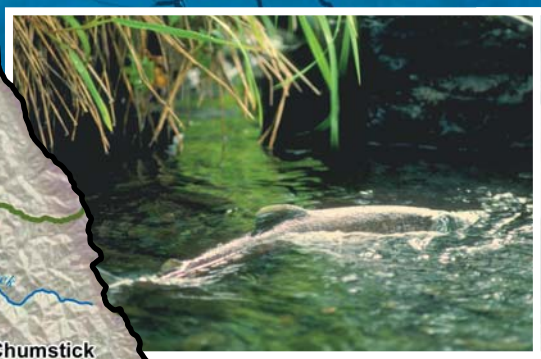
Final

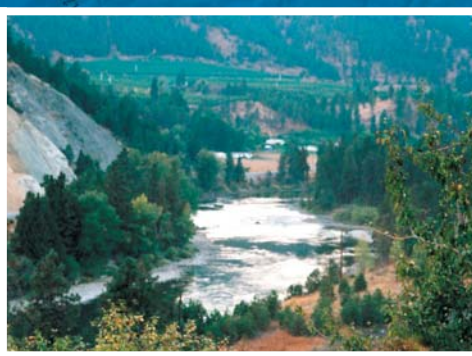
Wenatchee Watershed Management Plan

Volume I

Developed by

The WRIA 45 Planning Unit





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Wenatchee Watershed Management Plan
Executive Summary

INTRODUCTION

The Wenatchee Watershed Management Plan is the result of seven years of work by the Wenatchee Watershed Planning Unit (WWPU), which was formed in response to the 1998 Watershed Management Act (RCW 90.82). This statute provided the framework for locally-based watershed planning with a shared governance goal of giving local interests a voice and a forum for collaboration on water resource issues. The Act directs planning units to assess water supply and use, and develop strategies to meet current and future needs, including instream needs such as providing adequate aquatic habitat and out-of-stream needs such as irrigation, domestic and municipal supply. Through this process, stakeholders in the Wenatchee Watershed have reached a common ground in creating management strategies and recommending actions that address water quantity, water quality, instream flow, growth and land use, and habitat – as all of these components of watershed planning are linked. It is expected that the strategies presented in this Plan will be further refined in the implementation phase (Phase IV) of the watershed planning process.

The location of the Wenatchee Watershed (WRIA 45) and its component sub-watersheds is shown in Figure ES-1. The Wenatchee watershed lies completely within Chelan County and includes a number of cities and towns, agricultural lands primarily in fruit production, and private and public timber lands. Federal and State lands comprise over 80% of the WRIA. The entire watershed lies within the Yakama Nation's ceded lands wherein the Tribe has reserved rights to fish and hunt.

The 1370 square mile Wenatchee Watershed is unique. The WRIA extends from the snowfields, glaciers and steep, forested Cascade Mountains through orchards in the Wenatchee River Valley, to the shrub-steppe of the eastern watershed at the confluence of the Wenatchee and Columbia Rivers. The different climatic zones within the watershed are important because the largest irrigation and domestic water demands occur in the drier, lower valley near Wenatchee where streamflow can be limited in dry years. Due to the WRIA's diverse geography, climate, biology, human impacts, and human needs, the watershed has been divided into tributary areas, or sub-watersheds, as shown on Figure ES-1, to facilitate the application of water management strategies that are appropriate on a local scale.

Generally the watershed is in excellent condition; however, it has been impacted historically by concentrated development, transportation infrastructure and agriculture in the valley bottoms and along stream corridors. There continues to be development pressure near tributaries and the mainstem Wenatchee River. The highly variable and steep topography make the lower elevations and valley bottoms more attractive for development. In addition, less than 20% of the watershed is in private ownership, much of which is concentrated along valley bottoms.

The mission of the Wenatchee Planning Unit is *'to collaboratively develop a management plan for sustaining and improving watershed and community health by protecting water resources, habitat and water use in a way that balances the educational, economic and recreational values associated with a healthy community.'* In keeping with this mission, the main objectives of this Plan are to: identify strategies that will help meet current and future needs for both in-stream and out-of-stream uses; to protect and enhance habitat of threatened, endangered and culturally important species thereby improving overall habitat function and connectivity in the watershed; and to address impacts to water bodies that do not meet state and federal water quality standards. The Planning Unit and other local interests have worked together to prescribe solutions that meet these objectives.

Recommended actions in the Plan focus on the greatest water-related challenges in the watershed as determined through Planning Unit workshops. These challenges are organized under five central components: a water resource management strategy that addresses instream flows, water quantity,

growth and land use, water quality and habitat. The Wenatchee Planning Unit has opted to address Watershed Planning at two scales, a watershed-wide scale and a sub-watershed or tributary scale. The Plan first prescribes recommended actions in the form of management strategies and potential projects at a watershed scale for the five components. To address local issues that are specific to individual tributaries, sub-watershed strategies have been developed where pending water issues require tailored and near-term action.

During the assessment phase (Phase II) of watershed planning, the WWPU gained information from a variety of technical studies to build a strong scientific basis for decisions that guide this Plan. These assessments provided a compilation of existing data and technical relationships that were considered by the Planning Unit in developing the overall Watershed Management Plan. Supporting technical documents are summarized in Section 1 of the Plan. It is important to note that the majority of the technical information has not been repeated unless it was necessary to understand the basis for a recommendation.

This Executive Summary provides an overview of the Wenatchee Watershed Plan. For additional summary information refer to the tables in Section 2 that summarize all of the actions prescribed in the Plan.

PLAN ORGANIZATION

This Plan contains the following sections:

Section 1: Introduction and background information regarding watershed planning in WRIA 45, a brief summary of physical aspects of the watershed and references to technical data that support this Watershed Management Plan.

Section 2: Tables that summarize all of the actions recommended in the Plan.

Section 3: Overview of current and future water use estimates developed for this planning effort and used to guide decisions regarding the distribution of the WRIA 45 water reservation.

Sections 4 - 8: Background and recommended actions for each of the five water-related components identified by the Planning Unit, including (1) a water resource management strategy (WRMS) addressing instream flows and out-of-stream water needs; (2) water quantity actions that support the WRMS; (3) actions related to growth and land use policies; (4) water quality actions consistent with the Total Maximum Daily Load (TMDL) process; and, (5) habitat actions consistent with recovery planning efforts for fish in WRIA 45. Each section includes background information and recommended actions in the form of management strategies, recommendations, and projects.

Section 9: Summary of Plan recommendations that apply specifically to local tributary areas, or sub-watersheds. Sub-watersheds that have unique, pending water issues that require near-term action are addressed.

Sections 10-12: Implementation of the Plan, public outreach, and State Environmental Policy Act (SEPA) considerations, respectively.

BLANK SHEET FOR FIGURE ES-1

A WATER RESOURCE MANAGEMENT STRATEGY ADDRESSING INSTREAM FLOWS (SECTION 4)

The Wenatchee Watershed (WRIA 45) has been listed by the State Department of Ecology (Ecology) as one of 16 basins in the state with critical and inadequate streamflows for fish. Critical basins are also referred to as "over-appropriated," meaning that more water has been allocated to out-of-stream uses than is naturally available in some years. Snowmelt is a primary source of late summer and fall streamflow in the Wenatchee Watershed. Variability in winter precipitation results in highly variable streamflow, especially in late summer and early fall (July-October). Water demand is highest during the period when streamflows are lowest. Water is needed during this critical time of year for aquatic habitat, fruit production, fire protection, increased tourism needs, domestic irrigation and household needs, and municipal use.

The WWPU has developed a Water Resource Management Strategy (WRMS) to address concerns about protecting and enhancing flows for fish, while at the same time, providing a water reservation to accommodate future growth in the watershed. The WRMS includes proposed new management (instream) flows on the mainstem Wenatchee River and a number of tributaries; a water reservation to provide a year-round supply for future domestic and municipal use and stock water; and a seasonal supply of water (maximum allocation) for seasonal use and storage. The quantity of the water reserve has been determined based on both the protection of instream uses and the projected out-of-stream needs in the watershed.

The Plan recommends that a four (4) cfs water reservation from the mainstem Wenatchee River and its tributaries be made available to supply future municipal, domestic and stock water to the watershed. Currently, withdrawals for municipal and domestic use in the watershed total approximately 7.5 cfs. The reserve will be allocated between the upper and lower portions of the WRIA, and among sub-watersheds to ensure that the water available for servicing growth is distributed equitably and based on projected growth and future water needs. Additional limitations and sub-watershed allocations are based on protecting and sustaining local aquatic habitat needs.

The strategy also includes specific actions to be implemented at the local, or "sub-watershed" scale, as necessary. A number of actions are recommended to address water shortages in the Mission and Chumstick Sub-watersheds. The proposed water resource management strategy will not affect existing water rights and applies only to new water rights for new uses to be established in the future. Although the instream flows proposed as part of this strategy will not put water into streams, they will protect aquatic resources from degradation, and existing senior water rights from impairment.

WATER QUANTITY ACTIONS THAT SUPPORT THE WRMS (SECTION 5)

The Plan proposes watershed-wide measures to enhance the recommended water resource management strategy and help mitigate potential impacts of the water reservation established to support future growth. Many of the water quantity actions will provide additional water for both instream and out-of-stream purposes, help meet future water needs, and extend the life of the water reservation for WRIA 45.

Actions that address water right issues include recommendations to Ecology about the processing of water right applications and enforcement of existing regulations concerning water rights and use; development of a water bank for WRIA 45; and the purchase or lease of water rights within the WRIA.

Other Water Quantity Actions include the tracking of water availability and use for the reservation, metering of all new uses eligible under the reserve, studies and tracking of exempt well use, and conservation measures. Actions that will improve conservation efforts and prolong the life of the reserve include: requirements for developers to tie into irrigation water where available and practicable, encouraging City and County policies that require outdoor conservation measures as a condition of subdivision approval, and increasing the availability and accessibility of public information regarding conservation and water use. Other specific water quantity actions have been developed to address local issues in the Mission, Chumstick, and Peshastin Sub-watersheds, and the Northside Tributaries.

Storage opportunities are also discussed as tools that can be used to maximize the beneficial use of water while minimizing instream impacts. A general feasibility analysis has been completed that identifies potential opportunities across the watershed. These opportunities include (1) small-scale opportunities such as channel restoration and repair and small water storage tanks for fire protection and (2) larger-scale opportunities such as instream reservoirs and lakes, off-channel impoundments, and optimization of high alpine lakes. The next steps in the evaluation of water storage opportunities include a needs and alternatives analysis in each of the tributary areas.

GROWTH AND LAND USE ACTIONS (SECTION 6)

The Planning Unit recognizes the need to integrate the water resource management strategy proposed in this Plan with land use planning processes and decisions to ensure that reservation allocation and eligible uses are considered. As such, actions have been proposed that establish a technical water-resource base for use in land use change decisions, and when considering land use permit applications. The Plan also recommends that water availability be considered as part of Urban Growth Area (UGA) boundary decisions and encourages local governments to consider protection measures and strategies identified in the Watershed Plan as non-regulatory mechanisms to protect critical areas watershed-wide.

WATER QUALITY ACTIONS (SECTION 7)

Water quality monitoring has indicated that there are locations on the Wenatchee River and its tributaries where State and Federal water quality standards have been exceeded for temperature, fecal coliform bacteria, DDT, dissolved oxygen (DO) and pH. These water quality problems are likely due to development and historic land use practices. A Total Maximum Daily Load (TMDL) study and implementation plan are being completed to address these water quality issues. The Water Quality component of this Watershed Plan is the product of an effort to coordinate the TMDL process and watershed planning with local stakeholders in the watershed. The actions in this Plan reflect those that have been identified in the implementation strategy of the TMDL and subsequently agreed upon by the Planning Unit. The recommendations include actions that apply watershed-wide, and sub-watershed specific actions to address local exceedances of water quality standards.

ACTIONS ADDRESSING HABITAT (SECTION 8)

The habitat component of the Wenatchee Watershed Plan builds upon existing research, reports, and programs to initiate habitat improvement actions in WRIA 45. The Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan identifies actions to address habitat needs for these species in the Wenatchee Watershed and is used in conjunction with the Biological Strategy to identify both the restoration and protection actions prescribed in this Plan.

Actions are identified that will improve the function and connectivity of habitat throughout the watershed. Generally, the approach is to protect high quality habitat in the upper watershed and pursue opportunities to enhance habitat in the middle and lower watershed. As specified in the Watershed Planning Act, the Plan emphasizes salmonid and aquatic habitat. However, to benefit both aquatic and terrestrial species, upland habitat is considered as it relates to aquatic processes. Actions are based on the biological needs of each specific sub-watershed in the WRIA.

SUB-WATERSHED SPECIFIC ACTIONS (SECTION 9)

Members of the Planning Unit have chosen to address water-related planning activities more specifically at a sub-watershed level. Locally applied management strategies that are recommended for specific tributaries are outlined in Section 9. Sub-watershed specific actions vary across the watershed, and address unique, pending water issues that may require near-term action. These summaries may be particularly useful for community members that live in these areas.

STATE ENVIRONMENTAL POLICY ACT

Chelan County is the SEPA lead agency for this Watershed Management Plan, and must comply with a SEPA review of the Plan. The Final Environmental Impact Statement for Watershed Planning under Chapter 90.82 RCW (Ecology, 2003) summarizes a variety of SEPA related issues. All of the proposed actions outlined in the Plan that may trigger SEPA are consistent with actions evaluated in the statewide EIS. It is intended that Chelan County, as lead SEPA agency, adopt the statewide EIS with a Determination of Significance for the Watershed Plan to meet its responsibility to prepare a SEPA compliant review. A SEPA gap analysis is presented in Section 12.

IMPLEMENTATION OF THE PLAN

Phase IV of the watershed planning process is implementation, which commences when the final Watershed Plan is adopted by Chelan County. The Implementation section (Section 10) identifies actions that need additional assessment and planning before implementation can proceed and responsibilities can be assumed. The roles of the WWPU and Subcommittees will be preserved during Phase IV, Implementation; however, these entities will address any needed reorganization as necessary to successfully implement the Plan.

Effective implementation, including coordination and oversight, is critical to the success of this planning effort and the long-term future of the watershed. The Watershed Plan for the Wenatchee Watershed consists of a number of programs, plans and studies that will be implemented over time through numerous implementing agencies. Funding for these efforts will ebb and flow. At the same time, the voluntary efforts of many individuals and groups will continue to play a significant role.

FINAL

WENATCHEE WATERSHED MANAGEMENT PLAN

Developed by:
The WRIA 45 Planning Unit

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ACKNOWLEDGEMENTS

Initiating Governments

In 1998 the Washington Legislature passed House Bill 2514 that defined the conditions and funding for watershed planning across the State. After a series of meetings in 1998 and 1999, the local community in the Wenatchee watershed showed interest in participating in the watershed planning process. Under the law (RCW 90.82), the "initiating governments" must mutually decide to proceed with watershed planning. After a series of meetings in 1998 and 1999, **Chelan County, the City of Wenatchee, and the Wenatchee Reclamation District** elected to proceed with developing a watershed plan. They designated Chelan County as the Lead Agency for the effort and invited Colville Confederated Tribes and Yakama Nation to participate. Chelan County, as Lead Agency, secured the initial grant funding for the process and worked to establish the multi-stakeholder "Planning Unit" (WWPU) that would act as the overall decision-making body for the effort. Chelan County attended to the many needs of the effort and ensured consistent and diverse participation on the Planning Unit in addition to administering grant funds and contracts and providing staff to facilitate and coordinate the process, including an extensive public outreach effort.

Planning Unit

The Wenatchee Watershed Plan was developed through the participation and input of numerous stakeholders from the Wenatchee Watershed over the past eight years; many of whom spent countless hours providing information, reviewing and formulating plan actions, and attending meetings to represent their constituencies. These individuals are listed below:

Audubon Washington
Naki Stevens
Barn Beach Reserve
Jeff Parsons
Blue Star Growers
Bob Gix
Cascade Orchard Irrigation Company
Cot Rice
Center for Environmental Law and Policy
Karen Allston
Barry Goldstein
Chelan County Commissioners
Jim Lynch
Esther Stefaniw
John Hunter
Keith Goehner (current)
Ron Walter (current)
Buell Hawkins (current)
Chelan County Conservation District
Peggy Entzel
Mike Rickel
Chelan County Natural Resource Department
Lisa DeVera
Mike Kaputa
MaryJo Sanborn
Lee Duncan
Dana Bates
Matt Collins
Chelan County Planning Department
Larry Angell
Chelan County Port District
Dayle Rushing
Chelan County Public Utility District
Steve Hays
Dick Nason
Jeff Osborne
Keith Truscott
Chuck Peven
Waikele Hampton
David Johnson
Shaun Seaman
Julie Pyper

Chelan-Douglas Health District
Leslie Turner
Marc Marquis
Chelan-Douglas Land Trust
Gordon Congdon
Citizens
Dave Klinger
Lisi Ott
Lyle Hoeffner
Fred Smith
Edgar Meyer
City of Cashmere
Michelle Taylor
Charlie Cruickshank
Tom Hastings
City of Leavenworth
Mike Deason
Scott Hugill
Connie Krueger
City of Wenatchee
Dan Curry
Jessica Shaw
Governor's Salmon Recovery Office
Bob Bugert
Icicle Creek Watershed Council
Buford Howell
Dick Rieman
Icicle Irrigation District
Mel Weythman
Joel Teeley
Jones-Shotwell Ditch
Mel Weythman
KOHO Radio
Chris Rader
Lake Wenatchee State Park
Rick Halstead
Leavenworth Adopt-A-Forest
Pat Rasmussen
Longview Fibre
Steve Tift
North Central Homebuilders Association
Jim Blair
David Winters
North Central Washington Association of Realtors
John Wilson
North Central Washington Audubon Society
Jon Soest
Mark Oswood
Rachael Scown
National Oceanic & Atmospheric Administration – Fisheries
Dale Bambrick
Osprey Rafting Company
Gary Planagan
Peshastin Hi-Up
Jon Tall
Kameron Miller
Peshastin Irrigation District
Jim Robertson
Joel Teeley
Jim Koempel
Trout Unlimited
Ron and Jan Carpenter
Tom Kahler
Tumwater Drilling
Steve Ballew
US Bureau of Reclamation
Steve Kolk
US Forest Service
Glenn Hoffman
Ken MacDonald
Vaughn Marable
Cameron Thomas
Matt Karrer
Heather Murphy
Cindy Raekes
Sonny O'Neal
US Fish & Wildlife Service
Jim Craig
Kate Terrell
Judy DeLaVergne
Karl Halupka
Washington Department of Fish & Wildlife
Carmen Andonaegui
Mark Cookson
Chris Parsons
Dennis Beich

Bob Vadas
Hal Beecher
Washington Growers Clearinghouse Association
Kirk Mayer
Washington Rivers Conservancy
Lisa Pelly
Washington State Department of Ecology
John Monahan
David Holland
Bob Barwin
Jim Carroll
Derek Sandison
David Schneider
Jim Pacheco
Washington State Senate
Senator Linda Parlette
Wenatchee Reclamation District
Rick Smith
Wenatchee-Chiwawa Irrigation District
Dennis Pobst
Washington State University-Extension
Tim Smith
Kevin Powers (4H Forestry Education)
Yakama Nation
Tom Ring
Bob Rose
Lee Carlson

Appreciation and acknowledgement extends to all others that we have inadvertently excluded, and all the citizens who attended various public meetings and tours over the years to contribute their local knowledge to the development of the plan……Thank you.

Technical and Plan Development Support

The Wenatchee Watershed Plan could not have been developed without significant contributions from various professionals, contractors, experts and agencies who provided key technical, policy, facilitation and coordination support over the years. The result of these contributions is a technically sound and exceptional watershed plan that is accessible by the community and likely to be readily implemented.

Golder Associates
Lisa Dally Wilson and Alyssa Neir of Golder Associates were instrumental in organizing and writing the watershed plan. Golder provided key facilitation and technical expertise (including water use estimates) for the instream flow and water resource management strategy portions of the plan. Their hard work and commitment to this Planning Unit are greatly appreciated.

EES Consulting
Pete Rittmueller of EES Consulting performed key PHABSIM studies in the watershed and provided important technical advice on the instream flow and water resource management portions of the plan.

Montgomery Water Group
Bob Montgomery of the Montgomery Water Group (MWG) completed the initial Watershed Assessment which represented one of the first work products of the Planning Unit and the basis for future water resource decisions of the Planning Unit. MWG was a key contributor to the Lake Wenatchee Water Storage Feasibility Study and is currently completing the water storage component of the watershed plan.

Jones & Stokes
Mark Matthies and John Soden of Jones & Stokes completed the lower Wenatchee channel migration zone study, which provided the Planning Unit with its first habitat assessment and project development information. Jones & Stokes contributed particularly to the efforts of the habitat subcommittee and a series of watershed tours held in 2004.

Other Consultants
The following other consultants contributed in some way to the development of this plan: Dan McDonald with Montgomery Watson HARZA for his work on the Lake Wenatchee Water Storage Feasibility Study; Lisa Parks, Chuck Jones, and Kris Hansen of Alliance Consulting have helped to represent the City of Cashmere in the planning process; Carolyn Pearson with ECO-AIM for technical and biological assistance on various habitat projects; Peter Burgoon with Water Quality Engineering for his work on various water quality projects; Mike Ward with Terraqua for his work with the Regional Technical Team; Susan Gulick with Sound Resolutions for her work on facilitating the initial watershed planning meetings; and Steve Swope with Pacific Groundwater Group for his contributions to the water storage study.

Washington State Department of Ecology (Ecology)
Various staff members with Ecology provided PHABSIM study information for Chiwawa River and Nason Creek as well as technical reports for the various parameters in the water quality component of the plan.

United States Bureau of Reclamation (USBOR)
The USBOR provided key funding and technical expertise to the Planning Unit in order to complete the lower Wenatchee River, Peshastin Creek and Icicle Creek PHABSIM studies, without which many of the plan components could not have been completed.

Other Related Planning Efforts
Several other planning efforts overlapped with Wenatchee watershed planning and provided essential technical information and recommended actions that have been incorporated into this watershed plan. Numerous agency and consultant scientists and staff participated in these efforts, and while they may not have directly participated in this process, their work has been a significant contribution to this effort. These efforts include the Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan, the Wenatchee Subbasin Plan, the Wenatchee River Watershed Action Plan and the Wenatchee River TMDL Process.

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List of Acronyms and Abbreviations

ac-ft	acre-feet
ADD	Average Daily Demand
AF	acre-feet
BACI	Before-After-Control-Impact
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
BPA	Bonneville Power Administration
CCCD	Chelan County Conservation District
CCD	Census County Division
CCNRD	Chelan County Natural Resource Department
CD	Compact Disc
CDHD	Chelan-Douglas Health District
CELP	Center for Environmental Law and Policy
cfs	cubic feet per second
ChiwaukumH	Chiwaukum Creek Sub-watershed Habitat Actions
ChiwawaH	Chiwawa River Sub-watershed Habitat Actions
ChumH	Chumstick Creek Sub-watershed Habitat Actions
ChumQUAL	Chumstick Creek Sub-watershed Water Quality Actions
ChumQUANT	Chumstick Creek Sub-watershed Water Quantity Actions
CIR	Crop Irrigation Requirement
CMZ	channel migration zone
DDT	Dichlorodiphenyltrichloroethane
DIP	Detailed Implementation Strategy
DNR	Washington State Department of Natural Resources
DO	Dissolved Oxygen
DOH	Washington State Department of Health
DNS	Determination of Non-Significance
DS	Determination of Significance
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ERU	Equivalent Residential User or Unit
ESA	Endangered Species Act
ESHB	Engrossed Substitute House Bill
ESU	Evolutionarily Significant Unit
EWWD	East Wenatchee Water District
FC	Fecal Coliform
FLIR	Forward-Looking Infrared Radar
GIS	Geographic Information Systems
GLU	Growth and Land Use Actions
GMA	Growth Management Act
gpd	gallons per day
gpd/hh	gallons per day per household
gpm	gallons per minute
H	Habitat Actions
IcicleH	Icicle Creek Sub-watershed Habitat Actions
IcicleQUAL	Icicle Creek Sub-watershed Water Quality Actions
IMP	Implementation Actions

ISEMP	Integrated Status and Monitoring Program
ISF	instream flow
IRPP	Instream Resources Protection Program (current 1983 instream flow rule)
LiDAR	Light Detection and Ranging
LitWenH	Little Wenatchee River Sub-watershed Habitat Actions
LkWenH	Lake Wenatchee Sub-watershed Habitat Actions
LowWenH	Lower Wenatchee River Sub-watershed Habitat Actions
LowWenQUAL	Lower Wenatchee River Sub-watershed Water Quality Actions
LWD	large woody debris
MDD	Maximum Day Demand
MDNS	Mitigated Determination of Non-Significance
MGD	million gallons per day
MissionH	Mission Creek Sub-watershed Habitat Actions
MissionQUAL	Mission Creek Sub-watershed Water Quality Actions
MissionQUANT	Mission Creek Sub-watershed Water Quantity Actions
MWG	Montgomery Water Group
NasonH	Nason Creek Sub-watershed Habitat Actions
NEPA	National Environmental Policy Act
NOAA	National Oceanic & Atmospheric Administration
NPCC	Northwest Power and Conservation Council
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NSTQUANT	Northside Tributaries Water Quantity Actions
OCPI	Overriding Consideration of the Public Interest
OFM	Washington State Office of Financial Management
PeshastinH	Peshastin Creek Sub-watershed Habitat Actions
PeshastinQUANT	Peshastin Creek Sub-watershed Water Quantity Actions
PHABSIM	Physical Habitat Simulation
PO	Public Outreach Actions
PUD	Chelan County Public Utility District
Q	stream discharge, flow (usually measured in cfs)
Q_i	Instantaneous flow
QUAL	Water Quality Actions
QUANT	Water Quantity Actions
RCW	Revised Code of Washington
RM	River Mile
RTT	Regional Technical Team
SEPA	State Environmental Policy Act
SIS	Summary Implementation Strategy
SSHIAP	Salmon and Steelhead Habitat Inventory and Assessment Project
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
U and A	Usual and accustomed (hunting and fishing areas)
UCRTT	Upper Columbia Regional Technical Team
UCSRB	Upper Columbia Salmon Recovery Board
UGA	Urban Growth Area
UpWenH	Upper Wenatchee River Sub-watershed Habitat Actions
UpWenQUAL	Upper Wenatchee River Sub-watershed Water Quality Actions
US	United States
USBOR	U.S. Bureau of Reclamation

USFS	United States Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
VSP	viable salmonid population
WAC	Washington Administrative Code
WCC	Washington Conservation Commission
WDFW	Washington Department of Fish and Wildlife
WhiteH	White River Sub-watershed Habitat Actions
WQTS	Water Quality Technical Subcommittee
WRIA	Water Resource Inventory Area
WRMS	Water Resource Management Strategy
WUA	weighted usable area
WWPU	Wenatchee Watershed Planning Unit
WWTP	Wastewater treatment plant

Standard Water Unit Conversions

1 cfs = 448.8 gpm
1 cfs = 646,272 gpd
1 cfs = 1.98 ac-ft per day
1 cfs = 0.6463 mgd
1 cubic foot = 7.48 gallons
1 gpm = 1,440 gallons per 24 hour day
1 gpm = 1.61 ac-ft per year
1 ac-ft = 1 foot of water on 1 acre
1 ac-ft = 325,851 gallons

GLOSSARY

1983 Instream Flow Rule: All consumptive water rights appropriated after adoption of the 1983 Instream Flow Rule for the diversion of surface water from the main stem of the Wenatchee River and perennial tributaries are subject to the 1983 instream flow requirements which can be found in Chapter 173-545 WAC. All water rights junior to the instream flow rule are subject to interruption when regulatory flows are not achieved. The instream flow rule does not affect water rights that were in existence prior to 1983. (Montgomery Water Group (MWG), 2003:7-1).

90.22 RCW: The Minimum Water Flows and Levels Act of 1967 set forth a process for protecting instream flows through adoption of rules.

90.54 RCW: The Water Resources Act of 1971, particularly section 20, includes language that states base flows are to be retained in streams except where there are "overriding considerations of the public interest". Further, waters of the state are to be protected and utilized for the greatest benefit to the people and that allocation of water will be generally based on the securing of "maximum net benefits" to the people of the state. This Act also authorizes Ecology to reserve waters for future beneficial uses.

90.82 RCW: This established the framework and funding for watershed planning in Washington State. The Watershed Planning Act of 1998 also gives local watershed planning groups the authority to recommend minimum instream flows to Ecology for rule-making. See Watershed Management Act on p. xvii.

Adaptive Management: "Continual improvement of management programs, based on information collection and application of various actions over time." Adaptive management involves management that monitors the results of policies and/or management actions, and integrates this new learning, adapting policy and management actions as necessary.

Adjudication: "The process where all those claiming the right to use water from a water source are joined in a single legal action to determine the rights and priorities for the use of the water" (Clifford, et al., 2004:149).

Appropriation: "The establishment of a water right by diversion, due diligence and beneficial use. Must be adjudicated to establish seniority of right" (Clifford, et al., 2004:149).

Average Day Demand (ADD): The total amount of water delivered to the system in a year divided by the number of days in the year, or the average total amount of water used each day during a one-year period. The ADD is determined from the historical water use patterns of the system and can be used to project future demand within the system.

Beneficial use: Beneficial use shall include, but not be limited to, use for domestic water, irrigation, fish, shellfish, game and other aquatic life, municipal, recreation, industrial water, generation of electric power, and navigation (RCW 90.14.031(2)).

Bioaccumulation: A general term for the accumulation of substances, such as pesticides (DDT is an example), methylmercury, or other organic chemicals in an organism or part of an organism. The accumulation process involves the biological sequestering of substances that enter the organism through respiration, food intake, epidermal (skin) contact with the substance, and/or other means. The sequestering results in the organism having a higher concentration of the substance than the

concentration in the organism's surrounding environment. (http://toxics.usgs.gov/definitions/bioaccumulation.html).

Char: Bull trout and Dolly Varden (WAC 173-201A-200(1)(a)(i)).

Class A: Waters that typically exhibit extraordinary water quality that markedly and uniformly exceeds the requirements for all or substantially all uses (Cristea and Pelletier, 2005).

Class AA: Waters that typically exhibit excellent water quality that meets or exceeds the requirements for all or substantially all uses (Cristea and Pelletier, 2005).

Conservation: The management of resources so as to minimize waste and maximize efficiency of use.

Consumptive Use: "The amount of water consumed during use that does not return to a water system" (Clifford, et al., 2004:150).

Control point: A stream gage that is used to measure the discharge of the stream to ensure that the instream flow requirements are met.

Core population: A group of one or more local populations that exist within core habitat (UCSRB, 2005).

Crop Irrigation Requirement (CIR): Water supplied by irrigation to satisfy evapotranspiration that is not provided by water stored in the soil and precipitation. Where additional quantities of water are required for leaching, frost-protection, cooling and other miscellaneous crop requirements, these quantities are added to the CIR.

Domestic Water Use: For purposes of this plan, domestic water use is defined as water to satisfy human domestic needs of a household or business, including water used for drinking, bathing, sanitary purposes, cooking, laundering, irrigation of not over one-half acre of associated lawn or garden per dwelling, care of household pets, and other incidental household uses. For permit-exempt domestic water use of groundwater sources, total outdoor watering for multiple residences shall be consistent with the groundwater permit exemption provisions in RCW 90.44.050.

East Bank Aquifer Regional Water Supply (Regional Water Supply): The East Bank Aquifer Regional Water Supply is jointly owned and operated by the City of Wenatchee, East Wenatchee Water District (EWWD) and the Chelan County PUD. The water supply serves the greater Wenatchee area.

Efficiency: Increasing the output with the same amount of input. For example, increasing irrigation efficiency would mean that there is a greater crop production from the same amount of water use.

Enhancement: Actions that move toward creating the specific functional condition of restoration, without necessarily achieving all criteria necessary for restoration, or the complete creation of that condition.

Equivalent Residential User or Unit (ERU): A measure of water demand in terms of an equivalent number of single family dwellings.

Exceedance Hydrograph: A hydrograph showing the probability that a certain discharge will be exceeded in any given year. For example, the 10% exceedance hydrograph indicates that the flows of record exceeded the hydrograph flows 10% of the time. A 10% exceedance hydrograph is indicative of higher flows while a 90% exceedance hydrograph represents lower flows.

Exempt Wells: Wells that do not require a permit from the Department of Ecology and are generally used for domestic purposes, including stock water and small-scale irrigation.

Fire Suppression: The act of fighting an actual fire.

Group A Systems: Those water systems that regularly serve either 15 or more service connections or 25 or more people per day for 60 or more days per year.

Group B Systems: Those water systems that serve fewer than 15 service connections and fewer than 25 people per day, or 25 or more people per day for fewer than 60 days per year.

Group Domestic Systems: A water system that services 2-14 connections for domestic purposes including associated irrigation of lawn and garden.

Group Domestic Use: Water from a system that services 2-14 connections for domestic purposes. The water can also be used to water an associated lawn and garden.

Growth Management Act: The Act (Chapter 36.70A RCW) was adopted by the Legislature in 1990. The GMA requires state and local governments to manage Washington's growth by identifying and protecting critical areas and natural resource lands, designating urban growth areas, preparing comprehensive plans and implementing them through capital investments and development regulations. (from http://www.gmhb.wa.gov/gma/)

High Flow: The 10 percent exceedance probability which is the flow rate that is exceeded ten percent of the time.

Hydraulic continuity: The degree to which groundwater is connected to a nearby surface water body, such as a river or lake (also called groundwater surface water interaction) (Golder Technical Memo Jan 6, 2005)

Hydrograph: A graph of water discharge over time.

Hyporheic Zone: A zone of saturated sediments lying below the streambed and extending laterally beneath the stream bank (Boulton, 2000).

Impairment: Harmful effects to existing water rights. (http://www.ecy.wa.gov/pubs/961804swr.pdf)

Instream Flow: Used to identify a specific stream flow (typically measured in cubic feet per second, or cfs) at a specific location for a defined time, and typically following seasonal variations. Instream flows are usually defined as the streamflows needed to protect and preserve instream resources and values, such as fish, wildlife and recreation. (http://www.ecy.wa.gov/programs/wr/instream-flows/isfhm.html)

Instream Use: "A type of end application of water use that does not require withdrawal from the source. Examples of instream uses are recreational, navigational, and ecosystem preservation" (Clifford, et al., 2004:150).

Irrigation Efficiencies Program: Helps private landowners partner with local conservation districts to save water and aid in salmon recovery by implementing best management practices to increase the efficiency of on-farm water application and conveyance systems. (http://www.scc.wa.gov/programs/irrigation/)

Junior water right: "Water rights that were established more recently than senior rights. The more recent a date on a water right, the more "junior" it is relative to water rights with older issuance dates. All water rights are defined in relation to other rights, and a water right holder only acquires the right to use a specific quantity of water under specified conditions. Therefore, when limited water is available, junior rights cannot be exercised until all senior rights have been satisfied" (Clifford, et al., 2004:152).

Lease: A lease of a water right is a temporary acquisition of all or part of the right.

Limiting Factor: Conditions that limit the ability of habitat to fully sustain populations of anadromous and resident fish and other aquatic life.

Low flow: The 90 percent exceedance probability which is the flow rate that is exceeded ninety percent of the time.

Maximum allocation: The maximum flow that could be allocated from the watershed or sub-watershed, subject to instream flow requirements, for storage, seasonal allocation to new uses through water rights, and the reservation.

Maximum Day Demand (MDD): The average amount of water delivered to the system on the year's maximum water use day. This number is typically calculated using a peaking factor in conjunction with the ADD. According to DOH guidelines, water system facilities must be designed to convey maximum daily demands.

Median Flow: The 50 percent exceedance probability. It equals the flow rate that occurred five years out of ten (MWG, 2003:4-5).

Municipal Use: There are three situations where water is considered to be for municipal use. The first is when water is used for residential purposes by fifteen or more residential service connections or for a nonresidential population that is, on average, at least 25 people for at least 60 days a year. The second is when water is used for governmental or governmental proprietary purposes by a city, town, public utility district, county, sewer district, or water district. The third includes indirect uses of water for residential, governmental or governmental proprietary purposes through the delivery of treated or raw water to a public water system for such use (RCW 90.03.015).

National Environmental Policy Act (NEPA): A 1969 federal Act that requires federal agencies to integrate environmental values into their decision making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions. (http://www.epa.gov/compliance/nepa/)

Non-Consumptive use: Water use is non-consumptive when its use does not result in long-term diversion from the water source or diminishment of the source. Additionally, when water is diverted and returned to the source at the point of diversion following its use in the same quantity as diverted and meets water quality standards for the source, the water use is classified as non-consumptive.

Non-point source: Pollution that does not come from one particular source.

Nonuse: Water that has not been put to beneficial use.

Out-of-stream water use: A use that requires water to be taken out of the stream.

Overriding Consideration of the Public Interest (OCPI): An executive decision exercised by the Director of the Department of Ecology (Director) when implementation of a water resource management program, taken as a whole, is deemed to be in the interest of the public, but absent such a finding the program would be contrary to Washington State water law.

Periphyton: A complex matrix of algae and heterotrophic microbes attached to submerged substrata in almost all aquatic ecosystems. It serves as an important food source for invertebrates and some fish, and it can absorb contaminants. Periphyton is also an important indicator of water quality; responses of this community to pollutants can be measured at a variety of times scales representing physiological to community-level changes. (http://www.esd.ornl.gov/BMAP/comm_per.htm)

Physical Habitat Simulation (PHABSIM): Physical Habitat Simulation is a collection of computer programs that can be used to represent habitat suitability for specific fish species and life stages according to characteristics of micro-habitat (depth, velocity, and substrate). PHABSIM results in Weighted Usable Area (WUA) Curves, which represent habitat availability at different discharges. The results show the habitat loss associated with a change in stream discharge.

Planning Horizon: The time period that is considered in the planning process. For purposes of the Wenatchee Watershed Plan, the planning horizon is 20 years starting in 2005 and ending in 2025.

Planning Unit: "A group that represents a wide range of water resource interests, tasked with conducting a watershed assessment and completing a watershed plan for one (or more) WRIAs. The initiating governments are responsible for development of an inclusive Planning Unit for the WRIA (RCW 90.82)" (Association of Cities, 1999:viii).

Point source: Pollution that comes from one source (i.e., a discharge pipe).

Potable water: Water that is suitable for drinking.

Protection: Prevention of future more active or invasive land use activities than the current land use.

Restoration: Creating a specific functional condition that has the desired effect on a given species.

Return Flows: Water that flows back to a surface or groundwater source after it has been diverted or pumped.

Senior water right: Water rights that are older (more senior) than those of junior rights. All water rights are defined in relation to other rights, and a water right holder only acquires the right to use a specific quantity of water under specified conditions. Thus, when limited water is available, senior rights are satisfied first in the order of their Priority Date" (Clifford, et al., 2004:154).

Single domestic use: Water that is used in one residence or business for domestic purposes. The water can also be used to water an associated lawn and garden.

Stock water use: Water use for stock that is consistent with Chelan County Code, Section 11.88.030 or any subsequent amendments. It does not include feed lots and dairies, or other activities which are not related to normal grazing land uses.

Streamflow: The volume of water flowing in a stream channel.

Sub-watershed or Sub-basin: A geographic portion of a management area, defined by the planning unit, on the basis of hydrologic or hydrogeologic characteristics" (Association of Cities, 1999:viii).

Toe-width Methodology: A quick habitat assessment tool used primarily for small streams. The measurement from the toe of one stream bank to the toe of the other is put into an equation and an estimation of flows needed for salmon and steelhead spawning and rearing is derived. (http://www.ecy.wa.gov/programs/wr/instream-flows/isfsci.html)

Total Maximum Daily Load (TMDL): A "…calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources" (US EPA website, http://www.epa.gov/owow/tmdl/intro.html)

Total Maximum Daily Load process: A process to identify sources of pollution in waters, determine how much of each kind of pollution the waters can receive without violating water quality standards, and set allowable pollution limits for various sources. Federal law requires states to undertake a TMDL process" (Association of Cities, 1999:ix).

Tributary: A stream that contributes water to a larger stream.

Trust water: Water rights that have been donated, leased, or permanently sold and result in a trust water right for a specified beneficial purpose, including instream flows. A trust water right for instream flow is exercised when it is in the river. A water right exercised through the trust program for the beneficial use of instream flows is not relinquished for non-use while it is in the program.

Urban Growth Areas (UGA): Areas designated by a county, with input from towns and cities, where growth and higher densities are expected and supported by urban services.

Water Bank: An institutional mechanism that facilitates the legal transfer and market exchange of surface water, groundwater, or water storage. This mechanism may be administered by any type of entity, such as private, public, or non-profit.

Water Held in Trust: Per the Washington State trust water legislation (RCWs 90.38 and 90.42.040) *water can be held in trust by the State* to be put to instream uses and to protect it from relinquishment. Water cannot be held in trust by any entity except the State of Washington, but *water held in trust* can be a component of, and be managed by any Water Bank (even one that is not administered by the State). The term *water trust* defines an entity that operates only to manage *water held in trust*. (A *water bank* may choose to operate a *water trust* as a subset of the larger bank.)

Water Market: The term *water market* has been used interchangeably with the term *water bank* in discussions in WRIA 45. For purposes of consistency, the term *water bank* will be used from this point forward.

Water reservation: Water that is reserved for future out-of-stream use and exempt from instream flow requirements. Out-of-stream uses include domestic, municipal, and stock water uses, fire suppression, and fire emergency (with the exception of feedlots).

Water Resource Inventory Areas (WRIA): "One of 62 geographic areas comprising the State of Washington, defined on the basis of surface water resources and codified in Washington Administrative Code 173-500-040" (Association of Cities, 1999:ix).

Water Resource Management Flow (WRM): Also known as "Minimum Instream Flow." These flows are set in rule by the state to manage future water allocation. Ecology will use these flows to help guide future water resource decisions and to protect existing water rights. Minimum instream flows are not flows that *need* to be left in the river.

Water right certificate: The legal record of a water right issued by Ecology once the department confirms that all the conditions of the permit have been met. It is recorded at a county auditor's office. Once Ecology issues a certificate, the water right is considered appurtenant (attached) to the land on which the water is used. (http://www.ecy.wa.gov/pubs/961804swr.pdf)

Water right claim: A claim to a water right, for a water use that predates the state's water permitting system (for surface water, 1917/1932, for ground water, 1945). The validity of a claim can only be confirmed through judicial processes. (http://www.ecy.wa.gov/pubs/961804swr.pdf)

Water right permit: Permission by the state to develop a water right; it is not a final water right. A permit allows you to proceed with construction of the water system and start putting the water to beneficial use, in accordance with the terms of your permit. (http://www.ecy.wa.gov/pubs/961804swr.pdf)

Watershed: "The land area that drains into the defined waterbody" (Clifford, et al., 2004:156).

Watershed Management Act: The 1998 law (90.82 RCW) that sets a framework for developing local solutions to watershed issues on a watershed basis. The intent of this legislation is to have local stakeholders address issues in their own watersheds via a "Planning Unit" [See also 90.82 RCW above].

Watershed Management Plan: A document presenting the findings and recommendations of the planning unit for a Watershed Management Program in the management area" (Association of Cities, 1999:ix).

Wetland filtration strips: Areas of wetlands that capture runoff and through natural processes filter the water that infiltrates to the groundwater.

Xeriscaping: Low water use landscaping (Chelan County PUD).

1.0 WATERSHED PLANNING IN WRIA 45

1.1 Introduction

In 1998 the Washington State Legislature passed the Watershed Management Act (formed under ESHB 2514; Chapter RCW 90.82), which provided for locally-based watershed planning in each of the 62 Water Resource Inventory Areas (WRIAs) in the State. The intent of this legislation is to have local stakeholders address issues in their own watersheds via a "Planning Unit". The Planning Unit is comprised of those entities most familiar with instream and out-of-stream demands on the water resource: local citizens, businesses, public agencies, and Tribes. Many of those involved have worked on water-related issues in the community prior to "Watershed Planning" through development of the 1998 Watershed Action Plan and other programs. The Planning Unit for the Wenatchee Watershed (Water Resource Inventory Area 45; WRIA 45) has developed this Watershed Plan to help manage this water resource for the benefit of future generations, while meeting both the environmental and economic goals of the community.

The citizens of the Wenatchee community appreciate the need to protect the water resource into the future and to manage it in a sustainable way. Water management strategies have been developed based on best available science and local community input. The plan addresses a 20-year planning horizon (through 2025) and incorporates an adaptive management focus to allow flexibility and integration of new information into the Plan's current recommendations and actions. It is also important to note that this plan has been prepared as part of Phase III of the Watershed Planning process. Phase III integrates stakeholder issues and recommendations for the watershed and is a product of community and government participation in WRIA 45. Therefore, this plan builds upon earlier technical assessment phases of Watershed Planning, and integrates previous and concurrent studies that address water quantity, instream flow, habitat, growth and land use, and water quality in the Wenatchee Watershed.

1.2 Watershed Characterization

Figure 1-1 shows the Wenatchee Watershed (WRIA 45) and its component sub-watersheds. The Wenatchee Watershed (WRIA 45) is approximately 1,370 square miles, including some areas that drain directly into the Columbia River. This plan focuses on the areas that drain directly into the Wenatchee River: the 12 sub-watersheds shown in Figure 1-1. This area consists of approximately 1,330 square miles and includes 230 miles of major streams and rivers and associated aquatic habitat. The headwaters of WRIA 45 originate in the Cascade Mountain range as the Little Wenatchee and White Rivers. These rivers flow into Lake Wenatchee, the source of the Wenatchee River. Various tributaries to the Wenatchee River add significant volume to the river. The Chiwawa River, White River, Little Wenatchee River, Nason and Icicle Creeks are the source of over 90% of the surface water within the watershed (Wenatchee River Watershed Action Plan Addendum, 1996). Primary tributaries include: Nason Creek (River Mile [RM] 53.6), Chiwawa River (RM 48.6), Chiwaukum (RM 35.6), Icicle (RM 25.6), Chumstick (RM 23.5), Peshastin (RM 17.9), and Mission (RM 10.4) Creeks. The Wenatchee River discharges into the Columbia River in the City of Wenatchee.

Groundwater resources in WRIA 45 are located primarily in bedrock and sediment overlying bedrock. The productive aquifers are located in the alluvial and glaciofluvial outwash sediments (Wenatchee River Watershed Action Plan, 1998). There is no continuous, regional aquifer that characterizes the entire watershed due to the diverse geology and geography of the region. In addition, there have been no comprehensive estimates or calculations that indicate the amount of groundwater available in the watershed or sub-watersheds (Golder, 2005a).

The broad range of activities, natural resources, and economic opportunities in the Wenatchee Watershed can be attributed to the highly variable landscape over which the Wenatchee River and its headwaters flow. The WRIA extends from the snowfields, glaciers and steep, forested Cascade Mountains in the northwest, through orchards in the Wenatchee River Valley, to the shrub-steppe of the eastern watershed at the confluence of the Wenatchee and Columbia Rivers. Average annual precipitation over this drainage area varies from over 150 inches at the Cascade Crest to 8 inches in Wenatchee. The climate in the watershed is hot and dry in the summer, especially in the lower elevations. The higher elevations receive, on average, between 10 and 20 feet of snow in the winter (Wenatchee River Watershed Action Plan, 1998). Snowmelt is a primary source of late summer and fall streamflow. Variability in winter precipitation results in highly variable streamflow, especially in the more arid lower watershed. The different climatic zones within the watershed are important because the largest irrigation and domestic water demands occur in the drier, lower valley near Wenatchee where streamflow can be limited some years. Due to its diversity, the watershed has been divided into tributary areas, or sub-watersheds, to enable application of water management strategies that are appropriate on a local scale.

The Wenatchee River and its tributaries boast some of the healthiest anadromous fish runs in the Columbia River drainage and contain salmonid habitat that is important to the entire Columbia River region. However, spring Chinook in the Wenatchee Watershed have been federally listed as endangered and bull trout and steelhead have been listed as threatened under the Endangered Species Act (ESA) (listings occurred in 1998, 1999, and 2006 respectively). There are core populations of sockeye salmon, steelhead, bull trout, and both spring and Summer Chinook salmon in the upper Wenatchee that are relatively strong when compared to other populations in the Columbia Sub-basin. Anadromous salmonid populations in the Wenatchee are influenced by activities that occur both within and outside of the watershed as they must negotiate a 468-mile journey from the mouth of the Wenatchee River to the Pacific Ocean, once as smolts and again as adults. Within the watershed, human alterations are reducing habitat quality and quantity (Andonaegui, 2001).

In the Treaty of 1855, the Yakama Nation ceded a portion of its land to the United States and reserved a portion for the Yakama Reservation. The entire Wenatchee Watershed is contained within the ceded area. While ceding title to the land, the Yakama Nation reserved certain rights on the ceded lands including the right to hunt and fish at usual and accustomed places (U and A's) and on open and unclaimed lands. The right to fish carries with it a right to have water in the streams to ensure that fish survive their life histories. Therefore, the Yakama Nation's treaty fishing rights include the right to have water in the streams of WRIA 45 to ensure that fish survive their life histories. In the Yakima River adjudication, that right has been assigned a priority date of Time Immemorial, so it is the senior water right in the basin. The same applies to the Wenatchee, although the Wenatchee basin has not been adjudicated. In the Yakima basin, the court also made it clear that the right to fish at usual and accustomed places entails a right to water for fish in those stream reaches that are upstream of the U and A's where the fish harvested at the U and A's spawn and rear. In endorsing this watershed plan, the Yakama Nation does not give up any of its Treaty or Sovereign rights.

According to 2005 County Assessor parcel data, approximately 23,850 people reside within the watershed on a full- or part-time basis; approximately 18,500 residents were reported in the 2000 US Census. The majority of the population resides in the cities of Cashmere and Leavenworth, the communities of Monitor, Peshastin, Dryden and Plain, and in the rural areas along the mainstem Wenatchee River from Leavenworth to Wenatchee. The City of Wenatchee is not addressed by this management plan, as most of the land area within the city limits drains directly to the Columbia River. There is also a growing part-time population in the upper watershed associated with vacation homes. The population in the WRIA is projected to increase at an average rate of approximately 2.4% per year between 2000 and 2025 (Chelan County, 2000; Chelan County Planning, personal

communication, 2005). Much of that growth is intended to occur within Urban Growth Areas (UGAs) and on other privately owned land in the low-lying valley bottoms along the Wenatchee River and its major tributaries.

The land uses in the rural areas of the watershed are primarily forest management and production, orchard production, scattered residences, lodging facilities, agricultural support facilities, and small home-based industries. Highways, railroads and roads also comprise a significant portion of the land area in WRIA 45. Over eighty percent of the area encompassed by WRIA 45 is in public ownership; the majority of which is under federal land management. A significant portion of the forest in the upper watershed is congressionally designated wilderness area. Issues addressed by this plan that require action on federal land or by federal agencies will require National Environmental Policy Act (NEPA) compliance.

Less than twenty percent of the watershed is currently in private ownership. It is anticipated that most future development in the watershed will occur on these lands. Currently orchards comprise one of the largest private land uses (by acreage) in the WRIA. Recreation and tourism are also providing increasing economic opportunities in the region. People travel from across the region to enjoy river rafting, kayaking, climbing, hiking, fishing, and backpacking opportunities.

1.3 Agriculture in the Watershed

The largest industry in the Wenatchee Valley is agriculture, predominantly tree fruit. The watershed supports many family-owned orchards, some established well over one hundred years ago. This valley is internationally recognized for the tree fruit grown here, and has gained a reputation as one of the best production areas for winter pears in the United States. Tree fruit sales bring significant revenues to the watershed (approximately $100 million gross, annually) much of which supports the local economy. Various professionals in the area estimate that an acre of pears provides approximately $10,000 to $12,000 to the local economy (Smith, personal communication, 2005). Of the approximately 9,000 acres of tree fruit in production in the Wenatchee Watershed, the majority of the acreage is in pears, and a much smaller percentage is in cherries and apples (Gix, personal communication, 2006). Although the tree fruit industry and associated irrigation systems are common throughout central Washington, the operation of this industry in the Wenatchee Watershed is unique and has resulted in a successful economy for several generations and should be understood in the context of this plan.

Given the limited rainfall in the Wenatchee Valley, agriculture is only possible by providing a reliable source of water to orchards throughout the growing season (April – October) via irrigation systems. Although a few growers have individual water rights from a well or nearby creek or river that serves their orchard, the majority of orchards in the Wenatchee Valley are served by an elaborate system of effective irrigation canals. Some of these irrigation canal systems were constructed over 100 years ago and most operate on a gravity flow system, meaning water is diverted from an upstream location and is delivered to downstream users via an irrigation ditch. A certain amount of water in the canal is necessary to move water through the entire system and thus service the users at the end of the line. Those who use water from an irrigation canal do not hold their own water right, but instead hold shares of one larger right associated with the entire canal.

It’s important to note that fruit trees need water throughout the growing season. The amount of water needed varies constantly depending on the weather and the stage of fruit development. In growing high quality tree fruit, the greatest water demand for the trees occurs as fruit growth peaks during July and August. Unlike other crops where water conservation can be accomplished by skipping a cutting or allowing the crop to die early, limiting water to fruit trees will negatively affect the one harvest of

the season and may permanently affect the tree which takes years to establish itself as a productive fruit producer. Therefore, the opportunities for decreasing direct on-farm water use in an orchard are somewhat limited.

Significant improvements in both on-farm and off-farm water use efficiency have occurred over the last century through the improvement of irrigation systems and conveyance infrastructure. In the 1930s, rill irrigation (filling trenches with water) was common. In the 1940s and 1950s many growers transitioned to hand lines and overhead sprinklers and permanent cover crops (which helped minimize erosion). Now, permanent, under tree, irrigation systems are widespread.

Delivery system improvements have also occurred in the valley over the years. Many canal systems have been lined and are well maintained, although there is still opportunity to line some earthen canals in the WRIA. It is in the best interest of the agricultural community that canal systems continue to be well maintained, as they are relied upon by so many. An example of efforts being made in the WRIA includes the Peshastin Irrigation District's conversion of the Tandy Ditch from an open canal to a pipe. This conversion resulted in a 3.5 cfs savings that was conserved for instream use over the bypass reach. (Note that lining or piping canal water will benefit the reach between the diversion and the point at which non-consumptive return flows occur; this section of stream is often called a "bypass" reach).

This watershed plan encourages further evaluation of water use and consideration of improvements where possible. However, it is recognized that many efficiency improvements have been made by the agricultural community over the years and "smart" water use is implicit in orchard operations (too much water too early hurts tree fruit).

External economic and political factors impact the agricultural community in WRIA 45. These include decreased access to foreign markets, increased foreign access to the US market; increased costs associated with ensuring local pests are not introduced into foreign & domestic markets, increased transportation costs, state regulatory costs and seasonal labor shortages due in part to immigration and guest worker program policy. Growers continue to seek and adopt new technologies and innovative practices to address those challenges. However, due to the above issues and urban encroachment some orchard land in WRIA 45 has recently been sold for development purposes. Pressure to sell agricultural land for non-agricultural uses is expected to continue (Mayer, personal communication, 2006).

The WRIA 45 community values agricultural land uses in the watershed and encourages opportunities for agriculture to be sustainable. These opportunities may include the support of agricultural tourism and the ability to change the type of crop produced to respond to changing economic conditions.

1.4 WRIA 45 Participation

The Wenatchee Watershed Plan is the collaborative product of numerous stakeholders in the watershed. Many have spent countless hours providing information, developing plan issues and actions, and attending meetings to represent their constituencies. Many local citizens attended public meetings, workshops, and tours over the years and greatly contributed their local knowledge to the development of the plan.

Active entities represented on the Planning Unit are listed below. Governmental members are those members of the Planning Unit who have the ability, through their jurisdiction, responsibility, or authority, to implement specific elements of a watershed plan. Non-governmental members are those members of the Planning Unit who have an interest in the development of a watershed plan but do not

have the ability to implement specific and tangible elements of a watershed plan. A full list of individuals who have participated in this process is presented in the acknowledgements section of this plan.

Governmental Members

*Chelan County** **Initiating Governments*
*Wenatchee Reclamation District**
*City of Wenatchee**
Chelan County Public Utility District
City of Cashmere
City of Leavenworth
Chelan County Conservation District
Chelan-Douglas Health District
Washington State Agency Caucus
- *Washington State Department of Ecology (caucus lead)*
- *Washington State Department of Fish & Wildlife*
- *Washington State Department of Health*

Yakama Nation
US Forest Service
US Fish and Wildlife Service
US Bureau of Reclamation
Cascade Orchards Irrigation Company
Jones-Shotwell Ditch
Icicle Irrigation District
Peshastin Irrigation District
Wenatchee-Chiwawa Irrigation District

Non-Governmental Members

Blue Star Growers
Washington Growers Clearinghouse Association
Longview Fibre Company
North Central Washington Audubon Society
Citizens/Landowners
North Central Washington Association of Realtors
North Central Home Builders Association
Center for Environmental Law and Policy (CELP)

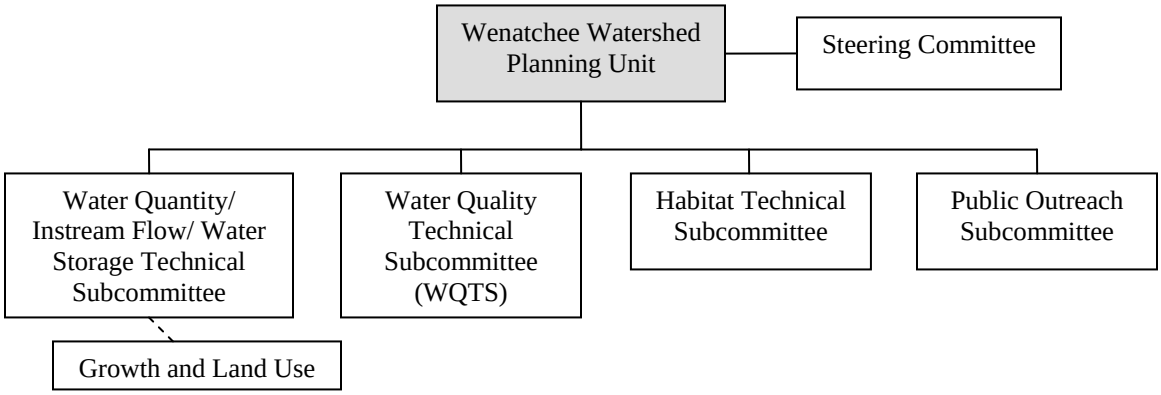
1.5 Planning Unit History and Operating Procedures

The three initiating governments, Chelan County (Lead Agency), the Wenatchee Reclamation District and the City of Wenatchee, assembled late in 1998 and determined they would pursue watershed planning under RCW 90.82. The Wenatchee Watershed Planning Unit (WWPU) formed in 1999; Chelan County was designated Lead Agency for grant management purposes and to provide administrative, facilitation and technical support to the process. Participation on the WWPU has always been open to include “anyone who has an interest in the Wenatchee River Watershed” (WWPU, 2003). Active Planning Unit members are grouped as governmental or non-governmental based on their ability to implement specific and tangible elements of the plan.

Much of the watershed planning work in WRIA 45 has been (and continues to be) performed by several key technical subcommittees under the direction of the Planning Unit. These committees address technical and policy issues associated with each of the technical elements and develop

alternative approaches for the Planning Unit's consideration. The Water Quantity/Instream Flow/Water Storage, Water Quality, and Habitat Technical Subcommittees include a broad range of representation from those with special technical expertise or an interest in the subject area. The flow chart below illustrates the structure of the Planning Unit, its steering committee and its subcommittees.

Planning Unit Structure



Decisions throughout this collaborative planning process have been made by consensus as defined by the WWPU to mean that the decision "allows every participating member to say, 'I can live with the decision and accept it, even though it may not be exactly what I want'" (WWPU, 2003). Each subcommittee has operated under consensus as well, developing more specific procedures as needed. Subcommittees make recommendations to the Planning Unit for consideration. For decisions that are substantive and binding, and for final plan approval, the Planning Unit will use the formal decision making process, as described in RCW 90.82. This formal process encourages consensus as described above where each entity will have one vote. However, if consensus cannot be achieved, then approval requires consensus of governmental entities and a majority vote among non-governmental entities.

1.6 Mission, Goal and Objectives

The intent of the Watershed Management Act is to "meet the needs of a growing population and a healthy economy statewide; meet the needs of fish and healthy watersheds statewide, and advancing these two principles, in increments over time." The Watershed Management Act goes on to state that, "enhancing the flexibility of our water management system to meet both environmental and economic goals are important steps to providing a better future for our State" (RCW 90.82 notes 2001 c 237).

Consistent with the intent of the Watershed Planning Act, the Wenatchee Watershed Planning Unit has defined its mission:

> "*to collaboratively develop a management plan for sustaining and improving watershed and community health.*"

In implementing this management plan, the Planning Unit's goal is to:

> "*protect water resources, habitat and water use in a way that balances the educational, economic and recreational values associated with a healthy community.*"

The Planning Unit is working to achieve this goal by meeting the following objectives:

1. Assess water supply and use, and develop strategies for meeting current and future needs for both in-stream and out-of-stream use (Water Quantity and Instream Flow Subcommittee).
2. Protect and enhance habitat of threatened and endangered and culturally important species throughout the Wenatchee Watershed, improving overall habitat function and connectivity (Habitat Subcommittee).
3. Address polluted water bodies that do not meet state and federal water quality standards [Water Quality Technical Subcommittee (WQTS)].

1.7 Relationship to Other Planning Processes in WRIA 45

Planning for salmon recovery and Total Maximum Daily Load (TMDL) development are occurring in parallel to watershed planning in WRIA 45. Both of these plans will be integrated into the Wenatchee Watershed Plan as aquatic habitat and water quality elements, respectively. The salmon recovery and TMDL planning processes provide an opportunity to discuss sub-watershed scale issues in depth.

Ongoing processes related to Watershed Planning in WRIA 45 include:

- Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Planning
- Wenatchee Subbasin Planning
- WRIA 45 Total Maximum Daily Load (TMDLs) (Temperature, Fecal Coliform, DDT, and pH and Dissolved Oxygen (DO))
- Instream Flow Assessment/Negotiations
- Multi-purpose Water Storage Assessment
- Lower Wenatchee Channel Migration Zone Study
- Northwest Forest Planning Process for the Wenatchee and Okanogan National Forests
- Local Governments Growth Management Act (GMA) Critical Area updates

1.8 Plan Components and Supporting Technical Documents

This plan includes the mandatory water quantity component, as well as the optional water quality, instream flow, and habitat components of a watershed management plan. A list of primary technical assessment documents that have been completed and used in support of this watershed plan is provided below. Many can be found on the Chelan County Natural Resource Department (CCNRD) Website (http://www.co.chelan.wa.us) using the "Natural Resource Program" link under "Departments". The water quantity and instream flow components are addressed in a WRIA 45 Water Resource Management Strategy detailed in Sections 3.0 through 5.0, related growth and land use issues (Section 6.0), and a storage study that is ongoing, concurrent to Plan development. The water quality component includes issues and strategies identified by the Total Maximum Daily Load (TMDL) study (Section 7.0). The habitat component was written concurrently with the Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan. The habitat component and the Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan are separate documents, but their goals and objectives are consistent. The habitat component, presented in Section 8.0 is

broader in scope than the Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan, and considers the needs of the terrestrial portion of the watershed system.

Habitat

- *Final Draft Habitat Component (Golder, 2005c)
- Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005)
- Upper Columbia Biological Strategy (UCRTT, 2002)
- Wenatchee Limiting Factors Assessment (WCC, 2001; Andonaegui, 2001)
- Wenatchee Subbasin Plan (prepared by Chelan County and Yakama Nation) (NPCC, 2004)

Instream Flow

- *Summary of Instream Flow Assessment Work (provided by CCNRD, 2005)
- *Final Technical Report Lower Wenatchee River PHABSIM Studies (includes Peshastin) (EES Consulting, Inc and Thomas R. Payne and Associates, August, 2005b)
- Instream Flow Study of Icicle Creek (US Bureau of Reclamation (USBOR), 2005)
- Toe-Width summary (provided by Washington State Department of Ecology (Ecology))
- Nason and Chiwawa WUA curves (provided by Ecology)
- Bull Trout Habitat Suitability Report (EES Consulting, Inc. 2005a)

Water Quantity

- *2003 Wenatchee Watershed Assessment (MWG, 2003)
- *WRIA 45 Groundwater Technical Memo (Golder, 2005a)

Water Quality

- 1998 Wenatchee River Watershed Action Plan (Wenatchee River Watershed Action Plan, 1998)
- *Supplemental Water Quality Assessment
    - Pesticide Use and Toxicity Assay in Mission, Brender and Yaksum Creeks (Burgoon and Rickel, 2003b)
    - Assessment of Sources of Fecal Coliform in Mission and Brender Creeks (Burgoon and Rickel, 2003a)
- Wenatchee TMDL
    - DDT in Lower Mission Creek (Serdar and Era-Miller, 2004)
    - Temperature Assessment (Cristea and Pelletier, 2005)
    - Forest Service Temperature Assessment (Wiley and Cleland, 2003)
    - Wenatchee pH, DO Assessment (Carroll and O'Neal, 2005b)
    - Wenatchee Fecal Coliform Assessment (Carroll and O'Neal, 2005a)

*reports completed with state Watershed Planning funds

1.9 Organization of the Wenatchee Watershed Plan

The Wenatchee Watershed Plan is the product of seven years of collaboration, during which the Planning Unit has developed management strategies and actions beneficial to the resources of the entire watershed. Habitat, water quality, water quantity and instream flow, and growth and land use

subcommittees have worked to develop these components to be consistent with other ongoing processes in the region.

This plan is intended for both the general public and for participants in the watershed planning process, as well as for the entities that will be implementing the prescribed actions. The Planning Unit's intent is to keep the plan concise and to provide a clear Executive Summary, allowing for easier presentation and review during the public review process. The body of this plan includes a summary of management recommendations developed by the WRIA 45 Planning Unit as a part of the planning process. The issues and corresponding actions are presented by plan component and sub-watershed and are identified by the following acronyms.

WRMS	Water Resource Management Strategy Issues and Recommended Actions
QUANT	Water Quantity Issues and Recommended Actions
GLU	Growth and Land Use Issues and Recommended Actions
QUAL	Water Quality Issues and Recommended Actions
H	Habitat Issues and Recommended Actions
IMP	Implementation Issues and Recommended Actions
PO	Public Outreach Issues and Recommended Actions
ChiwaukumH	Chiwaukum Creek Sub-watershed Habitat Recommended Actions
ChiwawaH	Chiwawa River Sub-watershed Habitat Recommended Actions
ChumQUANT	Chumstick Creek Sub-watershed Water Quantity Recommended Actions
ChumQUAL	Chumstick Creek Sub-watershed Water Quality Recommended Actions
ChumH	Chumstick Creek Sub-watershed Habitat Recommended Actions
IcicleQUAL	Icicle Creek Sub-watershed Water Quality Recommended Actions
IcicleH	Icicle Creek Sub-watershed Habitat Recommended Actions
LitWenH	Little Wenatchee River Sub-watershed Habitat Recommended Actions
LkWenH	Lake Wenatchee Sub-watershed Habitat Recommended Actions
LowWenQUAL	Lower Wenatchee River Sub-watershed Water Quality Recommended Actions
LowWenH	Lower Wenatchee River Sub-watershed Habitat Recommended Actions
MissionQUANT	Mission Creek Sub-watershed Water Quantity Recommended Actions
MissionQUAL	Mission Creek Sub-watershed Water Quality Recommended Actions
MissionH	Mission Creek Sub-watershed Habitat Recommended Actions
NasonH	Nason Creek Sub-watershed Habitat Recommended Actions
NSTQUANT	Northside Tributaries Water Quantity Recommended Actions
PeshastinQUANT	Peshastin Creek Sub-watershed Water Quantity Recommended Actions
PeshastinH	Peshastin Creek Sub-watershed Habitat Recommended Actions
UpWenQUAL	Upper Wenatchee River Sub-watershed Water Quality Recommended Actions
UpWenH	Upper Wenatchee River Sub-watershed Habitat Recommended Actions
WhiteH	White River Sub-watershed Habitat Recommended Actions

In addition, the Plan contains a summary of the recommendations organized by sub-watershed that enables local stakeholders to clearly identify the areas where they can take action. Supporting information can be found in the appendices and in Phase II Technical Assessment reports. It is important to note that the majority of the technical information has not been repeated in this report unless it was necessary to understand the basis for the recommendation. This plan contains the following sections:

Section 1	Watershed Planning in WRIA 45
Section 2	Summary of Issues in WRIA 45 and Recommended Actions
Section 3	Estimates of Current and Future Water Use
Section 4	A Water Resource Management Strategy for WRIA 45
Section 5	Water Quantity Recommended Actions that Support the Water Resource Management Strategy
Section 6	Growth and Land Use Issues and Recommended Actions
Section 7	Water Quality Issues and Recommended Actions
Section 8	Habitat Issues and Recommended Actions
Section 9	Summary of Plan Recommendations by Sub-watershed
Section 10	Plan Implementation
Section 11	Public Outreach
Section 12	State Environmental Policy Act (SEPA) Gap Analysis
Section 13	References

1.10 Plan Availability

Copies of this plan, including the Appendices, are available for review at the following locations:

- Wenatchee Public Library, 310 Douglas St., Wenatchee 662-5021
- Cashmere Public Library, 101 Woodring, Cashmere 782-3314
- Leavenworth Public Library, 700 Hwy 2, Leavenworth 548-7923
- Chelan County Natural Resource Department, 316 Washington Street, Wenatchee 667-6533

A copy of the plan is available online on the Chelan County Natural Resource Department Website (http://www.co.chelan.wa.us) using the "Natural Resource" link under "Departments" and on Compact Disc (CD) that can be obtained by calling the Chelan County Natural Resource Department office in Wenatchee, WA at (509) 667-6533.

2.0 SUMMARY OF ISSUES AND RECOMMENDED ACTIONS IN WRIA 45

The Wenatchee Watershed Planning Unit has identified a number of key water related issues and potential management strategies and actions to address those issues through a series of scoping workshops and subsequent discussion. This section presents a summary of those actions as recommended in this plan. Implementation of the recommended actions is subject to securing the necessary funding, resources, and legislative authorizations (where required). In addition, implementation will be subject to applicable regulations including SEPA and NEPA requirements.

Water in the Wenatchee Watershed supports agriculture, businesses, communities, cities (Cashmere, Leavenworth, part of Wenatchee), outdoor recreation, anadromous and resident fish and other aquatic life, other wildlife, and substantial public lands, predominantly National Forest lands. The aim of the Wenatchee Watershed Plan is to protect and enhance instream flows and associated habitat, while also providing adequate water for communities, citizens, businesses and agriculture into the future. The character of the watershed-wide issues has shaped this unique and complex plan. Many actions demonstrate the linkages that exist between water quantity, instream flow, growth and land use, water quality, and habitat in the watershed.

The characteristics of WRIA 45 vary widely in terms of population, development, future growth, economy, existing and future water use, water availability, habitat status and needs, streamflow, and water quality. Therefore, some actions are relevant for the entire WRIA while others are only applicable to specific sub-watersheds. In order to facilitate the implementation of the plan on a more local level, actions that are specific to an individual sub-watershed are identified and discussed in Section 9.0.

Tables 2-1 through 2-16 present a summary of the recommended actions in the plan and the agency(s) or entity(s) responsible for the implementation of each of the proposed actions. Tables 2-1 through 2-7 summarize watershed-wide actions pertaining to instream flow, quantity, growth and land use, quality, habitat, implementation, and outreach, respectively. Tables 2-8 through 2-16 summarize sub-watershed specific actions.

Further discussion of each issue, the recommended actions, and planned implementation of those actions can be found in the following sections:

Section 4: Water Resource Management Strategy (WRMS)

Section 5: Water Quantity Actions Supporting WRMS

Section 6: Growth & Land Use

Section 7: Water Quality

Section 8: Habitat

Section 9: Sub-watershed Summaries

Section 10: Implementation

Section 11: Public Outreach

3.0 CURRENT AND FUTURE WATER USE IN WRIA 45

This section presents a summary of surface and groundwater use estimates developed subsequent to the Phase II Technical Assessment to support planning goals in WRIA 45. The water quantity component of watershed planning under Chapter 90.82 RCW requires, among other things, estimates of current and future surface water and groundwater use in the watershed. Information summarized in this section includes estimates of current water use (2002), forecasts of future water use over the planning horizon (2025), and an annual water budget. Forecasted water use is used to help determine the quantity and geographic distribution of a water reservation for domestic, municipal and stock water use in WRIA 45. A discussion of the water reservation is included as part of an instream flow rule described further in Section 4.0.

A more detailed description of the methods and sources of data used to develop estimates of current and future water use and the water budget summarized in this section can be found in Appendix A.

3.1 Estimates of Current and Future Water Use

The general approach used to develop current water use estimates and water use projections through 2025 included the following steps.

1. Estimate the current number of households that are serviced by Group A (15 or greater connections) and Group B (less than 15 connections) water systems, and those serviced by a permit-exempt well.
2. Convert estimates of current population to estimates of current water use using water use factors for full and part-time use.
3. Clarify Chelan County's estimates of population growth rate between 2000 and 2025 for UGA and non-UGA areas of the Cashmere and Leavenworth-Lake Wenatchee Census County Divisions (CCDs).
4. Apply the growth rates (defined in Step 3) to current estimates of water use (defined in Step 2), on a sub-watershed scale, to estimate future municipal and domestic water use in 2025 by sub-watershed.
5. Where larger municipalities were able to provide direct projections of 2025 water use in their water system plans, those data were used directly, in place of step 4.

Each of these steps is described briefly below with the results of the analysis. A more detailed description of the methods and sources of data used to develop estimates of current and future water use and the water budget summarized in this section can be found in Appendix A.

3.1.1 Estimates of Current Population in WRIA 45

County Assessor parcel data, U.S. Census data, and Washington State Department of Health (DOH) water system data were used to gain an understanding of the distribution of people by types of water use (part-time or full-time) and by types of water service (Group A, Group B, or exempt well).

The distribution of current population by sub-watershed and by water use type and water service types is presented in Figure 3-1.

Groups that are shown include:

- **Full-time water users:** include any people which indicated WRIA 45 as their place of residence in the 2000 Census by the U.S. Census Bureau. The largest full-time population is estimated to be in the Lower Wenatchee Sub-watershed (7,886 people) and the smallest full-time population in the Little Wenatchee Sub-watershed (3 people).

- **Part-time water users:** include any people which may live in the WRIA but do not consider it their primary residence. This was calculated as the difference between the population estimated based the number of residential parcels in each sub-watershed and the population estimated from Census data. In general, sub-watersheds in the Leavenworth-Lake Wenatchee CCD are more likely to have large part-time populations. The Lake Wenatchee, Upper Wenatchee, Nason, and Chiwawa Sub-watersheds are all estimated to have part-time populations double that of full-time populations.

- **Population served by Group A and B water systems** was estimated using an internal DOH database (Nicodemus, 2005) which records the number of connections served by such systems. Certain water purveyors provided individual data that were used in place of DOH data, these details are presented in Appendix A. The population presented in Figure 3-1 includes only residential connections (not businesses or other non-residential users). The Chumstick Sub-watershed has the largest population serviced by Group A and B systems (3,351 people), due primarily to the City of Leavenworth Group A Water System.

- **Population served by exempt wells** was estimated as the difference between total population (full- and part-time water users), and Group A and B populations. Population served by exempt wells is of interest because this water use is not recorded under individual water rights and it is often difficult to estimate the total number of exempt wells in an area, as they are not tracked. In addition, exempt well use is dispersed which makes it difficult to estimate its cumulative effect on the WRIA water balance. The Lower Wenatchee Sub-watershed has the largest population served by exempt wells in the WRIA (4,910 people).

3.1.2 Population and Water Use Growth Rates

Two sources of data were used to provide an estimate of how water use will grow between 2002 and 2025:

- Water use projections from individual water purveyors. The Cities of Leavenworth and Cashmere (Urban Growth Areas) have water system plans for their service areas that included estimates of total future water use (including residential, commercial, industrial, etc.).

- Projected percent increases in population from Chelan County's use of the Office of Financial Management (OFM) "high" Total Resident Population projection for each of two Census County Divisions (CCDs), the Lake Wenatchee-Leavenworth CCD and the Cashmere CCD (MWG, 2003). Population projections provide an estimate of how water use will grow in the absence of large changes in water use (such as a large new industrial user or conservation).

The County's allocation of population to the urban and rural areas within each CCD is based on Urban Growth Area (UGA) allocations by Chelan County to the Cities of Cashmere and Leavenworth

and a third, future UGA[1] to be located in the Peshastin-Dryden area (Chelan County, 2002). The County has also made revisions to the total rural population in the Lake Wenatchee-Leavenworth CCD which is reflected in this analysis and discussed further in Appendix A. These urban-rural allocations were used to apply the percent increase in population at the sub-watershed level.

The resulting projected percent increases in water use are: [2]

- Leavenworth-Lake Wenatchee CCD
  - Non-UGA– 1.18%, based on County projections
  - Leavenworth UGA – 3.4%, growth rate (compounded) based on City of Leavenworth water system plan data (2002)
- Cashmere CCD
  - Non-UGA – 1.16%, based on County projections
  - Cashmere UGA – 1.0%, based on City of Cashmere water system plan data (2004)
  - Future UGA (Peshastin) – 6.09%, based on County projections

3.1.3 Estimates of Current and Future Domestic and Municipal Water Use

Municipal and domestic water use were estimated for the year 2002 and projected to 2025. The results, grouped by sub-watershed and use type, are presented in Table 3-1.

