most of the unchannelled reaches are steeper sections and again there are few primary pools. These have been assigned a rating of 1 (probably on the low end of the 1 range). No quantification of the habitat has been carried out and the ratings are purely conjectural so the confidence level of the rating is 5.

In historic times the reaches which are now channelled ran slowly and meandered through many oxbow turns so pools were probably found extensively. These are conjecturally rated at 2.

Rating the Tributary Streams

The steepest of the tributaries, Vaseux Creek, has few pools below the canyon. It has been rated 0. Shingle has more and is rated 1. Inkaneep has the most extensive pool habitat of the tributaries and is rated 2.

Rating the Lakes

This attribute does not apply to lakes.

Attribute # 27 - Habitat - pool tailouts

They are one of the main channel slow water habitats (along with primary pools, backwater pools, pool tailouts/glides, and beaver ponds)

Rating Okanagan River

See comments under pools.

Rating the Tributary Streams

See comments under pools.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #28 – Harassment

This attribute is meant to address the problem of poaching and harassment of spawning fish.

Rating Okanagan River

The access along Okanagan river is heavily developed. Dikes with good roads are present throughout most of the river, though in most reaches (see comments on the rating sheet) public access is limited to hiking and biking. Highways parallel the river in many reaches and major centers are located along the river (Penticton, Okanagan Falls and Oliver).

Boat traffic is nil in many reaches because of the 17 drop structures. However, floating on inner tubes has become a major tourist attraction with thousands of tubers using the river on hot summer days. Tubing is a major recreational industry in Penticton (Reaches 25 – 28) and it is beginning in Oliver (Reaches15-17). Waterski boats make heavy use of Reach 1 even though it is illegal. Skiers find it novel to ski on a river and wind is not a factor.

Despite the easy access and heavy recreational use of the river, harassment does not seem to be a major factor affecting salmonids. Salmon spawn in October and trout spawn from mid May to mid June. At these times low water temperatures prevent the use of the river for floating and water skiing. For this reason harassment ratings are assigned a higher number than would have been expected given the access and proximity to urban centers.

Historically (i.e. prior to European contact) harassment would have been low in most reaches. However, Okanagan Falls, the mouth of Shingle Creek and the island upstream from the mouth of Vaseaux (McIntyre) Creek are all known native fishing sites and so these reaches received a higher historic ratings for the harassment attributed.

Rating the Tributary Streams

Shingle Creek and Inakaneep Creeks are located on Indian Reserves with no access to non-natives but easy access for natives. Little information is available and the frequency or extent of harrassment. They were assigned a value of Index 2.

Vaseux Creek is near Gallagher Lake, Okanagan Falls and Oliver and has easy road access through the lower half of the reach. The upper half of the reach is on private land but is well used by trespassers and campers. It was assigned a value of 3.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #29 - Hatchery Outplants

The deleterious effects of hatchery outplants on wild fish stocks is well documented. This metric rates the degree of outplanting on the territory in question. Excellent records have been kept for all stocking throughout British Columbia and the results are easily accessible on line through the "Fish Wizard" http://srmaps.gov.bc.ca/apps/fidg/stockingQuery.do .

The Fish Wizard does not include salmon stockings that were part of the Grand Coulee mitigation scheme. Nor does it include the transfer of smallmouth bass into Skaha Lake in the mid 1980s.

Rating Okanagan River

A lot of stocking has been carried out in the Okanagan Basin but mainly in the headwater lakes well removed from the river. No stocking has been carried out in either the river or the Mainstem Lakes (adjacent to the river) in the last 10 years, so the rating is 0.

Stocking began in the Mainstem lakes as early as 1894, so it is difficult to know what number to assign to the historical column. However, the rating for the time period prior to mans interference the rating would be zero and that is what we have used.

It is well to note that Okangan sockeye eggs are presently incubating in Shuswap Falls hatchery and they were collected with the intention of releasing them at the top end of Okanagan River in the spring of 2004. If this occurs the current ratings would need to modified.

Rating the Tributary Streams

The Fish Wizard shows that there has never been any stocking into Inkaneep or Vaseux Creeks. Shingle Creek has been stocked with native rainbow twice but the stockings occurred in 1923 and 1936. Consequently all the tributaries were rated 0.

Rating the Lakes

See the comments under "Rating the River". A variety of fish (rainbow, brooks, sockeye, kokanee, lake whitefish and cutthroat) have been stocked in the mainstem lakes but the lasts stocking was 1989.

Attribute #30 - Hydrological Regime (natural)

This attribute is meant to describe the nature of the natural flow regime. It does not apply to highly regulated systems like current state of the Okanagan River. It does apply however to the historic state of river and to the tributary streams. The next heading applies to the current state of the Okanagan River.

Rating Okanagan River

Only the historic state is applicable. It is best described as Index Value 1. I.e. "Spring snowmelt dominated, non-glacial, temporarily consistent (*not flashy)* and moderate peak and low flows."

Rating the Tributary Streams

The tribuatary streams fit with the rating applied to the mainstem as compared with other categories such as "groundwater source dominated…or rain on snow transitional…or rainfall dominant with flashy winter peaks…or glacial runoff system."

Rating the Lakes

This attribute does not apply to lakes.

Attribute #31 - Hydrological Regime (regulated)

This attribute addresses the seasonal change in the hydrograph as a result of storage for hydro-electric purposes. In the case of the Okanagan River the storage is for flood control but the metric applies. A major storage project on Okanagan Lake retains the vast majority of flow passing through the system.

A very intensive computer modelling program is presently being developed which will assist water and fisheries authorities to regulate the hydrograph in an optimal fashion. The project is called Fish Water Management Tool and more information may be obtained by contacting any of the partners (Fisheries and Oceans Canada ; BC Ministry of Water, Land and Air Protection; Okanagan Alliance Fisheries Department; O Douglas County Public Utility District).

Rating Okanagan River

Summit Environmental Consultants Ltd. (2002d) used a model to reconstruct the natural hydrograph and compare it with the hydrograph that has resulted after storage was developed on the system. The model showed that regulated discharges exceed the estimated natural mean monthly discharges for the months of October to May, but are less than natural discharges in the months of June to September. These results were statistically significant ($\alpha = 0.01$) for all months except September and October.

Peak flows were reduced about 35% so the current index value was assigned a rating score of 4.

Rating the Tributary Streams

No storage has been developed on Shingle, Vaseux or Inkaneep Creek so the attribute does not apply.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #32 – Icing

Icing can damage fish habitat when anchor ice forms or when the channel freezes causing flooding and erosion on the floodplains.

<u>Rating Okanagan River</u>

Anchor ice is experienced frequently in the neighboring Similkameen Watershed but large lakes and a much warmer climate in the Okanagan mean that icing is very limited except in side channels. Nevertheless there are occasional problems such as icing of the dam control gates which can affect the hydrograph. Consequently the rating is 1 throughout.

<u>Rating the Tributary Streams</u>

Problems with anchor ice develop occasionally but the most applicable rating is 1.

<u>Rating the Lakes</u>

This attribute does not apply to lakes.

Attribute #33 - Metals in the Water Column

This attribute is intended to measure whether contamination from metals is affecting fish populations.

<u>Rating Okanagan River</u>

Metals were assigned the value Index Value 1 for all reaches of the Okanagan River based on samples taken in Reach OKR4 (Whipperman and Webber, 1996). The samples were collected every two weeks from 1991 to1995. There were also data prior to 1991, however, many of those samples had been inadvertently contaminated by the containers used to store the reagents added to the metals collection bottle in order to preserve the samples. The following metals were present in concentrations which always fell within guidelines (Nagpal, Pommen, and Swain 1995) for protecting aquatic life: arsenic, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, and zinc. Total aluminum, total chromium, and total iron sometimes exceeded the guidelines for the dissolved forms of these metals, particularly during freshet which indicates that much of these metals were in the suspended form which is relatively inert (Whipperman and Webber, 1996). Unfortunately dissolved metals were not measured and it is impossible to be certain that these metals would have always been within guidelines although it is likely that they were. Because of the uncertainty for these metals, the Index Value 1 rather than 0 seems appropriate. The Confidence Rating is 1 for Reach OKR4 and 2 for all other reaches.

It is recommended that a letter be written to Environment Canada and BC WLAP asking that in order to find out whether there may be toxicity, they test for the dissolved forms of Aluminum, Chromium, and Iron as recommended in their own report.

Sample data compiled by BC Ministry of Energy and Mines was used to determine the probable level of metals in sediments of the Okanagan River.

Rating the Tributary Streams

With no data available for the tributary streams they were given the same rating as the main river.

Rating the Lakes

J. Bryan searched the water quality data files of WLAP (B. C. Ministry of Water, Land, and Air Protection) for the last decade (1993-2003) of record. Because several techniques were used for metal analyses which differed in their analytical power, and consequent detection limit, only those results with the lowest detection limits were used in this exercise. Appendix 1 summarizes data for metals which have associated Canadian Environmental Quality guidelines for levels in freshwater to protect aquatic life (Anon. 1999). The data fell within the guidelines , with the qualifications explained in the next paragraph.

The data for cadmium are not adequate as the Guideline is an order of magnitude less than the minimum detection limit. This means that the data are likely to include false excedances just because of the level of quantification.

Chromium meets the Guideline assuming that all results are in the trivalent form. The sample analysis did not split chromium results into tri or hexavalent forms, but the waters were well oxygenated and under such conditions chromium is normally in the trivalent form (McKee and Wolf 1963, p163). The data for nickel and selenium in Okanagan Lake were three orders of magnitude greater than for Skaha or Osoyoos lakes. Since Okanagan Lake flows into the others, such a circumstance is exceedingly unlikely and it is probable that there was some error in coding these data making them 100 times higher than reasonable, so these data were disregarded.

Index Value 0 is appropriate for all three lakes (plus Vaseaux for which no data are available) as none of the metals fell outside the Canadian Environmental Quality Guidelines for levels in freshwater to protect aquatic life (Anon. 1999). As the data are unpublished, Confidence Level 4 was assigned.

Attribute #33 and 34 - Metals in the soil sediments

This attribute is intended to measure whether contamination from metals is affecting fish populations or other aquatic organisms.

Rating the Okanagan River

No information was located regarding metals in the sediments and this metric should be identified as a data gap. Comments under the section "Rating the Lakes" apply and the river is rated similarly

Rating the Tributary Streams

See comments pertaining to the river and lakes.

Rating the Lakes

The only known data on metal and pollutant levels in sediments are for Vaseaux and Osoyoos.

Contaminant levels in fish give an indication of levels in sediment as most of the contaminant load originates in the sediment and passes to fish from the benthic invertebrates which they eat. For rainbow trout from Okanagan Lake in 1988, the levels of PCB, DDT, and mercury in fish tissue fell within Canadian Guidelines for human consumption (Bryan and Jensen 1994). The same was true for 3 fish captured in Osoyoos Lake in 1998 and 2000 (E. V. Jensen, personal communication). A more extensive data set for fish from Vaseaux and Osoyoos Lakes is being evaluated by Environment Canada staff as part of a report scheduled for completion in 2004. The contact person for obtaining a copy of this report is Ms. B. McNaughton (telephone 604 664-4055).

Since there are some contaminants in lake sediments and biota, the Index Value 1 with Confidence Level 5 seems appropriate for the lakes just as it was for the Okanagan River. When the report by Environment Canada is available, these ratings may need to be revised. However, for now, this is a subject where further study seems warranted.

Attribute #35 - Miscellaneous toxic pollutants in water column

This attribute is intended to measure whether there are any toxic substance affecting fish populations.

Rating Okanagan River

There are no known toxic pollutants in the water column that continuously or periodically produce chronic toxicity to salmonids. There is only one discharge of wastewater directly to the Okanagan River and that is domestic wastewater with tertiary treatment from City of Penticton which has a diffuser pipe across the river channel in Reach OKR 27. Usually the quality of this discharge is very good, although in January 1995 there was an upset in the plant which resulted in poor treatment and a consequent release of wastewater high in ammonia. Caged trout above and below the outfall showed that there was no acute toxicity resulting from this discharge. There was, however, some mortality near a storm drain in the lower part of OKR27 and the toxicant would have affected OKR26 and OKR25 as well. There are also storm drains into Okanagan River from the town of Oliver in Reach OKR 13. As there are no known miscellaneous toxic pollutants in Okanagan River and growth of salmonids in the river is normal, Index Value 0 is appropriate for all reaches of the river and the Confidence Level is 4. This said, it is wise to note that Serdar (2000) found significant DDT and PCB loadings in the lower Okanagan River. The loadings were found to be largely internal, presumably through bottom sediments rather than incoming tributaries.

Rating the Tributary Streams

Comments from “Rating Okanagan River” and “Rating the Streams” apply.

Rating the Lakes

There are no known toxic pollutants in the water columns of any of the Okanagan Valley lakes. There are, however, sizable discharges of municipal wastewater with tertiary treatment. There has never been an evaluation of possible endocrine disrupters in this wastewater. This is an area where an assessment by a qualified expert would seem to be warranted.

Given that no toxic pollutants are known, the Index Level 0 seems appropriate for the lakes, the same as for the Okanagan River. Because there has been no evaluation of whether or not endocrine disrupters are a real or potential problem, Confidence Level 5 is appropriate.

Attribute #36 - Nutrient Enrichment

Nitrogen and phosphorus usually limit primary production. Enrichment of these nutrients as a result of agricultural runoff, failing septic tanks, wastewater discharges and stormwater runoff can increase algal growth. This in turn can choke off the interstitial spaces needed by fish eggs and benthic organisms. Water quality can be degraded due to lower Oxygen, higher pH and higher turbidity.

Rating Okanagan River

The Okanagan River has been enriched with nutrients from direct discharge of domestic wastewater as well as septic tanks, agriculture, and logging (Anon. 1974). Phosphorus is the controlling nutrient (Anon. 1982). In 1970, the phosphorus load from anthropogenic sources was about twice that from natural sources; whereas by 1980, improved wastewater treatment had dropped the anthropogenic load (10500 kg/yr) to less than the natural (10,700 kg/yr). Phosphorus loads from direct discharges continued decreasing while those from diffuse sources continued to rise through the 1980s, but the anthropogenic load by 1990 was still estimated to be less than the natural load (Nordin, Bryan, and Jensen 1990).

It is clear that the Okanagan River has been enriched but since the river has not developed dense mats of green or brown algae on river bottom during summer months, Index Level 1 is appropriate for all reaches of the Okanagan River. No published or unpublished measurements of periphyton chlorophyll a are available to confirm that Index Level 1 is appropriate. Because of this lack of direct evidence, the Confidence level 4 has been assigned. Periphyton standing crop data is an important data gap which ought to be filled through a study of levels in Okanagan River.

Rating the Tributary Streams

Some degree of enrichment has occurred due to land clearing in both Inakneep and Shingle Creeks. Vaseux Creek is less affected and is probably not substantially different form historical in terms of nutrient content.

Rating the Lakes

Sewage discharge into the lakes was having a noticeable affect in terms of nutrient enrichment in the 1970 era. This led to the installation of tertiary sewage treatment facilities in all the major centers. As a consequence point source nitrogen and phosphorus levels decreased significantly.

Nevertheless there has been nutrient enrichment of all the lakes in the Okanagan through many cultural activities including disposal of treated domestic wastewater. Okanagan Lake has been less affected than Skaha, Vaseaux, or Osoyoos. The appropriate Index Levels are 1 for Okanagan Lake (Bryan and Jensen, 1994) and 2 for Skaha, Vaseaux, and Osoyoos (Nordin 1994). The respective Confidence Levels are 1 for Okanagan and Skaha Lake and 2 for Vaseaux and Osoyoos Lake.

Attribute #37 - Predation Risk

This attribute is meant to assess whether predation rates on fish have been affected due to changes in rivers due to mans activities (e.g. building dams).

<u>Rating Okanagan River</u>

Man has radically altered the predation risk by altering both the species mix and the ease of predators capturing prey. Nine exotic fish species have entered the mix including two species of bass (known to be highly piscivorous). Seventeen artificial drop structures have been built in the river each with a bank-to-bank hydraulic curl which could temporarily confuse and dis-orient outmigrating fry.

If these were the only factors affecting predation risk a current rating of 4 would be assigned. However, channellization has shortened and simplified the river and this probably results in faster downstream passage and fewer dwelling spots for predators. These affects would lower the predation rating and as a result a level of 3 has been assigned to each reach.

<u>Rating the Tributary Streams</u>

Tributary streams have been simplified. Lack of woody debris and undercut banks and other micro-habitat niches have increased risk of predation by birds, mammals and fish. The streams also now support bass and brook trout. Thus a rating of 3 has been assigned.

<u>Rating the Lakes</u>

Bass have been added to Skaha, Vaseux and Osoyoos lakes but not Okanagan. Although Okanagan has received a wide variety of exotic species the major predatory types such as bass have not yet reached Okanagan. Thus Okanagan has been rated 2 while the other lakes have been rated 3.

Attribute #38 – Obstructions

This attribute records obstructions to fish passage.

<u>Rating Okanagan River</u>

Aerial photographs and site visits were used to rate obstructions to fish passage in the Okanagan River. A lot of expense and effort went into designing drop structures that would not obstruct migrating sockeye salmon (Hourston et. al., 1954). However, since sockeye salmon were not able to migrate past McIntyre Dam at the time of design, the drop structures upstream may not have been designed for fish passage and may present challenges to migrating fish. This is a knowledge gap that requires further consideration since salmon passage through this section is contemplated. To draw attention to this potential problem the reaches above McIntyre Dam that have drop structures have been rated 1 whereas those below have been rated 0.

The drop structures below McIntyre have affected migrating sockeye during times when flows were minimal and stop logs were used on some drop structures to raise water levels in order to service water intakes (Bruce Shepherd, DFO, personal communication). However, an agreement was made that stoplogs would no longer be used. Thus the rating is presently 0 for reaches downstream from McIntyre Dam.

Some fisheries authorities question whether the Okanagan Falls historically was a complete or partial barrier to fish migration. The question has never been completely resolved to everyone's liking but the bulk of the evidence appears to indicate that fish did pass that point (Bruce Shepherd, DFO and H. Wright, ONAFD, personal communication). Since this is a controversial point the historical rating has been assigned as 1 rather than 0.

Okanagan River reaches that terminate in a currently impassable dam were rated 4.

<u>Rating the Tributary Streams</u>

The reaches on the tributary stream have been selected so that they stop where an obstruction starts. Thus by definition the tributary reaches receive a rating of 0. Nevertheless it would be wise to investigate the barriers – particularly the fishway on Shingle Creek which is meant to pass kokanee and rainbow trout but may not.

<u>Rating the Lakes</u>

This attribute does not apply to lakes.

Attribute #39 - Riparian Function

This attribute provides an estimation of the extent to which a riparian zone is in a "Proper Functioning Condition". The riparian zone and wetland is considered to be functioning properly when adequate vegetation, landform, or large woody debris is present to:

- Dissipate energy associated with high water flow, thereby reducing erosion and improving water quality;
- Filter sediment, capture bedload, and aid floodplain development;
- Improve flood-water retention and ground water recharge;
- Develop root masses that stabilize streambanks against cutting action
- Develop divers ponding and channel characteristics to provide the habitat and the water depth, duration and temperature necessary for fish production , waterfowl breeding and other uses.
- Support greater biodiversity.

Rating Okanagan River

The points made under "Confinement – Hydrological Modifications" apply here. Every reach of the Okanagan River has been modified by man and most have been completely channelled and cut off from their riparian floodplains. The only completely untouched portion is 1128 meters of Reach 17 situated on Indian Reserve lands.

Information for rating this attribute was taken from pre and post channelling aerial photographs, maps and post channelling engineering surveys (Schubert, 1980), and on-site visits.

Rating the Tributary Streams

The riparian zones of all of the tributaries mentioned has been affected to some extent but not nearly as completely as the mainstem. Inkaneep was given a rating of 2 based upon significant loss of riparian vegetation with some channelization.

Vaseux was rated 3 based upon heavy diking and loss of riparian vegetation.

Shingle Creek was rated 2 since it has been channelled and has lost much of the original riparian vegetation. Replanting of cottonwoods is being undertaken by Penticton Indian Band (Enowkin Centre).

Rating the Lakes

This attribute does not apply to lakes.

Attribute #40 - Salmon Carcasses

The density of salmon carcasses in areas of the watershed is important because of the contribution they make in transporting energy and nutrients from the ocean to freshwater. This provides food for both fish and wildlife. This attribute rates the reaches based upon the abundance of carcasses.

Rating Okanagan River

Okanagan Nation Alliance Fisheries Department and DFO has recorded sockeye salmon spawner distribution in Okanagan River for a number of years (Stockwell and Hyatt, 2003). Most of the spawning takes place in the 5 mile long section of river between Vertical Drop Structure 13 in Oliver and the McIntyre Dam (Reaches 14- 18). The total number of sockeye spawning annually has averaged about 15,000 for the period 1935 – 1998 (Bull, 1999; Stockwell and Hyatt, 2003), therefore nearly 3,000 fish per mile would be available in these reaches and the index value is 0.

In reaches 1 – 12 the count would be low but some spawners are found near the drop structures and nutrient drift would be experienced from the upstream areas. Therefore these reaches were assigned an index value of 3.

Reaches 19 – 28 are above the present limit of migration and so they were assigned rated with an index number of 4.

The historic rating is more difficult. Two surveys below McIntyre Dam prior to river channellization indicated numbers and distributions similar to the present (Hourston et. al, 1954).

Prior to the construction of McIntyre Dam (which has been a complete barrier to salmon since about 1920) salmon were reportedly found throughout the system and were very abundant at Okanagan Falls. An index of 0 is therefore assigned to Reach 24. Most other reaches above McIntyre Dam are assigned an index of 3 based upon very low gradients (see section on gradients). Exceptions are Reaches 26 and 27 which were reported to be fishing sites and probably had higher historical gradients. These are rated 0. However, these suppositions are highly conjectural.

Rating the Tributary Streams

Traditional Ecological Knowledge reports that salmon were once common in Inkaneep Creek. However, few if any salmon use the system currently. Consequently the rating is 2 historically and 4 currently.

Local residents report that sockeye salmon were once abundant in Vaseux Creek (Blake Kennedy and Barry Barisoff, personal communication). Chinook salmon and steelhead trout were also found there according to Sandy McDonald, regional biologist, approximately 1970- 1974 (personal communication). Salmon are seldom observed today.

There are few reports of the exact species of fish that historically entered Shingle Creek. However, journals of the Okanagan Historical Society mention a major native fishing site at the confluence of Shingle Creek and Okanagan River. Thus the historic rating is 2 and the current rating is 4.

Rating the Lakes

This attribute does not apply to lakes.

Attributes #41 – 43 - Temperature (Maximum, Minimum and Spatial Variation)

Water temperature is a critical habitat attribute for aquatic organisms. Fish are poikilotherms (cold blooded) and so their metabolic rate varies according to the water temperatures. Maximum temperatures become a limiting factor for salmonids in some reaches Okanagan at certain times.

The spatial variation metric is meant to provide a measure of the extent of groundwater entering the system.

Rating Okanagan River

Temperature records for Okanagan River have been compiled by Stockwell, Hyatt and Rankin, 2001. The years covered run from 1971 to present.

Between year variances are large. For example minimum temperatures of less than 1°C were not found in the winter of 1999/2000 but occurred 54 days in 1996/1977. Nevertheless, a clear picture emerges of the water temperature regime. Minimum temperatures are not usually a major concern but maximum temperatures are a critical factor. This is not surprising given that the area is arid and hot, tributary flows are minimal in the late summer, and river water originates from the surface of large warm lakes. Biologists studying the system during the Okanagan Basin Study (1970s) were of the opinion that water temperatures were a controlling factor for rainbow trout and other riverine salmonids.

Spatial variation in water temperatures is not well studied. However, the Okanagan Basin Study work reported that water temperatures were very slightly lower at the downstream end of the river than they were at the upstream end. This is suspected to be due to groundwater return. This theory is supported by reports from biologists working in the river that occasional pockets of upwelling cold water are to be found. In addition, Park Rill Creek, a tributary to the Okanagan River that is known to carry a substantial amount of groundwater, runs about 2°C cooler than the main river during the hot season.

In summary then, the information indicates that Okanagan River approaches the upper limit of tolerable temperatures for salmonids in mid to late summer but there may well be micro-habitats that act as temperature refugia.