Water use is presented in terms of Average Day Demand (ADD), which represents the average daily use in a year, and Maximum Day Demand (MDD), which represents the maximum daily demand in a year. ADD was calculated by multiplying the number of full-time connections by a rate of 380 gallons per day (gpd), and each part-time connection by a use rate of 95 gpd (consistent with assumptions in the Phase II Technical Assessment; MWG, 2003). Households serviced by exempt wells were assumed to use a full-time rate of 380 gallons per day (gpd) (MWG, 2003). MDD was calculated by multiplying ADD by a peaking factor of 2.5 (MWG, 2003).

Future (2025) water use in rural areas was calculated by applying the rural population growth rate for that Census County Division to existing water use and assuming that the percentage of full-and part-time water use for Group A and B systems will remain constant. All new exempt wells were assumed to be full time use. Future (2025) water use in Leavenworth and Cashmere was based on projected use as reported in their water system plans. In the Peshastin-Dryden area, where a future UGA is expected, future water use is based on County Planning population allocations.

These estimates of future domestic and municipal water use have been used to help establish the quantities of water in a water reservation for each sub-watershed in the WRIA (see Section 4, Management Strategy).

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[1] The County anticipates development of a third UGA within the planning horizon of this watershed plan. For purposes of estimating future water use, the third UGA is assumed to be established in the Peshastin-Dryden area and growth calculations in the UGA are based on County allocations.

[2] It should be noted that population projections were not developed as part of this analysis, rather existing population projections were summarized and clarified through discussions with individual entities such as Chelan County and the cities within WRIA 45.

3.2 Water Budget

The intent of the water budget is to present the scale of major human water uses as compared to streamflow in each sub-watershed of WRIA 45, and for the WRIA overall, for periods of limited water availability (September). Water budgets, presented in Figure 3-2, compare water use (both groundwater and surface water) and surface water flows directly. Any delays of impacts to streamflow from demands met by groundwater are not directly represented by these data; groundwater storage has not been assessed to this extent. This snapshot is not a water balance that compares the timing and quantity of hydrologic inputs and outputs for each sub-watershed.

Municipal and domestic water use is presented as Maximum Day Demands (MDD) and Average Day Demands (ADD). MDD represents the peak daily demand in a year and ADD represents average daily demand in a year. For further discussion on MDD and ADD, see Section 3.1 and Appendix A. Additional water use demands (commercial/industrial, irrigation, and fish propagation) are presented as their instantaneous water rights reported in the Wenatchee River Basin Watershed Assessment (MWG, 2003). Using water right data as representative of certain uses is conservative because it assumes that the full extent of the water right is exercised and that water right claims are not duplicative.

In addition to water use, the table and figure include low flow (90% exceedance flow for September); average flow (50% exceedance flow for September), and high flow (10% exceedance flow for September) estimates. An exceedance flow represents the flow that has a given percent chance of being equaled or exceeded in any one year. This represents the range of flows that have historically occurred in September. September is a consistently low flow month throughout the period of record. Therefore, this budget provides a snapshot of the potential range of summer flow conditions combined with estimates of the maximum and average water use.

4.0 A WATER RESOURCE MANAGEMENT STRATEGY FOR WRIA 45

The Wenatchee Watershed Planning Unit (WWPU) recommends establishing a new water resource management strategy (WRMS) for the watershed that strikes a balance between protecting and enhancing flows for fish and providing adequate future water for communities, citizens, businesses and agriculture.

This section provides an overview of the proposed water resource management strategy and recommendations. Background information is provided for context, followed by issue statements and recommended actions. Actions include proposed new management flows at each control point[3], a water reservation to provide a year-round supply for specified uses, and a seasonal supply of water (maximum allocation) for seasonal use and storage. This section also includes specific strategies and actions to be implemented in each sub-watershed, as necessary. Watershed-wide measures to enhance this water resource management strategy and help mitigate potential impacts of use of the reservation are presented in Section 5.0; Watershed-wide Water Quantity Recommendations.

This water resource management strategy is intended to apply to water supply originating in WRIA 45 and does not currently include water sources outside the Wenatchee Watershed. The Wenatchee Watershed Planning Unit recognizes that there are ongoing discussions concerning the capacity and longevity of the East Bank Aquifer Regional Water Supply (Regional Water Supply) that serves the greater Wenatchee area (the East Bank Aquifer supply is located outside of WRIA 45). The Regional Water Supply is jointly owned and operated by the City of Wenatchee, East Wenatchee Water District (EWWD) and the Chelan County Public Utility District (PUD). At this time the Wenatchee Watershed Plan does not include recommendations that consider the Regional Water Supply as a source of water for the Lower Wenatchee River and its tributaries. The Regional Water Supply will only be considered a water source for the Lower Wenatchee River and its tributaries if the owners of the Regional Water Supply choose to provide water to these areas. Future coordination between the Wenatchee Watershed Planning Unit and owners of the Regional Water Supply should be encouraged. However, one of the owners, the EWWD, is not currently a member of the Wenatchee Watershed Planning Unit and therefore cannot be obligated to provide water to the Lower Wenatchee River and its tributaries as part of this watershed plan.

4.1 Background

1983 Rule – Wenatchee River Basin Instream Resources Protection Program

Water resources of the Wenatchee River Watershed (WRIA 45) are currently managed according to an administrative law (rule) established in 1983. This existing management program includes instream flows at specified control points and provision for year-round water for future use by single domestic uses, and for seasonal water uses subject to flow. This 1983 rule was established to assist with water allocation decisions and to protect senior water rights. There are currently five instream flow control points in the Wenatchee Basin, established by Chapter 173-545 WAC (See Figure 4-1). These points are, in order from upstream to downstream: (1) Wenatchee River at Plain, (2) Icicle Creek near Leavenworth, (3) Wenatchee River at Peshastin, (4) Mission Creek near Cashmere, and (5) Wenatchee River at Monitor. In addition, Peshastin Creek was closed to further appropriation between June 15 and October 15. Actual streamflow in the Wenatchee River at Monitor and Plain, and on Mission Creek are less than instream flows established by rule approximately half the time during low-flow months. When flows are not met, junior water rights (those water rights issued after 1983) are required to discontinue use until flows in the stream are higher than flows in the rule. Since

[3] A stream gage that is used to measure the discharge of the stream to ensure that the instream flow requirements are met.

1983, the Washington State Department of Ecology (Ecology) has regulated junior water right holders nine times. Water rights that were issued prior to the 1983 rule are not affected by the rule and are not subject to interruption due to low flows.

Why Revise the Existing "Water Resource Management Program" in the Wenatchee?
Water resource management programs are revised when new information is available or when it is necessary to address instream and/or out-of-stream water needs that were not addressed in the past. Since 1983, when the rule was established, a number of changes and issues have arisen related to aquatic resources protection (e.g. endangered species listings) and out-of-stream water use (e.g. municipal water legislation). The 1983 instream flows were not adequately based on the biological needs of fish, and may therefore provide inadequate protection. New information is now available that better identifies the biological requirements of threatened and endangered species. Although single domestic use is not limited, new supplies for group domestic and municipal uses are subject to flows under the 1983 rule. Group domestic and municipal systems are required to demonstrate that an Overriding Consideration of the Public Interest (OCPI) would be served before being authorized by Ecology to develop a new year-round supply. This situation makes it difficult for municipalities to provide water for growth, especially in designated urban growth areas (UGAs) as specified under the Growth Management Act (GMA). Lastly, the 1983 rule fails to address seasonal uses (e.g. irrigation) or storage of water to meet future seasonal or year-round water use needs.

A New Water Resource Management Strategy (WRMS) for the Wenatchee
The Planning Unit has clearly identified issues associated with the current program (1983 rule) and developed recommended actions to address these issues as part of a proposed new water resource management strategy. The issues and actions are outlined below.

4.2 Water Resource Management Strategy (WRMS) Issues

The following general issue statements were developed during the WWPU scoping process, and are included here as the overarching issues addressed by the overall water resource management strategy.

- There is a need to assess current management flows (1983 Flow Rule) and determine whether changes should be made to better meet the needs of aquatic species and humans in WRIA 45 through the year 2025.

- There is concern in the Wenatchee Watershed that instream flow regulations or closures may result in the inability to obtain water for new domestic use in areas serviced by exempt wells, group domestic and municipal water systems. Particular areas of concern include the Chumstick Creek, Chiwawa River, Mission Creek, and Peshastin Creek Sub-watersheds; the Monitor area, Northside tributaries, and other areas.

- There is a need to develop an adaptive management process for this Water Resource Management Strategy (WRMS) to address and integrate new data as they become available.

4.3 Water Resource Management Strategy (WRMS) Recommended Actions

The proposed water resource management strategy for WRIA 45 includes a reserve of water from which new domestic, municipal, and stock water (except feedlots) uses will be allocated. The reserve is not subject to instream flow. In addition to specified uses that require a water right permit, future domestic water uses that rely upon permit-exempt wells are also authorized under the reserve. Administration of the reserve and associated actions are addressed in Section 5.2.

Note that instream flow regulations and closures apply only to new uses. There is no loss of existing rights or diminishment of existing uses that result from a new water resource management strategy.

The following recommended actions were developed by the WWPU to address the issues identified above. Although listed as independent actions, they are recommended for implementation as a package. The Wenatchee Watershed Planning Unit (WWPU):

WRMS-1: Recommends that the State Department of Ecology adopt, in rule, the new water resource management strategy for WRIA 45, including the management flows (revised instream flows) at specified control points, the water reserve, and maximum allocations. The management flows, water reserve and maximum allocation are outlined in more detail in Sections 4.4 through 4.6.

WRMS-2: Recommends that the Planning Unit or future implementing body in WRIA 45 be involved with Ecology, in any scoping, study planning, study implementation, alternatives analysis, negotiations or rule development if Ecology undertakes instream flow or related water management studies or rulemaking in the watershed.

WRMS-3: The WWPU with Chelan County taking the lead role will participate in the development and implementation of an adaptive management process to support this water resource management strategy. The process should address flexibility in the distribution of the reserve across the WRIA. The details of the adaptive management process will be determined as part of Phase IV Implementation.

WRMS-4: Implementation of a new or existing instream flow rule in the Wenatchee Watershed will require that flow monitoring continues at all existing and proposed control points on the Wenatchee River and its tributaries. Figure 4-1 shows the locations of all control points and active stream gages in the watershed. The following actions address these requirements. The WWPU:

> **WRMS-4a**: Recommends that Ecology continue to support monitoring at all existing stream gages in the Wenatchee Watershed. Ecology and partners must ensure that the gages and streamflow data are well maintained. Updated data should be made available on the Ecology website in a timely manner for all gages managed by Ecology.
>
> **WRMS-4b**: Encourages the USGS to continue to maintain USGS gages in the watershed to support implementation of this water resource management strategy.
>
> **WRMS-4c**: Recommends a new stream gage be established at the existing control point on the Icicle Creek. Details will be determined during Phase IV, Implementation.
>
> **WRMS-4d**: Review the gage location on the Chiwawa River as related to the impacts on flows from withdrawals.

These actions, taken together, form a water resource management strategy for the Wenatchee River Watershed (WRIA 45), intended to manage water through the year 2025. The strategy is proposed to ensure that aquatic resources are protected while the water in the watershed is being put to maximum beneficial use. The strategy includes new and revised instream flows at specified control points; and associated conditions such as year-round reserve water for future domestic, municipal and stock water uses, and maximum allocations for storage and other seasonal uses that are subject to flow.

This strategy can be enhanced through development and implementation of additional tools and actions, including the establishment of a WRIA 45 water bank, storage, conservation, water right

transfers, use of a trust water program, and updates to subdivision and land use management requirements. These additional measures (tools) are discussed in Section 5.0.

It is important to note that this proposed water resource management strategy will not affect existing water rights; it applies only to new water rights for new uses to be established in the future. Although the instream flows proposed as part of this strategy will not put water into streams, they will protect aquatic resources from degradation, and existing senior water rights from impairment. However, additional measures discussed in Section 5.0 (e.g. storage, conservation, trust water program) can be used to return water to streams.

4.4 Instream Flow Recommendations

This portion of the strategy recommends that the existing Instream Resources Protection Program for the Wenatchee River Watershed (Chapter 173-545 WAC) be revised to reflect more current knowledge of the instream flow needs of aquatic species. The WWPU recommends revising existing instream flows and establishing new instream flows at new control points as described below.

4.4.1 Control Points in the Wenatchee River Watershed

Figure 4-1 shows the locations of existing and proposed future instream flow control points in WRIA 45. The following existing and new control points are recommended for use in managing instream flows under a revised water resource management program for the Wenatchee River Watershed:

1. Wenatchee River at Monitor (existing control point and gage)
2. Wenatchee River at Peshastin (existing control point and gage)
3. Wenatchee River at Plain (existing control point and gage)
4. Mission Creek Near Cashmere (existing control point and gage)
5. Peshastin Creek at Green Bridge (new control point at gage)
6. Icicle Creek near Leavenworth (existing control point, new gage needed)
7. Nason Creek (new control point at gage)
8. Chiwawa River (new control point at gage)

This strategy does not recommend eliminating any of the existing control points. Rather, the WWPU recommends establishing new control points for Peshastin Creek, Nason Creek, and the Chiwawa River to augment the program to monitor and manage water resources of the Wenatchee River Watershed. It will be necessary to secure additional funds to establish and maintain a streamflow gage for the Icicle River near Leavenworth. While this is an existing control point as a matter of administration, there has not been a streamflow gage at this control point for many years.

4.4.2 Management Flows (revised Instream Flows)

Figures 4-2 through 4-9 and Tables 4-1 through 4-8 show management flows (instream flows) proposed for this water resource management strategy for each control point. The tables also present the fish species and life stage that served as rationale for flow setting.

The WWPU recommends that existing instream flows for the Wenatchee River at Plain remain unchanged. However, the Planning Unit recommends that existing instream flows for the Wenatchee River at Monitor, Wenatchee River at Peshastin, Mission Creek near Cashmere, and Icicle Creek near Leavenworth be revised, as illustrated in Figures 4-2, 4-3, 4-5, and 4-7, respectively. The Planning Unit also recommends that Ecology adopt rules establishing instream flows for Peshastin Creek, Nason Creek, and the Chiwawa River as illustrated in Figures 4-6, 4-8 and 4-9 respectively. Instream

flow studies (EES, 2005b; USBOR, 2005) including modeling of flow needs for fish are used to support the new recommended flows. Appendix B presents additional information about the development of these management flow recommendations.

It is also important to note that establishment of proposed management flows in rule will not:

- affect existing water rights; it applies only to new rights established after the instream flow have been established in rule.
- put water in streams; instead it will protect flows from degradation, and existing senior water rights from impairment

Establishment of instream flows will address only one of several issues identified by the WWPU. A program addressing out-of stream water use is provided below to address concerns regarding future water use needs in the Wenatchee River Watershed.

4.5 Out-of-Stream Recommendations

The WWPU proposes two tools to manage new out-of-stream uses as part of this strategy. It is understood that the instream flow recommendations (Section 4.4) are not stand-alone recommendations. Instead, they are part of a package that also includes:

a. a water reservation
b. a maximum water allocation

A water reservation would provide water for future year-round use and a maximum allocation would provide water for seasonal use and storage. A revised water resource management program would not change access to existing water rights.

4.5.1 Water Reservation

This portion of the strategy proposes to establish a reserve of four (4) cubic feet per second (cfs) for the entire WRIA. The reserve is allocated by sub-watershed and was estimated to provide a year-round reliable supply of water for specific future uses in WRIA 45 through 2025 in a manner that would not impair aquatic resources. The reserve can include use of groundwater or surface water sources depending on site-specific conditions. The reservation is split among sub-watersheds and between the upper and lower watershed to ensure that sufficient water is available to service growth based on water use forecasts and GMA population allocations.

Reserved Uses

The following water uses qualify for the reserve and would not be subject to interruption when management flows (revised instream flows) are not met[4]:

- Domestic use: Water to satisfy the human domestic needs of a household or business, including water used for drinking, bathing, sanitary purposes, cooking, laundering, care of household pets, and outdoor irrigation of up to one-half acre of associated lawn or garden per dwelling[5,6], and other incidental uses. For permit-exempt domestic water use of ground water

[4] Fire suppression is not part of the reservation as it is not subject to a water right permit. It is assumed that water for fire suppression is not subject to instream flow and therefore, available year-round without interruption.

[5] ½ acre of associated lawn and garden refers to the amount of the lot that is irrigated, and is not prescribing lot sizes.

sources, total outdoor watering for multiple residences shall be consistent with the groundwater permit exemption provisions in RCW 90.44.050.,

- Municipal (including residential, commercial and industrial uses that are provided by a municipal water system within its water service area), and
- Stock water use (except feedlots), must be consistent with the Chelan County Code, Section 11.88.030 or any subsequent amendments.

Water uses that are not provided for by the reservation include:

- New commercial or industrial uses that require water right permits and are located outside of a municipal purveyor's water service area (acquire water rights through change applications of already appropriated water, a water bank, or a new water right that is subject to new instream flows).
- New agricultural uses (acquire water through change applications of already appropriated water, a water bank, or a new water right that is subject to new instream flows).
- Any uses not specified under Reserved Uses

Uses that are not eligible for water from the reserve will need to obtain water by acquiring valid water rights, new water rights that are subject to management flows, and/or water rights through a water bank.

Basis for 4 cfs Reservation

The quantity of the water reserve has been determined based on both the protection of instream uses and the projected out-of-stream needs in the watershed. The four cfs reservation in the Wenatchee as estimated based on acceptable habitat loss at the Monitor control point (downstream-most control point) should provide water for anticipated growth through 2025.

It is anticipated that 4 cfs, or 2.58 million gallons per day (MGD), would be sufficient to meet the projected demands for domestic, municipal, and stock water needs of the entire watershed through 2025 (Currently domestic and municipal use in the Wenatchee Watershed is approximately 7.5 cfs). Table 4-9 indicates the number of new residential and municipal connections anticipated in WRIA 45 through 2025 and the estimated water use associated with those connections by sub-watershed. Average daily demand (ADD) forecasts assume household use of 380 gpd.

The habitat loss associated with the use of a reservation in the mainstem Wenatchee River, Peshastin Creek, Icicle Creek, Nason Creek and the Chiwawa River has been assessed using PHABSIM. This assessment conservatively assumes that all reservation use (water from both groundwater and surface water sources) will directly impact surface water flows at the time of use. The resource agencies' goal is to limit reservation related habitat loss to less than 1% and to allow a 1% to 2% loss under some conditions (Ecology, 2004). This proposed water management strategy results in less than 1% habitat loss for most sub-watersheds. Average habitat loss is between 1% and 2% in the Lower Wenatchee River. The habitat impact of full reserve use at each location was reviewed with representatives of state resource agencies and other Planning Unit members to gain consensus that aquatic resources would be minimally impaired.

[6] This acreage limitation does not apply where separate irrigation water is used for outdoor watering.

Reservation by Sub-watershed

The 4 cfs reservation in the mainstem Wenatchee River applies to the entire watershed. The reserve is further allocated between the upper and lower portions of the WRIA, and among sub-watersheds to ensure that the water available for servicing growth is distributed equitably and based on projected growth and future water needs. Additional limitations and sub-watershed allocations are based on local aquatic habitat needs. Sub-watershed limitations and associated strategies are presented in Section 4.6. Table 4-10 presents the anticipated reserve by sub-watershed (column one) and the habitat loss that results from the use of reserve water in that sub-watershed (column two). Table 4-10 (column three) also indicates the maximum amount of water that can be debited to the reserve in a specific sub-watershed such that the resulting habitat loss for that tributary does not exceed one percent.

Flexibility has been built into the distribution of the reserve over the watershed. General rules that apply to the distribution of the reserve over the watershed, and to the approved use of reserve water are as follows:

Rule I: Watershed-wide reservation cannot exceed 4 cfs in total

Rule II:
1. Lower WRIA Reserve cannot exceed 3.5 cfs
2. Upper WRIA Reserve cannot exceed 1.0 cfs

Rule III: General Rule for Individual Sub-watershed Reservations:

Limited to the greater of:

a. Amount projected to meet 2025 water use needs
b. Amount that does not exceed 1% habitat loss

With the following exceptions:

Mission Creek: 0.03 cfs with conditions for 2 years after rule adoption (see Section 4.6.4)

Chumstick Ck: 0.043 cfs with conditions for 3 years after rule adoption (Section 4.6.6)

Icicle Creek: 0.1 cfs (In the near term, City of Leavenworth debits the Lower Wenatchee Reserve. An additional 0.4 cfs may be allocated after flow restoration efforts targeting habitat between the upstream diversions (hatchery, City of Leavenworth and Icicle Irrigation District) and hatchery return are addressed (Section 4.6.7).

Accounting of the reservation by Chelan County Natural Resource Department (CCNRD) is addressed in Section 5.2.

4.5.2 Maximum Water Allocation (Cap)

To best accommodate water storage opportunities, this portion of the strategy recommends the establishment of a maximum water allocation or “cap” of total water available for storage or other seasonal uses. The maximum allocation represents the maximum flow that could be allocated from the watershed or sub-watershed, subject to instream flow requirements, for storage and seasonal allocation to new uses through water rights. Table 4-11 presents the maximum allocation by sub-watershed, subject to management flows. The maximum allocation specified for a control point is the maximum flow that can be diverted above that control point, by the sum of new water uses. The

cumulative maximum allocation in the Wenatchee Watershed at any time cannot exceed the limits set at the Monitor gage. Although individual sub-watershed maximum allocations may sum to an amount greater than the specified maximum allocation at Monitor, they cannot all be put to use at the same time across the watershed. During months when no allocation is allowed at Monitor, there can be no allocation further upstream in the watershed.

The rationale in setting maximum allocations revolved around the following principles:

- Instream flows must first be met;
- Maximum allocation from each sub-watershed will be limited to 1/10th of the 50% exceedance flow for each month. This will result in a higher maximum allocation during spring runoff and a lower allocation for fall and winter months; and
- In each sub-watershed, there are 1- 2 months (Late summer to early fall) over which no maximum allocation for future diversion is likely, including storage. On the rare occasions when higher flows occur during months with no maximum allocation, these flows are of benefit to both spawning and rearing fish.
- Further analysis and discussion may need to take place regarding maximum allocation limits in specific sub-watersheds and the mainstem Wenatchee and the relationship between the allocations, and habitat and channel-forming processes.

The combination of new management flows and a maximum allocation serve to protect stream channel maintenance processes and outmigration of fish species in all sub-watersheds, while enabling the opportunity for diversion or storage. In most sub-watersheds the opportunity for diversion or storage will occur 10 months of the year. This wide time frame will allow for maximum flexibility in future water use projects.

4.5.3 Exemptions

No future water allocated in WRIA 45 will be exempt from management flows (eg., a new instream flow rule) other than that water allocated from the reservation. If established, this revised strategy would allow all new domestic, municipal, and stock water uses (including permit-exempt wells) projected to occur through 2025 to be allocated in an equitable manner through the reservation. Fire suppression and fire emergency use of water are also not subject to management flows.

4.6 Water Resource Management Strategy by Control Point

Development of instream flow and future water resource management recommendations in WRIA 45 is based on flows necessary to protect aquatic resources, water available for out-of-stream use or storage, and the need to provide a year-round (uninterruptible) reliable supply of water for future uses. This strategy recommends management flows, a maximum allocation and a reservation, where available, for each priority sub-watershed in the WRIA with an associated stream gage monitoring (control) point. Supporting aquatic resources data and analysis are included as instream flow (ISF) Appendix B.

The following information is provided for each control point proposed in this WRIA 45 Water Resource Management Program:

- A figure showing proposed (new or revised) management flows, exceedance hydrographs and, where appropriate, the 1983 management flows for comparison.

- A table presenting management flows and maximum allocation by month

The actual water reserved by sub-watershed is presented in Table 4-10.

4.6.1 Wenatchee River at Monitor: Watershed-Wide Control Point

These instream flow conditions reflect all in-stream and out-of-stream activities within the WRIA as the Monitor gage is the lowest most control point in WRIA 45.

Flow – Figure 4-2 and Table 4-1 show proposed management flows at the Monitor gage. These flow conditions reflect all in-stream and out-of-stream activities within the WRIA as the Monitor gage is the lowest most control point in WRIA 45.

Maximum Allocation (Cap) – Table 4-1 shows the maximum allocation associated with the Monitor gage, subject to management flow requirements. This is the total amount of water available for storage and appropriation of seasonal water rights for other uses, by month for the entire watershed.

Strategy for Future Use:

- **Reservation:** A cumulative reservation of 4 cfs sufficient to meet growth in WRIA 45 through 2025. Applies to domestic use and associated lawn and garden irrigation, municipal and stock water uses. The 4 cfs reserve is based on flows measured at the Monitor gage.

4.6.2 Wenatchee River at Peshastin

Flow: Figure 4-3 and Table 4-2 show proposed management flows at the Peshastin gage on the Wenatchee River

Maximum Allocation (Cap): Table 4-2 shows the maximum allocation associated with the Wenatchee River at Peshastin gage, subject to management flow requirements.

Strategy for Future Use:

- **Reservation:** The Monitor and Peshastin gages on the Wenatchee River are viewed as one unit for reservation accounting purposes.

4.6.3 Wenatchee River at Plain

The management flows at the Plain gage have not been revised for this management program. The flows continue to be set at the levels specified in the 1983 flow rule.

Flow: Figure 4-4 and Table 4-3 show 1983 management flows at the Plain gage on the Wenatchee River.

Maximum Allocation (Cap): Table 4-3 shows the maximum allocation associated with the Plain gage, subject to management flow requirements. This maximum allocation includes all water allocated above Plain gage.

Strategy for Future Use:

- **Reservation:** A reservation of 0.5 cfs to 1.0 cfs is available for the entire upper watershed, above Leavenworth. This reservation provides water for projected growth in the Upper

Wenatchee, Chiwaukum, Nason, Little Wenatchee, White, Chiwawa and Lake Wenatchee Sub-watersheds.

4.6.4 Mission Creek Near Cashmere

Flow: Figure 4-5 and Table 4-4 show proposed management flows at the Mission Creek gage on the Wenatchee River.

Maximum Allocation (Cap): Table 4-4 shows the maximum allocation associated with the Mission Creek gage, subject to flows. In the case of the Mission Creek Sub-watershed, the maximum allocation includes seasonal water for storage and other uses subject to instream flow. No water is available under this cap during the months of July, August, or September.

Strategy for Future Water Use:
Chelan County as lead (with support from Ecology), will convene a Mission Creek Forum to assess options to provide water for future growth (to provide an uninterruptible supply of water for domestic, municipal and stock water uses) through the purchase, lease, or transfer of existing, valid, water rights or from storage (storage oppoortunties within Mission Sub-watershed or through the Peshastin and/or Icicle Irrigation Districts). All new permit exempt wells in the Mission Sub-watershed will be debited to a Mission Creek reservation, once created through water right lease or purchase. A total of 0.12 cfs is necessary to provide water for growth to the Mission Creek Sub-watershed through 2025 (assuming the City of Cashmere obtains any new water from the mainstem Wenatchee and new Cashmere water is debited to the Lower Wenatchee Sub-watershed). In the interim, a 0.03 cfs reserve for Mission Creek is available for use for two years following initial rule adoption, given the following conditions:

- Allocate Cashmere water from Lower Wenatchee reservation.
- Metering of all new uses under the interim reserve.
- Recognizing that 0.12 cfs is needed, 0.03 cfs from the watershed-wide reserve can be allocated in the Mission Sub-watershed to accommodate current growth until water can be acquired through other alternatives as identified by the Mission Creek Forum. 0.03 cfs will be available for two years after rule adoption. Conservation can stretch this time period.
- As water rights are purchased or transferred for use in the Mission reserve to meet a “no net impact” standard, the first purchase(s) will credit the 0.03 cfs interim reserve, then the additional 0.09 cfs will be available for forecasted growth as it is purchased.
- If water rights are not purchased or leased to cover the interim reserve of 0.03 cfs within two years of rule adoption or if conservation measures that provide additional water are not implemented, Ecology would close the Mission Sub-watershed to further appropriation on a seasonal basis and existing outdoor water use could be curtailed when flows are not met.

Mission Issue Statement

The Mission Creek Sub-watershed is, at times, dry. Water is not left in the stream to appropriate for new users. Therefore, surface water and groundwater are not available for further appropriation to provide an uninterruptible supply for domestic, municipal and stock water uses during low flow periods. Different water management alternatives need to be evaluated to determine the most effective solutions to fulfill both instream and out-of-stream needs and mitigate impacts of withdrawals on habitat, streamflow, and groundwater levels in the Mission Creek Sub-watershed.

Mission Recommended Actions

MissionQUANT-1: Chelan County as lead (with support from Ecology), will convene a Mission Creek Forum to assess options to provide water for future growth through the purchase, lease or transfer of existing, valid water rights or from storage (storage opportunities within Mission Sub-watershed or through the Peshastin and/or Icicle Irrigation districts). This will be conducted for the purpose of providing an uninterruptible supply for domestic, municipal and stock water uses. During Phase IV, Implementation, the Mission Creek Forum will determine whether the strategies for Mission are relevant to Brender Creek, and consider assembling separate strategies to address local instream flow concerns and conditions for Brender Creek, if appropriate.

Within two years of rule adoption, the Forum will have developed opportunities and researched funding opportunities for these alternatives.

MissionQUANT-2: As part of Phase IV, Implementation, evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Mission Creek and evaluate water conservation, storage, purchase, lease and transfer of water rights, water from other sub-watersheds, and other alternatives as appropriate.

MissionQUANT-3: One quarter (0.03 cfs) of the 0.12 cfs projected 2025 water needs is available for growth for two years after rule adoption. If, after two years, water rights are not purchased or leased to cover the interim reserve of 0.03 cfs or conservation measures that provide additional water are not implemented, Ecology would close the Mission Sub-watershed to further appropriation on a seasonal basis, and existing outdoor water use established subsequent to the adoption of WAC 173-545 could be curtailed when flows are not met. All water allocated to the City of Cashmere will be debited to the Lower Wenatchee Reserve and not to the Mission Reserve.

MissionQUANT-4: Consider storing water in Icicle/Peshastin and use that water to augment flows and provide mitigation water in Mission Creek.

MissionQUANT-5: Consider storage opportunities within Mission Sub-watershed (See Section 5.5).

MissionQUANT-6: Metering of all new uses covered under the Mission reserve (includes all new domestic uses).

MissionQUANT-7: Evaluate out-of-kind mitigation and enhancement projects over time, if appropriate. Identify habitat and water quality improvements to mitigate additional reserve water.

MissionQUANT-8: Chelan County or other entity with agency funding assistance will investigate water rights for purchase or lease as part of the mitigation and enhancement strategy for Mission Sub-watershed. The County will seek funding from BPA, Ecology, Washington Rivers Conservancy, Washington Water Trust, and others. As water rights are purchased or transferred for use in the Mission reserve to meet a “no net impact” standard, the first purchase(s) will credit the 0.03 cfs interim reserve, then the additional 0.09 cfs will be available for forecasted growth as it is purchased.

4.6.5 Peshastin Creek at Green Bridge

Flow: Figure 4-6 and Table 4-5 show proposed management flows at the Green Bridge gage on Peshastin Creek.

Maximum Allocation (Cap): Table 4-5 shows the maximum allocation associated with the gage on Peshastin Creek at Green Bridge, subject to management flow requirements. The maximum

allocation would require lifting the current closure for the months of June through July, but would be subject to new flows during those months.

Strategy for Future Water Use:
Replace existing seasonal closure in June and July with new management flows. There is currently a seasonal closure (June 15 – Oct 15) to any future surface or groundwater allocation in the Peshastin Sub-watershed. This program recommends a **revised rule that would change the current closure to August 1 – October 15** (allowing allocation of water during spring runoff periods), the establishment of new flows and a maximum allocation for storage and seasonal use, subject to flows and the new closure. New domestic uses will be serviced through the reservation. Lifting the closure between June 15 and July 31 will provide storage opportunities that would not otherwise be possible and provide incentive for mitigation.

- **Reservation**: A reservation of 0.1 cfs would be made available for use in the Peshastin Sub-watershed. This reservation would consider reach specific issues, such as dewatered reaches in the lower Peshastin Creek.

Peshastin Issue Statement

Water is limited. Therefore, different water management alternatives need to be evaluated to determine the most effective solutions to fulfilling the instream and out-of-stream needs and mitigating the impacts to habitat, streamflow, and groundwater levels in the Peshastin Creek Sub-watershed.

Peshastin Recommended Actions

PeshastinQUANT-1: Evaluate passage requirements for fish immediately below the Peshastin Irrigation District diversion (addressing bypass reach/piping).

PeshastinQUANT-2: Consider other instream projects that improve habitat.

PeshastinQUANT-3: As part of Phase IV, Implementation, evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Peshastin and evaluate water conservation, storage, purchase, lease and transfer of water rights, and other alternatives.

PeshastinQUANT-4: Evaluate and institute programs to increase instream flows through water acquisitions, leases, and transfers.

4.6.6 Chumstick Creek (Interim closure with exceptions and data collection plan)

Preliminary hydrology and toe width data are available for the Chumstick and were analyzed; however, the synthesized hydrology data were not adequate to assess water availability on the Chumstick and the reach from which toe-width data were collected may not adequately represent the Creek. Therefore, instream (management) flows have not been developed for the Chumstick Sub-watershed.

Strategy for Future Water Use:
An interim closure for the Chumstick Sub-watershed is recommended for three years while data are collected and alternatives are assessed. Uses that are not subject to the closure (and can continue throughout the three year interim closure) include: fire suppression, domestic use from wells, stock water uses, and seasonal storage, pending evaluation by the Chumstick Water Forum and Ecology.

These exempt uses would be limited to a total of 0.043 cfs while studies are being performed to determine future water availability in the Chumstick. Seasonal storage opportunities and other alternatives in Chumstick will be evaluated by Ecology and the Chumstick Water Forum through the water right application process on a case-by-case basis during the three year interim period. Storage opportunities in Chumstick will be addressed as part of the Chumstick strategy after conclusion of the Forum's three year process and coordinated with the WRIA 45 Multi-Purpose Storage Assessment. This interim closure will be re-evaluated at the end of the three year period by the Chumstick Forum and Ecology.

Chelan County as lead (with support from Ecology), will convene a Chumstick Creek Forum to assess options to provide water for future growth (to provide uninterruptible supply for domestic, municipal and stock water uses) through the purchase, lease or transfer of existing, valid water rights or from storage. A cumulative impact analysis of permit exempt use and uses associated with permits and claims approved since 1983 will be conducted by Ecology as authorized under the 1983 flow rule (Ecology, 1983). Chelan County will partner with Ecology in this study. The cumulative impacts assessment will help to determine whether Ecology will curtail outdoor domestic water use of wells installed after 1983, and whether Ecology will close the Chumstick Sub-watershed to outdoor water use in the future. A total of 0.13 cfs is necessary to provide water for growth to the Chumstick Creek Sub-watershed through 2025 (assuming the City of Leavenworth obtains any new water from the mainstem Wenatchee or Icicle). In the interim, a 0.043 cfs reserve for Chumstick Creek is available for use for three years following initial rule adoption, given the following conditions:

- Metering of all new uses under the interim reserve.
- City of Leavenworth obtains any new water from the lower Wenatchee reserve.
- Recognizing that 0.13 cfs is needed, 0.043 cfs from the watershed-wide reserve can be allocated in the Chumstick Sub-watershed to accommodate current growth until water can be acquired through other alternatives as identified by the Chumstick Creek Forum. 0.043 cfs will be available for three years after rule adoption. Conservation can stretch this time period.
- As water rights are purchased or transferred for use in the Chumstick reserve to meet a "no net impact" standard, the first purchase(s) will credit the 0.043 cfs interim reserve, then the additional 0.09 cfs will be available for forecasted growth as it is purchased.
- If water rights are not purchased or leased to cover the interim reserve of 0.043 cfs within three years of rule adoption, or if conservation measures that provide additional water are not implemented, Ecology would close the Chumstick Sub-watershed to all further appropriation on a seasonal basis and existing outdoor water use could be curtailed when flows are not met.

Chumstick Issue Statement

The Chumstick Sub-watershed lacks the data to evaluate available water and recommended allocation strategies. Hydrogeology is complex and not well understood. There is a need to develop detailed water resource management strategies based on additional data indicating groundwater availability.

Alternatives for future water in the Chumstick are limited. Therefore, different water management alternatives need to be evaluated to determine the most effective solutions to fulfilling the instream and out-of-stream needs and mitigating the impacts to habitat, streamflow, and groundwater levels in the Chumstick Creek Sub-watershed.

Chumstick Recommended Actions

ChumQUANT-1: Chelan County as lead (with support from Ecology), will convene a Chumstick Water Forum to guide data collection, oversee the proposed water management strategy, and help develop mitigation measures.

ChumQUANT-2: Chumstick Water Forum to assist in developing a data collection plan to monitor surface water flows (specify location) and develop management flows.

ChumQUANT-3: Chumstick Water Forum, with assistance from Chelan County and Ecology, to conduct groundwater monitoring to understand hydraulic continuity and overall impact of exempt wells on groundwater levels and streamflows.

ChumQUANT-4: Recommend that Ecology close the Chumstick Sub-watershed for an interim period of three years while data are collected and alternatives are assessed. Uses that are not subject to the closure (and can continue throughout the three year interim closure) include: fire suppression, domestic use from wells, stock water uses, and seasonal storage, pending evaluation by the Chumstick Water Forum and Ecology. These exempt uses would be limited to a total of 0.043 cfs while studies are being performed to determine future water availability in the Chumstick and a future strategy is assessed. Seasonal storage opportunities and other alternatives in Chumstick will be evaluated by Ecology and the Chumstick Water Forum through the water right application process on a case-by-case basis during the three year interim period. Storage opportunities in Chumstick will be addressed as part of the Chumstick strategy after conclusion of the Forum's three year process and coordinated with the WRIA 45 Multi-Purpose Storage Assessment. This interim closure will be re-evaluated at the end of the three year period by the Chumstick Forum and Ecology. Note that water storage tanks as included in the Chumstick Community Wildfire Protection Program are exempt from this closure.

ChumQUANT-5: Ecology and Chelan County to implement reservation conditions as follows: One third (0.043 cfs) of the 0.13 cfs projected 2025 water needs is available for growth for three years after rule adoption. Allocation of the remainder of the reserve would be considered only after completion of additional instream flow assessments (ChumQUANT-2) and a cumulative impacts study (ChumQUANT-3, 6) and would be subject to appropriate conditions and limitations based on the result of those assessments (ChumQUANT-7). If, after completion of the cumulative impact study, Ecology determines that the cumulative effects of domestic water uses negatively affect water available for instream flows, Ecology will consider allowing only in-house water use from the reservation. If after 3 years, water rights are not purchased or leased to cover the interim reserve of 0.043 cfs or conservation measures that provide additional water are not implemented, Ecology would close the Chumstick Sub-watershed to further appropriation on a seasonal basis, and existing outdoor water use established subsequent to the adoption of WAC 173-545 could be curtailed when flows are not met. Note that the City of Leavenworth will debit any new water from the Lower Wenatchee Reserve and not the Chumstick Reserve.

ChumQUANT-6: A cumulative impact analysis of permit exempt use and uses associated with permits and claims approved since 1983 will be initiated by Ecology as authorized under the 1983 flow rule. Chelan County will partner with Ecology in this study. The cumulative impacts assessment will help to determine whether Ecology will curtail outdoor domestic water use of wells installed after 1983, and whether Ecology will close the Chumstick Sub-watershed to outdoor water use in the future.

ChumQUANT-7: Chumstick Forum, Chelan County and Ecology to re-evaluate a proposed strategy for the Chumstick in three years after rule adoption, when new monitoring data have been collected

and assessed and cumulative impact analysis is complete. Consider allowing group domestic groundwater use of deeper aquifer only as part of the Chumstick strategy addressed by the Forum.

ChumQUANT-8: Chelan County will evaluate alternatives to improve fish passage at the North Road culvert, and further pursue replacement of culverts upstream of North Road on Chumstick Creek.

ChumQUANT-9: Metering of all new uses covered under the Chumstick reserve (includes all new domestic uses).

ChumQUANT-10: As part of Phase IV, Implementation, the Planning Unit and the Chumstick Forum (with Chelan County as lead) will evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Chumstick and evaluate water conservation, storage opportunities, purchase, lease and transfer of water rights, water transfer from other sub-watersheds, and other alternatives. Consider conjunctive use and evaluate pumping from the deep aquifer to augment flows in the Chumstick. Investigate storage options where stored water could be used to augment flows and provide mitigation water.

ChumQUANT-11: Encourage conservation and outreach.

ChumQUANT-12: Chelan County or other entity with agency funding assistance will investigate water rights for purchase or lease as part of the mitigation and enhancement strategy for Chumstick Sub-watershed. The County will seek funding from BPA, Ecology, Washington Rivers Conservancy, Washington Water Trust, and others. As water rights are purchased or transferred for use in the Chumstick reserve to meet a "no net impact" standard, the first purchase(s) will credit the 0.043 cfs interim reserve, then the additional 0.09 cfs will be available for forecasted growth as it is purchased.

Consider information from adjudication records (1982-1984) when investigating water rights for purchase or lease.

4.6.7 Icicle Creek

Flow: Figure 4-7 and Table 4-6 show proposed management flows at the Icicle Creek control point at the East Leavenworth Road bridge. The gage, "Icicle Creek above Snow Creek near Leavenworth" is located upstream of the control point.

Maximum Allocation (Cap): Table 4-6 shows the maximum allocation associated with the Icicle gage, subject to management flow requirements.

Strategy for Future Use:

- Reservation: A reservation of 0.1 cfs would be made available for use in the Icicle Sub-watershed. An additional 0.4 cfs may be allocated after flow restoration efforts targeting habitat between the upstream diversions (hatchery, City of Leavenworth and Icicle Irrigation District) and hatchery return are addressed.

4.6.8 Nason Creek

Flow – Figure 4-8 and Table 4-7 show proposed management flows at the gage on Nason Creek near mouth.

Maximum Allocation (Cap): Table 4-7 shows the maximum allocation associated with the Nason Creek gage, subject to management flow requirements.

Strategy for Future Water Use:

- **Reservation**: A reservation of 0.5 to 1.0 cfs would be made available for the entire upper watershed, above Leavenworth. This includes 0.1 to 0.16 cfs in the Nason Sub-watershed.

4.6.9 Chiwawa River

Flow – Figure 4-9 and Table 4-8 show proposed management flows at the gage at Chiwawa River near Plain.

Maximum Allocation of new water: Table 4-8 shows the maximum allocation associated with the Chiwawa gage, subject to management flow requirements.

Strategy for Future Water Use:

- **Reservation**: A reservation of 0.5 to 1.0 cfs would be available for the entire upper watershed, above Leavenworth. This would include 0.1 to 0.5 cfs in the Chiwawa Sub-watershed.

4.6.10 Northside Tributaries

Issue Statement

There are limited flow and groundwater data for the Northside Tributaries that indicate whether there is a water availability problem or a pending future water availability problem. There is general concern about water availability in the canyons. However, it is difficult to characterize groundwater availability with this system. Canyon Public Meetings were held to gain input from property owners in developing long-term strategies for water supply. Future water management alternatives need to be evaluated to determine the most effective solutions to fulfilling water needs in the canyons.

The recommendations below envision water supplied from within WRIA 45 and not water supplied from the East Bank Aquifer Regional Water Supply system unless the owners of the Regional Water Supply choose to supply water to these areas.

Recommended Actions

NSTQUANT-1: Future water supply availability should be discussed with Chelan County Public Utility District (PUD) to determine whether they have the capacity and infrastructure to provide backup supply. The East Bank Aquifer Regional Water Supply will only be considered as a source of water for this area if approved by the owners of the Regional Water Supply.

NSTQUANT-2: PUD and Chelan County to consider pumping from Wenatchee Valley and a potential PUD hookup in Nahahum.

NSTQUANT-3: Chelan County and Ecology to provide public information regarding water limitations in Northside Tributaries (Fact Sheets).

NSTQUANT-4: Chelan County and Ecology to work with local community to design and implement a groundwater monitoring program in existing wells to determine trends in groundwater levels.

NSTQUANT-5: Alternatives Analysis for Northside Tributaries to include options such as use of out-of-basin water, pumping from lower Wenatchee reserve, PUD hookup, deep groundwater, storage, and water right purchase.

4.7 What happens after 2025 or when the reserve has been depleted?

There are a number of water management options available to extend the life of the reservation after the 4 cfs reserve has been allotted. Additional water management tools that could potentially extend the life of the reservation are discussed in Section 5.0. Furthermore, the reservation is subject to the adaptive management intent of the plan. This allows the per-household debit to the reservation be subject to review based on new data or information.

5.0 WATERSHED-WIDE WATER QUANTITY ACTIONS (THAT SUPPORT THE WATER RESOURCE MANAGEMENT STRATEGY)

This section presents recommended water quantity-related management actions that are tools to support the water resource management strategy (WRMS) presented in Section 4.0. Many of the actions provided in this section will provide additional water for both instream and out-of-stream purposes, will help meet future water needs, and will extend the life of the water reservation for WRIA 45. Issues and associated actions presented in this Section were initially identified by Planning Unit members during a series of workshops intended to focus this watershed management plan. Since that time, the issues and actions have been further refined.

5.1 Water Rights, Trusts and Banks

5.1.1 Water Rights - Background

Water Rights in Washington State

Surface and groundwater claims and permits and certificates in the State of Washington are based on different sets of laws; however, all require the demonstration of beneficial use. Water right claims are water rights established *before* the State Codes were adopted; water right permits and certificates are water rights established *after* the State Codes were adopted.

The State water codes for surface water were adopted in 1917 and for groundwater in 1945. In 1967, the Water Rights Claims Registration Act was passed to create a record of the water uses claimed to be rights established prior to adoption of the water code. The registry was initially open from July 1, 1969 through June 30, 1974 (Smith, 1998). Since then, the Water Rights Claims Registry has been opened three times. Therefore, claims for water use may have been registered multiple times resulting in duplicate, triplicate, or possibly quadruplicate records of what should be a single use.

All certificates and permits granted after the adoption of the State Water Codes are based on the prior appropriation doctrine (Smith, 1998). Each water right has an associated priority date (when the water was first put to beneficial use for claims or the date of the permit or certificate) that is used to determine seniority amongst water right holders. Senior water right holders have an earlier priority date than those water right holders that are junior to them (referred to as “first in time, first in right”). The existing 1983 Instream Resources Protection Program (IRPP) for the Wenatchee Watershed establishes instream flows and rules that are, in effect, water rights for the Wenatchee River, Mission Creek, Peshastin Creek and Icicle Creek with and priority date of 1983. Any water right granted subsequent to the 1983 rule is junior to the instream flow and subject to interruption during years where the management flows are not achieved. Those people who hold water rights established prior to the rule are senior to the instream flows, and are not affected by the rule.

Not all groundwater uses require a permit or certificate. “Exempt wells” are exempt from the water right permit application process (Chapter 90.44.050). Permit-exempt withdrawals are those uses that withdraw up to 5,000 gallons/day for single or group domestic purposes, industrial purposes, or watering a lawn or non-commercial garden of ½ acre or less, or watering stock (Smith, 1998).

Instream flows as recommended by the Planning Unit (WWPU), to be set for rivers or creeks that do not have existing minimum instream flow levels set by rule shall have a priority date of two years after funding was first received from Ecology under RCW 90.82.040, unless otherwise determined by a unanimous vote of the members of the WWPU but in no instance may it be later than the effective date of the rule adopting such flow (Chapter 90.82.080(2)(a) RCW). This would pertain to recommendations made for Peshastin Creek, Nason Creek, and the Chiwawa River.

Any increase to existing instream flows, as recommended by the WWPU, would have a priority date that is two years after funding was first received for planning in WRIA 45. This would pertain to recommendations made for the Wenatchee River at Monitor, the Wenatchee River at Peshastin, Mission Creek near Cashmere, and Icicle Creek near Leavenworth (Chapter 90.82.080 (2)(b) RCW).

It is possible to lose a water right or a portion of a water right through relinquishment or abandonment. A water right is relinquished if all or part of the water right is not used for a period of five or more consecutive years (RCW 90.14.160), unless sufficient cause is shown. There are specific circumstances (RCW 90.14.140(1)) and uses (RCW 90.14.140(2)) that do not result in a relinquishment or loss of the water right.

Tribal Water Rights

In the Treaty of 1855, the Yakama Nation ceded a portion of its land to the United States and reserved a portion for the Yakama Reservation. The entire Wenatchee Watershed is contained within the ceded area. While ceding title to the land, the Yakama Nation reserved certain rights on the ceded lands including the right to hunt and fish at usual and accustomed places (U and A's) and on open and unclaimed lands. The right to fish carries with it a right to have water in the streams to ensure that fish survive their life histories. Therefore, the Yakama Nation's treaty fishing rights include the right to have water in the streams of WRIA 45 to ensure that fish survive their life histories. In the Yakima River adjudication, that right has been assigned a priority date of Time Immemorial, so it is the senior water right in the basin. The same applies to the Wenatchee, although the Wenatchee basin has not been adjudicated. In the Yakima basin, the court also made it clear that the right to fish at usual and accustomed places entails a right to water for fish in those stream reaches that are upstream of the U and A's where the fish harvested at the U and A's spawn and rear.

In endorsing this Watershed Plan, the Yakama Nation does not relinquish any of its Treaty or Sovereign rights.

5.1.2 Trust Water - Background

One of the uses described in RCW 90.14.140(2)(h) is a trust water program. An example of a trust program is the Ecology Trust Water Program that allows water right holders to donate, lease, or permanently sell their water right to the program for whatever beneficial use they designate. This program can safeguard all or part of a water right for a specified length of time. This program allows right holders flexibility in the amount of water they use and protects the right from the risk of relinquishment or loss of the priority date. For example, if a water right is placed in the Trust program for five years then the water right can be exercised as an instream flow right (or any other beneficial use) and those five years are not considered a period of nonuse. Therefore relinquishment would not have occurred.

Five years in trust, if not designated for another use, would mean the right would be exercised for the five years as an instream flow water right. RCW 90.42 provides water users with legal processes whereby water rights can be donated, leased, or permanently sold and result in a trust water right for instream purposes. Procedures are somewhat different for donation, lease, and purchase of water rights, however, in each case, the water right when accepted into trust (in the case of donations and leases) or when created as a permanent trust water right, is an instream flow water right if that's what the donor, lessor, seller and state request. Unlike rights for irrigation, domestic, municipal, or industrial purposes, a trust water right for instream flow is exercised when it is in the river. A water right that is exercised for a beneficial use is therefore not relinquished for non-use.

Other important attributes of the Trust Water Program:

- A trust water right retains the same priority date as the originating water right. However, where a trust water right derives from a portion of another right, as between a trust water right and the original right, the trust right retains the same priority date but is junior to the original right.

- Generally, a water user may only change the portion of a water right that has been put to beneficial use. Additionally, the quantity of water transferred to trust is limited to the "extent to which the water right was exercised" during the five years prior to the transfer. RCW 90.42.080(4)(8).

- The change, as requested, may not impair any existing rights. Ecology considers multiple factors when making a decision on a transfer to trust including the following: (1) whether the right is valid; (2) whether the water right has been abandoned or relinquished for nonuse; (3) whether the change will increase the instantaneous or annual quantity of the water used; (4) whether the change will increase the consumptive use of the water; (5) whether the change will otherwise enlarge the water right; and (6) whether the change is contrary to the public interest.

- Any water right conveyed to trust as a gift for the purposes of instream flow is deductible as a gift for federal income tax purposes by the person conveying the water right. RCW 90.42.080(7).

- A water right may be donated or leased for transfer to trust on a temporary basis. In such situations, "the full quantity of water diverted or withdrawn to exercise the right before the donation or acquisition shall be placed in the trust water rights program and shall revert to the donor or person from whom it was acquired when the trust period ends."

- Water can be transferred to the Trust Water Program through a purchase, lease, donation, split-season lease, or dry year lease. Split-season and dry year leases are not practical alternatives for perennial crops like orchards.

    - Purchase – A purchase of a water right is a permanent acquisition of that right for change to an instream flow use.

    - Lease – A lease of a water right is a temporary acquisition of all or part of the right. For shorter-term leases (less than 5 years), Ecology uses an expedited administrative change process.

    - Donation – A water right owner may donate their water to trust on a temporary or permanent basis. A permanent donation may constitute a charitable contribution for the donor and therefore be tax deductible.

Potential partners in Trust Water programs and funding include Washington Water Trust, Washington Rivers Conservancy, BPA, USBOR, NPCC, Ecology and others.

5.1.3 Water Banks - Background

This proposed program recommends developing a water bank for the entire watershed. Water banking can be defined as "an institutional mechanism that facilitates the legal transfer and market

exchange of various surface, groundwater, and storage elements" (Clifford, et. al., 2004). The purposes of a water bank can be to: create a more reliable source of water, ensure future water, promote conservation, act as a market mechanism, and/or resolve issues of inequity.

Details regarding the bank would be developed during the implementation phase (Phase IV) of watershed planning. A water bank can be used to provide water for future domestic and municipal use or otherwise to service growth where no water is currently available. Water banks are recommended for development in the Mission and Chumstick Sub-watersheds, and may also be developed for the Northside Tributaries. Water banks can also help support mitigation requirements for reservations that will require that water be put back into streams. The bank could also serve as a central clearing house for water right purchase and transfers to support other uses such as agricultural, commercial and industrial uses that are not eligible for the reservation.

Water Bank Considerations in WRIA 45

Considerations for banks developed for Mission Creek, Chumstick Creek and the Northside Tributaries are listed below.

- The geographic extent of the bank for transfers of water rights and/or assignment of mitigation credits is the topographic boundary of the respective watershed, from its headwaters downstream to its confluence with the Wenatchee River, including groundwater in hydraulic continuity. For the Northside Tributaries, this would be defined as the topographic boundary for each of the Olalla, Nahahum, Hay, Williams and Derby watersheds, from their headwaters downstream to their confluence with the Wenatchee River, including groundwater in hydraulic continuity.

- The bank must maintain a consumptive use neutrality or surplus between the existing uses and water rights acquired and the prospective uses and transfer or change of water rights or mitigation credits granted. The consumptive use calculations should be conducted in a manner consistent with recognized methods. One example is Ecology's draft guidance document (Ecology and WDFW, 2003) which uses the Washington State Irrigation Guide (NRCS, 2005).

- The bank may grant mitigation credit for certain out-of-kind aquatic resource habitat improvements, provided that the bank shall maintain net habitat improvement over the baseline established in the Wenatchee Watershed Plan for the Mission Creek, Chumstick Creek or Olalla, Nahahum, Hay, Williams and Derby Watersheds. Out-of-kind mitigation banking will be considered in Phase IV, Implementation. The habitat estimates shall be conducted in a manner consistent with recognized methods. One example is Ecology's wetlands mitigation criteria.

- To protect the adopted instream flow, the transfer of water rights and/or assignment of mitigation credit must be conducted to maintain flow neutrality along Mission Creek.

- The purpose of a water bank for Mission, Chumstick, and/or Olalla, Nahahum, Hay, Williams and Derby is to ensure the availability of safe and reliable domestic water supplies, consistent with the Wenatchee Watershed Plan.

- The administrative manager of the bank will be a market maker. In that capacity, the administrative manager may acquire water rights and dedicate them to the bank, or create new water supplies through construction or purchase of storage facilities, or acquire

water rights and import water from outside the Mission, Chumstick or Olalla, Nahahum, Hay, and Derby Watersheds.

- The operation of new storage facilities and any new appropriations associated with importing water must be consistent with the appropriation limits and minimum flows contained in the Wenatchee Watershed Plan.

- The bank will ensure that water transfers and/or assignment of mitigation credit are consistent with RCW 90.03.380, RCW 90.44.100, and will not result in impairment to any existing water rights.

5.1.4 Water Rights, Trusts and Bank - Issues

The WRIA 45 Planning Unit encourages Ecology to process water right transfers and new water right applications, and to develop strategies that allow local flexibility in water right permitting and transfers.

The WRIA 45 Planning Unit would like to further explore options for temporary lease, transfer and purchase of water rights, including options to protect water from relinquishment and to accommodate change in the type of crop grown or conversion from agricultural to residential land use.

There is a need to develop an administrative structure for a water bank for WRIA 45.

5.1.5 Water Rights, Trusts and Bank - Recommended Actions

QUANT-1: Develop recommendations for Ecology regarding the processing of new water right applications and applications for water right changes and transfers in WRIA 45. Create the recommendations through a collaborative approach between the Planning Unit and the Chelan County Water Conservancy Board, and base them on knowledge of water availability, allocation and flows; consistent with the proposed instream flow rule and resulting reservation and maximum allocation requirements for sub-watersheds. Recommendations may include data requirements necessary to evaluate the impacts of an application on surface and groundwater, areas of concern, policy regarding changes and transfers (may link to land use conversions or incentives for agricultural preservation). Recommendations should also consider facilitation of water right transfers or changes that will result in new water for a reservation in flow impaired sub-watersheds such as Mission and Chumstick Creeks.

QUANT-2: Request additional Ecology staff time from the legislature to process WRIA 45 water rights. (Focus may be transfers or new applications).

QUANT-3: Ecology should enforce existing regulations and policies concerning water rights and use.

QUANT-4: Provide incentives for conserving water rather than using it to avoid losing it. Encourage efficiencies through current water law using tools such as water trusts and/or other innovative techniques. Consider the Irrigation Efficiencies Program, and other incentives programs offered by the state and other entities. Criteria for participation include a demonstration of financial need and environmental benefit, a minimum 10 year lease of the conserved water to the Trust Water Program, and the public investment in the project not exceeding 85% of the total cost. In general, the state offers financial programs and incentives to conserve when there is a public benefit. In

many cases, dedication of the conserved water to instream flows has been the legislature's preferred means of securing the public benefit.

QUANT-5: Consider Ecology's Trust Water Program as an option to temporarily safeguard water rights during times of non-use or reduced use while satisfying the needs of beneficial uses in the watershed. Develop strategies for using trust water to safeguard water that may be used in the future to support a more water-intensive crop type or conversion from agriculture to residential. Use of this program is consistent with the proposed water resource management strategy as described in Section 4.0.

QUANT-6: Develop an administrative structure for a water bank for WRIA 45. Section 5.1.3 introduces water banks; however, the details of the administration of a water bank in WRIA 45 will be determined in Phase IV, Implementation.

QUANT-7: Chelan County or other entity with agency funding assistance will investigate water rights for purchase or lease in WRIA 45. The County will seek funding from Washington Water Trust, Washington Rivers Conservancy, BPA, USBOR, NPCC, Ecology and others. Water rights that are purchased or leased can be used to extend the water reservation while adhering to a "no net impacts" standard.

5.2 Tracking Water Availability and Use

As part of the Water Resource Management Strategy for WRIA 45, Chelan County Natural Resource Department is responsible for administration of the water reserve, and will provide the accounting for the water reservation by sub-watershed. Domestic water use will be deducted from the reservation at a rate of 380 gallons per day/household (gpd/hh) (indoor and outdoor) for full time use. This is the average daily water use factor per residential connection, based upon usage and connection data from larger Group A systems in WRIA 45 (MWG, 2003). This applies to all future domestic and municipal water use connections that are not classified as part time by Group A and B water systems. This average daily use factor of 380 gpd/hh will initially be used for the purpose of reservation accounting. Assessments of actual domestic water use will be conducted to verify the 380 gpd assumption WRIA-wide and to adjust the amount of water remaining in the reservation at five year intervals as specified below. Domestic use of part time water connections (as classified by the DOH for Group A and B systems) is 95 gpd/hh.

The Planning Unit has discussed metering options and determined that metering all new uses eligible under the reserve, combined with a monitoring program that assesses a statistically significant sample of water use types in WRIA 45 can be used to estimate the average per household water use in the WRIA, and track the status of the reserve over time. The assessments would occur at five year intervals, or more frequently if the number of wells drilled or building permits indicates growth greater than the projection is occurring within any of the sub-watersheds. This program to assess average per household water use over time is detailed in QUANT-8. Chelan County will be tracking new domestic and municipal use as part of their administration of the water reservation as described in QUANT-9, and a strategy for measuring future use to assess the status of the reservation over time is discussed in QUANT-10 below.

The following actions will be required as part of reservation management.

5.2.1 Tracking Water Availability and Use - Issues

There is a need to track water use for both administration of the reservation and to better understand water availability for future use in WRIA 45.

5.2.2 Tracking Water Availability and Use - Recommended Actions

QUANT-8: Chelan County Natural Resource Department will develop and administer a monitoring program to assess actual domestic water use to verify the 380 gpd per household assumption used to debit the reservation and to adjust the amount of water remaining in the reservation at five year intervals, or more frequently if the number of wells drilled or building permits granted indicate that growth is occurring more rapidly than projected in any sub-watershed. These assessments will be conducted based on a statistical sample of new domestic water users (single domestic, group domestic and municipal water use and associated lawn and garden irrigation (some with separate irrigation, some without), some with stock, etc.). Metering data will be incorporated into the water use audit and the accounting system.

This monitoring program will be included as part of the adaptive management element to the water resource management strategy discussed in Section 4.0. If necessary, the per household water use factor used to debit the reservation will be adjusted based on statistical sampling and metering in the WRIA (380 gpd/hh is a guide, an accounting tool).

This water use audit will be further developed during Phase IV, Implementation. As part of this audit, the consumptive portion of the daily household water use factor will be assessed, and may be used to debit the reservation. This will be considered during the first year of implementation.

QUANT-9: Reservation accounting will include the tracking of new exempt wells by Chelan County through the building permit process, septic approval through the Chelan-Douglas Health District (CDHD), tracking new domestic and municipal water rights granted by Ecology and tracking well drilling permits as issued by Ecology. The mechanism for tracking the permitted uses will be determined as part of Phase IV, Implementation. Chelan County is currently developing a method for tracking new permit-exempt wells in WRIA 46. This should also be considered for WRIA 45.

> **QUANT-9a**: Chelan County Natural Resource Department will track new exempt wells through the building permit process and will coordinate with the CDHD. A joint city/county process will need to be implemented to assist the county in tracking any building permits requiring exempt wells that are issued by other cities (if applicable) within the watershed.
>
> **QUANT-9b**: New rights that are granted by Ecology for domestic water uses will be tracked by CCNRD. The mechanism for tracking the new permitted uses that will debit the reserve will be determined as part of Phase IV, Implementation.
>
> **QUANT-9c**: Long-term funding for tracking is required.

QUANT-10: The Planning Unit recommends metering be required for all new uses eligible under the reserve. The Planning Unit will further define responsible entities, and staffing, budget and funding considerations of the metering program as part of Phase IV, Implementation. Chelan County, CDHD, Ecology, utilities, and others will work together to structure the program. The following should be addressed as part of phase IV:

- Identify responsible entities, and address staffing, cost and funding concerns

- Consider implementation by an existing utility with an existing metering program
- Consider having water users read their own meters
- Consider use of Ecology's water measuring system and database
- Consider metering options for existing water users and development of a voluntary program that uses existing metering programs' available meters.

5.3 Exempt Wells

5.3.1 Background

RCW 90.44.050 requires that before any water user may withdraw groundwater for a beneficial use after enactment of the groundwater code in 1945 he or she must first obtain a permit from the state's water resources agency. However, the legislature allowed 4 exemptions from the permit requirement. They are:

- Domestic and group domestic purposes up to 5000 gpd
- Irrigation of up to ½ acre of non-commercial lawn or garden
- Industrial purposes up to 5000 gpd
- Stock watering

In addition, the Wenatchee 1983 instream flow rule (WAC 173-545-070(3)) provides that any single domestic water use in WRIA 45 is not subject to the adopted minimum instream flows. This exception applies to both surface and groundwater. It provides:

> *WAC 173-545-070(3): Single domestic and stock watering use, except that related to feedlots, shall be exempt from the provisions established in this chapter. If the cumulative impacts of numerous single domestic diversions would significantly affect the quantity of water available for instream uses, then only single domestic in–house use shall be exempt if no alternative source is available.*

Under RCW 90.44.050, a domestic water use that does not exceed 5000 gpd or the irrigation of lawn or non-commercial garden of not more than ½ acre in area is exempt from permitting. Therefore, if the water source is a well, a water right permit is not required as long as the amounts of water used are within the exempted amounts. If the use is for more than one residence, a group domestic use, or the combined non-commercial irrigation is greater than ½ acre, then the use would be subject to the adopted minimum flows because WAC 173-545 does not exempt group domestic use from the minimum instream flows.

If the group domestic system operator sought a water right permit, it could be approved without minimum flow conditions pursuant to WAC 173-545-070(2) only if Ecology determined that OCPI was served and no alternative source of water is available. And, finally, WAC 173-545-070(3) provides that if cumulative impacts of numerous single domestic diversions would significantly affect the quantity of water available for instream uses, then only single domestic in-house use can be exempted from the adopted instream flows.

5.3.2 Exempt Wells - Issues

There is a need to track overall exempt well use and to enforce current exempt well use for irrigation and domestic outdoor purposes. Ecology is responsible for determining compliance with the exempt well statute. However their staffing levels have not historically allowed them to do so. Therefore, no

one entity is currently determining whether actual use is within the range that is allowed by the rule in WRIA 45. Furthermore, no agency/entity is currently tracking the number of exempt wells or overall water usage by exempt wells in the watershed.

5.3.3 Exempt Wells - Recommended Actions

QUANT-11: Undertake hydrogeologic studies to assess the influence of groundwater withdrawals on surface water. Identify funding for this study and responsible parties (WWPU to identify sub-areas for study, responsible entity as part of Phase IV, Implementation).

QUANT-12: Funding should be requested to survey (using GPS) private wells. The CDHD should investigate collaborating with Ecology to include these new data in the water well report log database. Recommend that the county, health district, and Ecology work together to identify, log and provide oversight of exempt wells. As part of this oversight responsibility, the CDHD should work with DOH to survey wells with greater than 3 connections. Chelan County has already conducted a GPS survey and evaluation of Group A systems (> than 14 connections).

QUANT-13: Provide public education as to the roles, responsibilities and regulations pertinent to exempt wells, and encourage the proper entities to enforce/implement (CDHD, DOH, Ecology, County).

QUANT-14: Credit a water service provider for abandoned and/or decommissioned exempt wells. This action will be further developed in Phase IV, Implementation. The well consolidation process is addressed in RCW 90.44.105. This statute presumes a credit of 800 gpd/well unless an alternative minimum is established by Ecology in consultation with DOH or there is credible evidence of non-use.

5.4 Water Use, Efficiency and Conservation (Strategies for Increasing Future Water Availability)

5.4.1 Conservation and Efficiency - Issues

Policies are needed to address changes in water needs and usage resulting from land use conversions from agricultural to residential and from lower density to higher density uses. These policies should include strategies for improved water use efficiency and conservation for residential, industrial and commercial (public water systems and exempt wells) and agricultural (irrigation districts and ditches) water uses. There is a need to investigate opportunities for increased efficiency in outdoor water use in the watershed. Lack of incentives possibly results in higher consumption. Water conservation incentives should be more equitable among purveyors.

5.4.2 Conservation and Efficiency - Recommended Actions

QUANT-15: As part of Phase IV, Implementation, Chelan County and cities should develop policies that can be used to ensure efficient use of water in the event of a land division or new development. These include:

> **QUANT-15a**: For land division applications that have shares in an irrigation district, develop policies requiring that the developer provide tie-ins to the irrigation box; ensure easements; deliver water to parcels, where practicable; and form a Homeowners Association for residential uses. Encourage Irrigation Districts to work with the county and cities to extend infrastructure and irrigation water service where practicable.

QUANT-15b: For land division applications on property with individual water rights, Chelan County should develop policies that encourage the developer to provide residential tie-ins to the water source for residential irrigation purposes.

QUANT-15c: Encourage cities and Chelan County to develop policies that encourage conservation measures for outdoor water use as a condition of subdivision approval (eg., drought tolerant landscaping, maximum lawn size, stormwater collection systems, residential irrigation system installation). Encourage use of small scale storage, rain barrels, for outdoor irrigation.

QUANT-15d: Encourage cities to develop policy statements that address transfer of water rights from private water right holders in the event of a land use conversion. For example, the City of Cashmere has policies in place that require water rights to be transferred to the City upon land division/service provision by the City's system. This policy helps preserve the City's ability to serve future users within the UGA with water.

QUANT-15e: Provide public information that encourages actions QUANT-15a through QUANT-15d, and explains the benefits (provide this information during subdivision application or preliminary plat comment period).

QUANT-15f: Encourage cluster development, and group domestic over single domestic systems to increase water use efficiency. Explore encouraging group domestic over single domestic use as part of the approval process for land division applications. Further develop this recommendation as part of Phase IV, Implementation.

QUANT-16: Research how different entities in the watershed are implementing conservation measures and acknowledge current efforts. [Note that Leavenworth is metering and employs a rate and fee structure that encourages conservation. Cashmere is currently working on revising their rate structure such that there will be more incentive for conservation.]

Encourage additional conservation measures where needed. Encourage incentive based solutions. These may include:

Residential, Industrial and Commercial (Public Water System and exempt wells)

QUANT-16a: Encourage cities and other water providers to implement a rate and fee structure that promotes conservation (similar to Leavenworth's current program and Cashmere's proposed program).

Irrigation (Districts and Canal Companies)

QUANT-16b: Encourage funding to line canals or implement other delivery system improvements, where appropriate.

QUANT-16c: Encourage the use of reclaimed water (tertiary treatment) for outdoor irrigation, industrial, and commercial use (see Ecology Watershed Guidance).

QUANT-16d: As part of Phase IV, Implementation, convene a forum to investigate conservation strategies and how they could be implemented by irrigation districts, ditches and other private companies. Involve utilities, cities, Chelan County and Ecology when appropriate. There is a need to work with members of irrigation districts, ditches and others to determine ways to save water and ensure that water rights are protected into the future.

Items of discussion could include alternative rate structures based on purpose of water use; partnerships with cities and utilities; utility coordination during development; tools to conserve water, improve instream flows and protect water rights at the same time; and distribution of public education materials.

QUANT-17: Encourage on-farm efficiencies and implementation of Best Management Practices (BMPs) to encourage water conservation.

QUANT-18: Encourage the County to provide information and education about water conservation options and fire planning; including: outdoor watering, timing, types of native vegetation that require low water use, lawn size, low flow fixtures, etc. to the new land user. The Municipal Water Law requires that water systems provide education and outreach regarding water conservation. However, water users that are using irrigation ditch water for outdoor use and/or exempt wells will not receive this information. Irrigation systems may also be able to provide materials in monthly billings. The details of this educational program will be determined during Phase IV, Implementation. Realtors should be encouraged to distribute public education materials describing water conservation and efficient water management techniques.

5.5 Storage Opportunities

Storage is another tool that can be used to maximize the beneficial use of water while minimizing instream impacts. Storage opportunities can also provide water for out-of-stream uses without debiting the reserve, thereby lengthening the life of the reserve.

5.5.1 Background

Step A Storage Assessment Results

The Multi-Purpose Water Storage Assessment for the Wenatchee Watershed (MWG, 2006) identified and reviewed a number of potential water storage strategies to improve streamflow and water supply conditions in WRIA 45. These opportunities are shown on Figure 5-1. The first stage of the storage assessment identified potential water storage strategies and opportunities such as new surface water reservoirs, optimizing or enlarging the capacity of existing reservoirs or lakes, tapping existing lakes, storm water storage and groundwater recharge. The assessment also evaluated small scale storage strategies such as repairing stream headcuts, enhancement of natural floodplain storage through channel migration zone and wetland protection projects, use of rain barrels at individual residences and providing small fire storage tanks. At the end of the first stage all of the opportunities were ranked according to the factors such as:

- The potential improvement in instream flow, water supply, water quality and habitat
- The opportunity's consistency with the Biological Strategy for the Wenatchee Watershed
- The opportunity or sub-watershed importance relative to other opportunities and sub-watersheds

It was determined that small scale opportunities such as enhancement of natural floodplain storage through channel migration zone and wetland protection projects would proceed through funding by other grants. There are a number of habitat related storage opportunities that can be pursued, many of which include activities that help channels access their floodplains. The Storage Assessment provided the following programmatic recommendations for small scale storage opportunities:

Stream Channel Restoration and Repair

This strategy entails actions that restore habitat and riparian conditions to streams. It includes headcut repairs, placement of wood and gravel in streams to improve habitat, construction of off-channel rearing areas, and planting to enhance riparian areas. A number of creeks were identified by the Water Quantity Subcommittee as needing headcut repairs. Those creeks include Peavine Canyon, Poison Canyon, Sand, Ruby, Lower Camas, Mill and Larsen Creeks. There are other creeks in the watershed that would likely benefit from this strategy. Channel migration zone projects that enhance off-channel or floodplain areas also fall under this strategy. Stream channel restoration actions have the ability to increase bank storage and off-channel storage along streams and rivers while improving habitat and riparian conditions.

Small Water Storage Tanks for Fire Protection

This strategy entails placing 10,000 gallon water tanks in areas that are not served by a water system with fireflow capability. The tanks could be filled from nearby streams or wells and left until needed. In discussions with Fire District 3 in the Leavenworth area, there were about 10 locations for water tanks identified that would greatly improve the Fire District's capability to fight fires. Fire District 6 would have a similar need. The need for additional water storage was identified in the Peshastin Creek Drainage Community Wildfire Protection Plan (CCCD, 2005b) and Leavenworth Area Community Wildfire Protection Plan (CCCD, 2005a).

Rainwater Capture

Rainwater capture is a strategy that can be used by residents to funnel snowmelt or rainfall off of the roof of their house and into a storage basin where it can be used for domestic or irrigation purposes. This strategy is becoming common in rural areas, especially where water supplies are limited. Although the volume of water that can be captured seems limited, a 1000 square foot roof on a house in an area that receives 24 inches of precipitation per year could capture over 10,000 gallons of water annually.

Step B Storage Assessment Results

The Water Quantity Subcommittee recommended analysis of specific, larger scale opportunities as part of the second stage (Step B) of the Multi-purpose Storage Assessment. Eighteen opportunities were selected for a more detailed analysis; located primarily in the Mission, Icicle, Peshastin, Lower Wenatchee and Chumstick Sub-watersheds. Those sub-watersheds experience the greatest water supply and instream flow issues. A potential opportunity in the Nason Sub-watershed has since been added to the list.

The results of the Step B Assessment include:

- Instream reservoirs would have the largest storage capacity and be the most cost-effective to construct (reservoirs analyzed cost approximately $4,900 to $8,000 per acre-foot of storage and supplemented flows by approximately 6-19 cfs for a month in late summer). Although the opportunities could greatly improve instream flow and water supply conditions in some basins, the permitting of these opportunities requires public participation and the process can be lengthy. Most opportunities are located on federal public land. Potential sites on federal public lands managed by the U.S. Forest Service (USFS) will require public analysis and disclosure before they may be approved as a storage project.

- Enlargement of existing reservoirs and lakes was also identified as a cost efficient storage alternative ($15,000 to $25,000 per acre-foot of storage and flow supplementation is less than 1 cfs for a month). These opportunities would also be subject to extensive environmental review.

- An opportunity to transfer 3 cfs from the Chiwawa Basin to Little Chumstick Creek was identified in the Assessment. A water storage reservoir was analyzed in conjunction with a pumping station. This alternative was estimated to cost $21,500 per acre foot of water stored. The ability to implement this project quickly may be more feasible as the footprint of the reservoir is on private land.

- The most costly opportunities reviewed in the Step B Assessment were off-channel reservoirs ($19,000 to $181,000 per acre-foot). Most of these opportunities would present fewer permitting issues as the sites for the reservoirs are located on private land and the footprint of the opportunity much smaller than other alternatives. However, the flow benefits of these opportunities are generally small. The exception in this category is the Campbell Creek Reservoir. The Campbell Creek Reservoir opportunity would provide a significant storage and flow benefit (500 acre-feet, 7 cfs for 30 days). As a portion of the potential reservoir would be placed on federal public lands managed by the U.S. Forest Service, it will require public analysis and disclosure before it may be approved as a storage project.

- Overall the most cost-effective opportunity may be the optimization of high alpine lakes operated by the Leavenworth National Fish Hatchery and the Icicle and Peshastin Irrigation Districts. It is thought the cost of such an opportunity will be much less than other water storage opportunities because the reservoirs already exist and the opportunity will change only the operation of the reservoirs to provide more water in late summer. No cost estimates were prepared for this opportunity as it was determined that additional analyses would be performed with the next stage of water storage grants, starting in spring 2006.

Next Steps: Alternatives/Needs Analysis

The water storage opportunities analyzed in the assessment will be further ranked by the Water Quantity Subcommittee and it is expected that a handful of opportunities will be selected for the next stage of study. An alternatives analysis will be completed for each sub-watershed in which an opportunity is being considered, prior to the initiation of the permitting phase by the USFS, to ensure the storage opportunities meet the required water needs and are the best alternative to meeting those needs. Different water management alternatives will be evaluated to determine the most effective solutions to fulfilling the instream and out-of-stream needs and mitigating the impacts to habitat, streamflow, and groundwater levels. Alternatives analyses are particularly important for the Chumstick and Mission Sub-watersheds where water is limited and an interim reserve is in place (See Section 4.6). Alternatives to be evaluated include, but are not limited to: water conservation, storage, purchase, lease and transfer of water rights, water transfer from other sub-watersheds, conjunctive use, and pumping from the deep aquifer to augment surface flows in the applicable sub-watersheds. Storage options should be evaluated to determine whether stored water could be used to augment flows and provide mitigation water.

The Alternatives/Needs Analysis would include:

- Clearly identify the instream and out-of-stream water needs
- Identify potential alternatives to meeting some or all of those needs
- Analyze the costs and benefits of the alternatives in terms of water supply and other criteria used in the Water Storage Assessment
- Perform an extensive public participation and public involvement program to determine public acceptability of the water storage opportunities and the alternative opportunities

- Compare the costs and benefits of alternatives to the water storage opportunities described in the Water Storage Assessment. The cost/benefit analysis of the alternatives should also consider permitting and implementation feasibility.

Final Steps: Technical Feasibility
Thusfar, the evaluation of water storage opportunities in the Wenatchee Watershed has been a reconnaissance-level or preliminary study. Much more detailed information is required to adequately assess the feasibility of any one of the opportunities. The final stage of study will fully consider factors that will affect the technical feasibility of the opportunities and ability to obtain permits. Information required to assess the technical feasibility of the potential opportunities include:

- Subsurface explorations to determine geotechnical engineering issues
- Additional streamflow measurements and gaging at the site of the reservoirs to determine the yield of the basins
- Topographic information to determine the size of the project facilities
- Environmental reviews to assess wetland, fisheries, wildlife and botanical impacts
- Hydrologic modeling of basins to determine the effect the reservoirs will have on streamflow, both when capturing flow during spring and when releasing during late summer
- Additional review of permitting requirements with USFS and other agencies
- Public participation and input into new water storage opportunities to determine public acceptability

The opportunities that will be studied in this phase will likely be wholly or partially sited on land managed by the USFS. For a project to take place, a proponent would submit a proposal to the USFS. The USFS will follow agency regulations, including use of the NEPA process to evaluate the opportunities and alternatives to the proposed action.

5.5.2 Storage- Recommended Actions

QUANT-19: Consider funding storage options from the Storage Assessment. See relevant sub-watershed sections (Section 9.0) for specific storage opportunities as listed in the WRIA 45 Storage Assessment Report.

5.6 Studies and Projects to Support the Water Resource Management Strategy

5.6.1 Projects and Studies - Issues

There is a need for additional studies to better understand the water resources, water use, and effectiveness of management strategies implemented in WRIA 45 and its sub-watersheds.

5.6.2 Projects and Studies - Recommended Actions

QUANT-20: CCNRD or other entities to administer studies on water resources throughout the watershed, especially in areas where inadequate data exist to make decisions regarding future water use (eg., Chumstick, Northside Tributaries).

> **QUANT-20a**: Water budgets have been prepared by sub-watershed. These budgets indicate total water use by use type (eg., residential, industrial, commercial, agricultural, fish

propagation), but do not provide estimates of consumptive use. A consumptive crop irrigation requirement is presented. Further this study by defining the consumptive portion of the water use in the water budgets. Incorporate water usage rates with varying efficiencies for each water use type. Use this information to develop appropriate and useful water use efficiency requirements on lands that have been converted from agricultural to residential.

QUANT-20b: Study groundwater in specific areas of the watershed (eg., Mission Creek, Lower Chumstick/Eagle Creek area, Monitor area). Finalize the areas for study as part of Phase IV, Implementation.

QUANT-20c: There is a need to better understand the groundwater – surface water interaction in the watershed. Formalize studies to address this issue.

QUANT-21: Evaluate the consumptive portion of reserved water uses and determine if recharge credit should be included in the accounting of the reservation.

QUANT-11: Undertake hydrogeologic studies to assess the influence of groundwater withdrawals on surface water. Identify funding for this study and responsible parties (WWPU to identify sub-areas for study, responsible entity as part of Phase IV, Implementation).

ChumQUANT-2: Chumstick Water Forum to assist in developing a data collection plan to monitor surface water flows (specify location) and develop management flows.

ChumQUANT-3: Chumstick Water Forum, with assistance from Chelan County and Ecology, to conduct groundwater monitoring to understand hydraulic continuity and overall impact of exempt wells on groundwater levels and streamflows.

ChumQUANT-6: A cumulative impact analysis of permit exempt use and uses associated with permits and claims approved since 1983 will be initiated by Ecology as authorized under the 1983 flow rule. Chelan County will partner with Ecology in this study. The cumulative impacts assessment will help to determine whether Ecology will curtail outdoor domestic water use of wells installed after 1983, and whether Ecology will close the Chumstick Sub-watershed to outdoor water use in the future.

ChumQUANT-7: Chumstick Forum, Chelan County and Ecology to re-evaluate a proposed strategy for the Chumstick in three years after rule adoption, when new monitoring data have been collected and assessed and cumulative impact analysis is complete. Consider allowing group domestic groundwater use of deeper aquifer only as part of the Chumstick strategy addressed by the Forum.

NSTQUANT-1: Future water supply availability should be discussed with Chelan County Public Utility District (PUD) to determine whether they have the capacity and infrastructure to provide backup supply. The East Bank Aquifer Regional Water Supply will only be considered as a source of water for this area if approved by the owners of the Regional Water Supply.

QUANT-8: Chelan County Natural Resource Department will develop and administer a monitoring program to assess actual domestic water use to verify the 380 gpd per household assumption used to debit the reservation and to adjust the amount of water remaining in the reservation at five year intervals, or more frequently if the number of wells drilled or building permits granted indicate that growth is occurring more rapidly than projected in any sub-watershed. These assessments will be conducted based on a statistical sample of new domestic water users (single domestic, group domestic and municipal water use and associated lawn and garden irrigation (some with separate irrigation,

some without), some with stock, etc.). Metering data will be incorporated into the water use audit and the accounting system.

This monitoring program will be included as part of the adaptive management element to the water resource management strategy discussed in Section 4.0. If necessary, the per household water use factor used to debit the reservation will be adjusted based on statistical sampling and metering in the WRIA (380 gpd/hh is a guide, an accounting tool).

This water use audit will be further developed during Phase IV, Implementation. As part of this audit, the consumptive portion of the daily household water use factor will be assessed, and may be used to debit the reservation. This will be considered during the first year of implementation.

6.0 GROWTH AND LAND USE ISSUES AND RECOMMENDATIONS

6.1 Introduction

The water resource management strategy of this plan needs to be integrated into land use planning processes and decisions undertaken by local governments to ensure that the reservation allocations and eligible uses are considered. The following actions address the integration of the proposed water resource management strategy with land use planning.

6.2 Integrating Water Availability in Land Management Decisions

GLU-1: As part of reservation accounting, establish a resource base for decision-makers to use to consider technical water resource information when making land use change decisions and when considering land use permit applications. This should include:

> **GLU-1a**: Chelan County Natural Resource Department (CCNRD) will provide technical input regarding the reservation and eligible uses into the decision making process for consideration by city and county land use decision makers.
>
> **GLU-1b**: Water resource and supply related data for the watershed will be maintained in a database by CCNRD (eg., a water supply dataset including water system boundaries, an exempt well tracking system, on-going tally of water rights and water use per water system, instream flow and groundwater level data, an assessment of whether current water rights can service full build-out based on current zoning, etc.). CCNRD would update this information as a larger population is served in the future and ensure the information is available in a format that is easily understood by the public.

6.3 Chelan County Land Use/Zone Change Applications

GLU-2: As part of Chelan County's zone change process, water supply and water resource information is available for use from CCNRD.

6.4 City UGA and Comprehensive Plan Amendments

GLU-3: As there is urban growth in the WRIA, ensure that water availability is considered in UGA boundary decisions for existing and new UGAs. For proposed Urban Growth Area boundary expansions that are outside the jurisdiction of an existing water service area, the proposal for expansion should include documentation of a water purveyor's intention to provide water, their ability to provide water, or the ability of the development to provide water if it is to be self-served.

6.5 Consistency between the Critical Area Ordinance and the Wenatchee Watershed Plan

There is a need for consistency between 2514 Watershed Planning and critical areas protections under GMA, and to integrate regulatory and non-regulatory programs to achieve the goals of both Watershed Planning and critical areas protection under GMA. The following actions address this need for consistency.

GLU-4: The Wenatchee Watershed Planning Unit is supportive of the goals and intent of the GMA to provide critical area protections, as these are consistent with water quality, quantity and habitat goals of the Wenatchee Watershed Plan and the Watershed Planning Act. The Planning Unit further

supports the efforts of local jurisdictions to implement non-regulatory programs that protect critical areas and is interested in exploring potential partnerships in these efforts.

GLU-5: Data, protection measures and strategies relating to critical area protections should be documented as part of the watershed planning process. Encourage local jurisdictions to utilize the data, protection measures and strategies identified in the 2514 Wenatchee Watershed Plan in the development and update of critical area protections under GMA. Ensure that this information is readily available to local jurisdictions.

GLU-6: The protection measures and strategies identified in the 2514 Watershed Plan should be considered by local governments as non-regulatory mechanisms to protect critical areas watershed wide. These approaches include:

- Land protection measures such as easements, leases, purchases and other creative measures, such as transfer of development rights to protect remaining floodplain and riparian habitat
- Wetland restoration
- Fish passage improvements; removal of fish passage barriers
- Restore channel function
- Reconnect disconnected habitat areas
- Restore floodplain function
- Maintain forest roads
- Control and eradicate noxious weeds

7.0 WATER QUALITY ISSUES AND RECOMMENDATIONS

7.1 Introduction

The Water Quality Technical Subcommittee (WQTS) of the WRIA 45 Planning Unit is currently working with Ecology on the Total Maximum Daily Load (TMDL) study of temperature, fecal coliform bacteria, dichlorodiphenyltrichloroethane (DDT), dissolved oxygen (DO) and pH in the watershed. The Water Quality component of the Wenatchee Watershed Plan is the product of an effort to coordinate the ongoing programs within the watershed. In addition to recommendations in the TMDL Study, this plan integrates recommendations provided by the WQTS and considers the 1998 Watershed Action Plan's recommendations to improve water quality within the watershed. The 2004 303(d) listings are the most recent evaluation of the water quality in the Wenatchee Watershed.

Figure 7-1 displays the 2004 303(d) listings for impaired waters in WRIA 45. The TMDL listings are determined by sampling the water quality at points along the stream length. The points on the map do not represent the sampling points, but the center of the stream reach within the Township, Range, and Section in which the sampling point was located. The actual locations of sampling points in WRIA 45 are not currently available from Ecology.

7.1.1 Relevance of Water Quality Parameters

The role of each water quality parameter evaluated in the TMDL process in determining the overall health of the Wenatchee Watershed is discussed below. Temperature, DDT, and DO/pH may directly pose problems for characteristic uses in the Wenatchee Watershed while fecal coliform is considered an indicator of other specific water quality problems in the watershed.

Temperature
The State water quality standard for temperature targets temperature changes from human activities based on a stream's class designation and provides an exception for situations where the natural conditions violate the water quality standard. The maximum acceptable temperature is 16.0°C for Class AA streams, 18°C for Class A streams, or the temperature that can be characterized as the natural condition of the stream (Cristea and Pelletier, 2005). In cases where the standard is set by the natural conditions of the stream, "no temperature increases will be allowed which will raise the receiving water temperature by greater than 0.3°C" (Cristea and Pelletier, 2005, p. 25). The water quality standards protect the characteristic uses of a stream. The characteristic uses protected by the temperature standard in the Wenatchee Watershed "are salmonid and other fish migration, rearing, spawning, and harvesting" (Cristea and Pelletier, 2005, p. 25). The temperature considerations for aquatic life are detailed in WAC 173-201A-200(1)(c).

Fecal Coliform
The State water quality standards for fecal coliform protect the Wenatchee Watershed's characteristic uses from possible harmful, disease-causing pathogens (e.g., bacteria and viruses) associated with human and animal waste. The presence of fecal coliform is an indicator of the presence of waterborne diseases: dysentery, typhoid fever, viral and bacterial gastroenteritis, and hepatitis A (Carroll and O'Neal, 2005a). Characteristic uses include water supply; stock watering; salmonid and other fish migration, rearing, spawning, harvesting; wildlife habitat; and recreation (Carroll and O'Neal, 2005a).

DDT
The Mission Creek Sub-watershed is the area of concern for exceedances of the DDT standard in the Wenatchee Watershed. In the past, DDT was used in the area to control pests before it was banned by

the EPA in 1972. Due to its persistence, DDT takes decades to degrade, and still remains in the soil and waterbodies of some areas (Serdar and Era-Miller, 2004). The bioaccumulation of DDT in aquatic life can result in the concentration of DDT in fish tissue, for example, being greater than the DDT concentration in the surrounding environment. The characteristic uses protected by the water quality standard for DDT include aquatic habitat and human fish consumption (Serdar and Era-Miller, 2004).

DO/pH[7]

The standards for DO and pH protect fisheries (salmonids and other aquatic life and habitat) and wildlife, as well as public health and enjoyment in the Wenatchee Watershed. Phosphorus in the watershed affects DO levels and pH. Fish and other aquatic life are sensitive to DO and pH levels and can only survive within a specific range of these water quality characteristics.

7.1.2 Partnerships

To date the efforts of the WQTS and Ecology to produce these TMDLs or clean-up plans for DDT, fecal coliform bacteria and temperature have progressed under normal processes with predictable outcomes. However, the pH and DO parameters for the Wenatchee River pose some unique regulatory and wastewater infra-structure challenges. Additional collaborative partnerships to develop a strategy for pH and DO that meets the requirements of the TMDL and the needs of local communities and governments will be needed.

In an effort to address the pH and DO parameters, Chelan County, Chelan County PUD and the cities of Cashmere, Leavenworth and Wenatchee are entering into a partnership with funding assistance from Ecology, special legislative funding and their own funds to accomplish two primary tasks. The first task is to facilitate and develop a workable strategy that can be used and ultimately approved by the Environmental Protection Agency (EPA) in Ecology's TMDL submittal for DO and pH. The second task is to review and make suggestions for future improvements to Ecology's Technical Assessment, Summary Implementation Strategy (SIS), and adaptive management approaches to meet state water quality standards for these parameters. The goal is to develop a clean-up plan for these parameters that the local community and local governments can support and ultimately implement. As such, additional strategies to address point and non-point sources of phosphorus will be reported during the implementation phase of the Wenatchee Watershed planning effort.

7.2 TMDL Studies in WRIA 45

Water quality monitoring has indicated that there are locations in the Wenatchee River and its tributaries that exceed State and Federal water quality standards for temperature, fecal coliform, pH, dissolved oxygen, and DDT. A Total Maximum Daily Load (TMDL) study and implementation plan are being completed to comply with the federal mandate of the Clean Water Act, state laws to control point and non-point source pollution, and the 1997 Memorandum of Agreement between the EPA and Ecology.

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[7] Phosphorus is typically the limiting nutrient in algal (periphyton) growth; therefore, when excessive amounts of phosphorus are introduced into a waterbody, it leads to algal blooms. Algal growth may cause elevated DO levels and pH during the day and low DO levels and pH at night. DO is produced in the photosynthesis process and consumed when periphyton and bacteria respire. The pH is affected by the level of dissolved inorganic carbon in the water. When the periphyton consume dissolved inorganic carbon during the photosynthesis process, the pH increases; respiration then increases the amount of dissolved organic carbon in the water so the pH decreases.

The goal of the TMDL is to ensure that an impaired water body attains water quality standards within a reasonable period of time. The TMDL identifies pollutant sources, actions to be implemented, and potential implementing entities to reduce pollutant inputs and achieve water quality standards. A phased monitoring approach is also developed to assess the effectiveness of actions and verify that water quality standards are met.

Ecology began working with the Wenatchee WQTS in 2001 to develop the TMDL. The committee is comprised of representatives from the EPA, Ecology, Chelan County, Chelan County PUD (PUD), Chelan-Douglas Health District (CDHD), the Chelan County Conservation District (CCCD), irrigation districts, city agencies, environmental groups and private citizens.

Several key milestones in the evolution of the TMDL implementation plan are worth noting. Field studies addressing the 303(d) listed parameters were developed and conducted by Ecology between 2002 and 2004, with assistance from the CCCD. Technical reports were completed between 2004 and 2006. Successive drafts of the technical reports were reviewed and commented upon by the WQTS and Planning Unit. Ecology responded to those comments and they were incorporated into the technical reports. Scientists conducting the work provided numerous presentations and engaged in discussions with the group.

Success of the TMDL is based upon the collective implementation of the many actions identified in the TMDL SIS documents for each parameter. The SIS documents are general clean-up plans describing implementation actions and potential implementing entities. A Detailed Implementation Plan (DIP) will be prepared within one year following approval of the TMDL Submittal by EPA. The DIP should describe the specific implementation activities that should be performed by all of the various stakeholders in order to achieve the TMDL targets. The plan should identify in more detail how, when, and where implementation and monitoring activities should be conducted. Ecology and other entities should provide technical assistance and seek additional funding for these activities and any new activities that may be identified as the body of data grows. Public input should be sought to help prepare the plan. Additionally, continued monitoring of implementation activities and water quality will assess the progress of the TMDL.

7.3 Adaptive Management of the TMDL Process

The data collection and literature review conducted for and presented in the TMDL technical reports for the Wenatchee River Watershed represent the current state of knowledge for temperature, fecal coliform, pH, dissolved oxygen, and DDT in the watershed. It is the understanding of the WQTS that additional studies will be performed to fill data gaps and address unanswered questions as determined by the WQTS.

Conclusions and recommendations currently presented in the TMDL may be revised based on new data as they become available. It is also the understanding of the WQTS that any new data gathered from further study can be incorporated in the TMDL process in the SIS reports or DIP wherein recommendations and management strategies may be refined. This adaptive management approach is acceptable to both Ecology staff and the WQTS. Ecology will partner with stakeholders in the watershed to conduct studies addressing information gaps (eg., monitoring).

Further monitoring for purposes of the TMDL assessment will be addressed in the TMDL SIS reports and DIP. Any new science available as a result of these studies will be integrated into the SIS reports and DIP as new conclusions and management recommendations. Management strategies addressing both point and non-point sources are subject to this adaptive management approach.

7.4 Watershed-Wide Recommended Actions

Some recommendations resulting from the TMDL study are included in this watershed plan. Ecology and the WQTS have developed a SIS for each parameter addressed in the TMDL process in WRIA 45. The issue statements and recommendations in this plan have been agreed upon by the WQTS as of the March 22, 2006 WQTS meeting. Further revisions to these recommendations should be considered during Phase IV, Implementation of this watershed plan. The actions presented below and in Section 9.0 are based on the following Draft SIS Reports: DO/pH SIS (WQTS, 2006a), DDT SIS (WQTS, 2006b), Fecal Coliform SIS (2006c), and the Temperature SIS (2006d). These reports are summarized below:

DO/pH SIS (WQTS, 2006a)

- The SIS is the implementation section of the TMDL submittal to EPA that describes actions to be taken to improve dissolved oxygen and pH levels and meet water quality standards. It was originally developed by David Schneider, Department of Ecology TMDL Lead, utilizing conclusions and recommendations of the Wenatchee River Basin Dissolved Oxygen, pH and Phosphorus TMDL technical study. It has been further refined with comments from the WQTS. This is the latest version with comments incorporated following roundtable discussion at the March 22, 2006 WQTS meeting.

DDT SIS (WQTS, 2006b)

- The SIS is the implementation section of the TMDL submittal to EPA that describes actions to be taken to reduce DDT inputs and meet water quality standards. It was originally developed by David Schneider, Department of Ecology TMDL Lead, utilizing conclusions and recommendations of the Mission Creek DDT TMDL technical study (Serdar and Era-Miller, 2004). It has been further refined with comments from the WQTS. This is the latest version with comments incorporated following roundtable discussion at the February 16, 2006 WQTS meeting.

Fecal Coliform SIS (WQTS, 2006c)

- The SIS is the implementation section of the TMDL submittal to EPA that describes actions to be taken to reduce fecal coliform inputs and meet water quality standards. It was originally developed by David Schneider, Department of Ecology TMDL Lead, utilizing conclusions and recommendations of the Wenatchee River Basin Fecal Coliform TMDL Study (Carroll and O'Neal, 2005a), Wenatchee River Watershed Action Plan (1998), Assessment of Fecal Coliform in Mission and Brender Creeks (Burgoon and Rickel, 2003a), and Recommendations-Actions from a Mission Creek Stream Walk conducted by David Schneider and Michael Rickel in 2004. It has been further refined with comments from the WQTS. This is the latest version with comments incorporated following roundtable discussion at the March 22, 2006 WQTS meeting.

Temperature SIS (WQTS, 2006d)

- The SIS is the implementation section of the TMDL submittal to EPA that describes actions to be taken to reduce temperature inputs and meet water quality standards. It was originally developed by David Schneider, Department of Ecology TMDL Lead, utilizing conclusions and recommendations of the Wenatchee River Temperature TMDL Study (Cristea and Pelletier, 2005). The Draft SIS has been further refined with comments from the WQTS. This is the latest version with comments incorporated following roundtable discussion at the February 16, 2006 WQTS meeting.

7.4.1 Watershed-wide Water Quality (QUAL) Issue

There is a need to address the exceedances of State and Federal water quality standards for temperature, fecal coliform, pH, dissolved oxygen, and DDT in the Wenatchee River and its tributaries.

7.4.2 Watershed-wide Water Quality (QUAL) Recommendations

Water quality actions that apply to the watershed as a whole (WRIA 45) or to multiple sub-watersheds are included in this section. Sub-watershed specific water quality actions can be found for the applicable sub-watershed in Section 9.0. Note: the actions to address temperature exceedances listed below apply to the Wenatchee River and most of its tributaries, with the exception of the White River.

QUAL-1: Chelan County Conservation District (CCCD) should continue to oversee and implement recommendations in the Watershed Action Plan, ensure other entities are also implementing voluntary actions in the Watershed Action Plan, and encourage continued funding of these efforts.

QUAL-2: Ecology should continue to work with the local watershed planning group through both implementation of the current TMDL, and on future TMDLs if further listings arise.

QUAL-3: Ecology should continue to work with the local watershed planning group for funding future projects.

QUAL-4: Encourage the Wenatchee Watershed Planning Unit and its other subcommittees (Water Quantity, Instream Flow, Habitat, and Growth and Land Use) to use the information in the TMDL Technical Reports and SISs along with their conclusions, recommendations, and actions for a more holistic approach to restoration, preservation, and enhancement of the watershed for all beneficial uses (WQTS, 2006a; WQTS, 2006b; WQTS, 2006c; WQTS, 2006d).

7.4.3 Multi-Sub-watershed Temperature Issue

There is a need to address the exceedances of State and Federal water quality standards for temperature in the Wenatchee River and most of its tributaries, with the exception of the White River, based on the 2004 303(d) list for impaired waters for temperature in Washington State. Loss of riparian habitat and low streamflow are two factors that may contribute to exceedances of State and Federal temperature water quality standards in these sub-watersheds. In some cases, the natural conditions in some portions of the watershed are likely to be warmer than 16/18 degrees Centigrade (numeric criteria for state standards during critical conditions). The recommended actions presented below have not been duplicated in each of the sub-watershed sections.

7.4.4 Multi-Sub-watershed Temperature Recommendations

QUAL-5: Appropriate actions to be used in the appropriate location should be determined to address temperature exceedances in Phase IV, Implementation for all of the temperature-related recommendations in the Plan.

QUAL-6: Actions to improve shade near surface waters should be implemented, where feasible. Shade management practices should involve the development of mature riparian vegetation. The WQTS should use the information provided in the temperature technical report and Planning Unit studies (FLIR, LIDAR, PHABSIM, etc.) to create a prioritized list of locations and plan for

establishing riparian vegetation. Associated monitoring should be planned and implemented over time, as full riparian vegetation requires many years to become established. The upper watershed should be addressed first as it has the most potential for shade improvements and water temperature reductions. An evaluation of the 303(d) listed waters in the upper watershed should be conducted to see if they should be dropped from the 303(d) list due to natural conditions (Chiwaukum Creek, Little Wenatchee River). The WQTS should coordinate with the Planning Unit's other subcommittee conclusions, recommendations, and actions to reduce water temperatures (WQTS, 2006d).

QUAL-7: For U.S Forest Service land, the riparian reserves prescriptions in the Northwest Forest Plan should be implemented for the establishment of mature riparian vegetation, where appropriate. The U.S. Forest Service should be the primary implementing agency. The WQTS and the Department of Ecology should coordinate with the U.S. Forest Service (WQTS, 2006d).

QUAL-8: For State and privately owned forest land, the riparian vegetation prescriptions in the Forests and Fish Report (Washington State Department of Natural Resources (DNR), 1999) should be implemented for all perennial streams. Load allocations are included in this TMDL for forest lands in accordance with the section of the Forests and Fish Report entitled "TMDLs produced prior to 2009 in mixed use watersheds." The WQTS and the Department of Ecology will coordinate with the Department of Natural Resources (WQTS, 2006d).

QUAL-9: For areas that are not managed in accordance with either the Forest Plan or the Forests and Fish Report, voluntary programs to increase and protect riparian vegetation should be developed, such as riparian buffers and conservation easements. The WQTS and the Department of Ecology should work with private forested landowners, agencies, and stakeholders to develop and monitor the projects (WQTS, 2006d).

QUAL-10: Stream temperature is related to the amount of instream flow, and increases in flow generally result in decreases in temperatures. The WQTS should work with the Planning Unit and watershed entities to encourage projects that have the potential to increase and protect surface and groundwater flows. Voluntary retirement, purchase, leasing of existing water rights, or other conservation methods to preserve and enhance instream flow should be encouraged. In addition, water storage opportunities that have the potential to increase instream flows during critical periods should be considered (WQTS, 2006d).

QUAL-11: Adaptive management activities to control potential channel widening processes should be encouraged. Reductions in channel width are expected as mature riparian vegetation is established. For example, activities that reduce sediment runoff to surface waters from upland and channel erosion can affect channel width and temperatures (WQTS, 2006d).

QUAL-12: Actions to improve hyporheic exchange flows and groundwater-surface water recharge should be identified and implemented to improve the current temperature regime and reduce maximum daily instream temperatures. Factors that influence hyporheic exchange flow include the vertical hydraulic gradient between surface and subsurface waters as well as the hydraulic conductivity of streambed sediments. Activities that reduce instream flows, hyporheic exchange and hydraulic conductivity of streambed sediments can increase stream temperatures, such as drilling of wells along streams and connected ground water reservoirs, and development in the flood plain. The WQTS should work with the Planning Unit and its subcommittees to identify and implement management activities designed to protect and enhance instream flow and subsurface water exchange with streams. Actions should be identified and implemented to reduce upland and channel erosion and avoid sedimentation of fine materials in the stream substrate (WQTS, 2006d).

QUAL-13: Ecology should continue existing temperature monitoring, and expand the current temperature monitoring program such that it is consistent with flow monitoring actions recommended in WRMS-4a and WRMS-4c.

QUAL-14: The WQTS should work with the Planning Unit in the development of proposed water storage, irrigation, habitat, and development projects to provide input regarding shade, riparian vegetation, and engineering to reduce water temperatures (WQTS, 2006d).

QUAL-15: To determine the effects of management strategies within the Wenatchee River Basin, regular monitoring is recommended. Continuously-recording water temperature monitors should be deployed from July through August to capture the critical conditions. The following locations should be targeted for a minimal sampling program: Wenatchee River near mouth, Icicle Creek near mouth, Nason Creek near mouth, Peshastin Creek near mouth, and Mission Creek near mouth. Monitoring will be conducted associated with BMPs to track progress toward shade and water quality targets. Water temperature monitoring should be conducted and coordinated with associated BMP projects over time (WQTS, 2006d).

QUAL-16: Funding assistance should be sought from Ecology through its grants and loans programs to implement actions and ongoing monitoring. Other funding sources should be identified and applications submitted to provide funding for ongoing activities. The WQTS will recommend qualified entities to conduct associated monitoring (WQTS, 2006d).

7.5 Specific Sub-watershed Recommended Actions

Issues and recommended actions specific to individual sub-watersheds can be found in Section 9.0. These include actions addressing DDT and fecal coliform in the Mission Creek Sub-watershed, fecal coliform in the Chumstick Sub-watershed, and DO/pH in the Lower Wenatchee, Icicle and Upper Wenatchee Sub-watersheds.

8.0 HABITAT ISSUES AND RECOMMENDATIONS

The Wenatchee Watershed contains salmonid habitat important to the entire Columbia River region. The Upper Columbia Biological Strategy (Biological Strategy) states that, "the Wenatchee River is unique among sub-basins in the Upper Columbia Region in that it supports the greatest diversity of populations and overall abundance of salmonids, yet is facing the greatest risk of habitat loss and degradation. There are core populations of sockeye salmon, steelhead, bull trout, and both Spring and Summer Chinook salmon in the upper Wenatchee [Watershed] that are relatively strong when compared to other populations in the Columbia sub-basin" (UCRTT, 2002). However, spring Chinook in the Wenatchee Watershed has been federally listed as endangered and bull trout and steelhead have been listed as threatened under the Endangered Species Act (ESA) (listings occurred in 1997, 1999, and 2006 respectively).

This habitat component of the Wenatchee Watershed Plan builds upon existing research, reports, and programs to initiate habitat improvement actions in WRIA 45. The Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) is the most recent report that identifies issues and actions to address habitat needs for spring Chinook, steelhead, and bull trout in the Wenatchee River Watershed. The Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan, in conjunction with the Biological Strategy, is used to identify both restoration (UCSRB, 2005) and protection (UCRTT, 2002) actions in the watershed.

Actions are identified that will improve the function and connectivity of habitat throughout the watershed. As specified in the Watershed Planning Act (RCW 90.82.100), the Plan emphasizes salmonid and aquatic habitat. However, to benefit both aquatic and terrestrial species, upland habitat is considered as it relates to aquatic processes.

8.1 Goals and Intent

According to RCW 90.82.100, the 2514 habitat component of a watershed plan is designed to "protect or enhance fish habitat in the management area." This will be accomplished in WRIA 45 through existing laws and ordinances, and through coordination with ongoing activities in the watershed, such as Salmon Recovery planning. Beyond those requirements, the Planning Unit is taking a project-oriented, watershed-scale approach to habitat improvements based on Evolutionarily Significant Unit (ESU) priorities and will work to facilitate local involvement and public education within the watershed.

The Wenatchee Watershed Plan focuses on treating the source of habitat degradation, as opposed to treating only the effects. Treatments at the source are preferred over engineering solutions, which, rather than eliminate the problem, often move it further downstream. In recommending projects for habitat protection, enhancement, and restoration, the Planning Unit will consider the priorities of local residents within each sub-watershed, priorities of management agencies and the needs of the larger watershed-scale system.

8.2 Habitat Status and Information Sources

The Wenatchee Watershed provides habitat for a wide variety of terrestrial and aquatic species. Natural habitat characteristics vary throughout the watershed from the steep, forested mountains in the northwest to the shrub-steppe of the eastern watershed at the confluence of the Wenatchee and Columbia Rivers. Terrestrial species that inhabit the Wenatchee Watershed and receive special attention through a variety of planning and regulatory processes include the Peregrine falcon, Bald eagle, Northern Spotted owl, Marbled murrelet, lynx, Larch Mountain salamander, and other species

that are threatened or endangered, or otherwise closely monitored through federal and state programs. The Washington Department of Natural Resources (DNR) has completed a catalogued list of species and habitat types in the watershed recognized by its agency as priorities for management and preservation (WDFW, 2005).

The Wenatchee Watershed is home to a variety of aquatic species including the following salmonids: Spring and summer Chinook, sockeye, steelhead, westslope cutthroat, and migratory and resident bull trout. The documented, presumed, and potential distributions of anadromous salmonids in each of the sub-watersheds of the WRIA are illustrated in Figures 9-1 to 9-9 in this document as described by the Salmon and Steelhead Habitat Inventory and Assessment Project (SSHIAP) (WCC, 2001). The watershed is also home to other culturally important species such as lamprey and re-introduced coho. The potential distribution of these species is an important consideration in determining which habitat improvement activities to implement.

Much of the planning, protection, and restoration/enhancement work in the watershed has focused on the needs of salmonids because of the federal Endangered Species Act listings of Upper Columbia River (including the Wenatchee) spring Chinook as endangered and bull trout and steelhead as threatened in 1997, 1999, and 2006 respectively. All the fish stocks in the Wenatchee Watershed except summer Chinook and sockeye are classified as depressed in the Washington Department of Fish and Wildlife (WDFW) Salmonid Stock Inventory (SaSi) index. The watershed also supports resident westslope cutthroat trout. Coho salmon were extirpated from the region in the early 1900s; there are efforts underway by the Yakama Nation to reintroduce them. Additional information regarding the status of aquatic habitat can be reviewed in the Limiting Factors Analysis (Andonaegui, 2001), Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005), the Upper Columbia Biological Strategy (UCRTT, 2002), the Wenatchee Subbasin Plan (NPCC, 2004), Washington Conservation Commission fish distribution data (SSHIAP) (WCC, 2001), and an assortment of other reports as detailed in the Wenatchee Phase II Habitat Completion Memo (Golder, 2005b).

The WRIA 45 Limiting Factors Analysis described habitat conditions in relation to aquatic habitat needs in the Wenatchee Watershed as follows, “Anadromous salmonid populations in the Wenatchee [Watershed] are influenced by the following out-of-[watershed] impacts: degraded estuarine habitat, fish harvest, unfavorable ocean conditions, and the effects of seven Columbia River reservoirs and hydroelectric dams on smolt and adult migration. Spring and summer Chinook, sockeye salmon, and steelhead trout must negotiate a 468 mile journey from the mouth of the Wenatchee River to the Pacific Ocean, once as smolts and again as adults. Within the [watershed], human alterations to the environment are exacerbating naturally limiting conditions by reducing habitat quality and quantity, thereby reducing a species’ chances of successfully completing its life cycle. These alterations have primarily occurred in the lower gradient, lower reaches of sub-watersheds in the lower [part of WRIA 45] and include road building and placement, [railroads], conversion of riparian habitat to agriculture and residential development, water diversion, reduced large woody debris (LWD) recruitment, and flood control efforts that include LWD removal, berm construction, and stream channelization” (Andonaegui, 2001).

Much more has been researched and written about the salmonid and terrestrial habitat conditions in the Wenatchee Watershed, and many of those documents were used to provide background data for this Watershed Plan. Priorities for aquatic habitat projects in the Wenatchee Watershed Plan are based primarily on the biological needs identified in the Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005). These priorities were found to be consistent with the Wenatchee Subbasin Plan (NPPC, 2004) and the WRIA 45 Limiting Factors Analysis (Andonaegui, 2001).

Habitat improvement projects have been developed through a combination of input provided at public meetings held in various locations across the watershed in early 2005, noted project needs from various local agencies, and the needs established by the Habitat Subcommittee of the Wenatchee Watershed Planning Unit. In early 2005, the Planning Unit requested information on planned or needed habitat projects from many entities and agencies working in the watershed. These proposed projects were catalogued by sub-watershed and by status (complete, ongoing, proposed). The catalogued projects (as of June 2005) along with their location relative to fish distribution, land use, Northwest Forest Plan designation, and fish barriers can be found in Appendix C. Chelan County Natural Resource Department is currently maintaining this list of projects and continuing to track projects and funding opportunities. The Habitat Subcommittee with Chelan County as lead should coordinate with funding organizations, the Upper Columbia Salmon Recovery Implementation Team, and action agencies. The Habitat Subcommittee with Chelan County as lead intends to maintain a database of habitat projects for the Wenatchee Watershed.

8.3 Action Types: Protection and Restoration/Enhancement

The actions prescribed to address habitat issues fall into two categories: *Protection* and *Enhancement/Restoration*. Protection consists of actions to ensure that potential future activities or land uses will not interfere with habitat goals. Examples of this type of action are land acquisitions and conservation easements. Enhancement and restoration consist of actions to improve or restore habitat for a target species, such as the removal of fish passage barriers, restoration of channel function, or reconnection of disconnected habitat areas. These terms are defined by the Planning Unit as follows:

- Restoration – Creating a specific functional condition that has the desired effect on a given species.
- Enhancement Actions – Actions that move toward creating the specific functional condition of restoration, without necessarily achieving all criteria necessary for restoration, or the complete creation of that condition.
- Protection – Prevention of future more active or invasive land use activities than the current land use.

Protection is only applicable in areas that have retained healthy, functioning habitat in a relatively pristine condition. Protection is more cost and time-effective in the long term than restoration or enhancement actions because a larger, on-the-ground activity is not required to *create or restore* habitat. Where it is possible to protect functioning systems, protection is recommended over restoration/ enhancement actions. Actions to restore fish access to fully functioning protected areas are also a high priority. Throughout the watershed, there are areas where adequate stewardship is currently occurring. In these areas, continued maintenance is recommended before initiation of new protection or restoration/enhancement actions.

8.4 Public Outreach

In January 2005, nine workshops were held throughout the watershed to introduce residents to the various methods or “tools” that could be applied in their sub-watershed to help to protect or enhance habitat. The tools address instream, riparian, and upland areas, and include both policy and on-the-ground actions. However, certain tools are only applicable at specific locations. Members of the public were asked to voice preferences regarding habitat improvement in their areas. Workshops were held for the Chiwawa and Upper Wenatchee; Nason; Icicle; Chumstick; Peshastin; White, Little Wenatchee, and Lake Wenatchee; Mission, Brender, and Yaksum; Lower Wenatchee from

Leavenworth to Dryden; and Lower Wenatchee from Dryden to Mouth Sub-watersheds. Based on their familiarity with the area, residents identified locations in need of habitat improvement and proposed specific projects.

8.5 Evaluation Criteria for Habitat Projects

An internal, evolving list of proposed projects is currently being maintained by Chelan County Natural Resource Department. The list will be continually prioritized based on availability of funds, citizen interests, habitat needs, project feasibility, local and watershed-wide needs, and the foreseeable benefits of individual projects. The Habitat Subcommittee with Chelan County as lead will maintain a publicly accessible database of past and current habitat projects. The Planning Unit recognizes there is a need to take a watershed system approach to river health from upstream to downstream. This system approach will help us understand where to prioritize needs in the watershed. Key factors in prioritizing projects are as follows:

8.5.1 Biological Needs and Priorities

Prioritization of habitat projects should first consider the biological needs established for each sub-watershed in the Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005). The Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan considered sub-watershed habitat condition and relative location in the watershed to gauge effectiveness of habitat improvements in each sub-watershed and watershed-wide. This resulted in the assignment of a "sub-watershed biological priority category" ranging from 1 to 3 to each sub-watershed. This category describes the watershed-wide benefit resulting from implementation of habitat actions in that sub-watershed. Descriptions of the categories are as follows:

Category 1 – These areas represent systems that most closely resemble natural, fully functional aquatic ecosystems. They comprise large, connected blocks of high-quality habitat that support more than two listed species. Exotic species may be present but are not dominant in abundance. ***Protecting these areas is a priority, although restoration in some areas is also needed.***

Category 2 – These areas support important aquatic resources and are strongholds for one or more listed species. Compared to Category 1 areas, Category 2 areas have a higher level of fragmentation resulting from habitat disturbance or loss. These areas have a large number of sub-watersheds where native populations have been lost or are at risk for a variety of reasons. ***Restoring ecosystem function and connectivity within these areas are priorities.***

Category 3 – These areas may still contain sub-watersheds that support salmonids, but they have experienced substantial degradation and are strongly fragmented by habitat loss, especially through loss of connectivity with the mainstem corridor. ***The priority in these areas is to rectify the primary factors that cause habitat degradation.***

In general, watershed-scale prioritization of projects should be accomplished in the following way:

- **Category 1** sub-watersheds should receive priority allocation of financial and management resources.
- Subsequent allocation of resources should be given to **Categories 2** and **3**, in that order, once refuge habitats (**Category 1**) for the target species are protected and secured. This does not mean, however, that specific actions should not occur in **Category 2** and **3** sub-watersheds until all activities in **Category 1** sub-watersheds are completed. Any projects within those sub-watersheds that increase the range, life history diversity, or age cohorts

of one or more species would contribute to the overall strategy of making them more robust to disturbances outside and within the region.

Sub-watershed categories, and recommended actions for each sub-watershed as of the 2005 Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan and 2002 Biological Strategy, are illustrated in Figure 8-1.

8.5.2 Terrestrial Benefit

Terrestrial benefit(s) of projects will be factored into the initial biological prioritization (above). A project with anticipated terrestrial benefits should rank higher than other projects in the same aquatic biological benefit category (above) without terrestrial benefits. For example, if two projects are proposed that provide the same biological benefit to a Category 1 watershed, and one of those also provides critical habitat for avian species, it will rank higher than the other.

8.5.3 Community Awareness, Education and Acceptance

Community acceptance of proposed actions should be factored into the results from the prioritization above, resulting in a final list of prioritized projects. Community involvement in the habitat project planning process was initiated at the January 2005 public workshops. The public will continue to be engaged throughout the planning process.

8.5.4 Project Cost and Feasibility

Project cost and feasibility are also key factors to be considered in project prioritization.

8.5.5 Benefits to threatened, endangered, and/or other aquatic or culturally important species

Benefits to threatened, endangered, and/or other aquatic or culturally important species will be taken into consideration in project prioritization.

8.6 Watershed-Wide Habitat Actions

The WRIA 45 Planning Unit has identified actions for protection or restoration/enhancement of habitat over the entire watershed system. These actions address issues that affect the watershed as a whole. The following watershed scale-studies assessing terrestrial and aquatic habitat needs were used as resources in developing this action list:

- Chelan County Fish Barrier Inventory (Chelan County, 2001)
- Instream flow assessment (EES, 2005b) (Golder, 2003)
- Draft Wenatchee River Total Maximum Daily Load (TMDL) Study (Ecology, 2005)
- Channel Migration Zone (CMZ) Study (Jones and Stokes, 2004)

Watershed-wide actions identified by the Planning Unit are:

H-1: Implementation of watershed planning will be coordinated with the Salmon Recovery Implementation Schedule (the Implementation Plan Matrix is Appendix H in UCSRB (2005)) and the Upper Columbia Salmon Recovery Implementation Team. The Wenatchee Habitat Subcommittee will serve as the local coordinating body for implementation of salmon recovery habitat actions across the watershed. Chelan County Natural Resource Department is currently developing a habitat

project database that will be available to the subcommittee in the near future to list past projects, track current projects, and evaluate what future habitat actions should take place.

H-2: The WRIA 45 Planning Unit supports implementation of projects identified in the Wenatchee River and Nason Creek Channel Migration Zone Study (Jones and Stokes, 2004).

H-3: The WRIA 45 Planning Unit supports implementation of the actions in the Wenatchee Subbasin Plan (Subbasin Plan sections 7.4 to 7.8 (NPCC, 2004)), and supports the Subbasin Plan approach to evaluation and monitoring of terrestrial and aquatic ecosystems in the Wenatchee Watershed. Section 2.5.1 of the Wenatchee Subbasin Plan which lists key findings from the Terrestrial Assessment is reproduced in Appendix C. The Planning Unit asks the co-planners and co-managers to seek funding from Bonneville Power Administration (BPA) and other sources for implementation of these actions.

H-4: The Habitat Subcommittee with Chelan County as lead should coordinate with funding organizations and action agencies to maintain a publicly accessible database of past and current habitat projects for the Wenatchee Watershed.

H-5: The Planning Unit will provide opportunities for public comment on watershed scale studies and plans when, by a vote of the Planning Unit, they are determined to be a priority of the Planning Unit and important to aquatic health and habitat.

H-6: The mainstem Wenatchee River provides habitat *important to the entire watershed* for many life stages of spring and summer Chinook, steelhead, bull trout and other culturally important species, and needs to be protected, enhanced, and restored. All remaining intact areas on the mainstem should be maintained. Where possible, floodplain function should be restored, particularly from the Mission Creek confluence downstream to the Columbia River confluence.

H-7: All property owners and managers in the watershed are encouraged to continue to cooperate in maintaining forest roads. Opportunities for inter-agency or multiple owner cooperation in roads management should continue to be supported (Additional and background information on forest roads in presented in Appendix C).

H-8: Noxious weeds threaten aquatic and terrestrial ecosystems throughout the Wenatchee Watershed. The Planning Unit supports efforts toward noxious weed control and eradication.

H-9: Consider using the Icicle Fund "Natural Resource Profile" as a tool to identify terrestrial habitat opportunities (Pacific Biodiversity Institute, 2002).

H-10: A fish barrier inventory has been conducted in many areas of the watershed; however, key inventory data regarding each barrier is not always consistent (i.e. whether it is a partial or full barrier, etc.). A method for updating the inventory should be established and funded. The Chelan County fish barrier inventory should be integrated with fish barrier information collected by other land managers, such as the Forest Service. Look at SalmonScape as a starting point for integrating barrier information. The organization has been able to integrate barrier information from other land managers. In addition, the Habitat Subcommittee should try to address the need to include irrigation diversions, specifically pump diversions, in the Chelan County Fish barrier inventory using appropriate funding sources.

H-11: Efforts that are ongoing in the Wenatchee Watershed to improve or maintain habitat quality need to be encouraged and retained. Recognize and acknowledge achievements in the watershed that

have accomplished habitat improvement or protection. Develop a landowner or organization recognition program to recognize habitat improvement projects or achievements in the watershed.

H-12: Initiate public information efforts to discourage harassment of spawning salmonids (UCRTT, 2002).

H-13: Salmon habitat restoration and protection actions should be coordinated with the Wenatchee Habitat Subcommittee to ensure consistency with watershed-wide strategies as identified in the watershed plan and other plans. Additionally, all other actions related to salmon recovery, including hatchery, harvest and hydropower activities, should be coordinated with the Wenatchee Habitat Subcommittee. Hatchery, harvest and hydropower activities that have a negative or adverse affect on local habitat restoration or protection actions must be carefully considered in the context of the local habitat strategy.

Short-term

H-14: Address passage barriers (UCSRB, 2005).

H-15: Address diversion screens (UCSRB, 2005).

H-16: Reduce the abundance and distribution of brook trout through feasible means (e.g., increased harvest) (UCSRB, 2005).

H-17: Protect and maintain stream and riparian habitats within Category 1 assessment units (UCSRB, 2005).

H-18: Protect, maintain, or enhance beneficial stream and riparian habitat conditions established by implementing Short-term Actions within assessment units (UCSRB, 2005).

H-19: Where feasible and practical, maintain connectivity throughout the historical distribution of the species (UCSRB, 2005).

Administrative/Institutional

H-20: NOAA Fisheries, U.S. Fish and Wildlife Service (USFWS), the Army Corp of Engineers, and State agencies should improve the permitting process for projects specific to recovery actions by reducing the time, cost, and review process requirements. These entities should also implement programmatic consultations for actions related to the implementation of the Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan and improve their review of species recovery projects with the local governments (UCSRB, 2005).

Research and Monitoring

H-21: Wenatchee Habitat Subcommittee members can attend an annual Upper Columbia Monitoring Coordination Workshop for regular updates on all watershed-wide and other monitoring programs. In addition, the Subcommittee will be updated by the Regional Technical Team, as available, to ensure consistency across planning processes as well as to evaluate the effect of habitat improvement projects in the watershed.

Hatchery Related

H-22: The effects of hatchery practices in the Upper Columbia Basin on productivity are currently unknown. Research on reproductive success of hatchery produced fish that spawn in the wild is needed to assess effects on productivity (UCSRB, 2005).

H-23: Additionally, future hatchery facilities will support recovery goals, and minimize and mitigate any impacts (including goals within other hatchery, harvest and hydropower activities). This list should not be considered all inclusive and specific actions will be determined and negotiated by the responsible parties (UCSRB, 2005).

H-24: Determine whether supplementation programs in the Wenatchee Sub-basin affect the viable salmonid population (VSP) parameters of spring Chinook (UCSRB, 2005).

H-25: Develop, maintain, and provide a comprehensive inventory of habitat projects and their costs and benefits (effectiveness) to the public annually (UCSRB, 2005).

8.7 Sub-Watershed Scale Actions

For each sub-watershed within WRIA 45, a map has been created to illustrate documented, presumed, and potential salmonid species distribution (Figures 9-1 through 9-9). Salmonid distribution shown on these maps is as reported by SSHIAP (WCC, 2001). The Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) and Biological Strategy (UCRTT, 2002) identified biological needs within each sub-watershed of WRIA 45. Figures 9-1 through 9-9 present the biological recommendations for Category 1, 2, and 3 sub-watersheds. See Chapter 9 for the specific actions for each sub-watershed. These actions are also listed in Tables 2-8 through 2-16. Further identification of potential projects in these sub-watersheds will be a critical step in implementation of the habitat component of the Plan. In addition, Appendix C provides a habitat overview and a detailed description of historic, ongoing, and proposed habitat projects and actions for each sub-watershed, current as of June 2005.

8.8 Effectiveness Evaluation and Adaptive Management

Evaluating and documenting the effectiveness of habitat protection and restoration/enhancement actions, and ongoing adaptation of those actions, is critical to the successful implementation of the habitat component of the Wenatchee Watershed Plan, as well as the Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan. The Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) includes administrative reviews to assess whether the actions were carried out as planned and monitoring of the effectiveness of recovery actions using the Before-After-Control-Impact (BACI) design with stratified random sampling.

Another program to evaluate and document the effectiveness of habitat actions is the Wenatchee River Integrated Status and Effectiveness Monitoring Program (ISEMP). This program is funded through various federal, state, and local efforts and is a collaborative effort of many entities. It has two complementary components. The first consists of sub-basin-scale pilot status and trend monitoring efforts for anadromous salmonids and their habitat. The second consists of effectiveness monitoring for suites of habitat restoration projects in the Wenatchee Watershed. This work builds on current status and trend monitoring programs.

9.0 SUMMARY OF PLAN RECOMMENDATIONS BY SUB-WATERSHED

The broad range of activities, natural resources, and economic opportunities in the Wenatchee Watershed can be attributed to the highly variable landscape over which the Wenatchee River and its headwaters flow. The WRIA's diverse geography, climate, biology, human impacts, and human needs have been considered in the development of this plan. Due to its diversity, the watershed has been divided into tributary areas, or sub-watersheds, as shown on Figure 1-1, to enable application of water management strategies that are appropriate on a local scale. This section provides a summary of watershed actions that are relevant to each sub-watershed. Sub-watersheds are addressed from downstream to upstream in WRIA 45: Lower Wenatchee, Mission, Peshastin, Chumstick, Icicle, Upper Wenatchee, Chiwaukum, Chiwawa, Nason, Lake Wenatchee, White and Little Wenatchee Rivers. Figures 9-1 through 9-9 show each sub-watershed and corresponding land uses, surface waters, stream gage and control point locations, water quality listings, fish barriers, habitat recommendations, and fish presence.

This section is intended to serve as a convenient reference for those who wish to understand how the watershed plan applies to the sub-watershed in which they live. It is also intended to help facilitate the Plan's implementation on a sub-watershed level. It should be noted that, in addition to the recommended actions in these sub-watershed sections, there are also watershed-wide actions that apply to individual sub-watersheds. The watershed-wide actions are summarized in Tables 2-1 through 2-7, and further discussed in Sections 4 -8, 10, and 11 of this plan.

Tables 2-8 through 2-16 summarize the sub-watershed specific actions that are described in this section. Background information that provides context for sub-watershed issues and recommendations is provided in the following Sections:

Section 3: Estimates of Current and Future Water Use
Section 4: A Water Resource Management Strategy for WRIA 45 (including Instream Flows)
Section 5: Watershed-Wide Water Quantity Actions
Section 6: Watershed-Wide Growth and Land Use
Section 7: Watershed-Wide Water Quality
Section 8: Watershed-Wide Habitat

9.1 Lower Wenatchee Sub-watershed

Area Description

The 68,128-acre Lower Wenatchee Sub-watershed covers the area from below Tumwater Canyon downstream to the confluence with the Columbia River (RM 23.5 to RM 0). This drier portion of the WRIA receives 20 to 30 inches of precipitation per year. The Lower Wenatchee Sub-watershed is the most highly populated sub-watershed in the Wenatchee Basin, supports a significant portion of the agricultural economy in the WRIA, and includes the majority of the private land in the WRIA. The economy in this sub-watershed is strongly supported by agriculture (mainly apples, pears and cherries covering nine percent of the land area) and also includes services in Cashmere, Dryden and Peshastin. The City of Leavenworth, located just outside of the Lower Wenatchee Sub-watershed, also influences the economy, land and water use in the Lower Wenatchee. The total population (including 36% of the City of Cashmere's population) in the Lower Wenatchee was 7,886 people in 2000, approximately 42.6% of the population in the entire Wenatchee Watershed.

A significant portion of the irrigation water used in WRIA 45 is withdrawn from the Wenatchee River as it flows through the Lower Wenatchee Sub-watershed. The river channel has been constrained by

the major state highway corridor and railroad that run alongside the river. A large portion of riparian land is privately owned. The Lower Wenatchee River is a very popular whitewater rafting/kayaking destination. Rafting has become a significant industry in recent years, has increased the number of people on the river and has resulted in significant growth in local recreation and tourism.

Native salmonid species found in the Lower Wenatchee Sub-watershed are sockeye salmon, spring and summer Chinook, steelhead, rainbow, and migratory and resident bull trout. This sub-watershed provides spawning and rearing habitat for Summer Chinook and steelhead, and serves as an important passage corridor for anadromous species, and is therefore critical to the health of anadromous fish in the entire Wenatchee Watershed. Figure 9-1 provides an overview of the sub-watershed, its land uses, stream gage and control point locations, water quality issues, fish barriers, habitat recommendations, and fish presence.

The Northside Tributaries (Derby, Hay, Olalla, and Nahahum) are small, south-facing tributaries located on the north side of the Lower Wenatchee Sub-watershed. The tributaries face unique challenges with respect to water availability, as they are located at lower elevations, are naturally dry, do not drain a significant amount of land area and contribute very little runoff. The water in these creeks comes as spring runoff due to the melting snowpack and is used primarily for irrigation and stock watering (Ecology, 1983). Salmonids are present in Derby Canyon and are not known to be present in other Northside Tributaries. Specific recommendations for the Northside Tributaries are listed below.

Lower Wenatchee Issues

Seasonal low flows and diminished water quality are significant issues in the Lower Wenatchee Sub-watershed. Furthermore, low instream flows in the late summer months and changes in channel morphology disrupt the distribution and abundance of salmonid species (Peven, 2004). Roads and railroads have constrained river channel migration, cut off habitat, and decreased woody debris and gravel recruitment (Peven, 2004). The Lower Wenatchee River has exceeded State and federal water quality standards for pH, DO, temperature and other constituents (see Figure 9-1). DO and pH are related to phosphorus transport and loading in the sub-watershed. Increased flows may also help address temperature exceedances in the Lower Wenatchee River.

Similar to most sub-watersheds in the lower, more populated portion of the WRIA, water needs in the Lower Wenatchee include that for (1) current water right holders who may have difficulty obtaining water during low flow or dry conditions (this may currently be an issue in the Northside Tributaries); (2) future growth outside of municipal service areas; and (3) recreation.

Recommended Actions - Lower Wenatchee Sub-watershed

The following actions have been recommended to address water quantity, instream flows, water quality, and habitat issues as they relate specifically to the Lower Wenatchee Sub-watershed. The issues and recommended actions are also summarized in Table 2-8. These actions should be implemented along with the watershed-wide actions (Tables 2-1 through 2-7) as discussed in Sections 4 – 8, 10 and 11 in this Watershed Plan. Responsibility for implementing the actions in the Plan is subject to securing necessary funding.

9.1.1 Water Management Recommended Actions

There are two stream gages and control points located in the Lower Wenatchee Sub-watershed: 1) Wenatchee River at Monitor; and 2) Wenatchee River at Peshastin (see Figure 9-1). The stream gage at Monitor is used as an overall control point for WRIA 45. When minimum instream flows are not regularly met at the Monitor gage, Ecology notifies junior water right holders and requires them to

curtail water use. The Wenatchee River at Monitor and at Peshastin gages are two separate control points, however they are viewed as one unit for reservation accounting purposes.

New minimum instream flows (management flows), a water reservation for future year-round use, and a maximum allocation (that is subject to flows) for storage and other seasonal uses have been specified for each control point (Figures 4-2 and 4-3; Tables 4-1 and 4-2). The Monitor gage on the Wenatchee River is the downstream-most control point in the watershed and is used to manage flows in the watershed and as a measure of total reservation water use. The cumulative, WRIA-wide 4 cfs reservation is based on flows measured at the Monitor gage. The reserve available to the Lower Wenatchee Sub-watershed and tributaries to the Lower Wenatchee River is 3.0 – 3.5 cfs.

The Northside Tributaries are located within the Lower Wenatchee Sub-watershed. The strategy for future water use in the Northside Tributaries includes additional research to further understand the nature and extent of water shortages, and to identify subsequent actions that residents can implement to mitigate impacts of withdrawal and increase water availability in the area. These recommendations are listed below.

NSTQUANT-1: Future water supply availability should be discussed with Chelan County Public Utility District (PUD) to determine whether they have the capacity and infrastructure to provide backup supply. The East Bank Aquifer Regional Water Supply will only be considered as a source of water for this area if approved by the owners of the Regional Water Supply.

NSTQUANT-2: PUD and Chelan County to consider pumping from Wenatchee Valley and a potential PUD hookup in Nahahum.

NSTQUANT-3: Chelan County and Ecology to provide public information regarding water limitations in Northside Tributaries (Fact Sheets).

NSTQUANT-4: Chelan County and Ecology to work with local community to design and implement a groundwater monitoring program in existing wells to determine trends in groundwater levels.

NSTQUANT-5: Alternatives Analysis for Northside Tributaries to include options such as use of out-of-basin water, pumping from lower Wenatchee reserve, PUD hookup, deep groundwater, storage, and water right purchase.

Various water management alternatives need to be evaluated to determine the most effective methods to fulfill instream and out-of-stream needs and mitigate the impacts to habitat, streamflow, and groundwater levels in this sub-watershed. An alternatives analysis of water management options will be conducted as part of the implementation phase of watershed planning (Phase IV). The analysis will clearly address specific water needs in the Lower Wenatchee Sub-watershed and other areas as appropriate, and evaluate water conservation, storage opportunities, purchase, lease and transfer of water rights, inter-basin transfer of water and other alternatives to determine the appropriate combination of water management options that could be used to increase the water availability in the Lower Wenatchee Sub-watershed (including the Northside Tributaries). Alternatives for assessment are discussed further in Section 5 (watershed-wide water quantity recommendations). Sub-watershed specific storage opportunities included in the Multi-purpose Storage Assessment (MWG, 2006) for the Lower Wenatchee Sub-watershed are presented below.

- CMZ Project 6: Reconnect an oxbow/former channel using a bridge or large culverts which would increase the floodplain capacity.

- CMZ Project 9: Reconnect a cattail marsh located in a farmed area using an at-grade culvert through the railroad embankment to increase floodplain capacity.
- CMZ Project 10: Construct a surface connection to the river from the existing pond to increase floodplain capacity on a site that contains native riparian forest, an open-water wetland and several former back channels.
- CMZ Project 11: Create additional open water/backchannel habitat to increase the floodplain capacity of a floodplain hardwood forest between SR2 and the river which currently floods during 2 yr+ events.
- CMZ Project 15: Pull back or breach the levee to restore back-channel access on the site of a former floodplain that has an open water wetland. Plant riparian vegetation to maintain recreational river access.
- Cashmere Wastewater Lagoon (10 acre-feet): Replace the wastewater lagoon with a more compact wastewater treatment facility and use the lagoon as a stormwater holding pond, possibly using it to recharge groundwater.
- Derby Canyon Off-channel Reservoir (1-20 acre-feet): Construct small off-channel reservoirs on available private land to hold water diverted in the winter or spring months and release the water in the summer months.
- Williams Canyons Off-channel Reservoir (1-50 acre-feet): Construct small off-channel reservoirs on available private land or National Forest land to hold water diverted in the winter or spring months and release the water in the summer months.
- Olalla Canyon Off-channel Reservoir (1-20 acre-feet): Construct small off-channel reservoirs on available private land or National Forest land to hold water diverted in the winter or spring months and release the water in the summer months.
- Nahahum Canyon Off-channel Reservoir (1-20 acre-feet): Construct small off-channel reservoirs on available private land to hold water diverted in the winter or spring months and release the water in the summer months.
- Peshastin Recharge Basin: Divert water from the Wenatchee River to a recharge basin that would be constructed near the Wenatchee River to augment groundwater supplies.

9.1.2 Water Quality Recommended Actions

There is a need to address the exceedances of State and Federal water quality standards for pH and dissolved oxygen in the Lower Wenatchee River. Both point and non-point sources of phosphorus that affect the pH and DO levels in the Lower Wenatchee Sub-watershed should be addressed. The sub-watershed-specific water quality actions for temperature in the Lower Wenatchee Sub-watershed are listed in Section 7, Water Quality. See Table 2-4 for additional watershed-wide water quality actions.

DO/pH

LowWenQUAL-1: The partnership formed to secure funding for further study of DO and pH (Chelan County, Chelan County PUD and the cities of Cashmere, Leavenworth and Wenatchee) should continue to work together, with the WQTS to acquire funding assistance and work with the WQTS to:

- Facilitate and develop a workable strategy that can be used and ultimately approved by the EPA and in Ecology's TMDL submittal for DO and pH, and

- Review and make suggestions for future improvements to Ecology's technical assessment, summary implementation plan, and adaptive management approaches to meet state water quality standards for these parameters.

LowWenQUAL-2: Strategies to address point and non-point sources of phosphorus as part of the TMDL for DO and pH will be reported during the implementation phase of the Wenatchee Watershed planning effort.

LowWenQUAL-3: Large reductions of phosphorus inputs are needed from point sources in the Wenatchee River Watershed, especially waste water treatment plants (WWTPs). A regulatory strategy should be developed and implemented with WWTPs and Ecology to institute controls over time through National Pollutant Discharge Elimination System (NPDES) permits that will reduce phosphorous discharges to surface and groundwaters. WWTPs to be addressed include the Lake Wenatchee, Stevens Pass, Leavenworth, Peshastin, and Cashmere waste water treatment plants. Conduct associated monitoring and adaptive management (WQTS, 2006a).

LowWenQUAL-4: Controls should be developed and implemented through new and existing regulatory permits, if needed, to reduce phosphorous inputs to surface and groundwaters from other Wenatchee Watershed point sources. Conduct associated monitoring and adaptive management (WQTS, 2006a).

LowWenQUAL-5: Large reductions of phosphorus inputs are needed from nonpoint sources in the Wenatchee River Watershed. Mass-balance modeling showed that two reaches of the lower Wenatchee River exhibit higher diffuse phosphorous loading than other reaches. One reach brackets the community of Dryden and the other brackets the city of Cashmere. Studies should be done in these two reaches, focusing on groundwater-surface water interaction and land-uses that may be contributing phosphorus inputs to the river. Actions should be implemented based on the conclusions and recommendations of these studies to reduce inputs of phosphorous from these areas (WQTS, 2006a).

LowWenQUAL-6: Groundwater discharges to the Wenatchee River, Icicle Creek, and their tributaries affects dissolved oxygen levels and nutrient concentrations. Groundwater is discharged to the river or creeks in some reaches, and is recharged in other reaches. In the Wenatchee basin, groundwater flow and Biochemical Oxygen Demand (BOD)/nutrient concentrations may be elevated due to upland practices such as orchard irrigation and wastewater discharge to groundwater from lagoons and on-site septic systems. Assessments of groundwater contributions and sources of nutrients (phosphorous) should be conducted. Actions should be implemented based on the conclusions and recommendations of these studies to reduce inputs of phosphorous from these areas (WQTS, 2006a).

LowWenQUAL-7: Non-point sources along the length of the river may be contributing BOD and nutrients. Address failing septic systems through actions identified in the Wenatchee Watershed Fecal Coliform TMDL. Continue site specific inspections and enforcement of regulations that restrict placement of on-site septic drain fields from areas deemed to have unsuitable soils. A study should be conducted to assess soils and onsite septic systems. Estimates should be made of the maximum number and density of on-site drain fields that the upper basin can accommodate and still meet the water quality standards, as was done in the Lake Chelan study (Patmont et al., 1989). Conduct associated monitoring and adaptive management (WQTS, 2006a).

LowWenQUAL-8: Nutrients (phosphorous) can enter streams from storm water events. Work with Chelan County and municipalities to reduce storm water inputs, utilizing the Eastern Washington

Storm water Manual or equivalent. Encourage the appropriate entities to include language that addresses storm water in comprehensive plans and ordinances. Work with developers. (See LowWenQUAL-18). Conduct associated monitoring and adaptive management (WQTS, 2006a).

LowWenQUAL-9: Nutrients (phosphorous) can enter surface and ground water from residential yards and gardens, hobby farms, City and County Parks, business owned landscapes, etc. An education outreach plan should be developed and implemented to heighten awareness and reduce inputs from these sources. Policies and practices should be implemented in City and County Public Works departments. The County and cities should consider implementing a ban on the sale of high phosphate detergents, such as is being considered in Spokane. Conduct associated monitoring and adaptive management (WQTS, 2006a).

LowWenQUAL-10: Nutrients can enter streams from materials used to de-ice, clean, and maintain roads and parking lots. Animal waste from roads and parking lots can enter streams and increase nutrient loading. Work with the County, cities, businesses, and the WA State Department of Transportation to determine if road and parking lot maintenance practices may be contributing to nutrient loading and if necessary investigate ways to reduce nutrient inputs from these practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).

LowWenQUAL-11: Nutrients (phosphorous) can be released to ground and surface waters from development practices, such as disruption of soils during conversions of orchard lands to housing. Actions should be conducted to prevent nutrients from entering ground and surface waters before, during and after construction. Work with developers to implement these actions. Encourage entities to include appropriate language in county and city comprehensive plans, growth management, and critical area ordinances. Conduct associated monitoring and adaptive management (WQTS, 2006a).

LowWenQUAL-12: The operation of Columbia River dams apparently backs up the Wenatchee River from its mouth approximately one mile. It has been hypothesized that this back-water may contribute to the exceedances of pH and dissolved oxygen levels in that reach. Work with the Chelan PUD to conduct an assessment of the possible back-water effect that may be created by operation of the Rock Island dam. Implement actions from the report's conclusions and recommendations to improve water quality (WQTS, 2006a).

LowWenQUAL-13: Consider implementing actions recommended in the Wenatchee River Basin Temperature and Fecal Coliform TMDLs if the actions address problems that have been identified in the Lower Wenatchee. Lowering temperatures and reducing nutrient inputs will improve pH and dissolved oxygen levels in the Wenatchee River Watershed (WQTS, 2006a).

LowWenQUAL-14: Reserve load capacities for Biochemical Oxygen Demand (BOD) and nutrients should be established for the Upper Wenatchee River and Icicle Creek. Reserve load capacities are needed because there is no additional assimilative capacity for dissolved oxygen in the upper watershed during critical conditions. A point source regulatory strategy and nonpoint source BMP strategy should be developed to protect the reserve capacities and maintain water quality standards (WQTS, 2006a).

LowWenQUAL-15: Encourage lining of earthen canals where appropriate. Work with irrigation districts to implement BMPs and adaptive management programs to minimize any nutrient loading that is not already being addressed (WQTS, 2006a).

LowWenQUAL-16: Agricultural practices can contribute nutrients to ground and surface waters through crop watering practices, application of fertilizers, and soil disturbance activities. Work with

the agricultural community to encourage practices that will reduce nutrient inputs to ground and surface waters while enhancing crop quality and yield. Examples include technical assistance through farm plans and Best Management Practices (BMPs). Conduct associated monitoring and adaptive management (WQTS, 2006a).

LowWenQUAL-17: Funding for these projects should be sought through Department of Ecology Centennial and 319 grants and loans. Identify and access other funding sources through the Planning Unit and other entities. Ongoing adaptive management should be utilized to provide the best use of funds and environmental benefits (WQTS, 2006a).

LowWenQUAL-18: Proper filtration of nutrients through land use practices can have a beneficial effect on nutrient reductions to ground and surface waters. Encourage implementation of wetlands, filter strips, riparian vegetation, bio-swales, drainage basins, pervious surfaces, etc. in residential, commercial, agricultural, industrial, development, and municipal practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).

LowWenQUAL-19: Identify and investigate any non point sources in tributaries that may be contributing to nutrient loads (WQTS, 2006a).

9.1.3 Habitat Recommended Actions

The Lower Wenatchee Watershed has been assigned a Category 2 Habitat Priority. This implies that it is a sub-watershed that supports important aquatic resources and is a stronghold for one or more listed species. Compared to Category 1 areas, Category 2 areas are characterized by a higher level of fragmentation resulting from habitat disturbance or loss. In addition, native populations have been lost or are at risk because of limited habitat diversity and quantity, fragmentation of the sub-watershed due to habitat loss, and unstable channels. Restoring ecosystem function and connectivity within this area are priorities (UCSRB, 2005). Appendix C provides detail on habitat projects current as of June 2005. Habitat recommendations for the Lower Wenatchee as reported in the 2005 Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) and Biological Strategy (UCRTT, 2002) include:

LowWenH-1: Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in the Wenatchee River (UCSRB, 2005).

LowWenH-2: Reduce water temperatures by restoring riparian vegetation along the river (UCSRB, 2005).

LowWenH-3: Increase habitat diversity and quantity by restoring riparian habitat along the Wenatchee River, reconnecting side channels and the floodplain with the river, and increasing large woody debris in the side channels (UCSRB, 2005).

LowWenH-4: Protect existing riparian habitat and channel migration floodplain function (UCRTT, 2002).

9.2 Mission Sub-watershed

Area Description

Mission Creek drains a 59,794 acre area, joins the Wenatchee River at Wenatchee RM 10.4, and contributes 2% of the Wenatchee River's annual flow (Wenatchee River Watershed Action Plan Addendum, 1996). The sub-watershed receives an average of 19 inches of precipitation per year and

ranges in elevation between 795 to 6,800 feet. This highly variable topography has restricted settlement and agriculture (mainly pear and apple orchards) to the valley bottom in the lower elevations near the mouth of Mission Creek. Irrigation canals cross the area in the lower portion of the sub-watershed and service some orchards, but there are also a significant number of individual water right holders in the Mission Sub-watershed. The sources of water for the canals are the Icicle and Peshastin Sub-watersheds—not Mission Creek. Although agriculture comprises a small percent of the overall land area in the sub-watershed (3%), it is important to the local community, fruit packing industry, and economy.

A large portion of Mission Creek has been channelized to transport flood-flows due to major flood events in the 1940s and 1950s that damaged and jeopardized downstream development. Mission Creek has also been confined by development in its floodplain (Wenatchee River Watershed Action Plan Addendum, 1996). The upper portion of the sub-watershed is primarily forestland (77.4% of the sub-watershed) that is managed by the U.S. Forest Service (Wenatchee River Watershed Action Plan Addendum, 1996; MWG, 2003). The Mission Sub-watershed is home to 3,895 people (including 64% of the City of Cashmere's population), about 21.0% of the total population in the Wenatchee Watershed. A portion of the City of Cashmere is also located in the Mission Sub-watershed.

Native salmonid species in the Mission Creek Sub-watershed are juvenile spring Chinook and steelhead. At present, the Mission Sub-watershed is not considered to contribute significantly to salmonid population abundance; however, biologists consider Mission Creek to be important for preserving spatial and genetic diversity in the context of the entire species. Figure 9-2 provides an overview of the sub-watershed, its land uses, stream gage and control point locations, water quality issues, fish barriers, habitat recommendations, and fish presence.

Mission Issues

Limited water quantity, insufficient instream flow, and diminished quality are the leading issues in the Mission Creek Sub-watershed. The sub-watershed is fully appropriated during low flow periods (meaning that it is, at times, dry). Mission and Brender Creeks have exceeded State and federal water quality standards for DDT and fecal coliform; Yaksum Creek has exceeded State and federal water quality standards for DDT. There is a long history of water quality concerns and subsequent monitoring in the Mission Creek Sub-watershed (Wenatchee River Watershed Action Plan, 1998). Fecal coliform is a very difficult water quality parameter to address and is also a public health issue. Habitat is also a priority as efforts are being made to maintain the existing native salmonid diversity despite the small quantity of available quality habitat in the sub-watershed. Specific habitat concerns include the channelization of lower Mission, Brender and Yaksum Creeks; fish passage barriers (culverts); and low or non-existent flows with associated high instream temperatures in lower Mission Creek which disrupt the distribution and abundance of native species, particularly in summer.

Similar to most sub-watersheds in the lower, drier portions of the WRIA, water needs in the Mission Sub-watershed include that for (1) current water right holders who may have difficulty obtaining water during low flow or dry conditions; (2) future growth outside of the Cashmere municipal service areas; (3) improving water quality; and (4) providing instream flows to benefit fish and other aquatic resources.

Recommended Actions - Mission Sub-watershed

The following actions have been recommended to address water quantity, instream flows, water quality, and habitat issues as they relate specifically to the Mission Sub-watershed. The issues and recommended actions are also summarized in Table 2-9. These actions should be implemented along with the watershed-wide actions (Tables 2-1 through 2-7) as discussed in Sections 4 – 8, 10, and 11 in

this Watershed Plan. Responsibility for implementing the actions in the Plan is subject to securing necessary funding.

9.2.1 Water Management Recommended Actions

The Mission Creek Sub-watershed is, at times, dry. Water is not left in the stream to appropriate for new users. Therefore, surface water and groundwater are not available for further appropriation to provide an uninterruptible supply for domestic, municipal and stock water uses during low flow periods. The water resource management strategy is more complex for Mission; however, it still includes a control point, management flows, and a maximum allocation (Figure 4-5 and Table 4-4). The control point for the Mission Creek Sub-watershed is the Mission Creek at Cashmere stream gage. The maximum allocation, subject to flows, includes seasonal water for storage and other uses. The cap set by the maximum allocation means that there is no new water available for storage or seasonal uses in July, August or September.

A reservation needs to be created for the Mission Sub-watershed through the lease or purchase of water rights. However, this strategy for future use includes an interim, two-year reserve of 0.03 cfs that can be used while alternate water sources are identified to achieve the full 0.12 cfs that will be needed to sustain future growth until 2025. The availability of the interim reserve is conditioned on a number of requirements as outlined in Section 4.6.4. If the interim reserve is not supplemented by the purchase or transfer of existing water rights within two years of rule adoption, Ecology would close the Mission Sub-watershed to further appropriation, and existing outdoor water use could be curtailed when flows are not met. All water for the City of Cashmere is to be debited to the Lower Wenatchee reserve and not to the Mission Creek reserve.

The strategy for Mission is based on the need for water for future growth and for instream benefits in an over-appropriated basin. Some of the recommendations that have been identified to increase water availability are listed below.

MissionQUANT-1: Chelan County as lead (with support from Ecology), will convene a Mission Creek Forum to assess options to provide water for future growth through the purchase, lease or transfer of existing, valid water rights or from storage (storage opportunities within Mission Sub-watershed or through the Peshastin and/or Icicle Irrigation districts). This will be conducted for the purpose of providing an uninterruptible supply for domestic, municipal and stock water uses. During Phase IV, Implementation, the Mission Creek Forum will determine whether the strategies for Mission are relevant to Brender Creek, and consider assembling separate strategies to address local instream flow concerns and conditions for Brender Creek, if appropriate.

Within two years of rule adoption, the Forum will have developed opportunities and researched funding opportunities for these alternatives.

MissionQUANT-2: As part of Phase IV, Implementation, evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Mission Creek and evaluate water conservation, storage, purchase, lease and transfer of water rights, water from other sub-watersheds, and other alternatives as appropriate.

MissionQUANT-3: One quarter (0.03 cfs) of the 0.12 cfs projected 2025 water needs is available for growth for two years after rule adoption. If, after two years, water rights are not purchased or leased to cover the interim reserve of 0.03 cfs or conservation measures that provide additional water are not implemented, Ecology would close the Mission Sub-watershed to further appropriation on a seasonal basis, and existing outdoor water use established subsequent to the adoption of WAC 173-545 could

be curtailed when flows are not met. All water allocated to the City of Cashmere will be debited to the Lower Wenatchee Reserve and not to the Mission Reserve.

MissionQUANT-4: Consider storing water in Icicle/Peshastin and use that water to augment flows and provide mitigation water in Mission Creek.

MissionQUANT-5: Consider storage opportunities within Mission Sub-watershed (See Section 5.5).

MissionQUANT-6: Metering of all new uses covered under the Mission reserve (includes all new domestic uses).

MissionQUANT-7: Evaluate out-of-kind mitigation and enhancement projects over time, if appropriate. Identify habitat and water quality improvements to mitigate additional reserve water.

MissionQUANT-8: Chelan County or other entity with agency funding assistance will investigate water rights for purchase or lease as part of the mitigation and enhancement strategy for Mission Sub-watershed. The County will seek funding from BPA, Ecology, Washington Rivers Conservancy, Washington Water Trust, and others. As water rights are purchased or transferred for use in the Mission reserve to meet a "no net impact" standard, the first purchase(s) will credit the 0.03 cfs interim reserve, then the additional 0.09 cfs will be available for forecasted growth as it is purchased.

Various water management alternatives need to be evaluated to determine the most effective methods to fulfill instream and out-of-stream needs and mitigate the impacts to habitat, streamflow, and groundwater levels in this sub-watershed. An alternatives analysis of water management options will be conducted as part of the implementation phase of watershed planning (Phase IV). The analysis will clearly address specific water needs in the Mission Sub-watershed, and evaluate water conservation, storage opportunities, purchase, lease and transfer of water rights, inter-basin transfer of water and other alternatives to determine the appropriate combination of water management options that could be used to increase the water availability in the Mission Sub-watershed. Water management alternatives for this assessment are discussed further in Section 5 (watershed-wide water quantity recommendations). Sub-watershed specific storage opportunities included in the Multi-purpose Storage Assessment (MWG, 2006) for the Mission Sub-watershed are presented below.