Rating the tributary stream reaches

No empirical data was available for the tributaries, but the systems are well known to the raters. Temperatures are believed to be warm but not quite as warm as the mainstem since the water is coming from higher elevations and there is much more shading. Nevertheless the rating of 3 is probably valid for maximum water temperatures in the streams.

Groundwater (as measured by the "spatial variation in water temperature" metric) is not known to be a significant factor in the tributary streams studied though it is likely to be significant in Park Rill Creek where abundant groundwater sources are observable (as shown by the frequent and extensive seepage areas with growths of watercress). .

Rating the lake reaches

Temperature ratings for the lake reaches were rated by H. Wright and were based on the fact that temperature/oxygen squeeze is a concern in much of the system. Dangerously high temperatures are found to depths where oxygen levels become intolerable in the south and central basins of Osoyoos Lake and in Vaseux Lake. This temperature/oxygen "squeeze" makes these areas unsuitable during July, August and September. Most of the north basin of Osoyoos Lake is also considered to stressful to salmonids during these months. Conditions are more reasonable in Skaha Lake, and Okanagan Lake is even less of a concern because of large volume and high levels of wind circulation. Available back ground reports include Wright (2002), Wright and Lawrence 2003 and unpublished ONAFD 2003 field work.

Attribute #44 - Turbidity

This attribute should be thought of as suspended sediment – the transport of mineral and organic particles in the water column. Suspended sediments affect fish behaviour, physiology and survival. This habitat attribute is meant to reflect the intensity of land use.

Rating Okanagan River

Turbidity was assigned the value Index Value 1 for all reaches of the Okanagan River based on suspended sediment samples taken in Reach OKR4 (Whipperman and Webber, 1996). The samples were collected every two weeks from 1990 to spring 1996 and sporadically between 1980 and 1990. In their report, Whipperman and Webber (1996) presented the data graphically but the scale did not facilitate the determination of Index Value, so the tabulated data was requested and used for comparison with the numbers presented in GEA Table 3. Assumptions were made about the probable length of time that the suspended sediment values remained high, but it is very probable that daily measurements would show that the Okanagan River meets the criteria in Table 51 for Index Level 1. The Confidence Rating is 1 for Reach OKR4 and 2 for all other reaches.

<u>Rating the Tributary Streams</u>

In 1998 a major mass wasting event (landslide) in the Inkaneep Creek Watershed caused major changes in channel morphology and impacted fish habitat (Geostream Consulting, 2001). This was attributable to a combination of road building activities and unstable soils. A number of other unstable areas have been identified (Davies, 1999). As a result, Inkaneep was rated 2 currently. An historic rating of 1 was assigned because there were no anthropogenic factors in the watershed but the unstable banks were there.

Vaseux and Shingle Creeks are thought to experience turbidity problems from time to time but not to the same extent as Inkaneep Creek and not to an extent that would cause direct mortalities to fish. Consequently an index of 1 has been assigned.

<u>Rating the Lakes</u>

This attribute does not apply to lakes

Attribute #45 - Water Withdrawals

This attribute is meant to address the likelihood of entrainment or injury to fry migrating past unscreened outtakes. The effect due to loss of water is covered by another attribute (flow).

<u>Rating Okanagan River</u>

Data on the volume of water which can be legally withdrawn from the Okanagan River each day were obtained from staff of Ministry of Water, Land, and Air Protection for each reach of the River. The reaches which had improperly screened outfalls were determined from a report by Chapman (2000).

The reach which runs from McIntyre Dam to Vaseux Lake was rated as 4 by C. Bull because of the huge unscreened diversion known as SOLID (because it was constructed by South Okanagan Lands Irrigation District). Other reaches were rated by J. Bryan and the ratings were based upon recoded withdrawals.

Rating the Tributary Streams

A site visit to Inkaneep Creek revealed one area where there appears to be extensive withdrawal of water from the creek through an open ditch. In Vaseux Creek there were two such areas. Consequently both systems are rated 3.

In Shingle Creek there is reportedly a pipeline which takes-off from the dam at the upper end of the reach. This is reportedly screened but perhaps not effectively. This should be investigated and constitutes a data gap. However, in the absence of this information an index of 1 is assigned.

Rating the Lakes

This attribute does not apply to lakes.

Attribute #46 - Woody Debris

Large woody debris (greater than 0.1m in diameter and 2 m in length) plays a role in creating and maintaining the pools, side channels and backwaters. It also provides structural complexity and cover for fish and it affects the transport of sediment, gravel and organic matter.

Rating Okanagan River

In its current state the Okanagan River is lacking large woody debris. Channellization of nearly the entire system has robbed it of riparian vegetation and the straight uniform channels provide no opportunity for wood to pile up. Consequently Most of the river reaches currently receive a rating of 4 for wood. In the natural section (Reach 17) and in the semi-natural areas above and below it the rating is 3.

Historically, the Okanagan River was probably not a big producer of large woody debris. While cottonwoods, water birch and willows lined some of the riparian zone, there were few coniferous trees like cedars which would last much longer as large woody debris in the channel. The surrounding land was not heavily forested as the lower elevation Okanagan was dry grassland and shrubland rather than forest. Also the large mainstem lakes would have slowed the recruitment of wood from the uplands tributaries to the river. Because of these considerations, historic ratings are 1 or 2 instead of zero. Ratings of 3 are assigned in the areas which received in less wood because they were naturally confined.

Rating the Tributary Streams

None of the tributary streams have very much woody debris. This is a result of limited recruitment (land clearing and an arid area), limited retention (straight channels) and interference by man (debris removal and channelization for flood control). Consequently they were assigned a current rating of 4.

Many of the aforementioned factors would have been present historically so that ratings would have been lower but similar in those times.

Rating the Lakes

This attribute does not apply to lakes.

Table 64. Metal levels (uG/L) in the water columns of Three Okanagan Lakes and the CCME water quality guidelines

Table v. Metal levels (uG/L) in the water columns of Three Okanagan Lakes and the CCME water quality guidelines														
OKANAGAN LAKE														
				Chromium										
Metal:	Aluminum	Arsenic	Cadmium	Trivalent	Copper	Iron	Lead	Molybdenum	Nickel	Selenium	Silver	Zinc	Alkalinity	Hardness
CanGuideline	**5-100**	**5.0**	**0.0170**	**8.9**	**2.0-4.0**	**300.0**	**1.0-4.0**	**73.0**	**25-150**	**1.0**	**0.10**	**30.0**		
Minimum	1.1	0.7	0.01	0.4	0.52	8	1.00	2.50			<0.02	1.82	108	
Maximum	3.2	0.8	0.08	2.0	5.20	11	7.00	4.50			0.02	2.92	112	
Median	1.1	0.5	0.01	0.3	0.78	8	1.00	3.36			<0.02	2.55	110	
Mean	2.2	0.51	0.03	0.7	1.39	7.75	1.50	3.38			<0.02	2.47	110.7	
number	9	9	6	4	12	4	178	14			6	9	15	
Guideline?	**met**	**met**	*****	**met**	******	**met**	******	**met**	*******	*******	**met**	**met**		

SKAHA LAKE														
				Chromium										
Metal:	Aluminum	Arsenic	Cadmium	trivalent	Copper	Iron	Lead	Molybdenum	Nickel	Selenium	Silver	Zinc	Alkalinity	Hardness
CanGuideline	**5-100**	**5.0**	**0.0170**	**8.9**	**2.0-4.0**	**300.0**	**1.0-4.0**	**73.0**	**25-150**	**1.0**	**0.10**	**30.0**		
Minimum	0.4	0.4	<0.01	0.2	0.53	12	0.01	3.20	1.29	0.2	<0.02	<0.1	105	110
Maximum	10.5	1.1	0.07	8.0	2.80	60	0.60	4.00	1.36	0.5	0.02	5.60	114	125
Median	3.7	0.6	0.04	0.8	1.70	29	0.06	3.45	1.33	0.4	0.02	0.30	110.00	115.00
Mean	4.1	0.6	0.04	2.3	1.50	33	0.27	3.51	1.33	0.4	0.02	1.58	110.00	115.00
number	5	7	4	5	8	6	7	6	2	4	2	4	13	7
Guideline?	**met**	**met**	*****	**met**	**met**	**met**	**met**	**met**	**met**	**met**	**met**	**met**		

OSOYOOS LAKE														
				Chromium										
Metal:	Aluminum	Arsenic	Cadmium	trivalent	Copper	Iron	Lead	Molybdenum	Nickel	Selenium	Silver	Zinc	Alkalinity	Hardness
CanGuideline	**5-100**	**5.0**	**0.0170**	**8.9**	**2.0-4.0**	**300.0**	**1.0-4.0**	**73.0**	**25-150**	**1.0**	**0.10**	**30.0**		
Minimum	5.3	0.6	0.01	0.3	0.31	28	0.01	3.33	1.12	0.4	<0.02	0.10	93	118
Maximum	8.1	0.9	0.02	0.4	2.20	38	0.03	3.88	1.95	0.6	<0.02	8.00	126	130
Median	6.5	0.7	0.02	0.4	0.74	34	0.03	3.68	1.54	0.4	<0.02	0.35	113.00	124
Mean	6.6	0.7	0.02	0.4	0.99	33	0.02	3.64	1.54	0.5	<0.02	2.20	112.70	123.4
number	4	5	2	2	5	3	4	4	2	3	2	4	12	11
Guideline?	**met**	**met**	*****	**met**	**met**	**met**	**met**	**met**	**met**	**met**	**met**	**met**		

* Minimum detection limit of samples inadequate to check guideline. More detail in notes.

**Both mean and median within guidelines, so considered met despite one or a few high values.

***Water sample data available for Okanagan Lake are considered erroneous. More detail in notes.

14 Appendix G: Public Comments

Comments Received on the Draft Okanogan and Methow Subbasin Plans

Note: Every effort has been made to fully consider and implement applicable comments that were received during the formal public comment periods for the subbasin plan. However, given this, it is recognized that it may be possible that this was not completely accomplished due to the time constraint of meeting the May 28, 2004 NPCC deadline. During the NPCC's Response Period (after the 90 public and ISRP comment period), comments received on the initial plan will then be reconsidered.

PUBLIC COMMENTS ON THE METHOW AND OKANOGAN SUB BASIN PLANS

FEBRUARY 11, 2004 – APRIL 16, 2004

Sub-Basin - Comments on Draft Sub-basin Plan

Thanks for the opportunity to comment. Please note my attached comments. Thank you,

Dick Ewing

From: "Dick Ewing" <fawn@mymethow.com>

To: "Sub-Basin" <sbp@co.okanogan.wa.us>

Date: 3/10/2004 8:08 AM

Subject: Comments on Draft Sub-basin Plan

COMMENTS ON SUB-BASIN SUMMARY FOR METHOW BASIN:

1. P. 22. the USGS Water Resources Investigations Report # 03-4246 needs to be included in this section. So model runs with and without groundwater seepage from canals have already been made. What has been found needs to be cited here.

Response: The comment has been forwarded to the Habitat Working Group (HWG).

2. P. 22: regarding a test site for examining the affects of seepage from canals ….

This has already been done with the Twisp Power and Irrigation Canal study

initiated by the USGS. This work needs to be cited with its present conclusions.

Response: The comment has been forwarded to the Habitat Working Group (HWG).

3. Unfortunately the present draft is not complete. The information presented contains most of the background materials and ESA techno-babble that we are all familiar with concerning the region and listed species. What is missing is the core of the draft that actually explains the sub-basin planning perspective, its analysis of the problem and its proposed goals and solutions. Most importantly the present draft does not show any linkage with present watershed planning efforts and how they will be incorporated into sub-basin planning.

Response: Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact.

Last sentence of the paragraph: Sub basin planning outreach staff met with the Methow Basin Planning Unit to address the issue on March 31st,2004.

4. References to the Methow Sub Basin Summary by the Conservation Commission do not cite the deficiencies in this summary noted by Ken Williams' review of this summary which was part of the materials submitted for this process. It would be helpful to have as part of the sub basin plan a process cited on how these deficiencies are going to be addressed so a more accurate approach may be initiated in the Methow.

Response: The comment has been forwarded to the Habitat Working Group (HWG).

# # # # # # # # # # # # # # #

Sub-Basin - Okanogan County Subbasin Planning

Comments on Subbasin Plans attached. Thanks. Darlene

From: "hajny" <hajny@pctelecom.us>

To: "Julie Dagnon" <jdagnon@co.okanogan.wa.us>

Date: 3/11/2004 11:56 PM

Subject: Okanogan County Subbasin Planning

CC: "Mike Wilson" <mjwilson@televar.com>, <Commissioners@okanogan.wa.us>,

"Kurt Danison" <kdanison@ncidata.com>

Julie Dagnon, Water Resource Division Manager

Okanogan County Water Resources

123 N 5th Avenue – Room 110

Okanogan, WA 98840

Re: Comment Letter on Draft Subbasin Plans: Okanogan/Similkameen and Methow

Dear Ms. Dagnon:

There is growing concern that the Northwest Power and Conservation Council (NPPC) Subbasin Plans will ultimately be used to direct land management decisions on public and private lands. We adamantly oppose the use of sub basin Plans for land management purposes and strongly encourage our Legislators and Commissioners to support our position.

Response: Sub basin plans are not land management plans, as such. Local land use management continues to be the responsibility of local government. State government has existing land-use regulatory responsibilities in certain cases. The Sub basin plans are permissive, not prescriptive; they provide a framework for proposed projects. That framework recognizes existing legal mandates and may inform ongoing updates to existing regulations. Local and state government agencies and willing landowners may use the framework to inform land management actions. Effective species recovery will need to include land use management considerations.

The brief comment period of 13 days makes complete review of the draft Subbasin Plans impossible; however following is a list of several major concerns and specific comments on material that has been reviewed to date. It should be noted that the draft plans are very sketchy and core information about how or why species management assumptions were made is not included in the draft plans.

Response: The comment period has been extended; comments on the first draft will be taken until April 16th. (The final draft will be available for review and comment on April 23 – May 10, 2004.) EDT does explicitly document the assumptions made in habitat assessment and working hypotheses. Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact.

Subbasin Planning Limitations: The reported purpose of sub basin planning is to direct Bonneville Power Administration mitigation funding through the Northwest Power and Conservation Council. It is important that subbasin plans not be extended to land management planning and management due to fundamental limitations of the plans, which include:

•Subbasin plans are being developed solely for the benefit of fish and wildlife, with no consideration of costs, economic losses or conflicting human interests, which results in faulty findings.

Response: The purpose of Sub basin Planning is to develop management strategies to recover fish and wildlife. The April 23 draft plan will include economic goals, and the feasibility of the projects that are proposed to be implemented. Sub basin planning strategies may be constrained by human costs and interests. Sub basin planning does not impose mandatory actions, but provides a framework within which projects may be proposed. Projects may benefit the human community as well as target species.

•The "ecosystem approach" used does not make any distinction between public land and privately owned land in its determination of fish and wildlife management plans.

Response: Because ecosystems cross land boundaries, assessments included all land within each sub basin. Management strategies and actions may distinguish between public and private lands.

•Private property rights and land rights including water rights are not recognized.

Response: The April 23 draft sub basin plan will explicitly state that sub basin planning recognizes and will not impeded those legal rights.

•Management plan goals are based on comparisons to "historic" or perfect, untouched conditions that are thought to exist prior to European settlement, which are not attainable, sensible or necessary.

Response: A baseline of some sort is needed to provide a benchmark against which change can be measured. Where the baseline is set does not affect the focus of the assessment, which reflects the condition of the resource today. The baseline simply allows changes to be compared across reaches and streams. If the baseline were raised or lowered, relative change (compared to today's conditions) would remain the same. The issue remains the condition of the resource today and what to do about that. The sub basin plans do not advocate returning to a pristine baseline. Management strategies seek to return to properly functioning conditions when necessary for species recovery.

•Goals are widely based on data with significant information gaps and unmeasurable outcomes with minimal public involvement.

Response: Data gaps are explicitly documented in the process. Sub basin planning is not funded (nor intended) to remediate data gaps by new field work, but its recommendations provide the framework for proposals to conduct additional work to fill data gaps. Measurable objectives are included. The sub basin Coordinators have conducted a very substantial public outreach and involvement effort. This effort is more explained in the April 23 draft sub basin plan. Public outreach has included inviting the public to participate in defining goals and management strategies.

•The cumulative effects of restrictions and regulations on private property ownership and land use are not measured.

Response: The sub basin plan does not address cumulative socioeconomic effects. The plan provides a framework for potential projects and recovery planning, and proposed actions may require cumulative effects analysis.

•The economic losses to the private landowner, agriculture, natural resource-based industries and county economic viability are not considered.

Response: The sub basin plan does not address cumulative socioeconomic effects. The plan provides a framework for potential projects and recovery planning, and proposed actions may require cumulative effects analysis.

•The subbasin planning process bypasses land management planning safeguards and requirements such as economic review, public notice and public involvement.

Response: Sub basin plans provide a framework within which projects may be proposed. Land management planning requirements will be met prior to implementation of any proposed project.

•There is no legislative oversight of back-door ecosystem approaches to manage lands.

Response: Sub basin planning is a federal process, and has been the subject of considerable federal oversight. It is not subject to state legislative oversight; however, state and local (as well as federal) requirements will be met prior to implementation of any proposed project.

Examples of Faulty Model Outcomes: Ecosystem Diagnosis and Treatment (EDT) was elected as the model to establish watershed management plans in Okanogan County. The EDT dispenses priority ratings for management actions based on the input or assumptions it receives. The EDT does not consider costs or other competing human interests, which has resulted in flawed and shortsighted outcomes such as:

Response: EDT is a tool used for biological and ecological assessments. It is not intended to incorporate competing human interests. Human factors are addressed in the sub basin plan's goals, and may be addressed in project development and implementation.

The controversial Salmon Creek Project rising to the top of the priority list even though funding has been consistently denied in the past because of the unreasonable high costs per benefit and potential ongoing and escalating costs for maintenance of a pumping stations. Competing human interests and rights again are not considered in the EDT prioritization.

Response: Project prioritization is not complete, and won't be until recovery planning is complete. To the extent that Salmon Creek has been discussed in the sub basin planning process, it has been in an open public process with a multi-stakeholder sub basin core team.

Land acquisition and conservation easements identified as a recurring management priority in a county already burdened with excessive government ownership. This would place more land and land rights under state and federal control and ownership and further expand federal and state regulatory control over land use.

Response: Land and easements can be acquired by state, federal, or local agencies, by private nonprofit organizations. Easements neither take land out of production nor convert it from private ownership. They help keep land in production and in private ownership. Land acquired by agencies is sold to those agencies by willing landowners, often because its productive *capacity has been depleted and the owner no longer finds it profitable to manage. Both acquisition and easements can prevent subdivision; landowners sell land or easements as a means of keeping their holdings intact. We have also received the comment that the sub basin plan should not impair private property rights. By limiting land acquisitions and conservation easements, this action would do such impairment feared.*

Acquisitions and easements are particularly noticeable as a management strategy in the Methow Watershed. The draft plan recognizes that the government has accumulated 85% of the entire watershed, with only 15% remaining in private ownership; still the management plans call for continuous acquisitions and easements under the guise of increased protection of fish and wildlife.

Response: The comment has been forwarded to the SCT. As stated above as well, we have also received the comment that the sub basin plan should not impair private property rights. By limiting land acquisitions and conservation easements, this action would do such impairment feared.

Increasing flows irregardless of competing water rights and human demands is a dominant management outcome, as well as returning to "natural" pre-European conditions in post-European settlement areas.

Response: Flow rates are frequently a limiting factor, and management strategies address this concern. Flow recommendations seek improvements to flow regimes, but do not necessarily advocate restoring pristine flow regimes. There are numerous strategies to increase flows, many are listed in the Methow Basin watershed plan; may of these recommendations could be potential projects.

Sub basin planning process: Public outreach did not begin until approximately six months after the technical team began work on the plans and public involvement occurred at seven months. The technical team, called the Habitat Work Group, apparently consists of agency staff and consulting firms. Members of the group remain unidentified although we have asked for a list of who is involved in the group.

Response: Technical staff (the HWG) did begin to organize and assess data prior to public involvement, with the intention of efficiently completing the very technical work prior to inviting public participation. Stakeholders were offered opportunities to comment and to participate in development of the subbasin assessment, including opportunities to review the data being used and comment on decisions made about the use of that data. HWG members were identified in a list sent to the entire sub basin planning outreach email list; HWG members were introduced at early subbasin core team meetings and lists of HWG members were posted at those meetings.

The draft plans acknowledge some of the scheduling difficulties people have experienced throughout the sub basin planning process, which was attributed to NPCC's lack of adequate time for public outreach. Although there were scheduling conflicts and problems, the biggest problem has been the lack of core information.

Response: The subbasin planning process occurred on a very fast-track schedule to meet a deadline set by NPCC. The schedule was difficult for all participants. Evening meetings would have required 2-3 times as many meetings to accomplish what could be done in one full-day meeting, and the schedule would not have allowed for that, nor would a heavy evening meeting schedule have been well received. Evening summary meetings were scheduled in an attempt to provide a window for the public who could not attend day meetings. The number of participants and meetings and the status of work often required changes in meeting schedules and locations, and this was a problem.

Public outreach and involvement consists of 1) e-mails that advise only meeting dates and times and what "stage" the process is in, 2) evening meetings with a slide show and verbal presentations with no handouts and at times no technical person to answer questions and 3) day-long meetings consisting of technical people and "stakeholders." The day-long meetings are difficult for working people not on the payroll to attend, particularly on a regular basis.

Response: Handouts were not always available at public or sub basin core team (SCT) meetings because work was underway immediately before, and often during, the meetings. The SCT, including technical members, have been using their available time to keep the process on track in order to meet a deadline imposed by the NPCC, and had little time to create polished handouts. As noted in Response 4, members of the public have been invited to join as participants in the process, rather than receive materials about it after the fact. Technical team members could not attend all public meetings, but did attend most of them. The subbasin planning process occurred on a very fast-track schedule to meet a deadline set by NPCC. The schedule was difficult for all participants. Evening meetings would have required 2-3 times as many meetings to accomplish what could be done in one full-day meeting, and the schedule would not have allowed for that, nor would a heavy evening meeting schedule have been well received. Evening summary meetings were scheduled in an attempt to provide a window for the public who could not attend day meetings. The number of participants and meetings and the status of work often required changes in meeting schedules and locations, and this was a problem.

As noted, in spite of the complex information, that was shown on slides and presented verbally, no handouts were made available at the evening summary sessions. The complicated information that was presented in this way made it difficult to get a clear picture of the process itself let alone the content information and findings. Requests for handouts and more information have also gone answered. Members who asked questions about the complexity and reliability of the EDT model were referred to the Mobrand website.

Response: Handouts were not always available at public or sub basin core team (SCT) meetings because work was underway immediately before, and often during, the meetings. The SCT, including technical members, have been using their available time to keep the process on track in order to meet a deadline imposed by the NPCC, and had little time to create polished *handouts. Members of the public have been invited to join as participants in the process, rather than receive materials about it after the fact. Technical team members could not attend all public meetings, but did attend most of them. Outreach staff gave some information about EDT during presentations, and did refer stakeholders to Mobrand's website for more detailed information in order to use meeting time efficiently.*

Agencies and consultants in the Habitat Work Group have generated huge volumes of fast-paced information that has not been made available to the public. There is tremendous frustration throughout the county that this is just another process where an unidentified team of government entities and consultants has come together to write the plans and pass them off as "local" without meaningful local review or input.

Sincerely,

Mike Wilson, President

Okanogan County Farm Bureau

Attachment: Comments on the contents of the plans.

Cc: Okanogan County Commissioners

7th and 12th District Legislators

Kurt Danison, Highlands Associates

Specific Comments

Methow:

1. The USGS Water Resources Investigations Report # 03-4246 needs to be included in this section. So model runs with and without groundwater seepage from canals have already been made. What has been found needs to be cited here on Pg. 22.

Response: The comment has been forwarded to the Habitat Working Group (HWG).

2. Regarding a test site for examining the affects of seepage from canals: This has already been done with the Twisp Power and Irrigation Canal study initiated by the USGS. This work needs to be cited with its present conclusions. (Pg. 22)

Response: The comment has been forwarded to the Habitat Working Group (HWG).