- East Fork Mission Creek Reservoir (10-50 acre-feet): Divert water to an existing depression on National Forest land.
- Upper Reach Mission Creek Lake (10-50 acre-feet): Divert water to an existing lake on National Forest land.
- Little Camas Creek Reservoir (50-100 acre-feet): Instream reservoir located on National Forest land.
- Headcut Repair on Peavine Canyon, Poison Canyon, Sand Creek: Install check structures in the creeks to increase the bed level, thereby increasing bank storage along the creek.
- Cashmere Recharge Basin: Divert water in the winter or spring when flow is sufficient to a recharge basin located on privately owned land in the Lower Mission Creek area to augment groundwater supplies.

9.2.2 Water Quality Recommended Actions

Mission, Brender, and Yaksum Creeks have exceeded State and federal water quality standards for DDT. Transport of DDT contaminated soil to these creeks may contribute to water quality problems in the Mission Sub-watershed. It is also possible that DDT is moving through the groundwater system and discharging into the three creeks; however, this DDT transport mechanism in the sub-watershed has not been fully characterized.

Mission and Brender Creeks have exceeded State and federal water quality standards for fecal coliform. Fecal coliform is a public health issue and a very difficult water quality parameter to address because it requires the loading and transport of fecal coliform from non-point sources to be characterized and reduced.

The sub-watershed-specific water quality actions for temperature in the Mission Sub-watershed are listed in Section 7, Water Quality. See Table 2-4 for additional watershed-wide water quality actions.

DDT

MissionQUAL-1: Significant reductions in DDT loads may be achieved by preventing bank erosion or by other means of limiting transport of upland soils to streams. BMPs such as riparian buffers and wetlands can also filter and uptake DDT from surface and groundwater. Many BMPs are currently being implemented in the watershed. BMPs should be continued, refined, expanded, and monitored to further reduce erosion, surface runoff, TSS in the water column, and groundwater transport of DDT. BMPs include farm practices, storm water runoff, riparian vegetation planting, orchard conversions, residential practices, riparian buffers, wetlands, etc. These and other appropriate BMP actions and locations should be identified and implemented in coordination with the Planning Unit and its committees (WQTS, 2006b).

MissionQUAL-2: A phased monitoring approach should be conducted to assess the effectiveness of BMPs and DDT-TSS (Total Suspended Solids) reduction efforts. This may take time to achieve and, as TSS loads are reduced and DDT levels are monitored, TSS targets may be adjusted to correspond to DDT targets (WQTS, 2006b).

MissionQUAL-3: Evaluation of soil transport to streams should be conducted during large rainfall events when visual observations can be made and/or sections of streams with high sediment runoff and TSS can be isolated. An assessment should be conducted to investigate if any other events contribute soil to streams such as spring thaw processes or irrigation practices (WQTS, 2006b).

MissionQUAL-4: More comprehensive groundwater monitoring should be conducted, including further assessment of the relationship between surface water, groundwater, and DDT fate and transport (WQTS, 2006b).

MissionQUAL-5: Assessments are recommended for all irrigation systems in the watershed to identify any mechanisms that may contribute to sediment transport which are not yet being addressed by BMPs. Actions should be identified and implemented to address the findings. Lining of earthen canals should be encouraged (WQTS, 2006b).

MissionQUAL-6: Activities should be identified and undertaken to provide ongoing outreach, education, and technical assistance to growers, streamside landowners, developers, stakeholders, and the general public (WQTS, 2006b).

MissionQUAL-7: Funding assistance should be sought from Ecology through its grants and loans programs to implement actions and ongoing monitoring. Other funding sources should be identified and applications submitted to provide funding for ongoing activities. The WQTS will recommend qualified entities to conduct associated monitoring (WQTS, 2006b).

MissionQUAL-8: Development over old orchards is a primary concern. Measures should be implemented to prevent DDT laden orchard soils disturbed during construction from being transmitted to streams and lakes in the watershed. Language requiring measures to prevent DDT laden soils from entering the waterways during and after construction should be developed by the WQTS and included in County and municipality development ordinances, growth management plans, and critical area ordinances. The Stormwater Management Manual for Eastern Washington or an equivalent document should be utilized in developing ordinances, and guiding municipal, private, and construction storm water practices (WQTS, 2006b).

MissionQUAL-9: Assessments are recommended for stormwater control systems in the watershed to identify any mechanisms that may contribute to sediment transport which are not yet being addressed by BMPs. Actions should be identified and implemented to address the findings through a list of prioritized projects (WQTS, 2006b).

Fecal Coliform

MissionQUAL-10: Identify sources of fecal coliform (FC) pollution to Mission Creek Sub-watershed, utilizing the FC technical study. Identify human and nonhuman sources and/or failing on-site septic systems. Plan and implement corrective actions. The Chelan-Douglas Health District (CDHD) should address failing septic systems. Other entities should address manageable sources of FC pollution as appropriate. Assessments should include the following areas:

a. Mission Creek between Binder Road (RM 1.2) and Creekside Place (RM 0.9).
b. Mission Creek above RM 5.1, RM 3.8, and RM 1.2.
c. A pipe discharge just below the Tripp Canyon road crossing of Mission Creek (RM 3.0)
d. Mission Creek culvert at Pioneer Street that discharges from the City of Cashmere stormwater drain system and apparently runs in the dry season due to nearby seepage infiltration (RM 0.7)
e. Mission Creek culvert at Pioneer Street that diverts irrigation management return flows from the Peshastin Irrigation Canal to Mission Creek (RM 0.7)
f. The Peshastin Irrigation Canal discharge to the stormwater collection system to confirm it is not a source to Mission Creek (RM 0.7)
g. The Peshastin Irrigation District drain that returns water to Brender Creek (RM 0.1)
h. Yaksum Creek (RM 0.3 and RM 2.5), and two culverts at the Pioneer Street bridge crossing (RM 0.1 and RM 0.6)
i. Brender Creek between river mile 1.2 (where Brender Creek first crosses Pioneer Road) and river mile 2.5. Investigate suspect domestic on-site septic systems in this reach (RM1.2 to RM 1.6) for proper functioning. A walking inspection of the creek should be conducted to look for illegal discharges.
j. No Name Creek from its source (RM 1.3), downstream to Mill Pond (RM 0.5), to the mouth (RM 0.1).
k. Sand Creek in the forested area of upper Mission Creek (Station 45SN00.1)
l. The ditch from the Icicle Creek Irrigation District irrigation management flow return (RM 0.1) (WQTS, 2006c).

MissionQUAL-11: Implement and monitor BMPs to meet the Fecal Coliform TMDL Technical Assessment target reductions (WQTS, 2006c).

MissionQUAL-12: Utilizing this report, City of Cashmere, and Ecology information, work with the city of Cashmere to identify sewer system root intrusion in areas near streams. Repair and upgrade sewer collection and delivery system (WQTS, 2006c).

MissionQUAL-13: The CDHD will continue to work with consenting homeowners to conduct monitoring of on-site wells in areas of fecal coliform exceedances to help identify the source/s. Utilize this assessment (July 2003) to help identify locations for testing (WQTS, 2006c).

MissionQUAL-14: CDHD will continue to implement onsite sewage disposal system technical assistance and education programs for homeowners and the industry (WQTS, 2006c).

MissionQUAL-15: The CDHD will continue to permit sewage systems per Washington Administrative Code (WAC), including analyzing soils and technologies suitable for individual sites; review/approve the proposed design, specifications, installation and if required, the ongoing maintenance in accordance with the WAC; provide public information under real estate disclosure laws; and review all land use proposals to ensure that the WAC is properly enforced prior to approval by the County (WQTS, 2006c).

MissionQUAL-16: A grant/loan funding program should be developed and implemented to replace or repair failing septic systems (WQTS, 2006c).

MissionQUAL-17: The CDHD should explore obtaining legal authority from Chelan County to operate a pumper notification program with area septage pumpers as part of its onsite septic system operation and maintenance program. The septage pumpers would work with the CDHD to appropriately identify and correct failing septic systems (WQTS, 2006c).

MissionQUAL-18: The CDHD and watershed would benefit from the funding, development and maintenance of a digital system for all onsite septic system permits issued in Chelan County, and a Geographic Information Systems (GIS) database of the onsite septic systems (WQTS, 2006c).

MissionQUAL-19: When the TMDL DIP is developed, the committee should utilize detailed recommendations from the Wenatchee River Watershed Action Plan (WQTS, 2006c).

MissionQUAL-20: Conduct stream walk cleanups along the stream (Fall, Spring, Summer) with area schools, homeowners, and other groups (WQTS, 2006c).

MissionQUAL-21: Conduct ongoing community fecal coliform education/awareness campaigns throughout the year. Engage and get support from homeowners (WQTS, 2006c).

MissionQUAL-22: Work with City, County, State, and Federal governments, and the Humane Society to deal with the feral cats and dogs living within the stream corridor. Monitor and remove dead animals within the stream corridor throughout the year (WQTS, 2006c).

MissionQUAL-23: Conduct education and enforcement actions to stop illegal dumping of wastes either to storm drains or directly to surface waters. This dumping may be of portable toilet wastes, recreational vehicle wastes, etc. (WQTS, 2006c).

MissionQUAL-24: The WQTS should encourage the CDHD, Chelan County, Cities, DOH, and Utilities to continue ongoing review and upgrading of ordinances regarding developments and sewage systems technologies (WQTS, 2006c).

MissionQUAL-25: The WQTS and its participating entities should work with the public and homeowners regarding BMPs to reduce fecal coliform runoff. General actions should include public information, education, and technical assistance regarding watering practices, landscaping, stormwater runoff, filtration practices, animal waste, etc. (WQTS, 2006c).

MissionQUAL-26: Work with irrigation districts to implement and enforce policies to prevent illegal fecal coliform discharges to irrigation canals (WQTS, 2006c).

MissionQUAL-27: Work with landowners regarding fecal coliform runoff (WQTS, 2006c).

MissionQUAL-28: Encourage Chelan County and municipalities to develop and implement stormwater policies, standards, and guidelines, utilizing the Eastern Washington Stormwater Manual or equivalent, in comprehensive plans, critical area ordinances, growth management plans, and other appropriate plans (WQTS, 2006c).

MissionQUAL-29: Work with appropriate entities to reduce fecal coliform runoff from impervious surfaces (WQTS, 2006c).

MissionQUAL-30: Work with U.S. Forest Service, Washington State Department of Natural Resources, and private owners on forested lands to restore and protect streams from fecal coliform runoff pollution (WQTS, 2006c).

MissionQUAL-31: Work with wastewater purveyors to examine sewer collection systems to identify problems or damage within them that may contribute fecal coliform loading in the watershed. Correct identified problems as appropriate (WQTS, 2006c).

MissionQUAL-32: Funding assistance should be sought from Ecology through its grants and loans programs to implement actions and ongoing monitoring. Other funding sources should be identified and applications submitted to provide funding for ongoing activities. The WQTS will recommend qualified entities to conduct associated monitoring. Self-sustaining funding mechanisms to reduce fecal coliform inputs should be explored and developed in concert with the Wenatchee Watershed Planning Unit and its participating entities (WQTS, 2006c).

MissionQUAL-33: Work with the wastewater utilities regarding their ordinances to connect unconnected homes in the service area (WQTS, 2006c).

9.2.3 Habitat Recommended Actions

The Mission Creek Sub-watershed has been assigned a Category 3 Habitat Priority. This implies that it is a sub-watershed that supports salmonids, but has experienced substantial degradation and is strongly fragmented by habitat loss, especially due to a loss of connectivity in the mainstem corridor. The strategy in this area is to address the primary factors that cause habitat degradation: sedimentation and obstructions (UCSRB, 2005). Appendix C provides detail on habitat projects current as of June 2005. Habitat recommendations for Mission Creek as reported in the 2005 Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) include:

MissionH-1: Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts and diversions) (UCSRB, 2005).

MissionH-2: Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Mission Creek (UCSRB, 2005).

MissionH-3: Decrease water temperatures and improve water quality by restoring riparian vegetation along the stream (UCSRB, 2005).

MissionH-4: Reduce unnatural sediment recruitment to the stream by restoring riparian habitat and improving road maintenance (UCSRB, 2005).

MissionH-5: Increase habitat diversity and quantity by restoring riparian habitat, reconnecting side channels and the floodplain with the channel, increasing large woody debris within the channel, and by adding instream structures (UCSRB, 2005).

9.3 Peshastin Sub-watershed

Area Description

The Peshastin Sub-watershed drains an area of 86,291 acres, joins with the Wenatchee River at Wenatchee RM 17.9, and contributes less than 3% of the Wenatchee River's annual flow. Ingalls Creek provides up to 90% of the flow in Peshastin Creek during late summer as it drains Mt. Stuart. The upper portion of the sub-watershed receives close to 40 inches of precipitation per year while the lower portion receives approximately 20 inches per year. The Peshastin Irrigation District diverts a significant portion of Peshastin Creek's streamflow between RM 3 and 4 to supply a number of orchards. Commercial forest is by far the most dominant land use in the sub-watershed (94.8%). Other land uses are rural residential/resource (4%) and a small amount of commercial agriculture (MWG, 2003). There are a number of organic pear orchards along Peshastin Creek. The construction of Highway 97 along Peshastin Creek and the Tronsen Creek tributary from Blewett Pass to the confluence of Peshastin Creek and the Wenatchee River have resulted in a significant amount of channel straightening and loss of pools. The total population in the sub-watershed was 865 people (about 4.7% of the Wenatchee Watershed's population) in 2000.

Native salmonid species in the Peshastin Creek Sub-watershed are spring Chinook, steelhead, rainbow, migratory and resident bull trout, and westlope cutthroat trout. This sub-watershed provides important bull trout and steelhead spawning and rearing habitat, both in the mainstem Peshastin and in its tributaries. Figure 9-3 provides an overview of the sub-watershed, its land uses, stream gage and control point locations, water quality issues, fish barriers, habitat recommendations, and fish presence.

Peshastin Issues

Low late summer flows and limited habitat diversity and quantity for salmonids are the leading issues in the Peshastin Sub-watershed. Low flows also affect water temperatures and impede fish passage in the sub-watershed. Peshastin Creek has exceeded State and federal water quality standards for temperature. Salmonid populations are at risk because of limited habitat diversity and quantity and obstructions within the sub-watershed. The construction of Highway 97 along Peshastin Creek and Tronsen Creek has contributed to the loss of habitat quantity and diversity (i.e., the loss of pools). Long term effects of highway construction on the Creek (such as channelization) are evident.

Water needs in the Peshastin Sub-watershed include that for (1) current water right holders who may have difficulty obtaining water during low flow or dry conditions; (2) future growth outside of water service areas; and (3) providing instream flows to benefit fish and other aquatic resources.

Recommended Actions - Peshastin Sub-watershed

The following actions have been recommended to address water quantity, instream flows, water quality, and habitat issues as they relate specifically to the Peshastin Sub-watershed. The issues and recommended actions are also summarized in Table 2-10. These actions should be implemented along with the watershed-wide actions (Tables 2-1 through 2-7) as discussed in Sections 4 – 8, 10, and 11 in this Watershed Plan. Responsibility for implementing the actions in the Plan is subject to securing necessary funding.

9.3.1 Water Management Recommended Actions

The Peshastin Sub-watershed is currently closed seasonally (June 15 – October 15) to any future surface or groundwater allocation. The new strategy recommends the establishment of new minimum instream flows (management flows) and a revised rule that would change the current closure to August 1 – October 15 thereby allowing allocation of water for storage and seasonal uses, subject to flows, during spring runoff periods. Permit-exempt wells would no longer be exempt from the closure but would be eligible for the reservation in the Peshastin. A maximum allocation, or cap, is also included in the strategy and is applicable for all months where there is no closure (Figure 4-6 and Table 4-5). This revised management strategy uses the Peshastin Creek at Green Bridge gage as the control point. A reservation of 0.1 cfs would also be made available to service future growth in the sub-watershed.

The strategy for Peshastin is based on the need to make water available for future growth while protecting instream resources. Some of the recommendations that have been identified to increase water availability are listed below.

PeshastinQUANT-1: Evaluate passage requirements for fish immediately below the Peshastin Irrigation District diversion (addressing bypass reach/piping).

PeshastinQUANT-2: Consider other instream projects that improve habitat.

PeshastinQUANT-3: As part of Phase IV, Implementation, evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Peshastin and evaluate water conservation, storage, purchase, lease and transfer of water rights, and other alternatives.

PeshastinQUANT-4: Evaluate and institute programs to increase instream flows through water acquisitions, leases, and transfers.

Various water management alternatives need to be evaluated to determine the most effective methods to fulfill instream and out-of-stream needs and mitigate impacts to habitat, streamflow, and groundwater levels in this sub-watershed. An alternatives analysis of water management options will be conducted as part of the implementation phase of watershed planning (Phase IV). The analysis will clearly address specific water needs in the Peshastin Sub-watershed, and evaluate water conservation, storage opportunities, purchase, lease and transfer of water rights, inter-basin transfer of water and other alternatives to determine the appropriate combination of water management options that could be used to increase water availability in the Peshastin Sub-watershed. Water management alternatives for this assessment are discussed further in Section 5 (watershed-wide water quantity

recommendations). Sub-watershed specific storage opportunities included in the Multi-purpose Storage Assessment (MWG, 2006) for the Peshastin Sub-watershed are presented below.

- Upper Camas Creek Lakes (1-10 acre-feet): Divert water from Camas Creek to an off-channel reservoir located on private land at two small lakes in the upper reaches of the Camas Creek basin at about elevation 2,960 ft.
- Camas Land Off-channel Reservoir (1-10 acre-feet): Divert water from Camas Creek to an off-channel reservoir located on private land owned by a church camp at about elevation 2,900 ft.
- Camas Land Groundwater Level Management (1-10 acre-feet): Remove or block drainage ditches that are located on privately owned land or use other methods to increase groundwater levels in Camas Prairie.
- Campbell Off-channel Reservoir (500-1,000 acre-feet): Water from the existing Tandy pipeline and collected from the canyon can be used to supply an off-channel reservoir in a canyon on the west side of the Peshastin Creek valley.
- Hansel Lane Pond (1-10 acre-feet): Divert water to expand an existing pond located on privately owned land at about elevation 1640 ft to provide additional storage.
- Hansel Creek Off-channel Reservoir (1-10 acre-feet): Divert water from Peshastin Creek or Hansel Creek to an off-channel reservoir located on privately owned land at about elevation 1,760 ft.
- Ingalls Creek Off-channel Reservoir (100-300 acre-feet): Divert water to an off-channel reservoir on private land.
- Tronsen Creek Off-channel Reservoir (50-100 acre-feet): Divert water to an off-channel reservoir on National Forest land.
- Negro Creek Instream Reservoir (100-500 acre-feet): Instream reservoir located on National Forest land.
- Headcut Repairs to Ruby Creek, Lower Camas Creek, Mill Creek, Larsen Creek: Install check structures in the creeks to increase the bed level, thereby increasing bank storage along the creek.

9.3.2 Water Quality Recommended Actions

The sub-watershed-specific water quality actions for temperature in the Peshastin Sub-watershed are listed in Section 7, Water Quality. See Table 2-4 for additional watershed-wide water quality actions.

9.3.3 Habitat Recommended Actions

The Peshastin Creek Sub-watershed has been assigned a Category 2 Habitat Priority. This implies that it is a sub-watershed that supports important aquatic resources and is a stronghold for one or more listed species. Compared to Category 1 areas, Category 2 areas have a higher level of fragmentation resulting from habitat disturbance or loss. In addition, native populations have been lost or are at risk because of limited habitat diversity and quantity, obstructions, and critically low late summer instream flows with associated elevated water temperatures. Restoring ecosystem function and connectivity within this area are priorities (UCSRB, 2005). Appendix C provides detail on habitat projects current as of June 2005. Habitat recommendations from the 2005 Draft Upper

Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) include:

PeshastinH-1: Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (UCSRB, 2005).

PeshastinH-2: Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Peshastin Creek (UCSRB, 2005).

PeshastinH-3: Reduce water temperatures by increasing stream flows and restoring riparian vegetation along the stream (UCSRB, 2005).

PeshastinH-4: Increase habitat diversity and quantity by restoring riparian vegetation, adding instream structures and large woody debris, and reconnecting side channels and the floodplain with the stream (UCSRB, 2005).

9.4 Chumstick Sub-watershed

Area Description

The Chumstick Sub-watershed drains 52,969 acres above its confluence with the Wenatchee River at Wenatchee RM 23.5, contributing less than 3% of the Wenatchee River's annual flow. However, during periods of low flow, Chumstick Creek's contribution to the Wenatchee River is negligible (Ecology, 1983). This sub-watershed receives an average of 30 inches of precipitation per year. Local irrigation projects were established in the Chumstick and Eagle Creek drainages, and with the exception of a few small diversions, only one major irrigation system brings water from outside the drainage to irrigate the orchards in the lowest portion of the Chumstick Valley (Klinger, personal communication, 2006). Water rights in the Chumstick Sub-watershed were adjudicated in the 1980s, indicating that inadequate water quantity has been an issue in the Chumstick in the past (at least as early as the 1980s and likely earlier). Commercial forestry accounts for 74.5% of land use in the sub-watershed, followed by rural resource lands (22.5%). The total population was 3,665 people (19.8% of the Wenatchee Watershed's population) in 2000 and includes the City of Leavenworth. The Leavenworth Urban Growth Area comprises 1,300 acres in the lower reaches of the sub-watershed. The City of Leavenworth, originally a railroad and logging community, relies on a tourist-based business economy and had approximately 1.5 million visitors in 2001.

Summer steelhead is the only known salmonid species native to the Chumstick Sub-watershed. Chumstick Creek may have supported coho salmon as well, although few records exist. Figure 9-4 provides an overview of the sub-watershed, its land uses, stream gage and control point locations, water quality issues, fish barriers, habitat recommendations, and fish presence.

Chumstick Issues

The leading issues in Chumstick include inadequate water quantity (instream flows), diminished water quality, and lack of geologic and hydrologic data. Chumstick Creek's contribution to the Wenatchee River is negligible during low flow years as the sub-watershed's streams are partially dewatered. Chumstick Creek has exceeded State and federal water quality standards for fecal coliform and temperature. Fecal coliform is a very difficult water quality parameter to address and is also a public health issue. Specific habitat concerns for the summer steelhead population include obstructions that impede fish passage, low stream flows, and high water temperatures.

The Chumstick Sub-watershed lacks the data to evaluate available water and recommended allocation strategies. Hydrogeology is complex and not well understood. There is a need to develop detailed water resource management strategies based on additional data indicating groundwater availability.

Water needs in the Chumstick Sub-watershed include that for (1) current water right holders who may have difficulty obtaining water during low flow or dry conditions; (2) future growth outside of the Leavenworth Urban Growth Area including single and group domestic, and stock water use; (3) improving water quality; and (4) providing instream flows to benefit fish and other aquatic resources.

Recommended Actions - Chumstick Sub-watershed
The following actions have been recommended to address water quantity, instream flows, water quality, and habitat issues as they relate specifically to the Chumstick Sub-watershed. The issues and recommended actions are also summarized in Table 2-11. These actions should be implemented along with the watershed-wide actions (Tables 2-1 through 2-7) as discussed in Sections 4 - 8, 10, and 11 in this Watershed Plan. Responsibility for implementing the actions in the Plan is subject to securing necessary funding.

9.4.1 Water Management Recommended Actions

The control point in the Chumstick Sub-watershed is the Chumstick Creek gage; however, there are no management flows for Chumstick because the synthesized hydrology data were not adequate to assess water availability on the Chumstick. The strategy recommends an interim closure for the Chumstick Sub-watershed for three years while data are collected and alternatives are assessed. Uses that are not subject to the closure (and can continue throughout the three year interim closure) include: fire suppression, domestic use from wells, stock water uses, and seasonal storage, pending evaluation by the Chumstick Water Forum and Ecology. Seasonal storage opportunities and other alternatives in Chumstick will be evaluated by Ecology and the Chumstick Water Forum through the water right application process on a case-by-case basis during the three year interim period. Storage opportunities in Chumstick will be addressed as part of the Chumstick strategy after conclusion of the Forum's three year process and coordinated with the WRIA 45 Multi-Purpose Storage Assessment. This interim closure will be re-evaluated at the end of the three year period by the Chumstick Forum and Ecology.

A reservation needs to be created for the Chumstick Sub-watershed through lease, purchase or transfer of water rights. This strategy for future use includes an interim, three-year reserve of 0.043 cfs that can be used while alternate water sources are identified to achieve the 0.13 cfs that will be needed to sustain future growth until 2025. The availability of the interim 0.043 cfs is conditioned on a number of steps outlined in Section 4.6.6. If the interim reserve is not supplemented by the purchase, lease or transfer of water rights or by other means (eg., conservation, interbasin transfer), within three years of rule adoption, Ecology would close the Chumstick Sub-watershed to further appropriation and existing outdoor water use could be curtailed when flows are not met.

The strategy for Chumstick is based on the need for water for future growth and for instream benefits in an over-appropriated basin. Some of the recommendations that have been identified to increase water availability are listed below.

ChumQUANT-1: Chelan County as lead (with support from Ecology), will convene a Chumstick Water Forum to guide data collection, oversee the proposed water management strategy, and help develop mitigation measures.

ChumQUANT-2: Chumstick Water Forum to assist in developing a data collection plan to monitor surface water flows (specify location) and develop management flows.

ChumQUANT-3: Chumstick Water Forum, with assistance from Chelan County and Ecology, to conduct groundwater monitoring to understand hydraulic continuity and overall impact of exempt wells on groundwater levels and streamflows.

ChumQUANT-4: Recommend that Ecology close the Chumstick Sub-watershed for an interim period of three years while data are collected and alternatives are assessed. Uses that are not subject to the closure (and can continue throughout the three year interim closure) include: fire suppression, domestic use from wells, stock water uses, and seasonal storage, pending evaluation by the Chumstick Water Forum and Ecology. These exempt uses would be limited to a total of 0.043 cfs while studies are being performed to determine future water availability in the Chumstick and a future strategy is assessed. Seasonal storage opportunities and other alternatives in Chumstick will be evaluated by Ecology and the Chumstick Water Forum through the water right application process on a case-by-case basis during the three year interim period. Storage opportunities in Chumstick will be addressed as part of the Chumstick strategy after conclusion of the Forum's three year process and coordinated with the WRIA 45 Multi-Purpose Storage Assessment. This interim closure will be re-evaluated at the end of the three year period by the Chumstick Forum and Ecology. Note that water storage tanks as included in the Chumstick Community Wildfire Protection Program are exempt from this closure.

ChumQUANT-5: Ecology and Chelan County to implement reservation conditions as follows: One third (0.043 cfs) of the 0.13 cfs projected 2025 water needs is available for growth for three years after rule adoption. Allocation of the remainder of the reserve would be considered only after completion of additional instream flow assessments (ChumQUANT-2) and a cumulative impacts study (ChumQUANT-3, 6) and would be subject to appropriate conditions and limitations based on the result of those assessments (ChumQUANT-7). If, after completion of the cumulative impact study, Ecology determines that the cumulative effects of domestic water uses negatively affect water available for instream flows, Ecology will consider allowing only in-house water use from the reservation. If after 3 years, water rights are not purchased or leased to cover the interim reserve of 0.043 cfs or conservation measures that provide additional water are not implemented, Ecology would close the Chumstick Sub-watershed to further appropriation on a seasonal basis, and existing outdoor water use established subsequent to the adoption of WAC 173-545 could be curtailed when flows are not met. Note that the City of Leavenworth will debit any new water from the Lower Wenatchee Reserve and not the Chumstick Reserve.

ChumQUANT-6: A cumulative impact analysis of permit exempt use and uses associated with permits and claims approved since 1983 will be initiated by Ecology as authorized under the 1983 flow rule. Chelan County will partner with Ecology in this study. The cumulative impacts assessment will help to determine whether Ecology will curtail outdoor domestic water use of wells installed after 1983, and whether Ecology will close the Chumstick Sub-watershed to outdoor water use in the future.

ChumQUANT-7: Chumstick Forum, Chelan County and Ecology to re-evaluate a proposed strategy for the Chumstick in three years after rule adoption, when new monitoring data have been collected and assessed and cumulative impact analysis is complete. Consider allowing group domestic groundwater use of deeper aquifer only as part of the Chumstick strategy addressed by the Forum.

ChumQUANT-8: Chelan County will evaluate alternatives to improve fish passage at the North Road culvert, and further pursue replacement of culverts upstream of North Road on Chumstick Creek.

ChumQUANT-9: Metering of all new uses covered under the Chumstick reserve (includes all new domestic uses).

ChumQUANT-10: As part of Phase IV, Implementation, the Planning Unit and the Chumstick Forum (with Chelan County as lead) will evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Chumstick and evaluate water conservation, storage opportunities, purchase, lease and transfer of water rights, water transfer from other sub-watersheds, and other alternatives. Consider conjunctive use and evaluate pumping from the deep aquifer to augment flows in the Chumstick. Investigate storage options where stored water could be used to augment flows and provide mitigation water.

ChumQUANT-11: Encourage conservation and outreach.

ChumQUANT-12: Chelan County or other entity with agency funding assistance will investigate water rights for purchase or lease as part of the mitigation and enhancement strategy for Chumstick Sub-watershed. The County will seek funding from BPA, Ecology, Washington Rivers Conservancy, Washington Water Trust, and others. As water rights are purchased or transferred for use in the Chumstick reserve to meet a "no net impact" standard, the first purchase(s) will credit the 0.043 cfs interim reserve, then the additional 0.09 cfs will be available for forecasted growth as it is purchased.

Consider information from adjudication records (1982-1984) when investigating water rights for purchase or lease.

Alternatives for future water in the Chumstick are limited. Therefore, various water management alternatives need to be evaluated to determine the most effective methods to fulfill instream and out-of-stream needs and mitigate the impacts to habitat, streamflow, and groundwater levels in this sub-watershed. An alternatives analysis of water management options will be conducted as part of the implementation phase of watershed planning (Phase IV). The analysis will clearly address specific water needs in the Chumstick Sub-watershed, and evaluate water conservation, storage opportunities, purchase, lease and transfer of water rights, inter-basin transfer of water and other alternatives to determine the appropriate combination of water management options that could be used to increase the water availability in the Chumstick Sub-watershed. Water management alternatives for this assessment are discussed further in Section 5 (watershed-wide water quantity recommendations). Sub-watershed specific storage opportunities included in the Multi-purpose Storage Assessment (MWG, 2006) for the Chumstick Sub-watershed are presented below.

- Eagle Creek Tributary Lakes (10-50 acre-feet): Divert water to two small existing lakes or ponds on National Forest land.
- Eagle Creek SW Tributary Lake (10-50 acre-feet): Divert water to two small existing lakes on National Forest land.
- East Van Creek Off-channel Reservoir (10-50 acre-feet): Divert water to two small existing lakes or ponds on National Forest land.
- Small off-channel reservoirs in Chumstick Creek, Little Chumstick Creek and Eagle Creek valleys (1-10 acre-feet each): Divert water during winter or spring to reservoirs

which would be constructed on private land (where land is available) near Chumstick Creek. The water would be released in the summer.

- CMZ Project 19–Irwin Property: Construct a backchannel on an undeveloped floodplain across from the Leavenworth city park to increase storage capacity in the floodplain.
- CMZ Project 20: Provide additional backchannel habitat and increase floodplain storage on a particularly active portion of the floodplain which has one active side channel.
- Ski Hill Wetlands/Stormwater Storage or recharge (1-10 acre-feet): The City of Leavenworth would like to study a project that would help control runoff from the Ski Hill area, and store the water in constructed wetlands and recharge it where possible. The project would be located on city or currently privately owned land.
- Pump from Upper Wenatchee into Little Chumstick Creek (may be able to pump 3-5 cfs): Construct a pump station to pump water from the Wenatchee-Chiwawa Irrigation District ditch or Wenatchee River into a pipeline and over the hill to Little Chumstick Creek, where it would be allowed to recharge the creek valley.

9.4.2 Water Quality Recommended Actions

Chumstick Creek has exceeded State and federal water quality standards for fecal coliform. Fecal coliform is a public health issue and a difficult water quality parameter to address because it requires the identification and subsequent reduction of non-point sources. See Table 2-4 for additional watershed-wide water quality actions.

Fecal Coliform

ChumQUAL-1: Identify sources of fecal coliform pollution to Chumstick Creek Sub-watershed, including Van Creek and Upper Eagle Creek, utilizing the FC technical study. Identify human and nonhuman sources and/or failing on-site septic systems. Plan and implement corrective actions. The CDHD should address failing septic systems. Other entities should address manageable sources of FC pollution as appropriate (WQTS, 2006c).

ChumQUAL-2: Implement and monitor BMPs to meet the Fecal Coliform TMDL Technical Assessment target reductions (WQTS, 2006c).

ChumQUAL-3: CDHD will continue to implement onsite sewage disposal system technical assistance and education programs for homeowners and the industry (WQTS, 2006c).

ChumQUAL-4: The CDHD will continue to permit sewage systems per Washington Administrative Code (WAC), including analyzing soils and technologies suitable for individual sites; review/approve the proposed design, specifications, installation and if required, the ongoing maintenance in accordance with the WAC; provide public information under real estate disclosure laws; and review all land use proposals to ensure that the WAC is properly enforced prior to approval by the County (WQTS, 2006c).

ChumQUAL-5: A grant/loan funding program should be developed and implemented to replace or repair failing septic systems (WQTS, 2006c).

ChumQUAL-6: The CDHD should explore obtaining legal authority from Chelan County to operate a pumper notification program with area septage pumpers as part of its onsite septic system operation

and maintenance program. The septage pumpers would work with the CDHD to appropriately identify and correct failing septic systems (WQTS, 2006c).

ChumQUAL-7: The CDHD and watershed would benefit from the funding, development and maintenance of a digital system for all onsite septic system permits issued in Chelan County, and a GIS database of the onsite septic systems (WQTS, 2006c).

ChumQUAL-8: When the TMDL DIP is developed, the committee should utilize detailed recommendations from the Wenatchee River Watershed Action Plan (WQTS, 2006c).

ChumQUAL-9: Conduct stream walk cleanups along the stream (Fall, Spring, Summer) with area schools, homeowners, and other groups (WQTS, 2006c).

ChumQUAL-10: Conduct ongoing community fecal coliform education/awareness campaigns throughout the year. Engage and get support from homeowners (WQTS, 2006c).

ChumQUAL-11: Work with City, County, State, and Federal governments, and the Humane Society to deal with the feral cats and dogs living within the stream corridor. Monitor and remove dead animals within the stream corridor throughout the year. (WQTS, 2006c).

ChumQUAL-12: Conduct education and enforcement actions to stop illegal dumping of wastes either to storm drains or directly to surface waters. This dumping may be of portable toilet wastes, recreational vehicle wastes, etc. (WQTS, 2006c).

ChumQUAL-13: The WQTS should encourage the CDHD, Chelan County, Cities, DOH, and Utilities to continue ongoing review and upgrading of ordinances regarding developments and sewage systems technologies (WQTS, 2006c).

ChumQUAL-14: The WQTS and its participating entities should work with the public and homeowners regarding BMPs to reduce fecal coliform runoff. General actions should include public information, education, and technical assistance regarding watering practices, landscaping, stormwater runoff, filtration practices, animal waste, etc. (WQTS, 2006c).

ChumQUAL-15: Work with irrigation districts to implement and enforce policies to prevent illegal fecal coliform discharges to irrigation canals (WQTS, 2006c).

ChumQUAL-16: Work with landowners regarding fecal coliform runoff (WQTS, 2006c).

ChumQUAL-17: Encourage Chelan County and municipalities to develop and implement stormwater policies, standards, and guidelines, utilizing the Eastern Washington Stormwater Manual or equivalent, in comprehensive plans, critical area ordinances, growth management plans, and other appropriate plans (WQTS, 2006c).

ChumQUAL-18: Work with appropriate entities to reduce fecal coliform runoff from impervious surfaces (WQTS, 2006c).

ChumQUAL-19: Work with U.S. Forest Service, Washington State Department of Natural Resources, and private owners on forested lands to restore and protect streams from fecal coliform runoff pollution (WQTS, 2006c).

ChumQUAL-20: Funding assistance should be sought from Ecology through its grants and loans programs to implement actions and ongoing monitoring. Other funding sources should be identified and applications submitted to provide funding for ongoing activities. The WQTS will recommend qualified entities to conduct associated monitoring. Self-sustaining funding mechanisms to reduce fecal coliform inputs should be explored and developed in concert with the Wenatchee Watershed Planning Unit and its participating entities (WQTS, 2006c).

9.4.3 Habitat Recommended Actions

The Chumstick Creek Sub-watershed has been assigned a Category 3 Habitat Priority. This implies that it is a sub-watershed that supports salmonids, but has experienced substantial degradation and is strongly fragmented by habitat loss, especially through loss of connectivity with the mainstem corridor. The priority in this area is to rectify the primary factors that cause habitat degradation: obstructions, low stream flows, and high water temperatures (UCSRB, 2005). Appendix C provides detail on habitat projects current as of June 2005. Habitat recommendations for Chumstick Creek as reported in the 2005 Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) and the Biological Strategy (UCRTT, 2002) include:

ChumH-1: Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts and diversions) (UCSRB, 2005).

ChumH-2: Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Chumstick Creek (UCSRB, 2005).

ChumH-3: Decrease water temperatures and improve water quality by restoring riparian vegetation along the stream (UCSRB, 2005).

ChumH-4: Increase habitat diversity and quantity by restoring riparian habitat, reconnecting side channels and the floodplain with the channel, increasing large woody debris within the channel, and by adding instream structures (UCSRB, 2005).

ChumH-5: Protect remaining floodplain and riparian habitat (UCRTT, 2002).

9.5 Icicle Sub-watershed

Area Description

The Icicle Sub-watershed is the largest sub-watershed in WRIA 45, covering 136,916 acres. The Icicle joins the Wenatchee River at RM 25.6, contributing 20% of the Wenatchee River's annual flow (Wenatchee River Watershed Action Plan Addendum, 1996). Precipitation ranges from 120 inches at the Cascade crest to 20 inches at the mouth of the Icicle (USFS, 1995). Elevation ranges from approximately 9,000 feet at the Cascade Crest to 1,102 feet at the mouth (Wenatchee River Watershed Action Plan Addendum, 1996). The U.S. Forest Service manages 87% of the land in the sub-watershed, and 74% of the sub-watershed is located within the Alpine Lakes Wilderness Area (Wenatchee River Watershed Action Plan, 1998).

The major water diversions on the Icicle are used for irrigation of downstream orchards, municipal drinking water (City of Leavenworth) and the Leavenworth National Fish Hatchery. All of these diversions are located in the lower five miles of Icicle Creek (Ecology, 1983). In dry years, the flow in the lower portion of Icicle Creek is sustained by water releases from Colchuck, Eight Mile, Klonaqua, Square, and Snow Lakes. Although the City of Leavenworth's population is located primarily in the Chumstick Sub-watershed (and accounted for there), a portion of its water supply

originates in the Icicle Sub-watershed. The total population residing in the Icicle Sub-watershed was 723 people (3.9% of the Wenatchee Watershed's population) in 2000. There are also a significant number of part-time residents in the area that may not be accounted for by the US Census. The Icicle Creek area attracts outdoor enthusiasts from all over the world who enjoy camping, backpacking, rock climbing and kayaking.

The upper portion of the Icicle Sub-watershed above RM 5.7 contains high quality aquatic and terrestrial habitat, and is designated as a key watershed by the Northwest Forest Plan. Native salmonid species in the Icicle include steelhead, cutthroat, redband, and bull trout (migratory and resident bull trout spawn in the colder headwater tributaries and migrate within other Wenatchee sub-watersheds and the Columbia River). Spring Chinook currently spawn in the lower Icicle River but their origin is likely from hatcheries (Peven, 1994). The Leavenworth National Fish Hatchery is located on Icicle Creek. The *Wenatchapam* Fishery, a historic fishing area for the Wenatchi Tribe, is located at the confluence of Icicle Creek and the Wenatchee River. This is a very important tribal fishery that is recognized and honored under the Treaty of 1855 which reserved to the Yakama Nation the right to hunt and fish at usual and accustomed places. Figure 9-5 provides an overview of the sub-watershed, its land uses, stream gage and control point locations, water quality issues, fish barriers, habitat recommendations, and fish presence.

Icicle Issues

Seasonal low flows in the lower Icicle between the major diversions and the hatchery return, diminished water quality and limited habitat diversity for salmonids are the leading issues in the Icicle Sub-watershed. Water withdrawals in Icicle Creek (primarily between Rat Creek and the hatchery) likely contribute to low flows and high summer temperatures in lower Icicle Creek. Icicle Creek has exceeded State and federal water quality standards for temperature and DO/pH. Salmonid populations are at risk because of limited habitat diversity and quantity, obstructions and increased sediment loads. The change in the landscape and vegetation after the 1994 Rat Creek Fire has contributed to increased sediment loads in Icicle Creek (MWG, 2006).

Recommended Actions - Icicle Sub-watershed

The following actions have been recommended to address water quantity, instream flows, water quality, and habitat issues as they relate specifically to the Icicle Sub-watershed. The issues and recommended actions are also summarized in Table 2-12. These actions should be implemented along with the watershed-wide actions (Tables 2-1 through 2-7) as discussed in Sections 4 – 8, 10, and 11 in this Watershed Plan. Responsibility for implementing the actions in the Plan is subject to securing necessary funding.

9.5.1 Water Management Recommended Actions

The control point in the Icicle Sub-watershed is at or near the East Leavenworth Bridge. The actual stream gage, Icicle Creek above Snow Creek near Leavenworth, is currently located upstream of the existing control point. The majority of diversions on the Icicle occur between these two locations. Therefore it is recommended that a new stream gage be established at the existing control point on Icicle Creek (WRMS-4c). The strategy includes proposed management flows (Figure 4-7 and Table 4-6) and a maximum allocation subject to those flows. There is also a reservation of 0.1 cfs that would be made available for use in the Icicle Sub-watershed. An additional 0.4 cfs may be allocated to the reservation after flow restoration efforts targeting habitat between the upstream diversions (hatchery, City of Leavenworth and Icicle Irrigation District) and the hatchery return are addressed. Until additional water is credited to the reserve, new water allocation for the City of Leavenworth will be debited to the Lower Wenatchee reservation.

Various water management alternatives need to be evaluated to determine the most effective methods to fulfill instream and out-of-stream needs and mitigate the impacts to habitat, streamflow, and groundwater levels in this sub-watershed. An alternatives analysis of water management options will be conducted as part of the implementation phase of watershed planning (Phase IV). The analysis will clearly address specific water needs in the Icicle Sub-watershed, and evaluate water conservation, storage opportunities, purchase, lease and transfer of water rights, inter-basin transfer of water and other alternatives to determine the appropriate combination of water management options that could be used to increase the water availability in the Icicle Sub-watershed. Water management alternatives for this assessment are discussed further in Section 5 (watershed-wide water quantity recommendations).

Sub-watershed specific storage opportunities included in the Multi-purpose Storage Assessment (MWG, 2006) for the Icicle Sub-watershed are presented below.

- Alpine Lakes Optimization (total lake volume: 5,500 acre-feet): Review the potential to optimize the discharge from the high Alpine Lakes (Snow, Nada, Colchuck, Square, Klonaqua, Eightmile) to retain water longer and provide more flow in late summer and early fall.
- Icicle Creek Recharge Basin (10-50 acre-feet): Divert water in the winter or spring time when flow is sufficient from Icicle Creek or use an existing diversion to a recharge basin that would be constructed on privately owned land in the Icicle Creek valley to augment groundwater supplies.
- Mountain Home Off-channel Reservoirs (350 acre-feet): Divert water to two potential storage reservoir sites on privately owned land.

9.5.2 Water Quality Recommended Actions

There is a need to address the exceedances of State and Federal water quality standards for pH and dissolved oxygen in the Icicle Creek. Both point and non-point sources of phosphorus that affect the pH and DO levels in the Icicle Sub-watershed should be addressed. The sub-watershed-specific water quality actions addressing phosphorus loading are described below. Actions addressing temperature in the Icicle Sub-watershed are listed in Section 7, Water Quality. See Table 2-4 for additional watershed-wide water quality actions.

DO/pH

IcicleQUAL-1: The partnership formed to secure funding for further study of DO and pH (Chelan County, Chelan County PUD and the cities of Cashmere, Leavenworth and Wenatchee) should continue to work together, with the WQTS to acquire funding assistance and work with the WQTS to:

- Facilitate and develop a workable strategy that can be used and ultimately approved by the EPA and in Ecology's TMDL submittal for DO and pH, and
- Review and make suggestions for future improvements to Ecology's technical assessment, summary implementation plan, and adaptive management approaches to meet state water quality standards for these parameters.

IcicleQUAL-2: Strategies to address point and non-point sources of phosphorus as part of the TMDL for DO and pH will be reported during the implementation phase of the Wenatchee Watershed planning effort.

IcicleQUAL-3: Controls should be developed and implemented through new and existing regulatory permits, if needed, to reduce phosphorous inputs to surface and groundwaters from other Wenatchee Watershed point sources. Conduct associated monitoring and adaptive management (WQTS, 2006a).

IcicleQUAL-4: Groundwater discharges to the Wenatchee River, Icicle Creek, and their tributaries affects dissolved oxygen levels and nutrient concentrations. Groundwater is discharged to the river or creeks in some reaches, and is recharged in other reaches. In the Wenatchee basin, groundwater flow and BOD/nutrient concentrations may be elevated due to upland practices such as orchard irrigation and wastewater discharge to groundwater from lagoons and on-site septic systems. Assessments of groundwater contributions and sources of nutrients (phosphorous) should be conducted. Actions should be implemented based on the conclusions and recommendations of these studies to reduce inputs of phosphorous from these areas (WQTS, 2006a).

IcicleQUAL-5: Non-point sources along the length of the river may be contributing BOD and nutrients. Address failing septic systems through actions identified in the Wenatchee Watershed Fecal Coliform TMDL. Continue site specific inspections and enforcement of regulations that restrict placement of on-site septic drain fields from areas deemed to have unsuitable soils. A study should be conducted to assess soils and onsite septic systems. Estimates should be made of the maximum number and density of on-site drain fields that the upper basin can accommodate and still meet the water quality standards, as was done in the Lake Chelan study (Patmont et al., 1989). Conduct associated monitoring and adaptive management (WQTS, 2006a).

IcicleQUAL-6: Nutrients (phosphorous) can enter streams from storm water events. Work with Chelan County and municipalities to reduce storm water inputs, utilizing the Eastern Washington Storm water Manual or equivalent. Encourage appropriate entities to include language that addresses storm water in comprehensive plans and ordinances. Work with developers. (See IcicleQUAL-15). Conduct associated monitoring and adaptive management (WQTS, 2006a).

IcicleQUAL-7: Nutrients (phosphorous) can enter surface and ground water from residential yards and gardens, hobby farms, City and County Parks, business owned landscapes, etc. An education outreach plan should be developed and implemented to heighten awareness and reduce inputs from these sources. Policies and practices should be implemented in City and County Public Works departments. The County and cities should consider implementing a ban on the sale of high phosphate detergents, such as is being considered in Spokane. Conduct associated monitoring and adaptive management (WQTS, 2006a).

IcicleQUAL-8: Nutrients can enter streams from materials used to de-ice, clean, and maintain roads and parking lots. Animal waste from roads and parking lots can enter streams and increase nutrient loading. Work with the County, cities, and businesses to determine if road and parking lot maintenance practices may be contributing to nutrient loading and if necessary investigate ways to reduce nutrient inputs from these practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).

IcicleQUAL-9: Nutrients (phosphorous) can be released to ground and surface waters from development practices, such as disruption of soils during conversions of orchard lands to housing. Actions should be conducted to prevent nutrients from entering ground and surface waters before, during and after construction. Work with developers to implement these actions. Encourage entities to include appropriate language in county and city comprehensive plans, growth management, and critical area ordinances. Conduct associated monitoring and adaptive management (WQTS, 2006a).

IcicleQUAL-10: Consider implementing actions recommended in the Wenatchee River Basin Temperature and Fecal Coliform TMDLs if the actions address problems that have been identified in the Icicle Sub-watershed. Lowering temperatures and reducing nutrient inputs will improve pH and dissolved oxygen levels in the Wenatchee River Watershed (WQTS, 2006a).

IcicleQUAL-11: Reserve load capacities for Biochemical Oxygen Demand (BOD) and nutrients should be established for the Upper Wenatchee River and Icicle Creek. Reserve load capacities are needed because there is no additional assimilative capacity for dissolved oxygen in the upper watershed during critical conditions. A point source regulatory strategy and nonpoint source BMP strategy should be developed to protect the reserve capacities and maintain water quality standards (WQTS, 2006a).

IcicleQUAL-12: Encourage lining of earthen canals where appropriate. Work with irrigation districts to implement BMPs and adaptive management programs to minimize any nutrient loading that is not already being addressed (WQTS, 2006a).

IcicleQUAL-13: Agricultural practices can contribute nutrients to ground and surface waters through crop watering practices, application of fertilizers, and soil disturbance activities. Work with the agricultural community to encourage practices that will reduce nutrient inputs to ground and surface waters while enhancing crop quality and yield. Examples include technical assistance through farm plans and Best Management Practices (BMPs). Conduct associated monitoring and adaptive management (WQTS, 2006a).

IcicleQUAL-14: Funding for these projects should be sought through Department of Ecology Centennial and 319 grants and loans. Identify and access other funding sources through the Planning Unit and other entities. Ongoing adaptive management should be utilized to provide the best use of funds and environmental benefits (WQTS, 2006a).

IcicleQUAL-15: Proper filtration of nutrients through land use practices can have a beneficial effect on nutrient reductions to ground and surface waters. Encourage implementation of wetlands, filter strips, riparian vegetation, bio-swales, drainage basins, pervious surfaces, etc. in residential, commercial, agricultural, industrial, development, and municipal practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).

IcicleQUAL-16: Identify and investigate any non point sources in tributaries that may be contributing to nutrient loads (WQTS, 2006a).

9.5.3 Habitat Recommended Actions

The Icicle Creek Sub-watershed has been assigned a Category 2 Habitat Priority. This implies that it is a sub-watershed that supports important aquatic resources and is a stronghold for one or more listed species. Compared to Category 1 areas, Category 2 areas have a higher level of fragmentation resulting from habitat disturbance or loss. In addition, native populations have been lost or are at risk because of limited habitat diversity and quantity, obstructions and increased sediment loads. Restoring ecosystem function and connectivity within this area are priorities (UCSRB, 2005). Appendix C provides detail on habitat projects current as of June 2005. Habitat recommendations from the 2005 Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) and the Biological Strategy (UCRTT, 2002) include:

IcicleH-1: Increase connectivity by improving fish passage over Dam 5 in the lower Icicle Creek (UCSRB, 2005).

IcicleH-2: Reduce sediment recruitment by restoring riparian vegetation between the mouth of the Icicle and the boulder field (RM 0-5.4) (UCSRB, 2005).

IcicleH-3: Improve road maintenance to reduce fine sediment recruitment in the upper watershed (UCSRB, 2005).

IcicleH-4: Increase habitat diversity and quantity by restoring riparian vegetation, reconnecting side channels, and reconnecting the floodplain with the channel in lower Icicle Creek (UCSRB, 2005).

IcicleH-5: Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Icicle Creek (UCSRB, 2005).

IcicleH-6: Protect remaining floodplain and riparian habitat downstream of Chatter Creek. Emphasis should be placed on habitat downstream of Leavenworth Hatchery (UCRTT, 2002).

9.6 Upper Wenatchee and Chiwaukum Sub-watersheds

Area Description

The 36,301-acre Upper Wenatchee and 32,012-acre Chiwaukum Sub-watersheds encompass the area below Lake Wenatchee to the mouth of Tumwater Canyon (RM 54.2 to RM 23.5). These sub-watersheds receive approximately 50 inches of precipitation per year. The vast majority of the land in these sub-watersheds is in commercial forest use (88%) (MWG, 2003). The Chiwaukum Sub-watershed is primarily wilderness. The town of Plain is located in the Upper Wenatchee Sub-watershed, near its border with the Chiwawa Sub-watershed. The small amount of irrigation in the Plain area uses water from the Chiwawa River. The total population in the Upper Wenatchee, was 624 people (3.4% of the Wenatchee Watershed's population) in 2000. The total population in Chiwaukum was 20 people (0.1% of the Wenatchee Watershed's population) in 2000. There are also a number of part-time residents in the area that may not be accounted for by the US Census.

The Upper Wenatchee Sub-watershed provides an important passage corridor for many species and important spawning habitat for Summer Chinook and steelhead. Native salmonid species in the Upper Wenatchee Sub-watershed are sockeye salmon, spring and Summer Chinook, steelhead, rainbow, westlope cutthroat and migratory and resident bull trout. The forest service has designated the Fish Lake area in the upper portion of the Upper Wenatchee Sub-watershed as a "special interest area" because of the abundance of bogs and wetlands around the lake. The Chiwaukum Sub-watershed contains current and potential habitat for bull trout, Spring and Summer Chinook, and Summer Steelhead. The reach from Lake Wenatchee to the Chiwawa River confluence is designated a Key Watershed in the Northwest Forest Plan. Figure 9-6 provides an overview of the sub-watersheds, their land uses, stream gage and control point locations, water quality issues, fish barriers, habitat recommendations, and fish presence.

Upper Wenatchee and Chiwaukum Issues

Maintaining instream flows, addressing water quality exceedances, and protecting salmonid habitat are the leading issues in the Upper Wenatchee and Chiwaukum Sub-watersheds. Although the Chiwaukum Sub-watershed has 2004 303(d) listings for temperature, it is possible that this exceedance is due to natural conditions. Habitat concerns include improving habitat diversity and removing obstructions to preserve salmonid populations in the sub-watershed.

Recommended Actions – Upper Wenatchee and Chiwaukum Sub-watersheds

The following actions have been recommended to address water quantity, instream flows, water quality, and habitat issues as they relate specifically to the Upper Wenatchee and Chiwaukum Sub-

watersheds. The issues and recommended actions are also summarized in Table 2-13. These actions should be implemented along with the watershed-wide actions (Tables 2-1 through 2-7) as discussed in Sections 4 – 8, 10, and 11 in this Watershed Plan. Responsibility for implementing the actions in the Plan is subject to securing necessary funding.

9.6.1 Water Management Recommended Actions

The existing control point at the Wenatchee River at Plain gage is intended as a measuring point for all sub-watersheds above the age, including Upper Wenatchee and Chiwaukum. The management flows at the Plain gage (Figure 4-4 and Table 4-3) have not been revised for this management program. The flows continue to be set at the levels specified in the 1983 flow rule. The maximum allocation associated with the Plain gage is subject to flows. A reservation of 0.5 cfs to 1.0 cfs is available for the upper portion of WRIA 45, above Leavenworth. This reservation provides water for projected growth in the Upper Wenatchee, Chiwaukum, Nason, Little Wenatchee, White, Chiwawa and Lake Wenatchee Sub-watersheds. In addition, the Chiwaukum Sub-watershed has an associated 0.01 cfs reserve that can utilize a portion of the 0.5 – 1.0 cfs available the upper portion of the WRIA, above Leavenworth.

Various water management alternatives need to be evaluated to determine the most effective methods to fulfill instream and out-of-stream needs and mitigate the impacts to habitat, streamflow, and groundwater levels in the WRIA. Although these sub-watersheds do not have critical water quantity needs, opportunities in these geographic areas may be assessed as part of an alternatives analysis of water management options that will be conducted as part of the implementation phase of watershed planning (Phase IV). Water management alternatives for this assessment are discussed further in Section 5 (watershed-wide water quantity recommendations). Sub-watershed specific storage opportunities included in the Multi-purpose Storage Assessment (MWG, 2006) for the Upper Wenatchee and Chiwaukum Sub-watersheds are presented below.

Upper Wenatchee

- Wenatchee River Off-Channel Reservoir (100-200 acre-feet): Divert or pump water from the Wenatchee River to an off-channel reservoir on National Forest land.
- Upper Wenatchee Recharge Basin (10-100 acre-feet): Divert water from the Wenatchee River or enlarge the Wenatchee-Chiwawa Irrigation ditch to convey water to a recharge basin on private land near Plain.

Chiwaukum

- Canyon Creek Off-Channel Reservoir (50-100 acre-feet): Divert water to a reservoir on National Forest lands to store runoff from Chiwaukum and Canyon Creek.
- Lower Chiwaukum Creek Off-Channel Reservoir (100-200 acre-feet): Divert water to an off-stream reservoir located on private property near the mouth of Chiwaukum Creek.

9.6.2 Water Quality Recommended Actions

There is a need to address the exceedances of State and Federal water quality standards for pH and dissolved oxygen in the Upper Wenatchee River. Both point and non-point sources of phosphorus that affect the pH and DO levels in the Upper Wenatchee Sub-watershed should be addressed. The sub-watershed-specific water quality actions for phosphorus are addressed below. Actions for temperature in the Upper Wenatchee and Chiwaukum Sub-watersheds are listed in Section 7, Water Quality. See Table 2-4 for additional watershed-wide water quality actions.

DO/pH

UpWenQUAL-1: The partnership formed to secure funding for further study of DO and pH (Chelan County, Chelan County PUD and the cities of Cashmere, Leavenworth and Wenatchee) should continue to work together, with the WQTS to acquire funding assistance and work with the WQTS to:

- Facilitate and develop a workable strategy that can be used and ultimately approved by the EPA and in Ecology's TMDL submittal for DO and pH, and

- Review and make suggestions for future improvements to Ecology's technical assessment, summary implementation plan, and adaptive management approaches to meet state water quality standards for these parameters.

UpWenQUAL-2: Strategies to address point and non-point sources of phosphorus as part of the TMDL for DO and pH will be reported during the implementation phase of the Wenatchee Watershed planning effort.

UpWenQUAL-3: Large reductions of phosphorus inputs are needed from point sources in the Wenatchee River Watershed especially waste water treatment plants (WWTPs). A regulatory strategy should be developed and implemented with WWTPs and Ecology to institute controls over time through NPDES permits that will reduce phosphorous discharges to surface and groundwaters. WWTPs to be addressed include the Lake Wenatchee, Stevens Pass, Leavenworth, Peshastin, and Cashmere waste water treatment plants. Conduct associated monitoring and adaptive management (WQTS, 2006a).

UpWenQUAL-4: Controls should be developed and implemented through new and existing regulatory permits, if needed, to reduce phosphorous inputs to surface and groundwaters from other Wenatchee Watershed point sources. Conduct associated monitoring and adaptive management (WQTS, 2006a).

UpWenQUAL-5: Groundwater discharges to the Wenatchee River, Icicle Creek, and their tributaries affects dissolved oxygen levels and nutrient concentrations. Groundwater is discharged to the river or creeks in some reaches, and is recharged in other reaches. In the Wenatchee basin, groundwater flow and BOD/nutrient concentrations may be elevated due to upland practices such as orchard irrigation and wastewater discharge to groundwater from lagoons and on-site septic systems. Assessments of groundwater contributions and sources of nutrients (phosphorous) should be conducted. Actions should be implemented based on the conclusions and recommendations of these studies to reduce inputs of phosphorous from these areas (WQTS, 2006a).

UpWenQUAL-6: Non-point sources along the length of the river may be contributing BOD and nutrients. Address failing septic systems through actions identified in the Wenatchee Watershed Fecal Coliform TMDL. Continue site specific inspections and enforcement of regulations that restrict placement of on-site septic drain fields from areas deemed to have unsuitable soils. A study should be conducted to assess soils and onsite septic systems. Estimates should be made of the maximum number and density of on-site drain fields that the upper basin can accommodate and still meet the water quality standards, as was done in the Lake Chelan study (Patmont et al., 1989). Conduct associated monitoring and adaptive management (WQTS, 2006a).

UpWenQUAL-7: Nutrients (phosphorous) can enter streams from storm water events. Work with Chelan County and municipalities to reduce storm water inputs, utilizing the Eastern Washington Storm water Manual or equivalent. Encourage the appropriate entities to include language that

addresses storm water in comprehensive plans and ordinances. Work with developers. (See UpWenQUAL-16). Conduct associated monitoring and adaptive management (WQTS, 2006a).

UpWenQUAL-8: Nutrients (phosphorous) can enter surface and ground water from residential yards and gardens, hobby farms, City and County Parks, business owned landscapes, etc. An education outreach plan should be developed and implemented to heighten awareness and reduce inputs from these sources. Policies and practices should be implemented in City and County Public Works departments. The County and cities should consider implementing a ban on the sale of high phosphate detergents, such as is being considered in Spokane. Conduct associated monitoring and adaptive management (WQTS, 2006a).

UpWenQUAL-9: Nutrients can enter streams from materials used to de-ice, clean, and maintain roads and parking lots. Animal waste from roads and parking lots can enter streams and increase nutrient loading. Work with the County, cities, businesses, and the WA State Department of Transportation to determine if road and parking lot maintenance practices may be contributing to nutrient loading and if necessary investigate ways to reduce nutrient inputs from these practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).

UpWenQUAL-10: Nutrients (phosphorous) can be released to ground and surface waters from development practices, such as disruption of soils during conversions of orchard lands to housing. Actions should be conducted to prevent nutrients from entering ground and surface waters before, during and after construction. Work with developers to implement these actions. Encourage entities to include appropriate language in county and city comprehensive plans, growth management, and critical area ordinances. Conduct associated monitoring and adaptive management (WQTS, 2006a).

UpWenQUAL-11: Consider implementing actions recommended in the Wenatchee River Basin Temperature and Fecal Coliform TMDLs if the actions address problems that have been identified in the Upper Wenatchee Sub-watershed. Lowering temperatures and reducing nutrient inputs will improve pH and dissolved oxygen levels in the Wenatchee River Watershed (WQTS, 2006a).

UpWenQUAL-12: Reserve load capacities for Biochemical Oxygen Demand (BOD) and nutrients should be established for the Upper Wenatchee River and Icicle Creek. Reserve load capacities are needed because there is no additional assimilative capacity for dissolved oxygen in the upper watershed during critical conditions. A point source regulatory strategy and nonpoint source BMP strategy should be developed to protect the reserve capacities and maintain water quality standards (WQTS, 2006a).

UpWenQUAL-13: Encourage lining of earthen canals where appropriate. Work with irrigation districts to implement BMPs and adaptive management programs to minimize any nutrient loading that is not already being addressed (WQTS, 2006a).

UpWenQUAL-14: Agricultural practices can contribute nutrients to ground and surface waters through crop watering practices, application of fertilizers, and soil disturbance activities. Work with the agricultural community to encourage practices that will reduce nutrient inputs to ground and surface waters while enhancing crop quality and yield. Examples include technical assistance through farm plans and Best Management Practices (BMPs). Conduct associated monitoring and adaptive management (WQTS, 2006a).

UpWenQUAL-15: Funding for these projects should be sought through Department of Ecology Centennial and 319 grants and loans. Identify and access other funding sources through the Planning

Unit and other entities. Ongoing adaptive management should be utilized to provide the best use of funds and environmental benefits (WQTS, 2006a).

UpWenQUAL-16: Proper filtration of nutrients through land use practices can have a beneficial effect on nutrient reductions to ground and surface waters. Encourage implementation of wetlands, filter strips, riparian vegetation, bio-swales, drainage basins, pervious surfaces, etc. in residential, commercial, agricultural, industrial, development, and municipal practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).

UpWenQUAL-17: Identify and investigate any non point sources in tributaries that may be contributing to nutrient loads (WQTS, 2006a).

9.6.3 Habitat Recommended Actions

The Upper Wenatchee and the Chiwaukum Creek Sub-watersheds have both been assigned a Category 1 Habitat Priority, indicating that they represent systems that most closely resemble natural, fully functional aquatic ecosystems. They comprise large, connected blocks of high-quality habitat that support more than two listed species. Exotic species may be present but are not dominant in abundance because of limited habitat diversity. Protecting this area is a priority, although restoration in some areas is also needed which includes removing obstructions (UCSRB, 2005). Appendix C provides detail on habitat projects current as of June 2005. Habitat recommendations from the 2005 Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) include:

UpWenH-1: Increase habitat quantity in the Wenatchee River between Tumwater Canyon and Lake Wenatchee by restoring riparian habitat along the river and reconnecting side channels (where feasible) (UCSRB, 2005).

ChiwaukumH-1: Increase connectivity along Skinney Creek (UCSRB, 2005).

ChiwaukumH-2: Increase habitat diversity in Chiwaukum Creek along Tumwater Campground by restoring riparian vegetation, reconnecting the floodplain with the stream, and by increasing large woody debris within the channel (UCSRB, 2005).

9.7 Chiwawa Sub-watershed

Area Description

The Chiwawa Sub-watershed is second largest sub-watershed in WRIA 45, draining 126,271 acres before joining the Wenatchee at RM 58.6, and contributing 15% of the Wenatchee River's annual flow (Wenatchee River Watershed Action Plan Addendum, 1996). The precipitation on the sub-watershed ranges from 30 to 80 inches per year. Elevation ranges between 9,100 feet in the headwaters to 1,850 feet at its confluence with the Wenatchee River (Wenatchee River Watershed Action Plan, 1998). Most of this watershed is in public ownership and protected as Wilderness Area as specified in the Northwest Forest Plan (MWG, 2006). The total population was 406 people (2.2 % of the Wenatchee Watershed's population) in 2000. There are also a significant number of part-time residents in the area that may not be accounted for by the US Census.

Native salmonid species in the Chiwawa Sub-watershed are spring Chinook, steelhead, migratory and resident bull trout and westlope cutthroat trout. Overall, the Chiwawa Sub-watershed supports moderate to high-quality terrestrial habitat (USFS, 1997). The Chiwawa is designated as a key watershed by the Northwest Forest Plan and provides critical spawning and rearing habitat for

multiple species. Figure 9-7 provides an overview of the sub-watershed, its land uses, stream gage and control point locations, water quality issues, fish barriers, habitat recommendations, and fish presence.

Chiwawa Issues

Maintaining instream flows and protecting salmonid habitat are the leading issues in the Chiwawa Sub-watershed. Additional habitat concerns include removing obstructions and decreasing sediment loads to protect salmonid populations in the sub-watershed. Water needs in the Chiwawa Sub-watershed are limited primarily to providing and protecting instream flows to benefit fish and other aquatic resources.

Recommended Actions - Chiwawa Sub-watershed

The following actions have been recommended to address water quantity, instream flows, water quality, and habitat issues as they relate specifically to the Chiwawa Sub-watershed. The issues and recommended actions are also summarized in Table 2-14. These actions should be implemented along with the watershed-wide actions (Tables 2-1 through 2-7) as discussed in Sections 4 – 8, 10, and 11 in this Watershed Plan. Responsibility for implementing the actions in the Plan is subject to securing necessary funding.

9.7.1 Water Management Recommended Actions

The Chiwawa River gage is the control point for Chiwawa River Sub-watershed. The maximum allocation associated with the Chiwawa gage is subject to flows and includes seasonal water for storage and other uses. The strategy allocates 0.1 – 0.5 cfs of the 0.5 – 1.0 cfs available for the entire upper watershed, above Leavenworth, to the Chiwawa Sub-watershed. In addition, it has been recommended that the gage location on the Chiwawa River be reviewed with respect to the locations of withdrawals on the River (WRMS-4d).

Various water management alternatives need to be evaluated to determine the most effective methods to fulfill instream and out-of-stream needs in the WRIA. Although the Chiwawa does not have critical water quantity needs, opportunities in this sub-watershed may be assessed as part of an alternatives analysis of water management options conducted during the implementation phase of watershed planning (Phase IV). Water from the Chiwawa may be used to supplement needs in the Chumstick. Water management alternatives for this assessment are discussed further in Section 5 (watershed-wide water quantity recommendations). Sub-watershed specific storage opportunities included in the Multi-purpose Storage Assessment (MWG, 2006) for the Chiwawa Sub-watershed are presented below.

- Marble Creek Instream Reservoir (50-100 acre-feet): Construct an instream reservoir in the upper reaches of the Marble Creek basin at Marble Meadow on National Forest land at about elevation 5,920 ft.
- Marble Creek off-channel Reservoir (50-100 acre-feet): Divert water to an off-channel reservoir adjacent to Marble Creek on National Forest land at about elevation 2,940 ft.
- Gate Creek Off-channel Reservoir (50-100 acre-feet): Divert water to an off-channel reservoir between Gate Creek and Marble Creek on National Forest land at about elevation 2,560 ft.
- Minnow Creek Off-channel Reservoir (50-100 acre-feet): Divert water to an off-channel reservoir adjacent to Minnow Creek on National Forest land at about elevation 2,860 ft.

- Goose Creek North Tributary Reservoir (10-50 acre-feet): Divert water to an off-channel reservoir in a tributary valley north of Goose Creek on National Forest land at about elevation 2,380 ft.
- Deep Creek Instream Reservoir (10-50 acre-feet): Construct an instream reservoir opposite Morrow Meadow on National Forest land at an elevation of about 2,260 ft.
- Beaver Creek Off-channel Reservoir (10-50 acre-feet): Divert water to an off-channel reservoir located adjacent to Beaver Creek on private land at about elevation 2,240 ft.
- Connection to old oxbows and other floodplain storage areas: There are numerous areas in the Chiwawa River floodplain that may benefit from improving connection between the river and floodplain or constructing side channels or oxbows to increase water storage in the floodplain

9.7.2 Water Quality Recommended Actions

There are no additional sub-watershed-specific water quality actions for the Chiwawa Sub-watershed. See Table 2-4 for applicable watershed-wide water quality actions.

9.7.3 Habitat Recommended Actions

The Chiwawa River Sub-watershed has been assigned a Category 1 Habitat Priority. This implies that this sub-watershed represents systems that most closely resemble natural, fully functional aquatic ecosystems. They comprise large, connected blocks of high-quality habitat that support more than two listed species. Exotic species may be present but are not dominant in abundance because of limited habitat quantity. Protecting this area is a priority, although restoration in some areas is also needed which includes removing obstructions and decreasing sediment loads (UCSRB, 2005). Appendix C provides detail on habitat projects current as of June 2005. Habitat recommendations from the 2005 Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) and the Biological Strategy (UCRTT, 2002) include:

ChiwawaH-1: Increase habitat quantity by restoring riparian habitat along the lower 4 miles of the Chiwawa River (UCSRB, 2005).

ChiwawaH-2: Reduce sediment recruitment to the stream by improving road maintenance within the watershed (UCSRB, 2005).

ChiwawaH-3: Improve fish passage in tributaries (UCSRB, 2005).

ChiwawaH-4: Protect remaining floodplain and riparian habitat, particularly around Chikamin Flats (UCRTT, 2002).

9.8 Nason Sub-watershed

Area Description

Nason Creek drains a 69,010 acre area and joins the Wenatchee River at Wenatchee RM 53.6, contributing 18% of the Wenatchee Watershed's annual flow (Wenatchee River Watershed Action Plan Addendum, 1996). The precipitation on this sub-watershed ranges from approximately 40 to 80 inches per year at Stevens Pass. The U.S. Forest Service manages approximately 78% of the sub-watershed (Wenatchee River Watershed Action Plan, 1998). The total population was 144 people (0.8% of the Wenatchee Watershed's population) in 2000. There are small unincorporated

communities located throughout the drainage with service facilities located primarily at Coles Corner, Stevens Pass and near the mouth of Nason Creek.

The Great Northern Railroad was routed up Nason Creek and across Stevens Pass in the 1890s. State Highway 2 also traverses the sub-watershed. Both the highway and railroad follow the creek and have fragmented habitat and constrained channel movement, especially in the lower 8 to 9 miles of the creek. Stevens Pass Ski Resort is located at the upper bound of the sub-watershed and a wastewater treatment plant now operates on Stevens Creek near the east portal of the 2 1/2 mile original Cascade Tunnel. In 1943 the lower four miles of Nason Creek were constrained when State Highway 207 was straightened and relocated through the existing meander zone of the creek from Coles Corner to the headwaters of the Wenatchee River.

Native salmonid species in the Nason Creek Sub-watershed are spring Chinook, steelhead, migratory and resident bull trout, and westlope cutthroat trout (migratory and resident bull trout spawn in the colder headwater tributaries and migrate within other Wenatchee sub-watersheds and the Columbia River). Figure 9-8 provides an overview of the sub-watershed, its land uses, stream gage and control point locations, water quality issues, fish barriers, habitat recommendations, and fish presence.

Nason Issues

Meeting water quality standards, maintaining instream flows and protecting salmonid habitat are the leading issues in the Nason Sub-watershed. Nason Creek has exceeded State and federal water quality standards for temperature. Temperature, along with limited habitat diversity, channel instability, sedimentation, and obstructions could pose risks for salmonid populations in the sub-watershed. Water needs in the Nason Sub-watershed are limited primarily to providing and protecting instream flows to benefit fish and other aquatic resources and possibly to improve water quality.

Recommended Actions - Nason Sub-watershed

The following actions have been recommended to address water quantity, instream flows, water quality, and habitat issues as they relate specifically to the Nason Sub-watershed. The issues and recommended actions are also summarized in Table 2-15. These actions should be implemented along with the watershed-wide actions (Tables 2-1 through 2-7) as discussed in Sections 4 – 8, 10, and 11 in this Watershed Plan. Responsibility for implementing the actions in the Plan is subject to securing necessary funding.

9.8.1 Water Management Recommended Actions

The Nason Creek near mouth gage is used to administer the water resource management strategy this sub-watershed. The maximum allocation associated with the Nason Creek gage is subject to flows. In the case of the Nason Creek Sub-watershed, the strategy includes both a maximum allocation for seasonal water for storage and other uses, and a reservation of 0.1 – 0.16 cfs. The reservation is part of the 0.5 – 1.0 cfs that is available for the entire upper watershed, above Leavenworth

Various water management alternatives need to be evaluated to determine the most effective methods to fulfill instream and out-of-stream needs and mitigate the impacts to habitat, streamflow, and groundwater levels in this sub-watershed. An alternatives analysis of water management options will be conducted as part of the implementation phase of watershed planning (Phase IV). The analysis will clearly address specific water needs in the Nason Sub-watershed, and evaluate water conservation, storage opportunities, purchase, lease and transfer of water rights, inter-basin transfer of water and other alternatives to determine the appropriate combination of water management options that could be used to increase the water availability in the Nason Sub-watershed. Water management

alternatives for this assessment are discussed further in Section 5 (watershed-wide water quantity recommendations). Sub-watershed specific storage opportunities included in the Multi-purpose Storage Assessment (MWG, 2006) for the Nason Sub-watershed are presented below.

- CMZ Project N1: Reconnect an oxbow located to the east of Hwy 207 to the main Nason Creek channel using a culvert to provide high-flow off-channel habitat for juvenile salmonids and increase floodplain storage.
- CMZ Project N2: Reconnect an oxbow located to the east of Hwy 207 using a culvert which has been cut-off to fish access from the main Nason Creek channel to provide high-flow off-channel habitat for juvenile salmonids.
- CMZ Project N3: Reconnect a remnant oxbow to the mainstem by the construction of a proper culvert to provide high-flow off-channel habitat for juvenile salmonids within the N3 and N2 wetland complex. A larger connection would increase floodplain storage.
- CMZ Project N4: Reconnect a remnant oxbow to the mainstem by the construction of a proper culvert to provide high-flow off-channel habitat for juvenile salmonids and increase floodplain storage Channel reconstruction on the west side of Hwy 207 would also be necessary for fish passage to and from the Nason Creek mainstem.
- Nason Creek Floodplain Storage (10-50 acre-feet): Review the feasibility of improving the connection between Nason Creek and the floodplain wetland that is separated from Nason Creek by the railroad embankment or constructing a water level control in the wetland to increase storage.
- Coulter Creek Instream Reservoir (10-50 acre-feet): Potential site for an instream reservoir on National Forest land at elevation 3,300 ft.
- Roaring Creek Tributary Off-channel Reservoir (1-10 acre-feet): Potential site for an off-channel reservoir at the site of a small existing lake on National Forest land at about elevation 5,120 ft.
- Roaring Creek instream reservoir (10-50 acre-feet): Potential site for instream reservoir is at elevation 4,400 ft. Site is located on National Forest land.
- Lanham Lake (10-50 acre-feet): Potential site at small existing lake on National Forest land at about elevation 4,140 ft.
- Nason Creek Off-channel Reservoir (10-100 acre-feet): Divert water to an off-channel reservoir on National Forest land at an elevation of about 2,350 ft near the confluence of Whitepine Creek and Nason Creek.
- Rock Lake (10-50 acre-feet): Potential site at a small existing lake on National Forest land at about elevation 5,900 ft.
- Cresent Lake (10-50 acre-feet): Potential site at a small existing lake on National Forest land at about elevation 5,450 ft.
- Canaan Lake (10-50 acre-feet): Potential site at a small existing lake on National Forest land at about elevation 5,900 ft.
- Merritt Lake (10-50 acre-feet): Potential site at a small existing lake on National Forest land at about elevation 5,000 ft.

- Mill Creek Instream Reservoir (100-500 acre-feet): Construct a large instream reservoir on National Forest land. A potential problem is a railroad tunnel located 200-300 feet under the reservoir site.
- Upper Nason Creek Off-channel Reservoir (50-100 acre-feet): Construct an off-channel reservoir on the north side of Hwy 2 to hold diverted water.

9.8.2 Water Quality Recommended Actions

The sub-watershed-specific water quality actions for temperature in the Nason Sub-watershed are listed in Section 7, Water Quality. See Table 2-4 for additional watershed-wide water quality actions.