3. The information presented contains most of the background materials and ESA information that we are all familiar with concerning the region and listed species. What is missing is the core

of the draft that actually explains the sub basin planning perspective, its analysis of the problem and its proposed goals and solutions.

Response: Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact.

4. Most importantly the present draft does not show any linkage with present watershed planning efforts and how they will be incorporated into sub basin planning.

Response: Sub basin planning outreach staff met with the Methow Basin Planning Unit to address the issue on March 31st. An organized planning unit for the Okanogan sub basin has not been developed.

5. References to the Methow Sub basin Summary by the Conservation Commission do not cite the deficiencies in the summary noted by Ken Williams' review, which was part of the materials submitted for this process. It would be helpful to have as part of the sub basin plan a process cited on how these noted deficiencies are going to be addressed so a more accurate approach may be initiated in the Methow.

Response: The comment has been forwarded to the Habitat Working Group (HWG).

Okanogan:

Comments Regarding Farm Bureau Outreach: Please correct your statements to reflect that an article was submitted to Okanogan County Farm Bureau for consideration of printing in the B Newsletter." Sandra contacted us and asked us if she could write an article for our newsletter; we did not request it. I told her to feel free to submit an article if she would like.

Response: Flow rates are frequently a limiting factor, and management strategies address this concern. Flow recommendations seek improvements to flow regimes, but do not necessarily advocate restoring pristine flow regimes. There are numerous strategies to increase flows, many are listed in the Methow Basin watershed plan; may of these recommendations could be potential projects.

General: Numerous statements are made and conclusion rendered without benefit of resources cited. It is difficult to determine what is author's opinion and what is cited references, particularly as related to perceived environmental threats. (Third Paragraph, Page 21, 5th Paragraph, Page 21, Paragraph 2, Page 24)

Response: The comment has been forwarded to the technical writer. This is a very early rough draft. Some references are missing and need to be supplied, and the references section needs to be edited. The assessment of environmental conditions was done by the Habitat Work Group.

The Projects Inventories should show costs of projects as an accountability feature to the public.

Response: The comment has been forwarded to the technical writer.

In an apparent effort to combine BC and US portions of the watershed yet keep them distinct, it is difficult to distinguish between the two in portions of the material.

Response: The comment has been forwarded to the technical writer.

Paragraph 3, Page 23 (statement repeated in Paragraph 5)

The Forest section appears to have numerous unreferenced claims.

Response: The comment has been forwarded to the technical writer. "North of Oroville" has been corrected to read "south of Oroville."

Sub basin in Relation to Region, 2nd Paragraph, Page 18

The following statements appear to be more philosophically poetic than factual which does not seem appropriate, and the first sentence in particular is unclear in its meaning.

Response: The comment has been forwarded to the technical writer.

No references are cited.

The Okanogan Subbasin exemplifies the popularity of the modern rural lifestyle and the controlling-protection paradox practiced by the growing number of valley residents. Constraints to the sustainability of anadromous and resident fish, wildlife, and their habitats result from the footprints of this growth within the basin; many of these impacts and their resolution have cross-border implications. Such impacts include matured agriculture, forest and hydroelectric industries, and their extended affects which reach from the alpine mountain tops to the confluence with the Columbia River and beyond.

5th Paragraph, Page 18

The following statement is unclear. Also, is this author's opinion?

Dealing with these constraints will require both institutional and technical approaches, and links between communities of science, interest and place.

Paragraph 1, Page 26

No reference quoted for final portion of the sentence. Is this author's opinion?

Dominant riparian species include black cottonwood, water birch, and white and thinleaf alder (Arno, 1977), but riparian forests and shrub steppe have been virtually eliminated in the basin.

Paragraph 3, Page 27

Who/what is OWSAC? Is this listed in references?

Conversion of privately owned timber areas into other uses, such as residential subdivisions, is a trend, but not on the large scale that it is further south, in Wenatchee and Entiat (NMFS, 1998). During a recent four year period (1994 1997), approximately 11,000 acres of forestland were subdivided (OWSAC, 2000).

<u>Land Use and Demographics</u>, Paragraph 1, Page 28

In order to present a more accurate and complete picture, more specifics on protected land would be in order, i.e. how much land is in wildlife areas, etc. What does "dominated" mean? Perhaps forestry and range should be broken down rather than grouped together. Is this author's opinion?

Forestry and range are by the far the major uses of land in the Okanogan Basin, followed by croplands (Figure 8). Most of the landscape, from the riparian areas to the upper elevation forests, have been used extensively for agriculture and resource extraction. The valley bottom is dominated by agriculture, primarily orchards and livestock feed. The benches are dominated by livestock grazing, and the lower to mid-upper elevation forests have been harvested for timber and used for livestock grazing. The Okanogan Basin contains six state wildlife areas, a natural preserve in the DNR's Loomis Forest, and a portion of the USFS.s Pasayten Wilderness.

Response: The comment has been forwarded to the technical writer. Forest and range are represented in different parts of Figure 8. "Dominated" has been changed to "predominantly".

<u>Urbanization and population growth, Table, Page 29</u>

Is the 2000 census that last census available?

Response: Yes

<u>Socio-Economic Conditions – Colville Reservation</u>

Is the following statement actual wording of the court's findings? Reference to court ruling?

The Court also ruled that the Colville Tribes possess federally reserved water rights to stream flows sufficient to preserve or restore tribal fisheries.

Response: Federally reserved water rights are established for all tribes under the Winters Doctrine. The statement cited is an accurate reflection of that doctrine.

<u>Starting Paragraph 3, Page 30</u>

Treaties and mitigation for dams are complex issues. Is this the correct forum to discuss the "unfairness" of the mitigation programs to the Colville Tribe? Are some of the following statements fact or opinion?

In 2000, the Bureau of Reclamation agreed with the Colville Confederated Tribes that the Federal government had not completed its authorized anadromous fish mitigation for construction of Grand Coulee Dam over 60 years ago. Planned artificial production programs were not implemented for the Okanogan River Basin when the outbreak of World War II halted non-war related construction projects.

Tribes of the Colville Reservation have been seriously harmed by the lack of Grand Coulee mitigation, with ceremonial and subsistence fisheries declining to minimal levels, even in years of substantial runs entering the Columbia River. Fishing opportunity is now severely limited to summer/fall Chinook immediately below Chief Joseph Dam and an occasional sockeye fishery in the Okanogan River. This situation has been adversely compounded by later formulas for mitigation of mid-Columbia Public Utility District dams where the Federal Energy Regulatory Commission does not require mitigation for now, non-existing. Additional hatchery production under the proposed mitigation agreement with the PUDs is based on the run sizes of salmon and steelhead in a 10-year period during the 1970.s and 1980.s (Bugert 1998). Most of these post-dam runs were supported in large part by the initial hatchery mitigation programs funded by the PUDs and the Federal government. Since the CCT did not receive the initial mitigation from the construction of Federal and PUD dams, the basis for the new agreements discounts obligations to the CCT. Without the initial Federal salmon mitigation that other watersheds in the province obtained, the Okanogan Basin and Colville Tribes again were provided without mitigation. Additionally, the Federal government has never provided Okanogan anadromous fish mitigation for the Colville Tribes for the loss of adult and juvenile fish passing through the four Corps of Engineers hydroelectric projects on the Lower Columbia River. Fish mortality at these projects have been generally estimated at about 10% per project, but were historically higher. Finally, Chinook mitigation by Douglas PUD for losses due to inundation and passage has been sited downriver, at Wells Hatchery and in the Methow River, away from the Colville Tribes reservation fisheries. The Colville Tribes total anadromous salmonid harvest is normally below 1,000 total salmon and steelhead combined and similar estimates are reflected in the Okanagan Nation fisheries upstream in Canada. Yet, in the 1800.s prior to over harvest in lower river commercial fisheries and subsequent habitat destruction, the Colville Tribes were estimated to have harvested in excess of 2 million pounds of salmon and steelhead annually (Koch 1976).

Response: The Tribes' representative advises that the points made in the text have been upheld. The mitigation cited is directly germane to sub basin planning.

<u>Agriculture</u>, Paragraph 5, Page 31

Says who?

Livestock grazing practices have led to trampled stream banks, increased bank erosion and sedimentation, and changes in vegetation, including loss of native grasses, impacts to woody vegetation, and establishment of noxious weeds.

Response: Livestock impacts are based on the habitat assessment conducted by the HWG and reviewed by the SCT. The assessment process documented the level of certainty associated with each habitat attribute. The sub basin plan should recognize the benefits of limited grazing under proper management and monitoring.

Paragraph 6, Page 31

Who is PNRBC? Is a 1970's report relevant?

A 1970s rangeland evaluation indicated that 25 percent of rangeland in the basin was in good condition, 34 percent in fair condition, and 41 percent was in poor condition (PNRBC, 1977).

Response: PNRBC is the Pacific Northwest River Basin Commission. The technical writer has been asked to search for more current information.

Appendix A, Page 147

Federal ESA species are listed "that are present or may be present in Okanogan" but there is no way to know which listings are actually present and affect Okanogan County. Two separate lists would correct that.

Response: The comment has been forwarded to the technical writer.

# # # # # # # # # # # # # # #

Sub-Basin - Comments on Draft Methow Subbasin plan

Comments on Draft Methow Subbasin plan:

To All on distribution:

My comments prior to 11 March initial comment period deadline attached as MS Word2002 .doc. Please let me know if you have any problem reading that document.

Cordially,

Ken Sletten

360-620-5008 (cell)

From: <wasbra@wavecable.com>

To: <sbp@co.okanogan.wa.us>

Date: 3/8/2004 12:20 AM

Subject: Comments on Draft Methow Subbasin plan

CC: <tkarier@ewu.edu>, <fcassidy@nwcouncil.org>, <lpalensky@nwcouncil.org>, <parlette_li@leg.wa.gov>, <armstron_mi@leg.wa.gov>, <condotta_ca@leg.wa.gov>, <commissioners@co.okanogan.wa.us>, <jdagnon@co.okanogan.wa.us>, <beichdvb@dfw.wa.gov>, <kdanison@ncidata.com>, <JPratt@entrix.com>, <fawn@mymethow.com>, <ramshead@methow.com>, wasbra@wavecable.com Sub-Basin - Methow Subbasin issues; + missing document.

FROM:

Ken Sletten

Box 902

688 Wolf Creek Road

Winthrop, WA 98862-0902

wasbra@charter.net cell: 360-620-5008

TO:

Lynn Palensky, NWPCC Subbasin Planning Coordinator lpalensky@nwcouncil.org 503-222-5161

COPIES:

Senator Linda Evans Parlette parlette_li@leg.wa.gov, Senator Bob Morton morton_bo@leg.wa.gov, Rep. Mike Armstrong armstron_mi@leg.wa.gov, Rep. Cary Condotta condotta_ca@leg.wa.gov, Okanogan County Commissioners commissioners@co.okanogan.wa.us, Okanogan County - Julie Dagnon sbp@co.okanogan.wa.us, MBWPU: Dick Ewing fawn@mymethow.com, Ron Perrow ramshead@methow.com

SUBJECT:

Methow Subbasin planning issues; and important missing document.

REFERENCE:

(a) http://www.nwcouncil.org/fw/subbasinplanning/Methow/default.asp

(b) http://www.nwcouncil.org/fw/subbasinplanning/admin/recommendations.htm

(c) http://www.cbfwa.org/cfsite/ReviewCycle.cfm?ReviewCycleURL=FY%202003%20Columbia%20Cascade#reports (CBFWA draft Methow

Subbasin Summary dated 2002-05-17)

Lynn,

I am aware from the 11 February 2004 Okanogan Chronicle that the Methow Basin Watershed Planning Unit (MBWPU) has filed a formal complaint with the NWPCC about effectively being left out of the regional subbasin planning process. I'm not necessarily saying the reasons for this complaint are completely the fault of the NWPCC: There are some issues internal to Okanogan County with respect to officially finishing 'final final' revisions to the Methow Basin Watershed Management Plan (MBWMP). However, given looming NWPCC subbasin planning deadlines I'm afraid that an opportunity to integrate the MBWMP in the NWPCC subbasin process will be lost if steps are not taken to immediately correct this situation. Three key points:

(1) Under headings of full disclosure and presenting an honest picture of the situation in each subbasin, a formal complaint by key players in local watershed planning like members of the MBWPU clearly deserves and needs to be prominently accessible through your Methow Subbasin web page (reference (a)). Now it's possible that it COULD be hidden somewhere on the very extensive NWPCC web site (which is generally pretty well put together and organized); all I can say is I can't find it. I guess nothing is stopping me or members of the MBWPU from posting their complaint to the currently-empty Methow Subbasin public file exchange page, but in my opinion citizens should not have to informally take action to get a document this important and pertinent to Methow Subbasin planning included on the reference (a) web page. This should be done officially by the NWPCC: Please add a link to the MBWPU complaint at least at the reference (a) level ASAP.

Response: The comment letter was addressed to the NPCC; we are not sure what comment is appropriate from us.

(2) I am fully in accord with opinions expressed by the MBWPU in their complaint. I note a few key snippets from your 'Notice of request for recommendations' document on the NWPCC web site at reference (b):

'.... The Council intends to incorporate these specific objectives and measures into the program in locally developed subbasin plans for the 62 subbasins of the Columbia River'

and especially:

'Integration with local efforts - The Council recognizes that there are other watershed and recovery planning efforts taking place across the Columbia basin. Where groups are already working at a local level, the Council will work in partnership with those efforts. The desired approach is to make those existing planning groups aware of the opportunity to have their subbasin plans adopted as part of the fish and wildlife Program, and where there is interest, to make additional resources and guidance available to those planners so that they can assimilate the Council's subbasin planning components into their existing efforts.'

After many years of intensive, dedicated work by members of the MBWPU, no one can deny that they are (and have been) actively working at the local level; and they are without doubt 'interested'. The next phrase in your above says: ' the Council will work in partnership with those efforts.' It does not say 'might' or 'may': It says WILL work. I respectfully suggest that the apparent complete failure to date by the NWPCC subbasin planning process to work with the MBWPU or to in any substantive way recognize and incorporate the large amount of excellent technical work already done by that group is unacceptable. In fact, that omission appears to be such a glaring violation of above quoted NWPCC principles that from my admittedly amateur perspective it appears that if the situation is not promptly corrected it might be a valid legal 'cause for action'. At the very least it will be cause for serious complaint to the Washington State Legislature.

Response: The Methow Basin Planning Unit was one of the key groups identified early in the sub basin planning outreach process. The group's participation was expressly solicited; Planning Unit members elected not to participate because completion of the Watershed Plan was demanding a great deal of time and energy during the period when sub-basin planning was initiated. Planning Unit members have been included in outreach efforts throughout the process.

(3) If you click on reference (a) 'Read full subbasin summary', you get redirected to the reference (c) CBFWA web site. The 'Draft Methow Subbasin Summary' info listed on that page is dated 17 May 2002. Given that public meetings have already been held this month to discuss the latest updates, shouldn't the CBFWA web site be better than nearly two years out of date ?... wherever they are publicly posted, latest draft versions of the various subbasin plans should be as up to date as possible.

Response: Since the comment letter was addressed to the NPCC we are unsure as to what comment is appropriate from us.

Respectfully submitted,

Ken Sletten

# # # # # # # # # # # # # # #

Sub-Basin - Comments on Okanogan/Methow subbasin planning

From: "Patrick Plumb" <pplumb@nvhospital.org>

To: <lpalensky@nwcouncil.org>, <jdagnon@co.okanogan.wa.us>, "Mary Lou Peterson"

<PETE6976@co.okanogan.wa.us>, <jsto461@ecy.wa.gov>, <barbaram@iac.wa.gov>

Date: 3/18/2004 3:37 PM

Subject: Comments on Okanogan/Methow subbasin planning

CC: <oc3@northcascades.net>, "hajny" <hajny@pctelecom.us>, <plr@bossig.com>

As a Tonasket City Councilman and also as the Chairman Elect of Okanogan County Citizens Coalition, I would like to concur with the Okanogan County Farm Bureau on the statement below, and also air my cautionary position that local involvement in this subbasin planning process has not been satisfactory to having my input. Whether that be my fault or a fault of bureaucracy I am not sure yet, but I would like to be a part of this process. Promises made in the plan that I have read so far says that local officials will be made aware of what is going on, and I would like to see someone give an update to the Tonasket City Council on where this process is and how we should be able to give input to the watershed planning. I am not sure if a WIRA has been formed for the Okanogan River Watershed, and also I have attended a WIRA meeting for the Kettle River watershed, and I would like to be involved with the watershed that I have a direct connection to (Okanogan River). The comments that I concur with the Okanogan County Farm Bureau are listed below.

Response: Sub basin plans are not land management plans, as such. Local land use management continues to be the responsibility of local government. State government has existing land-use regulatory responsibilities in certain cases. The Sub basin plans are permissive, not prescriptive; they provide a framework for proposed projects. That framework recognizes existing legal mandates and may inform ongoing updates to existing regulations. Local and state government agencies and willing landowners may use the framework to inform land management actions. Effective species recovery will need to include land use management considerations.

There is growing concern that the Northwest Power and Conservation Council (NPPC) Subbasin Plans will ultimately be used to direct land management decisions on public and private lands. I adamantly oppose the use of Subbasin Plans for land management purposes and strongly encourage our Legislators and Commissioners to support our position.

The brief comment period of 13 days makes complete review of the draft Subbasin Plans impossible; however following is a list of several major concerns and specific comments on material that has been reviewed to date. It should be noted that the draft plans are very sketchy and core information about how or why species management assumptions were made is not included in the draft plans.

Response: The comment period has been extended; comments on the first draft will be taken until April 16th. (The final draft will be available for review and comment on April 23rd.) Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact. EDT does explicitly document the assumptions made in habitat assessment and working hypotheses.

Subbasin Planning Limitations: The reported purpose of subbasin planning is to direct Bonneville Power Administration mitigation funding through the Northwest Power and Conservation Council. It is important that subbasin plans not be extended to land management planning and management due to fundamental limitations of the plans, which include:

Subbasin plans are being developed solely for the benefit of fish and wildlife, with no consideration of costs, economic losses or conflicting human interests, which results in faulty findings.

Response: The purpose of Sub basin Planning is to develop management strategies to recover fish and wildlife. The April 23 draft plan will include economic goals, and the feasibility of the projects that are proposed to be implemented. Sub basin planning strategies may be constrained by human costs and interests. Sub basin planning does not impose mandatory actions, but provides a framework within which projects may be proposed. Projects may benefit the human community as well as target species.

The "ecosystem approach" used does not make any distinction between public land and privately owned land in its determination of fish and wildlife management plans. Private property rights and land rights including water rights are not recognized.

Response: Because ecosystems cross land boundaries, assessments included all land within each sub basin. Management strategies and actions may distinguish between public and private lands. The April 23 draft sub basin plan will explicitly state that sub basin planning recognizes and will not impeded those legal rights.

Management plan goals are based on comparisons to "historic" or perfect, untouched conditions that are thought to exist prior to European settlement, which are not attainable, sensible or necessary.

Response: A baseline of some sort is needed to provide a benchmark against which change can be measured. Where the baseline is set does not affect the focus of the assessment, which reflects the condition of the resource today. The baseline simply allows changes to be compared across reaches and streams. If the baseline were raised or lowered, relative change (compared to today's conditions) would remain the same. The issue remains the condition of the resource today and what to do about that. The sub basin plans do not advocate returning to a pristine baseline. Management strategies seek to return to properly functioning conditions when necessary for species recovery.

Goals are widely based on data with significant information gaps and unmeasurable outcomes with minimal public involvement.

Response: Data gaps are explicitly documented in the process. Sub basin planning is not funded (nor intended) to remediate data gaps by new field work, but its recommendations provide the framework for proposals to conduct additional work to fill data gaps. Measurable objectives are included. The sub basin Coordinators have conducted a very substantial public outreach and involvement effort. This effort is more explained in the April 23 draft sub basin plan. Public outreach has included inviting the public to participate in defining goals and management strategies.

The cumulative effects of restrictions and regulations on private property ownership and land use are not measured.

Response: The sub basin plan does not address cumulative socioeconomic effects. The plan provides a framework for potential projects and recovery planning, and proposed actions may require cumulative effects analysis.

The economic losses to the private landowner, agriculture, natural resource-based industries and county economic viability are not considered.

Response: The sub basin plan does not address cumulative socioeconomic effects. The plan provides a framework for potential projects and recovery planning, and proposed actions may require cumulative effects analysis.

The subbasin planning process bypasses land management planning safeguards and requirements such as economic review, public notice and public involvement.

Response: Sub basin plans provide a framework within which projects may be proposed. Land management planning requirements will be met prior to implementation of any proposed project.

There is no legislative oversight of back-door ecosystem approaches to manage lands.

Response: Sub basin planning is a federal process, and has been the subject of considerable federal oversight. It is not subject to state legislative oversight; however, state and local (as well as federal) requirements will be met prior to implementation of any proposed project.

Examples of Faulty Model Outcomes: Ecosystem Diagnosis and Treatment (EDT) was selected as the model to establish watershed management plans in Okanogan County. The EDT dispenses priority ratings for management actions based on the input or assumptions it receives. The EDT does not consider costs or other competing human interests, which has resulted in flawed and shortsighted outcomes such as:

Response: EDT is a tool used for biological and ecological assessments. It is not intended to incorporate competing human interests. Human factors are addressed in the sub basin plan's goals, and may be addressed in project development and implementation.

The controversial Salmon Creek Project rising to the top of the priority list even though funding has been consistently denied in the past because of the unreasonably high costs per benefit and potential ongoing and escalating costs for maintenance of a pumping station. Competing human interests and rights again are not considered in the EDT prioritization.

Response: Project prioritization is not complete, and won't be until recovery planning is complete. To the extent that Salmon Creek has been discussed in the sub basin planning process, it has been in an open public process with a multi-stakeholder sub basin core team.

Land acquisitions and conservation easements identified as a recurring management priority in a county already burdened with excessive government ownership. This would place more land and land rights under state and federal control and ownership and further expand federal and state regulatory control over land use.

Response: Land and easements can be acquired by state, federal, or local agencies, by private nonprofit organizations. Easements neither take land out of production nor convert it from private ownership. They help keep land in production and in private ownership. Land acquired by agencies is sold to those agencies by willing landowners, often because its productive capacity has been depleted and the owner no longer finds it profitable to manage. Both *acquisition and easements can prevent subdivision; landowners sell land or easements as a means of keeping their holdings intact. We have also received the comment that the sub basin plan should not impair private property rights. By limiting land acquisitions and conservation easements, this action would do such impairment feared.*

Acquisitions and easements are particularly noticeable as a management strategy in the Methow Watershed. The draft plan recognizes that the government has accumulated 85% of the entire watershed, with only 15% remaining in private ownership; still the management plans call for continuous acquisitions and easements under the guise of increased protection of fish and wildlife.

Response: The comment has been forwarded to the SCT. As stated above as well, we have also received the comment that the sub basin plan should not impair private property rights. By limiting land acquisitions and conservation easements, this action would do such impairment feared.

Increasing flows irregardless of competing water rights and human demands is a dominant management outcome, as well as returning to "natural" pre-European conditions in post-European settlement areas.

Response: Flow rates are frequently a limiting factor, and management strategies address this concern. Flow recommendations seek improvements to flow regimes, but do not necessarily advocate restoring pristine flow regimes. There are numerous strategies to increase flows, many are listed in the Methow Basin watershed plan; may of these recommendations could be potential projects.

Subbasin Planning Process: Public outreach did not begin until approximately six months after the technical team began work on the plans and public involvement occurred at seven months. The technical team, called the Habitat Work Group, apparently consists of agency staff and consulting firms. Members of the group remain unidentified although we have asked for a list of who is involved in the group.

Response: Technical staff (the HWG) did begin to organize and assess data prior to public involvement, with the intention of efficiently completing the very technical work prior to inviting public participation. Stakeholders were offered opportunities to comment and to participate in development of the subbasin assessment, including opportunities to review the data being used and comment on decisions made about the use of that data. HWG members were identified in a list sent to the entire sub basin planning outreach email list; HWG members were introduced at early subbasin core team meetings and lists of HWG members were posted at those meetings.

The draft plans acknowledge some of the scheduling difficulties people have experienced throughout the subbasin planning process, which was attributed to NPCC's lack of adequate time for public outreach. Although there were scheduling conflicts and problems, the biggest problem has been the lack of core information.