9.8.3 Habitat Recommended Actions

The Nason Creek Sub-watershed has been assigned a Category 2 Habitat Priority. This implies that it is a sub-watershed that supports important aquatic resources and is a stronghold for one or more listed species. Compared to Category 1 areas, Category 2 areas have a higher level of fragmentation resulting from habitat disturbance or loss. In addition, native populations have been lost or are at risk because of limited habitat diversity, channel instability, sedimentation, and obstructions. Restoring ecosystem function and connectivity within this area are priorities (UCSRB, 2005). Appendix C provides detail on habitat projects current as of June 2005. Habitat recommendations from the 2005 Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) and the Biological Strategy (UCRTT, 2002) include:

NasonH-1: Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts) (UCSRB, 2005).

NasonH-2: Increase habitat diversity and natural channel stability by increasing in-channel large wood complexes, restoring riparian habitat, and reconnecting side channels, wetlands, and floodplains to the stream (UCSRB, 2005).

NasonH-3: Improve road maintenance to reduce fine sediment recruitment to the stream (UCSRB, 2005).

NasonH-4: Reduce high water temperatures by reconnecting side channels and the floodplain and improving riparian habitat conditions (UCSRB, 2005).

NasonH-5: Protect remaining floodplain and riparian habitat (UCRTT, 2002).

9.9 White River, Little Wenatchee River, and Lake Wenatchee Sub-watersheds

Area Description

The headwaters of the Wenatchee Watershed contain three sub-watersheds: White, Little Wenatchee, and Lake Wenatchee, one of the few remaining large, free flowing, natural lakes in the state. These watersheds contain some of the most pristine habitat found in the state of Washington today. The Little Wenatchee and White Rivers flow into Lake Wenatchee, the outlet of which is the source of the Wenatchee River, at RM 54.2. The White River contributes 25% of the Wenatchee River's annual flow; the Little Wenatchee River, 15% (Wenatchee River Watershed Action Plan Addendum, 1996). The precipitation on these sub-watersheds ranges from 30 to 120 inches per year, and the White River is fed by glaciers along the Cascade Crest. Elevation ranges from 1,870 feet at the lake (MWG, 2003) to above 5,000 feet in the Little Wenatchee River drainage along the Cascade Crest and above 7,000 feet along the Cascade Crest in the White River drainage. The primary land cover in all three sub-

watersheds is forest, which makes up 63.7% of the White, 84.3% of the Little Wenatchee, and 73.4% of the Lake Wenatchee. In the Lake Wenatchee area only 10,322 acres are considered commercial forest.

The total population was 281 people (1.5% of the Wenatchee Watershed's population) in these three sub-watersheds in 2000 based on census data. There are also a significant number of part-time residents in the area that may not be accounted for by the US Census. A number of people camp at the Lake Wenatchee State Park in the summer months. Lake Wenatchee and Fish Lake support recreational activities and tourism, providing opportunities for camping, boating, fishing, hiking, biking horseback riding, golfing, cross country skiing, snowmobiling, and other outdoor activities. The Little Wenatchee and White Sub-watersheds also offer recreational opportunities and allow hikers access to the large wilderness areas.

Native species in these sub-watersheds are sockeye, spring Chinook, steelhead, rainbow, westlope cutthroat and bull trout (migratory and resident bull trout spawn in the colder headwater tributaries and migrate within other Wenatchee sub-watersheds and the Columbia River). The White and Little Wenatchee Sub-watersheds are also designated as key watersheds by the Northwest Forest Plan, and provide critical spawning and rearing habitat for multiple species. The Lake Wenatchee Sub-watershed is a necessary adult holding and juvenile rearing area for sockeye salmon and bull trout. The sub-watershed is located at an important point along the Cascade Range and provides connectivity for terrestrial wildlife for species moving north-south and east-west.

Reconnecting the floodplain area to the wetlands where the Little Wenatchee and White Rivers enter Lake Wenatchee is important for maintaining habitat diversity (UCSRB, 2005). Some National Forest land in these sub-watersheds has been designated as "Riparian Reserve," which protects it from harvest, and protects stream water quality and riparian function. Figure 9-9 provides an overview of the sub-watersheds, their land uses, stream gage and control point locations, water quality issues, fish barriers, habitat recommendations, and fish presence.

White River, Little Wenatchee, and Lake Wenatchee Sub-watersheds Issues

Maintaining the existing pristine conditions found in much of the White and Little Wenatchee Rivers is a key issue. Other issues are improving water quality, reducing erosion, the reduction of high water temperatures found at the mouth of the Little Wenatchee River, maintaining unrestricted fish passage, protecting spawning areas from motorized water craft, and the protection of riparian and upland areas. Within the Lake Wenatchee area possible pollution from fish pens and the reduction of ground cover in wetlands at the western end of the lake are areas of concern. These sub-watersheds are relatively pristine and require protection to maintain the stream channel and flood-plain integrity. Although the Little Wenatchee Sub-watershed has 2004 303(d) listings for temperature, it is possible that this temperature exceedance is due to natural conditions. The White and Little Wenatchee Rivers have been considered for nomination to the status of Wild, Scenic, or Recreational River status.

Water needs in the White, Little Wenatchee, and Lake Wenatchee Sub-watersheds include that for (1) maintaining instream flows to benefit fish and other aquatic resources to maintain a high quality aquatic and terrestrial habitat environment; (2) small domestic water supply to support future growth; and (3) recreational activities.

Recommended Actions – White River, Little Wenatchee, and Lake Wenatchee Sub-watersheds

The following actions have been recommended to address water quantity, instream flows, water quality, and habitat issues as they relate specifically to the White, Little Wenatchee, and Lake Wenatchee Sub-watersheds. The issues and recommended actions are also summarized in Table 2-16. These actions should be implemented along with the watershed-wide actions (Tables 2-1 through

2-7) as discussed in Sections 4 – 8, 10, and 11 in this Watershed Plan. Responsibility for implementing the actions in the Plan is subject to securing necessary funding.

9.9.1 Water Management Recommended Actions

The existing control point at the Wenatchee River at Plain gage is intended as a measuring point for the upper portion of WRIA 45 including the White, Little Wenatchee and Lake Wenatchee Sub-watersheds. The maximum allocation associated with the Plain gage is subject to flows. In the case of these sub-watersheds, the maximum allocation includes seasonal water for storage and other uses, subject to flows, and a reserve of 0.05 cfs for the White and Little Wenatchee Sub-watersheds and 0.1 cfs for the Lake Wenatchee Sub-watershed.

Various water management alternatives need to be evaluated to determine the most effective methods to fulfill instream and out-of-stream needs in WRIA 45. An alternatives analysis of water management options will be conducted as part of the implementation phase of watershed planning (Phase IV). The analysis will clearly address specific water needs in the White, Little Wenatchee, and Lake Wenatchee Sub-watersheds, and evaluate water conservation, storage opportunities, purchase, lease and transfer of water rights, inter-basin transfer of water and other alternatives to determine the appropriate combination of water management options that could be used to increase the water availability in these three sub-watersheds. Water management alternatives for this assessment are discussed further in Section 5 (watershed-wide water quantity recommendations). Sub-watershed specific storage opportunities included in the Multi-purpose Storage Assessment (MWG, 2006) for the White, Little Wenatchee, and Lake Wenatchee Sub-watersheds are presented below.

White

- Connection to old oxbows and other floodplain storage areas: There are numerous areas in the White River floodplain that may benefit from improving connection between the river and floodplain or constructing side channels or oxbows to increase water storage in the floodplain.

Little Wenatchee

- Lake Creek Instream Reservoir (100-500 acre-feet): Construct an instream reservoir on Lake Creek on National Forest land at about elevation 2,600 ft.
- Fish Creek Instream Reservoir (100-500 acre-feet): Construct an instream reservoir Fish Creek on National Forest land at about elevation 2,800 ft.

9.9.2 Water Quality Recommended Actions

The sub-watershed-specific water quality actions for temperature in the Little Wenatchee Sub-watershed are listed in Section 7, Water Quality. There are no additional sub-watershed-specific water quality actions for the White or Lake Wenatchee Sub-watersheds. See Table 2-4 for applicable watershed-wide water quality actions.

9.9.3 Habitat Recommended Actions

The White River, Little Wenatchee, and Lake Wenatchee Sub-watersheds have been assigned a Category 1 Habitat Priority. This implies that these sub-watersheds represent systems that most closely resemble natural, fully functional aquatic ecosystems. They comprise large, connected blocks of high-quality habitat that support more than two listed species. Exotic species may be present but are not dominant in abundance. Protecting this area is a priority (especially from development

pressure in the White River Sub-watershed) although restoration in some areas is also needed due to sedimentation (UCSRB, 2005). Appendix C provides detail on habitat projects current as of June 2005. Habitat recommendations from the 2005 Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) and the Biological Strategy (UCRTT, 2002) include:

WhiteH-1: Increase habitat diversity within the lower 2 miles of the White River by reconnecting the floodplain and wetlands to the river (UCSRB, 2005).

WhiteH-2: Protect stream channel, riparian, and floodplain functions. Focus on Panther Creek downstream to mouth (UCRTT, 2002).

WhiteH-3: Protect shorelines along Lake Wenatchee near White River mouth (UCRTT, 2002).

LitWenH-1: Reduce sediment recruitment to the stream by improving road maintenance within the watershed (UCSRB, 2005).

LitWenH-2: Protect stream channel, riparian, and floodplain functions; focus on Little Wenatchee River falls downstream to mouth (UCRTT, 2002).

LkWenH-1: Protect remaining near shore habitat, and develop a means to reduce impacts of bulkheads (UCRTT, 2002).

10.0 PLAN IMPLEMENTATION

Phase IV of the watershed planning process is implementation, which commences when the final plan is adopted by Chelan County and the Planning Unit agrees to apply for Phase IV funding for implementation. Effective implementation, including coordination and oversight, is critical to the success of the watershed planning process. Although the Planning Unit has put years of work into this Watershed Plan, it can only be successful if it is seen through Phase IV. Planning Units are encouraged to develop a detailed implementation plan within one year of the Wenatchee Watershed Plan's adoption. State funding for Implementation is $400,000, distributed over five years, and requires 10% matching funds, which may consist of in-kind goods and services.

10.1 Plan Obligations

The Wenatchee Watershed Planning Unit recommends that voluntary, cooperative measures are preferred over regulatory enforcement approaches to obligate State, local and Tribal governments.

The Planning Unit accepts that any strategies, actions, obligations or potential obligations assigned to local, State or federal agencies and Tribes as a result of this Planning Process and the current Wenatchee Watershed Plan are contingent on securing necessary funding, resources, and legislative authorizations where required, and are subject to applicable regulations including SEPA and NEPA requirements.

The Planning Unit recognizes that many of the implementation actions included in this plan may need additional assessment and planning before implementation can proceed and responsibilities can be assumed. It also recognizes that implementation is subject to budgetary constraints, and that no entity is obligated to implement a prescribed action in this Plan unless adequate funding is available to do so, as described in 2E2SHB 1336. It is expected that Federal entities will support the Plan elements within the limits of available resources.

10.2 Implementation Actions

This plan recommends a number of both watershed-wide and sub-watershed specific actions concerning the water resource management strategy, water quantity, growth and land use, water quality and habitat. There are overall implementation actions that will be necessary to provide the structure under which individual actions can be implemented. These "implementation actions," summarized in Table 2-6, are provided below:

10.2.1 Watershed Planning Administration and Plan Updates

IMP-1: WWPU and Subcommittees will continue to exist and operate under the current operating procedures and will address any needed reorganization to implement the plan as part of Phase IV, Implementation.

IMP-2: Build a revision process and schedule for the Wenatchee Watershed Plan into plan implementation. Ensure that new plan actions and best available science can be integrated in the future. Planning horizon will be 20 years (through 2025). Updates should be scheduled every seven years, also consistent with County comprehensive plan revision schedule. If additional updates are necessary based on the availability of data or unforeseen water-related issues, the process should be designed such that those updates are possible.

Future amendments and additions to the Plan will be approved by the Planning Unit (implementing body) according to an Intergovernmental Agreement, bylaws, and/or operating procedures and will be subject to a public review process including opportunities for comment at meetings of the PU (or other implementing body) and special community or public meetings. *No organization can be obligated to implement an action included in the plan or a plan update, unless they agree to the obligation (RCW90.82.130(3)).*

10.2.2 Funding and Staffing

IMP-3: Prioritize educational needs, projects, policies and management strategies for funding and implementation (may accomplish some prioritization for Aquatic Habitat Actions through salmon recovery).

IMP-4: Continue to identify alternate funding sources (alternate to watershed planning funds).

IMP-5: Consider implementation funding for grant writers.

IMP-6: Develop recommendations (such as cooperative agreements) for formalizing obligations with the entities identified as responsible for Plan actions.

IMP-7: The Chelan County Natural Resource Department (CCNRD) provides a vital link between water availability, land management and the Watershed Planning Unit. The Watershed Planning Unit supports the ongoing efforts of CCNRD to work with the Watershed Planning Unit to ensure natural resource concerns and technical resources and databases are maintained.

10.2.3 Coordination within the Watershed

IMP-8: In developing its implementation plan, the Watershed Planning Unit will support the development and implementation of existing plans and programs occurring within the watershed while striving to avoid inconsistent or duplicative activities and policies.

IMP-9: The Planning Unit can choose to review and provide comment on large projects proposed in the watershed that would likely have an impact on the water resource. This could be a review of project or programmatic level Environmental Impact Statements (EISs) or other documents.

IMP-10: The WRIA 45 Planning Unit members will be involved in the public planning process. The Planning Unit will disseminate information about public comment opportunities to its members. Additionally, the Planning Unit will provide opportunities for public comment on watershed scale studies and plans when, by a vote of the Planning Unit, they are determined to be a priority of the Planning Unit and important to the overall health of the watershed.

10.2.4 Monitoring

IMP-11: Ensure that there is an ongoing coordinated monitoring program consistent with the Intensively Monitored Watershed Program currently being administered through NOAA Fisheries and the RTT. Designate responsible entities, a single data management hub for long term monitoring, and a single custodian to store and manage and generally oversee this effort into the future (requires long term commitment).

10.3 Adaptive Management

Adaptive management, or revising strategies and recommendations as new information is gathered, will be applied to actions in the Phase III Plan during Phase IV, Implementation. Adaptive management has been recognized as an approach to maintain the relevance of the Plan over the 20-year planning horizon. To that effect, specific actions and strategies have been noted that require further development, additional data collection and subsequent modification. The actions and strategies listed below will require further development in Phase IV Implementation.

WRMS-3: The WWPU with Chelan County taking the lead role will participate in the development and implementation of an adaptive management process to support this water resource management strategy. The process should address flexibility in the distribution of the reserve across the WRIA. The details of the adaptive management process will be determined as part of Phase IV Implementation.

WRMS-4c: Recommends a new stream gage be established at the existing control point on the Icicle Creek. Details will be determined during Phase IV, Implementation.

MissionQUANT-1: Chelan County as lead (with support from Ecology), will convene a Mission Creek Forum to assess options to provide water for future growth through the purchase, lease or transfer of existing, valid water rights or from storage (storage opportunities within Mission Sub-watershed or through the Peshastin and/or Icicle Irrigation districts). This will be conducted for the purpose of providing an uninterruptible supply for domestic, municipal and stock water uses. During Phase IV, Implementation, the Mission Creek Forum will determine whether the strategies for Mission are relevant to Brender Creek, and consider assembling separate strategies to address local instream flow concerns and conditions for Brender Creek, if appropriate.

Within two years of rule adoption, the Forum will have developed opportunities and researched funding opportunities for these alternatives.

MissionQUANT-2: As part of Phase IV, Implementation, evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Mission Creek and evaluate water conservation, storage, purchase, lease and transfer of water rights, water from other sub-watersheds, and other alternatives as appropriate.

PeshastinQUANT-3: As part of Phase IV, Implementation, evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Peshastin and evaluate water conservation, storage, purchase, lease and transfer of water rights, and other alternatives.

ChumQUANT-10: As part of Phase IV, Implementation, the Planning Unit and the Chumstick Forum (with Chelan County as lead) will evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Chumstick and evaluate water conservation, storage opportunities, purchase, lease and transfer of water rights, water transfer from other sub-watersheds, and other alternatives. Consider conjunctive use and evaluate pumping from the deep aquifer to augment flows in the Chumstick. Investigate storage options where stored water could be used to augment flows and provide mitigation water.

QUANT-6: Develop an administrative structure for a water bank for WRIA 45. Section 5.1.3 introduces water banks; however, the details of the administration of a water bank in WRIA 45 will be determined in Phase IV, Implementation.

QUANT-8: Chelan County Natural Resource Department will develop and administer a monitoring program to assess actual domestic water use to verify the 380 gpd per household assumption used to debit the reservation and to adjust the amount of water remaining in the reservation at five year intervals, or more frequently if the number of wells drilled or building permits granted indicate that growth is occurring more rapidly than projected in any sub-watershed. These assessments will be conducted based on a statistical sample of new domestic water users (single domestic, group domestic and municipal water use and associated lawn and garden irrigation (some with separate irrigation, some without), some with stock, etc.). Metering data will be incorporated into the water use audit and the accounting system.

This monitoring program will be included as part of the adaptive management element to the water resource management strategy discussed in Section 4.0. If necessary, the per household water use factor used to debit the reservation will be adjusted based on statistical sampling and metering in the WRIA (380 gpd/hh is a guide, an accounting tool).

This water use audit will be further developed during Phase IV, Implementation. As part of this audit, the consumptive portion of the daily household water use factor will be assessed, and may be used to debit the reservation. This will be considered during the first year of implementation.

QUANT-9: Reservation accounting will include the tracking of new exempt wells by Chelan County through the building permit process, septic approval through the Chelan-Douglas Health District (CDHD), tracking new domestic and municipal water rights granted by Ecology and tracking well drilling permits as issued by Ecology. The mechanism for tracking the permitted uses will be determined as part of Phase IV, Implementation. Chelan County is currently developing a method for tracking new permit-exempt wells in WRIA 46. This should also be considered for WRIA 45.

> **QUANT-9b**: New rights that are granted by Ecology for domestic water uses will be tracked by CCNRD. The mechanism for tracking the new permitted uses that will debit the reserve will be determined as part of Phase IV, Implementation.

QUANT-10: The Planning Unit recommends metering be required for all new uses eligible under the reserve. The Planning Unit will further define responsible entities, and staffing, budget and funding considerations of the metering program as part of Phase IV, Implementation. Chelan County, CDHD, Ecology, utilities, and others will work together to structure the program. The following should be addressed as part of phase IV:

- Identify responsible entities, and address staffing, cost and funding concerns
- Consider implementation by an existing utility with an existing metering program
- Consider having water users read their own meters
- Consider use of Ecology's water measuring system and database
- Consider metering options for existing water users and development of a voluntary program that uses existing metering programs' available meters.

QUANT-11: Undertake hydrogeologic studies to assess the influence of groundwater withdrawals on surface water. Identify funding for this study and responsible parties (WWPU to identify sub-areas for study, responsible entity as part of Phase IV, Implementation).

QUANT-14: Credit a water service provider for abandoned and/or decommissioned exempt wells. This action will be further developed in Phase IV, Implementation. The well consolidation process is

addressed in RCW 90.44.105. This statute presumes a credit of 800 gpd/well unless an alternative minimum is established by Ecology in consultation with DOH or there is credible evidence of non-use.

QUANT-15: As part of Phase IV, Implementation, Chelan County and cities should develop policies that can be used to ensure efficient use of water in the event of a land division or new development. These include:

> **QUANT-15a**: For land division applications that have shares in an irrigation district, develop policies requiring that the developer provide tie-ins to the irrigation box; ensure easements; deliver water to parcels, where practicable; and form a Homeowners Association for residential uses. Encourage Irrigation Districts to work with the county and cities to extend infrastructure and irrigation water service where practicable.
>
> **QUANT-15f**: Encourage cluster development, and group domestic over single domestic systems to increase water use efficiency. Explore encouraging group domestic over single domestic use as part of the approval process for land division applications. Further develop this recommendation as part of Phase IV, Implementation.

QUANT-16d: As part of Phase IV, Implementation, convene a forum to investigate conservation strategies and how they could be implemented by irrigation districts, ditches and other private companies. Involve utilities, cities, Chelan County and Ecology when appropriate. There is a need to work with members of irrigation districts, ditches and others to determine ways to save water and ensure that water rights are protected into the future. Items of discussion could include alternative rate structures based on purpose of water use; partnerships with cities and utilities; utility coordination during development; tools to conserve water, improve instream flows and protect water rights at the same time; and distribution of public education materials.

QUANT-18: Encourage the County to provide information and education about water conservation options and fire planning; including: outdoor watering, timing, types of native vegetation that require low water use, lawn size, low flow fixtures, etc. to the new land user. The Municipal Water Law requires that water systems provide education and outreach regarding water conservation. However, water users that are using irrigation ditch water for outdoor use and/or exempt wells will not receive this information. Irrigation systems may also be able to provide materials in monthly billings. The details of this educational program will be determined during Phase IV, Implementation. Realtors should be encouraged to distribute public education materials describing water conservation and efficient water management techniques.

QUANT-20b: Study groundwater in specific areas of the watershed (eg., Mission Creek, Lower Chumstick/Eagle Creek area, Monitor area). Finalize the areas for study as part of Phase IV, Implementation.

QUANT-21: Evaluate the consumptive portion of reserved water uses and determine if recharge credit should be included in the accounting of the reservation.

IMP-12: Revise and refine water quality management strategies for both point and nonpoint source pollutants to reflect new data.

IMP-13: Perform additional studies to fill data gaps and address unanswered questions as determined by the Water Quality Technical Subcommittee. Ecology will partner with stakeholders in the watershed to conduct studies addressing information gaps (eg., monitoring).

QUAL-4: Encourage the Wenatchee Watershed Planning Unit and its other subcommittees (Water Quantity, Instream Flow, Habitat, and Growth and Land Use) to use the information in the TMDL Technical Reports and SISs along with their conclusions, recommendations, and actions for a more holistic approach to restoration, preservation, and enhancement of the watershed for all beneficial uses (WQTS, 2006a; WQTS, 2006b; WQTS, 2006c; WQTS, 2006d).

QUAL-5: Appropriate actions to be used in the appropriate location should be determined to address temperature exceedances in Phase IV, Implementation for all of the temperature-related recommendations in the Plan.

LowWenQUAL-2, **IcicleQUAL-2** and **UpWenQUAL-2:** Strategies to address point and non-point sources of phosphorus as part of the TMDL for DO and pH will be reported during the implementation phase of the Wenatchee Watershed planning effort.

IMP-14: Further analysis and discussion may need to take place in Phase IV, Implementation regarding maximum allocation limits in specific sub-watersheds and the mainstem Wenatchee and the relationship between the allocations, and habitat and channel-forming processes.

IMP-15: All actions specified in the Wenatchee Watershed Plan should be revisited by the Planning Unit during Phase IV, Implementation.

11.0 PUBLIC OUTREACH

A coordinated public outreach effort is necessary to garner support for ongoing watershed management efforts, proposed efforts, and the actions recommended in this plan. Several previous programs have proposed public outreach efforts as part of their implementation: 1998 Wenatchee River Watershed Action Plan, Wenatchee Subbasin Plan, Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan, the Wenatchee TMDL process, Lead Entity Strategy Development, and others. This Plan supports the continued public outreach efforts associated with those efforts and outlines public outreach activities that will support this Plan, are consistent with ongoing efforts, and avoid duplication. The outreach strategies identified in this Watershed Plan are consistent with those identified in the WRIA 45 Integration Framework (Golder, 2004) wherein public outreach tasks were identified and prioritized by the WRIA 45 Public Outreach Subcommittee based on funding and staffing needs.

Some of the outreach-related recommendations proposed in the 1998 Watershed Action Plan are very relevant to actions proposed in this Watershed Plan. They include:

1) "informing the public about on-site septic systems and encouraging available alternatives to on-site septic systems";

2) "informing and educating the public about improving agricultural practices to decrease non-point source pollution";

3) "informing and educating landowners, businesses, and the public about forest rules, regulations, best management practices, and forest issues";

4) "educating the public about the water quality impacts of development, storm water, and erosion and actions that can reduce those impacts"; and

5) "establishing an Environmental Education Committee to oversee public education on water quality issues and actions".

The general actions proposed by this Plan involve public information and education efforts to: 1) promote support for the Plan; 2) involve the stakeholders in the Plan's implementation; 3) encourage water conservation measures and programs that support the water resource management strategy; and 4) promote community awareness about the watershed's ability to support human, biological, ecological, and environmental needs.

Public outreach actions proposed in this plan (Table 2-7) include the involvement of the general public, youth groups, interest groups, elected officials, implementers, funding agencies and entities, and resource industries. The actions, listed in the order in which they appear in the plan, include:

ChumQUANT-11: Encourage conservation and outreach.

NSTQUANT-3: Chelan County and Ecology to provide public information regarding water limitations in Northside Tributaries (Fact Sheets).

QUANT-13: Provide public education as to the roles, responsibilities and regulations pertinent to exempt wells, and encourage the proper entities to enforce/implement (CDHD, DOH, Ecology, County).

QUANT-15e: Provide public information that encourages actions QUANT-15a through QUANT-15d, and explains the benefits (provide this information during subdivision application or preliminary plat comment period).

QUANT-16d: As part of Phase IV, Implementation, convene a forum to investigate conservation strategies and how they could be implemented by irrigation districts, ditches and other private companies. Involve utilities, cities, Chelan County and Ecology when appropriate. There is a need to work with members of irrigation districts, ditches and others to determine ways to save water and ensure that water rights are protected into the future. Items of discussion could include alternative rate structures based on purpose of water use; partnerships with cities and utilities; utility coordination during development; tools to conserve water, improve instream flows and protect water rights at the same time; and distribution of public education materials.

QUANT-18: Encourage the County to provide information and education about water conservation options and fire planning; including: outdoor watering, timing, types of native vegetation that require low water use, lawn size, low flow fixtures, etc. to the new land user. The Municipal Water Law requires that water systems provide education and outreach regarding water conservation. However, water users that are using irrigation ditch water for outdoor use and/or exempt wells will not receive this information. Irrigation systems may also be able to provide materials in monthly billings. The details of this educational program will be determined during Phase IV, Implementation. Realtors should be encouraged to distribute public education materials describing water conservation and efficient water management techniques.

H-11: Efforts that are ongoing in the Wenatchee Watershed to improve or maintain habitat quality need to be encouraged and retained. Recognize and acknowledge achievements in the watershed that have accomplished habitat improvement or protection. Develop a landowner or organization recognition program to recognize habitat improvement projects or achievements in the watershed.

PO-1: Provide support of specific education and outreach programs in the watershed. Programs include: 4H Forestry Education Program, Kids in the Creek, Salmon Fest, Trout Unlimited education programs, Bird Fest, Chelan Douglas Land Trust field trips, Hatchery programs (Leavenworth National Fish Hatchery, and friends of NW Hatcheries), existing noxious weed/native plant education programs, and others.

PO-2: Encourage the 4-H program and CCCD to develop and conduct watershed clean-up education programs.

H-12: Initiate public information efforts to discourage harassment of spawning salmonids (UCRTT, 2002).

LowWenQUAL-9, **IcicleQUAL-7** and **UpWenQUAL-8**: Nutrients (phosphorous) can enter surface and ground water from residential yards and gardens, hobby farms, City and County Parks, business owned landscapes, etc. An education outreach plan should be developed and implemented to heighten awareness and reduce inputs from these sources. Policies and practices should be implemented in City and County Public Works departments. The County and cities should consider implementing a ban on the sale of high phosphate detergents, such as is being considered in Spokane. Conduct associated monitoring and adaptive management (WQTS, 2006a).

MissionQUAL-6: Activities should be identified and undertaken to provide ongoing outreach, education, and technical assistance to growers, streamside landowners, developers, stakeholders, and the general public (WQTS, 2006b).

MissionQUAL-14 and **ChumQUAL-3**: CDHD will continue to implement onsite sewage disposal system technical assistance and education programs for homeowners and the industry (WQTS, 2006c).

MissionQUAL-15 and **ChumQUAL-4**: The CDHD will continue to permit sewage systems per Washington Administrative Code (WAC), including analyzing soils and technologies suitable for individual sites; review/approve the proposed design, specifications, installation and if required, the ongoing maintenance in accordance with the WAC; provide public information under real estate disclosure laws; and review all land use proposals to ensure that the WAC is properly enforced prior to approval by the County (WQTS, 2006c).

MissionQUAL-20 and **ChumQUAL-9**: Conduct stream walk cleanups along the stream (Fall, Spring, Summer) with area schools, homeowners, and other groups (WQTS, 2006c).

MissionQUAL-21 and **ChumQUAL-10**: Conduct ongoing community fecal coliform education/awareness campaigns throughout the year. Engage and get support from homeowners (WQTS, 2006c).

MissionQUAL-23 and **ChumQUAL-12**: Conduct education and enforcement actions to stop illegal dumping of wastes either to storm drains or directly to surface waters. This dumping may be of portable toilet wastes, recreational vehicle wastes, etc. (WQTS, 2006c).

MissionQUAL-25 and **ChumQUAL-14**: The WQTS and its participating entities should work with the public and homeowners regarding BMPs to reduce fecal coliform runoff. General actions should include public information, education, and technical assistance regarding watering practices, landscaping, stormwater runoff, filtration practices, animal waste, etc. (WQTS, 2006c).

PO-3: CCNRD to ensure that summary fact sheets are created by sub-watershed and develop and provide outreach materials for people at different levels: technical, non-technical, etc.

PO-4: Prepare Community Documents by tributary (or sub-watershed) that describe the watershed and the water related management strategies that have been recommended to address specific issues in the individual sub-watersheds. An example was prepared for the Icicle Sub-watershed. Obtain funding to create, produce and distribute these documents.

12.0 STATE ENVIRONMENTAL POLICY ACT (SEPA) GAP ANALYSIS

This Chapter of the Wenatchee Watershed Plan provides documentation of programmatic State Environmental Policy Act (SEPA) compliance specific to the Wenatchee Water Resource Inventory Area 45 (WRIA 45) Watershed Plan for adoption of the Plan by Chelan County.

This Chapter provides the following information:

- A description of the process used to evaluate consistency of the Wenatchee Watershed Plan with the statewide Programmatic Environmental Impact Statement (EIS) for Watershed Planning;
- A summary of the assumptions and judgments used in determining SEPA compliance of Wenatchee Watershed Plan actions; and,
- Documentation of compliance of each action recommended in the Wenatchee Watershed Plan with requirements for programmatic, non-project SEPA review.

12.1 Wenatchee Watershed Plan Approach for Programmatic SEPA compliance

The following options for were considered for SEPA compliance in WRIA 45:

- **Adoption of the statewide programmatic Watershed Planning EIS and Determination of Significance (DS).** This is an option if the statewide programmatic Watershed Planning EIS adequately addresses all probable adverse impacts. The County (as lead SEPA agency) will use all or part of an existing document (the statewide programmatic Watershed Planning EIS) to meet all or part of the proponent's responsibilities under SEPA to prepare an EIS or other environmental document. A Determination of Significance (DS) is a written decision by the lead SEPA agency that the proposal is likely to have a significant adverse environmental impact and therefore an EIS is required (WAC 197-11-310 and WAC 197-11-360).
- **Adoption, DS, and Addendum.** Same as DS option above, with the addition of an addendum which provides local decision makers with additional local information on compliance with the statewide programmatic Watershed Planning EIS.
- **Adoption, DS, and Supplemental EIS.** If the statewide programmatic Watershed Planning EIS addresses some but not all of the probable significant adverse environmental impacts, a supplemental EIS is necessary.
- **Determination of Non-Significance (DNS).** A DNS could be issued if it is determined that there are no probable significant adverse impacts associated with the recommended actions contained in the Wenatchee Watershed Plan. In the event that a DNS includes mitigation measures as a result of the process specified in WAC 197-11-350, a **Mitigated Determination of Non-Significance (MDNS)** could be issued.

The qualifications, assumptions, and consistencies analyzed to achieve programmatic SEPA compliance for the Wenatchee Watershed Plan are included within this Chapter of the Plan (Chapter 12). This Chapter is considered as the addendum to the statewide programmatic Watershed Planning EIS. The purpose of this Chapter is to document the logic used in the SEPA gap analysis and the compliance of each action in the Plan with programmatic SEPA.

After reviewing the Wenatchee Watershed Plan (Plan), Chelan County (as the lead SEPA agency) has determined they will adopt the statewide programmatic Watershed Planning EIS and issue a determination of significance (DS) to meet its responsibility to prepare a SEPA compliant review of the Plan. Adoption of the statewide programmatic Watershed Planning EIS is addressed with this Chapter (Chapter 12) of the Plan. After adoption of the statewide programmatic Watershed Planning EIS, there is a seven (7) day waiting period before an action can be taken to approve the Plan (WAC 197-11-630).

12.2 SEPA and Watershed Planning

The State Environmental Policy Act (SEPA) (Chapter 43.21C RCW) was enacted by the State legislature to ensure that State and local agencies consider likely environmental consequences of proposed actions during decision-making processes concerning such activities. These consequences are considered during the SEPA review process.

Under SEPA rules, non-project actions are defined as governmental actions involving decisions on policies, plans, and programs. Such actions can include the adoption or amendment of policies, programs, and plans, such as Watershed Plans under Chapter 90.82 RCW. Any non-project action must be reviewed under SEPA unless specifically exempted.

The Washington State Department of Ecology (Ecology) published a Final Environmental Impact Statement for Watershed Planning under Chapter 90.82 RCW in August 2003 (Ecology, 2003). A copy of this statewide programmatic Watershed Planning EIS is available for review at the Chelan County Natural Resource Department offices in Wenatchee, WA and on the internet at http://www.ecy.wa.gov/biblio/0306013.html. Actions that could be included in local watershed plans are considered as SEPA "alternatives" in this statewide programmatic Watershed Planning EIS. Probable significant adverse environmental impacts that may be associated with these "alternatives" were also discussed in the statewide programmatic Watershed Planning EIS. If actions in a local watershed plan are consistent with the alternatives listed in the statewide programmatic Watershed Planning EIS, non-project programmatic SEPA requirements can be fulfilled by the statewide programmatic Watershed Planning EIS.

There are three SEPA compliance processes associated with actions in the Wenatchee Watershed Plan:

1) Programmatic coverage of the County Watershed Plan approval process.

   Programmatic coverage of the Wenatchee Watershed Plan is achieved through adoption of the statewide programmatic Watershed Planning EIS and the issuance of a Determination of Significance for the Wenatchee Watershed Plan.

2) SEPA compliance related directly to rule-making by the State. The State may accept an obligation to propose a Water Resource Management rule as an outcome of actions in the Wenatchee Watershed Plan. This SEPA process for rule-making will be implemented by the State when the action is initiated, and is not the responsibility of the Planning Unit or the lead SEPA agency for Watershed Planning.

   SEPA compliance for rule-making will be accomplished through a separate SEPA process, led by the State, at the time the action is implemented.

3) Non-programmatic SEPA for specific actions. Some specific project or non-project actions recommended in the Wenatchee Watershed Plan, such as the initiation of a specific construction or management activity, will go through a separate SEPA review of the

individual action itself at the time the action is implemented. The SEPA review completed at the current programmatic, non-project level of the SEPA process is adequate for County approval. Where alternatives in the statewide programmatic Watershed Planning EIS provide coverage for these actions, some of the documentation needed for the project-level SEPA approval process may reference the statewide programmatic Watershed Planning EIS and this Chapter. However, the extent of the project SEPA process needed for each action is dependent entirely upon the nature of the specific action and its potential adverse environmental impacts. In some cases, these individual actions are in their early planning stages and are not sufficiently developed to make a SEPA judgment at the time of plan adoption by the County.

This non-programmatic SEPA review of specific actions is not a prerequisite for the SEPA compliance necessary to achieve County approval of the Wenatchee Watershed Plan, but will generally be necessary for plan implementation.

In summary, this chapter of the Wenatchee Watershed Plan and adoption of the statewide programmatic Watershed Planning EIS fulfills the programmatic SEPA requirements necessary for County approval of the Wenatchee Watershed Plan. SEPA compliance for individual (project and non-project) actions in the Wenatchee Watershed Plan may also be granted during this approval process; however, some actions will be required to undergo specific project or non-project level review at the time that the individual action is implemented.

For federal actions, NEPA compliance is required when the action is implemented. However, this compliance is not a prerequisite for approval of the Wenatchee Watershed Plan by the County, nor is it necessary during the programmatic SEPA review. Additionally, the Watershed Planning Unit cannot obligate a federal agency to implement any actions, but can make recommendations to a federal agency.

12.3 SEPA compliance for the Wenatchee Watershed Plan

12.3.1 Plan Consistencies with the Statewide Programmatic Watershed Planning EIS

Recommended actions in the Wenatchee Watershed Plan that are consistent with alternatives described in the statewide programmatic Watershed Planning EIS do not require supplemental information or additional consideration to achieve non-project programmatic SEPA compliance. A SEPA gap analysis was conducted where all alternatives in the statewide programmatic Watershed Planning EIS were reviewed and compared with recommended actions in the Wenatchee Watershed Plan.

The alternatives from the statewide programmatic Watershed Planning EIS that were applied to the Wenatchee Watershed Plan are listed below. Further descriptions of these alternatives and potential environmental impacts can be found in the statewide programmatic Watershed Planning EIS.

The following alternatives apply to one or more actions in the Wenatchee Watershed Plan:

Water Quantity

- WP 1 – Develop and implement municipal conservation programs including demand management and operational efficiency measures.
- WP 2 – Develop and implement agricultural water conservation and irrigation efficiency efforts through regional or irrigation district infrastructure improvements.

- WP 3 – Develop and implement on- farm agricultural water conservation and irrigation efficiency efforts.
- WP 4 – Develop and implement industrial conservation measures.
- WP 5 – Request local governments or sewer utilities to construct and operate water reclamation and reuse facilities (for example, reclamation plants and use areas) to provide water for beneficial uses.
- WP 6 – Promote greywater segregation and use in accordance with Department of Health standards.
- WP 7 – Request Ecology to transfer existing water rights for out-of-stream beneficial uses acquired through purchase, lease, voluntary methods, or condemnation to other out-of-stream beneficial uses.
- WP 8 – Request Ecology to transfer existing water rights for out-of-stream beneficial uses acquired through purchase, lease, voluntary methods, or condemnation to instream beneficial uses through the state's Trust Water Right Program.
- WP 9 – Transfer water through interties of public water systems or irrigation systems.
- WP 10 – Request Ecology to allocate additional ground or surface water on a shortterm or long-term basis.
- WP 11 – Request Ecology to adopt a rule to close or partially close a basin or subbasin.
- WP 14 – Request Ecology to increase enforcement against illegal water use within a basin or subbasin.
- WP 16 – Request local governments to adopt regulations or for Ecology to adopt rules to minimize use of exempt wells, to restrict the siting of wells in proximity to streams, and/or to restrict the finished depth of new wells to the second aquifer unit or lower.
- WP 17 – Where adequate public water supplies are available, extend public water system service into areas served by exempt wells and require any new development to connect to such public water supplies.
- WP 18 – Request Ecology to require water users to install, operate, and maintain water quantity monitoring devices such as meters and gauges.
- WP 19 – Construct and operate new on-channel storage facilities.
- WP 20 – Raise and operate existing on-channel storage facilities.
- WP 21 – Construct and operate new off-channel storage facilities.
- WP 22 – Raise and operate existing off-channel storage facilities.
- WP 23 – Use existing storage facilities for additional beneficial uses.
- WP 24 – Construct and operate artificial recharge/aquifer storage projects.

Instream Flow

- WP 26 – Request Ecology to set instream flows by administrative rule (in the Washington Administrative Code, or WAC).

Water Quality

- WP 30 – Request Ecology to incorporate requirements for improving the quality of discharges from existing industries when issuing State Waste Discharge Permits or National Pollutant Discharge Elimination System Permits.
- WP 31 – Request Ecology to increase the level of inspection of commercial dairy operations and enforcement of water quality as appropriate.
- WP 33 – Request conservation districts or irrigation districts to assist in achieving reductions in nonpoint pollution and/or to implement Total Maximum Daily Loads established for specific federal 303 (d) listed water bodies.
- WP 34 – Request conservation districts to modify individual farm plans as necessary to reduce or prevent nonpoint pollution and erosion.
- WP 35 – Request local governments and state agencies to continue to implement or more fully implement existing water quality plans, including plans developed under Chapter 400-12 WAC.
- WP 36 – Develop and implement a water quality public education program intended to prevent or reduce nonpoint pollution with focus on pollution sources associated with an urban setting, or with focus on pollution sources associated with a rural setting.
- WP 37 – Request local governments and Ecology to develop and operate water quality monitoring programs, including installation and maintenance of monitoring devices, to measure the extent of nonpoint pollution and/or measure the effectiveness of nonpoint pollution control measures.
- WP 38 – Request local governments to modify Growth Management Act comprehensive plans and other land use plans to help reduce the potential for nonpoint pollution and/or to implement Total Maximum Daily Loads established for federal 303 (d) listed water bodies.
- WP 39 – Request local governments to amend shoreline master programs to help reduce the potential for nonpoint pollution and/or to implement Total Maximum Daily Loads established for federal 303 (d) listed water bodies.
- WP 40 – Request local governments to modify local regulations such as critical areas ordinances, stormwater regulations, and on-site sewage regulations to help reduce the potential for nonpoint pollution and/or to implement Total Maximum Daily Loads established for federal 303 (d) listed water bodies.

Habitat

- WP 42 – Implement habitat improvement projects involving construction or placement of instream structures, such as cross vanes, vortex weirs, large woody debris, fish screens, or side-channels.
- WP 43 – Implement habitat improvement projects intended to “daylight” streams that are currently contained within enclosed channels.
- WP 45 – Request the Washington Department of Transportation, local governments, or other applicable agencies to remove or replace bridges, culverts, roadways, and other infrastructure as necessary to eliminate or reduce their impacts as fish passage obstructions and/or channel constrictions.

- WP 46 – Support construction of fish passage facilities where such facilities do not currently exist.
- WP 47 – Implement habitat improvement projects involving out-of-stream riparian restoration or enhancement such as replanting or bank stabilization projects. Bioengineering methodologies should be incorporated into bank stabilization projects.
- WP 48 – Move river dikes back from existing river channels to allow for floodplain restoration and channel maintenance.
- WP 49 – Request local governments to amend or modify Growth Management Act comprehensive plans or other land use plans, shoreline master programs, and/or critical areas ordinances to protect habitat or control floodplain development.
- WP 50 – Request local governments to develop regulations or programs to control sources of sediment that are not addressed through critical areas ordinances or other existing regulations and programs.
- WP 52 – Request conservation districts and irrigation districts to assist in achieving protection of habitat including, as appropriate, establishment and maintenance of riparian buffers and control of erosion and sedimentation.
- WP 53 – Request local, state, and federal governments, conservation districts, and private entities to acquire land and/or conservation easements for purposes of protecting habitat.
- WP 54 – Request Ecology and local governments to increase the level of enforcement of Shoreline Management Act violations in critical habitat areas.
- WP 56 – Support implementation of the recommendations of Washington's Forest and Fish Report.

12.3.2 Other SEPA Assumptions and Qualifications

During the SEPA gap analysis, a number of recommended actions in the Wenatchee Watershed Plan were found that are not described explicitly by alternatives in the statewide programmatic Watershed Planning EIS. However, it was determined that all of the actions not explicitly covered by the statewide programmatic Watershed Planning EIS either do not have adverse environmental impacts or do not require additional SEPA coverage at the programmatic level based on the qualifications and assumptions listed below. Therefore an additional EIS is not required.

The following are the qualifications and assumptions that are not specifically discussed in the statewide programmatic Watershed Planning EIS that are relevant to the Wenatchee Watershed Plan:

- Recommended actions that do not have a foreseeable "adverse environmental impact" do not require a SEPA alternative, or a statement of SEPA compliance. The following types of actions are listed in the Wenatchee Watershed Plan and are not expected to have an adverse environmental impact:
    - Recommendations for 1) improving communication between interest/stakeholder groups, government agencies, and/or non-governmental organizations; 2) encouraging entities to work together on specific projects; and/or 3) encouraging entities to work together to formulate strategies to address specific issues in the watershed (Noted in the tables below as **coordination/collaboration**);
    - Recommendations to find funding for new or existing projects (Noted in the tables below as **funding**);

- Recommendations for data gathering, research, data management, and/or project planning (Noted in the tables below as **study)**;
- Recommendations for 1) maintaining, adding, or changing the location of streamflow and groundwater monitoring gages and associated programs; 2) installing water meters; 3) developing a water usage monitoring program; and/or 4) continuing or developing monitoring programs (Noted in the tables below as **monitoring**),
- Recommendations to support existing efforts, programs, and projects (Noted in the tables below as **support**) and,
- Recommendations for 1) convening citizen and stakeholder forums to obtain public input; 2) providing opportunities for public involvement in watershed cleanup activities; 3) developing public outreach programs; 4) supporting existing public outreach programs; and/or 5) developing and distributing educational materials to the public (Noted in the tables below as **public involvement and education**).

- Recommendations that call for enforcement of existing regulations or continuation of existing programs that have undergone SEPA review at the initiation of the regulation or program and would not require further review at this time (Noted in the tables below as **continue existing**).
- Recommendations to evaluate and/or revise a strategy, program, policy or activity based on new or revised information (Noted in the Tables below as **adaptive management**).

  Recommendations for adaptive management are not required to undergo SEPA review at this time. Generally, adaptive management actions in watershed plans that depend upon the outcome of monitoring to direct a policy or program would be expected to have a positive or neutral effect on the environment. Actions such as these are consistent with the intent and spirit of both the Watershed Planning Act and the Watershed Planning EIS. However, this is not explicitly stated in the Watershed Planning EIS.
- Recommended actions that involve review or revision of existing ordinances /policies/programs will go through a SEPA review process during adoption of the revised ordinance/policy/program; therefore, these are not subject to individual SEPA alternative statements at this time (Noted in the tables below as **other SEPA**).
- Actions that require rule-making are not expected to comply with SEPA at this time, as they will undergo a separate SEPA review process lead by the State at the time that the rule is adopted (Noted in the tables below as **State SEPA**).
- For some actions, too little information is provided to make a SEPA judgment at this time because the action has not been fully developed. No foreseeable impacts are evident at this time. The action may undergo project or non-project level SEPA review at a later date or may be covered under statewide programmatic Watershed Planning EIS alternatives (Noted in the tables below as **early planning stages**).

12.3.3 Wenatchee Watershed Plan SEPA Compliance Tables

Tables 12-1 through 12-16 below list each action in the Wenatchee Watershed Plan, along with the statewide programmatic Watershed Planning EIS alternative or other analysis criteria used to achieve non-project programmatic SEPA compliance. The tables include a SEPA analysis of the implementation actions presented in Chapter 10 of this plan (Table 12-15), the public outreach actions presented in Chapter 11 of this plan (Table 12-16) as well as the actions that address the five issue categories (WRMS, water quantity, growth and land use, water quality and habitat) at both a

watershed and sub-watershed scale. The tables are included within the text so that Chelan County can use this Chapter of the Plan (Chapter 12) as supporting information to adopt the statewide programmatic Watershed Planning EIS and issue a determination of significance (DS) to meet its responsibility to prepare a SEPA compliant review of the Plan.

In some cases, more than one Watershed Planning alternative or a combination of qualifications and assumptions and alternatives are consistent with one action. Where combinations of alternatives and/or qualifications or assumptions are used, evidence for SEPA compliance is more robust.

TABLE 12-1

SEPA Analysis for WRMS Recommended Actions

Proposed Water Resource Management Strategy and Adaptive Management

Recommended Action	SEPA Analysis
WRMS-1: Recommends that the State Department of Ecology adopt, in rule, the new water resource management strategy for WRIA 45, including the management flows (revised instream flows) at specified control points, the water reserve, and maximum allocations. The management flows, water reserve and maximum allocation are outlined in more detail in Sections 4.4 through 4.6.	WP 7, WP 10, WP 11, WP 26, State SEPA
WRMS-2: Recommends that the Planning Unit or future implementing body in WRIA 45 be involved with Ecology, in any scoping, study planning, study implementation, alternatives analysis, negotiations or rule development if Ecology undertakes instream flow or related water management studies or rulemaking in the watershed.	Coordination/ Collaboration
WRMS-3: The WWPU with Chelan County taking the lead role will participate in the development and implementation of an adaptive management process to support this water resource management strategy. The process should address flexibility in the distribution of the reserve across the WRIA. The details of the adaptive management process will be determined as part of Phase IV Implementation.	Adaptive Management, WP 10, WP 11
WRMS-4: Implementation of a new or existing instream flow rule in the Wenatchee Watershed will require that flow monitoring continues at all existing and proposed control points on the Wenatchee River and its tributaries. Figure 4-1 shows the locations of all control points and active stream gages in the watershed. The following actions address these requirements. The WWPU:	Study, Monitoring
WRMS-4a: Recommends that Ecology continue to support monitoring at all existing stream gages in the Wenatchee Watershed. Ecology and partners must ensure that the gages and streamflow data are well maintained. Updated data should be made available on the Ecology website in a timely manner for all gages managed by Ecology.	Study, Monitoring
WRMS-4b: Encourages the USGS to continue to maintain USGS gages in the watershed to support implementation of this water resource management strategy.	Monitoring
WRMS-4c: Recommends a new stream gage be established at the existing control point on the Icicle Creek. Details will be determined during Phase IV, Implementation.	Monitoring
WRMS-4d: Review the gage location on the Chiwawa River as related to the impacts on flows from withdrawals.	Study, Monitoring

TABLE 12-2

SEPA Analysis for Water Quantity Recommended Actions

Water Rights, Trusts and Bank

Recommended Action	SEPA Analysis
QUANT-1: Develop recommendations for Ecology regarding the processing of new water right applications and applications for water right changes and transfers in WRIA 45. Create the recommendations through a collaborative approach between the Planning Unit and the Chelan County Water Conservancy Board, and base them on knowledge of water availability, allocation and flows; consistent with the proposed instream flow rule and resulting reservation and maximum allocation requirements for sub-watersheds. Recommendations may include data requirements necessary to evaluate the impacts of an application on surface and groundwater, areas of concern, policy regarding changes and transfers (may link to land use conversions or incentives for agricultural preservation). Recommendations should also consider facilitation of water right transfers or changes that will result in new water for a reservation in flow impaired sub-watersheds such as Mission and Chumstick Creeks.	Coordination/ Collaboration, Study, WP 7, WP 8, WP 10
QUANT-2: Request additional Ecology staff time from the legislature to process WRIA 45 water rights. (Focus may be transfers or new applications).	Funding, WP 7, WP 8, WP 10
QUANT-3: Ecology should enforce existing regulations and policies concerning water rights and use.	Continue Existing, WP 14
QUANT-4: Provide incentives for conserving water rather than using it to avoid losing it. Encourage efficiencies through current water law using tools such as water trusts and/or other innovative techniques. Consider the Irrigation Efficiencies Program, and other incentives programs offered by the state and other entities. Criteria for participation include a demonstration of financial need and environmental benefit, a minimum 10 year lease of the conserved water to the Trust Water Program, and the public investment in the project not exceeding 85% of the total cost. In general, the state offers financial programs and incentives to conserve when there is a public benefit. In many cases, dedication of the conserved water to instream flows has been the legislature's preferred means of securing the public benefit.	WP 1, WP 2, WP 3, WP 4, WP 8
QUANT-5: Consider Ecology's Trust Water Program as an option to temporarily safeguard water rights during times of non-use or reduced use while satisfying the needs of beneficial uses in the watershed. Develop strategies for using trust water to safeguard water that may be used in the future to support a more water-intensive crop type or conversion from agriculture to residential. Use of this program is consistent with the proposed water resource management strategy as described in Section 4.0.	WP 1, WP 2, WP 3, WP 4, WP 8
QUANT-6: Develop an administrative structure for a water bank for WRIA 45. Section 5.1.3 introduces water banks; however, the details of the administration of a water bank in WRIA 45 will be determined in Phase IV, Implementation.	Study, Early Planning Stages, WP 7, WP 8
QUANT-7: Chelan County or other entity with agency funding assistance will investigate water rights for purchase or lease in WRIA 45. The County will seek funding from Washington Water Trust, Washington Rivers Conservancy, BPA, USBOR, NPCC, Ecology and others. Water rights that are purchased or leased can be used to extend the water reservation while adhering to a "no net impacts" standard.	Funding, Study, WP 7, WP 8

Tracking Water Availability and Use

Recommended Action	SEPA Analysis
QUANT-8: Chelan County Natural Resource Department will develop and administer a monitoring program to assess actual domestic water use to verify the 380 gpd per household assumption used to debit the reservation and to adjust the amount of water remaining in the reservation at five year intervals, or more frequently if the number of wells drilled or building permits granted indicate that growth is occurring more rapidly than projected in any sub-watershed. These assessments will be conducted based on a statistical sample of new domestic water users (single domestic, group domestic and municipal water use and associated lawn and garden irrigation (some with separate irrigation, some without), some with stock, etc.). Metering data will be incorporated into the water use audit and the accounting system. See the recommended action in the Plan for more details.	Study, Adaptive Management, Monitoring
QUANT-9: Reservation accounting will include the tracking of new exempt wells by Chelan County through the building permit process, septic approval through the Chelan-Douglas Health District (CDHD), tracking new domestic and municipal water rights granted by Ecology and tracking well drilling permits as issued by Ecology. The mechanism for tracking the permitted uses will be determined as part of Phase IV, Implementation. Chelan County is currently developing a method for tracking new permit-exempt wells in WRIA 46. This should also be considered for WRIA 45.	Study
QUANT-9a: Chelan County Natural Resource Department will track new exempt wells through the building permit process and will coordinate with the CDHD. A joint city/county process will need to be implemented to assist the county in tracking any building permits requiring exempt wells that are issued by other cities (if applicable) within the watershed.	Study, Coordination/ Collaboration
QUANT-9b: New rights that are granted by Ecology for domestic water uses will be tracked by CCNRD. The mechanism for tracking the new permitted uses that will debit the reserve will be determined as part of Phase IV, Implementation.	Study
QUANT-9c: Long-term funding for tracking is required.	Funding
QUANT-10: The Planning Unit recommends metering be required for all new uses eligible under the reserve. The Planning Unit will further define responsible entities, and staffing, budget and funding considerations of the metering program as part of Phase IV, Implementation. Chelan County, CDHD, Ecology, utilities, and others will work together to structure the program. The following should be addressed as part of phase IV: • Identify responsible entities, and address staffing, cost and funding concerns • Consider implementation by an existing utility with an existing metering program • Consider having water users read their own meters • Consider use of Ecology's water measuring system and database • Consider metering options for existing water users and development of a voluntary program that uses existing metering programs' available meters.	Study, Funding, Coordination/ Collaboration, Monitoring, WP 18

Exempt Wells

Recommended Action	SEPA Analysis
QUANT-11: Undertake hydrogeologic studies to assess the influence of groundwater withdrawals on surface water. Identify funding for this study and responsible parties (WWPU to identify sub-areas for study, responsible entity as part of Phase IV, Implementation).	Study, Funding
QUANT-12: Funding should be requested to survey (using GPS) private wells. The CDHD should investigate collaborating with Ecology to include these new data in the water well report log database. Recommend that the county, health district, and Ecology work together to identify, log and provide oversight of exempt wells. As part of this oversight responsibility, the CDHD should work with DOH to survey wells with greater than 3 connections. Chelan County has already conducted a GPS survey and evaluation of Group A systems (> than 14 connections).	Funding, Study, Coordination/ Collaboration
QUANT-13: Provide public education as to the roles, responsibilities and regulations pertinent to exempt wells, and encourage the proper entities to enforce/implement (CDHD, DOH, Ecology, County).	Public Involvement and Education, Continue Existing, WP 14
QUANT-14: Credit a water service provider for abandoned and/or decommissioned exempt wells. This action will be further developed in Phase IV, Implementation. The well consolidation process is addressed in RCW 90.44.105. This statute presumes a credit of 800 gpd/well unless an alternative minimum is established by Ecology in consultation with DOH or there is credible evidence of non-use.	WP 16, WP 17

Conservation and Efficiency

Recommended Action	SEPA Analysis
QUANT-15: As part of Phase IV, Implementation, Chelan County and cities should develop policies that can be used to ensure efficient use of water in the event of a land division or new development. These include:	WP 1, WP 2, Other SEPA
QUANT-15a: For land division applications that have shares in an irrigation district, develop policies requiring that the developer provide tie-ins to the irrigation box; ensure easements; deliver water to parcels, where practicable; and form a Homeowners Association for residential uses. Encourage Irrigation Districts to work with the county and cities to extend infrastructure and irrigation water service where practicable.	WP 1, WP 2, Other SEPA
QUANT-15b: For land division applications on property with individual water rights, Chelan County should develop policies that encourage the developer to provide residential tie-ins to the water source for residential irrigation purposes.	WP 1, WP 2, Other SEPA
QUANT-15c: Encourage cities and Chelan County to develop policies that encourage conservation measures for outdoor water use as a condition of subdivision approval (eg., drought tolerant landscaping, maximum lawn size, stormwater collection systems, residential irrigation system installation). Encourage use of small scale storage, rain barrels, for outdoor irrigation.	WP 1, WP 2, Other SEPA

Recommended Action	SEPA Analysis
QUANT-15d: Encourage cities to develop policy statements that address transfer of water rights from private water right holders in the event of a land use conversion. For example, the City of Cashmere has policies in place that require water rights to be transferred to the City upon land division/service provision by the City's system. This policy helps preserve the City's ability to serve future users within the UGA with water.	WP 9, Other SEPA
QUANT-15e: Provide public information that encourages actions QUANT-15a through QUANT-15d, and explains the benefits (provide this information during subdivision application or preliminary plat comment period).	Public Involvement and Education
QUANT-15f: Encourage cluster development, and group domestic over single domestic systems to increase water use efficiency. Explore encouraging group domestic over single domestic use as part of the approval process for land division applications. Further develop this recommendation as part of Phase IV, Implementation.	WP 1
QUANT-16: Research how different entities in the watershed are implementing conservation measures and acknowledge current efforts. [Note that Leavenworth is metering and employs a rate and fee structure that encourages conservation. Cashmere is currently working on revising their rate structure such that there will be more incentive for conservation.] Encourage additional conservation measures where needed. Encourage incentive based solutions. These may include QUANT-16a through QUANT-16d.	Study, WP 1, WP 2, WP 3, WP 4, WP 5, WP 6

Conservation and Efficiency: Residential, Industrial and Commercial (Public Water System and exempt wells)

Recommended Action	SEPA Analysis
QUANT-16a: Encourage cities and other water providers to implement a rate and fee structure that promotes conservation (similar to Leavenworth's current program and Cashmere's proposed program).	WP 1

Conservation and Efficiency: Irrigation (Districts and Canal Companies)

Recommended Action	SEPA Analysis
QUANT-16b: Encourage funding to line canals or implement other delivery system improvements, where appropriate.	Funding, WP 2
QUANT-16c: Encourage the use of reclaimed water (tertiary treatment) for outdoor irrigation, industrial, and commercial use (see Ecology Watershed Guidance).	WP 3, WP 4, WP 5, WP 6
QUANT-16d: As part of Phase IV, Implementation, convene a forum to investigate conservation strategies and how they could be implemented by irrigation districts, ditches and other private companies. Involve utilities, cities, Chelan County and Ecology when appropriate. There is a need to work with members of irrigation districts, ditches and others to determine ways to save water and ensure that water rights are protected into the future. Items of discussion could include alternative rate structures based on purpose of water use; partnerships with cities and utilities; utility coordination during development; tools to conserve water, improve instream flows and protect water rights at the same time; and distribution of public education materials.	Coordination/ Collaboration, Study, Public Involvement and Education, WP 1, WP 2, WP 3, WP 4

Conservation and Efficiency: On-Farm Efficiencies

Recommended Action	SEPA Analysis
QUANT-17: Encourage on-farm efficiencies and implementation of Best Management Practices (BMPs) to encourage water conservation.	WP 3
QUANT-18: Encourage the County to provide information and education about water conservation options and fire planning; including: outdoor watering, timing, types of native vegetation that require low water use, lawn size, low flow fixtures, etc. to the new land user. The Municipal Water Law requires that water systems provide education and outreach regarding water conservation. However, water users that are using irrigation ditch water for outdoor use and/or exempt wells will not receive this information. Irrigation systems may also be able to provide materials in monthly billings. The details of this educational program will be determined during Phase IV, Implementation. Realtors should be encouraged to distribute public education materials describing water conservation and efficient water management techniques.	Public Involvement and Education, WP 1, WP 2, WP 3

Storage Opportunities

Recommended Action	SEPA Analysis
QUANT-19: Consider funding storage options from the Storage Assessment. See relevant sub-watershed sections (Section 9.0) for specific storage opportunities as listed in the WRIA 45 Storage Assessment Report.	Funding, WP 19, WP 20, WP 21, WP 22, WP 23, WP 24

Projects and Studies

Recommended Action	SEPA Analysis
QUANT-20: CCNRD or other entities to administer studies on water resources throughout the watershed, especially in areas where inadequate data exist to make decisions regarding future water use (eg., Chumstick, Northside Tributaries).	Study
QUANT-20a: Water budgets have been prepared by sub-watershed. These budgets indicate total water use by use type (eg., residential, industrial, commercial, agricultural, fish propagation), but do not provide estimates of consumptive use. A consumptive crop irrigation requirement is presented. Further this study by defining the consumptive portion of the water use in the water budgets. Incorporate water usage rates with varying efficiencies for each water use type. Use this information to develop appropriate and useful water use efficiency requirements on lands that have been converted from agricultural to residential.	Study, WP 1, WP 3
QUANT-20b: Study groundwater in specific areas of the watershed (eg., Mission Creek, Lower Chumstick/Eagle Creek area, Monitor area). Finalize the areas for study as part of Phase IV, Implementation.	Study
QUANT-20c: There is a need to better understand the groundwater – surface water interaction in the watershed. Formalize studies to address this issue.	Study
QUANT-21: Evaluate the consumptive portion of reserved water uses and determine if recharge credit should be included in the accounting of the reservation.	Study

Recommended Action	SEPA Analysis
QUANT-11: Undertake hydrogeologic studies to assess the influence of groundwater withdrawals on surface water. Identify funding for this study and responsible parties (WWPU to identify sub-areas for study, responsible entity as part of Phase IV, Implementation).	Study, Funding
ChumQUANT-2: Chumstick Water Forum to assist in developing a data collection plan to monitor surface water flows (specify location) and develop management flows.	Study, Monitoring
ChumQUANT-3: Chumstick Water Forum, with assistance from Chelan County and Ecology, to conduct groundwater monitoring to understand hydraulic continuity and overall impact of exempt wells on groundwater levels and streamflows.	Study, Monitoring
ChumQUANT-6: A cumulative impact analysis of permit exempt use and uses associated with permits and claims approved since 1983 will be initiated by Ecology as authorized under the 1983 flow rule. Chelan County will partner with Ecology in this study. The cumulative impacts assessment will help to determine whether Ecology will curtail outdoor domestic water use of wells installed after 1983, and whether Ecology will close the Chumstick Sub-watershed to outdoor water use in the future.	Study
ChumQUANT-7: Chumstick Forum, Chelan County and Ecology to re-evaluate a proposed strategy for the Chumstick in three years after rule adoption, when new monitoring data have been collected and assessed and cumulative impact analysis is complete. Consider allowing group domestic groundwater use of deeper aquifer only as part of the Chumstick strategy addressed by the Forum.	Study, Adaptive Management, WP 16
NSTQUANT-1: Future water supply availability should be discussed with Chelan County Public Utility District (PUD) to determine whether they have the capacity and infrastructure to provide backup supply. The East Bank Aquifer Regional Water Supply will only be considered as a source of water for this area if approved by the owners of the Regional Water Supply.	Study, Coordination/ Collaboration
QUANT-8: Chelan County Natural Resource Department will develop and administer a monitoring program to assess actual domestic water use to verify the 380 gpd per household assumption used to debit the reservation and to adjust the amount of water remaining in the reservation at five year intervals, or more frequently if the number of wells drilled or building permits granted indicate that growth is occurring more rapidly than projected in any sub-watershed. These assessments will be conducted based on a statistical sample of new domestic water users (single domestic, group domestic and municipal water use and associated lawn and garden irrigation (some with separate irrigation, some without), some with stock, etc.). Metering data will be incorporated into the water use audit and the accounting system. See the recommended action in the Plan for more details.	Study, Adaptive Management, Monitoring

TABLE 12-3

SEPA Analysis for Growth and Land Use Recommended Actions

Integrating Water Availability in Land Management Decisions (Water for Growth/Land Use)

Recommended Action	SEPA Analysis
GLU-1: As part of reservation accounting, establish a resource base for decision-makers to use to consider technical water resource information when making land use change decisions and when considering land use permit applications. This should include:	Study
GLU-1a: Chelan County Natural Resource Department (CCNRD) will provide technical input regarding the reservation and eligible uses into the decision making process for consideration by city and county land use decision makers.	Coordination/ Collaboration
GLU-1b: Water resource and supply related data for the watershed will be maintained in a database by CCNRD (eg., a water supply dataset including water system boundaries, an exempt well tracking system, on-going tally of water rights and water use per water system, instream flow and groundwater level data, an assessment of whether current water rights can service full build-out based on current zoning, etc.). CCNRD would update this information as a larger population is served in the future and ensure the information is available in a format that is easily understood by the public.	Study
GLU-2: As part of Chelan County's zone change process, water supply and water resource information is available for use from CCNRD.	Study
GLU-3: As there is urban growth in the WRIA, ensure that water availability is considered in UGA boundary decisions for existing and new UGAs. For proposed Urban Growth Area boundary expansions that are outside the jurisdiction of an existing water service area, the proposal for expansion should include documentation of a water purveyor's intention to provide water, their ability to provide water, or the ability of the development to provide water if it is to be self-served.	Early Planning Stages

Consistency between Critical Area Ordinance and WRIA 45 Watershed Plan

Recommended Action	SEPA Analysis
GLU-4: The Wenatchee Watershed Planning Unit is supportive of the goals and intent of the GMA to provide critical area protections, as these are consistent with water quality, quantity and habitat goals of the Wenatchee Watershed Plan and the Watershed Planning Act. The Planning Unit further supports the efforts of local jurisdictions to implement non-regulatory programs that protect critical areas and is interested in exploring potential partnerships in these efforts.	Coordination/ Collaboration, Support
GLU-5: Data, protection measures and strategies relating to critical area protections should be documented as part of the watershed planning process. Encourage local jurisdictions to utilize the data, protection measures and strategies identified in the 2514 Wenatchee Watershed Plan in the development and update of critical area protections under GMA. Ensure that this information is readily available to local jurisdictions.	Study, WP 38, WP 40, Other SEPA

Recommended Action	SEPA Analysis
GLU-6: The protection measures and strategies identified in the 2514 Watershed Plan should be considered by local governments as non-regulatory mechanisms to protect critical areas watershed wide. These approaches include: • Land protection measures such as easements, leases, purchases and other creative measures, such as transfer of development rights to protect remaining floodplain and riparian habitat • Wetland restoration • Fish passage improvements; removal of fish passage barriers • Restore channel function • Reconnect disconnected habitat areas • Restore floodplain function • Maintain forest roads • Control and eradicate noxious weeds	Coordination/ Collaboration, WP 45, WP 46, WP 47, WP 48, WP 53

TABLE 12-4

SEPA Analysis for Watershed-wide Water Quality Recommended Actions

Temperature, Fecal Coliform, pH/DO, and DDT

Recommended Action	SEPA Analysis
QUAL-1: Chelan County Conservation District (CCCD) should continue to oversee and implement recommendations in the Watershed Action Plan, ensure other entities are also implementing voluntary actions in the Watershed Action Plan, and encourage continued funding of these efforts.	Coordination/ Collaboration, Funding, WP 35
QUAL-2: Ecology should continue to work with the local watershed planning group through both implementation of the current TMDL, and on future TMDLs if further listings arise.	Coordination/ Collaboration
QUAL-3: Ecology should continue to work with the local watershed planning group for funding future projects.	Coordination/ Collaboration, Funding
QUAL-4: Encourage the Wenatchee Watershed Planning Unit and its other subcommittees (Water Quantity, Instream Flow, Habitat, and Growth and Land Use) to use the information in the TMDL Technical Reports and SISs along with their conclusions, recommendations, and actions for a more holistic approach to restoration, preservation, and enhancement of the watershed for all beneficial uses (WQTS, 2006a; WQTS, 2006b; WQTS, 2006c; WQTS, 2006d).	Coordination/ Collaboration, WP 35

Temperature

Recommended Action	SEPA Analysis
QUAL-5: Appropriate actions to be used in the appropriate location should be determined to address temperature exceedances in Phase IV, Implementation for all of the temperature-related recommendations in the Plan.	Study

Recommended Action	SEPA Analysis
QUAL-6: Actions to improve shade near surface waters should be implemented, where feasible. Shade management practices should involve the development of mature riparian vegetation. The WQTS should use the information provided in the temperature technical report and Planning Unit studies (FLIR, LIDAR, PHABSIM, etc.) to create a prioritized list of locations and plan for establishing riparian vegetation. Associated monitoring should be planned and implemented over time, as full riparian vegetation requires many years to become established. The upper watershed should be addressed first as it has the most potential for shade improvements and water temperature reductions. An evaluation of the 303(d) listed waters in the upper watershed should be conducted to see if they should be dropped from the 303(d) list due to natural conditions (Chiwaukum Creek, Little Wenatchee River). The WQTS should coordinate with the Planning Unit's other subcommittee conclusions, recommendations, and actions to reduce water temperatures (WQTS, 2006d).	Study, Coordination/ Collaboration, Monitoring, WP 35
QUAL-7: For U.S Forest Service land, the riparian reserves prescriptions in the Northwest Forest Plan should be implemented for the establishment of mature riparian vegetation, where appropriate. The U.S. Forest Service should be the primary implementing agency. The WQTS and the Department of Ecology should coordinate with the U.S. Forest Service (WQTS, 2006d).	Coordination/ Collaboration, WP 35
QUAL-8: For State and privately owned forest land, the riparian vegetation prescriptions in the Forests and Fish Report (Washington State Department of Natural Resources (DNR), 1999) should be implemented for all perennial streams. Load allocations are included in this TMDL for forest lands in accordance with the section of the Forests and Fish Report entitled "TMDLs produced prior to 2009 in mixed use watersheds." The WQTS and the Department of Ecology will coordinate with the Department of Natural Resources (WQTS, 2006d).	Coordination/ Collaboration, WP 35, WP 56
QUAL-9: For areas that are not managed in accordance with either the Forest Plan or the Forests and Fish Report, voluntary programs to increase and protect riparian vegetation should be developed, such as riparian buffers and conservation easements. The WQTS and the Department of Ecology should work with private forested landowners, agencies, and stakeholders to develop and monitor the projects (WQTS, 2006d).	Study, Coordination/ Collaboration, Monitoring, WP 35
QUAL-10: Stream temperature is related to the amount of instream flow, and increases in flow generally result in decreases in temperatures. The WQTS should work with the Planning Unit and watershed entities to encourage projects that have the potential to increase and protect surface and groundwater flows. Voluntary retirement, purchase, leasing of existing water rights, or other conservation methods to preserve and enhance instream flow should be encouraged. In addition, water storage opportunities that have the potential to increase instream flows during critical periods should be considered (WQTS, 2006d).	Coordination/ Collaboration, WP 8, WP 19, WP 20, WP 21, WP 22, WP 23, WP 24, WP 35
QUAL-11: Adaptive management activities to control potential channel widening processes should be encouraged. Reductions in channel width are expected as mature riparian vegetation is established. For example, activities that reduce sediment runoff to surface waters from upland and channel erosion can affect channel width and temperatures (WQTS, 2006d).	Adaptive Management, WP 35

Recommended Action	SEPA Analysis
QUAL-12: Actions to improve hyporheic exchange flows and groundwater-surface water recharge should be identified and implemented to improve the current temperature regime and reduce maximum daily instream temperatures. Factors that influence hyporheic exchange flow include the vertical hydraulic gradient between surface and subsurface waters as well as the hydraulic conductivity of streambed sediments. Activities that reduce instream flows, hyporheic exchange and hydraulic conductivity of streambed sediments can increase stream temperatures, such as drilling of wells along streams and connected ground water reservoirs, and development in the flood plain. The WQTS should work with the Planning Unit and its subcommittees to identify and implement management activities designed to protect and enhance instream flow and subsurface water exchange with streams. Actions should be identified and implemented to reduce upland and channel erosion and avoid sedimentation of fine materials in the stream substrate (WQTS, 2006d).	Coordination/ Collaboration, Study, WP 35
QUAL-13: Ecology should continue existing temperature monitoring, and expand the current temperature monitoring program such that it is consistent with flow monitoring actions recommended in WRMS-4a and WRMS-4c.	WP 37
QUAL-14: The WQTS should work with the Planning Unit in the development of proposed water storage, irrigation, habitat, and development projects to provide input regarding shade, riparian vegetation, and engineering to reduce water temperatures (WQTS, 2006d).	Study, Coordination/ Collaboration, WP 35
QUAL-15: To determine the effects of management strategies within the Wenatchee River Basin, regular monitoring is recommended. Continuously-recording water temperature monitors should be deployed from July through August to capture the critical conditions. The following locations should be targeted for a minimal sampling program: Wenatchee River near mouth, Icicle Creek near mouth, Nason Creek near mouth, Peshastin Creek near mouth, and Mission Creek near mouth. Monitoring will be conducted associated with BMPs to track progress toward shade and water quality targets. Water temperature monitoring should be conducted and coordinated with associated BMP projects over time (WQTS, 2006d).	Study, WP 35, WP 37
QUAL-16: Funding assistance should be sought from Ecology through its grants and loans programs to implement actions and ongoing monitoring. Other funding sources should be identified and applications submitted to provide funding for ongoing activities. The WQTS will recommend qualified entities to conduct associated monitoring (WQTS, 2006d).	Funding, WP 35, WP 37

TABLE 12-5

SEPA Analysis for Habitat Recommended Actions

Habitat Protection and Restoration/Enhancement

Recommended Action	SEPA Analysis
H-1: Implementation of watershed planning will be coordinated with the Salmon Recovery Implementation Schedule (the Implementation Plan Matrix is Appendix H in UCSRB (2005)) and the Upper Columbia Salmon Recovery Implementation Team. The Wenatchee Habitat Subcommittee will serve as the local coordinating body for implementation of salmon recovery habitat actions across the watershed. Chelan County Natural Resource Department is currently developing a habitat project database that will be available to the subcommittee in the near future to list past projects, track current projects, and evaluate what future habitat actions should take place.	Coordination/ Collaboration, Study
H-2: The WRIA 45 Planning Unit supports implementation of projects identified in the Wenatchee River and Nason Creek Channel Migration Zone Study (Jones and Stokes, 2004).	Support
H-3: The WRIA 45 Planning Unit supports implementation of the actions in the Wenatchee Subbasin Plan (Subbasin Plan sections 7.4 to 7.8 (NPCC, 2004)), and supports the Subbasin Plan approach to evaluation and monitoring of terrestrial and aquatic ecosystems in the Wenatchee Watershed. Section 2.5.1 of the Wenatchee Subbasin Plan which lists key findings from the Terrestrial Assessment is reproduced in Appendix C. The Planning Unit asks the co-planners and co-managers to seek funding from Bonneville Power Administration (BPA) and other sources for implementation of these actions.	Support, Funding
H-4: The Habitat Subcommittee with Chelan County as lead should coordinate with funding organizations and action agencies to maintain a publicly accessible database of past and current habitat projects for the Wenatchee Watershed.	Coordination/ Collaboration, Study, Funding
H-5: The Planning Unit will provide opportunities for public comment on watershed scale studies and plans when, by a vote of the Planning Unit, they are determined to be a priority of the Planning Unit and important to aquatic health and habitat.	Public Involvement and Education
H-6: The mainstem Wenatchee River provides habitat *important to the entire watershed* for many life stages of spring and summer Chinook, steelhead, bull trout and other culturally important species, and needs to be protected, enhanced, and restored. All remaining intact areas on the mainstem should be maintained. Where possible, floodplain function should be restored, particularly from the Mission Creek confluence downstream to the Columbia River confluence.	WP 48, WP 49, WP 52, WP 53
H-7: All property owners and managers in the watershed are encouraged to continue to cooperate in maintaining forest roads. Opportunities for inter-agency or multiple owner cooperation in roads management should continue to be supported (Additional and background information on forest roads in presented in Appendix C).	Coordination/ Collaboration
H-8: Noxious weeds threaten aquatic and terrestrial ecosystems throughout the Wenatchee Watershed. The Planning Unit supports efforts toward noxious weed control and eradication.	Support
H-9: Consider using the Icicle Fund "Natural Resource Profile" as a tool to identify terrestrial habitat opportunities (Pacific Biodiversity Institute, 2002).	Study