Response: The subbasin planning process occurred on a very fast-track schedule to meet a deadline set by NPCC. The schedule was difficult for all participants. Evening meetings would have required 2-3 times as many meetings to accomplish what could be done in one full-day meeting, and the schedule would not have allowed for that, nor would a heavy evening meeting schedule have been well received. Evening summary meetings were scheduled in an attempt to provide a window for the public who could not attend day meetings. The number of participants and meetings and the status of work often required changes in meeting schedules and locations, and this was a problem.

Public outreach and involvement consists of 1) e-mails that advise only meeting dates and times and what "stage" the process is in, 2) evening meetings with a slide show and verbal presentations with no handouts and at times no technical person to answer questions and 3) day-long meetings consisting of technical people and "stakeholders." The day-long meetings are difficult for working people not on the payroll to attend, particularly on a regular basis.

Response: Handouts were not always available at public or sub basin core team (SCT) meetings because work was underway immediately before, and often during, the meetings. The SCT, including technical members, have been using their available time to keep the process on track in order to meet a deadline imposed by the NPCC, and had little time to create polished handouts. As noted in Response 4, members of the public have been invited to join as participants in the process, rather than receive materials about it after the fact. Technical team members could not attend all public meetings, but did attend most of them. The subbasin planning process occurred on a very fast-track schedule to meet a deadline set by NPCC. The schedule was difficult for all participants. Evening meetings would have required 2-3 times as many meetings to accomplish what could be done in one full-day meeting, and the schedule would not have allowed for that, nor would a heavy evening meeting schedule have been well received. Evening summary meetings were scheduled in an attempt to provide a window for the public who could not attend day meetings. The number of participants and meetings and the status of work often required changes in meeting schedules and locations, and this was a problem.

As noted, in spite of the complex information that was shown on slides and presented verbally, no handouts were made available at the evening summary sessions. The complicated information that was presented in this way made it difficult to get a clear picture of the process itself let alone the content information and findings. Requests for handouts and more information have also gone unanswered. Members who asked questions about the complexity and reliability of the EDT model were referred to the Mobrand website.

Response: Handouts were not always available at public or sub basin core team (SCT) meetings because work was underway immediately before, and often during, the meetings. The SCT, including technical members, have been using their available time to keep the process on track in order to meet a deadline imposed by the NPCC, and had little time to create polished handouts. As noted in Response 4, members of the public have been invited to join as *participants in the process, rather than receive materials about it after the fact. Technical team members could not attend all public meetings, but did attend most of them.*

Agencies and consultants in the Habitat Work Group have generated huge volumes of fast-paced information that has not been made available to the public. There is tremendous frustration throughout the county that this is just another process where an unidentified team of government entities and consultants has come together to write the plans and pass them off as “local” without meaningful local review or input.

Specific Comments

Methow:

1. The USGS Water Resources Investigations Report # 03-4246 needs to be included in this section. So model runs with and without groundwater seepage from canals have already been made. What has been found needs to be cited here on Pg. 22.

Response: The comment has been forwarded to the Habitat Working Group (HWG).

2. Regarding a test site for examining the affects of seepage from canals: This has already been done with the Twisp Power and Irrigation Canal study initiated by the USGS. This work needs to be cited with its present conclusions. (Pg. 22)

Response: The comment has been forwarded to the Habitat Working Group (HWG).

3. The information presented contains most of the background materials and ESA information that we are all familiar with concerning the region and listed species. What is missing is the core of the draft that actually explains the subbasin planning perspective, its analysis of the problem and its proposed goals and solutions.

Response: Okanogan County’s public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact.

4. Most importantly the present draft does not show any linkage with present watershed planning efforts and how they will be incorporated into subbasin planning.

Response: Sub basin planning outreach staff met with the Methow Basin Planning Unit to address the issue on March 31st.

5. References to the Methow Subbasin Summary by the Conservation Commission do not cite the deficiencies in the summary noted by Ken Williams’ review, which was part of the materials submitted for this process. It would be helpful to have as part of the subbasin plan a process cited on how these noted deficiencies are going to be addressed so a more accurate approach may be initiated in the Methow.

Response: The comment has been forwarded to the Habitat Working Group (HWG).

Okanogan:

General: Numerous statements are made and conclusion rendered without benefit of resources cited. It is difficult to determine what is author's opinion and what is cited references, particularly as related to perceived environmental threats. (Third Paragraph, Page 21, 5th Paragraph, Page 21, Paragraph 2, Page 24)

Response: The comment has been forwarded to the technical writer. This is a very early rough draft. Some references are missing and need to be supplied, and the references section needs to be edited. The assessment of environmental conditions was done by the Habitat Work Group.

The Projects Inventories should show costs of projects as an accountability feature to the public.

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Constraints to the sustainability of anadromous and resident fish, wildlife, and their habitats result from the footprints of this growth within the basin; many of these impacts and their resolution have cross-border implications. Such impacts include matured agriculture, forest and hydroelectric industries, and their extended affects which reach from the alpine mountain tops to the confluence with the Columbia River and beyond.

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5th Paragraph, Page 18

The following statement is unclear. Also, is this author's opinion?

Dealing with these constraints will require both institutional and technical approaches, and links between communities of science, interest and place.

Paragraph 1, Page 26

No reference quoted for final portion of the sentence. Is this author's opinion?

Dominant riparian species include black cottonwood, water birch, and white and thinleaf alder (Arno, 1977), but riparian forests and shrub steppe have been virtually eliminated in the basin.

Paragraph 3, Page 27

Who/what is OWSAC? Is this listed in references?

Conversion of privately owned timber areas into other uses, such as residential subdivisions, is a trend, but not on the large scale that it is further south, in Wenatchee and Entiat (NMFS, 1998). During a recent four year period (1994 1997), approximately 11,000 acres of forestland were subdivided (OWSAC, 2000).

<u>Land Use and Demographics</u>, Paragraph 1, Page 28

In order to present a more accurate and complete picture, more specifics on protected land would be in order, i.e. how much land is in wildlife areas, etc. What does "dominated" mean? Perhaps forestry and range should be broken down rather than grouped together. Is this author's opinion?

Forestry and range are by the far the major uses of land in the Okanogan Basin, followed by croplands (Figure 8). Most of the landscape, from the riparian areas to the upper elevation forests, have been used extensively for agriculture and resource extraction. The valley bottom is dominated by agriculture, primarily orchards and livestock feed. The benches are dominated by livestock grazing, and the lower to mid-upper elevation forests have been harvested for timber and used for livestock grazing. The Okanogan Basin contains six state wildlife areas, a natural preserve in the DNR.s Loomis Forest, and a portion of the USFS.s Pasayten Wilderness.

Response: The comment has been forwarded to the technical writer. Forest and range are represented in different parts of Figure 8. "Dominated" has been changed to "predominantly".

Socio-Economic Conditions – Colville Reservation

Is the following statement actual wording of the court's findings? Reference to court ruling? The Court also ruled that the Colville Tribes possess federally reserved water rights to stream flows sufficient to preserve or restore tribal fisheries.

Response: Federally reserved water rights are established for all tribes under the Winters Doctrine. The statement cited is an accurate reflection of that doctrine.

<u>Starting Paragraph 3, Page 30</u>

Treaties and mitigation for dams are complex issues. Is this the correct forum to discuss the "unfairness" of the mitigation programs to the Colville Tribe? Are some of the following statements fact or opinion?

In 2000, the Bureau of Reclamation agreed with the Colville Confederated Tribes that the Federal government had not completed its authorized anadromous fish mitigation for construction of Grand Coulee Dam over 60 years ago. Planned artificial production programs were not implemented for the Okanogan River Basin when the outbreak of World War II halted non-war related construction projects. Tribes of the Colville Reservation have been seriously harmed by the lack of Grand Coulee mitigation, with ceremonial and subsistence fisheries declining to minimal levels, even in years of substantial runs entering the Columbia River. Fishing opportunity is now severely limited to summer/fall Chinook immediately below Chief Joseph Dam and an occasional sockeye fishery in the Okanogan River. This situation has been adversely compounded by later formulas for mitigation of mid- Columbia Public Utility District dams where the Federal Energy Regulatory Commission does not require mitigation for now, non-existing. Additional hatchery production under the proposed mitigation agreement with the PUDs is based on the run sizes of salmon and steelhead in a 10-year period during the 1970.s and 1980.s (Bugert 1998). Most of these post-dam runs were supported in large part by the initial hatchery mitigation programs funded by the PUDs and the Federal government. Since the CCT did not receive the initial mitigation from the construction of Federal and PUD dams, the basis for the new agreements discounts obligations to the CCT. Without the initial Federal salmon mitigation that other watersheds in the province obtained, the Okanogan Basin and Colville Tribes again were provided without mitigation. Additionally, the Federal government has never provided Okanogan anadromous fish mitigation for the Colville Tribes for the loss of adult and juvenile fish passing through the four Corps of Engineers. hydroelectric projects on the Lower Columbia River. Fish mortality at these projects have been generally estimated at about 10% per project, but were historically higher. Finally, Chinook mitigation by Douglas PUD for losses due to inundation and passage has been sited downriver, at Wells Hatchery and in the Methow River, away from the Colville Tribes. reservation fisheries. The Colville Tribes. total anadromous salmonid harvest is normally below 1,000 total salmon and steelhead combined and similar estimates are reflected in the Okanagan Nation fisheries upstream in Canada. Yet, in the 1800.s prior to over harvest in lower river commercial fisheries and subsequent habitat destruction, the Colville Tribes were estimated to have harvested in excess of 2 million pounds of salmon and steelhead annually (Koch 1976).

Response: The Tribes' representative advises that the points made in the text have been upheld. The mitigation cited is directly germane to sub basin planning.

Agriculture, Paragraph 5, Page 31

Says who? I cannot agree with a statement that does not list the positive benefits of Livestock Grazing and this needs to be corrected.

Livestock grazing practices have led to trampled stream banks, increased bank erosion and sedimentation, and changes in vegetation, including loss of native grasses, impacts to woody vegetation, and establishment of noxious weeds.

Response: Livestock impacts are based on the habitat assessment conducted by the HWG and reviewed by the SCT. The assessment process documented the level of certainty associated with each habitat attribute. The sub basin plan should recognize the benefits of limited grazing under proper management and monitoring.

Paragraph 6, Page 31

Who is PNRBC? Is a 1970's report relevant?

A 1970s rangeland evaluation indicated that 25 percent of rangeland in the basin was in good condition, 34 percent in fair condition, and 41 percent was in poor condition (PNRBC, 1977).

Response: PNRBC is the Pacific Northwest River Basin Commission. The technical writer has been asked to search for more current information.

Appendix A, Page 147

Federal ESA species are listed "that are present or may be present in Okanogan" but there is no way to know which listings are actually present and affect Okanogan County. Two separate lists would correct that.

Response: The comment has been forwarded to the technical writer.

Thank you for reading my comments and pass them on to any organization or entity that you deem necessary.

Patrick Plumb

Tonasket City Councilman

Okanogan County Citizens Coalition chairman-elect

pplumb@ncidata.com

work: 509-486-3105

home: 509-486-0688

# # # # # # # # # # # # # # #

From: "Ron Perrow" <ramshead@methow.com>

To: <sbp@co.okanogan.wa.us>

Date: 3/8/2004 12:50 PM

Subject: extension for comment

Please see attached letter

Thank you

Ron Perrow, chairman

Methow Basin Watershed Planning Unit

March 8, 2004

Okanogan County Water Resources

Northwest Power and Conservation Council

Re: DRAFT Methow and Okanogan Subbasin Planning

Dear Sirs:

This letter is in response to the February 23rd Memo soliciting comments by March 11th from "Interested Stakeholders" for the Draft Methow and Okanogan Sub-Basin Plans. Many of the individuals involved in watershed planning have been monitoring this process. It is the determination of the planning unit that there should be an extension of the comment deadline for the following reasons:

• Incomplete and inadequate information available for substantive comments.

Response: Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact.

• Public meetings provided only verbal/visual presentations without informational handouts or technical personnel to answer questions.

Response: Handouts were not always available at public or sub basin core team (SCT) meetings because work was underway immediately before, and often during, the meetings. The SCT, including technical members, have been using their available time to keep the process on track in order to meet a deadline imposed by the NPCC, and had little time to create polished handouts. As noted in Response 4, members of the public have been invited to join as participants in the process, rather than receive materials about it after the fact. Technical team members could not attend all public meetings, but did attend most of them.

• Failure to provide comment document in a timely fashion. (Several reported they had to make repeated requests for the draft and in fact received it between several days to one week after Feb 23rd Memo.)

Response: Delays in data processing (EDT model runs) resulted in delays in releasing the draft. The sub basin planning Coordinators sent the draft to all those who requested it, as soon as it was available.

• Unknown agency bureaucrats selected information and programmed computer models for subbasins before any public involvement.

Response: Technical staff (the HWG) did begin to organize and assess data prior to public involvement, with the intention of efficiently completing the very technical work prior to inviting public participation. Stakeholders were offered opportunities to comment and to participate in development of the subbasin assessment, including opportunities to review the data being used and comment on decisions made about the use of that data. HWG members were identified in a list sent to the entire sub basin planning outreach email list; HWG members were introduced at early subbasin core team meetings and lists of HWG members were posted at those meetings.

• Public meetings were generally held during the day when much of the public is working and not able to attend.

Response: The subbasin planning process occurred on a very fast-track schedule to meet a deadline set by NPCC. The schedule was difficult for all participants. Evening meetings would have required 2-3 times as many meetings to accomplish what could be done in one full-day meeting, and the schedule would not have allowed for that, nor would a heavy evening meeting schedule have been well received. Evening summary meetings were scheduled in an attempt to provide a window for the public who could not attend day meetings. The number of participants and meetings and the status of work often required changes in meeting schedules and locations, and this was a problem.

Since the full extent of how these plans will be used for water management are not known, we are concerned about the fast-track development at the expense of any meaningful public participation.

Sincerely,

Ronald E. Perrow

Chairman

# # # # # # # # # # # # # # #

March 10, 2004

TO: Okanogan County Water Resources

RE: Methow Subbasin Plan

Time for public comment was to brief.

Response: The comment period has been extended; comments on the first draft will be taken until April 16th. (The final draft will be available for review and comment on April 23rd.)

The document is not complete.

Response: Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact.

No public comment before EDT model runs were conducted.

Response: The sub basin planning process was designed to solicit and respond to stakeholder comment after the EDT run for each assessment unit. Comments regarding the data used and the outcomes will be incorporated in the findings for each assessment unit and will be considered in establishing priorities and management strategies for each sub basin.

No input from the Methow Basin Planning Unit was included before model runs were conducted.

Response: The Methow Basin Planning Unit was one of the key groups identified early in the sub basin planning outreach process. The group's participation was expressly solicited; Planning Unit members elected not to participate because completion of the Watershed Plan was demanding a great deal of time and energy during the period when sub-basin planning was initiated. Planning Unit members have been included in outreach efforts throughout the process.

The Methow Basin Planning Unit Rejected the EDT model, it's a black box we don't know anything about, it should not have been used. Because it was this plan looses credibility with the citizens of the valley.

Response: The NPCC required sub-basin planners to use either EDT or QHA. Planners in the Upper Columbia province elected to use EDT because it incorporates empirical data rather than relying solely on expert opinion.

Politics and state policy do show through bright and clear on page 22 – 6th paragraph. For the benefit of the Methow Basin please stop talking about lining our open canals. Look what was done to Skyline and Wolf Cr. It cost one million to destroy Wolf Cr. Now it's costing another million almost to fix it. Two million, it was working fine the way it was.

Response: The comment has been forwarded to the SCT.

Hannelor Vandenhengel

Box 533

Twisp, WA. 98856

# # # # # # # # # # # # # # #

Okanogan County Water Resources

Comments on Methow Subbasin Plan

March 10, 2004

The time allowed for responses was to short. Please extend it.

Response: The comment period has been extended; comments on the first draft will be taken until April 16th. (The final draft will be available for review and comment on April 23rd.)

The plan is not complete. The plan should have been complete. Putting out incomplete plans is a strategy that's used when you have something to hide, or something you don't want the public to see just yet. This reduces the publics response time overall on specific information that may be controversial.

Response: Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact.

It's my understanding that the Methow Planning Unit (PU) was not a part of this plan. The integration of all information in the planning process is key to successful planning. Your desire for citizen input in this plan seems a shame without input from the PU.

Response: The Methow Basin Planning Unit was one of the key groups identified early in the sub basin planning outreach process. The group's participation was expressly solicited; Planning Unit members elected not to participate because completion of the Watershed Plan was *demanding a great deal of time and energy during the period when sub-basin planning was initiated. Planning Unit members have been included in outreach efforts throughout the process.*

EDT model runs were made prior to input from the public. This process is backwards, unless your plan has a predetermined outcome, then public comments are just a nuisance and will probably end up in the trash can.

Response: The sub basin planning process was designed to solicit and respond to stakeholder comment after the EDT run for each assessment unit. Comments regarding the data used and the outcomes will be incorporated in the findings for each assessment unit and will be considered in establishing priorities and management strategies for each sub basin.

State agencies have ignored the possibility that recharge from unlined canals is a benefit. When I read page 22 I can see the plan was not based on science, just politics and state policy. The county and state have been represented on the PU. Why hasn't Okanogan County given direction as to the multiple benefits of recharge water form open canals as identified by the PU? Why hasn't the state seen to it that this information was incorporated in the Subbasin Plan?

Response: The comment has been forwarded to the SCT.

The determinations made by the PU do not jive with Washington state policy. So it seems the state has decided to go out on their own with backing from the NWPCC, using rate payer monies, ignoring the PU findings, and push state policy down our throats.

Response: Please note that the sub basin plan is permissive, not prescriptive. It includes a range of strategies that may be used depending on the limiting factors being addressed in a particular situation, and the characteristics of the project site.

Ken Bruce

488 Twisp-Carlton Rd.

Carlton, WA 98856

# # # # # # # # # # # # # # #

OC3 – OKANOGAN COUNTY CITIZENS COALITION LETTERHEAD

PO Box 1662 – Omak, WA 98841

Email: **oc3@northcascades.net**

United For Multiple Use Resources and Constitutional Government

To: Okanogan County Water Resources

Northwest Power and Conservation Council

From: Okanogan County Citizens Coalition

Date: March 5, 2004

Re: DRAFT Methow and Okanogan Subbasin Planning

Subject: Request for Extension of Comment Period

This letter is in response to the February 23rd Memo soliciting comments by March 11th from "Interested Stakeholders" for the Draft Methow and Okanogan Subbasin Plans.

Individuals from several OC3 member groups have been monitoring this process. Following reports/discussion at the March 2nd OC3 meeting, all those in attendance (delegates representing 13 member groups) unanimously approved a letter to request an extension of the comment deadline for the following reasons:

Response: The comment period has been extended; comments on the first draft will be taken until April 16th. (The final draft will be available for review and comment on April 23rd.)

Incomplete and inadequate information available for substantive comments.

Response: Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact.

Public meetings provided only verbal and visual presentations without informational handouts or technical personnel present to answer questions.

Response: Handouts were not always available at public or sub basin core team (SCT) meetings because work was underway immediately before, and often during, the meetings. The SCT, including technical members, have been using their available time to keep the process on track in order to meet a deadline imposed by the NPCC, and had little time to create polished handouts. As noted in Response 4, members of the public have been invited to join as participants in the process, rather than receive materials about it after the fact. Technical team members could not attend all public meetings, but did attend most of them.

Failure to provide comment document in a timely fashion. (Several reported they had to make repeated requests for the draft and in fact received it between several days to one week <u>after</u> Feb 23rd Memo.)

Response: Delays in data processing (EDT model runs) resulted in delays in releasing the draft. The sub basin planning Coordinators sent the draft to all those who requested it, as soon as it was available.

Unknown agency bureaucrats selected information and programmed computer models for subbasins before any public involvement.

Response: Technical staff (the HWG) did begin to organize and assess data prior to public involvement, with the intention of efficiently completing the very technical work prior to inviting public participation. Stakeholders were offered opportunities to comment and to participate in development of the subbasin assessment, including opportunities to review the data being used and comment on decisions made about the use of that data. HWG members were identified in a list sent to the entire sub basin planning outreach email list; HWG members were introduced at early subbasin core team meetings and lists of HWG members were posted at those meetings.

Since the full extent of how these plans will be used for land and water management and, more importantly, how they will impact private property and water rights; OC3 groups are concerned about the fast-track development of these plans at the expense of any meaningful public participation.

Sincerely,

Ronald E. Perrow

Chairman

CC: Okanogan County Commissioners

7th & 12th Dist Legislators

Congressman George Nethercutt

Senators Patty Murray / Maria Cantwell

Bonneville Power Administration, Administrator Steve Wright

NOAA Fisheries, Regional Director Bob Lohn

# # # # # # # # # # # # # # #

March 12, 2004

To: Julie Dagnon, Okanogan County Water Resources

From: Mike Gage

Re: Methow Subbasin Plan Comments

Julie,

The comment time on the Subbasin Plan was not along enough. There's a lot to read. Then you need time to digest it and respond.

Response: The comment period has been extended; comments on the first draft will be taken until April 16th. (The final draft will be available for review and comment on April 23rd.)

The subbasin Plan is not a complete plan, there's a lot missing. This means that in future drafts the public will have even less time to correct problems in the plan.

Response: Okanogan County's public involvement strategy has been to offer opportunities for involvement while the process was ongoing and work was in progress. The public has been invited to join as a participant in the process, rather than receive materials about it after the fact.

There has been no attempt to coordinate planning efforts with the citizens driven MBPU. This is not what was indicated by the county over one year ago. There is a feeling by some members of the MBPU that the county and state are trying to do an end run around the MBPU. I hope that's not true.

Response: The Methow Basin Planning Unit was one of the key groups identified early in the sub basin planning outreach process. The group's participation was expressly solicited; Planning Unit members elected not to participate because completion of the Watershed Plan was demanding a great deal of time and energy during the period when sub-basin planning was initiated. Planning Unit members have been included in outreach efforts throughout the process.

I have a problem with the EDT model that was used in the Subbasin Plan. The MBPU was not comfortable with EDT. We has our TAG member, Ken Williams review information regarding EDT, Ken recommended the MBPU not use the EDT model. Models can be manipulated and they are only as good as the data that's put into them. If you control the input of data going into the model you control the results the model will spit out. The MBPU was not allowed a part in the control of data that went into the Subbasin Plan. I now have no confidence in the model results. The citizens of the Methow Basin have been hammered, by state and Federal agencies to the point where we would be total fools to trust anything they tell us. The county sits on both planning groups, why didn't the county step in and ask that EDT not be used, you knew it was very controversial.

Response: The NPCC required sub-basin planners to use either EDT or QHA. Planners in the Upper Columbia province elected to use EDT because it incorporates empirical data rather than relying solely on expert opinion. Material addressing the deficiencies of EDT and the MBPU's rationale for rejecting it will be appended to the Methow sub basin plan.

Through the parts of the Subbasin Plan that I had time to read the plan talks about bringing things back to natural. Yes there Probably is less "natural" riparian habitat today than there was 110 years ago. But there is more riparian habitat over all in the Methow Basin today then there ever was naturally. RCW 90.82 is about not just protecting existing habitat but enhancing what we have. Today we have more trees in the basin than it ever had before the white man came. We have more habitat for wildlife than was here naturally. Because of our farming practices etc. we have more nutrients going into the streams, these enhance the food web providing more food for fish, thus increasing the fish populations by as much as 30% in some streams. Pollution is not a problem in the Methow Basin, nor is sediment. Mullan & Williams found that sediment was only 10% above natural levels. The gradients in the basin are steep and sediments are washed away causing no problems. Natural is not always better.

Response: A baseline of some sort is needed to provide a benchmark against which change can be measured. Where the baseline is set does not affect the focus of the assessment, which reflects the condition of the resource today. The baseline simply allows changes to be compared across reaches and streams. If the baseline were raised or lowered, relative change (compared to today's conditions) would remain the same. The issue remains the condition of the resource today and what to do about that. The sub basin plans do not advocate returning to a pristine baseline. Management strategies seek to return to properly functioning conditions when necessary for species recovery.

Page 22 is scary, the authors of this plan are still looking at unlined canals as being detrimental. These ideas come from state policy. State policy lags way behind good current science. This is another area where the county should have stepped in and contributed recharge information from the MBPU plan, the county didn't, now we have two plans that will be conflicting with one another in the direction they take. The county is creating a big mess, will the residents ever get out of it, and how much will it cost them in the end.

Response: The comment has been forwarded to the SCT. In addition, sub basin planning outreach staff met with the Methow Basin Planning Unit to address the issue on March 31st. Please note that the sub basin plan is permissive, not prescriptive. It includes a range of strategies that may be used depending on the limiting factors being addressed in a particular situation, and the characteristics of the project site.

Reading this plan has been irritating. After 20 years of trying to see the truth come out I now wonder if it ever will. I feel like a thief is going from door to door and window to window at my house, every time he finds a door locked and bared he tries another then he tries the windows, if one is locked he goes to another. Doors and windows keep appearing and I keep running around locking them and baring them but it never ends. You call for help and they send out more thieves to help the ones already there. The state wants our water, they will take it anyway they can. Next it will be our property.

MBPU members sent a letter of concern to the county and NWPCC. I am sending a copy of the letter and would like it to be part of my comments on the Subbasin plan.

Michael D Gage

Carlton

MBPU Letter enclosed with Michael D Gage's letter:

Northwest Power and Conservation Council

Bonneville Power Administration

Upper Columbia Salmon Recovery Board

Okanogan County Commissioners

RE: Sub-basin Planning

Attention: Sub-basin Planners

It appears that the Northwest Power and Conservation Council (NPCC) sub-basin planning process (SBP) initiated by Okanogan County, Colville Tribes and Washington Department of Fish and Wildlife for determining the restoration measures in the Methow Basin is flawed. The Methow Basin Watershed Planning Unit (planning unit) has not been included in this process. In fact the planning unit has not been contacted nor allowed input into this process. The planning unit was told the process was being initiated well over a year ago. We were told we would be receiving a letter from the SBP group asking that a representative from the planning unit sit on a board with the three SBP agencies named above to set the course in determining the restoration measures that would be taken in the Methow Basin, this never happened. Later we were told the SBP group would be attending a planning unit meeting to gather input in determining restoration measures, this has not happened.

Response: The comment letter was addressed to the NPCC; we are not sure what comment is appropriate from us.

We can not overlook the fact that the key to successful sub-basin planning is the integration of any efforts into the watershed plan developed by the planning unit. Further more the planning unit has been involved in watershed issues for the last five years with some members also having involvement in the Pilot Plan and Ground water advisory Board, which goes back to the 1980's. Due to the planning unit not being included in the SBP, the ingredients for good planning is not there. This is primarily because the studies and information developed by the planning unit are not being considered or included in the SBP. Thus your desire for local expertise is not even represented.

Response: The subbasin planning process occurred on a very fast-track schedule to meet a deadline set by NPCC. The schedule was difficult for all participants. Evening meetings would have required 2-3 times as many meetings to accomplish what could be done in one full-day meeting, and the schedule would not have allowed for that, nor would a heavy evening meeting schedule have been well received. Evening summary meetings were scheduled in an attempt to provide a window for the public who could not attend day meetings. The number of participants *and meetings and the status of work often required changes in meeting schedules and locations, and this was a problem. Because most of the SCT meetings were held during the day, a summary meeting was held to accommodate those stakeholders who were not able to attend day-time meetings. The MBPU's schedule was a factor in choosing the meeting date; the sub basin coordinators chose an evening on which the MBPU had decided not to meet. After the SCT meeting had been scheduled and advertised, the MBPU decided to hold a meeting on the same evening. While the conflict was regrettable, the coordinators did not think it would be fair to other members of the public to cancel a meeting that had already been advertised. Sub basin Planning outreach staff met with the MBPU on March 31st to discuss the sub basin plan and receive comments. The Methow Basin Planning Unit was one of the key groups identified early in the sub basin planning outreach process. The group's participation was expressly solicited; Planning Unit members elected not to participate because completion of the Watershed Plan was demanding a great deal of time and energy during the period when sub-basin planning was initiated. Planning Unit members have been included in outreach efforts throughout the process. The NPCC required sub-basin planners to use either EDT or QHA. Planners in the Upper Columbia province elected to use EDT because it incorporates empirical data rather than relying solely on expert opinion. Material addressing the deficiencies of EDT and the MBPU's rationale for rejecting it will be appended to the Methow sub basin plan.*

While some efforts have been made to make this process know to the planning unit this ignores the fact that the planning unit is on a fast track to complete its plan, and that the planning unit was told that this process would be integrated with watershed planning. It now appears that an end run is being made around the planning unit because there has been no contact nor integration attempted and because the SBP effort is creating a demanding schedule in parallel with the planning units heavy schedule.

In observing these things there is a real fear that efforts such as this will create conflicting or duplicate planning. This is reinforced by the fact that recent key meetings have been held during the day or in conflict with the planning unit meetings. This has eliminated in effect comments that could be provided by experienced planning unit members. Also sub-basin planning is being done without integration of the planning unit priorities. One such priority is that the planning unit on advise from its TAG rejected the EDT modeling technique as a valid tool for assessing habitat conditions and functions in the Methow Basin. This has not been considered by the SBP. The planning unit TAG recommended that an actual habitat assessment be completed focused on what the fish are doing in relation to existing habitat conditions. The planning unit was not able to do this because of funding and time constraints.

Furthermore how can there be valid input if the model runs are already one without citizen or planning unit input? The invitational letter shows that the Upper Columbia Salmon Recovery Board is doing the integrating. They are forming an overall strategy not a Methow Basin specific strategy. The planning unit has specifically made provisions for future planning by setting up a Methow Watershed Council (MWC). The SBP should be seeking to make provisions to integrate its efforts with the planning unit and in the future with the MWC. Without such considerations it is our belief that the SBP group is doing an end run around the state legislature which specifically intended that watershed planning be done by the local citizens. Salmon recovery was a key component of the watershed planning act.

There are too many mandates and differing agendas not based on real science, which in the long run look to be more damaging to the environment than helpful. Such pitfalls should be avoided and agencies responsible for funding restoration and recovery efforts are obligated to see that the process was not done incorrectly, and that funds were spent wisely.

Would it be appropriate for you to come directly to the planning unit for recommendations on recovery and funding projects?

Please send your responses to:

Methow Basin Watershed Planning Unit

PO Box 247

Twisp, WA 98856

Signed by:

Marty Williams – Planning Unit Member

Ron Perrow - Planning Unit Member

Mike Fort - Planning Unit Member

Mark Love - Planning Unit Member

Karla Christianson - Planning Unit Member

John Umberger - Planning Unit Member

Michael D Gage - Planning Unit Member

Dick Ewing - Planning Unit Member

Fred Colley - Planning Unit Member

Ray Campbell - Planning Unit Member

Gary W Erickson - Planning Unit Member

Cc: Sen. Linda Evans Parlette

Sen. Bob Morton

Rep. Cary Condotta

Rep. Michael Armstrong

Rep. Bob Sump

Rep. Cathy McMorris

# # # # # # # # # # # # # # #

April 13, 2004

TO: Okanogan County Water Resources

Northwest Power and Conservation Subbasin Planning

123 North 5th Avenue Rm. 110

Okanogan, WA. 98840

RE: Methow Subbasin Plan

In 1999, Okanogan County, the Town of Twisp, the Methow Valley Irrigation District (MVID), and the Colville Tribe established themselves as "initiating governments" for the watershed planning process, and began developing a stakeholder group, now called the Methow Basin Planning Unit, or MBPU. Members of the MBPU represent the diverse interests in the Methow Valley, and the group has been meeting regularly for about five years.

The MVID represents about 200 members. The Methow Valley Canal Associates (MVCA) is also represented on the MBPU and has about 90 members. I have represented the MVID and the MVCA for just about 5 years. I have concerns with the Methow Subbasin Plan (MSP). Why wasn't the MBPU involved in the MSP? Its true a meeting was set up between the MBPU and the MSP but this happened only after the plan came out for public review and after many comments and complaints over this. The group of MBPU members that attended the meeting were given a lot of lip service. We were told that you realized things were not done right, but tough you were going forward anyway. I guess we'll see if any of our comments will be incorporated in the next draft.

The legislature felt that the local development of watershed plans for managing water resources and for protecting existing water rights was vital to both state and local interests. The development of such plans serves the state's vital interests by ensuring that the state's water resources are used wisely, while protecting existing water rights and ESA listed fish, and by providing for the economic well-being of the state's citizenry and communities.

Okanogan County was sent a letter of concern from members of the MBPU, and I was one of those concerned members that signed on to the letter. Okanogan County Water Resources replied to the letter, but did not address the concerns of the MBPU members. The counties reply was just a whitewash. This sends up red flags of warning.

On page iii – you state coordinators delivered briefings to interest groups, and you have a list of interest groups that were included in the MSP. The MBPU is a much larger interest group with about 26 stakeholder groups being represented. The MBPU was told over a year ago we would be included in the MSP and would have a member sitting on your board, this never happened. The MBPU was latter told the MSP group would be attending a MBPU meeting to get input from the MBPU, it never happened. It appears you have misrepresented your intentions and were purposely avoiding the MBPU.

On page iv – you mention EDT, the model used to develop your management strategies. The EDT model is a black box, the public is keep in the dark as to how it works. The MBPU TAG rejected the EDT modeling technique as a valid tool for assessing habitat conditions and functions in the Methow Basin. The MBPU TAG recommended that an actual habitat assessment be completed focused on what the fish are doing in relation to existing habitat conditions. Furthermore the model runs were already done without citizen or planning unit input. When asked for the information that was feed to the model I was not supplied with it but was told there was to much paper to deal with. At this time I do not know what information was feed to the EDT model. Was the information any good? Was the information controversial? There was no information/input from the MBPU, nor from local citizens that went into the EDT model. Models can be manipulated just like a crooked roulette wheel, the person in control of the wheel will get the numbers he wants. More red flags.

On page xii – the Methow Basin Summary is mentioned. The Methow Basin Summary was done using the limiting factors review. The MBPU was to have input on the Limiting Factors Review, MBPU TAG member Ken Williams reviewed it, Ken stated it should not go to print in its presently written form. Many MBPU members also had input on the Limiting Factors review and were waiting for Ken to finish his review so all input from the MBPU could be included at one time. The review and the comments from the MBPU were never looked at because the Limiting Factors Review was completed without the MBPU input being allowed. The MBPU was never told what the comment closing date was. The County Water Resources head at that time was Dennis Beich, Beich was also the county representative to the MBPU and at this time MBPU chair. Carmin Andonaegui, Washington Conservation Commission, was writing the limiting factors review. Carmin was living with Beich as his girl friend at the time the Limiting Factors Review was written. Beich was dealing with Ken Williams and was the MBPU go between. When the review was completed Beich said sorry to late for comments the Limiting Factors is finished and its being printed. So errors in the Limiting Factors Review were never corrected these errors then were included in the Methow Basin Summary, then were they feed into the EDT model? Garbage in garbage out.

I gave input on the Methow Basin Summary, I asked that winter be recognized as the bottle neck for fish production, I asked that Mullan and Williams statement "Irrigation at current levels in the Methow River Basin, may be more beneficial than detrimental to salmonid habitat because of its positive influence on groundwater" be included and researched. I thought these were key elements in planning but they were not included in the final product, except Ken Williams review was put in an appendix after much debate with Dennis Beich now the regional head for WDF&W. All three of the above mentioned plans had a very limited amount of time in which to do them. It was rush, rush, rush, no time for this, not enough time to do that. Why is the BPA in such a hurry to spend rate payers money. From the Limiting Factors Review to the Methow summary to the Methow Subbasin Plan the whole process has been questionable and there are a lot of red flags.

On page xii – at the bottom of the page are a number of important headings that are not complete, why? If you don't know what the Subbasin Goals, Recovery Goals, and the Vision Statement is by now there is a problem. Why didn't you complete all these headings? The plan is incomplete, how did you even make the model runs without some of this information, and the model should have provided the information for the rest. More red flags.

On page 22 – the plan talks about the lining of irrigation canals, you say this plan is based on science, what science has been done in the Methow Basin, that is worth anything, where it has been determined unlined irrigation canals are detrimental. Those of us that have been involved in water planning know, in the Methow Basin unlined canals are beneficial. Transportation water does recharge the water table. This recharge occurrence is but one of the multiple benefits derived from irrigation water rights.

Data provided by the USGS shows that recharge water is significantly delayed in its return to the river. Because of the delay in returning to the river, and other factors, the MBPU has determined that recharge water has many benefits. These benefits have been known by local residents, and were mentioned in previous studies by Mullan and Willams and by Buell & Assoc. The DOE has refused to recognize these benefits, and has even denied their existence.

We have seen the negative affects caused by piping unlined canals in the Wolf Creek area. The lowering of the water table, loss of wet lands, and unseen at this time or at least not admitted to, the lost of instream flows for fish during the winter bottle neck. Everyone on the valley floor is a secondary water user of water from an unlined irrigation canal. Wake up, don't screw with our ground water. All of these benefits are supposed to be protected by state agencies like the DOE and WDF&W. I'll bet none of this recharge information went into the EDT model.

<u>The plan and the whole process should to be reevaluated.</u>

I have not had time to fully review this plan, its doubtful if anyone has had sufficient time to fully review the MSP.

The plan is incomplete and should not have been set out for review until it was complete.

The final USGS data was not incorporated into the plan nor does it look like the final USGS data was feed to nor part of the EDT modeling.

Information fed to the EDT model may have been incorrect. If information from the limiting factors review was used, or if information from the Methow Subbasin Summary was used, that information may have been wrong because of errors found by the MBPU TAG review. These errors in the Limiting factors Review were never corrected and were passed on to the Methow Subbasin Summary and would have corrupted the EDT models findings.

Information submitted by me on irrigation benefits and the winter bottle were not included in the Methow Subbasin Summary. This was information key to the EDT model and it appears this information may have been purposely left out.

Transportation water from unlined irrigation canals has multiple benefits which need to be protected and not ignored nor done away with as suggested on page 22. Recharge projects will increase instream flows for fish through the entire year, particularly during winter, the bottle neck for fish production. Groundwater recharge projects should be at the top of the funding list. Recharge projects are not mentioned in the MSP, why?

Ratepayer monies are being spent on this process so make sure the process is done right, and is above board. Right now the process is very questionable.

Michael D Gage

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PUBLIC COMMENTS RECEIVED ON THE APRIL 23, 2004 – MAY 10, 2004 DRAFT METHOW AND OKANOGAN SUB BASIN PLANS

Public Comments on Methow Basin Draft Subbasin Plan

Bailey / Boshard, submitted May 10, 2004

Page 1 of 8

Public comments submitted for inclusion in Methow Subbasin Plans

Prepared by: Larry Bailey, Michelle Boshard Phone: 509 486 2400

Submitted to J. Dagnon, Okanogan County Water Resources Coordinator

May 10, 2004

Methow Subbasin Plan

General comments:

1) The plan is grossly incomplete in content (many sections and/or discussion of critical tables and reference documents are not provided in the text where they are brought up—to the point where it is not ready for presentation / understandable). Some sections appear to just be incomplete with notes left for what to include, which might indicate the writers have not met time deadlines for production. This document is marginally better in places than the Okanogan plan in terms of pointing out and acknowledging things like gaps in knowledge which need to be addressed to better implement priorities and projects.

2) Plan is incomplete in presentation (critical tables and figures are missing which makes it impossible for full understanding by public, not to mention that not all the supporting material was made available)

3) Plan lacks professionalism, even for a draft (spelling errors, formatting issues which make it difficult to navigate the document)

4) The document was dated April 23, 2004. The deadline for public review is May 10th, 2004. The article in the newspaper (Omak Chronicle) letting the public know the plan was even available for review did not occur until April 28th. This left effectively 10 days for the public to review the document, which was not posted on the internet in all the places it said it would be (not on County Water Resources website as of April 30, 2004) and copies not easily made available for pickup for public to review when they could (i.e. they would have to photocopy the 400 of 1600 pages made available themselves, or sit in the library for hours). Additionally, the full document was not made available. This is a grossly insufficient amount of time even for the "pared down" version of the document. It took a team of agency people and consultants a year to produce the document and it still appears to be incomplete. The fact community groups and/or local governments could not take this back to regular monthly meetings because they did not have enough time, and that they did not have access to major sections important for understanding the document make it impossible for the kind of review needed to approve the plan and claim stakeholders were involved.

5) There is no evidence that this plan has been based on anything that the public or stakeholders desire(s) or consider(s) important, despite the fact NWPPC and these planning exercises were "created by Congress to give the citizens of Idaho, Montana, Oregon and Washington a stronger voice in determining and balancing the future of key resources". There is a complete lack of appendices of any public feedback, opinion, questionnaires, responses to inquiries or requests for public input anywhere in the document. No information is available on the already completed public review that was supposed to have occurred during the development of the plans.

6) This plan vastly out of step with current thinking regarding the way agencies in the Columbia Basin should be approaching planning exercises such as the Subbasin process. Executive Director of the Columbia Basin Fish and Wildlife Authority, told the Columbia Basin Bulletin, 'Agencies have to come to grips with the idea that they have to let loose of the controls. They have to lead from behind. This is not about controlling people and making them do things. It's about enabling them to do their best. People really respond to that. The vast majority of people want to do things to make things better. But mostly they don't have the ideas of how to do it. Or they don't have the resources to get it done.' ".

Response: Comment noted. An extensive and responsive public outreach program was conducted; see appropriate plan appendix. The subbasin plan needs to be edited to be more concise, rather than to include more technical information. Supporting technical information can be found in the references cited by the plan. See response to comment S3-S4 regarding public involvement. Prioritization for fish and wildlife is being developed and will be included in the formal draft plan that will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

7) Executive Summary: Vision. The vision statement in this plan is verbatim what is stated as in the Okanogan Plan. The Methow and the Okanogan subbasins are different landscapes physically, socially and economically and require very different solutions tailored to suit the people/demographics, landscapes/impacts and local resource restoration needs. The vision statements of both the Okanogan and Methow plans, if truly based on the individual subbasin and the stakeholders in it, are not likely to be exactly the same. This indicates that the vision comes from the writers of the plan rather than from a collective understanding and agreement reflected in a statement generated by stakeholders based on that basin's needs. What is written just sounds good and is generic enough not to really mean anything in either basin. It does not reflect useful vision which achievement can be measured against in any real terms, which is the point of this plan.

Response: The vision statement is intended to provide broad guidance for future desired conditions. The objectives and strategies are specific to the subbasins and stream reaches.

8) See other comments in Okanogan Subbasin Plan "General Comments" Section.

Specific comments:

1) Section 2.1 Subbasin Assessment--Subbasin Overview. Plan states it will solve challenges facing the Methow by “providing a compendium of resource information and the tools to empower planners and decision-makers to implement programs appropriately and in a coordinated manner at the local level”. The goal of this document was to provide such a plan, not the tools for others to make the plan.

Response: The subbasin plan is not intended to be prescriptive but to provide a framework for implementation.

Public Comments on Methow Basin Draft Subbasin Plan

Bailey / Boshard, submitted May 10, 2004

Page 3 of 8

2) Section 2.1 –Methow watersheds. No simplified comparative impact scale summary provided to help understanding of prioritization of restoration projects and funding expenditures.

Response: The subbasin plan is not intended to address impacts but to assess current condition of habitat for fish and wildlife recovery. It does not identify and prioritize specific projects or funding.

3) Section 2.1 –Anthropogenic Disturbances. No inclusion of public / landowner perspective on results of these disturbances and impact to them as given by the public/ landowners. Neither is there recognition of the considerations resulting from those issues that later will affect the plan implementation, and how to deal with them. This plan is not occurring in a vacuum and will need to deal with these realities. There is no background or linkages to other major initiatives in the area involving public in watershed planning and dealing with anthropogenic disturbances, nor inclusion of reports on already accumulated consensus on how to deal with anthropogenic and social issues.

Response: The subbasin plan is based on an objective habitat assessment and an extensive and responsive public outreach program; see appropriate plan appendix. The Subbasin Core Team sought public involvement to address the issues raised in this comment.

4) Section 2.1—Terrestrial Wildlife Relationships, Special Plant Species. Not provided.

5) Section 2.2—Focal Species: Population Characterization and Status. Although technical reasons for species selection (and the impacts causing the selections) are provided, there is no information on what implications plans for restoration of these species will have for public, landowners and other stakeholders, nor is there information on how or where the restoration will occur and who will be responsible, which is what the plan is meant to do. Sections such as “Population Management Regimes and Activities “, “Ecologic Effects / Relationships”, “Relationship with Other Species” and other more basic technical information are not provided for some species. The prioritized list of limiting factors for each species and how these limiting factors compare to the limiting factors of other selected focal species in order to determine which

species to fix first is neither provided nor discussed in the text in this section. It is impossible for the public to assess and provide feedback on these plans and their impacts to the public when no information is provided to the public on these issues. If it is not completed, it also seems difficult for agencies to determine priorities based on this information and comes across as a regurgitation of what is already known.

Response: Focal species were selected to be representative of a broad range of habitat types located within the basin. It does not exclude other species from consideration. The subbasin plan develops strategies for species recovery; it is not intended to address the effects of species recovery on landowners and other stakeholders. It addresses action strategies; it does not identify specific projects. Prioritized limiting factors will be provided in the formal draft plan that will be posted for public review from June 5 through August 12, 2004 on the NPCC website. S3, S4: *An extensive and responsive public outreach program was conducted; see appropriate plan appendix.*

6) Section 2.3—Environmental Conditions, Changes in Wildlife Habitats. Plan only briefly states that major land use changes have cause shifts in critical habitat-type shifts which affect the focal species, but does not discuss or reference technical or objective documents which demonstrate what these implications mean. Neither does it provide references to support the statement that "subbasin wildlife managers, however, believe that significant physical and functional losses have occurred to these important wetland habitats from hydroelectric facility construction and inundation, agricultural development, and livestock grazing." This seems to be either a subjective impression by agency employees which is unsupported or contradicted by their own data, or an unexplained "group conclusion" of the SCT for which no explanation was provided.

It appears landowners or industries influencing the land use changes and habitat itself were

not consulted despite the fact their livelihoods depend on having a significant amount of this knowledge. While feedback from such sources is not scientific in nature, the plan writers themselves admit that the technical bases which agency employees use to make their determinations (e.g. IBIS databases etc) are not accurate. This results in a "we don't have a clue, and we haven't asked anyone who lives there, but we're going to plan anyway" approach which is no longer a scientific debate but a political contest in which the public and landowners don't have an even footing, and often lose.

Response: The comment is not clear.

7) Section 2.3—Environmental Conditions, Re-iteration and Expansion of the Guiding Principles. The plan begins this section by stating "The economic, cultural, and social valuation of fish resources is derived from the characteristics of the ecosystem that supports them" and then launches into technical prioritizations of ecological objectives set by agencies and their technicians (most of which were developed without specific or broad public input in regards to the impacts at local levels where priorities would be applied). The premise that this argument is

built on—the statement that economic values are determined by the ecosystem—is fundamentally untrue. It is not surprising that fish and wildlife scientists writing this plan do not have a firm grasp on economic realities, which are determined by social, cultural and market values not in their realm of expertise. But this affects the appropriateness of the plan because the logic thread proposed by the technical people seems to be basically that "the economy is based on the health of the environment/ watershed and its capacity, which we measure in focal / indicator species performance, and that if we set and meet the objectives we set for how a certain fish does it therefore improves (or meets objectives set by community for) the economy, and furthermore that science technicians would know best about that without asking the local community or researching what economic plans are already in place". There is no true inclusion of economic, social or cultural values referenced or included at all in the priorities set by the Regional Technical Committee (RTT), likely because the RTT is a strictly (and self-admittedly) defined technical body that doesn't deal with non-science issues. There is a vast amount of economic and cultural information in relation to the environment and economy, derived locally and paid for with public money in order that they be specifically included in plans like this, which are not included in this plan. Yet the writers of this plan insist the priorities set by the RTT "reflect a synthesis of goals and objectives from the various management plans directing tribal, state and federal agency policies within the Methow Basin." This is a specific demonstration of how science and government agencies are using their argument (made later in the paper) for separating policies (which they say specifically in the plan should be based on public goals) from the "how to get there" (the guiding principles for technical priorities). This excludes the opportunity for public to comment on specific application. This is a kind of sleight of hand saying "we want technically sound plans and we are technical people so we didn't collect social data--that's the policy department" while the policy department says " we

base our policies on scientific data and broad public goals our agency is given" without referencing or collecting the local economic and social community information a specific subbasin plan should be tied to and of which there is a vast amount. This process therefore never allows for the ground-truthing and reality checking and may cause Public

subbasin plans to be rejected by the public due to conflicts with community interests and ongoing initiatives, not to mention they will be useless to project proponents in seeing where they fit in the big picture in this regard.