Recommended Action	SEPA Analysis
H-10: A fish barrier inventory has been conducted in many areas of the watershed; however, key inventory data regarding each barrier is not always consistent (i.e. whether it is a partial or full barrier, etc.). A method for updating the inventory should be established and funded. The Chelan County fish barrier inventory should be integrated with fish barrier information collected by other land managers, such as the Forest Service. Look at SalmonScape as a starting point for integrating barrier information. The organization has been able to integrate barrier information from other land managers. In addition, the Habitat Subcommittee should try to address the need to include irrigation diversions, specifically pump diversions, in the Chelan County Fish barrier inventory using appropriate funding sources.	Study, Funding, Coordination/ Collaboration
H-11: Efforts that are ongoing in the Wenatchee Watershed to improve or maintain habitat quality need to be encouraged and retained. Recognize and acknowledge achievements in the watershed that have accomplished habitat improvement or protection. Develop a landowner or organization recognition program to recognize habitat improvement projects or achievements in the watershed.	Public Involvement and Education, Support
H-12: Initiate public information efforts to discourage harassment of spawning salmonids (UCRTT, 2002).	Public Involvement and Education
H-13: Salmon habitat restoration and protection actions should be coordinated with the Wenatchee Habitat Subcommittee to ensure consistency with watershed-wide strategies as identified in the watershed plan and other plans. Additionally, all other actions related to salmon recovery, including hatchery, harvest and hydropower activities, should be coordinated with the Wenatchee Habitat Subcommittee. Hatchery, harvest and hydropower activities that have a negative or adverse affect on local habitat restoration or protection actions must be carefully considered in the context of the local habitat strategy.	Coordination/ Collaboration

Short-term

Recommended Action	SEPA Analysis
H-14: Address passage barriers (UCSRB, 2005).	WP 45
H-15: Address diversion screens (UCSRB, 2005).	WP 42
H-16: Reduce the abundance and distribution of brook trout through feasible means (e.g., increased harvest) (UCSRB, 2005).	Early Planning Stages
H-17: Protect and maintain stream and riparian habitats within Category 1 assessment units (UCSRB, 2005).	WP 49, WP 52, WP 53
H-18: Protect, maintain, or enhance beneficial stream and riparian habitat conditions established by implementing Short-term Actions within assessment units (UCSRB, 2005).	WP 42, WP 43, WP 45, WP 49, WP 52, WP 53
H-19: Where feasible and practical, maintain connectivity throughout the historical distribution of the species (UCSRB, 2005).	WP 45, WP 46

Administrative/Institutional

Recommended Action	SEPA Analysis
H-20: NOAA Fisheries, U.S. Fish and Wildlife Service (USFWS), the Army Corp of Engineers, and State agencies should improve the permitting process for projects specific to recovery actions by reducing the time, cost, and review process requirements. These entities should also implement programmatic consultations for actions related to the implementation of the Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan and improve their review of species recovery projects with the local governments (UCSRB, 2005).	Other SEPA, Coordination/ Collaboration

Research and Monitoring

Recommended Action	SEPA Analysis
H-21: Wenatchee Habitat Subcommittee members can attend an annual Upper Columbia Monitoring Coordination Workshop for regular updates on all watershed-wide and other monitoring programs. In addition, the Subcommittee will be updated by the Regional Technical Team, as available, to ensure consistency across planning processes as well as to evaluate the effect of habitat improvement projects in the watershed.	Coordination/ Collaboration

Hatchery Related

Recommended Action	SEPA Analysis
H-22: The effects of hatchery practices in the Upper Columbia Basin on productivity are currently unknown. Research on reproductive success of hatchery produced fish that spawn in the wild is needed to assess effects on productivity (UCSRB, 2005).	Study
H-23: Additionally, future hatchery facilities will support recovery goals, and minimize and mitigate any impacts (including goals within other hatchery, harvest and hydropower activities). This list should not be considered all inclusive and specific actions will be determined and negotiated by the responsible parties (UCSRB, 2005).	Early Planning Stages, Support
H-24: Determine whether supplementation programs in the Wenatchee Sub-basin affect the viable salmonid population (VSP) parameters of spring Chinook (UCSRB, 2005).	Study
H-25: Develop, maintain, and provide a comprehensive inventory of habitat projects and their costs and benefits (effectiveness) to the public annually (UCSRB, 2005).	Study

TABLE 12-6

SEPA Analysis for the Lower Wenatchee River Sub-watershed Recommended Actions

Water Availability in the Northside Tributaries area

Recommended Action	SEPA Analysis
NSTQUANT-1: Future water supply availability should be discussed with Chelan County Public Utility District (PUD) to determine whether they have the capacity and infrastructure to provide backup supply. The East Bank Aquifer Regional Water Supply will only be considered as a source of water for this area if approved by the owners of the Regional Water Supply.	Coordination/ Collaboration, Study
NSTQUANT-2: PUD and Chelan County to consider pumping from Wenatchee Valley and a potential PUD hookup in Nahahum.	Study, WP 17
NSTQUANT-3: Chelan County and Ecology to provide public information regarding water limitations in Northside Tributaries (Fact Sheets).	Public Involvement and Education
NSTQUANT-4: Chelan County and Ecology to work with local community to design and implement a groundwater monitoring program in existing wells to determine trends in groundwater levels.	Coordination/ Collaboration, Study, Monitoring
NSTQUANT-5: Alternatives Analysis for Northside Tributaries to include options such as use of out-of-basin water, pumping from lower Wenatchee reserve, PUD hookup, deep groundwater, storage, and water right purchase.	Study, WP 7, WP 8, WP 10, WP 16, WP 17, WP 19, WP 20, WP 21, WP 22, WP 23, WP 24

pH/ DO

Recommended Action	SEPA Analysis
LowWenQUAL-1: The partnership formed to secure funding for further study of DO and pH (Chelan County, Chelan County PUD and the cities of Cashmere, Leavenworth and Wenatchee) should continue to work together, with the WQTS to acquire funding assistance and work with the WQTS to: • Facilitate and develop a workable strategy that can be used and ultimately approved by the EPA and in Ecology's TMDL submittal for DO and pH, and • Review and make suggestions for future improvements to Ecology's technical assessment, summary implementation plan, and adaptive management approaches to meet state water quality standards for these parameters.	Coordination/ Collaboration, Funding, Study
LowWenQUAL-2: Strategies to address point and non-point sources of phosphorus as part of the TMDL for DO and pH will be reported during the implementation phase of the Wenatchee Watershed planning effort.	Study, Early Planning Stages
LowWenQUAL-3: Large reductions of phosphorus inputs are needed from point sources in the Wenatchee River Watershed, especially waste water treatment plants (WWTPs). A regulatory strategy should be developed and implemented with WWTPs and Ecology to institute controls over time through National Pollutant Discharge Elimination System (NPDES) permits that will reduce phosphorous discharges to surface and groundwaters. WWTPs to be addressed include the Lake Wenatchee, Stevens Pass, Leavenworth, Peshastin, and Cashmere waste water treatment plants. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Study, Adaptive Management, WP 30, WP 35, WP 37

Recommended Action	SEPA Analysis
LowWenQUAL-4: Controls should be developed and implemented through new and existing regulatory permits, if needed, to reduce phosphorous inputs to surface and groundwaters from other Wenatchee Watershed point sources. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Continue Existing, Study, Adaptive Management, WP 30, WP 35, WP 37
LowWenQUAL-5: Large reductions of phosphorus inputs are needed from nonpoint sources in the Wenatchee River Watershed. Mass-balance modeling showed that two reaches of the lower Wenatchee River exhibit higher diffuse phosphorous loading than other reaches. One reach brackets the community of Dryden and the other brackets the city of Cashmere. Studies should be done in these two reaches, focusing on groundwater-surface water interaction and land-uses that may be contributing phosphorus inputs to the river. Actions should be implemented based on the conclusions and recommendations of these studies to reduce inputs of phosphorous from these areas (WQTS, 2006a).	Study, Early Planning Stages, WP 33, WP 34, WP 35, WP 36, WP 37, WP 38, WP 39, WP 40
LowWenQUAL-6: Groundwater discharges to the Wenatchee River, Icicle Creek, and their tributaries affects dissolved oxygen levels and nutrient concentrations. Groundwater is discharged to the river or creeks in some reaches, and is recharged in other reaches. In the Wenatchee basin, groundwater flow and Biochemical Oxygen Demand (BOD)/nutrient concentrations may be elevated due to upland practices such as orchard irrigation and wastewater discharge to groundwater from lagoons and on-site septic systems. Assessments of groundwater contributions and sources of nutrients (phosphorous) should be conducted. Actions should be implemented based on the conclusions and recommendations of these studies to reduce inputs of phosphorous from these areas (WQTS, 2006a).	Study, Early Planning Stages, WP 33, WP 34, WP 35, WP 36, WP 40
LowWenQUAL-7: Non-point sources along the length of the river may be contributing BOD and nutrients. Address failing septic systems through actions identified in the Wenatchee Watershed Fecal Coliform TMDL. Continue site specific inspections and enforcement of regulations that restrict placement of on-site septic drain fields from areas deemed to have unsuitable soils. A study should be conducted to assess soils and onsite septic systems. Estimates should be made of the maximum number and density of on-site drain fields that the upper basin can accommodate and still meet the water quality standards, as was done in the Lake Chelan study (Patmont et al., 1989). Conduct associated monitoring and adaptive management (WQTS, 2006a).	Study, Continue Existing, Adaptive Management, WP 35, WP 37
LowWenQUAL-8: Nutrients (phosphorous) can enter streams from storm water events. Work with Chelan County and municipalities to reduce storm water inputs, utilizing the Eastern Washington Storm water Manual or equivalent. Encourage the appropriate entities to include language that addresses storm water in comprehensive plans and ordinances. Work with developers. (See LowWenQUAL-18). Conduct associated monitoring and adaptive management (WQTS, 2006a).	Coordination/ Collaboration, Adaptive Management, Other SEPA, WP 35, WP 37, WP 40
LowWenQUAL-9: Nutrients (phosphorous) can enter surface and ground water from residential yards and gardens, hobby farms, City and County Parks, business owned landscapes, etc. An education outreach plan should be developed and implemented to heighten awareness and reduce inputs from these sources. Policies and practices should be implemented in City and County Public Works departments. The County and cities should consider implementing a ban on the sale of high phosphate detergents, such as is being considered in Spokane. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Public Involvement and Education, Adaptive Management, Other SEPA, WP 35, WP 36, WP 37, WP 40

Recommended Action	SEPA Analysis
LowWenQUAL-10: Nutrients can enter streams from materials used to de-ice, clean, and maintain roads and parking lots. Animal waste from roads and parking lots can enter streams and increase nutrient loading. Work with the County, cities, businesses, and the WA State Department of Transportation to determine if road and parking lot maintenance practices may be contributing to nutrient loading and if necessary investigate ways to reduce nutrient inputs from these practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Coordination/ Collaboration, Adaptive Management, Study, WP 35, WP 37
LowWenQUAL-11: Nutrients (phosphorous) can be released to ground and surface waters from development practices, such as disruption of soils during conversions of orchard lands to housing. Actions should be conducted to prevent nutrients from entering ground and surface waters before, during and after construction. Work with developers to implement these actions. Encourage entities to include appropriate language in county and city comprehensive plans, growth management, and critical area ordinances. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Coordination/ Collaboration, Adaptive Management, Other SEPA, WP 35, WP 37, WP 38, WP 40
LowWenQUAL-12: The operation of Columbia River dams apparently backs up the Wenatchee River from its mouth approximately one mile. It has been hypothesized that this back-water may contribute to the exceedances of pH and dissolved oxygen levels in that reach. Work with the Chelan PUD to conduct an assessment of the possible back-water effect that may be created by operation of the Rock Island dam. Implement actions from the report's conclusions and recommendations to improve water quality (WQTS, 2006a).	Study, Early Planning Stages, WP 35
LowWenQUAL-13: Consider implementing actions recommended in the Wenatchee River Basin Temperature and Fecal Coliform TMDLs if the actions address problems that have been identified in the Lower Wenatchee. Lowering temperatures and reducing nutrient inputs will improve pH and dissolved oxygen levels in the Wenatchee River Watershed (WQTS, 2006a).	WP 35
LowWenQUAL-14: Reserve load capacities for Biochemical Oxygen Demand (BOD) and nutrients should be established for the Upper Wenatchee River and Icicle Creek. Reserve load capacities are needed because there is no additional assimilative capacity for dissolved oxygen in the upper watershed during critical conditions. A point source regulatory strategy and nonpoint source BMP strategy should be developed to protect the reserve capacities and maintain water quality standards (WQTS, 2006a).	WP 30, WP 31, WP 33, WP 34, WP 35, WP 37, WP 38, WP 39, WP 40
LowWenQUAL-15: Encourage lining of earthen canals where appropriate. Work with irrigation districts to implement BMPs and adaptive management programs to minimize any nutrient loading that is not already being addressed (WQTS, 2006a).	Adaptive Management, WP 33, WP 34, WP 35
LowWenQUAL-16: Agricultural practices can contribute nutrients to ground and surface waters through crop watering practices, application of fertilizers, and soil disturbance activities. Work with the agricultural community to encourage practices that will reduce nutrient inputs to ground and surface waters while enhancing crop quality and yield. Examples include technical assistance through farm plans and Best Management Practices (BMPs). Conduct associated monitoring and adaptive management (WQTS, 2006a).	Adaptive Management, WP 33, WP 34, WP 35, WP 37

Recommended Action	SEPA Analysis
LowWenQUAL-17: Funding for these projects should be sought through Department of Ecology Centennial and 319 grants and loans. Identify and access other funding sources through the Planning Unit and other entities. Ongoing adaptive management should be utilized to provide the best use of funds and environmental benefits (WQTS, 2006a).	Funding, Adaptive Management, WP 35
LowWenQUAL-18: Proper filtration of nutrients through land use practices can have a beneficial effect on nutrient reductions to ground and surface waters. Encourage implementation of wetlands, filter strips, riparian vegetation, bio-swales, drainage basins, pervious surfaces, etc. in residential, commercial, agricultural, industrial, development, and municipal practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Adaptive Management, WP 33, WP 34, WP 35, WP 37
LowWenQUAL-19: Identify and investigate any non point sources in tributaries that may be contributing to nutrient loads (WQTS, 2006a).	Study, WP 35

Habitat Restoration/Enhancement

Recommended Action	SEPA Analysis
LowWenH-1: Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in the Wenatchee River (UCSRB, 2005).	WP 1, WP 2, WP 3, WP 4, WP 8, WP 19, WP 20, WP 21, WP 22, WP 23
LowWenH-2: Reduce water temperatures by restoring riparian vegetation along the river (UCSRB, 2005).	WP 35, WP 47
LowWenH-3: Increase habitat diversity and quantity by restoring riparian habitat along the Wenatchee River, reconnecting side channels and the floodplain with the river, and increasing large woody debris in the side channels (UCSRB, 2005).	WP 42, WP 47, WP 48
LowWenH-4: Protect existing riparian habitat and channel migration floodplain function (UCRTT, 2002).	WP 49, WP 52, WP 53

TABLE 12-7

SEPA Analysis for the Mission Creek Sub-watershed Recommended Actions

Water Availability

Recommended Action	SEPA Analysis
MissionQUANT-1: Chelan County as lead (with support from Ecology), will convene a Mission Creek Forum to assess options to provide water for future growth through the purchase, lease or transfer of existing, valid water rights or from storage (storage opportunities within Mission Sub-watershed or through the Peshastin and/or Icicle Irrigation districts). This will be conducted for the purpose of providing an uninterruptible supply for domestic, municipal and stock water uses. During Phase IV, Implementation, the Mission Creek Forum will determine whether the strategies for Mission are relevant to Brender Creek, and consider assembling separate strategies to address local instream flow concerns and conditions for Brender Creek, if appropriate. Within two years of rule adoption, the Forum will have developed opportunities and researched funding opportunities for these alternatives.	Coordination/ Collaboration, Study, Funding, WP 7, WP 8, WP 9, WP 19, WP 20, WP 21, WP 22, WP 23, WP 24

Recommended Action	SEPA Analysis
MissionQUANT-2: As part of Phase IV, Implementation, evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Mission Creek and evaluate water conservation, storage, purchase, lease and transfer of water rights, water from other sub-watersheds, and other alternatives as appropriate.	Study, WP 1, WP 2, WP 3, WP 4, WP 7, WP 8, WP 10, WP 19, WP 20, WP 21, WP 22, WP 23, WP 24
MissionQUANT-3: One quarter (0.03 cfs) of the 0.12 cfs projected 2025 water needs is available for growth for two years after rule adoption. If, after two years, water rights are not purchased or leased to cover the interim reserve of 0.03 cfs or conservation measures that provide additional water are not implemented, Ecology would close the Mission Sub-watershed to further appropriation on a seasonal basis, and existing outdoor water use established subsequent to the adoption of WAC 173-545 could be curtailed when flows are not met. All water allocated to the City of Cashmere will be debited to the Lower Wenatchee Reserve and not to the Mission Reserve.	WP 8, WP 10, WP 11
MissionQUANT-4: Consider storing water in Icicle/Peshastin and use that water to augment flows and provide mitigation water in Mission Creek.	WP 19, WP 20, WP 21, WP 22, WP 23, WP 24
MissionQUANT-5: Consider storage opportunities within Mission Sub-watershed (See Section 5.5).	WP 19, WP 20, WP 21, WP 22, WP 23, WP 24
MissionQUANT-6: Metering of all new uses covered under the Mission reserve (includes all new domestic uses).	Monitoring
MissionQUANT-7: Evaluate out-of-kind mitigation and enhancement projects over time, if appropriate. Identify habitat and water quality improvements to mitigate additional reserve water.	Study
MissionQUANT-8: Chelan County or other entity with agency funding assistance will investigate water rights for purchase or lease as part of the mitigation and enhancement strategy for Mission Sub-watershed. The County will seek funding from BPA, Ecology, Washington Rivers Conservancy, Washington Water Trust, and others. As water rights are purchased or transferred for use in the Mission reserve to meet a "no net impact" standard, the first purchase(s) will credit the 0.03 cfs interim reserve, then the additional 0.09 cfs will be available for forecasted growth as it is purchased.	Study, Funding, WP 7, WP 8

DDT

Recommended Action	SEPA Analysis
MissionQUAL-1: Significant reductions in DDT loads may be achieved by preventing bank erosion or by other means of limiting transport of upland soils to streams. BMPs such as riparian buffers and wetlands can also filter and uptake DDT from surface and groundwater. Many BMPs are currently being implemented in the watershed. BMPs should be continued, refined, expanded, and monitored to further reduce erosion, surface runoff, TSS in the water column, and groundwater transport of DDT. BMPs include farm practices, storm water runoff, riparian vegetation planting, orchard conversions, residential practices, riparian buffers, wetlands, etc. These and other appropriate BMP actions and locations should be identified and implemented in coordination with the Planning Unit and its committees (WQTS, 2006b).	Coordination/ Collaboration, Study, WP 35, WP 37

Recommended Action	SEPA Analysis
MissionQUAL-2: A phased monitoring approach should be conducted to assess the effectiveness of BMPs and DDT-TSS (Total Suspended Solids) reduction efforts. This may take time to achieve and, as TSS loads are reduced and DDT levels are monitored, TSS targets may be adjusted to correspond to DDT targets (WQTS, 2006b).	Study, Adaptive Management, WP 35, WP 37
MissionQUAL-3: Evaluation of soil transport to streams should be conducted during large rainfall events when visual observations can be made and/or sections of streams with high sediment runoff and TSS can be isolated. An assessment should be conducted to investigate if any other events contribute soil to streams such as spring thaw processes or irrigation practices (WQTS, 2006b).	Study, WP 35
MissionQUAL-4: More comprehensive groundwater monitoring should be conducted, including further assessment of the relationship between surface water, groundwater, and DDT fate and transport (WQTS, 2006b).	Study, WP 35, WP 37
MissionQUAL-5: Assessments are recommended for all irrigation systems in the watershed to identify any mechanisms that may contribute to sediment transport which are not yet being addressed by BMPs. Actions should be identified and implemented to address the findings. Lining of earthen canals should be encouraged (WQTS, 2006b).	Study, WP 31, WP 33, WP 34, WP 35
MissionQUAL-6: Activities should be identified and undertaken to provide ongoing outreach, education, and technical assistance to growers, streamside landowners, developers, stakeholders, and the general public (WQTS, 2006b).	Public Involvement and Education, WP 35, WP 36
MissionQUAL-7: Funding assistance should be sought from Ecology through its grants and loans programs to implement actions and ongoing monitoring. Other funding sources should be identified and applications submitted to provide funding for ongoing activities. The WQTS will recommend qualified entities to conduct associated monitoring (WQTS, 2006b).	Funding, WP 35, WP 37
MissionQUAL-8: Development over old orchards is a primary concern. Measures should be implemented to prevent DDT laden orchard soils disturbed during construction from being transmitted to streams and lakes in the watershed. Language requiring measures to prevent DDT laden soils from entering the waterways during and after construction should be developed by the WQTS and included in County and municipality development ordinances, growth management plans, and critical area ordinances. The Stormwater Management Manual for Eastern Washington or an equivalent document should be utilized in developing ordinances, and guiding municipal, private, and construction storm water practices (WQTS, 2006b).	Other SEPA, WP 35, WP 38, WP, 39, WP 40
MissionQUAL-9: Assessments are recommended for stormwater control systems in the watershed to identify any mechanisms that may contribute to sediment transport which are not yet being addressed by BMPs. Actions should be identified and implemented to address the findings through a list of prioritized projects (WQTS, 2006b).	Study, WP 35

Fecal Coliform

Recommended Action	SEPA Analysis
MissionQUAL-10: Identify sources of fecal coliform (FC) pollution to Mission Creek Sub-watershed, utilizing the FC technical study. Identify human and nonhuman sources and/or failing on-site septic systems. Plan and implement corrective actions. The Chelan-Douglas Health District (CDHD) should address failing septic systems. Other entities should address manageable sources of FC pollution as appropriate. See the complete action in the plan for the areas in which assessment should be conducted (WQTS, 2006c).	Study, WP 35
MissionQUAL-11: Implement and monitor BMPs to meet the Fecal Coliform TMDL Technical Assessment target reductions (WQTS, 2006c).	Monitoring, WP 35
MissionQUAL-12: Utilizing this report, City of Cashmere, and Ecology information, work with the city of Cashmere to identify sewer system root intrusion in areas near streams. Repair and upgrade sewer collection and delivery system (WQTS, 2006c).	Coordination/ Collaboration, Study, WP 35
MissionQUAL-13: The CDHD will continue to work with consenting homeowners to conduct monitoring of on-site wells in areas of fecal coliform exceedances to help identify the source/s. Utilize this assessment (July 2003) to help identify locations for testing (WQTS, 2006c).	Study, WP 35, WP 37
MissionQUAL-14: CDHD will continue to implement onsite sewage disposal system technical assistance and education programs for homeowners and the industry (WQTS, 2006c).	Public Involvement and Education, WP 35, WP 36
MissionQUAL-15: The CDHD will continue to permit sewage systems per Washington Administrative Code (WAC), including analyzing soils and technologies suitable for individual sites; review/approve the proposed design, specifications, installation and if required, the ongoing maintenance in accordance with the WAC; provide public information under real estate disclosure laws; and review all land use proposals to ensure that the WAC is properly enforced prior to approval by the County (WQTS, 2006c).	Continue Existing, Public Involvement and Education, WP 35
MissionQUAL-16: A grant/loan funding program should be developed and implemented to replace or repair failing septic systems (WQTS, 2006c).	Funding, WP 35
MissionQUAL-17: The CDHD should explore obtaining legal authority from Chelan County to operate a pumper notification program with area septage pumpers as part of its onsite septic system operation and maintenance program. The septage pumpers would work with the CDHD to appropriately identify and correct failing septic systems (WQTS, 2006c).	Study, Other SEPA, WP 35
MissionQUAL-18: The CDHD and watershed would benefit from the funding, development and maintenance of a digital system for all onsite septic system permits issued in Chelan County, and a Geographic Information Systems (GIS) database of the onsite septic systems (WQTS, 2006c).	Funding, Study, WP 35
MissionQUAL-19: When the TMDL DIP is developed, the committee should utilize detailed recommendations from the Wenatchee River Watershed Action Plan (WQTS, 2006c).	WP 35
MissionQUAL-20: Conduct stream walk cleanups along the stream (Fall, Spring, Summer) with area schools, homeowners, and other groups (WQTS, 2006c).	Public Involvement and Education, WP 35, WP 36

Recommended Action	SEPA Analysis
MissionQUAL-21: Conduct ongoing community fecal coliform education/awareness campaigns throughout the year. Engage and get support from homeowners (WQTS, 2006c).	Public Involvement and Education, WP 35, WP 36
MissionQUAL-22: Work with City, County, State, and Federal governments, and the Humane Society to deal with the feral cats and dogs living within the stream corridor. Monitor and remove dead animals within the stream corridor throughout the year (WQTS, 2006c).	Coordination/ Collaboration, Monitoring, WP 35
MissionQUAL-23: Conduct education and enforcement actions to stop illegal dumping of wastes either to storm drains or directly to surface waters. This dumping may be of portable toilet wastes, recreational vehicle wastes, etc. (WQTS, 2006c).	Public Involvement and Education, Continue Existing, WP 35, WP 36
MissionQUAL-24: The WQTS should encourage the CDHD, Chelan County, Cities, DOH, and Utilities to continue ongoing review and upgrading of ordinances regarding developments and sewage systems technologies (WQTS, 2006c).	Continue Existing, Other SEPA, WP 35
MissionQUAL-25: The WQTS and its participating entities should work with the public and homeowners regarding BMPs to reduce fecal coliform runoff. General actions should include public information, education, and technical assistance regarding watering practices, landscaping, stormwater runoff, filtration practices, animal waste, etc. (WQTS, 2006c).	Public Involvement and Education, WP 35, WP 36
MissionQUAL-26: Work with irrigation districts to implement and enforce policies to prevent illegal fecal coliform discharges to irrigation canals (WQTS, 2006c).	WP 33, WP 35
MissionQUAL-27: Work with landowners regarding fecal coliform runoff (WQTS, 2006c).	WP 31, WP 33, WP 34, WP 35, WP 36
MissionQUAL-28: Encourage Chelan County and municipalities to develop and implement stormwater policies, standards, and guidelines, utilizing the Eastern Washington Stormwater Manual or equivalent, in comprehensive plans, critical area ordinances, growth management plans, and other appropriate plans (WQTS, 2006c).	Other SEPA, WP 35, WP 38, WP 39, WP 40
MissionQUAL-29: Work with appropriate entities to reduce fecal coliform runoff from impervious surfaces (WQTS, 2006c).	Coordination/ Collaboration, WP 35
MissionQUAL-30: Work with U.S. Forest Service, Washington State Department of Natural Resources, and private owners on forested lands to restore and protect streams from fecal coliform runoff pollution (WQTS, 2006c).	Coordination/ Collaboration, WP 35
MissionQUAL-31: Work with wastewater purveyors to examine sewer collection systems to identify problems or damage within them that may contribute fecal coliform loading in the watershed. Correct identified problems as appropriate (WQTS, 2006c).	Coordination/ Collaboration, Study, WP 35
MissionQUAL-32: Funding assistance should be sought from Ecology through its grants and loans programs to implement actions and ongoing monitoring. Other funding sources should be identified and applications submitted to provide funding for ongoing activities. The WQTS will recommend qualified entities to conduct associated monitoring. Self-sustaining funding mechanisms to reduce fecal coliform inputs should be explored and developed in concert with the Wenatchee Watershed Planning Unit and its participating entities (WQTS, 2006c).	Funding, WP 35, WP 37

Recommended Action	SEPA Analysis
MissionQUAL-33: Work with the wastewater utilities regarding their ordinances to connect unconnected homes in the service area (WQTS, 2006c).	WP 35, WP 40

Habitat Restoration/Enhancement

Recommended Action	SEPA Analysis
MissionH-1: Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts and diversions) (UCSRB, 2005).	WP 45
MissionH-2: Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Mission Creek (UCSRB, 2005).	WP 1, WP 2, WP 3, WP 4, WP 8, WP 19, WP 20, WP 21, WP 22, WP 23
MissionH-3: Decrease water temperatures and improve water quality by restoring riparian vegetation along the stream (UCSRB, 2005).	WP 35, WP 47
MissionH-4: Reduce unnatural sediment recruitment to the stream by restoring riparian habitat and improving road maintenance (UCSRB, 2005).	WP 45, WP 47, WP 50, WP 52
MissionH-5: Increase habitat diversity and quantity by restoring riparian habitat, reconnecting side channels and the floodplain with the channel, increasing large woody debris within the channel, and by adding instream structures (UCSRB, 2005).	WP 42, WP 47, WP 48

TABLE 12-8

SEPA Analysis for the Peshastin Creek Sub-watershed Recommended Actions

Water Availability

Recommended Action	SEPA Analysis
PeshastinQUANT-1: Evaluate passage requirements for fish immediately below the Peshastin Irrigation District diversion (addressing bypass reach/piping).	Study, WP 45, WP 46
PeshastinQUANT-2: Consider other instream projects that improve habitat.	WP 42, WP 48
PeshastinQUANT-3: As part of Phase IV, Implementation, evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Peshastin and evaluate water conservation, storage, purchase, lease and transfer of water rights, and other alternatives.	Study, WP 1, WP 2, WP 3, WP 4, WP 7, WP 8, WP 10, WP 19, WP 20, WP 21, WP 22, WP 23, WP 24
PeshastinQUANT-4: Evaluate and institute programs to increase instream flows through water acquisitions, leases, and transfers.	WP 8

Habitat Restoration/Enhancement

Recommended Action	SEPA Analysis
PeshastinH-1: Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (UCSRB, 2005).	WP 45
PeshastinH-2: Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Peshastin Creek (UCSRB, 2005).	WP 1, WP 2, WP 3, WP 4, WP 8, WP 19, WP 20, WP 21, WP 22, WP 23
PeshastinH-3: Reduce water temperatures by increasing stream flows and restoring riparian vegetation along the stream (UCSRB, 2005).	WP 1, WP 2, WP 3, WP 4, WP 8, WP 19, WP 20, WP 21, WP 22, WP 23, WP 35, WP 47
PeshastinH-4: Increase habitat diversity and quantity by restoring riparian vegetation, adding instream structures and large woody debris, and reconnecting side channels and the floodplain with the stream (UCSRB, 2005).	WP 42, WP 47, WP 48

TABLE 12-9

SEPA Analysis for the Chumstick Creek Sub-watershed Recommended Actions

Water Availability

Recommended Action	SEPA Analysis
ChumQUANT-1: Chelan County as lead (with support from Ecology), will convene a Chumstick Water Forum to guide data collection, oversee the proposed water management strategy, and help develop mitigation measures.	Coordination/ Collaboration, Study
ChumQUANT-2: Chumstick Water Forum to assist in developing a data collection plan to monitor surface water flows (specify location) and develop management flows.	Study, Monitoring
ChumQUANT-3: Chumstick Water Forum, with assistance from Chelan County and Ecology, to conduct groundwater monitoring to understand hydraulic continuity and overall impact of exempt wells on groundwater levels and streamflows.	Study, Monitoring

Recommended Action	SEPA Analysis
ChumQUANT-4: Recommend that Ecology close the Chumstick Sub-watershed for an interim period of three years while data are collected and alternatives are assessed. Uses that are not subject to the closure (and can continue throughout the three year interim closure) include: fire suppression, domestic use from wells, stock water uses, and seasonal storage, pending evaluation by the Chumstick Water Forum and Ecology. These exempt uses would be limited to a total of 0.043 cfs while studies are being performed to determine future water availability in the Chumstick and a future strategy is assessed. Seasonal storage opportunities and other alternatives in Chumstick will be evaluated by Ecology and the Chumstick Water Forum through the water right application process on a case-by-case basis during the three year interim period. Storage opportunities in Chumstick will be addressed as part of the Chumstick strategy after conclusion of the Forum's three year process and coordinated with the WRIA 45 Multi-Purpose Storage Assessment. This interim closure will be re-evaluated at the end of the three year period by the Chumstick Forum and Ecology. Note that water storage tanks as included in the Chumstick Community Wildfire Protection Program are exempt from this closure.	Study, Coordination/ Collaboration, Adaptive Management, Continue Existing, WP 10, WP 11, WP 19, WP 20, WP 21, WP 22, WP 23, WP 24
ChumQUANT-5: Ecology and Chelan County to implement reservation conditions as follows: One third (0.043 cfs) of the 0.13 cfs projected 2025 water needs is available for growth for three years after rule adoption. Allocation of the remainder of the reserve would be considered only after completion of additional instream flow assessments (ChumQUANT-2) and a cumulative impacts study (ChumQUANT-3, 6) and would be subject to appropriate conditions and limitations based on the result of those assessments (ChumQUANT-7). If, after completion of the cumulative impact study, Ecology determines that the cumulative effects of domestic water uses negatively affect water available for instream flows, Ecology will consider allowing only in-house water use from the reservation. If after 3 years, water rights are not purchased or leased to cover the interim reserve of 0.043 cfs or conservation measures that provide additional water are not implemented, Ecology would close the Chumstick Sub-watershed to further appropriation on a seasonal basis, and existing outdoor water use established subsequent to the adoption of WAC 173-545 could be curtailed when flows are not met. Note that the City of Leavenworth will debit any new water from the Lower Wenatchee Reserve and not the Chumstick Reserve.	Study, WP 1, WP 2, WP 3, WP 4, WP 7, WP 8, WP 10, WP 11
ChumQUANT-6: A cumulative impact analysis of permit exempt use and uses associated with permits and claims approved since 1983 will be initiated by Ecology as authorized under the 1983 flow rule. Chelan County will partner with Ecology in this study. The cumulative impacts assessment will help to determine whether Ecology will curtail outdoor domestic water use of wells installed after 1983, and whether Ecology will close the Chumstick Sub-watershed to outdoor water use in the future.	Study
ChumQUANT-7: Chumstick Forum, Chelan County and Ecology to re-evaluate a proposed strategy for the Chumstick in three years after rule adoption, when new monitoring data have been collected and assessed and cumulative impact analysis is complete. Consider allowing group domestic groundwater use of deeper aquifer only as part of the Chumstick strategy addressed by the Forum.	Study, Adaptive Management, WP 16
ChumQUANT-8: Chelan County will evaluate alternatives to improve fish passage at the North Road culvert, and further pursue replacement of culverts upstream of North Road on Chumstick Creek.	Study, WP 45
ChumQUANT-9: Metering of all new uses covered under the Chumstick reserve (includes all new domestic uses).	Monitoring

Recommended Action	SEPA Analysis
ChumQUANT-10: As part of Phase IV, Implementation, the Planning Unit and the Chumstick Forum (with Chelan County as lead) will evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Chumstick and evaluate water conservation, storage opportunities, purchase, lease and transfer of water rights, water transfer from other sub-watersheds, and other alternatives. Consider conjunctive use and evaluate pumping from the deep aquifer to augment flows in the Chumstick. Investigate storage options where stored water could be used to augment flows and provide mitigation water.	Study, WP 1, WP 2, WP 3, WP 4, WP 5, WP 6, WP 7, WP 8, WP 9, WP 10, WP 16, WP 19, WP 20, WP 21, WP 22, WP 23, WP 24
ChumQUANT-11: Encourage conservation and outreach.	Public Involvement and Education
ChumQUANT-12: Chelan County or other entity with agency funding assistance will investigate water rights for purchase or lease as part of the mitigation and enhancement strategy for Chumstick Sub-watershed. The County will seek funding from BPA, Ecology, Washington Rivers Conservancy, Washington Water Trust, and others. As water rights are purchased or transferred for use in the Chumstick reserve to meet a "no net impact" standard, the first purchase(s) will credit the 0.043 cfs interim reserve, then the additional 0.09 cfs will be available for forecasted growth as it is purchased. Consider information from adjudication records (1982-1984) when investigating water rights for purchase or lease.	Funding, Study, WP 7, WP 8

Fecal Coliform

Recommended Action	SEPA Analysis
ChumQUAL-1: Identify sources of fecal coliform pollution to Chumstick Creek Sub-watershed, including Van Creek and Upper Eagle Creek, utilizing the FC technical study. Identify human and nonhuman sources and/or failing on-site septic systems. Plan and implement corrective actions. The CDHD should address failing septic systems. Other entities should address manageable sources of FC pollution as appropriate (WQTS, 2006c).	Study, WP 35, Early Planning Stages
ChumQUAL-2: Implement and monitor BMPs to meet the Fecal Coliform TMDL Technical Assessment target reductions (WQTS, 2006c).	Monitoring, WP 35
ChumQUAL-3: CDHD will continue to implement onsite sewage disposal system technical assistance and education programs for homeowners and the industry (WQTS, 2006c).	Public Involvement and Education, WP 35, WP 36
ChumQUAL-4: The CDHD will continue to permit sewage systems per Washington Administrative Code (WAC), including analyzing soils and technologies suitable for individual sites; review/approve the proposed design, specifications, installation and if required, the ongoing maintenance in accordance with the WAC; provide public information under real estate disclosure laws; and review all land use proposals to ensure that the WAC is properly enforced prior to approval by the County (WQTS, 2006c).	Continue Existing, Public Involvement and Education, WP 35
ChumQUAL-5: A grant/loan funding program should be developed and implemented to replace or repair failing septic systems (WQTS, 2006c).	Funding, WP 35

Recommended Action	SEPA Analysis
ChumQUAL-6: The CDHD should explore obtaining legal authority from Chelan County to operate a pumper notification program with area septage pumpers as part of its onsite septic system operation and maintenance program. The septage pumpers would work with the CDHD to appropriately identify and correct failing septic systems (WQTS, 2006c).	Study, Other SEPA, WP 35
ChumQUAL-7: The CDHD and watershed would benefit from the funding, development and maintenance of a digital system for all onsite septic system permits issued in Chelan County, and a GIS database of the onsite septic systems (WQTS, 2006c).	Study, Funding, WP 35
ChumQUAL-8: When the TMDL DIP is developed, the committee should utilize detailed recommendations from the Wenatchee River Watershed Action Plan (WQTS, 2006c).	WP 35
ChumQUAL-9: Conduct stream walk cleanups along the stream (Fall, Spring, Summer) with area schools, homeowners, and other groups (WQTS, 2006c).	Public Involvement and Education, WP 35, WP 36
ChumQUAL-10: Conduct ongoing community fecal coliform education/awareness campaigns throughout the year. Engage and get support from homeowners (WQTS, 2006c).	Public Involvement and Education, WP 35, WP 36
ChumQUAL-11: Work with City, County, State, and Federal governments, and the Humane Society to deal with the feral cats and dogs living within the stream corridor. Monitor and remove dead animals within the stream corridor throughout the year. (WQTS, 2006c).	Coordination/ Collaboration, Monitoring, WP 35
ChumQUAL-12: Conduct education and enforcement actions to stop illegal dumping of wastes either to storm drains or directly to surface waters. This dumping may be of portable toilet wastes, recreational vehicle wastes, etc. (WQTS, 2006c).	Public Involvement and Education, Continue Existing, WP 35, WP 36
ChumQUAL-13: The WQTS should encourage the CDHD, Chelan County, Cities, DOH, and Utilities to continue ongoing review and upgrading of ordinances regarding developments and sewage systems technologies (WQTS, 2006c).	Continue Existing, Other SEPA, WP 35
ChumQUAL-14: The WQTS and its participating entities should work with the public and homeowners regarding BMPs to reduce fecal coliform runoff. General actions should include public information, education, and technical assistance regarding watering practices, landscaping, stormwater runoff, filtration practices, animal waste, etc. (WQTS, 2006c).	Public Involvement and Education, WP 35, WP 36
ChumQUAL-15: Work with irrigation districts to implement and enforce policies to prevent illegal fecal coliform discharges to irrigation canals (WQTS, 2006c).	WP 33, WP 35
ChumQUAL-16: Work with landowners regarding fecal coliform runoff (WQTS, 2006c).	WP 31, WP 33, WP 34, WP 35, WP 36
ChumQUAL-17: Encourage Chelan County and municipalities to develop and implement stormwater policies, standards, and guidelines, utilizing the Eastern Washington Stormwater Manual or equivalent, in comprehensive plans, critical area ordinances, growth management plans, and other appropriate plans (WQTS, 2006c).	Other SEPA, WP 35, WP 38, WP 39, WP 40
ChumQUAL-18: Work with appropriate entities to reduce fecal coliform runoff from impervious surfaces (WQTS, 2006c).	Coordination/ Collaboration, WP 35

Recommended Action	SEPA Analysis
ChumQUAL-19: Work with U.S. Forest Service, Washington State Department of Natural Resources, and private owners on forested lands to restore and protect streams from fecal coliform runoff pollution (WQTS, 2006c).	Coordination/ Collaboration, WP 35
ChumQUAL-20: Funding assistance should be sought from Ecology through its grants and loans programs to implement actions and ongoing monitoring. Other funding sources should be identified and applications submitted to provide funding for ongoing activities. The WQTS will recommend qualified entities to conduct associated monitoring. Self-sustaining funding mechanisms to reduce fecal coliform inputs should be explored and developed in concert with the Wenatchee Watershed Planning Unit and its participating entities (WQTS, 2006c).	Funding, WP 35, WP 37

Habitat Restoration/Enhancement

Recommended Action	SEPA Analysis
ChumH-1: Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts and diversions) (UCSRB, 2005).	WP 45
ChumH-2: Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Chumstick Creek (UCSRB, 2005).	WP 1, WP 2, WP 3, WP 4, WP 8, WP 19, WP 20, WP 21, WP 22, WP 23
ChumH-3: Decrease water temperatures and improve water quality by restoring riparian vegetation along the stream (UCSRB, 2005).	WP 35, WP 47
ChumH-4: Increase habitat diversity and quantity by restoring riparian habitat, reconnecting side channels and the floodplain with the channel, increasing large woody debris within the channel, and by adding instream structures (UCSRB, 2005).	WP 42, WP 47, WP 48
ChumH-5: Protect remaining floodplain and riparian habitat (UCRTT, 2002).	WP 49, WP 52, WP 53

TABLE 12-10

SEPA Analysis for the Icicle Creek Sub-watershed Recommended Actions

Water Resource Management Strategy

Recommended Action	SEPA Analysis
WRMS-4c: Recommends a new stream gage be established at the existing control point on the Icicle Creek. Details will be determined during Phase IV, Implementation.	Monitoring

DO/pH

Recommended Action	SEPA Analysis
IcicleQUAL-1: The partnership formed to secure funding for further study of DO and pH (Chelan County, Chelan County PUD and the cities of Cashmere, Leavenworth and Wenatchee) should continue to work together, with the WQTS to acquire funding assistance and work with the WQTS to: • Facilitate and develop a workable strategy that can be used and ultimately approved by the EPA and in Ecology's TMDL submittal for DO and pH, and • Review and make suggestions for future improvements to Ecology's technical assessment, summary implementation plan, and adaptive management approaches to meet state water quality standards for these parameters.	Coordination/ Collaboration, Funding, Study
IcicleQUAL-2: Strategies to address point and non-point sources of phosphorus as part of the TMDL for DO and pH will be reported during the implementation phase of the Wenatchee Watershed planning effort.	Study, Early Planning Stages
IcicleQUAL-3: Controls should be developed and implemented through new and existing regulatory permits, if needed, to reduce phosphorous inputs to surface and groundwaters from other Wenatchee Watershed point sources. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Continue Existing, Study, Adaptive Management, WP 30, WP 35, WP 37
IcicleQUAL-4: Groundwater discharges to the Wenatchee River, Icicle Creek, and their tributaries affects dissolved oxygen levels and nutrient concentrations. Groundwater is discharged to the river or creeks in some reaches, and is recharged in other reaches. In the Wenatchee basin, groundwater flow and BOD/nutrient concentrations may be elevated due to upland practices such as orchard irrigation and wastewater discharge to groundwater from lagoons and on-site septic systems. Assessments of groundwater contributions and sources of nutrients (phosphorous) should be conducted. Actions should be implemented based on the conclusions and recommendations of these studies to reduce inputs of phosphorous from these areas (WQTS, 2006a).	Study, Early Planning Stages, WP 33, WP 34, WP 35, WP 36, WP 40
IcicleQUAL-5: Non-point sources along the length of the river may be contributing BOD and nutrients. Address failing septic systems through actions identified in the Wenatchee Watershed Fecal Coliform TMDL. Continue site specific inspections and enforcement of regulations that restrict placement of on-site septic drain fields from areas deemed to have unsuitable soils. A study should be conducted to assess soils and onsite septic systems. Estimates should be made of the maximum number and density of on-site drain fields that the upper basin can accommodate and still meet the water quality standards, as was done in the Lake Chelan study (Patmont et al., 1989). Conduct associated monitoring and adaptive management (WQTS, 2006a).	Study, Continue Existing, Adaptive Management, WP 35, WP 37
IcicleQUAL-6: Nutrients (phosphorous) can enter streams from storm water events. Work with Chelan County and municipalities to reduce storm water inputs, utilizing the Eastern Washington Storm water Manual or equivalent. Encourage appropriate entities to include language that addresses storm water in comprehensive plans and ordinances. Work with developers. (See IcicleQUAL-15). Conduct associated monitoring and adaptive management (WQTS, 2006a).	Coordination/ Collaboration, Adaptive Management, Other SEPA, WP 35, WP 37, WP 40

Recommended Action	SEPA Analysis
IcicleQUAL-7: Nutrients (phosphorous) can enter surface and ground water from residential yards and gardens, hobby farms, City and County Parks, business owned landscapes, etc. An education outreach plan should be developed and implemented to heighten awareness and reduce inputs from these sources. Policies and practices should be implemented in City and County Public Works departments. The County and cities should consider implementing a ban on the sale of high phosphate detergents, such as is being considered in Spokane. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Public Involvement and Education, Adaptive Management, Other SEPA, WP 35, WP 36, WP 37, WP 40
IcicleQUAL-8: Nutrients can enter streams from materials used to de-ice, clean, and maintain roads and parking lots. Animal waste from roads and parking lots can enter streams and increase nutrient loading. Work with the County, cities, and businesses to determine if road and parking lot maintenance practices may be contributing to nutrient loading and if necessary investigate ways to reduce nutrient inputs from these practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Coordination/ Collaboration, Adaptive Management, Study, WP 35, WP 37
IcicleQUAL-9: Nutrients (phosphorous) can be released to ground and surface waters from development practices, such as disruption of soils during conversions of orchard lands to housing. Actions should be conducted to prevent nutrients from entering ground and surface waters before, during and after construction. Work with developers to implement these actions. Encourage entities to include appropriate language in county and city comprehensive plans, growth management, and critical area ordinances. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Coordination/ Collaboration, Adaptive Management, Other SEPA, WP 35, WP 37, WP 38, WP 40
IcicleQUAL-10: Consider implementing actions recommended in the Wenatchee River Basin Temperature and Fecal Coliform TMDLs if the actions address problems that have been identified in the Icicle Sub-watershed. Lowering temperatures and reducing nutrient inputs will improve pH and dissolved oxygen levels in the Wenatchee River Watershed (WQTS, 2006a).	WP 35
IcicleQUAL-11: Reserve load capacities for Biochemical Oxygen Demand (BOD) and nutrients should be established for the Upper Wenatchee River and Icicle Creek. Reserve load capacities are needed because there is no additional assimilative capacity for dissolved oxygen in the upper watershed during critical conditions. A point source regulatory strategy and nonpoint source BMP strategy should be developed to protect the reserve capacities and maintain water quality standards (WQTS, 2006a).	WP 30, WP 31, WP 33, WP 34, WP 35, WP 37, WP 38, WP 39, WP 40
IcicleQUAL-12: Encourage lining of earthen canals where appropriate. Work with irrigation districts to implement BMPs and adaptive management programs to minimize any nutrient loading that is not already being addressed (WQTS, 2006a).	Adaptive Management, WP 33, WP 34, WP 35
IcicleQUAL-13: Agricultural practices can contribute nutrients to ground and surface waters through crop watering practices, application of fertilizers, and soil disturbance activities. Work with the agricultural community to encourage practices that will reduce nutrient inputs to ground and surface waters while enhancing crop quality and yield. Examples include technical assistance through farm plans and Best Management Practices (BMPs). Conduct associated monitoring and adaptive management (WQTS, 2006a).	Adaptive Management, WP 33, WP 34, WP 35, WP 37

Recommended Action	SEPA Analysis
IcicleQUAL-14: Funding for these projects should be sought through Department of Ecology Centennial and 319 grants and loans. Identify and access other funding sources through the Planning Unit and other entities. Ongoing adaptive management should be utilized to provide the best use of funds and environmental benefits (WQTS, 2006a).	Adaptive Management, Funding, WP 35
IcicleQUAL-15: Proper filtration of nutrients through land use practices can have a beneficial effect on nutrient reductions to ground and surface waters. Encourage implementation of wetlands, filter strips, riparian vegetation, bio-swales, drainage basins, pervious surfaces, etc. in residential, commercial, agricultural, industrial, development, and municipal practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Adaptive Management, WP 33, WP 34, WP 35, WP 37
IcicleQUAL-16: Identify and investigate any non point sources in tributaries that may be contributing to nutrient loads (WQTS, 2006a).	Study, WP 35

Habitat Restoration/Enhancement

Recommended Action	SEPA Analysis
IcicleH-1: Increase connectivity by improving fish passage over Dam 5 in the lower Icicle Creek (UCSRB, 2005).	WP 45, WP 46
IcicleH-2: Reduce sediment recruitment by restoring riparian vegetation between the mouth of the Icicle and the boulder field (RM 0-5.4) (UCSRB, 2005).	WP 35, WP 47, WP 50
IcicleH-3: Improve road maintenance to reduce fine sediment recruitment in the upper watershed (UCSRB, 2005).	WP 45
IcicleH-4: Increase habitat diversity and quantity by restoring riparian vegetation, reconnecting side channels, and reconnecting the floodplain with the channel in lower Icicle Creek (UCSRB, 2005).	WP 47, WP 48
IcicleH-5: Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Icicle Creek (UCSRB, 2005).	WP 1, WP 2, WP 3, WP 4, WP 8, WP 19, WP 20, WP 21, WP 22, WP 23
IcicleH-6: Protect remaining floodplain and riparian habitat downstream of Chatter Creek. Emphasis should be placed on habitat downstream of Leavenworth Hatchery (UCRTT, 2002).	WP 49, WP 52, WP 53

TABLE 12-11

SEPA Analysis for the Upper Wenatchee River and Chiwaukum Creek Sub-watershed Recommended Actions

DO/pH

Recommended Action	SEPA Analysis
UpWenQUAL-1: The partnership formed to secure funding for further study of DO and pH (Chelan County, Chelan County PUD and the cities of Cashmere, Leavenworth and Wenatchee) should continue to work together, with the WQTS to acquire funding assistance and work with the WQTS to: • Facilitate and develop a workable strategy that can be used and ultimately approved by the EPA and in Ecology's TMDL submittal for DO and pH, and • Review and make suggestions for future improvements to Ecology's technical assessment, summary implementation plan, and adaptive management approaches to meet state water quality standards for these parameters.	Coordination/ Collaboration, Funding, Study
UpWenQUAL-2: Strategies to address point and non-point sources of phosphorus as part of the TMDL for DO and pH will be reported during the implementation phase of the Wenatchee Watershed planning effort.	Study, Early Planning Stages
UpWenQUAL-3: Large reductions of phosphorus inputs are needed from point sources in the Wenatchee River Watershed especially waste water treatment plants (WWTPs). A regulatory strategy should be developed and implemented with WWTPs and Ecology to institute controls over time through NPDES permits that will reduce phosphorous discharges to surface and groundwaters. WWTPs to be addressed include the Lake Wenatchee, Stevens Pass, Leavenworth, Peshastin, and Cashmere waste water treatment plants. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Study, Adaptive Management, WP 30, WP 35, WP 37
UpWenQUAL-4: Controls should be developed and implemented through new and existing regulatory permits, if needed, to reduce phosphorous inputs to surface and groundwaters from other Wenatchee Watershed point sources. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Continue Existing, Study, Adaptive Management, WP 30, WP 35, WP 37
UpWenQUAL-5: Groundwater discharges to the Wenatchee River, Icicle Creek, and their tributaries affects dissolved oxygen levels and nutrient concentrations. Groundwater is discharged to the river or creeks in some reaches, and is recharged in other reaches. In the Wenatchee basin, groundwater flow and BOD/nutrient concentrations may be elevated due to upland practices such as orchard irrigation and wastewater discharge to groundwater from lagoons and on-site septic systems. Assessments of groundwater contributions and sources of nutrients (phosphorous) should be conducted. Actions should be implemented based on the conclusions and recommendations of these studies to reduce inputs of phosphorous from these areas (WQTS, 2006a).	Study, Early Planning Stages, WP 33, WP 34, WP 35, WP 36, WP 40

Recommended Action	SEPA Analysis
UpWenQUAL-6: Non-point sources along the length of the river may be contributing BOD and nutrients. Address failing septic systems through actions identified in the Wenatchee Watershed Fecal Coliform TMDL. Continue site specific inspections and enforcement of regulations that restrict placement of on-site septic drain fields from areas deemed to have unsuitable soils. A study should be conducted to assess soils and onsite septic systems. Estimates should be made of the maximum number and density of on-site drain fields that the upper basin can accommodate and still meet the water quality standards, as was done in the Lake Chelan study (Patmont et al., 1989). Conduct associated monitoring and adaptive management (WQTS, 2006a).	Study, Continue Existing, Adaptive Management, WP 35, WP 37
UpWenQUAL-7: Nutrients (phosphorous) can enter streams from storm water events. Work with Chelan County and municipalities to reduce storm water inputs, utilizing the Eastern Washington Storm water Manual or equivalent. Encourage the appropriate entities to include language that addresses storm water in comprehensive plans and ordinances. Work with developers. (See UpWenQUAL-16). Conduct associated monitoring and adaptive management (WQTS, 2006a).	Coordination/ Collaboration, Adaptive Management, Other SEPA, WP 35, WP 37, WP 40
UpWenQUAL-8: Nutrients (phosphorous) can enter surface and ground water from residential yards and gardens, hobby farms, City and County Parks, business owned landscapes, etc. An education outreach plan should be developed and implemented to heighten awareness and reduce inputs from these sources. Policies and practices should be implemented in City and County Public Works departments. The County and cities should consider implementing a ban on the sale of high phosphate detergents, such as is being considered in Spokane. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Public Involvement and Education, Adaptive Management, Other SEPA, WP 35, WP 36, WP 37, WP 40
UpWenQUAL-9: Nutrients can enter streams from materials used to de-ice, clean, and maintain roads and parking lots. Animal waste from roads and parking lots can enter streams and increase nutrient loading. Work with the County, cities, businesses, and the WA State Department of Transportation to determine if road and parking lot maintenance practices may be contributing to nutrient loading and if necessary investigate ways to reduce nutrient inputs from these practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Coordination/ Collaboration, Adaptive Management, Study, WP 35, WP 37
UpWenQUAL-10: Nutrients (phosphorous) can be released to ground and surface waters from development practices, such as disruption of soils during conversions of orchard lands to housing. Actions should be conducted to prevent nutrients from entering ground and surface waters before, during and after construction. Work with developers to implement these actions. Encourage entities to include appropriate language in county and city comprehensive plans, growth management, and critical area ordinances. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Coordination/ Collaboration, Adaptive Management, Other SEPA, WP 35, WP 37, WP 38, WP 40
UpWenQUAL-11: Consider implementing actions recommended in the Wenatchee River Basin Temperature and Fecal Coliform TMDLs if the actions address problems that have been identified in the Upper Wenatchee Sub-watershed. Lowering temperatures and reducing nutrient inputs will improve pH and dissolved oxygen levels in the Wenatchee River Watershed (WQTS, 2006a).	WP 35

Recommended Action	SEPA Analysis
UpWenQUAL-12: Reserve load capacities for Biochemical Oxygen Demand (BOD) and nutrients should be established for the Upper Wenatchee River and Icicle Creek. Reserve load capacities are needed because there is no additional assimilative capacity for dissolved oxygen in the upper watershed during critical conditions. A point source regulatory strategy and nonpoint source BMP strategy should be developed to protect the reserve capacities and maintain water quality standards (WQTS, 2006a).	WP 30, WP 31, WP 33, WP 34, WP 35, WP 37, WP 38, WP 39, WP 40
UpWenQUAL-13: Encourage lining of earthen canals where appropriate. Work with irrigation districts to implement BMPs and adaptive management programs to minimize any nutrient loading that is not already being addressed (WQTS, 2006a).	Adaptive Management, WP 33, WP 34, WP 35
UpWenQUAL-14: Agricultural practices can contribute nutrients to ground and surface waters through crop watering practices, application of fertilizers, and soil disturbance activities. Work with the agricultural community to encourage practices that will reduce nutrient inputs to ground and surface waters while enhancing crop quality and yield. Examples include technical assistance through farm plans and Best Management Practices (BMPs). Conduct associated monitoring and adaptive management (WQTS, 2006a).	Adaptive Management, WP 33, WP 34, WP 35, WP 37
UpWenQUAL-15: Funding for these projects should be sought through Department of Ecology Centennial and 319 grants and loans. Identify and access other funding sources through the Planning Unit and other entities. Ongoing adaptive management should be utilized to provide the best use of funds and environmental benefits (WQTS, 2006a).	Funding, Adaptive Management, WP 35
UpWenQUAL-16: Proper filtration of nutrients through land use practices can have a beneficial effect on nutrient reductions to ground and surface waters. Encourage implementation of wetlands, filter strips, riparian vegetation, bio-swales, drainage basins, pervious surfaces, etc. in residential, commercial, agricultural, industrial, development, and municipal practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Adaptive Management, WP 33, WP 34, WP 35, WP 37
UpWenQUAL-17: Identify and investigate any non point sources in tributaries that may be contributing to nutrient loads (WQTS, 2006a).	Study, WP 35

Habitat Protection

Recommended Action	SEPA Analysis
UpWenH-1: Increase habitat quantity in the Wenatchee River between Tumwater Canyon and Lake Wenatchee by restoring riparian habitat along the river and reconnecting side channels (where feasible) (UCSRB, 2005).	WP 47, WP 48
ChiwaukumH-1: Increase connectivity along Skinney Creek (UCSRB, 2005).	WP 45, WP 46
ChiwaukumH-2: Increase habitat diversity in Chiwaukum Creek along Tumwater Campground by restoring riparian vegetation, reconnecting the floodplain with the stream, and by increasing large woody debris within the channel (UCSRB, 2005).	WP 42, WP 47, WP 48

TABLE 12-12

SEPA Analysis for the Chiwawa River Sub-watershed Recommended Actions

Water Resource Management Strategy

Recommended Action	SEPA Analysis
WRMS-4d: Review the gage location on the Chiwawa River as related to the impacts on flows from withdrawals.	Study, Monitoring

Habitat Protection

Recommended Action	SEPA Analysis
ChiwawaH-1: Increase habitat quantity by restoring riparian habitat along the lower 4 miles of the Chiwawa River (UCSRB, 2005).	WP 47
ChiwawaH-2: Reduce sediment recruitment to the stream by improving road maintenance within the watershed (UCSRB, 2005).	WP 45
ChiwawaH-3: Improve fish passage in tributaries (UCSRB, 2005).	WP 45, WP 46
ChiwawaH-4: Protect remaining floodplain and riparian habitat, particularly around Chikamin Flats (UCRTT, 2002).	WP 49, WP 52, WP 53

TABLE 12-13

SEPA Analysis for the Nason Creek Sub-watershed Recommended Actions

Habitat Restoration/Enhancement

Recommended Action	SEPA Analysis
NasonH-1: Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts) (UCSRB, 2005).	WP 45
NasonH-2: Increase habitat diversity and natural channel stability by increasing in-channel large wood complexes, restoring riparian habitat, and reconnecting side channels, wetlands, and floodplains to the stream (UCSRB, 2005).	WP 42, WP 35, WP 47, WP 48
NasonH-3: Improve road maintenance to reduce fine sediment recruitment to the stream (UCSRB, 2005).	WP 45
NasonH-4: Reduce high water temperatures by reconnecting side channels and the floodplain and improving riparian habitat conditions (UCSRB, 2005).	WP 35, WP 47, WP 48
NasonH-5: Protect remaining floodplain and riparian habitat (UCRTT, 2002).	WP 49, WP 52, WP 53

TABLE 12-14

SEPA Analysis for the White River, Little Wenatchee River, and Lake Wenatchee Sub-watersheds Recommended Actions

Habitat Protection

Recommended Action	SEPA Analysis
WhiteH-1: Increase habitat diversity within the lower 2 miles of the White River by reconnecting the floodplain and wetlands to the river (UCSRB, 2005).	WP 42, WP 48
WhiteH-2: Protect stream channel, riparian, and floodplain functions. Focus on Panther Creek downstream to mouth (UCRTT, 2002).	WP 49, WP 52, WP 53
WhiteH-3: Protect shorelines along Lake Wenatchee near White River mouth (UCRTT, 2002).	WP 54
LitWenH-1: Reduce sediment recruitment to the stream by improving road maintenance within the watershed (UCSRB, 2005).	WP 45
LitWenH-2: Protect stream channel, riparian, and floodplain functions; focus on Little Wenatchee River falls downstream to mouth (UCRTT, 2002).	WP 49, WP 52, WP 53
LkWenH-1: Protect remaining near shore habitat, and develop a means to reduce impacts of bulkheads (UCRTT, 2002).	Study, WP 54

TABLE 12-15

SEPA Analysis for Implementation Recommended Actions

Watershed Planning Administration and Plan Updates

Recommended Action	SEPA Analysis
IMP-1: WWPU and Subcommittees will continue to exist and operate under the current operating procedures and will address any needed reorganization to implement the plan as part of Phase IV, Implementation.	Continue Existing
IMP-2: Build a revision process and schedule for the Wenatchee Watershed Plan into plan implementation. Ensure that new plan actions and best available science can be integrated in the future. Planning horizon will be 20 years (through 2025). Updates should be scheduled every seven years, also consistent with County comprehensive plan revision schedule. If additional updates are necessary based on the availability of data or unforeseen water-related issues, the process should be designed such that those updates are possible. Future amendments and additions to the Plan will be approved by the Planning Unit (implementing body) according to an Intergovernmental Agreement, bylaws, and/or operating procedures and will be subject to a public review process including opportunities for comment at meetings of the PU (or other implementing body) and special community or public meetings. *No organization can be obligated to implement an action included in the plan or a plan update, unless they agree to the obligation (RCW90.82.130(3)).*	Adaptive Management, Early Planning Stages

Funding and Staffing

Recommended Action	SEPA Analysis
IMP-3: Prioritize educational needs, projects, policies and management strategies for funding and implementation (may accomplish some prioritization for Aquatic Habitat Actions through salmon recovery).	Study, Funding
IMP-4: Continue to identify alternate funding sources (alternate to watershed planning funds).	Study, Funding
IMP-5: Consider implementation funding for grant writers.	Funding
IMP-6: Develop recommendations (such as cooperative agreements) for formalizing obligations with the entities identified as responsible for Plan actions.	Coordination/ Collaboration
IMP-7: The Chelan County Natural Resource Department (CCNRD) provides a vital link between water availability, land management and the Watershed Planning Unit. The Watershed Planning Unit supports the ongoing efforts of CCNRD to work with the Watershed Planning Unit to ensure natural resource concerns and technical resources and databases are maintained.	Study

Coordination within the Watershed

Recommended Action	SEPA Analysis
IMP-8: In developing its implementation plan, the Watershed Planning Unit will support the development and implementation of existing plans and programs occurring within the watershed while striving to avoid inconsistent or duplicative activities and policies.	Coordination/ Collaboration, Support
IMP-9: The Planning Unit can choose to review and provide comment on large projects proposed in the watershed that would likely have an impact on the water resource. This could be a review of project or programmatic level Environmental Impact Statements (EISs) or other documents.	Coordination/ Collaboration
IMP-10: The WRIA 45 Planning Unit members will be involved in the public planning process. The Planning Unit will disseminate information about public comment opportunities to its members. Additionally, the Planning Unit will provide opportunities for public comment on watershed scale studies and plans when, by a vote of the Planning Unit, they are determined to be a priority of the Planning Unit and important to the overall health of the watershed.	Public Involvement and Education

Monitoring

Recommended Action	SEPA Analysis
IMP-11: Ensure that there is an ongoing coordinated monitoring program consistent with the Intensively Monitored Watershed Program currently being administered through NOAA Fisheries and the RTT. Designate responsible entities, a single data management hub for long term monitoring, and a single custodian to store and manage and generally oversee this effort into the future (requires long term commitment).	Coordination/ Collaboration, Study, Monitoring

Adaptive Management

Recommended Action	SEPA Analysis
WRMS-3: The WWPU with Chelan County taking the lead role will participate in the development and implementation of an adaptive management process to support this water resource management strategy. The process should address flexibility in the distribution of the reserve across the WRIA. The details of the adaptive management process will be determined as part of Phase IV Implementation.	Adaptive Management, WP 10, WP 11
WRMS-4c: Recommends a new stream gage be established at the existing control point on the Icicle Creek. Details will be determined during Phase IV, Implementation.	Monitoring
MissionQUANT-1: Chelan County as lead (with support from Ecology), will convene a Mission Creek Forum to assess options to provide water for future growth through the purchase, lease or transfer of existing, valid water rights or from storage (storage opportunities within Mission Sub-watershed or through the Peshastin and/or Icicle Irrigation districts). This will be conducted for the purpose of providing an uninterruptible supply for domestic, municipal and stock water uses. During Phase IV, Implementation, the Mission Creek Forum will determine whether the strategies for Mission are relevant to Brender Creek, and consider assembling separate strategies to address local instream flow concerns and conditions for Brender Creek, if appropriate. Within two years of rule adoption, the Forum will have developed opportunities and researched funding opportunities for these alternatives.	Coordination/ Collaboration, Study, Funding, WP 7, WP 8, WP 9, WP 19, WP 20, WP 21, WP 22, WP 23, WP 24
MissionQUANT-2: As part of Phase IV, Implementation, evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Mission Creek and evaluate water conservation, storage, purchase, lease and transfer of water rights, water from other sub-watersheds, and other alternatives as appropriate.	Study, WP 1, WP 2, WP 3, WP 4, WP 7, WP 8, WP 10, WP 19, WP 20, WP 21, WP 22, WP 23, WP 24
PeshastinQUANT-3: As part of Phase IV, Implementation, evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Peshastin and evaluate water conservation, storage, purchase, lease and transfer of water rights, and other alternatives.	Study, WP 1, WP 2, WP 3, WP 4, WP 7, WP 8, WP 10, WP 19, WP 20, WP 21, WP 22, WP 23, WP 24
ChumQUANT-10: As part of Phase IV, Implementation, the Planning Unit and the Chumstick Forum (with Chelan County as lead) will evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Chumstick and evaluate water conservation, storage opportunities, purchase, lease and transfer of water rights, water transfer from other sub-watersheds, and other alternatives. Consider conjunctive use and evaluate pumping from the deep aquifer to augment flows in the Chumstick. Investigate storage options where stored water could be used to augment flows and provide mitigation water.	Study, WP 1, WP 2, WP 3, WP 4, WP 5, WP 6, WP 7, WP 8, WP 9, WP 10, WP 16, WP 19, WP 20, WP 21, WP 22, WP 23, WP 24
QUANT-6: Develop an administrative structure for a water bank for WRIA 45. Section 5.1.3 introduces water banks; however, the details of the administration of a water bank in WRIA 45 will be determined in Phase IV, Implementation.	Study, Early Planning Stages, WP 7, WP 8

Recommended Action	SEPA Analysis
QUANT-8: Chelan County Natural Resource Department will develop and administer a monitoring program to assess actual domestic water use to verify the 380 gpd per household assumption used to debit the reservation and to adjust the amount of water remaining in the reservation at five year intervals, or more frequently if the number of wells drilled or building permits granted indicate that growth is occurring more rapidly than projected in any sub-watershed. These assessments will be conducted based on a statistical sample of new domestic water users (single domestic, group domestic and municipal water use and associated lawn and garden irrigation (some with separate irrigation, some without), some with stock, etc.). Metering data will be incorporated into the water use audit and the accounting system. See the recommended action in the Plan for more details.	Study, Adaptive Management, Monitoring
QUANT-9: Reservation accounting will include the tracking of new exempt wells by Chelan County through the building permit process, septic approval through the Chelan-Douglas Health District (CDHD), tracking new domestic and municipal water rights granted by Ecology and tracking well drilling permits as issued by Ecology. The mechanism for tracking the permitted uses will be determined as part of Phase IV, Implementation. Chelan County is currently developing a method for tracking new permit-exempt wells in WRIA 46. This should also be considered for WRIA 45.	Study
QUANT-9b: New rights that are granted by Ecology for domestic water uses will be tracked by CCNRD. The mechanism for tracking the new permitted uses that will debit the reserve will be determined as part of Phase IV, Implementation.	Study
QUANT-10: The Planning Unit recommends metering be required for all new uses eligible under the reserve. The Planning Unit will further define responsible entities, and staffing, budget and funding considerations of the metering program as part of Phase IV, Implementation. Chelan County, CDHD, Ecology, utilities, and others will work together to structure the program. The following should be addressed as part of phase IV: • Identify responsible entities, and address staffing, cost and funding concerns • Consider implementation by an existing utility with an existing metering program • Consider having water users read their own meters • Consider use of Ecology's water measuring system and database • Consider metering options for existing water users and development of a voluntary program that uses existing metering programs' available meters.	Study, Funding, Coordination/ Collaboration, Monitoring, WP 18
QUANT-11: Undertake hydrogeologic studies to assess the influence of groundwater withdrawals on surface water. Identify funding for this study and responsible parties (WWPU to identify sub-areas for study, responsible entity as part of Phase IV, Implementation).	Study, Funding
QUANT-14: Credit a water service provider for abandoned and/or decommissioned exempt wells. This action will be further developed in Phase IV, Implementation. The well consolidation process is addressed in RCW 90.44.105. This statute presumes a credit of 800 gpd/well unless an alternative minimum is established by Ecology in consultation with DOH or there is credible evidence of non-use.	WP 16, WP 17

Recommended Action	SEPA Analysis
QUANT-15: As part of Phase IV, Implementation, Chelan County and cities should develop policies that can be used to ensure efficient use of water in the event of a land division or new development. See QUANT-15a to QUANT-15f for a list of the policies.	Other SEPA, WP 1, WP 2
QUANT-15a: For land division applications that have shares in an irrigation district, develop policies requiring that the developer provide tie-ins to the irrigation box; ensure easements; deliver water to parcels, where practicable; and form a Homeowners Association for residential uses. Encourage Irrigation Districts to work with the county and cities to extend infrastructure and irrigation water service where practicable.	Other SEPA, WP 1, WP 2
QUANT-15f: Encourage cluster development, and group domestic over single domestic systems to increase water use efficiency. Explore encouraging group domestic over single domestic use as part of the approval process for land division applications. Further develop this recommendation as part of Phase IV, Implementation.	WP 1
QUANT-16d: As part of Phase IV, Implementation, convene a forum to investigate conservation strategies and how they could be implemented by irrigation districts, ditches and other private companies. Involve utilities, cities, Chelan County and Ecology when appropriate. There is a need to work with members of irrigation districts, ditches and others to determine ways to save water and ensure that water rights are protected into the future. Items of discussion could include alternative rate structures based on purpose of water use; partnerships with cities and utilities; utility coordination during development; tools to conserve water, improve instream flows and protect water rights at the same time; and distribution of public education materials.	Coordination/ Collaboration, Study, Public Involvement and Education, WP 1, WP 2, WP 3, WP 4
QUANT-18: Encourage the County to provide information and education about water conservation options and fire planning; including: outdoor watering, timing, types of native vegetation that require low water use, lawn size, low flow fixtures, etc. to the new land user. The Municipal Water Law requires that water systems provide education and outreach regarding water conservation. However, water users that are using irrigation ditch water for outdoor use and/or exempt wells will not receive this information. Irrigation systems may also be able to provide materials in monthly billings. The details of this educational program will be determined during Phase IV, Implementation. Realtors should be encouraged to distribute public education materials describing water conservation and efficient water management techniques.	Public Involvement and Education, WP 1, WP 2, WP 3
QUANT-20b: Study groundwater in specific areas of the watershed (eg., Mission Creek, Lower Chumstick/Eagle Creek area, Monitor area). Finalize the areas for study as part of Phase IV, Implementation.	Study
QUANT-21: Evaluate the consumptive portion of reserved water uses and determine if recharge credit should be included in the accounting of the reservation.	Study
IMP-12: Revise and refine water quality management strategies for both point and nonpoint source pollutants to reflect new data.	Adaptive Management
IMP-13: Perform additional studies to fill data gaps and address unanswered questions as determined by the Water Quality Technical Subcommittee. Ecology will partner with stakeholders in the watershed to conduct studies addressing information gaps (eg., monitoring).	Study, Coordination/ Collaboration, Monitoring

Recommended Action	SEPA Analysis
QUAL-4: Encourage the Wenatchee Watershed Planning Unit and its other subcommittees (Water Quantity, Instream Flow, Habitat, and Growth and Land Use) to use the information in the TMDL Technical Reports and SISs along with their conclusions, recommendations, and actions for a more holistic approach to restoration, preservation, and enhancement of the watershed for all beneficial uses (WQTS, 2006a; WQTS, 2006b; WQTS, 2006c; WQTS, 2006d).	Coordination/ Collaboration, WP 35
QUAL-5: Appropriate actions to be used in the appropriate location should be determined to address temperature exceedances in Phase IV, Implementation for all of the temperature-related recommendations in the Plan.	Study
LowWenQUAL-2, **IcicleQUAL-2** and **UpWenQUAL-2:** Strategies to address point and non-point sources of phosphorus as part of the TMDL for DO and pH will be reported during the implementation phase of the Wenatchee Watershed planning effort.	Study, Early Planning Stages
IMP-14: Further analysis and discussion may need to take place in Phase IV, Implementation regarding maximum allocation limits in specific sub-watersheds and the mainstem Wenatchee and the relationship between the allocations, and habitat and channel-forming processes.	Study, Adaptive Management
IMP-15: All actions specified in the Wenatchee Watershed Plan should be revisited by the Planning Unit during Phase IV, Implementation.	Adaptive Management

TABLE 12-16

SEPA Analysis for Public Outreach Recommended Actions

Water Quantity

Recommended Action	SEPA Analysis
ChumQUANT-11: Encourage conservation and outreach.	Public Involvement and Education
NSTQUANT-3: Chelan County and Ecology to provide public information regarding water limitations in Northside Tributaries (Fact Sheets).	Public Involvement and Education
QUANT-13: Provide public education as to the roles, responsibilities and regulations pertinent to exempt wells, and encourage the proper entities to enforce/implement (CDHD, DOH, Ecology, County).	Public Involvement and Education, Continue Existing, WP 14
QUANT-15e: Provide public information that encourages actions QUANT-15a through QUANT-15d, and explains the benefits (provide this information during subdivision application or preliminary plat comment period).	Public Involvement and Education, WP 1, WP 2, WP 9
QUANT-16d: As part of Phase IV, Implementation, convene a forum to investigate conservation strategies and how they could be implemented by irrigation districts, ditches and other private companies. Involve utilities, cities, Chelan County and Ecology when appropriate. There is a need to work with members of irrigation districts, ditches and others to determine ways to save water and ensure that water rights are protected into the future. Items of discussion could include alternative rate structures based on purpose of water use; partnerships with cities and utilities; utility coordination during development; tools to conserve water, improve instream flows and protect water rights at the same time; and distribution of public education materials.	Coordination/ Collaboration, Study, Public Involvement and Education, WP 1, WP 2, WP 3, WP 4

Recommended Action	SEPA Analysis
QUANT-18: Encourage the County to provide information and education about water conservation options and fire planning; including: outdoor watering, timing, types of native vegetation that require low water use, lawn size, low flow fixtures, etc. to the new land user. The Municipal Water Law requires that water systems provide education and outreach regarding water conservation. However, water users that are using irrigation ditch water for outdoor use and/or exempt wells will not receive this information. Irrigation systems may also be able to provide materials in monthly billings. The details of this educational program will be determined during Phase IV, Implementation. Realtors should be encouraged to distribute public education materials describing water conservation and efficient water management techniques.	Public Involvement and Education, WP 1, WP 2, WP 3

Habitat

Recommended Action	SEPA Analysis
H-11: Efforts that are ongoing in the Wenatchee Watershed to improve or maintain habitat quality need to be encouraged and retained. Recognize and acknowledge achievements in the watershed that have accomplished habitat improvement or protection. Develop a landowner or organization recognition program to recognize habitat improvement projects or achievements in the watershed.	Public Involvement and Education, Support
PO-1: Provide support of specific education and outreach programs in the watershed. Programs include: 4H Forestry Education Program, Kids in the Creek, Salmon Fest, Trout Unlimited education programs, Bird Fest, Chelan Douglas Land Trust field trips, Hatchery programs (Leavenworth National Fish Hatchery, and friends of NW Hatcheries), existing noxious weed/native plant education programs, and others.	Public Involvement and Education, Support
PO-2: Encourage the 4-H program and CCCD to develop and conduct watershed clean-up education programs.	Public Involvement and Education
H-12: Initiate public information efforts to discourage harassment of spawning salmonids (UCRTT, 2002).	Public Involvement and Education

Water Quality

Recommended Action	SEPA Analysis
LowWenQUAL-9, **IcicleQUAL-7** and **UpWenQUAL-8**: Nutrients (phosphorous) can enter surface and ground water from residential yards and gardens, hobby farms, City and County Parks, business owned landscapes, etc. An education outreach plan should be developed and implemented to heighten awareness and reduce inputs from these sources. Policies and practices should be implemented in City and County Public Works departments. The County and cities should consider implementing a ban on the sale of high phosphate detergents, such as is being considered in Spokane. Conduct associated monitoring and adaptive management (WQTS, 2006a).	Public Involvement and Education, Adaptive Management, Other SEPA, WP 35, WP 36, WP 37, WP 40
MissionQUAL-6: Activities should be identified and undertaken to provide ongoing outreach, education, and technical assistance to growers, streamside landowners, developers, stakeholders, and the general public (WQTS, 2006b).	Public Involvement and Education, WP 35, WP 36

Recommended Action	SEPA Analysis
MissionQUAL-14 and **ChumQUAL-3**: CDHD will continue to implement onsite sewage disposal system technical assistance and education programs for homeowners and the industry (WQTS, 2006c).	Public Involvement and Education, WP 35, WP 36
MissionQUAL-15 and **ChumQUAL-4**: The CDHD will continue to permit sewage systems per Washington Administrative Code (WAC), including analyzing soils and technologies suitable for individual sites; review/approve the proposed design, specifications, installation and if required, the ongoing maintenance in accordance with the WAC; provide public information under real estate disclosure laws; and review all land use proposals to ensure that the WAC is properly enforced prior to approval by the County (WQTS, 2006c).	Continue Existing, Public Involvement and Education, WP 35
MissionQUAL-20 and **ChumQUAL-9**: Conduct stream walk cleanups along the stream (Fall, Spring, Summer) with area schools, homeowners, and other groups (WQTS, 2006c).	Public Involvement and Education, WP 35,WP 36
MissionQUAL-21 and **ChumQUAL-10**: Conduct ongoing community fecal coliform education/awareness campaigns throughout the year. Engage and get support from homeowners (WQTS, 2006c).	Public Involvement and Education, WP 35,WP 36
MissionQUAL-23 and **ChumQUAL-12**: Conduct education and enforcement actions to stop illegal dumping of wastes either to storm drains or directly to surface waters. This dumping may be of portable toilet wastes, recreational vehicle wastes, etc. (WQTS, 2006c).	Public Involvement and Education, WP 35, WP 36
MissionQUAL-25 and **ChumQUAL-14**: The WQTS and its participating entities should work with the public and homeowners regarding BMPs to reduce fecal coliform runoff. General actions should include public information, education, and technical assistance regarding watering practices, landscaping, stormwater runoff, filtration practices, animal waste, etc. (WQTS, 2006c).	Public Involvement and Education, WP 35, WP 36

Sub-watersheds

Recommended Action	SEPA Analysis
PO-3: CCNRD to ensure that summary fact sheets are created by sub-watershed and develop and provide outreach materials for people at different levels: technical, non-technical, etc.	Public Involvement and Education, WP 36
PO-4: Prepare Community Documents by tributary (or sub-watershed) that describe the watershed and the water related management strategies that have been recommended to address specific issues in the individual sub-watersheds. An example was prepared for the Icicle Sub-watershed. Obtain funding to create, produce and distribute these documents.	Public Involvement and Education, Funding, WP 36

12.4 Summary

This chapter (Chapter 12) of the Wenatchee Watershed (WRIA 45) Management Plan (Plan) provides documentation of compliance of the WRIA 45 Plan with statewide programmatic SEPA requirements. This chapter (Chapter 12) is to be attached to the Determination of Significance filed for the Plan adoption action by Chelan County and provides local information relevant to the WRIA 45 Plan that is not explicitly included in the statewide programmatic Watershed Planning EIS (Ecology, 2003).