Response: The subbasin plan presents broad guiding values and goals in its vision statement. It is not intended to develop these in the body of the plan. The formal draft plan will be edited with this in mind.

8) Section 2.3—“Relationship of Scientific Conceptual Foundation to Subbasin Goals” Not provided (see above—affects publics ability to understand how exactly their needs and interests have been considered or not).

9) Section 2.3—Historical conditions, current conditions, no-action conditions, or future desired conditions are not provided.

10) Section 2.3—“Out-of-Subbasin Effects” and “Environment/Population Relationships” not provided.

11) Section 2.6— Synthesis Of The Most Important Factors For Decline. Plan states it will “summarize and compare some of the central findings and conclusions offered in a number of key reports”. Although a lengthy regurgitation of ideas from obviously libraries of information, this section does not then provide a meaningful discussion or prioritization of what the central findings of the current knowledge base mean, or indicate what should be done further based on common knowledge. The plan subsequently states that ”to date no quantitatively structured analysis of limiting factors has been reported in the documents discussed here. Such analyses are being considered or planned using EDT or QHA. Until those analyses are published these qualitative assessments will have to suffice.” This seems to mean that this subbasin plan, although it could not provide what it was supposed to, was done anyway, and without public input. It does therefore not meet the task assigned for the plan, and admits to itself this plan is not what it is supposed to be. The public cannot make an assessment of this plan based on either its content, or how it meets the goals set out for itself if it is has not been written to respond to the goals set out for it. Even if it manages to get by the public because of the short review period, it will likely never gain true public support and implementation, but instead will either sit on a shelf or draw lawsuits and opposition.

Response: Prioritization for fish and wildlife is being developed and will be included in the formal draft plan that will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

12) Section 2.6—Synthesis and Interpretation of Assessment in regard to Terrestrial / Wildlife. Plan states “Subbasin assessment conclusions are identical to those found at the Ecoprovince level for focal habitat types and species. An assessment synthesis is included in section 6 in Ashley and Stovall (unpublished report 2004).” The draft then has a comment which reads “Need more wildlife material summarizing conclusions

here??”. This is evidence of the derivative “cut and paste” nature of the document and unnecessary padding after conclusions are already drawn, perhaps to distract from the obvious lack of content in the plan. This section does not draw ecosystem linkages across fish and wildlife priorities in assessment units or discuss how separate fish and wildlife projects will be prioritized for maximization of funding efficiency.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. Missing information will be included in the formal draft plan will be posted for public review from June 5 through August 12, 2004 on the NPCC website. Agree that linkages across fish and wildlife priorities are not made, and represent an unfinished agenda that should be addressed in future plan update or implementation.

13) Section 2.6—Fisheries Assessment Methodology. Section does not provide the rationale for the basis of the "exceptions" made during technical prioritizations, was this because they didn't fit the model? If so, how do those exceptions relate to real life impacts on fish—which is the priority, not making the model run smoothly.

Response: Exceptions included some reaches where sediment load or temperature only had a high impact to spawning or egg incubation. Additionally, a survival factor was considered a primary limiting factor if there was small to moderate impacts across most (9-12) life stages, thereby producing a cumulative impact that could be just as severe as high and extreme impacts to fewer life stages. Secondary limiting factors generally had small to moderate impacts to several (5-8) life stages. An exception occurred with the survival factor "food"; when there was small to moderate impacts to two or three juvenile life stages in most of the reaches of a particular assessment unit then we considered it a secondary limiting factor. To clarify further, the assessment of a given reach may or may not result in a rating for a particular attribute that denotes "poor" or altered habitat conditions. However, if it is rated as altered, and if fish spend little time in this reach, or if the reach is not specifically tied to a life history phase where the condition would cause mortality (e.g., high sediment in a migration reach), then the planners refrained from citing this as a primary or even a secondary limiting factor. This is because for the reach in question the habitat condition, in and of itself, may not necessarily result in direct mortality or even "harm,".

14) Section 2.6—Strengths and Weakness of Assessment Methods / Data Availability and Quality. Not provided. This section is critical to public's ability to assess the plan in terms of the appropriateness of use based on the model used and the data it generates, on which assumptions for plan are based. Just like the IBIS database, we cannot make plans on incorrect models—no crosscheck process is outlined to verify findings.

Response: Missing information will be included in the formal draft plan will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

15) Synthesis of Key Findings. Not provided. Social and economic implications for landowners and public not discussed.

Response: Missing information will be included in the formal draft plan will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

16) Integrated Priority Assessment Units. Plan states "The integrated priority list for restoration and protection can be seen in tables Table 50 and Table 51, respectively." Not provided.

Response: Missing information will be included in the formal draft plan will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

17) Plan states "We also integrated the inter-species priority list with the assessment unit limiting habitat attribute summary analysis to provide a matrix of "where" and "what" needs restoration in the Methow Subbasin." Not provided.

Response: Missing information will be included in the formal draft plan will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

18) Section 3. Inventory of Existing Activities. This section provides a text summary (some of which is inaccurate) of the groups in the region, but does not provide an assessment of what projects are fulfilling what priorities found in the analysis, how they will be tied together, cost-saving analyses etc for review. Although this would be the foundation piece to a sound management strategy acceptable to the public (is not provided for their consideration), a detailed management strategy and approach is then subsequently proposed for consideration in the following sections. This seems to indicate that despite needing to work with existing bodies and stakeholders already undertaking activities / implementing plans or listening to the public about what will work on the ground in consideration of technical issues, planners are forging ahead alone. The management strategies later proposed do not refer to or link to appropriate sections of other plans by other groups. The writers then refer to their own flawed argument of "mixing of conceptual foundations" (i.e. keeping public policy and technical separate) as

the reason things aren't working, and as a reason for ignoring anything but technical

considerations. The plan states "Too often in the past, the implementation of inappropriate strategies was made possible by altering the science (conceptual foundation) until it was consistent with the favored strategy. That was possible as long as the conceptual foundation remained unstated and hidden from view. In some hatchery and harvest management programs, as well as salmon restoration programs, scientific knowledge was suppressed or "bent" in order to justify the desired strategies". While this is an expectable backlash by science to political decisions which have damaged salmon stocks in the past, it implies another "technical only" solution created in a vacuum rather than a balanced one. Generally judgments made are inappropriate, and the plan's proposed directions do not even live up to its stated plan goal of balancing science, policy and on-ground local community/public needs, concerns and interests (economic and social issues).

19) Section 4. Management Plan. Our Vision for the Methow subbasin. Given the fact that any local and specific watershed based data, public involvement and conceptual conflicts discussed above are not provided or do not exist, the entire Section 4—the Management Plan for the future—becomes entirely suspect as to whether it will work in the Methow at all. Likewise for

the Okanogan plan, despite the fact that both plans state in their "Specific Planning Assumptions" portion that "the ultimate success of the projects, process, and programs used to implement the sub basin plan will require a cooperative and collaborative approach that balances the economies, customs, cultures, subsistence and recreational opportunities within the basin with the federal/state mandates to protect fish and wildlife." This plan does not reach this goal in process, content, or direction.

Response: Comment noted.

20) This plan does and will not allow the specific goals in the "Specific Planning Assumptions" section to be reached, including 1) that "The Bonneville Power Administration should make available sufficient funds to implement projects developed within the framework providing by this plan in a timely fashion", because it does not provide the list for funding, and 2) "participation of stakeholders, local and regional planning organizations and/or groups in implementation of subbasin plans should be fostered to the fullest extent possible or where appropriate", for reasons discussed above.

Response: Comment noted.

21) Section 4.1 Recovery Goals. These goals and opinions are not goals as reflected by landowners and public to truly make this plan a reality, but rather either the incomplete or unprovided technical / scientific agency-based goals and priorities (sections 4.2 through 4.4) which may or may not be reachable, given local realities and considerations not incorporated in this plan. Of the five criteria listed presumably for determining for recovery goals (none of which are actually provided or discussed for comment), the community and social considerations (a.k.a. "social based criteria" which presumably

refer to the direct impacts to the landowners and public this plan will have) are listed last,

below even the way agencies administrative way will handle the money to come for the projects they have not prioritized yet. This shows exactly the level of interest by planners in ensuring the local community and stakeholders are involved in the plan.

Response: An extensive and responsive public outreach program was conducted; see appropriate plan appendix. The Subbasin Core Team sought public involvement to address the issues raised in this comment.

22) Section 4.7—Recommendations For Monitoring In Subbasin Plans. Plan states "Both top-down, and bottom-up approaches are necessary to develop a regional monitoring plan. Generally, subbasin plans embody the bottom-up approach, as they will contain input from a wide range of stakeholders and provide professional input from those who are most familiar with the logistical needs for these programs. When first written two years ago, the requirements for the monitoring

components of subbasin plans also followed this philosophy, recognizing that the majority of on-going monitoring activity is at the project and subbasin scale.” This plan does not provide a strategy for this. Plan lacks specificity on monitoring needed for this basin and the priority projects planned or ongoing that require monitoring. Misses one of the most cost-effective and beneficial strategies for accomplishing monitoring by not including where, when or how community can be involved in the monitoring, its synthesis, priority development, projects or initiatives to effect improvement of habitat as a result of good monitoring. Noone knows their river or their land better than the landowner or local community members. The public is a vast untapped resource which enjoys and would like to help in resource protection and restoration. Employing volunteer monitoring programs provides cost-effective leverage, relationship building, public outreach opportunities that can never be realized by conventional agency approaches. Well developed, coordinated, supported and funded it can even reach the landscape scale at which the agencies cannot. It requires training, quality assurance and control measures, and consistency in funding support but is a far more cost-effective mechanism for monitoring than currently spent monitoring dollars can do when used in a conventional manner. There are many regional, statewide and national organizations ready to help with a program that makes sense. The fact that this is not included in the plan is a major omission and flies in the face of the plan’s stated goals of “inclusion of communities of science, interest and place”.

Response: The monitoring plan was completed in April 2004 is now available for public review of the NPCC website.

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Public Comments on Okanogan Basin Draft Subbasin Plan

Bailey / Boshard, submitted May 10, 2004

Page 1 of 8

Public comments submitted for inclusion in Okanogan Subbasin Plans Prepared by: Larry Bailey, Michelle Boshard Phone: 509 486 2400

Submitted to J. Dagnon, Okanogan County Water Resources Coordinator

May 10, 2004

Public Comments on Okanogan Basin Draft Subbasin Plan

Bailey / Boshard, submitted May 10, 2004

Page 2 of 8

Okanogan Subbasin Plan

General comments:

1) Plan is incomplete in content (many uncompleted sections—to the point where it is not ready for presentation, some sections appear to be incomplete or hold some outdated information). It does not draw conclusions for the reader to consider and debate.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

2) Plan is incomplete in presentation (tables and figures are missing which makes it impossible for full understanding by public, not to mention that not all the supporting material was made available)

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

3) Plan lacks professionalism, even for a draft (spelling errors, formatting issues which make it difficult to navigate the document)

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

4) The document was dated April 23, 2004. The deadline for public review is May 10th, 2004. The article in the newspaper (Omak Chronicle) letting the public know the plan was even available for review did not occur until April 28th. This left effectively 10 days for the public to review the document, which was not posted on the internet in all the places it said it would be (not on County Water Resources website as of April 30, 2004) and copies not easily made available for pickup for public to review when they could (i.e. they would have to photocopy the 400 of 1600 pages made available themselves, or sit in the library for hours). Additionally, the full document was not made available. This is a grossly insufficient amount of time even for the "pared down" version of the document. It took a team of agency people and consultants a year to produce the document and it still appears to be incomplete. The fact community groups and/or local governments could not take this back to regular monthly meetings because they did not have enough time, and that they did not have access to major sections important for understanding the document make it impossible for the kind of review needed to approve the plan and claim stakeholders were involved.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

5) There is no evidence that this plan has been based on anything that the public or stakeholders desire(s) or consider(s) important, despite the fact NWPPC and these planning exercises were

"created by Congress to give the citizens of Idaho, Montana, Oregon and Washington a stronger voice in determining and balancing the future of key resources". There is a complete lack of appendices of any public feedback, opinion, questionnaires, responses to inquiries or requests for public input anywhere in the document. No information is available on the already completed public review that was supposed to have occurred during the development of the plans.

Response: Extensive public outreach was conducted; please see appropriate plan appendix. Public review comments are provided as an appendix to the plan.

6) Plan does not provide an overall clear prioritization of fish and wildlife initiatives, projects and activities in basin for funders to contribute towards as their funding envelopes allow.

Response: Prioritization for fish and wildlife is being developed and will be included in the formal draft plan that will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

7) Plan's "Vision" and foundational principles seem to be limited to tribal and tourist perspectives—those of residents and community organizations and initiatives of their interest are not included at all, or are not referenced. This does not reflect the citizenry of the region as shown in the demographic profiles.

Response: The vision statement was created in a collaborative process through the Subbasin Core Team and included a broad range of interests.

8) Plan does not articulate (or give examples of) how this plan will relate to, or help coordinate multiple existing operational and budgetary linkages of other planning and program documents at all the levels of government. It does not identify how any or all of these plans relate to, or could leverage cost-saving opportunities in conjunction with, major efforts and initiatives by non-profit and community organizations. This plan is supposed to provide a prioritized list of projects and initiatives for the future, inclusive of those of non-agency community origin, which all regional partners and the public agree can be participated on and that hydropower mitigation and other funding should be spent on. This plan does not include the community projects and initiatives into that prioritization.

Response: The subbasin plan's relationship to other concurrent planning process is addressed in plan's inventory section. The subbasin plan is not intended to propose specific projects and initiatives.

9) Overall quality of the plan is neither commensurate with the time and energy, technical knowledge and ability of bureaucrats, staffers, and consultants working on it, nor the level of funding spent to date considering what has yet to be spent and the drastic improvements needed.

10) Overall this comes across as a very expensive library "cut and paste" exercise with nothing new learned and no strategies or action plans proposed for the future, and is unequal in value to the amount of time, energy and funding put into it. It is derivative in approach and contains little new information. The holes that leaves are important, as it does not address vast gaps in knowledge, particularly community knowledge, which creates a plan of dubious value at best.

Response: The subbasin planning process is designed to use existing information.

11) As stated succinctly by international river restoration expert Dr. Bob Newbury who resides in the Canadian portion of this river basin and who has worked on this river system “much of what needs to be done is obvious, simple and locally doable” –this plan does not clarify a plan of attack for what is already known to be important to be done.

Response: The subbasin plan provides a framework to support implementations actions.

Specific Comments

1) Executive Summary. Not Provided.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

2) Section 1.1. Not Provided.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

3) Section 1.1—Participation. Despite the fact public outreach was assigned to the Okanogan County, all key leads on the planning process have access to public outreach

capacity and bear responsibility for lack of public and stakeholder participation, not just

Okanogan County. It is doubtful, for example, for Okanogan County to be expected to reach regular tribal members and constituents regarding the plan and its impacts—something better done by CCT themselves. Likewise, WDFW should use existing and partner programs it is involved with (such as the WDFW hosted and State legislated RFEG program to assist in public outreach) to support the plan regionally. There is no documentation provided on exactly what public outreach occurred, the specific outreach, education or involvement strategies employed and explanation of why they were most effective, and no estimate in any change in level of understanding of those reached. There was no copy of the flier provided to the public to determine if it contained all the information needed for the public. There was no compilation of notes and results on public feedback. There was no list of specific groups spoken with or amount of public reached in the document. The approach to public outreach was a “we’ll tell you” rather than “what do you have to say” exercise that effectively blocked true guidance and grounding of the plan which would have provided it the foundation for public acceptance of subsequent plans to spend recovery funds. Other methods and opportunities for collection of this input offered by organizations outside the SCT wishing to partner and who were experts in this arena were specifically declined by Okanogan County.

Response: An extensive and responsive public outreach plan program was conducted; see appropriate plan appendix.

4) Section 1.1—Infrastructure and Organization, Subbasin Core Team (SCT). There is no evidence that at any time did the SCT ever provide regular detailed (not summary) updates to the public or specific stakeholders about their intended technical approach and considerations being made in the development of the plan, nor how stakeholders could contribute to the SCT efforts. There was no effective way that stakeholders could input on or affect the approach in which SCT made the plans. 5) Section 1.2—Socioeconomic conditions. The plan state that "dealing with constraints will require both institutional and technical approaches, and links between communities of science, interest and place", but does not indicate how the plan will address or link to those already addressing the critical issue of large existing gaps in communications and coordination between scientists, government and tribal agents and landowners / communities in this region. The public will not accept the plan if it conflicts with their interests in this regard.

Response: An extensive and responsive public outreach plan program was conducted; see appropriate plan appendix.

5.)Section 1.2 – Socioeconomic conditions. The state that "dealing with constraints will require both institutional and technical approaches, and links between communities of science, interest, and place", but does not indicate how the plan will address or link to those already addressing the critical issue of large existing gaps in communications and coordination between scientists, government and tribal agents and landowners / communities of science in this region. The public will not accept the plan if it conflicts with their interest in this regard.

Response: Comment noted.)

6) Section 1.4—Key findings and conclusions. Not Provided.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

7) Section 1.5—Plan Goals. Not Provided.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

8) Section 1.7— Synopsis of Major Findings and Conclusions. Not Provided.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

9) Section 1.8—Review of Recovery Actions. Not Provided.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife *section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.*

10) Section 1.9—Review of Recovery Commitments. Not Provided.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

11) Section 2.1—Subbasin Overview, Socioeconomic conditions. Although it provides background on tribal socioeconomic impact backgrounds, this section does not assess how the current economic climate in the region might influence the prioritization of funding to be spent based on this plan, which was one of the points of the plan. It does not even mention (or reference available documents that do) any of the many non-tribal related economic issues, including massive changes in economic trade which has regionally and largely affected agricultural patterns in the apple, cattle, and logging industries. These industries have key habitat and resource impacts. It would appear from this that either no-one but tribal members live in the Okanogan, or that there are no other considerations from a non-tribal perspective considered important in the plan.

Response: The subbasin plan is not intended to provide an economic analysis.

12) Section 2.1—Subbasin Overview, Agriculture. The plan states that as "Agriculture is not a focal wildlife habitat type and there is little opportunity to effect change in agricultural land use at the landscape scale, Ecoprovince and subbasin planners did not conduct a full-scale analysis of agricultural conditions". This boils down to an untrue excuse to avoid looking at one of the foremost and key issues in the US portion of the Okanogan ecosystem. Most of the major impacts to the most sensitive salmon habitat and overall to watersheds have occurred as a result of agriculture and not addressing this issue is a complete failure by planners. The assertion that there is no way to change things at a landscape scale is untrue—the writers either must not know how, or will not work with the partners necessary to do so. Working with all landowners on all parcels can be done and is currently being worked on, with very little or no support from agencies. If salmon recovery is to take effect in the Okanogan, there is no other way to fix habitat than to deal with individual landowners and involve communities and other land ownership partners. This applies also to the other major land-use impacts discussed in the rest of this section.

13) Section 2.1—Subbasin Overview, Tourism. The plan states that the "most potentially developable land (including many areas formerly covered by wetlands) in the basin has now been developed…" While this might be true in the Canadian portion of the Okanogan basin

where impacts are extreme in comparison with the relatively pristine US river conditions, it is extremely untrue that land development has reached its maximum capacity. Regional economic development efforts are in fact pushing development of the region. For example, there is a major development proposed for waterfront and other sensitive habitat on Osoyoos Lake, a critical habitat for the most impacted and limiting lifestage of one of the last two wild Sockeye salmon runs in the Columbia Basin. Additional examples include major landowners planning to do hundreds of property developments in the headwaters of Bonaparte Creek, which has already been recognized in the regional Water Quality Implementation Plan as the single largest contributor of sediment to the Okanogan River in the US portion of the basin. These issues are swept away with the broad statement that somehow development has reached a peak in the US portion of the Okanogan, when in fact it is only beginning. Anyone that goes to the Methow or the Canadian portion of the Okanogan can see the future of this watershed

and the potential impacts to these resources. Clearly the US portion of the Okanogan is the next target for regional development, and none of these factors are considered in the plan or its priorities for monitoring actions, protection of existing habitat, and restoration efforts.

14) Section 2.2— Focal Wildlife and Fish Species and Representative Habitats. There needs to be more reference to or inclusion of more detailed scientific information on the overall “indicator habitat & indicator species” approach being used to base plans on, such as examples of where it has been employed to date and how it worked. Also, more information on or reference to specific sections of documents explaining monitoring protocols and procedures, and adaptive management processes would be employed to ensure subbasin plans are always relevant to the on-ground habitat restoration realities discovered by monitoring. Plan does not mention how the public involvement in monitoring (well established as useful in other ecosystems), and does not touch on or consider key strategies that would provide cost-effective support and leverage opportunities to on-ground recovery, general agency knowledge and benefit community relationship building. In the end, it would cost way less if you involved landowners and communities. This plan as stands instead is the kind of plan that draws lawsuits instead of partnership. The minor initial cost of involving public from the beginning saves more in the end. This is given lip-service by agencies but no true in this plan, as exampled by statement by Executive Director of the Columbia Basin Fish and Wildlife Authority, told the Columbia Basin Bulletin, 'Agencies have to come to grips with the idea that they have to let loose of the controls. They have to lead from behind. This is not about controlling people and making them do things. It's about enabling them to do their best. People really respond to that. The vast majority of people want to do things to make things better. But mostly they don't have the ideas of how to do it. Or they don't have the resources to get it done.' ". The specific selection of focal fish and wildlife species identified in this section for recovery focus, including the comparative scientific criteria and processes employed by reviewers and others involved to put them in this plan, are neither explained in the text or appendices, nor referenced elsewhere to provide scientific basis for this approach. A brief rationale for selection is given with each species as to why they are

generally selected, but no comparative prioritization for restoration purposes is provided between species, nor is a reference to documents that do. Most of the information contained in this section is a "cut-and-paste" repeat of prior and assembled information and does not fulfill the plan's goal of providing new and coordinated direction and guidance to restoration priorities. The public can not make an assessment of the appropriateness of this plan on this information.

Response: The subbasin plan needs to be edited to be more concise, rather than to include more technical information. Supporting technical information can be found in the references cited by the plan. See response to comment S3-S4 regarding public involvement. Prioritization for fish and wildlife is being developed and will be included in the formal draft plan that will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

15) Section 2.3 Environmental Conditions, Descriptions of Focal Wildlife Habitat. All major sections relating to fish are not provided, including: In-channel condition and function, Riparian/floodplain condition and function, Water quality, Water quantity,

Flow, Future No-action Conditions (2050). This completely disallows public ability to provide feedback on whether they feel the plan is appropriate for the existing conditions or not.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

16) Section 2.3 Environmental Conditions, Synthesis of Environment / Population Relationships. This part of the plan states what is already known—that we need to fix things, and we know what is important. It does not provide general or specific recommendations for prioritization and debate. It lists the wildlife species of importance and what their situation is but does not provides a prioritization of (or reference to documents that prioritize) projects to be funded with mitigation money and how this money will leverage additional money. Although it contains wildlife, this section does not provide the aquatically related species of importance and what their desired future condition is, much less a prioritization of projects to be funded. The plan states "To move forward on either (mitigating hydropower development or stopping degradation of ecological function) alone, or delay efforts in one sector, may constrain the rate of recovery, or even prevent it. Implementing improvements in hydro and habitat in tandem should maximize productivity by compounding survival improvements across several life stages in lock-step. We think this interaction will maximize the potential for a swifter recovery of these ESUs." but provides no plan as to how to do these things which is the point of the plan itself. It covers objectives and strategies that are already well known and in place, and is basically a repeated laundry list of things everyone knows should be done but is not structured in a useful way to

prioritize which projects get what money when or how to fill gaps in order to proceed through priorities.

Response: The subbasin plan does provide recommendations for prioritization and debate. It is not intended to identify or prioritize specific projects. Desired future conditions for aquatic species will be provided in the formal draft plan that will be posted for public review from June 5 through August 12, 2004 on the NPCC website. The subbasin plan identifies the linkage between habitat and hydro but is limited to addressing habitat; it is not intended to develop a plan for hydro and the other "H's".