13.0 REFERENCES

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TABLE 2-1

Water Resource Management Strategy Recommended Actions

Recommended Action	Responsible Entity
Proposed Water Resource Management Strategy and Adaptive Management	
WRMS-1: Recommends that the State Department of Ecology adopt, in rule, the new water resource management strategy for WRIA 45, including the management flows (revised instream flows) at specified control points, the water reserve, and maximum allocations. The management flows, water reserve and maximum allocation are outlined in more detail in Sections 4.4 through 4.6.	Ecology
WRMS-2: Recommends that the Planning Unit or future implementing body in WRIA 45 be involved with Ecology, in any scoping, study planning, study implementation, alternatives analysis, negotiations or rule development if Ecology undertakes instream flow or related water management studies or rulemaking in the watershed.	Ecology, WWPU
WRMS-3: The WWPU with Chelan County taking the lead role will participate in the development and implementation of an adaptive management process to support this water resource management strategy. The process should address flexibility in the distribution of the reserve across the WRIA. The details of the adaptive management process will be determined as part of Phase IV Implementation.	Chelan County, WWPU
WRMS-4: Implementation of a new or existing instream flow rule in the Wenatchee Watershed will require that flow monitoring continues at all existing and proposed control points on the Wenatchee River and its tributaries. Figure 4-1 shows the locations of all control points and active stream gages in the watershed. The following actions address these requirements. The WWPU:	
WRMS-4a: Recommends that Ecology continue to support monitoring at all existing stream gages in the Wenatchee Watershed. Ecology and partners must ensure that the gages and streamflow data are well maintained. Updated data should be made available on the Ecology website in a timely manner for all gages managed by Ecology.	Ecology
WRMS-4b: Encourages the USGS to continue to maintain USGS gages in the watershed to support implementation of this water resource management strategy.	USGS
WRMS-4c: Recommends a new stream gage be established at the existing control point on the Icicle Creek. Details will be determined during Phase IV, Implementation.	Ecology
WRMS-4d: Review the gage location on the Chiwawa River as related to the impacts on flows from withdrawals.	

TABLE 2-2

Water Quantity Recommended Actions

Recommended Action	Responsible Entity
Water Rights, Trusts and Bank	
QUANT-1: Develop recommendations for Ecology regarding the processing of new water right applications and applications for water right changes and transfers in WRIA 45. Create the recommendations through a collaborative approach between the Planning Unit and the Chelan County Water Conservancy Board, and base them on knowledge of water availability, allocation and flows; consistent with the proposed instream flow rule and resulting reservation and maximum allocation requirements for sub-watersheds. Recommendations may include data requirements necessary to evaluate the impacts of an application on surface and groundwater, areas of concern, policy regarding changes and transfers (may link to land use conversions or incentives for agricultural preservation). Recommendations should also consider facilitation of water right transfers or changes that will result in new water for a reservation in flow impaired sub-watersheds such as Mission and Chumstick Creeks.	WWPU and Chelan Water Conservancy Board
QUANT-2: Request additional Ecology staff time from the legislature to process WRIA 45 water rights. (Focus may be transfers or new applications).	Ecology
QUANT-3: Ecology should enforce existing regulations and policies concerning water rights and use.	Ecology
QUANT-4: Provide incentives for conserving water rather than using it to avoid losing it. Encourage efficiencies through current water law using tools such as water trusts and/or other innovative techniques. Consider the Irrigation Efficiencies Program, and other incentives programs offered by the state and other entities. Criteria for participation include a demonstration of financial need and environmental benefit, a minimum 10 year lease of the conserved water to the Trust Water Program, and the public investment in the project not exceeding 85% of the total cost. In general, the state offers financial programs and incentives to conserve when there is a public benefit. In many cases, dedication of the conserved water to instream flows has been the legislature's preferred means of securing the public benefit.	Chelan County, Irrigation Districts, Canal Companies, other Agriculture. Assistance by Ecology
QUANT-5: Consider Ecology's Trust Water Program as an option to temporarily safeguard water rights during times of non-use or reduced use while satisfying the needs of beneficial uses in the watershed. Develop strategies for using trust water to safeguard water that may be used in the future to support a more water-intensive crop type or conversion from agriculture to residential. Use of this program is consistent with the proposed water resource management strategy as described in Section 4.0.	Chelan County, Irrigation Districts, Canal Companies, other Agriculture. Assistance by Ecology
QUANT-6: Develop an administrative structure for a water bank for WRIA 45. Section 5.1.3 introduces water banks; however, the details of the administration of a water bank in WRIA 45 will be determined in Phase IV, Implementation.	WWPU, Chelan County
QUANT-7: Chelan County or other entity with agency funding assistance will investigate water rights for purchase or lease in WRIA 45. The County will seek funding from Washington Water Trust, Washington Rivers Conservancy, BPA, USBOR, NPCC, Ecology and others. Water rights that are purchased or leased can be used to extend the water reservation while adhering to a "no net impacts" standard.	Chelan County, funding Entities could include: BPA, WWT, WRC, BOR, NPCC, Ecology, others

TABLE 2-2

Water Quantity Recommended Actions

Recommended Action	Responsible Entity
Tracking Water Availability and Use	
QUANT-8: Chelan County Natural Resource Department will develop and administer a monitoring program to assess actual domestic water use to verify the 380 gpd per household assumption used to debit the reservation and to adjust the amount of water remaining in the reservation at five year intervals, or more frequently if the number of wells drilled or building permits granted indicate that growth is occurring more rapidly than projected in any sub-watershed. These assessments will be conducted based on a statistical sample of new domestic water users (single domestic, group domestic and municipal water use and associated lawn and garden irrigation (some with separate irrigation, some without), some with stock, etc.). Metering data will be incorporated into the water use audit and the accounting system. See the recommended action in the Plan for more details.	CCNRD
QUANT-9: Reservation accounting will include the tracking of new exempt wells by Chelan County through the building permit process, septic approval through the Chelan-Douglas Health District (CDHD), tracking new domestic and municipal water rights granted by Ecology and tracking well drilling permits as issued by Ecology. The mechanism for tracking the permitted uses will be determined as part of Phase IV, Implementation. Chelan County is currently developing a method for tracking new permit-exempt wells in WRIA 46. This should also be considered for WRIA 45.	CCNRD
QUANT-9a: Chelan County Natural Resource Department will track new exempt wells through the building permit process and will coordinate with the CDHD. A joint city/county process will need to be implemented to assist the county in tracking any building permits requiring exempt wells that are issued by other cities (if applicable) within the watershed.	CCNRD, CDHD, and possibly cities
QUANT-9b: New rights that are granted by Ecology for domestic water uses will be tracked by CCNRD. The mechanism for tracking the new permitted uses that will debit the reserve will be determined as part of Phase IV, Implementation.	CCNRD, Ecology
QUANT-9c: Long-term funding for tracking is required.	CCNRD and potential funding agencies
QUANT-10: The Planning Unit recommends metering be required for all new uses eligible under the reserve. The Planning Unit will further define responsible entities, and staffing, budget and funding considerations of the metering program as part of Phase IV, Implementation. Chelan County, CDHD, Ecology, utilities, and others will work together to structure the program. The following should be addressed as part of phase IV: • Identify responsible entities, and address staffing, cost and funding concerns • Consider implementation by an existing utility with an existing metering program • Consider having water users read their own meters • Consider use of Ecology's water measuring system and database • Consider metering options for existing water users and development of a voluntary program that uses existing metering programs' available meters.	WWPU

TABLE 2-2

Water Quantity Recommended Actions

Recommended Action	Responsible Entity
Exempt Wells	
QUANT-11: Undertake hydrogeologic studies to assess the influence of groundwater withdrawals on surface water. Identify funding for this study and responsible parties (WWPU to identify sub-areas for study, responsible entity as part of Phase IV, Implementation).	CCNRD
QUANT-12: Funding should be requested to survey (using GPS) private wells. The CDHD should investigate collaborating with Ecology to include these new data in the water well report log database. Recommend that the county, health district, and Ecology work together to identify, log and provide oversight of exempt wells. As part of this oversight responsibility, the CDHD should work with DOH to survey wells with greater than 3 connections. Chelan County has already conducted a GPS survey and evaluation of Group A systems (> than 14 connections).	CDHD, Chelan County with Ecology
QUANT-13: Provide public education as to the roles, responsibilities and regulations pertinent to exempt wells, and encourage the proper entities to enforce/implement (CDHD, DOH, Ecology, County).	CDHD, DOH, Ecology, County
QUANT-14: Credit a water service provider for abandoned and/or decommissioned exempt wells. This action will be further developed in Phase IV, Implementation. The well consolidation process is addressed in RCW 90.44.105. This statute presumes a credit of 800 gpd/well unless an alternative minimum is established by Ecology in consultation with DOH or there is credible evidence of non-use.	Ecology, Chelan County, Water Systems
Conservation and Efficiency	
QUANT-15: As part of Phase IV, Implementation, Chelan County and cities should develop policies that can be used to ensure efficient use of water in the event of a land division or new development. These include:	Chelan County, cities
QUANT-15a: For land division applications that have shares in an irrigation district, develop policies requiring that the developer provide tie-ins to the irrigation box; ensure easements; deliver water to parcels, where practicable; and form a Homeowners Association for residential uses. Encourage Irrigation Districts to work with the county and cities to extend infrastructure and irrigation water service where practicable.	Chelan County, cities
QUANT-15b: For land division applications on property with individual water rights, Chelan County should develop policies that encourage the developer to provide residential tie-ins to the water source for residential irrigation purposes.	Chelan County
QUANT-15c: Encourage cities and Chelan County to develop policies that encourage conservation measures for outdoor water use as a condition of subdivision approval (eg., drought tolerant landscaping, maximum lawn size, stormwater collection systems, residential irrigation system installation). Encourage use of small scale storage, rain barrels, for outdoor irrigation.	Chelan County, cities
QUANT-15d: Encourage cities to develop policy statements that address transfer of water rights from private water right holders in the event of a land use conversion. For example, the City of Cashmere has policies in place that require water rights to be transferred to the City upon land division/service provision by the City's system. This policy helps preserve the City's ability to serve future users within the UGA with water.	Cities

TABLE 2-2

Water Quantity Recommended Actions

Recommended Action	Responsible Entity
QUANT-15e: Provide public information that encourages actions QUANT-15a through QUANT-15d, and explains the benefits (provide this information during subdivision application or preliminary plat comment period).	Chelan County, cities, other water purveyors, also CDHD
QUANT-15f: Encourage cluster development, and group domestic over single domestic systems to increase water use efficiency. Explore encouraging group domestic over single domestic use as part of the approval process for land division applications. Further develop this recommendation as part of Phase IV, Implementation.	Chelan County, cities
QUANT-16: Research how different entities in the watershed are implementing conservation measures and acknowledge current efforts. [Note that Leavenworth is metering and employs a rate and fee structure that encourages conservation. Cashmere is currently working on revising their rate structure such that there will be more incentive for conservation.] Encourage additional conservation measures where needed. Encourage incentive based solutions. These may include QUANT-16a through QUANT-16d.	
Conservation and Efficiency: Residential, Industrial and Commercial (Public Water System and exempt wells)	
QUANT-16a: Encourage cities and other water providers to implement a rate and fee structure that promotes conservation (similar to Leavenworth's current program and Cashmere's proposed program).	Chelan County, cities, water purveyors
Conservation and Efficiency: Irrigation (Districts and Canal Companies)	
QUANT-16b: Encourage funding to line canals or implement other delivery system improvements, where appropriate.	Chelan County, Irrigation Districts, Canal Companies, other Agriculture. Assistance by Ecology
QUANT-16c: Encourage the use of reclaimed water (tertiary treatment) for outdoor irrigation, industrial, and commercial use (see Ecology Watershed Guidance).	
QUANT-16d: As part of Phase IV, Implementation, convene a forum to investigate conservation strategies and how they could be implemented by irrigation districts, ditches and other private companies. Involve utilities, cities, Chelan County and Ecology when appropriate. There is a need to work with members of irrigation districts, ditches and others to determine ways to save water and ensure that water rights are protected into the future. Items of discussion could include alternative rate structures based on purpose of water use; partnerships with cities and utilities; utility coordination during development; tools to conserve water, improve instream flows and protect water rights at the same time; and distribution of public education materials.	Chelan County, Irrigation Districts, Canal Companies, other Agriculture, cities, PUD. Ecology, others
Conservation and Efficiency: On-Farm Efficiencies	
QUANT-17: Encourage on-farm efficiencies and implementation of Best Management Practices (BMPs) to encourage water conservation.	Chelan County

TABLE 2-2

Water Quantity Recommended Actions

Recommended Action	Responsible Entity
QUANT-18: Encourage the County to provide information and education about water conservation options and fire planning; including: outdoor watering, timing, types of native vegetation that require low water use, lawn size, low flow fixtures, etc. to the new land user. The Municipal Water Law requires that water systems provide education and outreach regarding water conservation. However, water users that are using irrigation ditch water for outdoor use and/or exempt wells will not receive this information. Irrigation systems may also be able to provide materials in monthly billings. The details of this educational program will be determined during Phase IV, Implementation. Realtors should be encouraged to distribute public education materials describing water conservation and efficient water management techniques.	Chelan County
Storage Opportunities	
QUANT-19: Consider funding storage options from the Storage Assessment. See relevant sub-watershed sections (Section 9.0) for specific storage opportunities as listed in the WRIA 45 Storage Assessment Report.	
Projects and Studies	
QUANT-20: CCNRD or other entities to administer studies on water resources throughout the watershed, especially in areas where inadequate data exist to make decisions regarding future water use (eg., Chumstick, Northside Tributaries).	CCNRD, other entities
QUANT-20a: Water budgets have been prepared by sub-watershed. These budgets indicate total water use by use type (eg., residential, industrial, commercial, agricultural, fish propagation), but do not provide estimates of consumptive use. A consumptive crop irrigation requirement is presented. Further this study by defining the consumptive portion of the water use in the water budgets. Incorporate water usage rates with varying efficiencies for each water use type. Use this information to develop appropriate and useful water use efficiency requirements on lands that have been converted from agricultural to residential.	
QUANT-20b: Study groundwater in specific areas of the watershed (eg., Mission Creek, Lower Chumstick/Eagle Creek area, Monitor area). Finalize the areas for study as part of Phase IV, Implementation.	
QUANT-20c: There is a need to better understand the groundwater – surface water interaction in the watershed. Formalize studies to address this issue.	
QUANT-21: Evaluate the consumptive portion of reserved water uses and determine if recharge credit should be included in the accounting of the reservation.	
QUANT-11: Undertake hydrogeologic studies to assess the influence of groundwater withdrawals on surface water. Identify funding for this study and responsible parties (WWPU to identify sub-areas for study, responsible entity as part of Phase IV, Implementation).	
ChumQUANT-2: Chumstick Water Forum to assist in developing a data collection plan to monitor surface water flows (specify location) and develop management flows.	

TABLE 2-2

Water Quantity Recommended Actions

Recommended Action	Responsible Entity
ChumQUANT-3: Chumstick Water Forum, with assistance from Chelan County and Ecology, to conduct groundwater monitoring to understand hydraulic continuity and overall impact of exempt wells on groundwater levels and streamflows.	Chumstick Water Forum with assistance from Chelan County and Ecology
ChumQUANT-6: A cumulative impact analysis of permit exempt use and uses associated with permits and claims approved since 1983 will be initiated by Ecology as authorized under the 1983 flow rule. Chelan County will partner with Ecology in this study. The cumulative impacts assessment will help to determine whether Ecology will curtail outdoor domestic water use of wells installed after 1983, and whether Ecology will close the Chumstick Sub-watershed to outdoor water use in the future.	
ChumQUANT-7: Chumstick Forum, Chelan County and Ecology to re-evaluate a proposed strategy for the Chumstick in three years after rule adoption, when new monitoring data have been collected and assessed and cumulative impact analysis is complete. Consider allowing group domestic groundwater use of deeper aquifer only as part of the Chumstick strategy addressed by the Forum.	
NSTQUANT-1: Future water supply availability should be discussed with Chelan County Public Utility District (PUD) to determine whether they have the capacity and infrastructure to provide backup supply. The East Bank Aquifer Regional Water Supply will only be considered as a source of water for this area if approved by the owners of the Regional Water Supply.	
QUANT-8: Chelan County Natural Resource Department will develop and administer a monitoring program to assess actual domestic water use to verify the 380 gpd per household assumption used to debit the reservation and to adjust the amount of water remaining in the reservation at five year intervals, or more frequently if the number of wells drilled or building permits granted indicate that growth is occurring more rapidly than projected in any sub-watershed. These assessments will be conducted based on a statistical sample of new domestic water users (single domestic, group domestic and municipal water use and associated lawn and garden irrigation (some with separate irrigation, some without), some with stock, etc.). Metering data will be incorporated into the water use audit and the accounting system. See the recommended action in the Plan for more details.	CCNRD

TABLE 2-3

Growth and Land Use Recommended Actions

Recommended Action	Responsible Entity
Integrating Water Availability in Land Management Decisions (Water for Growth/Land Use)	
GLU-1: As part of reservation accounting, establish a resource base for decision-makers to use to consider technical water resource information when making land use change decisions and when considering land use permit applications. This should include: **GLU-1a**: Chelan County Natural Resource Department (CCNRD) will provide technical input regarding the reservation and eligible uses into the decision making process for consideration by city and county land use decision makers. **GLU-1b**: Water resource and supply related data for the watershed will be maintained in a database by CCNRD (eg., a water supply dataset including water system boundaries, an exempt well tracking system, on-going tally of water rights and water use per water system, instream flow and groundwater level data, an assessment of whether current water rights can service full build-out based on current zoning, etc.). CCNRD would update this information as a larger population is served in the future and ensure the information is available in a format that is easily understood by the public.	CCNRD
GLU-2: As part of Chelan County's zone change process, water supply and water resource information is available for use from CCNRD.	CCNRD
GLU-3: As there is urban growth in the WRIA, ensure that water availability is considered in UGA boundary decisions for existing and new UGAs. For proposed Urban Growth Area boundary expansions that are outside the jurisdiction of an existing water service area, the proposal for expansion should include documentation of a water purveyor's intention to provide water, their ability to provide water, or the ability of the development to provide water if it is to be self-served.	Cashmere, Leavenworth, Wenatchee, CCNRD
Consistency between Critical Area Ordinance and WRIA 45 Watershed Plan	
GLU-4: The Wenatchee Watershed Planning Unit is supportive of the goals and intent of the GMA to provide critical area protections, as these are consistent with water quality, quantity and habitat goals of the Wenatchee Watershed Plan and the Watershed Planning Act. The Planning Unit further supports the efforts of local jurisdictions to implement non-regulatory programs that protect critical areas and is interested in exploring potential partnerships in these efforts.	WWPU
GLU-5: Data, protection measures and strategies relating to critical area protections should be documented as part of the watershed planning process. Encourage local jurisdictions to utilize the data, protection measures and strategies identified in the 2514 Wenatchee Watershed Plan in the development and update of critical area protections under GMA. Ensure that this information is readily available to local jurisdictions.	CCNRD

TABLE 2-3

Growth and Land Use Recommended Actions

Recommended Action	Responsible Entity
GLU-6: The protection measures and strategies identified in the 2514 Watershed Plan should be considered by local governments as non-regulatory mechanisms to protect critical areas watershed wide. These approaches include: • Land protection measures such as easements, leases, purchases and other creative measures, such as transfer of development rights to protect remaining floodplain and riparian habitat • Wetland restoration • Fish passage improvements; removal of fish passage barriers • Restore channel function • Reconnect disconnected habitat areas • Restore floodplain function • Maintain forest roads • Control and eradicate noxious weeds	Local Governments

TABLE 2-4

Water Quality Recommended Actions

Recommended Action	Responsible Entity
Temperature, Fecal Coliform, pH/DO, and DDT	
QUAL-1: Chelan County Conservation District (CCCD) should continue to oversee and implement recommendations in the Watershed Action Plan, ensure other entities are also implementing voluntary actions in the Watershed Action Plan, and encourage continued funding of these efforts.	CCCD
QUAL-2: Ecology should continue to work with the local watershed planning group through both implementation of the current TMDL, and on future TMDLs if further listings arise.	Ecology and WWPU
QUAL-3: Ecology should continue to work with the local watershed planning group for funding future projects.	Ecology
QUAL-4: Encourage the Wenatchee Watershed Planning Unit and its other subcommittees (Water Quantity, Instream Flow, Habitat, and Growth and Land Use) to use the information in the TMDL Technical Reports and SISs along with their conclusions, recommendations, and actions for a more holistic approach to restoration, preservation, and enhancement of the watershed for all beneficial uses (WQTS, 2006a; WQTS, 2006b; WQTS, 2006c; WQTS, 2006d).	WWPU, WQTS, Water Quantity Subcommittee, Instream Flow Subcommittee, Habitat Subcommittee, and Growth and Land Use Subcommittee
Temperature	
QUAL-5[a]: Appropriate actions to be used in the appropriate location should be determined to address temperature exceedances in Phase IV, Implementation for all of the temperature-related recommendations in the Plan.	
QUAL-6 [a]: Actions to improve shade near surface waters should be implemented, where feasible. Shade management practices should involve the development of mature riparian vegetation. The WQTS should use the information provided in the temperature technical report and Planning Unit studies (FLIR, LIDAR, PHABSIM, etc.) to create a prioritized list of locations and plan for establishing riparian vegetation. Associated monitoring should be planned and implemented over time, as full riparian vegetation requires many years to become established. The upper watershed should be addressed first as it has the most potential for shade improvements and water temperature reductions. An evaluation of the 303(d) listed waters in the upper watershed should be conducted to see if they should be dropped from the 303(d) list due to natural conditions (Chiwaukum Creek, Little Wenatchee River). The WQTS should coordinate with the Planning Unit's other subcommittee conclusions, recommendations, and actions to reduce water temperatures (WQTS, 2006d).	See Implementation Activities Table in WQTS (2006d)
QUAL-7 [a]: For U.S Forest Service land, the riparian reserves prescriptions in the Northwest Forest Plan should be implemented for the establishment of mature riparian vegetation, where appropriate. The U.S. Forest Service should be the primary implementing agency. The WQTS and the Department of Ecology should coordinate with the U.S. Forest Service (WQTS, 2006d).	See Implementation Activities Table in WQTS (2006d)

a = This recommended action *only* applies to the sub-watersheds that have a 2004 303(d) listing for temperature. See Figure 7-1.

TABLE 2-4

Water Quality Recommended Actions

Recommended Action	Responsible Entity
QUAL-8[a]: For State and privately owned forest land, the riparian vegetation prescriptions in the Forests and Fish Report (Washington State Department of Natural Resources (DNR), 1999) should be implemented for all perennial streams. Load allocations are included in this TMDL for forest lands in accordance with the section of the Forests and Fish Report entitled "TMDLs produced prior to 2009 in mixed use watersheds." The WQTS and the Department of Ecology will coordinate with the Department of Natural Resources (WQTS, 2006d).	See Implementation Activities Table in WQTS (2006d)
QUAL-9[a]: For areas that are not managed in accordance with either the Forest Plan or the Forests and Fish Report, voluntary programs to increase and protect riparian vegetation should be developed, such as riparian buffers and conservation easements. The WQTS and the Department of Ecology should work with private forested landowners, agencies, and stakeholders to develop and monitor the projects (WQTS, 2006d).	See Implementation Activities Table in WQTS (2006d)
QUAL-10[a]: Stream temperature is related to the amount of instream flow, and increases in flow generally result in decreases in temperatures. The WQTS should work with the Planning Unit and watershed entities to encourage projects that have the potential to increase and protect surface and groundwater flows. Voluntary retirement, purchase, leasing of existing water rights, or other conservation methods to preserve and enhance instream flow should be encouraged. In addition, water storage opportunities that have the potential to increase instream flows during critical periods should be considered (WQTS, 2006d).	See Implementation Activities Table in WQTS (2006d)
QUAL-11[a]: Adaptive management activities to control potential channel widening processes should be encouraged. Reductions in channel width are expected as mature riparian vegetation is established. For example, activities that reduce sediment runoff to surface waters from upland and channel erosion can affect channel width and temperatures (WQTS, 2006d).	See Implementation Activities Table in WQTS (2006d)
QUAL-12[a]: Actions to improve hyporheic exchange flows and groundwater-surface water recharge should be identified and implemented to improve the current temperature regime and reduce maximum daily instream temperatures. Factors that influence hyporheic exchange flow include the vertical hydraulic gradient between surface and subsurface waters as well as the hydraulic conductivity of streambed sediments. Activities that reduce instream flows, hyporheic exchange and hydraulic conductivity of streambed sediments can increase stream temperatures, such as drilling of wells along streams and connected ground water reservoirs, and development in the flood plain. The WQTS should work with the Planning Unit and its subcommittees to identify and implement management activities designed to protect and enhance instream flow and subsurface water exchange with streams. Actions should be identified and implemented to reduce upland and channel erosion and avoid sedimentation of fine materials in the stream substrate (WQTS, 2006d).	See Implementation Activities Table in WQTS (2006d)
QUAL-13[a]: Ecology should continue existing temperature monitoring, and expand the current temperature monitoring program such that it is consistent with flow monitoring actions recommended in WRMS-4a and WRMS-4c.	

a = This recommended action *only* applies to the sub-watersheds that have a 2004 303(d) listing for temperature. See Figure 7-1.

TABLE 2-4

Water Quality Recommended Actions

Recommended Action	Responsible Entity
QUAL-14[a]: The WQTS should work with the Planning Unit in the development of proposed water storage, irrigation, habitat, and development projects to provide input regarding shade, riparian vegetation, and engineering to reduce water temperatures (WQTS, 2006d).	See Implementation Activities Table in WQTS (2006d)
QUAL-15[a]: To determine the effects of management strategies within the Wenatchee River Basin, regular monitoring is recommended. Continuously-recording water temperature monitors should be deployed from July through August to capture the critical conditions. The following locations should be targeted for a minimal sampling program: Wenatchee River near mouth, Icicle Creek near mouth, Nason Creek near mouth, Peshastin Creek near mouth, and Mission Creek near mouth. Monitoring will be conducted associated with BMPs to track progress toward shade and water quality targets. Water temperature monitoring should be conducted and coordinated with associated BMP projects over time (WQTS, 2006d).	See Implementation Activities Table in WQTS (2006d)
QUAL-16[a]: Funding assistance should be sought from Ecology through its grants and loans programs to implement actions and ongoing monitoring. Other funding sources should be identified and applications submitted to provide funding for ongoing activities. The WQTS will recommend qualified entities to conduct associated monitoring (WQTS, 2006d).	See Implementation Activities Table in WQTS (2006d)

a = This recommended action *only* applies to the sub-watersheds that have a 2004 303(d) listing for temperature. See Figure 7-1.

TABLE 2-5

Habitat Recommended Actions

Recommended Action	Responsible Entity
Habitat protection and restoration/enhancement	
H-1: Implementation of watershed planning will be coordinated with the Salmon Recovery Implementation Schedule (the Implementation Plan Matrix is Appendix H in UCSRB (2005)) and the Upper Columbia Salmon Recovery Implementation Team. The Wenatchee Habitat Subcommittee will serve as the local coordinating body for implementation of salmon recovery habitat actions across the watershed. Chelan County Natural Resource Department is currently developing a habitat project database that will be available to the subcommittee in the near future to list past projects, track current projects, and evaluate what future habitat actions should take place.	CCNRD
H-2: The WRIA 45 Planning Unit supports implementation of projects identified in the Wenatchee River and Nason Creek Channel Migration Zone Study (Jones and Stokes, 2004).	WWPU
H-3: The WRIA 45 Planning Unit supports implementation of the actions in the Wenatchee Subbasin Plan (Subbasin Plan sections 7.4 to 7.8 (NPCC, 2004)), and supports the Subbasin Plan approach to evaluation and monitoring of terrestrial and aquatic ecosystems in the Wenatchee Watershed. Section 2.5.1 of the Wenatchee Subbasin Plan which lists key findings from the Terrestrial Assessment is reproduced in Appendix C. The Planning Unit asks the co-planners and co-managers to seek funding from Bonneville Power Administration (BPA) and other sources for implementation of these actions.	WWPU, Co-managers, BPA
H-4: The Habitat Subcommittee with Chelan County as lead should coordinate with funding organizations and action agencies to maintain a publicly accessible database of past and current habitat projects for the Wenatchee Watershed.	Habitat Subcommittee
H-5: The Planning Unit will provide opportunities for public comment on watershed scale studies and plans when, by a vote of the Planning Unit, they are determined to be a priority of the Planning Unit and important to aquatic health and habitat.	WWPU
H-6: The mainstem Wenatchee River provides habitat *important to the entire watershed* for many life stages of spring and summer Chinook, steelhead, bull trout and other culturally important species, and needs to be protected, enhanced, and restored. All remaining intact areas on the mainstem should be maintained. Where possible, floodplain function should be restored, particularly from the Mission Creek confluence downstream to the Columbia River confluence.	Chelan County, others?
H-7: All property owners and managers in the watershed are encouraged to continue to cooperate in maintaining forest roads. Opportunities for inter-agency or multiple owner cooperation in roads management should continue to be supported (Additional and background information on forest roads in presented in Appendix C).	Forest Service, Private forest interests: Property owners and managers
H-8: Noxious weeds threaten aquatic and terrestrial ecosystems throughout the Wenatchee Watershed. The Planning Unit supports efforts toward noxious weed control and eradication.	WWPU
H-9: Consider using the Icicle Fund "Natural Resource Profile" as a tool to identify terrestrial habitat opportunities (Pacific Biodiversity Institute, 2002).	CCNRD

TABLE 2-5

Habitat Recommended Actions

Recommended Action	Responsible Entity
H-10: A fish barrier inventory has been conducted in many areas of the watershed; however, key inventory data regarding each barrier is not always consistent (i.e. whether it is a partial or full barrier, etc.). A method for updating the inventory should be established and funded. The Chelan County fish barrier inventory should be integrated with fish barrier information collected by other land managers, such as the Forest Service. Look at SalmonScape as a starting point for integrating barrier information. The organization has been able to integrate barrier information from other land managers. In addition, the Habitat Subcommittee should try to address the need to include irrigation diversions, specifically pump diversions, in the Chelan County Fish barrier inventory using appropriate funding sources.	CCNRD, others?
H-11: Efforts that are ongoing in the Wenatchee Watershed to improve or maintain habitat quality need to be encouraged and retained. Recognize and acknowledge achievements in the watershed that have accomplished habitat improvement or protection. Develop a landowner or organization recognition program to recognize habitat improvement projects or achievements in the watershed.	CCNRD
H-12: Initiate public information efforts to discourage harassment of spawning salmonids (UCRTT, 2002).	
H-13: Salmon habitat restoration and protection actions should be coordinated with the Wenatchee Habitat Subcommittee to ensure consistency with watershed-wide strategies as identified in the watershed plan and other plans. Additionally, all other actions related to salmon recovery, including hatchery, harvest and hydropower activities, should be coordinated with the Wenatchee Habitat Subcommittee. Hatchery, harvest and hydropower activities that have a negative or adverse affect on local habitat restoration or protection actions must be carefully considered in the context of the local habitat strategy.	CCNRD
Short-term	
H-14: Address passage barriers (UCSRB, 2005).	
H-15: Address diversion screens (UCSRB, 2005).	
H-16: Reduce the abundance and distribution of brook trout through feasible means (e.g., increased harvest) (UCSRB, 2005).	
H-17: Protect and maintain stream and riparian habitats within Category 1 assessment units (UCSRB, 2005).	
H-18: Protect, maintain, or enhance beneficial stream and riparian habitat conditions established by implementing Short-term Actions within assessment units (UCSRB, 2005).	
H-19: Where feasible and practical, maintain connectivity throughout the historical distribution of the species (UCSRB, 2005).	

TABLE 2-5

Habitat Recommended Actions

Recommended Action	Responsible Entity
Administrative/Institutional	
H-20: NOAA Fisheries, U.S. Fish and Wildlife Service (USFWS), the Army Corp of Engineers, and State agencies should improve the permitting process for projects specific to recovery actions by reducing the time, cost, and review process requirements. These entities should also implement programmatic consultations for actions related to the implementation of the Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan and improve their review of species recovery projects with the local governments (UCSRB, 2005).	
Research and Monitoring	
H-21: Wenatchee Habitat Subcommittee members can attend an annual Upper Columbia Monitoring Coordination Workshop for regular updates on all watershed-wide and other monitoring programs. In addition, the Subcommittee will be updated by the Regional Technical Team, as available, to ensure consistency across planning processes as well as to evaluate the effect of habitat improvement projects in the watershed.	CCNRD, Regional Technical Team
Hatchery Related	
H-22: The effects of hatchery practices in the Upper Columbia Basin on productivity are currently unknown. Research on reproductive success of hatchery produced fish that spawn in the wild is needed to assess effects on productivity (UCSRB, 2005).	
H-23: Additionally, future hatchery facilities will support recovery goals, and minimize and mitigate any impacts (including goals within other hatchery, harvest and hydropower activities). This list should not be considered all inclusive and specific actions will be determined and negotiated by the responsible parties (UCSRB, 2005).	
H-24: Determine whether supplementation programs in the Wenatchee Sub-basin affect the viable salmonid population (VSP) parameters of spring Chinook (UCSRB, 2005).	
H-25: Develop, maintain, and provide a comprehensive inventory of habitat projects and their costs and benefits (effectiveness) to the public annually (UCSRB, 2005).	

TABLE 2-6

Implementation Recommended Actions

Recommended Action	Responsible Entity
Watershed Planning Administration and Plan Updates	
IMP-1: WWPU and Subcommittees will continue to exist and operate under the current operating procedures and will address any needed reorganization to implement the plan as part of Phase IV, Implementation.	WWPU, CCNRD
IMP-2: Build a revision process and schedule for the Wenatchee Watershed Plan into plan implementation. Ensure that new plan actions and best available science can be integrated in the future. Planning horizon will be 20 years (through 2025). Updates should be scheduled every seven years, also consistent with County comprehensive plan revision schedule. If additional updates are necessary based on the availability of data or unforeseen water-related issues, the process should be designed such that those updates are possible. Future amendments and additions to the Plan will be approved by the Planning Unit (implementing body) according to an Intergovernmental Agreement, bylaws, and/or operating procedures and will be subject to a public review process including opportunities for comment at meetings of the PU (or other implementing body) and special community or public meetings. *No organization can be obligated to implement an action included in the plan or a plan update, unless they agree to the obligation (RCW90.82.130(3)).*	WWPU, Chelan County
Funding and Staffing	
IMP-3: Prioritize educational needs, projects, policies and management strategies for funding and implementation (may accomplish some prioritization for Aquatic Habitat Actions through salmon recovery).	WWPU or other implementing body
IMP-4: Continue to identify alternate funding sources (alternate to watershed planning funds).	CCNRD, WWPU
IMP-5: Consider implementation funding for grant writers.	CCNRD, WWPU
IMP-6: Develop recommendations (such as cooperative agreements) for formalizing obligations with the entities identified as responsible for Plan actions.	CCNRD, WWPU
IMP-7: The Chelan County Natural Resource Department (CCNRD) provides a vital link between water availability, land management and the Watershed Planning Unit. The Watershed Planning Unit supports the ongoing efforts of CCNRD to work with the Watershed Planning Unit to ensure natural resource concerns and technical resources and databases are maintained.	CCNRD
Coordination within the Watershed	
IMP-8: In developing its implementation plan, the Watershed Planning Unit will support the development and implementation of existing plans and programs occurring within the watershed while striving to avoid inconsistent or duplicative activities and policies.	WWPU
IMP-9: The Planning Unit can choose to review and provide comment on large projects proposed in the watershed that would likely have an impact on the water resource. This could be a review of project or programmatic level Environmental Impact Statements (EISs) or other documents.	WWPU

TABLE 2-6

Implementation Recommended Actions

Recommended Action	Responsible Entity
IMP-10: The WRIA 45 Planning Unit members will be involved in the public planning process. The Planning Unit will disseminate information about public comment opportunities to its members. Additionally, the Planning Unit will provide opportunities for public comment on watershed scale studies and plans when, by a vote of the Planning Unit, they are determined to be a priority of the Planning Unit and important to the overall health of the watershed.	WWPU
Monitoring	
IMP-11: Ensure that there is an ongoing coordinated monitoring program consistent with the Intensively Monitored Watershed Program currently being administered through NOAA Fisheries and the RTT. Designate responsible entities, a single data management hub for long term monitoring, and a single custodian to store and manage and generally oversee this effort into the future (requires long term commitment).	WWPU
Adaptive Management	
WRMS-3: The WWPU with Chelan County taking the lead role will participate in the development and implementation of an adaptive management process to support this water resource management strategy. The process should address flexibility in the distribution of the reserve across the WRIA. The details of the adaptive management process will be determined as part of Phase IV Implementation.	WWPU, Chelan County
WRMS-4c: Recommends a new stream gage be established at the existing control point on the Icicle Creek. Details will be determined during Phase IV, Implementation.	Ecology
MissionQUANT-1: Chelan County as lead (with support from Ecology), will convene a Mission Creek Forum to assess options to provide water for future growth through the purchase, lease or transfer of existing, valid water rights or from storage (storage opportunities within Mission Sub-watershed or through the Peshastin and/or Icicle Irrigation districts). This will be conducted for the purpose of providing an uninterruptible supply for domestic, municipal and stock water uses. During Phase IV, Implementation, the Mission Creek Forum will determine whether the strategies for Mission are relevant to Brender Creek, and consider assembling separate strategies to address local instream flow concerns and conditions for Brender Creek, if appropriate. Within two years of rule adoption, the Forum will have developed opportunities and researched funding opportunities for these alternatives.	Chelan County, with participation from Ecology
MissionQUANT-2: As part of Phase IV, Implementation, evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Mission Creek and evaluate water conservation, storage, purchase, lease and transfer of water rights, water from other sub-watersheds, and other alternatives as appropriate.	
PeshastinQUANT-3: As part of Phase IV, Implementation, evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Peshastin and evaluate water conservation, storage, purchase, lease and transfer of water rights, and other alternatives.	

TABLE 2-6

Implementation Recommended Actions

Recommended Action	Responsible Entity
ChumQUANT-10: As part of Phase IV, Implementation, the Planning Unit and the Chumstick Forum (with Chelan County as lead) will evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Chumstick and evaluate water conservation, storage opportunities, purchase, lease and transfer of water rights, water transfer from other sub-watersheds, and other alternatives. Consider conjunctive use and evaluate pumping from the deep aquifer to augment flows in the Chumstick. Investigate storage options where stored water could be used to augment flows and provide mitigation water.	
QUANT-6: Develop an administrative structure for a water bank for WRIA 45. Section 5.1.3 introduces water banks; however, the details of the administration of a water bank in WRIA 45 will be determined in Phase IV, Implementation.	WWPU, Chelan County
QUANT-8: Chelan County Natural Resource Department will develop and administer a monitoring program to assess actual domestic water use to verify the 380 gpd per household assumption used to debit the reservation and to adjust the amount of water remaining in the reservation at five year intervals, or more frequently if the number of wells drilled or building permits granted indicate that growth is occurring more rapidly than projected in any sub-watershed. These assessments will be conducted based on a statistical sample of new domestic water users (single domestic, group domestic and municipal water use and associated lawn and garden irrigation (some with separate irrigation, some without), some with stock, etc.). Metering data will be incorporated into the water use audit and the accounting system. See the recommended action in the Plan for more details.	CCNRD
QUANT-9: Reservation accounting will include the tracking of new exempt wells by Chelan County through the building permit process, septic approval through the Chelan-Douglas Health District (CDHD), tracking new domestic and municipal water rights granted by Ecology and tracking well drilling permits as issued by Ecology. The mechanism for tracking the permitted uses will be determined as part of Phase IV, Implementation. Chelan County is currently developing a method for tracking new permit-exempt wells in WRIA 46. This should also be considered for WRIA 45.	CCNRD
QUANT-9b: New rights that are granted by Ecology for domestic water uses will be tracked by CCNRD. The mechanism for tracking the new permitted uses that will debit the reserve will be determined as part of Phase IV, Implementation.	CCNRD, Ecology

TABLE 2-6

Implementation Recommended Actions

Recommended Action	Responsible Entity
QUANT-10: The Planning Unit recommends metering be required for all new uses eligible under the reserve. The Planning Unit will further define responsible entities, and staffing, budget and funding considerations of the metering program as part of Phase IV, Implementation. Chelan County, CDHD, Ecology, utilities, and others will work together to structure the program. The following should be addressed as part of phase IV: • Identify responsible entities, and address staffing, cost and funding concerns • Consider implementation by an existing utility with an existing metering program • Consider having water users read their own meters • Consider use of Ecology's water measuring system and database • Consider metering options for existing water users and development of a voluntary program that uses existing metering programs' available meters.	WWPU
QUANT-11: Undertake hydrogeologic studies to assess the influence of groundwater withdrawals on surface water. Identify funding for this study and responsible parties (WWPU to identify sub-areas for study, responsible entity as part of Phase IV, Implementation).	CCNRD
QUANT-14: Credit a water service provider for abandoned and/or decommissioned exempt wells. This action will be further developed in Phase IV, Implementation. The well consolidation process is addressed in RCW 90.44.105. This statute presumes a credit of 800 gpd/well unless an alternative minimum is established by Ecology in consultation with DOH or there is credible evidence of non-use.	Ecology, Chelan County, Water Systems
QUANT-15: As part of Phase IV, Implementation, Chelan County and cities should develop policies that can be used to ensure efficient use of water in the event of a land division or new development. See QUANT-15a to QUANT-15f for a list of the policies.	Chelan County, cities
QUANT-15a: For land division applications that have shares in an irrigation district, develop policies requiring that the developer provide tie-ins to the irrigation box; ensure easements; deliver water to parcels, where practicable; and form a Homeowners Association for residential uses. Encourage Irrigation Districts to work with the county and cities to extend infrastructure and irrigation water service where practicable.	Chelan County, cities
QUANT-15f: Encourage cluster development, and group domestic over single domestic systems to increase water use efficiency. Explore encouraging group domestic over single domestic use as part of the approval process for land division applications. Further develop this recommendation as part of Phase IV, Implementation.	Chelan County, cities
QUANT-16d: As part of Phase IV, Implementation, convene a forum to investigate conservation strategies and how they could be implemented by irrigation districts, ditches and other private companies. Involve utilities, cities, Chelan County and Ecology when appropriate. There is a need to work with members of irrigation districts, ditches and others to determine ways to save water and ensure that water rights are protected into the future. Items of discussion could include alternative rate structures based on purpose of water use; partnerships with cities and utilities; utility coordination during development; tools to conserve water, improve instream flows and protect water rights at the same time; and distribution of public education materials.	Chelan County, Irrigation Districts, Canal Companies, other Agriculture, cities, PUD. Ecology, others

TABLE 2-6

Implementation Recommended Actions

Recommended Action	Responsible Entity
QUANT-18: Encourage the County to provide information and education about water conservation options and fire planning; including: outdoor watering, timing, types of native vegetation that require low water use, lawn size, low flow fixtures, etc. to the new land user. The Municipal Water Law requires that water systems provide education and outreach regarding water conservation. However, water users that are using irrigation ditch water for outdoor use and/or exempt wells will not receive this information. Irrigation systems may also be able to provide materials in monthly billings. The details of this educational program will be determined during Phase IV, Implementation. Realtors should be encouraged to distribute public education materials describing water conservation and efficient water management techniques.	Chelan County
QUANT-20b: Study groundwater in specific areas of the watershed (eg., Mission Creek, Lower Chumstick/Eagle Creek area, Monitor area). Finalize the areas for study as part of Phase IV, Implementation.	
QUANT-21: Evaluate the consumptive portion of reserved water uses and determine if recharge credit should be included in the accounting of the reservation.	
IMP-12: Revise and refine water quality management strategies for both point and nonpoint source pollutants to reflect new data.	
IMP-13: Perform additional studies to fill data gaps and address unanswered questions as determined by the Water Quality Technical Subcommittee. Ecology will partner with stakeholders in the watershed to conduct studies addressing information gaps (eg., monitoring).	WQTS, Ecology
QUAL-4: Encourage the Wenatchee Watershed Planning Unit and its other subcommittees (Water Quantity, Instream Flow, Habitat, and Growth and Land Use) to use the information in the TMDL Technical Reports and SISs along with their conclusions, recommendations, and actions for a more holistic approach to restoration, preservation, and enhancement of the watershed for all beneficial uses (WQTS, 2006a; WQTS, 2006b; WQTS, 2006c; WQTS, 2006d).	WWPU, WQTS, Water Quantity Subcommittee, Instream Flow Subcommittee, Habitat Subcommittee, and Growth and Land Use Subcommittee
QUAL-5: Appropriate actions to be used in the appropriate location should be determined to address temperature exceedances in Phase IV, Implementation for all of the temperature-related recommendations in the Plan.	
LowWenQUAL-2, **IcicleQUAL-2** and **UpWenQUAL-2:** Strategies to address point and non-point sources of phosphorus as part of the TMDL for DO and pH will be reported during the implementation phase of the Wenatchee Watershed planning effort.	
IMP-14: Further analysis and discussion may need to take place in Phase IV, Implementation regarding maximum allocation limits in specific sub-watersheds and the mainstem Wenatchee and the relationship between the allocations, and habitat and channel-forming processes.	
IMP-15: All actions specified in the Wenatchee Watershed Plan should be revisited by the Planning Unit during Phase IV, Implementation.	

TABLE 2-7

Public Outreach Recommended Actions

Recommended Action	Responsible Entity
Water Quantity	
ChumQUANT-11: Encourage conservation and outreach.	CDHD, CCNRD, Chelan County
NSTQUANT-3: Chelan County and Ecology to provide public information regarding water limitations in Northside Tributaries (Fact Sheets).	Chelan County, Ecology
QUANT-13: Provide public education as to the roles, responsibilities and regulations pertinent to exempt wells, and encourage the proper entities to enforce/implement (CDHD, DOH, Ecology, County).	CDHD, DOH, Ecology, County
QUANT-15e: Provide public information that encourages actions QUANT-15a through QUANT-15d, and explains the benefits (provide this information during subdivision application or preliminary plat comment period).	Chelan County, cities, other water purveyors, also CDHD
QUANT-16d: As part of Phase IV, Implementation, convene a forum to investigate conservation strategies and how they could be implemented by irrigation districts, ditches and other private companies. Involve utilities, cities, Chelan County and Ecology when appropriate. There is a need to work with members of irrigation districts, ditches and others to determine ways to save water and ensure that water rights are protected into the future. Items of discussion could include alternative rate structures based on purpose of water use; partnerships with cities and utilities; utility coordination during development; tools to conserve water, improve instream flows and protect water rights at the same time; and distribution of public education materials.	Chelan County, Irrigation Districts, Canal Companies, other Agriculture, cities, PUD. Ecology, others
QUANT-18: Encourage the County to provide information and education about water conservation options and fire planning; including: outdoor watering, timing, types of native vegetation that require low water use, lawn size, low flow fixtures, etc. to the new land user. The Municipal Water Law requires that water systems provide education and outreach regarding water conservation. However, water users that are using irrigation ditch water for outdoor use and/or exempt wells will not receive this information. Irrigation systems may also be able to provide materials in monthly billings. The details of this educational program will be determined during Phase IV, Implementation. Realtors should be encouraged to distribute public education materials describing water conservation and efficient water management techniques.	Chelan County
Habitat	
H-11: Efforts that are ongoing in the Wenatchee Watershed to improve or maintain habitat quality need to be encouraged and retained. Recognize and acknowledge achievements in the watershed that have accomplished habitat improvement or protection. Develop a landowner or organization recognition program to recognize habitat improvement projects or achievements in the watershed.	CCNRD
PO-1: Provide support of specific education and outreach programs in the watershed. Programs include: 4H Forestry Education Program, Kids in the Creek, Salmon Fest, Trout Unlimited education programs, Bird Fest, Chelan Douglas Land Trust field trips, Hatchery programs (Leavenworth National Fish Hatchery, and friends of NW Hatcheries), existing noxious weed/native plant education programs, and others.	

TABLE 2-7

Public Outreach Recommended Actions

Recommended Action	Responsible Entity
PO-2: Encourage the 4-H program and CCCD to develop and conduct watershed clean-up education programs.	
H-12: Initiate public information efforts to discourage harassment of spawning salmonids (UCRTT, 2002).	
Water Quality	
LowWenQUAL-9, **IcicleQUAL-7** and **UpWenQUAL-8**: Nutrients (phosphorous) can enter surface and ground water from residential yards and gardens, hobby farms, City and County Parks, business owned landscapes, etc. An education outreach plan should be developed and implemented to heighten awareness and reduce inputs from these sources. Policies and practices should be implemented in City and County Public Works departments. The County and cities should consider implementing a ban on the sale of high phosphate detergents, such as is being considered in Spokane. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
MissionQUAL-6: Activities should be identified and undertaken to provide ongoing outreach, education, and technical assistance to growers, streamside landowners, developers, stakeholders, and the general public (WQTS, 2006b).	See Implementation Activities Table in WQTS (2006b)
MissionQUAL-14 and **ChumQUAL-3**: CDHD will continue to implement onsite sewage disposal system technical assistance and education programs for homeowners and the industry (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-15 and **ChumQUAL-4**: The CDHD will continue to permit sewage systems per Washington Administrative Code (WAC), including analyzing soils and technologies suitable for individual sites; review/approve the proposed design, specifications, installation and if required, the ongoing maintenance in accordance with the WAC; provide public information under real estate disclosure laws; and review all land use proposals to ensure that the WAC is properly enforced prior to approval by the County (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-20 and **ChumQUAL-9**: Conduct stream walk cleanups along the stream (Fall, Spring, Summer) with area schools, homeowners, and other groups (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-21 and **ChumQUAL-10**: Conduct ongoing community fecal coliform education/awareness campaigns throughout the year. Engage and get support from homeowners (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-23 and **ChumQUAL-12**: Conduct education and enforcement actions to stop illegal dumping of wastes either to storm drains or directly to surface waters. This dumping may be of portable toilet wastes, recreational vehicle wastes, etc. (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-25 and **ChumQUAL-14**: The WQTS and its participating entities should work with the public and homeowners regarding BMPs to reduce fecal coliform runoff. General actions should include public information, education, and technical assistance regarding watering practices, landscaping, stormwater runoff, filtration practices, animal waste, etc. (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)

TABLE 2-7

Public Outreach Recommended Actions

Recommended Action	Responsible Entity
Sub-watersheds	
PO-3: CCNRD to ensure that summary fact sheets are created by sub-watershed and develop and provide outreach materials for people at different levels: technical, non-technical, etc.	
PO-4: Prepare Community Documents by tributary (or sub-watershed) that describe the watershed and the water related management strategies that have been recommended to address specific issues in the individual sub-watersheds. An example was prepared for the Icicle Sub-watershed. Obtain funding to create, produce and distribute these documents.	

TABLE 2-8

Lower Wenatchee River Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
Water Availability in the Northside Tributaries area	
NSTQUANT-1: Future water supply availability should be discussed with Chelan County Public Utility District (PUD) to determine whether they have the capacity and infrastructure to provide backup supply. The East Bank Aquifer Regional Water Supply will only be considered as a source of water for this area if approved by the owners of the Regional Water Supply.	Chelan County PUD, others?
NSTQUANT-2: PUD and Chelan County to consider pumping from Wenatchee Valley and a potential PUD hookup in Nahahum.	PUD, Chelan County
NSTQUANT-3: Chelan County and Ecology to provide public information regarding water limitations in Northside Tributaries (Fact Sheets).	Chelan County, Ecology
NSTQUANT-4: Chelan County and Ecology to work with local community to design and implement a groundwater monitoring program in existing wells to determine trends in groundwater levels.	Chelan County, Ecology
NSTQUANT-5: Alternatives Analysis for Northside Tributaries to include options such as use of out-of-basin water, pumping from lower Wenatchee reserve, PUD hookup, deep groundwater, storage, and water right purchase.	
pH/ DO	
LowWenQUAL-1: The partnership formed to secure funding for further study of DO and pH (Chelan County, Chelan County PUD and the cities of Cashmere, Leavenworth and Wenatchee) should continue to work together, with the WQTS to acquire funding assistance and work with the WQTS to: • Facilitate and develop a workable strategy that can be used and ultimately approved by the EPA and in Ecology's TMDL submittal for DO and pH, and • Review and make suggestions for future improvements to Ecology's technical assessment, summary implementation plan, and adaptive management approaches to meet state water quality standards for these parameters.	Chelan County, Chelan County PUD, Cashmere, Leavenworth, Wenatchee, WQTS
LowWenQUAL-2: Strategies to address point and non-point sources of phosphorus as part of the TMDL for DO and pH will be reported during the implementation phase of the Wenatchee Watershed planning effort.	
LowWenQUAL-3: Large reductions of phosphorus inputs are needed from point sources in the Wenatchee River Watershed, especially waste water treatment plants (WWTPs). A regulatory strategy should be developed and implemented with WWTPs and Ecology to institute controls over time through National Pollutant Discharge Elimination System (NPDES) permits that will reduce phosphorous discharges to surface and groundwaters. WWTPs to be addressed include the Lake Wenatchee, Stevens Pass, Leavenworth, Peshastin, and Cashmere waste water treatment plants. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
LowWenQUAL-4: Controls should be developed and implemented through new and existing regulatory permits, if needed, to reduce phosphorous inputs to surface and groundwaters from other Wenatchee Watershed point sources. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)

TABLE 2-8

Lower Wenatchee River Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
LowWenQUAL-5: Large reductions of phosphorus inputs are needed from nonpoint sources in the Wenatchee River Watershed. Mass-balance modeling showed that two reaches of the lower Wenatchee River exhibit higher diffuse phosphorous loading than other reaches. One reach brackets the community of Dryden and the other brackets the city of Cashmere. Studies should be done in these two reaches, focusing on groundwater-surface water interaction and land-uses that may be contributing phosphorus inputs to the river. Actions should be implemented based on the conclusions and recommendations of these studies to reduce inputs of phosphorous from these areas (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
LowWenQUAL-6: Groundwater discharges to the Wenatchee River, Icicle Creek, and their tributaries affects dissolved oxygen levels and nutrient concentrations. Groundwater is discharged to the river or creeks in some reaches, and is recharged in other reaches. In the Wenatchee basin, groundwater flow and Biochemical Oxygen Demand (BOD)/nutrient concentrations may be elevated due to upland practices such as orchard irrigation and wastewater discharge to groundwater from lagoons and on-site septic systems. Assessments of groundwater contributions and sources of nutrients (phosphorous) should be conducted. Actions should be implemented based on the conclusions and recommendations of these studies to reduce inputs of phosphorous from these areas (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
LowWenQUAL-7: Non-point sources along the length of the river may be contributing BOD and nutrients. Address failing septic systems through actions identified in the Wenatchee Watershed Fecal Coliform TMDL. Continue site specific inspections and enforcement of regulations that restrict placement of on-site septic drain fields from areas deemed to have unsuitable soils. A study should be conducted to assess soils and onsite septic systems. Estimates should be made of the maximum number and density of on-site drain fields that the upper basin can accommodate and still meet the water quality standards, as was done in the Lake Chelan study (Patmont et al., 1989). Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
LowWenQUAL-8: Nutrients (phosphorous) can enter streams from storm water events. Work with Chelan County and municipalities to reduce storm water inputs, utilizing the Eastern Washington Storm water Manual or equivalent. Encourage the appropriate entities to include language that addresses storm water in comprehensive plans and ordinances. Work with developers. (See LowWenQUAL-18). Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
LowWenQUAL-9: Nutrients (phosphorous) can enter surface and ground water from residential yards and gardens, hobby farms, City and County Parks, business owned landscapes, etc. An education outreach plan should be developed and implemented to heighten awareness and reduce inputs from these sources. Policies and practices should be implemented in City and County Public Works departments. The County and cities should consider implementing a ban on the sale of high phosphate detergents, such as is being considered in Spokane. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)

TABLE 2-8

Lower Wenatchee River Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
LowWenQUAL-10: Nutrients can enter streams from materials used to de-ice, clean, and maintain roads and parking lots. Animal waste from roads and parking lots can enter streams and increase nutrient loading. Work with the County, cities, businesses, and the WA State Department of Transportation to determine if road and parking lot maintenance practices may be contributing to nutrient loading and if necessary investigate ways to reduce nutrient inputs from these practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
LowWenQUAL-11: Nutrients (phosphorous) can be released to ground and surface waters from development practices, such as disruption of soils during conversions of orchard lands to housing. Actions should be conducted to prevent nutrients from entering ground and surface waters before, during and after construction. Work with developers to implement these actions. Encourage entities to include appropriate language in county and city comprehensive plans, growth management, and critical area ordinances. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
LowWenQUAL-12: The operation of Columbia River dams apparently backs up the Wenatchee River from its mouth approximately one mile. It has been hypothesized that this back-water may contribute to the exceedances of pH and dissolved oxygen levels in that reach. Work with the Chelan PUD to conduct an assessment of the possible back-water effect that may be created by operation of the Rock Island dam. Implement actions from the report's conclusions and recommendations to improve water quality (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
LowWenQUAL-13: Consider implementing actions recommended in the Wenatchee River Basin Temperature and Fecal Coliform TMDLs if the actions address problems that have been identified in the Lower Wenatchee. Lowering temperatures and reducing nutrient inputs will improve pH and dissolved oxygen levels in the Wenatchee River Watershed (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
LowWenQUAL-14: Reserve load capacities for Biochemical Oxygen Demand (BOD) and nutrients should be established for the Upper Wenatchee River and Icicle Creek. Reserve load capacities are needed because there is no additional assimilative capacity for dissolved oxygen in the upper watershed during critical conditions. A point source regulatory strategy and nonpoint source BMP strategy should be developed to protect the reserve capacities and maintain water quality standards (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
LowWenQUAL-15: Encourage lining of earthen canals where appropriate. Work with irrigation districts to implement BMPs and adaptive management programs to minimize any nutrient loading that is not already being addressed (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
LowWenQUAL-16: Agricultural practices can contribute nutrients to ground and surface waters through crop watering practices, application of fertilizers, and soil disturbance activities. Work with the agricultural community to encourage practices that will reduce nutrient inputs to ground and surface waters while enhancing crop quality and yield. Examples include technical assistance through farm plans and Best Management Practices (BMPs). Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)

TABLE 2-8

Lower Wenatchee River Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
LowWenQUAL-17: Funding for these projects should be sought through Department of Ecology Centennial and 319 grants and loans. Identify and access other funding sources through the Planning Unit and other entities. Ongoing adaptive management should be utilized to provide the best use of funds and environmental benefits (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
LowWenQUAL-18: Proper filtration of nutrients through land use practices can have a beneficial effect on nutrient reductions to ground and surface waters. Encourage implementation of wetlands, filter strips, riparian vegetation, bio-swales, drainage basins, pervious surfaces, etc. in residential, commercial, agricultural, industrial, development, and municipal practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
LowWenQUAL-19: Identify and investigate any non point sources in tributaries that may be contributing to nutrient loads (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
Habitat Restoration/Enhancement	
LowWenH-1: Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in the Wenatchee River (UCSRB, 2005).	
LowWenH-2: Reduce water temperatures by restoring riparian vegetation along the river (UCSRB, 2005).	
LowWenH-3: Increase habitat diversity and quantity by restoring riparian habitat along the Wenatchee River, reconnecting side channels and the floodplain with the river, and increasing large woody debris in the side channels (UCSRB, 2005).	
LowWenH-4: Protect existing riparian habitat and channel migration floodplain function (UCRTT, 2002).	

TABLE 2-9

Mission Creek Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
Water Availability	
MissionQUANT-1: Chelan County as lead (with support from Ecology), will convene a Mission Creek Forum to assess options to provide water for future growth through the purchase, lease or transfer of existing, valid water rights or from storage (storage opportunities within Mission Sub-watershed or through the Peshastin and/or Icicle Irrigation districts). This will be conducted for the purpose of providing an uninterruptible supply for domestic, municipal and stock water uses. During Phase IV, Implementation, the Mission Creek Forum will determine whether the strategies for Mission are relevant to Brender Creek, and consider assembling separate strategies to address local instream flow concerns and conditions for Brender Creek, if appropriate. Within two years of rule adoption, the Forum will have developed opportunities and researched funding opportunities for these alternatives.	Chelan County, with participation from Ecology
MissionQUANT-2: As part of Phase IV, Implementation, evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Mission Creek and evaluate water conservation, storage, purchase, lease and transfer of water rights, water from other sub-watersheds, and other alternatives as appropriate.	
MissionQUANT-3: One quarter (0.03 cfs) of the 0.12 cfs projected 2025 water needs is available for growth for two years after rule adoption. If, after two years, water rights are not purchased or leased to cover the interim reserve of 0.03 cfs or conservation measures that provide additional water are not implemented, Ecology would close the Mission Sub-watershed to further appropriation on a seasonal basis, and existing outdoor water use established subsequent to the adoption of WAC 173-545 could be curtailed when flows are not met. All water allocated to the City of Cashmere will be debited to the Lower Wenatchee Reserve and not to the Mission Reserve.	
MissionQUANT-4: Consider storing water in Icicle/Peshastin and use that water to augment flows and provide mitigation water in Mission Creek.	
MissionQUANT-5: Consider storage opportunities within Mission Sub-watershed (See Section 5.5).	
MissionQUANT-6: Metering of all new uses covered under the Mission reserve (includes all new domestic uses).	
MissionQUANT-7: Evaluate out-of-kind mitigation and enhancement projects over time, if appropriate. Identify habitat and water quality improvements to mitigate additional reserve water.	
MissionQUANT-8: Chelan County or other entity with agency funding assistance will investigate water rights for purchase or lease as part of the mitigation and enhancement strategy for Mission Sub-watershed. The County will seek funding from BPA, Ecology, Washington Rivers Conservancy, Washington Water Trust, and others. As water rights are purchased or transferred for use in the Mission reserve to meet a “no net impact” standard, the first purchase(s) will credit the 0.03 cfs interim reserve, then the additional 0.09 cfs will be available for forecasted growth as it is purchased.	Chelan County or other entity

TABLE 2-9

Mission Creek Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
DDT	
MissionQUAL-1: Significant reductions in DDT loads may be achieved by preventing bank erosion or by other means of limiting transport of upland soils to streams. BMPs such as riparian buffers and wetlands can also filter and uptake DDT from surface and groundwater. Many BMPs are currently being implemented in the watershed. BMPs should be continued, refined, expanded, and monitored to further reduce erosion, surface runoff, TSS in the water column, and groundwater transport of DDT. BMPs include farm practices, storm water runoff, riparian vegetation planting, orchard conversions, residential practices, riparian buffers, wetlands, etc. These and other appropriate BMP actions and locations should be identified and implemented in coordination with the Planning Unit and its committees (WQTS, 2006b).	See Implementation Activities Table in WQTS (2006b)
MissionQUAL-2: A phased monitoring approach should be conducted to assess the effectiveness of BMPs and DDT-TSS (Total Suspended Solids) reduction efforts. This may take time to achieve and, as TSS loads are reduced and DDT levels are monitored, TSS targets may be adjusted to correspond to DDT targets (WQTS, 2006b).	See Implementation Activities Table in WQTS (2006b)
MissionQUAL-3: Evaluation of soil transport to streams should be conducted during large rainfall events when visual observations can be made and/or sections of streams with high sediment runoff and TSS can be isolated. An assessment should be conducted to investigate if any other events contribute soil to streams such as spring thaw processes or irrigation practices (WQTS, 2006b).	See Implementation Activities Table in WQTS (2006b)
MissionQUAL-4: More comprehensive groundwater monitoring should be conducted, including further assessment of the relationship between surface water, groundwater, and DDT fate and transport (WQTS, 2006b).	See Implementation Activities Table in WQTS (2006b)
MissionQUAL-5: Assessments are recommended for all irrigation systems in the watershed to identify any mechanisms that may contribute to sediment transport which are not yet being addressed by BMPs. Actions should be identified and implemented to address the findings. Lining of earthen canals should be encouraged (WQTS, 2006b).	See Implementation Activities Table in WQTS (2006b)
MissionQUAL-6: Activities should be identified and undertaken to provide ongoing outreach, education, and technical assistance to growers, streamside landowners, developers, stakeholders, and the general public (WQTS, 2006b).	See Implementation Activities Table in WQTS (2006b)
MissionQUAL-7: Funding assistance should be sought from Ecology through its grants and loans programs to implement actions and ongoing monitoring. Other funding sources should be identified and applications submitted to provide funding for ongoing activities. The WQTS will recommend qualified entities to conduct associated monitoring (WQTS, 2006b).	See Implementation Activities Table in WQTS (2006b)

TABLE 2-9

Mission Creek Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
MissionQUAL-8: Development over old orchards is a primary concern. Measures should be implemented to prevent DDT laden orchard soils disturbed during construction from being transmitted to streams and lakes in the watershed. Language requiring measures to prevent DDT laden soils from entering the waterways during and after construction should be developed by the WQTS and included in County and municipality development ordinances, growth management plans, and critical area ordinances. The Stormwater Management Manual for Eastern Washington or an equivalent document should be utilized in developing ordinances, and guiding municipal, private, and construction storm water practices (WQTS, 2006b).	See Implementation Activities Table in WQTS (2006b)
MissionQUAL-9: Assessments are recommended for stormwater control systems in the watershed to identify any mechanisms that may contribute to sediment transport which are not yet being addressed by BMPs. Actions should be identified and implemented to address the findings through a list of prioritized projects (WQTS, 2006b).	See Implementation Activities Table in WQTS (2006b)
Fecal Coliform	
MissionQUAL-10: Identify sources of fecal coliform (FC) pollution to Mission Creek Sub-watershed, utilizing the FC technical study. Identify human and nonhuman sources and/or failing on-site septic systems. Plan and implement corrective actions. The Chelan-Douglas Health District (CDHD) should address failing septic systems. Other entities should address manageable sources of FC pollution as appropriate. See the complete action in the plan for the areas in which assessment should be conducted (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-11: Implement and monitor BMPs to meet the Fecal Coliform TMDL Technical Assessment target reductions (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-12: Utilizing this report, City of Cashmere, and Ecology information, work with the city of Cashmere to identify sewer system root intrusion in areas near streams. Repair and upgrade sewer collection and delivery system (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-13: The CDHD will continue to work with consenting homeowners to conduct monitoring of on-site wells in areas of fecal coliform exceedances to help identify the source/s. Utilize this assessment (July 2003) to help identify locations for testing (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-14: CDHD will continue to implement onsite sewage disposal system technical assistance and education programs for homeowners and the industry (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-15: The CDHD will continue to permit sewage systems per Washington Administrative Code (WAC), including analyzing soils and technologies suitable for individual sites; review/approve the proposed design, specifications, installation and if required, the ongoing maintenance in accordance with the WAC; provide public information under real estate disclosure laws; and review all land use proposals to ensure that the WAC is properly enforced prior to approval by the County (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)

TABLE 2-9

Mission Creek Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
MissionQUAL-16: A grant/loan funding program should be developed and implemented to replace or repair failing septic systems (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-17: The CDHD should explore obtaining legal authority from Chelan County to operate a pumper notification program with area septage pumpers as part of its onsite septic system operation and maintenance program. The septage pumpers would work with the CDHD to appropriately identify and correct failing septic systems (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-18: The CDHD and watershed would benefit from the funding, development and maintenance of a digital system for all onsite septic system permits issued in Chelan County, and a Geographic Information Systems (GIS) database of the onsite septic systems (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-19: When the TMDL DIP is developed, the committee should utilize detailed recommendations from the Wenatchee River Watershed Action Plan (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-20: Conduct stream walk cleanups along the stream (Fall, Spring, Summer) with area schools, homeowners, and other groups (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-21: Conduct ongoing community fecal coliform education/awareness campaigns throughout the year. Engage and get support from homeowners (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-22: Work with City, County, State, and Federal governments, and the Humane Society to deal with the feral cats and dogs living within the stream corridor. Monitor and remove dead animals within the stream corridor throughout the year (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-23: Conduct education and enforcement actions to stop illegal dumping of wastes either to storm drains or directly to surface waters. This dumping may be of portable toilet wastes, recreational vehicle wastes, etc. (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-24: The WQTS should encourage the CDHD, Chelan County, Cities, DOH, and Utilities to continue ongoing review and upgrading of ordinances regarding developments and sewage systems technologies (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-25: The WQTS and its participating entities should work with the public and homeowners regarding BMPs to reduce fecal coliform runoff. General actions should include public information, education, and technical assistance regarding watering practices, landscaping, stormwater runoff, filtration practices, animal waste, etc. (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-26: Work with irrigation districts to implement and enforce policies to prevent illegal fecal coliform discharges to irrigation canals (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-27: Work with landowners regarding fecal coliform runoff (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)

TABLE 2-9

Mission Creek Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
MissionQUAL-28: Encourage Chelan County and municipalities to develop and implement stormwater policies, standards, and guidelines, utilizing the Eastern Washington Stormwater Manual or equivalent, in comprehensive plans, critical area ordinances, growth management plans, and other appropriate plans (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-29: Work with appropriate entities to reduce fecal coliform runoff from impervious surfaces (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-30: Work with U.S. Forest Service, Washington State Department of Natural Resources, and private owners on forested lands to restore and protect streams from fecal coliform runoff pollution (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-31: Work with wastewater purveyors to examine sewer collection systems to identify problems or damage within them that may contribute fecal coliform loading in the watershed. Correct identified problems as appropriate (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-32: Funding assistance should be sought from Ecology through its grants and loans programs to implement actions and ongoing monitoring. Other funding sources should be identified and applications submitted to provide funding for ongoing activities. The WQTS will recommend qualified entities to conduct associated monitoring. Self-sustaining funding mechanisms to reduce fecal coliform inputs should be explored and developed in concert with the Wenatchee Watershed Planning Unit and its participating entities (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
MissionQUAL-33: Work with the wastewater utilities regarding their ordinances to connect unconnected homes in the service area (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
Habitat Restoration/Enhancement	
MissionH-1: Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts and diversions) (UCSRB, 2005).	
MissionH-2: Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Mission Creek (UCSRB, 2005).	
MissionH-3: Decrease water temperatures and improve water quality by restoring riparian vegetation along the stream (UCSRB, 2005).	
MissionH-4: Reduce unnatural sediment recruitment to the stream by restoring riparian habitat and improving road maintenance (UCSRB, 2005).	
MissionH-5: Increase habitat diversity and quantity by restoring riparian habitat, reconnecting side channels and the floodplain with the channel, increasing large woody debris within the channel, and by adding instream structures (UCSRB, 2005).	

TABLE 2-10

Peshastin Creek Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
Water Availability	
PeshastinQUANT-1: Evaluate passage requirements for fish immediately below the Peshastin Irrigation District diversion (addressing bypass reach/piping).	
PeshastinQUANT-2: Consider other instream projects that improve habitat.	
PeshastinQUANT-3: As part of Phase IV, Implementation, evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Peshastin and evaluate water conservation, storage, purchase, lease and transfer of water rights, and other alternatives.	
PeshastinQUANT-4: Evaluate and institute programs to increase instream flows through water acquisitions, leases, and transfers.	
Habitat Restoration/Enhancement	
PeshastinH-1: Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (UCSRB, 2005).	
PeshastinH-2: Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Peshastin Creek (UCSRB, 2005).	
PeshastinH-3: Reduce water temperatures by increasing stream flows and restoring riparian vegetation along the stream (UCSRB, 2005).	
PeshastinH-4: Increase habitat diversity and quantity by restoring riparian vegetation, adding instream structures and large woody debris, and reconnecting side channels and the floodplain with the stream (UCSRB, 2005).	