17) Most sections of Section 2.6, HAVE NOT BEEN WRITTEN including:

Synthesis of Key Findings

Status of species

Status and Health of the Environment

Biological Performance of the Environment

Summary Key Limiting Factors

Working Hypothesis

Description of Key Assumptions

Key Decisions and Rational

Desired Future Conditions

Reference Conditions

Species Loss from Historic Conditions

Estimated Species Abundance and Productivity

Relationship to Subbasin Goals

Opportunities and Challenges

Despite the technical background information that is included on specific species, this section is supposed to provide "the point" and is one of the most critical section to the

plan for the public in terms of understanding what the basis and background for management is. It does not provide understanding of the basis of the prioritization of future actions and spending of funding which the plan is meant to provide. If this has not been synthesized already after a year, the management plans provided in section 4 become suspect. If it has been synthesized, then the plan should include it for public review. The public can not make assessments based on this level of information.

18) Section 3. Inventory of Existing Activities. GROSSLY INCOMPLETED, with outdated information included. No summary of how these plans or ongoing initiatives interrelate or will be coordinated for the accomplishment of subbasin priorities is provided. No summary of ongoing initiatives outside of government and tribal agents are listed. This is an insult to community efforts and non-profit initiatives making some of the biggest differences to habitat improvement on ground, and who in comparison to agencies have no resources. Some of the most extensive studies on the largest stretches of the most important habitat has been coordinated by or done by non-profit groups and is not really mentioned or discussed. The public cannot decide whether it wants to participate or support the plans if they don't know the players and the scene correctly—they also cannot determine if the plan's priorities are appropriate based on this incomplete and in places inaccurate picture of efforts in the basin.

Response: Comment noted.

19) Section 4 Management Plan—Definition of Conceptual Foundation. The plan states that its "Goals are a result of a public process, while the conceptual foundation is result of a scientific process. Strategies are derived from the combination of goals (what we want to achieve) and conceptual foundation (the ecological condition needed to achieve the goals)." While once public sets the goals science can provide the answer to "how we get there", this section seems to completely inappropriately infer that public should not, is not capable of, or has no place in being involved in developing and determining if the "how we get there" answer is appropriate one or will have the most cost-effective and/or beneficial results to the public. This is often used to effectively block community involvement in salmon recovery and watershed planning which results in the very clash that is even specifically recognized in the plan between strategy and on-ground implementation. It is, in fact, imperative that the public be involved in the "how we get there" in order to point out ground truths that will affect the effectiveness of the strategies employed. There is no mechanism for this proposed in the plan. Science and government / tribal bureaucrats argue their tactical reasons for keeping technical or logistical planning and policy development on separate tracks, which ends up continually creating the well-known and almost universally acknowledged difference between having a plan with goals that doesn't really result in getting something done or spending money well. What it does result in is the ability of science and government to control the plans, spend money on

their portions of the plans and programs without public interference, and keep Public communities excluded to the detriment of the entire process. This plan reflects the needs of the consultants and bureaucrats writing it and not the best interest of public money expenditure. Rather than developing this strategy and have the public continually reject it, the public should be involved the development of the strategy (not just goal setting) so the plan that results is automatically accepted and well coordinated at the ground level for maximum cost-effectiveness. This has been done in other areas and can be done if the scientists, agencies and tribes embrace it.

Response: An extensive and responsive public outreach program was conducted; see appropriate plan appendix. The Subbasin Core Team sought public involvement to address the issues raised in this comment.

20) Section 4 Management Plan, Management and Recovery goals. NOT PROVIDED FOR FISHERIES SECTION. The public cannot make a determination on the appropriateness of this plan if there is no information.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

21) Section 4 Near-Term Opportunities AND Prudent Strategies. GROSSLY INCOMPLETE.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

22) Section 4.5 and 4.6 NOT PROVIDED

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

23) Section 4.7 Recommendations for Monitoring. Lacks specificity on monitoring needed for this basin and the priority projects planned or ongoing that require monitoring. Misses one of the most cost-effective and beneficial strategies for accomplishing monitoring by not including where, when or how community can be involved in the monitoring, its synthesis, priority development, projects or initiatives to effect improvement of habitat as a result of good monitoring. No-one knows their river or their land better than the landowner or local community members. The public is a vast untapped resource which enjoys and would like to help in resource protection and restoration. Employing volunteer monitoring programs provides cost-effective leverage, relationship building, public outreach opportunities that can never be realized by conventional agency approaches. Well developed, coordinated, supported and funded it can even reach the landscape scale at which the agencies cannot. It requires training, quality assurance and control measures, and consistency in funding support but is a far more cost-effective mechanism for monitoring than currently spent monitoring dollars can do when used in a conventional manner. There are many regional, statewide and national organizations ready to help with a program that makes sense. The fact that this is not included in the plan is a major omission and

flies in the face of the plan's stated goals of "inclusion of communities of science, interest and place".

Response: The monitoring plan was completed in April and is now available for public review on the NPCC website.

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COMMENTS ON PRELIMINARY DRAFT METHOW SUB-BASIN

Submitted by: Dick Ewing

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Date: May 10, 2004

In general it is not possible to devote the time necessary to review the plan and suggest rewrites for all the sections I am concerned about. In general I feel the plan adopts the usual environmentalist position that: 1) population must be limited, 2) the best way to preserve the environment is to keep it away from human intrusion, 3) government management of lands is better than private ownership and the resulting human activities on it and 4) addresses problems in environmentalist generalities which are not true or specific to the Methow. If we are to succeed as humans in living well with our environment more time and credibility needs to be given to how human activity improves the environment including activities on private lands.

Response: This paragraph addresses several generalities beyond the scope of this planning effort. Thanks for comment.

Below is a snapshot of what I have seen through out the document. If I had the time to be complete in my comments you would have another document of similar size to read.

P. 19 Regulation of land use: The planning assumptions associated with regulation of land use presuppose that only government owned or tribal lands contribute to restoration. None of the planning assumptions addressed the positive contribution of private land ownership to the environment or species recovery. It appears that all human ownership and use of private lands do not contribute to the environment.

Response: The document does not address comparative benefits of public versus private ownership.

P.40 This wording needs to replace the paragraph beginning with "The natural flow..:

Response: The USGS report is one of three relevant reports addressing the issues raised in this comment. Inclusion of sections from one necessitates inclusion of the counterpoint and context contained in the Phase II report (Golder 2003) and the USGS Precipitation-runoff Simulations for the Current and Natural Streamflow Conditions in the Methow River Basin Report No. 03-4246. Additionally, subbasin planners requested information such as this from the Planning Unit in late 2003. Because the Watershed Plan was not completed, and has not been approved yet by Okanogan County and the Department of Ecology, inclusion of the referenced is information is problematic until the parties can agree and jointly endorse its findings.

The USGS completed in July 2003 a natural flow watershed model. The resulting Water-Resource Investigation Report 03-4246 simulated current, natural flows and the effect of irrigation canal seepage on stream flow. Irrigation- canal seepage contributes to streamflow throughout the year with the greatest effect during the irrigation season.[4]

Response: Wording will be considered by technical reviewers/editors for inclusion.

P. 41 Delete paragraph beginning with "Leaking irrigation canals are expected.." Then add:

Field studies have shown that 50 per cent or more of the canal discharge can be returned to the ground-water system through canal seepage. Data modeled on the Chewuch and Twisp rivers showed that there is an increasing gain in streamflow from May through October 7. When the canals are shut off after October 7 the net gain begins to decrease, but remains throughout the year[5].

Response: Wording will be considered by technical reviewers/editors for inclusion. Further, the USFWS requires mitigation and assessment "at the point of impact" marking the claim of benefit to fish from irrigation ditch recharge as an unresolved issue and an issue that does not have broad agreement or support.

P. 41 Delete paragraph beginning with "To date the timing…" replace with:

The seepage from irrigation canals recharges the unconsolidated aquifer during the late spring and summer and may contribute as much as 38,000 acre ft. annually to aquifer recharge to the basin[6]. This represents about 9 percent of annual non-fluvial ground-water recharge in the basin simulated by the water model for years 1992 to 2001. Seepage from the canals is likely to have the greatest effect on stream flow in September and October when streamflow and diversions are

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[4] Precipitation-Runoff Simulations of Current and Natural Streamflow conditions in the Methow River Basin, Washington; Water Resources Investigations Report 03-4246; USGS, 2003 p. 1 of Abstract

[5] Precipitation-Runoff Simulations of Current and Natural Streamflow conditions in the Methow River Basin, Washington; Water Resources Investigations Report 03-4246; USGS, 2003 p. 27

[6] Hydrology of the Unconsolidated Sediments, Water Quality and Ground-water/Surface-water Exchanges in the Methow River Basin, Okanogan County, Washington; Water Resources Investigations Report 03-4244, USGS, 2003 p. 1 Abstract.

relatively low but ground-water flow from the seepage is still relatively high. A transient increase in ground-water discharge of about 30 cfs to the Methow River from Winthrop to Twisp and of about 10 cfs to the lower Twisp River was observed in late summer and early autumn correspond to winter[7].

Response: *Wording will be considered by technical reviewers/editors for inclusion. Further, the USFWS requires mitigation and assessment "at the point of impact" marking the claim of benefit to fish from irrigation ditch recharge as an unresolved issue and an issue that does not have broad agreement or support.*

P. 41 Delete the last paragraph beginning with "There is a great deal of conflicting.." Replace with:

Golder Associates as part of the Phase II Assessment of Watershed Planning made an assessment of agriculture uses including water rights, claims, certificates, and actual acreage of irrigated lands. An assessment of municipal, industrial and domestic uses was made as well.

Response: *Wording will be considered by technical reviewers/editors for inclusion. Further, the USFWS requires mitigation and assessment "at the point of impact" marking the claim of benefit to fish from irrigation ditch recharge as an unresolved issue and an issue that does not have broad agreement or support.*

P.45 Water and Habitat Quality. This section failed to mention the USGS study on water quality which concluded: Surface and ground-water generally was of high quality. Water temperature measurements at all surface water sites at the time of sampling was within the criteria for class AA streams[8]. This statement should call into question that more data is needed for the stated 303 (d) listings mentioned and the associated effects of low stream flows or absence of flows associated with natural aquifer properties. Perhaps natural occurrences should be considered when designating a 303(d) listing.

Response: Wording will be considered by technical reviewers/editors for inclusion. Further, the USFWS requires mitigation and assessment "at the point of impact" marking the claim of benefit to fish from irrigation ditch recharge as an unresolved issue and an issue that does not have broad agreement or support.

P. 52 References to anthropogenic disturbances: It is important to note that not all human disturbances are negative, in fact they may improve habitat. For example Mullan, *et. al.* notes the positive contribution of rip rap at certain sites. Conversion of riparian areas to agriculture and residences is not necessarily a negative. There needs to be more of an attitude of a case by case evaluation of human activity.

Response: Agree in concept, but more recent studies and independent scientific review do not support conclusions of Mullen. Contemporary studies refute many of the claims, findings and assumptions contained in Mullen et al. Specifically, rip rap has not been found to provide a positive contribution, or surrogate to natural conditions, for fish life and health. Additionally,

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[7] *Ibid*, USGS, p. 55.

[8] *Ibid,* USGS, p. 22.

extensive use of rip rap along stream banks can exacerbate temperature problems in near shore areas through conductive heating.

P.63 No one has explained why just after the ESA listing of Chinook Salmon there have been good returns up to the present. Mullen *et.al.* and later evaluations by Ken Williams showed that spawner recruitment for the Methow was at restocking levels based upon the harvest catch. Harvest and later the dams, not degradation of the Methow basin is more the issue on why salmon returns were low in the Methow.

Response: Factors outside the subbasins such as ocean conditions and harvest regulations may account for strong returns

P. 113 References to grazing show an ignorance of various activities by the Okanogan Conservation District, NCRS and rancher which have changed grazing practices and have fenced off livestock from critical riparian areas. The tone and direction of these statements give no credence to the many changes in agricultural practices that have occurred in the Methow since 1988.

Response: Grazing discussion is based on existing published information; authors would appreciate any additional references to be incorporated in subbasin plan.

P. 114 References to Timber management are important. However, I would stress that logging has for the most part been terminated from the Okanogan National Forest. What is left is a forest that in some places has been over harvested and needs restoration and in areas where the forest has returned it is thick dog hair trees. Both situations do not allow for good precipitation capture and water retention which is needed in order to have higher stream flows later in the season. I saw no comments which stressed the need for restoration and management of forests for their potential to increase stream flows.

Response: References are needed for assertions made regarding termination of timber harvest and regarding precipitation capture and retention. Timber harvest management is beyond scope of subbasin plan.

P.114 This particular statement is untrue based upon the USGS water quality study completed in 2003 which said that Methow waters meet drinking water standards. They did not find any levels of pesticides or herbicides that warrant this conclusion Agricultural operations have increased sediment loads and introduced herbicides and pesticides into streams. Its also doubtful that Agricultural activity whether grazing or raising of crops has contributed to the sedimentation load. The Chewuch is naturally high in sediments. Most of the man made influence on sedimentation may come from road banks. Lastly there is a contingent of the WDFW that is seeking to preserve or increase the sediment loading during high flows. So there appears to be a contradiction of fact among the agencies on this one.

Response: USGS water quality study was not released to subbasin team for review. Water quality needs differ for aquatic life (e.g., bioaccumulation due to long exposure) and human consumption.

P.116: This statement: “Channelization and development along water courses has eliminated riparian and wetland habitats.” would be more honest if it said: “Where development along stream banks has occurred riparian and wetland habitat has been confined to the existing channel.”

Response: This will be reworded for accuracy. Reworded to: “Channelization and development along water courses has altered riparian and wetland habitats.”

P.116: The comments on environmental and ecologic relationships is definitely biased in its conclusions that humans have only done bad things. Current data shows that water quality is high in Methow streams. If that is so how has residential development degraded water quality? Also I would point out that a holistic management of forests by MAN that includes harvest, proper thinning, restoration and use of fire would be a better statement. Is it really true that species are forced out of their habitats due to human development? Initially I would say yes during the development stages, but later once normal human is maintained species return. How do you account for the return of birds, deer, raccoons coyotes etc. where humans are present? Its more an issue of whether or not people welcome these species and restore habitat they can use after they have built their home. Even the Audubon Society knows this and provides books on how you can do this.

Response: Subbasin plan data is based on objective findings of fact. Additional scientific information has invited through SCT review and public comment.

P.145 In reference to how human land management affects the environment it might also be pointed out that man made decisions to restore the environment by lining canals or doing other activities has negatively impacted the environment because cumulative effects were not considered. This factor of net benefit is never discussed in the document. This evaluation should include both the positive contribution that human presence provides as well as negative and the evaluation of whether or not returning an ecosystem back to its perceived original native state is a better benefit than what now exists.

Response: Subbasin plan did not analyze effects of activities, but assessed current habitat conditions and modeled historic conditions.

P. 145 This statement is a good example of environmental propaganda:

Response: This will be reworded to improve accuracy. Reworded to: “Seasonal naturally occurring and human influenced low stream flows and occasional dewatering can alter fish passage to upstream spawning and rearing habitat. Low flows also affect water quality by contributing to higher stream temperatures in summer months. Stream borne sediment, when present in altered or unnatural amounts and timing, degrade overall water quality. In addition, low stream flows tend to concentrate any toxic material or other contaminants entrained in stream flow.

Seasonal naturally occurring and human influenced low stream flows and occasional dewatering can alter fish passage to upstream spawning and rearing habitat. Low flows also affect water quality by contributing to higher stream temperatures in summer months. Stream borne sediment also degrades overall water quality. In addition, low stream flows tend to concentrate any toxic materials or other contaminants entrained in the stream flow.

These are generalized statements which cause the uniformed reader to conclude that low flows and dewatered areas are bad, sediment is always bad, low flows always mean higher stream temperatures etc. For the Methow this is not the case. Most low flows are natural. Its not clear that human use of water has caused low flows that have been passage barriers when fish need it, and water temperatures in the Methow don't necessarily correlate with low flows as much as a streams orientation towards the path of the sun and its not been proven that there are toxic materials and other contaminants in the Methow basin to concentrate. Lately on a project I am working it has just been stress to me that sedimentation recruitment is needed in order to rejuvenate fish habitat each year not to mention the need for significant enough flows to move boulders downstream to rearrange the stream channel. So such statements above are not truthful and of the sort that should be in a plan like this.

# #

May 7, 2004

Okanogan County Water Resources

123 North 5th Ave., Room 110

Okanogan, WA 98840

Attn: Julie Dagnon, OCWR Manager

Mark Walker, Director of Public Affairs
Northwest Power and Conservation Council
851 SW 6th Ave., Suite 1100
Portland, OR 97204

Subject: Subbasin Watershed Planning Recommendations and Comments on two plans

Please accept the following recommendation and comments on behalf of over 800 members of Kettle Range Conservation Group, whose mission is to defend wilderness, protect biodiversity, and restore ecosystems of the Columbia River Basin.

Recommendation

The goals of the Subbasin Watershed Planning Process should remain flexible through the years. Attendance at several meetings during the current effort indicate that the process is being viewed as a "solution" rather than a "process". To meet this recommendation would require that the Subbasin Watershed Planning Process include a means for incorporating changes. What we found at the meetings was more akin to a few spreadsheets with no formalized procedure or designation of authority. The document provided at your website titled "Considerations for Monitoring in Subbasin Plans", by the Pacific Northwest Aquatic Monitoring Partnership make the mistake of equating a programmatic approach with a coarse-scale approach. This is a serious flaw which will result in wasted expenditures, because it doesn't incorporate "adaptive management".

Response: Adaptive management is integral to the subbasin plan; it is intended to be flexible. The intent is to be strategic, rather than opportunistic in management. The subbasin plan process does incorporate changes through its monitoring program and the use of objectives and working hypotheses.

Yet this is exactly what is being proposed--to move away from project-specific pilot projects toward state and regional models. The document claims that "these pilot projects demonstrate how the top-down approach can work to create monitoring projects that have systemwide applications." We can only accept this if the program to continue with pilot projects that deliver money to the ground rather than to remove beltway bureaucrats is continued.

The list of projects is then divided into top-down and bottom-up categories, yet these categories are never defined, nor does the document indicate if coarse scale measurements will be applied to time series as well as spatial data. In other words, we believe this is a veiled attempt to keep money within the agencies rather than disbursing it to the collaborators. While there may be good reasons to minimize the huge costs to disbursing funds to individuals or non-profit groups, you can obtain the same results by simply defining the parameters of "monitoring" to define who makes what decision when. What needs to be specifically described are a roadmap of the plan and checkpoints along the way, that identify who will be making decisions and what the criteria will be for "success".

We believe that it is in the best interest of both the Northwest Power and Conservation Council as well as the public interests to establish a clear and concise process for incorporating changes in input parameters, and hope you can honor our recommendation with specific answers.

Response: The subbasin does not propose projects. The comments in paragraphs 1-3 address the PNAMP document, which is one of a number of sources used to develop the subbasin plan monitoring section. The monitoring section develops a framework that addresses the watershed environment against the objectives of the subbasin plan, rather than specific projects. Adaptive management and criteria are both developed in the subbasin plan monitoring section. The subbasin plan is silent on implementation and funding.

Comments on the Methow Subbasin Plan

We would like to prioritize increased aquifer and groundwater storage within the basin to benefit both fish, wildlife and agricultural uses.

We would like to prioritize restoration of beaver dams and beaver habitats throughout the basin. Basic research on the benefits of beaver dams and their habitats is lacking throughout the northwest. Research should include surveys on the quality and quantity of beaver dams as they relate to water storage, fish habitat, flood protection and wildlife habitat. More research is needed on the value of beaver dams to downstream water users and fisheries.

More funding is needed for protecting riparian and floodplain integrity. Problems continue to increase with flooding, sedimentation, stream gravel embeddedness, lack of quality pools, lack of LWD, and debris flows resulting from managed landscapes. There should be incentive programs to protect these resources and disincentives for shoreline development.

There needs to be more emphasis on shoreline restoration projects that increase fisheries and beaver dam habitats. Funding needs to be targeted toward endangered species restoration. Bull trout should receive special protection as an indicator species for clear water habitats. Projects are needed for restoration of side channels and breeding habitats off of the main channels, including native plant species restoration.

Increase protection for all native fish species including bull trout in all the areas where they historically occurred. Maintain separate demographic tallies for native species and hatchery fish. Do not fund projects that spend funds to count wild and hatchery fish together.

There should be increased funding to support the lower reaches of the Methow River, from Carlton to the mouth, and including tributaries Gold Creek, Libby Creek and Squaw Creek.

Some studies should be concerned with the relationship of upland ponderosa pine and shrub-steppe habitats to the riparian ecosystems. A number of key species may be linked to the protection of both these ecosystems, including moose, beaver, black and grizzly bear.

There should be funding for research on the distribution and abundance of Western Gray Squirrels, a State listed species that occurs in the southern portion of the Methow subbasin. Funding for conservation and restoration projects should be prioritized to protect and enhance Western Gray Squirrel habitat.

There should be more funding for non-chemical noxious weed control programs and plans. The Noxious Weed Control Boards have shown that there is insufficient encouragement from the state to use more sensitive methods of weed control, and as a result, there are a number of areas where healthy ecosystem values along sprayed roads are being lost due to denudification of the ground and vegetation. Areas treated are sometimes directly in streams, and the county Weed Boards do not have the resources to address the technical aspects of the chemical industry.

Response: The suggestions made in these sections of the comment letter exemplify the kind of project that are expected would be conducted during subbasin plan implementation. The subbasin plan does identify specific projects.

Comments on the Okanogan Subbasin Plan

We would like to prioritize increased aquifer and groundwater storage within the basin to benefit both fish, wildlife and agricultural uses.

We would like to prioritize restoration of beaver dams and beaver habitats throughout the basin. Basic research on the benefits of beaver dams and their habitats is lacking throughout the northwest. Research should include surveys on the quality and quantity of beaver dams as they relate to water storage, fish habitat, flood protection and wildlife habitat. More research is needed on the value of beaver dams to downstream water users and fisheries.

More funding is needed for protecting riparian and floodplain integrity. Problems continue to increase with flooding, sedimentation, stream gravel embeddedness, lack of quality pools, lack of LWD, and debris flows resulting from managed landscapes. There should be incentive programs to protect these resources and disincentives for shoreline development.

There needs to be more emphasis on shoreline restoration projects that increase fisheries and beaver dam habitats. Funding needs to be targeted toward endangered species restoration. Bull trout should receive special protection as an indicator species for clear water habitats. Projects are needed for restoration of side channels and breeding habitats off of the main channels, including native plant species restoration.

Increase protection for all native fish species including bull trout in all the areas where they historically occurred. Maintain separate demographic tallies for native species and hatchery fish. Do not fund projects that spend funds to count wild and hatchery fish together.

Some studies should be concerned with the relationship of upland ponderosa pine and shrub-steppe habitats to the riparian ecosystems. A number of key species may be linked to the protection of both these ecosystems, including moose, beaver, black and grizzly bear.

There should be funding for research on the distribution and abundance of Western Gray Squirrels, a State listed species that occurs in the southern portion of the Methow subbasin. Funding for conservation and restoration projects should be prioritized to protect and enhance Western Gray Squirrel habitat.

There should be more funding for non-chemical noxious weed control programs and plans. The Noxious Weed Control Boards have shown that there is insufficient encouragement from the state to use more sensitive methods of weed control, and as a result, there are a number of areas where healthy ecosystem values along sprayed roads are being lost due to denudification of the ground and vegetation. Areas treated are sometimes directly in streams, and the county Weed Boards do not have the resources to address the technical aspects of the chemical industry.

Response: The suggestions made in these sections of the comment letter exemplify the kind of project that are expected would be conducted during subbasin plan implementation. The subbasin plan does identify specific projects.

Thank you. We appreciate the opportunity to participate and comment on these issues.

Sincerely yours,

George Wooten, Botanist
Kettle Range Conservation Group
<gwooten@kettlerange.org>
509-997-6010

# #

From: "Lee Bernheisel" <owl@mymethow.com>

To: "Julie Dagnon" <jdagnon@co.okanogan.wa.us>

Date: Sun, May 9, 2004 7:37 AM

Subject: Subbasin Plan

Julie

Here's a couple of quick comment on the Draft

1. Pateros Dam

On page 42 and 81 the plan still says that the dam in the Methow near Pateros blocked all passage for fish.(Impoundment and Irrigation Projects) This is incorrect and has remained in the literature long enough its time to correct it in this plan with the fisheries agency's addressing its past mistakes. Please contact me if you need more information than I have already submitted.

Response: This will be reworded to improve accuracy.

2. Irrigation Districts

The Methow Valley Irrigation District was reorganized in and around 2000 and at that time the acreage was reduced to about 850 acres. The MVID is not required to supply 12cfs to the Barkley ditch. Their agreement is for the Barkley to supply water to the MVID ditch for its patrons along the ditch. (For conformation or more info check with me or Bob Barwin,WDOE)

Response: Discussion of MVID will be researched and revised.

The Skyline ditch is now completely lined or piped (p44 check with Greg Knott, BPR for details)

Response: The lowest ¼ mile not yet lined/piped.

That's it for now, good luck

Lee Bernheisel

# #

Methow Valley Citizens' Council
P.O. Box 774, Twisp, WA 98856

Okanogan County Water Resources May 10, 2004
123 North 5th Ave., Room 110
Okanogan, WA 98840
Attn: Julie Dagnon, OCWR Manager

Subject: Subbasin Watershed Plan Draft Comments

We feel the main priority of watershed planning is to increase aquifer surface and groundwater storage for overall subbasin ecosystem health. Areas for which we support funding include:

Removal of bank armoring/dikes/riprap etc.

Riparian and floodplain integrity preservation. Funding for monetary incentive programs that protect and restore fisheries habitat. Disincentives for shoreline development including removal of riparian vegetation, subdivision or any kind of bank armoring.

Shoreline restoration projects to increase suitable fisheries habitat. Funding for projects that will nurture endangered species restoration. Funding of projects for research and restoration of side channel restoration for breeding habitat, water storage and riparian area improvement, including native plant species restoration.

Native fish species protection. Increase protection for all native fish species including bull trout in all the areas where they historically occurred. Keep native species categorized separately from hatchery fish when assessing threatened and endangered species status.

Restoration of beaver habitat. This needs to include funding of research projects such as inventory of existing beaver dams and development of historical data. Also more research is needed on the value of beaver dam induced water storage on downstream water users, benefits to wildlife, and fisheries.

Conservation easements and public land acquisition in critical habitat areas.

Funding to support further study of the lower reach of the Methow river, from Carlton to the mouth.

We also believe that the conservation of upland Ponderosa Pine and Shrub- Steppe habitat is crucial to the health of the subbasin. Areas for which we support funding include:

Funding for research on the distribution and abundance of Western Gray Squirrels, a State listed species, in the southern portion of the Methow subbasin. Funding for conservation and restoration projects that protect and enhance Western Gray Squirrel habitat.

Funding to study the local distribution and abundance of focal species identified in the Draft Subbasin Plan, and to conserve key habitat that provides connectivity for these species.

Funding for educational programs that assist private landowners in the Shrub steppe and Ponderosa Pine habitat types to integrate habitat conservation with forest restoration and fire prevention activities.

Funding that supports landowners and the Okanogan County Weed Board in performing non-toxic noxious weed control for such species as knapweed, white top, toadflax, etc.

Response: The suggestions made in these sections of the comment letter exemplify the kind of project that are expected would be conducted during subbasin plan implementation. The subbasin plan does not identify specific projects.

The draft Subbasin Plan document is missing information under key headings such as "Key findings and Conclusions;" "Synopsis of Major findings;" and "Plan Scope." We expect that these and other headings in the document will be completed before the Final draft, in time for public review.

Response: We recognize that information is missing and will be incorporated in the draft that will be posted for public review from June 5 through August 12, 2004 on the NPCC website.

We appreciate the opportunity to participate and comment on this important plan.

Sincerely,

Vicky Welch, Chairman, MVCC

# #

OKANOGAN COUNTY
FARM BUREAU

May 10, 2004

10 Wilson Ranch Rd

Riverside, WA 98849

Julie Dagnon, Water Resource Division Manager

Okanogan County Water Resources

123 N 5th Avenue – Room 110

Okanogan, WA 98840

Re: Okanogan County Farm Bureau Comments on 2nd Draft Subbasin Plans: Okanogan/Similkameen and Methow

Dear Ms. Dagnon:

Following are the Okanogan County Farm Bureau comments and concerns.

Local Concerns

County Commissioners' Concerns: Okanogan County Commissioners met on 5/3/04 to outline county concerns about the content and tone of the subbasin plans. Those in attendance (county staff, public outreach contractor, and representatives from WDFW and the Colville Tribe) agreed with the concerns and the need to rewrite large segments prior to submitting the plans to Northwest Power Conservation Council (NPCC). Extensive and repetitive attacks on agriculture, grazing, irrigation and forestry throughout the plans were a major concern and remain very troubling.

Response: Comment noted.

Okanogan County Farm Bureau agrees with the concerns expressed by Okanogan County Commissioners and we support the need for considerable revisions to the plans. The following comments are based on the 4/23/04 draft as the public will not have access to the revised plans before they are submitted to NPCC.

Process Concerns/EDT: Subbasin plans are heralded as *local plans* in spite of inadequate local public involvement and lack of information provided to the public even when requested. The Habitat Working Group (referred to as the "technical folks") met outside public purview for approximately seven months to make assessments relying on "expert opinion." After defining and describing 148 stream reaches, rating 46 habitat attributes for those reaches, reforming those reaches into 21 Assessment Units, the information was fed into the controversial Ecosystem Diagnosis and Treatment (EDT) Model to determine the working hypothesis and management strategies. Excerpts from a scientific review outlines the *pitfalls of the EDT Model* used in subbasin planning (See Appendix A). The review states, "EDT exemplifies how modeling should not be done."

The Methow Watershed Planning Unit elected not to use the EDT because of the problems associated with the model.

Response: All Habitat Work Group meetings were open to the public and were advertised through the County. The habitat assessment relied on the full range of data available, including empirical data, expanded and derived information, expert opinion/local knowledge. The documentation is transparent as to what level of data was available, the confidence associated with the data used, and identifies where more information is needed. EDT is the preferred model authorized by the NPCC for the subbasin planning process.

Local Watershed Planning Ignored: The Methow Watershed Planning Unit that includes years of work and research by local volunteers and experts was virtually ignored in the subbasin process. No direct contact was solicited for input and key on-the-ground studies that were conducted in the Methow were discredited and/or minimized in the Methow subbasin plan and replaced with hypothetical analysis.

Response: The Methow watershed planning unit was invited to participate, and opportunities were made available for their involvement. USGS water quality study was not released to subbasin team for review.

It is of interest also that the Methow USGS study was previously disregarded because it had not been published, and the subbasin plans are riddled with unpublished data.

Summary: The plans touch on some of the limitations of the process with the "compressed process that has allowed little flexibility in stakeholder involvement" [Page 4] but does not give an accurate picture of the difficulties those who tried to participate experienced. The closed-door assessment process by the technical Habitat Working Group, the lack of handouts of information, difficulty in obtaining any core information throughout the process, unanswered requests and disregard for reasonable public input makes these plans "local" in name only. This is just another case of the state and federal agencies and tribe writing the plan; the only difference is that they came to the county to do it. Credibility of information and accountability to the public are lacking.

Response: All Habitat Work Group meetings were open to the public and were advertised through the County. Requests for information were honored and opportunities for reasonable public input were provided throughout the process.

General Concerns

Due to the complexities of the subbasin planning process and plans, repeated revisions, significant data gaps and access to only approximately 378 pages of the 1,600-page plans, it is extremely difficult for Okanogan County Farm Bureau members and other stakeholders and groups to make substantative comment. Many of our comments will be general in nature where continued review has raised several topics of overriding concern.

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan and supporting materials in plan appendices will be posted for public review from June 5 through August 12, 2004 on the NPCC website. The subbasin plan is not 1600 pages in length.

Our previous comments stressed the importance that *subbasin plans not be extended to land management planning and management due to fundamental limitations of the plans* (Appendix G). In spite of the severe limitations of the plans:

The original purpose of subbasin planning to direct NPCC funding has been expanded to function as a general "framework" for future projects, actions, activities and land use planning throughout the county.

Subbasin plans expand land management beyond legal mandates for Endangered Species Act (ESA) listed species to include management of all fish and wildlife.

Subbasin plans and the NPCC Fish and Wildlife Program are elevated to ESA and Clean Water Act status, creating another layer of federal land management extended to all fish and wildlife.

Subbasin plans will be used for federal recovery plans.

Response: Subbasin plans are not land management plans, as such. Local land use management continues to be the responsibility of local government. State government has existing land use regulatory responsibilities in certain cases. The subbasin plans provide a framework for proposed projects. That framework recognizes existing legal mandates and may inform ongoing updates to existing regulations. It also provides recommendations to local and state government and willing landowners, that may be implemented by them. Effective species recovery will need to include land use management considerations. The subbasin plan guides Bonneville's actions under the existing Biological Opinion, but has no regulatory authority and is not characterized as having regulatory authority. It does not expand the legal mandates of the ESA. Background information developed through subbasin planning will be used in recovery planning, however implementation of a federal recovery plan is strictly voluntary.

Expanded Purpose: The purpose stated over and over to the public was that subbasin plans would be used by NPCC to prioritize and direct Bonneville Power Administration NPCC mitigation project funding. Language now shows that the NPCC subbasin plans will be used as a "framework" for all actions and activities in the Okanogan and Methow Subbasins:

“Actions taken in the subbasin[s] should be consistent with, and designed to fulfill the vision of the Okanogan [and Methow] subbasins.” “This vision and subbasin plan…is intended to provide a framework under which future projects can be developed and implemented*.”[Okanogan, Page 207 – Methow, Page 19]*

Response: Subbasin plans will be used as a framework for <u>all BPA-funded</u> actions and activities, not “all actions and activities” in the Okanogan and Methow. The mission statement and introduction language will be clarified.

Expanded to All Fish and Wildlife: NPCC mitigation reaches beyond listed species and includes all fish and wildlife. Use of subbasin plans as a framework for county projects, actions and land management goes beyond legal mandates and expands all fish and wildlife to ESA-listed recovery status.

“Future land use planning and activities that involve potential impacts to fish and wildlife and their habitats should be fully discussed with the agencies and tribes with management authority prior to implementation.”

[Okanogan, Page 207 - Methow Page 19]

<u>Subbasin Plans Expand Federal Land Management</u>: The following indicates subbasin plans are being developed as a back-door land management authority despite the lack of openness and credibility of the process and the plans and the limitations of the process, methods and results and elevates NPCC and the Fish and Wildlife Program to federal ESA/CWA status.

Actions taken in the sub basin should be consistent with the Okanogan sub basin plan, the NPCC Columbia Basin Fish and Wildlife Program, Clean Water Act, and the Endangered Species Act.”[Okanogan, Page 2]

<u>Use of Subbasin Plans Extended to Federal Recovery Planning</u>: Again in spite of the limitations, the plans will be used as the foundation for NOAA (National Marine Fisheries Service) and US Fish and Wildlife Service ESA federal recovery planning requirements.

Response: Background information developed through subbasin planning will be used in recovery planning.

Management Plans

<u>Conflict of Interest</u>: The plans will direct future project funding and the writers of the plans are the recipients of the project funds. Several project needs continued to resurface throughout the Okanogan plan that are known to be “pet projects” of the agencies and tribe. Among those specifically noted are Salmon Creek, Omak Creek, and the Conservation Reserve Program (CRP). It appears there may be a conflict of interest in order to receive funding.

Response: The subbasin plan is silent on implementation and funding.

Land acquisitions and purchase of water rights are also common management tools throughout the plans.

Wildlife Section: This is the first opportunity the public has had to review the Wildlife portion of the plans. The Wildlife portion was produced outside the public and Subbasin Core Team process and information requested by the public throughout the process was not provided.

The focal species descriptions do not apply to our area and cannot be viewed as "local information." At least one focal species does not inhabit the Okanogan or surrounding areas. Many references are outdated or unpublished and mostly unavailable to the public.

The focal species and broad management appears to follow the information from Partners In Flight referenced in the plan, which is a group of agencies, environmentalists, consultants and academia with established focal species and management plans. It appears the wildlife section for focal bird species used much of the information from Partners in Flight. The wildlife portions were written outside the county with little application to our specific area and no public input, which is a disservice to our county.

Further research will determine whether the wildlife portions of the plans were re-writes of the Partners In Flight information. Regardless, the wildlife portion is far from "local."

Response: These comments respond to an early draft of the subbasin plan, made available in order to increase the opportunity for public review. The formal draft plan including the wildlife section will be posted for public review from June 5 through August 12, 2004 on the NPCC website. The focal species were selected as indicative of habitat types that occur in the subbasins.

<u>Missing Information:</u> As noted above, agriculture, grazing, forestry, irrigation and any human contact with the land are viewed as damage to the environment compared to "natural pre-European conditions. Agency mismanagement is not listed, such as lack of predator control or predator introduction, bird impacts on migrating smolts, state-required removal of LWD from streams and rivers, etc.

Response: Comment notes. The subbasin plan does not consider land ownership or impacts, but only assesses the current condition of the land and its ability to support fish and wildlife.

Summary

Please refer to the comment letter by Okanogan County Farm Bureau dated March 11, 2004 for further comments and concerns that have yet to be addressed.

We will continue to review the subbasin planning process and make further general and specific comments during the NPCC comment period when it is anticipated the complete plans will be available. We look forward to the NPCC scientific review with the hope that further direction will solve some of the local conflicts and credibility issues.

Sincerely,

Mike Wilson, President

Attachments: Appendix A and B

Cc:	Washington Farm Bureau

Okanogan County Commissioners

7th and 12th District Legislators

Northwest Power and Conservation Council

Emphasis added throughout.

[ ] Writer's comments

Appendix A

Excerpts from the

SALMON RECOVERY SCIENCE REVIEW PANEL

Report for the meeting held

December 4-6, 2000

Northwest Fisheries Science Center

National Marine Fisheries Service

Seattle, Washington

II. MODELS

A. STYLES OF MODELS AND THEIR UNDERLYING PHILOSOPHIES

The management of natural populations is an exercise in quantitative science; hence mathematical models are essential and invaluable tools. However, they must be used wisely and with understanding of limitations. Fisheries biology, in particular, has been a rich breeding ground for mathematical descriptions ever since the great mathematician Vito Volterra turned his attention to the fluctuations of the Adriatic fisheries. Volterra's models were simple in structure, but complex in dynamics; this duality made them powerful aids in understanding key features of complex population fluctuations. Years later, William Ricker, perhaps the most innovative and influential of fishery scientists, showed how fairly simple age-structured models of fish populations could exhibit even more complicated dynamics (Ricker 1954); indeed, his simulations were probably the first demonstrations in ecology of chaotic population dynamics, whose importance was clarified twenty years later in a landmark paper of Robert May (1974).

The lessons of these seminal studies are inescapable: Models can play a fundamental role in demonstrating the mechanisms underlying observed phenomena, but even simple models can have complicated dynamics. The more complex models become, the more easily one can twist them to do almost anything, and the less reliable they become. Ludwig and Walters (1985) explored these truths in detail for fishery models in particular, taking into account explicitly the problems associated with parameter estimation. Their work demonstrated that, although models must include enough detail to capture the essential, unique aspects of a problem, too much detail can render models useless. The key to intelligent modeling is to find the optimal level of detail and to suppress confounding statistical noise. This is basically the approach that has worked so effectively in physics, in which statistical mechanical methods allow one to capture robust macroscopic features in terms of the collective dynamics of large numbers of unpredictable parts. This is the only approach that makes sense for modeling large-scale, intrinsically complex and dynamic systems.

The conclusions to be derived are that large-scale models that attempt to capture the dynamics of many species, or that rely upon the measurement of massive numbers of parameters, are doomed to failure. They substitute sledgehammer simulation for analytical investigation and efforts to identify the few key driving variables. Large models are bedeviled by problems of parameter estimation, the representation of key relationships, and error propagation. When the phenomena are fundamentally non-linear, this leads naturally to path dependence and to sensitivity of results to parameter estimates. As the number of parameters increases, the potential for mischief increases.

Thus it is essential to rid models of irrelevant parameters, and to identify key relationships. It also emphasizes the importance of locating what aspects of the model are most likely to lead to the expansion of error, and to focus on representing these as accurately as possible. This can only be done reliably through data-driven methods, with attention to appropriate statistical methodology.

When the data are not available for the needed estimates of parameter values, there is a tendency to insert values based on opinion or expert testimony. This practice is dangerous. The idea that opinion and "expert testimony" might substitute for rigorous scientific methodology is anathema to a serious modeler and clearly represents a dangerous trend. Indeed, there are limitations even to what can be done on the basis of data: the fact that relationships are often nonlinear, and further that interest often rests on understanding the behavior of populations beyond the range of variables that has been observed, creates vexing problems for the modeler. It provides a compelling argument for experimentation in order to elucidate underlying mechanisms, for the recognition of limits to predictability, and for the use of adaptive assessment and management (Ludwig and Hilborn 1983; Holling 1978).

EDT is a case study of the problems just discussed. The current version which uses 45 habitat variables might be a useful list of things to consider, but the incorporation of so many variables into a formal model renders the predictions of such a model virtually useless. Even more vexing is that EDT depends upon a large number of functional relationships that are simply not known, (and cannot be known adequately) and yet they play key roles in model dynamics. The inclusion of so much detail may creates an unjustified sense of accuracy; but actually it introduces sources of inaccuracy, uncertainty and error propagation. Subjective efforts to quantify these models with "expert opinion" compound these ills. (Pages 4-5)

EDT exemplifies how modeling should not be done. It is overparameterized, includes key functional relationships that cannot be known and cannot be tested, creates a false sense of accuracy, yet introduces error and uncertainty. Its very complexity makes it difficult to determine the effect of various assumptions and parameter values on the model's behavior and relation to data. The attempt at quantification through subjective "expert opinion" compounds these fatal weaknesses, especially the model's inability to confront and improve with confrontation of data. (Page 8)

Emphasis Added

The entire document can be viewed at: http://publicnwfsc.afsc.noaa.gov/trt/rsrpdoc2.pdf

Appendix B

Subbasin Planning Limitations

Okanogan County Farm Bureau Comment Letter – March 11, 2004

Subbasin Planning Limitations: The reported purpose of subbasin planning is to direct Bonneville Power Administration mitigation funding through the Northwest Power and Conservation Council. It is important that subbasin plans not be extended to land management planning and management due to fundamental limitations of the plans, which include:

Subbasin plans are being developed solely for the benefit of fish and wildlife, with no consideration of costs, economic losses or conflicting human interests, which results in faulty findings.

The "ecosystem approach" used does not make any distinction between public land and privately owned land in its determination of fish and wildlife management plans.

Private property rights and land rights including water rights are not recognized.

Management plan goals are based on comparisons to "historic" or perfect, untouched conditions that are thought to exist prior to European settlement, which are not attainable, sensible or necessary.

Goals are widely based on data with significant information gaps and unmeasurable outcomes with minimal public involvement.

The cumulative effects of restrictions and regulations on private property ownership and land use are not measured.

The economic losses to the private landowner, agriculture, natural resource-based industries and county economic viability are not considered.

The subbasin planning process bypasses land management planning safeguards and requirements such as economic review, public notice and public involvement.

There is no legislative oversight of back-door ecosystem approaches to manage lands.

# #

TO: Okanogan County Water Resources

Northwest Power and Conservation Subbasin Planning

123 North 5th Avenue Rm. 110

Okanogan, WA. 98840

RE: Comments on Methow Subbasin Plan

This document should not be called a plan because it's not a plan. It's a bunch of philosophical statements, most of which have nothing to do with the Methow Basin. It's also made up of policy judgements and a lot of assumptions. Where is the science you claim this plan is based on? Policy judgements and assumptions should not be funded with rate payer monies, and flowery philosophical statements that have no relationship to what really needs to be done in the Methow Basin are nothing but filler for the document. You don't really say anything in this document, it's a complete waste of ratepayers monies. What you do in this document is leave the door open to do anything you wish. The plans a blank check with nothing but a signature, the citizenry is supposed to trust that the state will do the right thing with it, haven't seen it happen yet. This is why we have a public comment period so we can weed out the garbage. In this case you were afraid of getting caught so you didn't include the garbage "yet", even though what you do present I also consider garbage of another type. The people responsible for this garbage should be fired and put into positions fitting their abilities, garbage collectors.

Again this document is incomplete, the following categories have all been left out.

1.2 Local and Regional Scio-economic Conditions

1.3 Overall Direction and Goal of Subbasin Plan

1.4 Key Findings and Conclusions

1.5 Plan Goals

1.6 Plan Scope

1.7 Synopsis of Major Findings and Conclusions

1.8 Review of Recovery Actions

1.9 Review of recovery Commitments

The above list is the meat of the plan. What you have us reviewing is nothing, you wasted our time, you wasted our money, and you've destroyed your credibility.

I sat on the MBPU for the last five years. We had preliminary information supplied to us by the USGS, which the MBPU wished to incorporate into our plan. John Storman the DOE representative to the MBPU was adamantly opposed to this incorporation of information supplied by the USGS even though it was based on very good science. He stated that USGS information could not be used until the USGS report had been reviewed and completed. I see John Stormon is listed on the Habitat Work Group list representing the DOE. It appears the DOE is now willing to use policy judgements, assumptions and Philosophical statements in place of good science. What ever it takes to get them where they want to be.

You make a statement on page 145 about low flows affecting water quality by contributing to higher stream temperature in summer months. I assume you are claiming this condition is occurring in the Methow Basin or why would you have put it in the Methow Subbasin Plan.

Well the USGS state that irrigation withdrawals on the Twisp River "were not" raising water temperatures. They also state that they had not done the work to say whether or not recharge water was cooling the Twisp River, but studies have been done that show recharge water from groundwater aquifers helps cool stream flows. I'm sure the folks on the Habitat work Group are aware of this occurrence but I don't see where you included this language in the plan, I guess it doesn't fit in with your policy goals.

You seem to think natural or what was here before the white mans settled the area was better than what is here today. You hammer everything the white man has touched. In those times before the white man came the Methow Basin was a very harsh place for all species of life to make a living in. Dry and hot in the summers (high Desert), it lie's in the coldest of the 24 western climate zones, even the native Americans left the valley in the winter time. In early times the Methow Basin was not the Garden of Eden, we were thrown out of the Garden of Eden because of a liar and manipulator, does this remind you of someone. Today the Methow Basin is a friendlier place to all forms of life due to mans influence on the environment. Sure there has been some thing's done that were not beneficial, hell, Washington State agencies are still doing them under the guise of fish recovery. Today there is more riparian habitat, more habitat of all kinds due to mans influence. There is 10% to 30% more fish being reared naturally in the rivers because of nutrients from mans activities entering wasteways. Recharge water from unlined irrigation canals recharge groundwater aquifers that in turn recharge instream flows. "Salmon populations are greatest in streams that receive high groundwater input, which sterilizes base flows and water temperatures, and promotes greater water fertility" (Hendrickson and Doonan 1972; White et al. 1976; Meisner et al. 1988). This is happening today here in the Methow Basin. Its time to stop hammering the things man has influenced in the basin and start realizing the benefits of mans influence in the basin. These beneficial influences need protection from those that would destroy them. This plan does not recognize the benefits of mans influence on the environment and would destroy 100 years of beneficial influence. The Methow Basin Watershed Planning Units Plan did recognize these benefits, if the Northwest Power and Conservation Council really wants to protect and enhance habitat, fish and wildlife they should contact the MBPU for funding direction.

Michael D Gage

15 Appendix H: Electronic Appendices

e-Appendix A EDT Attribute Ratings

e-Appendix B EDT Reports

e-Appendix C Pubic Outreach

e-Appendix D Spring Chinook HGMP

e-Appendix E Summer/Fall Chinook HGMP

e-Appendix F Hatchery Information

e-Appendix G Chief Joseph Dam Hatchery Program

e-Appendix H Independent Populations and Limiting Factors

e-Appendix I Skaha Lake Sockeye

e-Appendix J 2005 Recovery Plan Drafts

e-Appendix K Okanogan Limiting Factors Report

e-Appendix L 2001 Okanogan Subbasin Summary

e-Appendix M Wildlife Assessment

e-Appendix N Supporting Maps

e-Appendix M BPA Funding Summary 2001-2003