TABLE 2-11

Chumstick Creek Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
Water Availability	
ChumQUANT-1: Chelan County as lead (with support from Ecology), will convene a Chumstick Water Forum to guide data collection, oversee the proposed water management strategy, and help develop mitigation measures.	Chelan County with support from Ecology
ChumQUANT-2: Chumstick Water Forum to assist in developing a data collection plan to monitor surface water flows (specify location) and develop management flows.	Chumstick Water Forum
ChumQUANT-3: Chumstick Water Forum, with assistance from Chelan County and Ecology, to conduct groundwater monitoring to understand hydraulic continuity and overall impact of exempt wells on groundwater levels and streamflows.	Chumstick Water Forum with assistance from Chelan County and Ecology
ChumQUANT-4: Recommend that Ecology close the Chumstick Sub-watershed for an interim period of three years while data are collected and alternatives are assessed. Uses that are not subject to the closure (and can continue throughout the three year interim closure) include: fire suppression, domestic use from wells, stock water uses, and seasonal storage, pending evaluation by the Chumstick Water Forum and Ecology. These exempt uses would be limited to a total of 0.043 cfs while studies are being performed to determine future water availability in the Chumstick and a future strategy is assessed. Seasonal storage opportunities and other alternatives in Chumstick will be evaluated by Ecology and the Chumstick Water Forum through the water right application process on a case-by-case basis during the three year interim period. Storage opportunities in Chumstick will be addressed as part of the Chumstick strategy after conclusion of the Forum's three year process and coordinated with the WRIA 45 Multi-Purpose Storage Assessment. This interim closure will be re-evaluated at the end of the three year period by the Chumstick Forum and Ecology. Note that water storage tanks as included in the Chumstick Community Wildfire Protection Program are exempt from this closure.	
ChumQUANT-5: Ecology and Chelan County to implement reservation conditions as follows: One third (0.043 cfs) of the 0.13 cfs projected 2025 water needs is available for growth for three years after rule adoption. Allocation of the remainder of the reserve would be considered only after completion of additional instream flow assessments (ChumQUANT-2) and a cumulative impacts study (ChumQUANT-3, 6) and would be subject to appropriate conditions and limitations based on the result of those assessments (ChumQUANT-7). If, after completion of the cumulative impact study, Ecology determines that the cumulative effects of domestic water uses negatively affect water available for instream flows, Ecology will consider allowing only in-house water use from the reservation. If after 3 years, water rights are not purchased or leased to cover the interim reserve of 0.043 cfs or conservation measures that provide additional water are not implemented, Ecology would close the Chumstick Sub-watershed to further appropriation on a seasonal basis, and existing outdoor water use established subsequent to the adoption of WAC 173-545 could be curtailed when flows are not met. Note that the City of Leavenworth will debit any new water from the Lower Wenatchee Reserve and not the Chumstick Reserve.	Ecology, Chelan County

TABLE 2-11

Chumstick Creek Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
ChumQUANT-6: A cumulative impact analysis of permit exempt use and uses associated with permits and claims approved since 1983 will be initiated by Ecology as authorized under the 1983 flow rule. Chelan County will partner with Ecology in this study. The cumulative impacts assessment will help to determine whether Ecology will curtail outdoor domestic water use of wells installed after 1983, and whether Ecology will close the Chumstick Sub-watershed to outdoor water use in the future.	
ChumQUANT-7: Chumstick Forum, Chelan County and Ecology to re-evaluate a proposed strategy for the Chumstick in three years after rule adoption, when new monitoring data have been collected and assessed and cumulative impact analysis is complete. Consider allowing group domestic groundwater use of deeper aquifer only as part of the Chumstick strategy addressed by the Forum.	
ChumQUANT-8: Chelan County will evaluate alternatives to improve fish passage at the North Road culvert, and further pursue replacement of culverts upstream of North Road on Chumstick Creek.	Chelan County
ChumQUANT-9: Metering of all new uses covered under the Chumstick reserve (includes all new domestic uses).	
ChumQUANT-10: As part of Phase IV, Implementation, the Planning Unit and the Chumstick Forum (with Chelan County as lead) will evaluate alternatives that could increase available water for instream and out-of-stream uses. Clearly address specific water needs in the Chumstick and evaluate water conservation, storage opportunities, purchase, lease and transfer of water rights, water transfer from other sub-watersheds, and other alternatives. Consider conjunctive use and evaluate pumping from the deep aquifer to augment flows in the Chumstick. Investigate storage options where stored water could be used to augment flows and provide mitigation water.	WWPU, Chumstick Water Forum, Chelan County
ChumQUANT-11: Encourage conservation and outreach.	
ChumQUANT-12: Chelan County or other entity with agency funding assistance will investigate water rights for purchase or lease as part of the mitigation and enhancement strategy for Chumstick Sub-watershed. The County will seek funding from BPA, Ecology, Washington Rivers Conservancy, Washington Water Trust, and others. As water rights are purchased or transferred for use in the Chumstick reserve to meet a "no net impact" standard, the first purchase(s) will credit the 0.043 cfs interim reserve, then the additional 0.09 cfs will be available for forecasted growth as it is purchased. Consider information from adjudication records (1982-1984) when investigating water rights for purchase or lease.	Chelan County or other entity
Fecal Coliform	
ChumQUAL-1: Identify sources of fecal coliform pollution to Chumstick Creek Sub-watershed, including Van Creek and Upper Eagle Creek, utilizing the FC technical study. Identify human and nonhuman sources and/or failing on-site septic systems. Plan and implement corrective actions. The CDHD should address failing septic systems. Other entities should address manageable sources of FC pollution as appropriate (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)

TABLE 2-11

Chumstick Creek Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
ChumQUAL-2: Implement and monitor BMPs to meet the Fecal Coliform TMDL Technical Assessment target reductions (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
ChumQUAL-3: CDHD will continue to implement onsite sewage disposal system technical assistance and education programs for homeowners and the industry (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
ChumQUAL-4: The CDHD will continue to permit sewage systems per Washington Administrative Code (WAC), including analyzing soils and technologies suitable for individual sites; review/approve the proposed design, specifications, installation and if required, the ongoing maintenance in accordance with the WAC; provide public information under real estate disclosure laws; and review all land use proposals to ensure that the WAC is properly enforced prior to approval by the County (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
ChumQUAL-5: A grant/loan funding program should be developed and implemented to replace or repair failing septic systems (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
ChumQUAL-6: The CDHD should explore obtaining legal authority from Chelan County to operate a pumper notification program with area septage pumpers as part of its onsite septic system operation and maintenance program. The septage pumpers would work with the CDHD to appropriately identify and correct failing septic systems (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
ChumQUAL-7: The CDHD and watershed would benefit from the funding, development and maintenance of a digital system for all onsite septic system permits issued in Chelan County, and a GIS database of the onsite septic systems (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
ChumQUAL-8: When the TMDL DIP is developed, the committee should utilize detailed recommendations from the Wenatchee River Watershed Action Plan (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
ChumQUAL-9: Conduct stream walk cleanups along the stream (Fall, Spring, Summer) with area schools, homeowners, and other groups (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
ChumQUAL-10: Conduct ongoing community fecal coliform education/awareness campaigns throughout the year. Engage and get support from homeowners (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
ChumQUAL-11: Work with City, County, State, and Federal governments, and the Humane Society to deal with the feral cats and dogs living within the stream corridor. Monitor and remove dead animals within the stream corridor throughout the year. (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
ChumQUAL-12: Conduct education and enforcement actions to stop illegal dumping of wastes either to storm drains or directly to surface waters. This dumping may be of portable toilet wastes, recreational vehicle wastes, etc. (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)

TABLE 2-11

Chumstick Creek Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
ChumQUAL-13: The WQTS should encourage the CDHD, Chelan County, Cities, DOH, and Utilities to continue ongoing review and upgrading of ordinances regarding developments and sewage systems technologies (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
ChumQUAL-14: The WQTS and its participating entities should work with the public and homeowners regarding BMPs to reduce fecal coliform runoff. General actions should include public information, education, and technical assistance regarding watering practices, landscaping, stormwater runoff, filtration practices, animal waste, etc. (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
ChumQUAL-15: Work with irrigation districts to implement and enforce policies to prevent illegal fecal coliform discharges to irrigation canals (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
ChumQUAL-16: Work with landowners regarding fecal coliform runoff (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
ChumQUAL-17: Encourage Chelan County and municipalities to develop and implement stormwater policies, standards, and guidelines, utilizing the Eastern Washington Stormwater Manual or equivalent, in comprehensive plans, critical area ordinances, growth management plans, and other appropriate plans (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
ChumQUAL-18: Work with appropriate entities to reduce fecal coliform runoff from impervious surfaces (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
ChumQUAL-19: Work with U.S. Forest Service, Washington State Department of Natural Resources, and private owners on forested lands to restore and protect streams from fecal coliform runoff pollution (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
ChumQUAL-20: Funding assistance should be sought from Ecology through its grants and loans programs to implement actions and ongoing monitoring. Other funding sources should be identified and applications submitted to provide funding for ongoing activities. The WQTS will recommend qualified entities to conduct associated monitoring. Self-sustaining funding mechanisms to reduce fecal coliform inputs should be explored and developed in concert with the Wenatchee Watershed Planning Unit and its participating entities (WQTS, 2006c).	See Implementation Activities Table in WQTS (2006c)
Habitat Restoration/Enhancement	
ChumH-1: Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts and diversions) (UCSRB, 2005).	
ChumH-2: Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Chumstick Creek (UCSRB, 2005).	
ChumH-3: Decrease water temperatures and improve water quality by restoring riparian vegetation along the stream (UCSRB, 2005).	

TABLE 2-11

Chumstick Creek Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
ChumH-4: Increase habitat diversity and quantity by restoring riparian habitat, reconnecting side channels and the floodplain with the channel, increasing large woody debris within the channel, and by adding instream structures (UCSRB, 2005).	
ChumH-5: Protect remaining floodplain and riparian habitat (UCRTT, 2002).	

TABLE 2-12

Icicle Creek Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
Water Resource Management Strategy	
WRMS-4c: Recommends a new stream gage be established at the existing control point on the Icicle Creek. Details will be determined during Phase IV, Implementation.	Ecology
DO/pH	
IcicleQUAL-1: The partnership formed to secure funding for further study of DO and pH (Chelan County, Chelan County PUD and the cities of Cashmere, Leavenworth and Wenatchee) should continue to work together, with the WQTS to acquire funding assistance and work with the WQTS to: • Facilitate and develop a workable strategy that can be used and ultimately approved by the EPA and in Ecology's TMDL submittal for DO and pH, and • Review and make suggestions for future improvements to Ecology's technical assessment, summary implementation plan, and adaptive management approaches to meet state water quality standards for these parameters.	Chelan County, Chelan County PUD, Cashmere, Leavenworth, Wenatchee, WQTS
IcicleQUAL-2: Strategies to address point and non-point sources of phosphorus as part of the TMDL for DO and pH will be reported during the implementation phase of the Wenatchee Watershed planning effort.	
IcicleQUAL-3: Controls should be developed and implemented through new and existing regulatory permits, if needed, to reduce phosphorous inputs to surface and groundwaters from other Wenatchee Watershed point sources. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
IcicleQUAL-4: Groundwater discharges to the Wenatchee River, Icicle Creek, and their tributaries affects dissolved oxygen levels and nutrient concentrations. Groundwater is discharged to the river or creeks in some reaches, and is recharged in other reaches. In the Wenatchee basin, groundwater flow and BOD/nutrient concentrations may be elevated due to upland practices such as orchard irrigation and wastewater discharge to groundwater from lagoons and on-site septic systems. Assessments of groundwater contributions and sources of nutrients (phosphorous) should be conducted. Actions should be implemented based on the conclusions and recommendations of these studies to reduce inputs of phosphorous from these areas (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
IcicleQUAL-5: Non-point sources along the length of the river may be contributing BOD and nutrients. Address failing septic systems through actions identified in the Wenatchee Watershed Fecal Coliform TMDL. Continue site specific inspections and enforcement of regulations that restrict placement of on-site septic drain fields from areas deemed to have unsuitable soils. A study should be conducted to assess soils and onsite septic systems. Estimates should be made of the maximum number and density of on-site drain fields that the upper basin can accommodate and still meet the water quality standards, as was done in the Lake Chelan study (Patmont et al., 1989). Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)

TABLE 2-12

Icicle Creek Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
IcicleQUAL-6: Nutrients (phosphorous) can enter streams from storm water events. Work with Chelan County and municipalities to reduce storm water inputs, utilizing the Eastern Washington Storm water Manual or equivalent. Encourage appropriate entities to include language that addresses storm water in comprehensive plans and ordinances. Work with developers. (See IcicleQUAL-15). Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
IcicleQUAL-7: Nutrients (phosphorous) can enter surface and ground water from residential yards and gardens, hobby farms, City and County Parks, business owned landscapes, etc. An education outreach plan should be developed and implemented to heighten awareness and reduce inputs from these sources. Policies and practices should be implemented in City and County Public Works departments. The County and cities should consider implementing a ban on the sale of high phosphate detergents, such as is being considered in Spokane. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
IcicleQUAL-8: Nutrients can enter streams from materials used to de-ice, clean, and maintain roads and parking lots. Animal waste from roads and parking lots can enter streams and increase nutrient loading. Work with the County, cities, and businesses to determine if road and parking lot maintenance practices may be contributing to nutrient loading and if necessary investigate ways to reduce nutrient inputs from these practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
IcicleQUAL-9: Nutrients (phosphorous) can be released to ground and surface waters from development practices, such as disruption of soils during conversions of orchard lands to housing. Actions should be conducted to prevent nutrients from entering ground and surface waters before, during and after construction. Work with developers to implement these actions. Encourage entities to include appropriate language in county and city comprehensive plans, growth management, and critical area ordinances. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
IcicleQUAL-10: Consider implementing actions recommended in the Wenatchee River Basin Temperature and Fecal Coliform TMDLs if the actions address problems that have been identified in the Icicle Sub-watershed. Lowering temperatures and reducing nutrient inputs will improve pH and dissolved oxygen levels in the Wenatchee River Watershed (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
IcicleQUAL-11: Reserve load capacities for Biochemical Oxygen Demand (BOD) and nutrients should be established for the Upper Wenatchee River and Icicle Creek. Reserve load capacities are needed because there is no additional assimilative capacity for dissolved oxygen in the upper watershed during critical conditions. A point source regulatory strategy and nonpoint source BMP strategy should be developed to protect the reserve capacities and maintain water quality standards (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
IcicleQUAL-12: Encourage lining of earthen canals where appropriate. Work with irrigation districts to implement BMPs and adaptive management programs to minimize any nutrient loading that is not already being addressed (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)

TABLE 2-12

Icicle Creek Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
IcicleQUAL-13: Agricultural practices can contribute nutrients to ground and surface waters through crop watering practices, application of fertilizers, and soil disturbance activities. Work with the agricultural community to encourage practices that will reduce nutrient inputs to ground and surface waters while enhancing crop quality and yield. Examples include technical assistance through farm plans and Best Management Practices (BMPs). Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
IcicleQUAL-14: Funding for these projects should be sought through Department of Ecology Centennial and 319 grants and loans. Identify and access other funding sources through the Planning Unit and other entities. Ongoing adaptive management should be utilized to provide the best use of funds and environmental benefits (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
IcicleQUAL-15: Proper filtration of nutrients through land use practices can have a beneficial effect on nutrient reductions to ground and surface waters. Encourage implementation of wetlands, filter strips, riparian vegetation, bio-swales, drainage basins, pervious surfaces, etc. in residential, commercial, agricultural, industrial, development, and municipal practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
IcicleQUAL-16: Identify and investigate any non point sources in tributaries that may be contributing to nutrient loads (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
Habitat Restoration/Enhancement	
IcicleH-1: Increase connectivity by improving fish passage over Dam 5 in the lower Icicle Creek (UCSRB, 2005).	
IcicleH-2: Reduce sediment recruitment by restoring riparian vegetation between the mouth of the Icicle and the boulder field (RM 0-5.4) (UCSRB, 2005).	
IcicleH-3: Improve road maintenance to reduce fine sediment recruitment in the upper watershed (UCSRB, 2005).	
IcicleH-4: Increase habitat diversity and quantity by restoring riparian vegetation, reconnecting side channels, and reconnecting the floodplain with the channel in lower Icicle Creek (UCSRB, 2005).	
IcicleH-5: Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Icicle Creek (UCSRB, 2005).	
IcicleH-6: Protect remaining floodplain and riparian habitat downstream of Chatter Creek. Emphasis should be placed on habitat downstream of Leavenworth Hatchery (UCRTT, 2002).	

TABLE 2-13

Upper Wenatchee River and Chiwaukum Creek Sub-watersheds Recommended Actions

Upper Wenatchee

Recommended Action	Responsible Entity
DO/pH	
UpWenQUAL-1: The partnership formed to secure funding for further study of DO and pH (Chelan County, Chelan County PUD and the cities of Cashmere, Leavenworth and Wenatchee) should continue to work together, with the WQTS to acquire funding assistance and work with the WQTS to: • Facilitate and develop a workable strategy that can be used and ultimately approved by the EPA and in Ecology's TMDL submittal for DO and pH, and • Review and make suggestions for future improvements to Ecology's technical assessment, summary implementation plan, and adaptive management approaches to meet state water quality standards for these parameters.	Chelan County, Chelan County PUD, Cashmere, Leavenworth, Wenatchee, WQTS
UpWenQUAL-2: Strategies to address point and non-point sources of phosphorus as part of the TMDL for DO and pH will be reported during the implementation phase of the Wenatchee Watershed planning effort.	
UpWenQUAL-3: Large reductions of phosphorus inputs are needed from point sources in the Wenatchee River Watershed especially waste water treatment plants (WWTPs). A regulatory strategy should be developed and implemented with WWTPs and Ecology to institute controls over time through NPDES permits that will reduce phosphorous discharges to surface and groundwaters. WWTPs to be addressed include the Lake Wenatchee, Stevens Pass, Leavenworth, Peshastin, and Cashmere waste water treatment plants. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
UpWenQUAL-4: Controls should be developed and implemented through new and existing regulatory permits, if needed, to reduce phosphorous inputs to surface and groundwaters from other Wenatchee Watershed point sources. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
UpWenQUAL-5: Groundwater discharges to the Wenatchee River, Icicle Creek, and their tributaries affects dissolved oxygen levels and nutrient concentrations. Groundwater is discharged to the river or creeks in some reaches, and is recharged in other reaches. In the Wenatchee basin, groundwater flow and BOD/nutrient concentrations may be elevated due to upland practices such as orchard irrigation and wastewater discharge to groundwater from lagoons and on-site septic systems. Assessments of groundwater contributions and sources of nutrients (phosphorous) should be conducted. Actions should be implemented based on the conclusions and recommendations of these studies to reduce inputs of phosphorous from these areas (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
UpWenQUAL-6: Non-point sources along the length of the river may be contributing BOD and nutrients. Address failing septic systems through actions identified in the Wenatchee Watershed Fecal Coliform TMDL. Continue site specific inspections and enforcement of regulations that restrict placement of on-site septic drain fields from areas deemed to have unsuitable soils. A study should be conducted to assess soils and onsite septic systems. Estimates should be made of the maximum number and density of on-site drain fields that the upper basin can accommodate and still meet the water quality standards, as was done in the Lake Chelan study (Patmont et al., 1989). Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)

TABLE 2-13

Upper Wenatchee River and Chiwaukum Creek Sub-watersheds Recommended Actions

Upper Wenatchee

Recommended Action	Responsible Entity
UpWenQUAL-7: Nutrients (phosphorous) can enter streams from storm water events. Work with Chelan County and municipalities to reduce storm water inputs, utilizing the Eastern Washington Storm water Manual or equivalent. Encourage the appropriate entities to include language that addresses storm water in comprehensive plans and ordinances. Work with developers. (See UpWenQUAL-16). Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
UpWenQUAL-8: Nutrients (phosphorous) can enter surface and ground water from residential yards and gardens, hobby farms, City and County Parks, business owned landscapes, etc. An education outreach plan should be developed and implemented to heighten awareness and reduce inputs from these sources. Policies and practices should be implemented in City and County Public Works departments. The County and cities should consider implementing a ban on the sale of high phosphate detergents, such as is being considered in Spokane. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
UpWenQUAL-9: Nutrients can enter streams from materials used to de-ice, clean, and maintain roads and parking lots. Animal waste from roads and parking lots can enter streams and increase nutrient loading. Work with the County, cities, businesses, and the WA State Department of Transportation to determine if road and parking lot maintenance practices may be contributing to nutrient loading and if necessary investigate ways to reduce nutrient inputs from these practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
UpWenQUAL-10: Nutrients (phosphorous) can be released to ground and surface waters from development practices, such as disruption of soils during conversions of orchard lands to housing. Actions should be conducted to prevent nutrients from entering ground and surface waters before, during and after construction. Work with developers to implement these actions. Encourage entities to include appropriate language in county and city comprehensive plans, growth management, and critical area ordinances. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
UpWenQUAL-11: Consider implementing actions recommended in the Wenatchee River Basin Temperature and Fecal Coliform TMDLs if the actions address problems that have been identified in the Upper Wenatchee Sub-watershed. Lowering temperatures and reducing nutrient inputs will improve pH and dissolved oxygen levels in the Wenatchee River Watershed (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
UpWenQUAL-12: Reserve load capacities for Biochemical Oxygen Demand (BOD) and nutrients should be established for the Upper Wenatchee River and Icicle Creek. Reserve load capacities are needed because there is no additional assimilative capacity for dissolved oxygen in the upper watershed during critical conditions. A point source regulatory strategy and nonpoint source BMP strategy should be developed to protect the reserve capacities and maintain water quality standards (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
UpWenQUAL-13: Encourage lining of earthen canals where appropriate. Work with irrigation districts to implement BMPs and adaptive management programs to minimize any nutrient loading that is not already being addressed (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)

TABLE 2-13

Upper Wenatchee River and Chiwaukum Creek Sub-watersheds Recommended Actions

Upper Wenatchee

Recommended Action	Responsible Entity
UpWenQUAL-14: Agricultural practices can contribute nutrients to ground and surface waters through crop watering practices, application of fertilizers, and soil disturbance activities. Work with the agricultural community to encourage practices that will reduce nutrient inputs to ground and surface waters while enhancing crop quality and yield. Examples include technical assistance through farm plans and Best Management Practices (BMPs). Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
UpWenQUAL-15: Funding for these projects should be sought through Department of Ecology Centennial and 319 grants and loans. Identify and access other funding sources through the Planning Unit and other entities. Ongoing adaptive management should be utilized to provide the best use of funds and environmental benefits (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
UpWenQUAL-16: Proper filtration of nutrients through land use practices can have a beneficial effect on nutrient reductions to ground and surface waters. Encourage implementation of wetlands, filter strips, riparian vegetation, bio-swales, drainage basins, pervious surfaces, etc. in residential, commercial, agricultural, industrial, development, and municipal practices. Conduct associated monitoring and adaptive management (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
UpWenQUAL-17: Identify and investigate any non point sources in tributaries that may be contributing to nutrient loads (WQTS, 2006a).	See Implementation Activities Table in WQTS (2006a)
Habitat Protection	
UpWenH-1: Increase habitat quantity in the Wenatchee River between Tumwater Canyon and Lake Wenatchee by restoring riparian habitat along the river and reconnecting side channels (where feasible) (UCSRB, 2005).	

Chiwaukum

Recommended Action	Responsible Entity
Habitat Protection	
ChiwaukumH-1: Increase connectivity along Skinney Creek (UCSRB, 2005).	
ChiwaukumH-2: Increase habitat diversity in Chiwaukum Creek along Tumwater Campground by restoring riparian vegetation, reconnecting the floodplain with the stream, and by increasing large woody debris within the channel (UCSRB, 2005).	

TABLE 2-14

Chiwawa River Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
Water Resource Management Strategy	
WRMS-4d: Review the gage location on the Chiwawa River as related to the impacts on flows from withdrawals.	
Habitat Protection	
ChiwawaH-1: Increase habitat quantity by restoring riparian habitat along the lower 4 miles of the Chiwawa River (UCSRB, 2005).	
ChiwawaH-2: Reduce sediment recruitment to the stream by improving road maintenance within the watershed (UCSRB, 2005).	
ChiwawaH-3: Improve fish passage in tributaries (UCSRB, 2005).	
ChiwawaH-4: Protect remaining floodplain and riparian habitat, particularly around Chikamin Flats (UCRTT, 2002).	

TABLE 2-15

Nason Creek Sub-watershed Recommended Actions

Recommended Action	Responsible Entity
Habitat Restoration/Enhancement	
NasonH-1: Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts) (UCSRB, 2005).	
NasonH-2: Increase habitat diversity and natural channel stability by increasing in-channel large wood complexes, restoring riparian habitat, and reconnecting side channels, wetlands, and floodplains to the stream (UCSRB, 2005).	
NasonH-3: Improve road maintenance to reduce fine sediment recruitment to the stream (UCSRB, 2005).	
NasonH-4: Reduce high water temperatures by reconnecting side channels and the floodplain and improving riparian habitat conditions (UCSRB, 2005).	
NasonH-5: Protect remaining floodplain and riparian habitat (UCRTT, 2002).	

TABLE 2-16

White River, Little Wenatchee River, and Lake Wenatchee Sub-watersheds Recommended Actions

White River

Recommended Action	Responsible Entity
Habitat Protection	
WhiteH-1: Increase habitat diversity within the lower 2 miles of the White River by reconnecting the floodplain and wetlands to the river (UCSRB, 2005).	
WhiteH-2: Protect stream channel, riparian, and floodplain functions. Focus on Panther Creek downstream to mouth (UCRTT, 2002).	
WhiteH-3: Protect shorelines along Lake Wenatchee near White River mouth (UCRTT, 2002).	

Little Wenatchee River

Recommended Action	Responsible Entity
Habitat Protection	
LitWenH-1: Reduce sediment recruitment to the stream by improving road maintenance within the watershed (UCSRB, 2005).	
LitWenH-2: Protect stream channel, riparian, and floodplain functions; focus on Little Wenatchee River falls downstream to mouth (UCRTT, 2002).	

Lake Wenatchee

Recommended Action	Responsible Entity
Habitat Protection	
LkWenH-1: Protect remaining near shore habitat, and develop a means to reduce impacts of bulkheads (UCRTT, 2002).	

TABLE 3-1

Estimated Current and Future Municipal and Domestic Water Use (5)

			2002							2025					
				ADD		MDD		Annual [7]			ADD		MDD		Annual [7]
Sub-Watershed	Notes	Type	Total Number of Connections or ERUs	mgd	cfs	mgd	cfs	AF/yr	Applied Annual Percent Increase [8]	Total Number of Connections or ERUs	mgd	cfs	mgd	cfs	AF/yr
Chiwaukum	1	Part-Time	28	0.003	0.004	0.007	0.010	3	1.18%	36	0.003	0.005	0.008	0.013	4
Chiwaukum	2	Full-Time	8	0.003	0.005	0.008	0.012	3	1.18%	10	0.004	0.006	0.010	0.015	4
Chiwaukum	3	Connections with Exempt Wells	7	0.003	0.004	0.007	0.010	3	1.18%	9	0.003	0.005	0.008	0.013	4
Chiwawa	1	Part-Time	3	0.000	0.000	0.001	0.001	0	1.18%	4	0.000	0.001	0.001	0.001	0
Chiwawa	2	Full-Time	298	0.113	0.175	0.283	0.438	127	1.18%	379	0.144	0.223	0.360	0.556	161
Chiwawa	3	Connections with Exempt Wells	86	0.033	0.051	0.082	0.126	37	1.18%	109	0.042	0.064	0.104	0.161	47
Chiwawa	10	Chiwawa Communities Association	309	0.055	0.085	0.138	0.213	62	1.18%	393	0.070	0.108	0.175	0.270	78
Chumstick	1	Part-Time	1	0.000	0.000	0.000	0.000	0	1.18%	1	0.000	0.000	0.000	0.000	0
Chumstick	2	Full-Time	141	0.054	0.083	0.134	0.207	60	1.18%	179	0.068	0.105	0.170	0.263	76
Chumstick	3	Connections with Exempt Wells	680	0.258	0.400	0.646	0.999	290	1.18%	864	0.328	0.508	0.821	1.270	368
Icicle	1	Part-Time	3	0.000	0.000	0.001	0.001	0	1.18%	4	0.000	0.001	0.001	0.001	0
Icicle	2	Full-Time	47	0.018	0.028	0.045	0.069	20	1.18%	60	0.023	0.035	0.057	0.088	25
Icicle	3	Connections with Exempt Wells	402	0.153	0.236	0.382	0.591	171	1.18%	511	0.194	0.300	0.485	0.751	218
Icicle	9	City of Leavenworth	2,028	1.011	1.564	2.528	3.911	1,133		4,714	2.195	3.396	5.693	8.490	2,461
Lake Wenatchee	1	Part-Time	257	0.024	0.038	0.061	0.094	27	1.18%	327	0.031	0.048	0.078	0.120	35
Lake Wenatchee	2	Full-Time	129	0.049	0.076	0.123	0.190	55	1.18%	164	0.062	0.096	0.156	0.241	70
Lake Wenatchee	3	Connections with Exempt Wells	336	0.128	0.198	0.319	0.494	143	1.18%	427	0.162	0.251	0.406	0.627	182
Little Wenatchee	3	Connections with Exempt Wells	1	0.000	0.001	0.001	0.002	0	1.18%	1	0.001	0.001	0.001	0.002	1
Lower Wenatchee	1	Part-Time	174	0.017	0.026	0.041	0.064	19	1.16%	220	0.021	0.032	0.052	0.081	23
Lower Wenatchee	2	Full-Time	488	0.185	0.287	0.464	0.717	208	1.16%	618	0.235	0.363	0.587	0.908	263
Lower Wenatchee	3	Connections with Exempt Wells	1,874	0.712	1.102	1.780	2.755	798	1.16%	2,373	0.902	1.395	2.255	3.488	1,011
Lower Wenatchee	4	City of Cashmere (36%)	819	0.364	0.563	0.910	1.408	408		1,000	0.447	0.691	0.763	1.728	501
Lower Wenatchee	10	Chelan County PUD NO. 1 - Dryden	64	0.017	0.026	0.043	0.066	19	1.16%	81	0.022	0.033	0.763	0.083	24
Lower Wenatchee	6	Peshastin Water District/Full-Time	243	0.092	0.143	0.231	0.357	104	6.09%	583	0.222	0.343	0.554	0.858	249
Lower Wenatchee	6	Peshastin Domestic Water Association/Part-Time	17	0.002	0.002	0.004	0.006	2	1.16%	22	0.002	0.003	0.005	0.008	2
Lower Wenatchee	6	Peshastin Domestic Water Association/Full-Time	56	0.021	0.033	0.053	0.082	24	1.16%	71	0.027	0.042	0.067	0.104	30
Mission	1	Part-Time	2	0.000	0.000	0.000	0.001	0	1.16%	3	0.000	0.000	0.001	0.001	0
Mission	2	Full-Time	144	0.055	0.085	0.137	0.212	61	1.16%	182	0.069	0.107	0.173	0.268	78
Mission	3	Connections with Exempt Wells	596	0.226	0.350	0.566	0.876	254	1.16%	754	0.287	0.444	0.717	1.109	321
Mission	4	City of Cashmere (64%)	1,455	0.647	1.001	1.618	2.503	725		1,777	0.794	1.229	1.357	3.072	890
Nason	1	Part-Time	193	0.018	0.028	0.046	0.071	21	1.18%	245	0.023	0.036	0.058	0.090	26
Nason	2	Full-Time	162	0.062	0.095	0.154	0.238	69	1.18%	206	0.078	0.121	0.196	0.303	88
Nason	3	Connections with Exempt Wells	148	0.056	0.087	0.141	0.218	63	1.18%	188	0.071	0.111	0.179	0.276	80
Peshastin	1	Part-Time	88	0.008	0.013	0.021	0.032	9	1.16%	111	0.011	0.016	0.026	0.041	12
Peshastin	2	Full-Time	49	0.019	0.029	0.047	0.072	21	1.16%	62	0.024	0.036	0.059	0.091	26
Peshastin	6	Valley Hi Community Club, Inc/Part-Time	24	0.002	0.004	0.006	0.009	3	1.16%	30	0.003	0.004	0.007	0.011	3
Peshastin	6	Valley Hi Community Club, Inc./Full-Time	105	0.040	0.062	0.100	0.154	45	1.16%	133	0.051	0.078	0.126	0.195	57
Peshastin	3	Connections with Exempt Wells	263	0.100	0.155	0.250	0.387	112	1.16%	333	0.127	0.196	0.316	0.490	142

TABLE 3-1

Estimated Current and Future Municipal and Domestic Water Use (5)

			2002							2025					
				ADD		MDD		Annual [7]			ADD		MDD		Annual [7]
Sub-Watershed	Notes	Type	Total Number of Connections or ERUs	mgd	cfs	mgd	cfs	AF/yr	Applied Annual Percent Increase [8]	Total Number of Connections or ERUs	mgd	cfs	mgd	cfs	AF/yr
Upper Wenatchee	1	Part-Time	62	0.006	0.009	0.015	0.023	7	1.18%	79	0.007	0.012	0.019	0.029	8
Upper Wenatchee	2	Full-Time	41	0.016	0.024	0.039	0.060	17	1.18%	52	0.020	0.031	0.049	0.077	22
Upper Wenatchee	3	Connections with Exempt Wells	330	0.125	0.194	0.314	0.485	141	1.18%	419	0.159	0.246	0.398	0.616	179
Upper Wenatchee	6	Ponderosa Community Club, Inc./Part-Time	457	0.043	0.067	0.109	0.168	49	1.18%	581	0.055	0.085	0.138	0.213	62
Upper Wenatchee	6	Ponderosa Community Club, Inc./Full-Time	125	0.048	0.073	0.119	0.184	53	1.18%	159	0.060	0.093	0.151	0.233	68
White	1	Part-Time	12	0.001	0.002	0.003	0.004	1	1.18%	15	0.001	0.002	0.004	0.006	2
White	2	Full-Time	25	0.010	0.015	0.024	0.037	11	1.18%	32	0.012	0.019	0.030	0.047	14
White	3	Connections with Exempt Wells	64	0.024	0.038	0.061	0.094	27	1.18%	81	0.031	0.048	0.077	0.120	35
WRIA 45 TOTAL			**12,844**	**4.82**	**7.46**	**12.05**	**18.65**	**5,405**		**18,602**	**7.092**	**10.972**	**17.662**	**27.431**	**7,950**

NOTES:
This table builds on data presented in the Phase 2 - Level 1 Technical Assessment (MWG, 2003)
ADD = Average Day Demand; MDD = Maximum Day Demand; mgd = million gallons per day; AF/yr = acre-feet per year; DOH - Department of Health; ERU - Equivalent Residential Unit or User
(1) Part Time Connections obtained from DOH Database request (Nicodemus, personal communication, 2005). Includes Group A and B purveyors and water use classifications of single family part-time, part-time residential units, and recreational services (e.g. camp sites, RV parks). ADD calculated as the number of connections times 95 gpd/connections (i.e. 380/4, assuming use occurs only half of the year and at half the rate of average residential water production). MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45).
(2) Full-Time connections obtained from DOH Database request (Nicodemus, personal communication, 2005) includes Group A and B purveyor and water use classifications of single family full-time, full-time residential units, multi-family residential buildings, commercial and industrial, industrial and any other non-residential services. ADD calculated as number of connections times 380 gpd/connection. MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45 as presented in the Technical Assessment). 380 GPD REPRESENT THE TOTAL USE (CONSUMPTIVE AND NONCONSUMPTIVE) AND IS THE AVERAGE WATER PRODUCTION FACTOR REPORTED FOR WRIA 45 (MWG, 2003). THIS USAGE RATE IS NOT A REQUIREMENT BUT AN ASSUMPTION TO ENABLE CALCULATION OF RESIDENTIAL WATER USE FOR THE WATERSHED PLAN.
(3) Exempt Well Connections are calculated as the Total Number of Residential Parcels minus the total group A and group B residential connections (full and part-time) from the DOH database (Nicodemus, personal communication, 2005). Parcel data obtained from Chelan County Assessors database (June 6, 2005). Assumes that one residential parcel is equivalent to one household unless otherwise noted. Parcel types with a primary or secondary land use of the following types were included: All other residential, Household 2-4 units (assume 3 units) , Mobile home parks/courts, Multi-units 5 or more (assume 5 units) , Single family units, Vacation and cabin, and Residential Hotels - Condominiums. Only parcels with an improvement value of $5,000 or greater are considered. Errors in the assessor's database are possible (Chelan County Planning, personal communication, 2005). The following assumptions are implicit in this calculation: data obtained from the Department of Health classifying Group A and Group B water systems do not include any systems served by exempt wells; Assumes all exempt well connections are full time (conservative). ADD calculated as number of connections times 380 gpd/connection (average water production factor for WRIA 45 as presented in the Technical Assessment). MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45 as presented in the Technical Assessment).
(4) Data obtained from Cashmere Comprehensive Water System Plan (3/2004), 2025 data is based on 2021 projections in WSP and an applied linear growth rate in water use between 2021 and 2025. Future use projections assume the "no conservation" scenario. The City of Cashmere is divided over two sub-watersheds, the Lower Wenatchee and the Mission, therefore the water use is divided across these two sub-watersheds with approximately 36% of the use in the Lower Wenatchee and 64% of the use in the Mission.
(5) Water Use reported in this table is for all water uses including residential indoor and outdoor, commercial, industrial, institutional, etc.
(6) Connections (part-time and full time) data obtained from DOH (Nicodemus, personal communication, 2005) from an in-house database. ADD calculated as number of connections times 380 gpd/connection (average water production factor for WRIA 45 as presented in the Technical Assessment). MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45 as presented in the Technical Assessment).
(7) Average day demand converted to AF/yr by multiplying by 1,121.
(8) Percent Increase based on Cheland County data (see Table A-2). The percent increase is applied to all residential and non-residential water use types (e.g. commercial, industrial).
(9) Data obtained from City of Leavenworth Water System Plan Final Draft, November, 2002 (Varela and Associates, 2002). Plan reported a 3.4% population growth rate (compounded). This rate was used to project 2020 population estimates in the WSP from 2020 to 2025. Current "Total Number of Connections or ERUs" represents estimate from the year 2000 (not 2002). City of Leavenworth water source obtained from Icicle Sub-watershed; however the majority of the population resides in the Chumstick Sub-watershed. Subsequent to the setting of sub-watershed boundaries it was determined that a large portion of the City of Leavenworth was located in the Wenatchee River drainage rather than the Chumstick drainage.
(10) Connections data obtained from DOH (Nicodemus, personal communication, 2005) from an in-house database. ADD obtained from Technical Assessment. MDD calculated as ADD times 2.5.
(11) In the Lake Wenatchee Sub-watershed, connections with exempt wells include many residences that are served directly from Lake Wenatchee. While the amount of water used is the same, the source is surface rather than groundwater.

Revision Notes:
7/20/05: The water usage for exempt well connections was incorrectly calculated using PT usage rates. All exempt well connections now use FT rates (380 mgd/connection)
8/1/2005: Changes to notes section.

TABLE 4-1

Summary of Water Management Recommendations for Wenatchee River at Monitor

Month	*Day*	*Management Flow (cfs)*	*Maximum Allocation**		*Reason*
			Cfs	*Ac-ft/day*	
January	1	1867	132	261	Chinook Intragravel Incubation
	31	1867	132	261	
February	1	1867	148	293	
	14	1867	148	293	
	15	2400	148	293	Steelhead Spawning
March	1	2400	192	380	
April	1	2400	360	713	
May	1	2400	710	1,406	
June	1	2400	813	1,610	
	15	2400	813	1,610	
	16	1600	813	1,610	Steelhead Intragravel Incubation
July	1	1600	373	739	
August	1	1600	117	232	
	15	1600	117	232	
	16	900	117	232	Steelhead Rearing
September	1	900	72	143	
	15	900	72	143	
	16	1338	0***	0	Summer Chinook Spawning/ 10% Exceedance Flow
	30	1338	0***	0	
October	1	1723	0***	0	Summer Chinook Spawning/ 10% Exceedance Flow
	15	1723	0***	0	
	16	2427	0***	0	Summer Chinook Spawning/ 10% Exceedance Flow
	31	2427	0***	0	
November	1	2800	139	275	Summer Chinook Spawning
	30	2800	139	275	
December	1	1867	130	257	Chinook Intragravel Incubation
	31	1867	130	257	

Notes: * = All Allocation subject to meeting instream flow. Maximum Allocation does not include reserve

***= No Allocation - Flows set lower than optimum

TABLE 4-2

Summary of Water Management Recommendations for Wenatchee River at Peshastin

Month	*Day*	*Management Flow (cfs)*	*Maximum Allocation**		*Reason*
			cfs	*Ac-ft/day*	
January	1	1933	113	224	Chinook Intragravel Incubation
	31	1933	113	224	
February	1	1933	111	220	
	14	1933	111	220	
	15	2800	111	220	Steelhead Spawning
March	1	2800	147	291	
April	1	2800	335	663	
May	1	2800	711	1,408	
June	1	2800	800	1,584	
	15	2800	800	1,584	Steelhead Spawning
	16	1933	800	1,584	Steelhead Intragravel Incubation
July	1	1933	376	744	
August	1	1933	122	242	
	15	1933	122	242	Steelhead Intragravel Incubation
	16	1400	122	242	Steelhead Rearing
	31	1400	122	242	
September	1	1311	0**	0**	Steelhead Rearing/ 10% Exceedance Flow
	15	1311	0**	0**	
	16	1311	0**	0**	Summer Chinook Spawning/ 10% Exceedance Flow
	30	1311	0**	0**	
October	1	1932	0**	0**	Summer Chinook Spawning/ 10% Exceedance Flow
	15	1932	0**	0**	
	16	2672	0**	0**	Summer Chinook Spawning/ 10% Exceedance Flow
	31	2672	0**	0**	
November	1	2900	128	253	Summer Chinook Spawning
	30	2900	128	253	
December	1	1933	122	242	Chinook Intragravel Incubation
	31	1933	122	242	

Notes: * = All Allocation subject to meeting instream flow. Maximum Allocation does not include reserve

**= No Allocation - Flows set lower than optimum

TABLE 4-3

Summary of Water Management Recommendations for Wenatchee River near Plain

Month	*Day*	*Management Flow (cfs)*	*Maximum Allocation**		*Reason*
			cfs	*Ac-ft/day*	
January	1	550	82	162	Existing 1983 Rule for Mgt. Flow
February	1	550	78	154	
March	1	550	96	190	
	15	700	96	190	
April	1	910	243	481	
	15	1150	243	481	
May	1	1500	525	1,040	
	15	2000	525	1,040	
June	1	2500	604	1,196	
	15	2000	604	1,196	
July	1	1500	296	586	
	15	1200	296	586	
August	1	880	102	202	
	15	700	102	202	
September	1	660	0**	0	
	15	620	0**	0	
	16	620	0**	0	
	30	620	0**	0	
October	1	580	0**	0	
	31	520	0**	0	
November	1	550	95	188	
	15	550	95	188	
December	1	550	92	182	
	15	550	92	182	

Notes: * = All Allocation subject to meeting instream flow. Maximum Allocation does not include reserve

**= No Allocation due to 0 cfs allocation at Wenatchee R @ Peshastin or Monitor control points

TABLE 4-4

Summary of Water Management Recommendations for Mission Creek near Cashmere

Month	*Day*	*1983 Flow*	*Management Flow (cfs)*	*Maximum Allocation**		*Reason*
				Cfs	*Ac-ft/day*	
January	1	6	4.7	0.6	1.1	Steelhead Rearing
February	1	6	4.7	1.2	2.5	
	14	6	4.7	1.2	2.5	
	15	6	24.2	1.2	2.5	Steelhead Spawning
March	1	6	24.2	1.4	2.8	Steelhead Spawning
	15	11	24.2	1.4	2.8	
April	1	22	24.2	2.7	5.3	Steelhead Spawning
	15	40	24.2	2.7	5.3	
May	1	40	24.2	3.1	6.2	Steelhead Spawning
	31	40	24.2	3.1	6.2	
June	1	28	24.2	1.9	3.8	Steelhead Spawning
	15	20	24.2	1.9	3.8	
	16	20	16.2	1.9	3.8	Steelhead Incubation
	30	20	16.2	1.9	3.8	
July	1	14	11	0***	0	Steelhead Incubation/10% Exceedance Flow
	15	10	11	0***	0	
	31	10	11	0***	0	
August	1	7	6	0***	0	
	15	5	6	0***	0	Steelhead Incubation/10% Exceedance Flow
	16	5	4.7	0.3	0.6	Steelhead Rearing
	31	5	4.7	0.3	0.6	
September	1	4	4.7	0**	0	Steelhead Rearing
	15	4	4.7	0**	0	
	16	4	4.7	0**	0	
	30	4	4.7	0**	0	
October	1	4	4.7	0**	0	Steelhead Rearing
	31	5	4.7	0**	0	
November	1	6	4.7	0.4	0.9	Steelhead Rearing
	30	6	4.7	0.4	0.9	
December	1	6	4.7	0.4	0.9	Steelhead Rearing
	31	6	4.7	0.4	0.9	

Notes: * = All Allocation subject to meeting instream flow. Maximum Allocation does not include reserve
** = No Allocation due to 0 cfs allocation at Wenatchee R @ Peshastin or Monitor control points
*** = No Allocation – Mission flows set lower than optimum

TABLE 4-5

Summary of Water Management Recommendations for Peshastin Creek at Green Bridge

Month	*Day*	*Management Flow (cfs)*	*Maximum Allocation**		*Reason*
			Cfs	*Ac-ft/day*	
January	1	53	6	12	Chinook Intragravel Incubation
	31	53	6	12	
February	1	53	6	12	
	14	53	6	12	
	15	120	6	12	Steelhead Spawning
March	1	120	7	14	
April	1	120	16	32	
May	1	120	38	75	
June	1	120	44	87	
	15	120	44	87	Steelhead Spawning
	16	110	44	87	Steelhead Rearing
July	1	110	20	40	
August	1	80	0***	0	Spring Chinook Spawning
	15	80	0***	0	
	16	80	0***	0	
September	1	80	0***	0	
	15	80	0***	0	
	16	80	0**	0	
	30	80	0**	0	Spring Chinook Spawning
October	1	53	0**	0	Chinook Intragravel Incubation
	15	53	0**	0	
	16	53	0**	0	
	31	53	0**	0	
November	1	53	7	14	
	30	53	7	14	
December	1	53	7	14	
	31	53	7	14	Chinook Intragravel Incubation

Notes: * = All Allocation subject to meeting instream flow. Maximum Allocation does not include reserve

** = No Allocation due to 0 cfs allocation at Wenatchee R @ Peshastin or Monitor control points

*** = No allocation due to seasonal closure on Peshastin Creek (August 1 – October 15)

TABLE 4-6

Summary of Water Management Recommendations for Icicle Creek near Leavenworth

Month	*Day*	*Management Flow (cfs)*	*Maximum Allocation**		*Reason*
			Cfs	*Ac-ft/day*	
January	1	267	21	42	Chinook Intragravel Incubation
	31	267	21	42	
February	1	267	20	40	
	14	267	20	40	
	15	566	0***	0	Steelhead Spawning/10% Exceedance Flow
	28	566	0***	0	
March	1	518	0***	0	
	15	518	0***	0	Steelhead Spawning/10% Exceedance Flow
April	1	650	59	117	Steelhead Spawning
May	1	650	149	295	
June	1	650	175	347	
	15	650	175	347	Steelhead Spawning
	16	550	175	347	Steelhead Rearing
July	1	550	76	150	
	31	550	76	150	Steelhead Rearing
August	1	400	28	55	Spring Chinook Spawning
	15	400	28	55	
	16	343	0***	0	Spring Chinook Spawning/ 10% Exceedance Flow
	31	343	0***	0	
September	1	275	0***	0	
October	1	267	0**	0	Chinook Intragravel Incubation
	31	267	0**	0	
November	1	267	23	46	
	30	267	23	46	
December	1	267	25	50	Chinook Intragravel Incubation
	31	267	25	50	

Notes: * = All Allocation subject to meeting instream flow. Maximum Allocation does not include reserve

** = No Allocation due to 0 cfs allocation at Wenatchee R @ Peshastin or Monitor control points

*** = No Allocation – Icicle flows set lower than optimum

TABLE 4-7

Summary of Water Management Recommendations for Nason Creek near Plain

Month	*Day*	*Management Flow (cfs)*	*Maximum Allocation**		*Reason*
			cfs	*Ac-ft/day*	
January	1	120	13	26	Chinook Intragravel Incubation
	31	120	13	26	
February	1	120	12	24	
	14	120	12	24	
	15	160	12	24	Steelhead Spawning
March	1	160	15	30	
	15	160	15	30	
	16	160	15	30	
April	1	160	44	87	
May	1	160	99	196	
June	1	160	114	226	
	15	160	114	226	
	16	210	114	226	Steelhead Rearing
July	1	210	54	107	
August	1	180	17	34	Spring Chinook Spawning
	15	180	17	34	
	16	180	17	34	
September	1	165	0***	0	Spring Chinook Spawning/ 10% Exceedance Flow
	15	165	0***	0	
	16	165	0***	0	
	30	165	0***	0	
October	1	120	0**	0	Chinook Intragravel Incubation
	15	120	0**	0	
	16	120	0**	0	
	31	120	0**	0	
November	1	120	15	30	
	30	120	15	30	
December	1	120	15	30	Chinook Intragravel Incubation
	31	120	15	30	

Notes: * = All Allocation subject to meeting instream flow. Maximum Allocation does not include reserve

**= No Allocation due to 0 cfs allocation at Wenatchee R @ Peshastin or Monitor control points

***= No Allocation – Nason flows set lower than optimum

TABLE 4-8

Summary of Water Management Recommendations for Chiwawa River near Plain

Month	*Day*	*Management Flow (cfs)*	*Maximum Allocation**		*Reason*
			Cfs	*Ac-ft/day*	
January	1	267	12	24	Chinook Intragravel Incubation
	31	267	12	24	
February	1	267	12	24	
	14	267	12	24	
	15	277	0***	0	Steelhead Spawning/ 10% Exceedance Flow
	28	277	0***	0	
March	1	277	0***	0	
	15	277	0***	0	Steelhead Spawning/ 10% Exceedance Flow
	16	475	16	32	Steelhead Spawning
April	1	475	58	115	
May	1	475	139	275	
June	1	475	147	291	
	15	475	147	291	Steelhead Spawning
	16	375	147	291	Steelhead Rearing
July	1	375	71	141	
	31	375	71	141	Steelhead Rearing
August	1	400	24	48	Spring Chinook Spawning
	15	400	24	48	
	16	369	0***	0	Spring Chinook Spawning/ 10% Exceedance Flow
	31	369	0***	0	
September	1	270	0***	0	
	15	270	0***	0	
	16	270	0***	0	
	30	270	0***	0	Spring Chinook Spawning/ 10% Exceedance Flow
October	1	267	0**	0	Chinook Intragravel Incubation
	31	267	0**	0	
November	1	267	16	32	
	30	267	16	32	
December	1	267	14	28	Chinook Intragravel Incubation
	31	267	14	28	

Notes: * **=** All Allocation subject to meeting instream flow. Maximum Allocation does not include reserve

**= No Allocation due to 0 cfs allocation at Wenatchee R @ Peshastin or Monitor control points

***= No Allocation – Chiwawa flows set lower than optimum

TABLE 4-10

WRIA 45 Water Reservation and Associated Habitat Loss

	Reserve (CFS)	Habitat Loss [a]	Max Reserve (CFS)=1% Habitat Loss [e]	Notes
Wenatchee Watershed	4.0	1.5%		Upper limit for WRIA 45. Habitat loss measured at Monitor gage
Lower Wenatchee Watershed	3.0 – 3.5	n.a.		Sum of all water use below Tumwater Canyon
Mission Creek	0.12[b]	n.a	n.a	
Peshastin Creek	0.1	0.3%	0.4	
Icicle Creek	0.1[d]	0.09%	1.2	
Chumstick Creek	0.13[c]	n.a	n.a	
Upper Wenatchee Watershed	0.5 – 1.0	n.a		Sum of all water use above Tumwater Canyon
Chiwawa River	0.1	0.19%	0.5	
Nason Creek	0.1	0.6%	0.16	
Lake Wenatchee	0.1	n.a	n.a	
White/Little Wenatchee	0.05	n.a	n.a	Sum of White, Little Wenatchee, and Chiwaukum = 0.1 cfs
Chiwaukum Creek	0.01	n.a	n.a	

Notes:

a. Estimate of percent decrease in salmon or steelhead habitat that would occur during low flows for the specified reservation withdrawal.

b. Mission Creek Reserve Limited to 0.03 cfs for 2 years following rule adoption or until alternate sources are identified.

c. Chumstick Cr. Reserve Limited to 0.043 cfs for 3 years following rule adoption or until alternate sources are identified.

d. Icicle Creek Reserve Limited to 0.1 cfs until flow restoration efforts between diversion & hatchery return are addressed.

e. The withdrawal (in cfs) that would result in a 1% habitat loss in a particular tributary. Where specified, this withdrawal is considered the upper limit of the reservation.

n.a. = not available

Single Domestic, Group Domestic and Municipal Use -- Projections for a WRIA 45 Water Reservation

Notes	Sub-Watershed	Type of User	No. New Connections or ERUs (2002 - 2025)	New ADD (cfs) (2002-2025)
3	Chiwaukum	Connections with Exempt Wells	2	0.001
2	Chiwaukum	Full-Time	2	0.001
1	Chiwaukum	Part-Time	8	0.001
		Sub-Watershed Sub-Total (cfs)		0.003
10	Chiwawa	*Chiwawa Communities Association*	84	0.023
3	Chiwawa	Connections with Exempt Wells	23	0.014
2	Chiwawa	Full-Time	81	0.047
1	Chiwawa	Part-Time	1	0.000
		Sub-Watershed Sub-Total (cfs)		0.084
3	Chumstick	Connections with Exempt Wells	184	0.108
2	Chumstick	Full-Time	38	0.022
1	Chumstick	Part-Time	0	0.000
		Sub-Watershed Sub-Total (cfs)		0.131
9	Icicle	*City of Leavenworth (Leavenworth Water System Plan, Varela, assumes 2.5 people per residence)*	2,686	1.832
3	Icicle	Connections with Exempt Wells	109	0.064
2	Icicle	Full-Time	13	0.007
1	Icicle	Part-Time	1	0.000
		Sub-Watershed Sub-Total (cfs)		1.903
3	Lake Wenatchee	Withdrawals	91	0.053
2	Lake Wenatchee	Full-Time	35	0.021
1	Lake Wenatchee	Part-Time	70	0.010
		Sub-Watershed Sub-Total (cfs)		0.084
3	Little Wenatchee	Connections with Exempt Wells	0	0.000
		Sub-Watershed Sub-Total (cfs)		0.000
	Lower Wenatchee	*Chelan County PUD NO. 1 - Dryden*	17	0.007
4	Lower Wenatchee	*City of Cashmere (36%)*	181	0.128
3	Lower Wenatchee	Connections with Exempt Wells	499	0.293
2	Lower Wenatchee	Full-Time	130	0.076
1	Lower Wenatchee	Part-Time	46	0.007
6	Lower Wenatchee	*Peshastin Domestic Water Association/Full-Time*	15	0.009
6	Lower Wenatchee	*Peshastin Domestic Water Association/Part-Time*	5	0.001
6	Lower Wenatchee	*Peshastin Water District/Full-Time*	340	0.200
		Sub-Watershed Sub-Total (cfs)		0.721
4	Mission	*City of Cashmere (64%)*	322	0.228
3	Mission	Connections with Exempt Wells	159	0.093
2	Mission	Full-Time	38	0.023
1	Mission	Part-Time	1	0.000
		Sub-Watershed Sub-Total (cfs)		0.344
3	Nason	Connections with Exempt Wells	40	0.024
2	Nason	Full-Time	44	0.026
1	Nason	Part-Time	52	0.008
		Sub-Watershed Sub-Total (cfs)		0.057
3	Peshastin	Connections with Exempt Wells	70	0.041
2	Peshastin	Full-Time	13	0.008
1	Peshastin	Part-Time	23	0.003
6	Peshastin	*Valley Hi Community Club, Inc./Full-Time*	28	0.016
6	Peshastin	*Valley Hi Community Club, Inc/Part-Time*	6	0.001
		Sub-Watershed Sub-Total (cfs)		0.070
	Upper Wenatchee	Connections with Exempt Wells	89	0.052
2	Upper Wenatchee	Full-Time	11	0.007
1	Upper Wenatchee	Part-Time	17	0.002
6	Upper Wenatchee	*Ponderosa Community Club, Inc./Full-Time*	34	0.020
6	Upper Wenatchee	*Ponderosa Community Club, Inc./Part-Time*	124	0.018
		Sub-Watershed Sub-Total (cfs)		0.099
3	White	Connections with Exempt Wells	17	0.010
2	White	Full-Time	7	0.004
1	White	Part-Time	3	0.000
		Sub-Watershed Sub-Total (cfs)		0.015
	Total		**5758**	**3.51**
	Total exempt well ADD =		0.755	

WATER USE ASSUMPTIONS:

This table builds on data presented in the Phase 2 - Level 1 Technical Assessment (MWG, 2003)

ADD = Average Day Demand; MDD = Maximum Day Demand; mgd = million gallons per day; AF/yr = acre-feet per year; DOH - Department of Health; ERU = Equivalent Residential Unit or User

(assumptions continued on next page)

Single Domestic, Group Domestic and Municipal Use -- Projections for a WRIA 45 Water Reservation

(1) Part Time Connections obtained from DOH Database request (Nicodemus, personal communication, 2005). Includes Group A and B purveyors and water use classifications of single family part-time, part-time residential units, and recreational services (e.g. camp sites, RV parks). ADD calculated as the number of connections times 95 gpd/connections (i.e. 380/4, assuming use occurs only half of the year and at half the rate of average residentia water production). MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45).

(2) Full-Time connections obtained from DOH Database request (Nicodemus, personal communication, 2005) includes Group A and B purveyor and water use classifications of single family full-time, full-time residential units, multi-family residential buildings, and other non-residential services (institutional, industrial, commercial, or agricultural). ADD calculated as number of connections times 380 gpd/connection (average water production factor for WRIA 45 as presented in the Technical Assessment). MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45 as presented in the Technical Assessment).

(3) Exempt Well Connections are calculated as the Total Number of Residential Parcels minus the total group A and group B residential connections (full and part-time) from the DOH database (Nicodemus, personal communication, 2005). Parcel data obtained from Chelan County Assessors database (June 6, 2005). Assume that one residential parcel is equivalent to one household unless otherwise noted. Parcel types included: All other residential, Household 2-4 units (assume 3 units) , Mobile home parks/courts, Multi-units 5 or more (assume 5 units) , Single family units, Vacation and cabin, and Residential Hotels - Condominiums. Only parcels with an improvement value of $5,000 or greater are considered. Primary and Secondary land use types are identified in the Assessor's database. Errors in the assessor's database are possible (Chelan County Planning, personal communication, 2005). The following assumptions are implicit in this calculation: data obtained from the Department of Health classifying Group A and Group B water systems do not include any systems served by exempt wells;
Assumes all exempt well connections are full time (conservative). ADD calculated as number of connections times 380 gpd/connection (average water production factor for WRIA 45 as presented in the Technical Assessment). MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45 as presented in the Technical Assessment).

(4) Data obtained from Cashmere Comprehensive Water System Plan (3/2004), 2025 data is based on 2021 projections in WSP and an applied linear growth rate in water use between 2021 and 2025. Future use projections assume the "no conservation" scenario. The City of Cashmere is divided over two sub-watersheds, the Lower Wenatchee and the Mission, therefore the water use is divided across these two sub-watersheds with approximately 36% of the use in the Lower Wenatchee and 64% of the use in the Mission.

(5) ASSUMED WATER USE OF 380 GPD PER HOUSEHOLD (OR ERU) FOR FULL TIME USE IS NOT A REQUIREMENT BUT AN ASSUMPTION FOR USE TO ENABLE CALCULATION OF RESIDENTIAL WATER USE FOR THE WATERSHED PLAN. 380 GPD IS TOTAL USE (CONSUMPTIVE AND NONCONSUMPTIVE) AND IS THE AVERAGE WATER PRODUCTION FACTOR REPORTED FOR WRIA 45 (MWG, 2003).

(6) Connections (part-time and full time) data obtained from DOH (Nicodemus, personal communication, 2005) from an in-house database. ADD calculated as number of connections times 380/gpd/connection, MDD calculated as ADD times 2.5.

(7) Average day demand converted to AF/yr by multiplying by 1,121.

(8) Assumes that the growth rate for all water use types are the same.

(9) Data obtained from City of Leavenworth Water System Plan Final Draft, November, 2002 (Varela and Associates, 2002). Plan reported a 3.4% population growth rate. This rate was used to project 2020 population estimates in the WSP from 2020 to 2025. Current "Total Number of Connections" represents estimate from the year 2000 (not 2002). City of Leavenworth water source obtained from Icicle Sub-watershed however the majority of the population resides in the Chumstick Sub-watershed.

(10) Connections data obtained from DOH (Nicodemus, personal communication, 2005) from an in-house database. ADD obtained from Technical Assessment. MDD calculated as ADD times 2.5.

Maximum Allocation for Wenatchee River and Tributaries Subject to Instream Flows

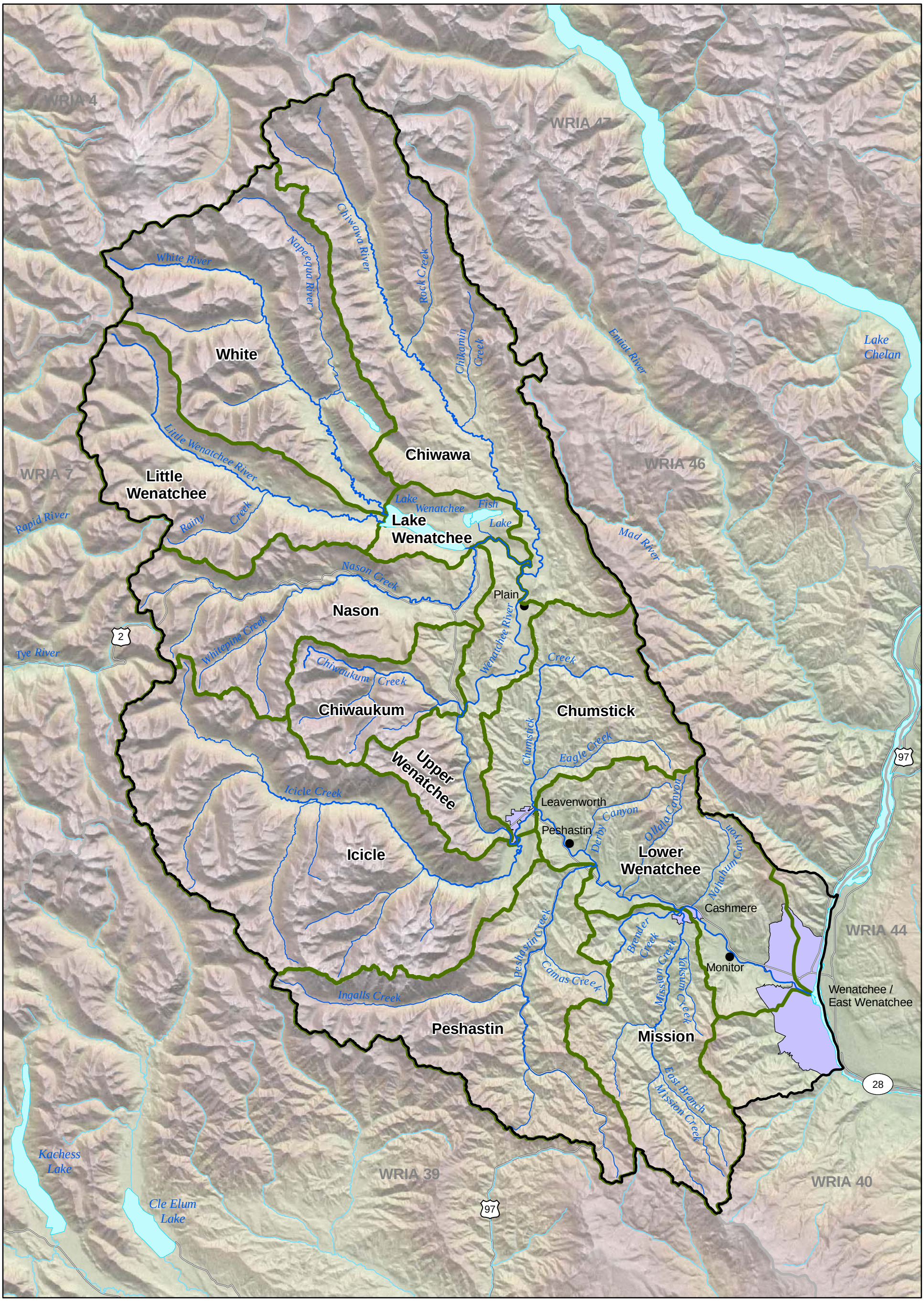
	WENATCHEE R @ MONITOR			WENATCHEE R @ PESHASTIN			WENATCHEE RIVER @ PLAIN			CHIWAWA R NEAR PLAIN			NASON CREEK			PESHASTIN CREEK			ICICLE CREEK			MISSION CREEK		
	Avg 50% Exceedance (cfs)	Max Allocation		Avg 50% Exceedance (cfs)	Max Allocation		Avg 50% Exceedance (cfs)	Max Allocation		Avg 50% Exceedance (cfs)	Max Allocation		Avg 50% Exceedance (cfs)	Max Allocation		Avg 50% Exceedance (cfs)	Max Allocation		Avg 50% Exceedance (cfs)	Max Allocation		Avg 50% Exceedance (cfs)	Max Allocation	
		cfs	Acre-ft/day		cfs	Acre-ft/day		cfs	Acre-ft/day		cfs	Acre-ft/day		cfs	Acre-ft/day		cfs	Acre-ft/day		cfs	Acre-ft/day		cfs	Acre-ft/day
October	838	0[a]	0[a]	796	0[a]	0[a]	626	0[b]	0[b]	132	0[b]	0[b]	88	0[b]	0[b]	52	0[b,c]	0[b,c]	165	0[b]	0[b]	3	0[b]	0[b]
November	1394	139	275	1280	128	253	953	95	188	158	16	32	153	15	30	69	7	14	235	23	46	4	0.4	0.9
December	1297	130	257	1219	122	242	924	92	182	138	14	28	148	15	30	73	7	14	249	25	50	4	0.4	0.9
January	1321	132	261	1132	113	224	816	82	162	125	12	24	126	13	26	64	6	12	215	21	42	6	0.6	1.1
February 1-14	1476	148	293	1113	111	220	778	78	154	118	12	24	119	12	24	60	6	12	199	20	40	12	1.2	2.5
February 15-28	1476	148	293	1113	111	220	778	78	154	118	0[a]	0[a]	119	12	24	60	6	12	193	0[a]	0[a]	12	1.2	2.5
March 1-15	1923	192	380	1472	147	291	964	96	190	145	0[a]	0[a]	154	15	30	69	7	14	238	0[a]	0[a]	14	1.4	2.8
March 16-31	1923	192	380	1472	147	291	964	96	190	164	16	32	154	15	30	69	7	14	238	0[a]	0[a]	14	1.4	2.8
April	3601	360	713	3348	335	663	2425	243	481	576	58	115	437	44	87	156	16	32	590	59	117	27	2.7	5.3
May	7101	710	1,406	7109	711	1,408	5249	525	1,040	1386	139	275	988	99	196	378	38	75	1490	149	295	31	3.1	6.2
June	8130	813	1,610	7999	800	1,584	6037	604	1,196	1470	147	291	1141	114	226	443	44	87	1752	175	347	19	1.9	3.8
July	3725	373	739	3759	376	744	2959	296	586	709	71	141	542	54	107	198	20	40	762	76	150	7	0[a]	0[a]
August 1-15	1175	117	232	1223	122	242	1022	102	202	236	24	48	165	17	34	67	0[c]	0[c]	279	28	55	3	0[a]	0[a]
August 16-31	1175	117	232	1223	122	242	1022	102	202	197	0[a]	0[a]	165	17	34	67	0[c]	0[c]	179	0[a]	0[a]	3	0.3	0.6
September 1-15	722	72	143	719	0[a]	0[a]	596	0[b]	0[b]	145	0[a]	0[a]	82	0[a]	0[a]	44	0[c]	0[c]	145	0[a]	0[a]	2	0[b]	0[b]
September 16-30	969	0[a]	0[a]	719	0[a]	0[a]	596	0[b]	0[b]	145	0[a]	0[a]	82	0[a]	0[a]	44	0[b,c]	0[b,c]	145	0[a]	0[a]	2	0[b]	0[b]

Notes: [a] = No Allocation - Flows set lower than optimum

[b] = No Allocation due to 0 cfs allocation at Wenatchee R @ Peshastin or Monitor control points

[c] = No allocation due to seasonal closure on Peshastin Creek (August 1 - October 15)

All Allocations are subject to Instream Flow



LEGEND

- WRIA 45 Boundary
- WRIA Boundary
- Sub-Watershed Boundary
- Major Road
- Waterbody
- Watercourse
- Urban Area

0 5

Scale in Miles

Map Projection:
Washington State Plane,
North Zone, NAD 83, Feet

Source: Chelan County, USGS, WAGDA, WSDOE, WSDOT

N

This figure was originally produced in color. Reproduction in black and white may result in loss of information

WENATCHEE WATERSHED OVERVIEW

Chelan/WRIA 45 Watershed Plan/WA

Drawn: KBD	Revison: 4	Date: Apr. 26, 2006	Figure: 1-1

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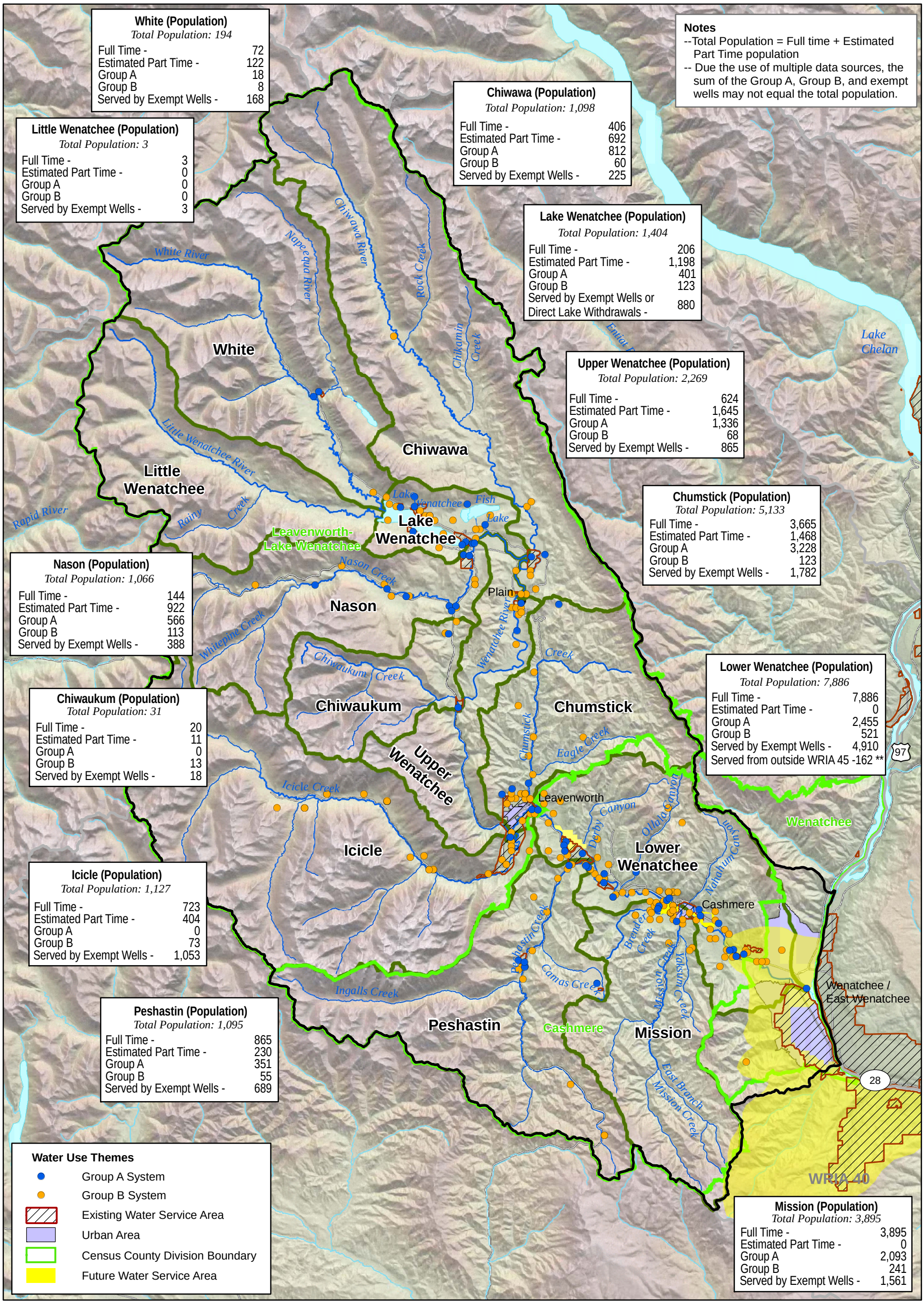
Golder Associates



LEGEND

- WRIA 45 Boundary
- WRIA Boundary
- Sub-Watershed Boundary
- Major Road
- Waterbody
- Watercourse

** If full build-out of Chelan PUD service area - population served from outside of WRIA 45 in 2025 is 1,841.

0 5

Scale in Miles

Map Projection:
Washington State Plane,
North Zone, NAD 83, Feet
Source: Chelan County Assessor (6/6/05),
USGS, WAGDA, WSDOE, WSDOT,
WDOH (2003, 2005)

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WRIA 45 POPULATION BY WATER USE TYPE

Chelan/WRIA 45 Watershed Plan/WA

Drawn: AMN	Revision: 9	Date: Apr. 26, 2006	Figure: 3-1

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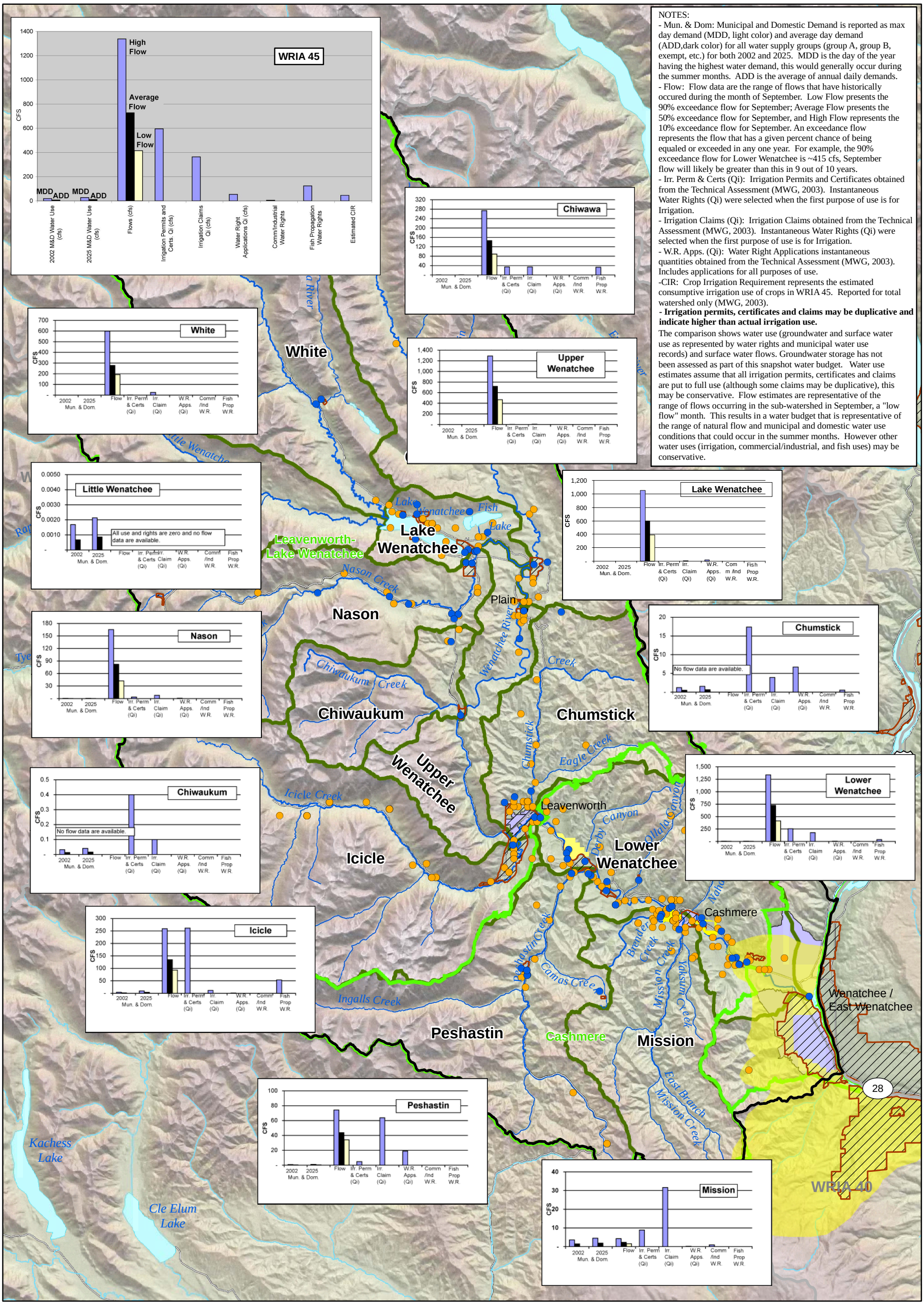
Golder Associates



NOTES:
- Mun. & Dom: Municipal and Domestic Demand is reported as max day demand (MDD, light color) and average day demand (ADD,dark color) for all water supply groups (group A, group B, exempt, etc.) for both 2002 and 2025. MDD is the day of the year having the highest water demand, this would generally occur during the summer months. ADD is the average of annual daily demands.
- Flow: Flow data are the range of flows that have historically occured during the month of September. Low Flow presents the 90% exceedance flow for September; Average Flow presents the 50% exceedance flow for September, and High Flow represents the 10% exceedance flow for September. An exceedance flow represents the flow that has a given percent chance of being equaled or exceeded in any one year. For example, the 90% exceedance flow for Lower Wenatchee is ~415 cfs, September flow will likely be greater than this in 9 out of 10 years.
- Irr. Perm & Certs (Qi): Irrigation Permits and Certificates obtained from the Technical Assessment (MWG, 2003). Instantaneous Water Rights (Qi) were selected when the first purpose of use is for Irrigation.
- Irrigation Claims (Qi): Irrigation Claims obtained from the Technical Assessment (MWG, 2003). Instantaneous Water Rights (Qi) were selected when the first purpose of use is for Irrigation.
- W.R. Apps. (Qi): Water Right Applications instantaneous quantities obtained from the Technical Assessment (MWG, 2003). Includes applications for all purposes of use.
-CIR: Crop Irrigation Requirement represents the estimated consumptive irrigation use of crops in WRIA 45. Reported for total watershed only (MWG, 2003).
- Irrigation permits, certificates and claims may be duplicative and indicate higher than actual irrigation use.

The comparison shows water use (groundwater and surface water use as represented by water rights and municipal water use records) and surface water flows. Groundwater storage has not been assessed as part of this snapshot water budget. Water use estimates assume that all irrigation permits, certificates and claims are put to full use (although some claims may be duplicative), this may be conservative. Flow estimates are representative of the range of flows occurring in the sub-watershed in September, a "low flow" month. This results in a water budget that is representative of the range of natural flow and municipal and domestic water use conditions that could occur in the summer months. However other water uses (irrigation, commercial/industrial, and fish uses) may be conservative.

LEGEND

- WRIA 45 Boundary
- Sub-Watershed Boundary
- WRIA Boundary
- Census County Division Boundary
- Future Water Service Area
- Major Road
- Waterbody
- Existing Water Service Area
- Urban Area
- Group A Well
- Group B Well

0 5
Scale in Miles

Map Projection:
Washington State Plane,
North Zone, NAD 83, Feet
Source: Chelan County Assessor (6/6/05), USGS, WAGDA, WSDOE, WSDOT, Golder Associates, WDOH (2003, 2005)

N

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WRIA 45 Water Budget

Chelan/WRIA 45 Watershed Plan/WA

Drawn: KBD	Revision: 9	Date: Apr. 26, 2006	Figure: 3-2

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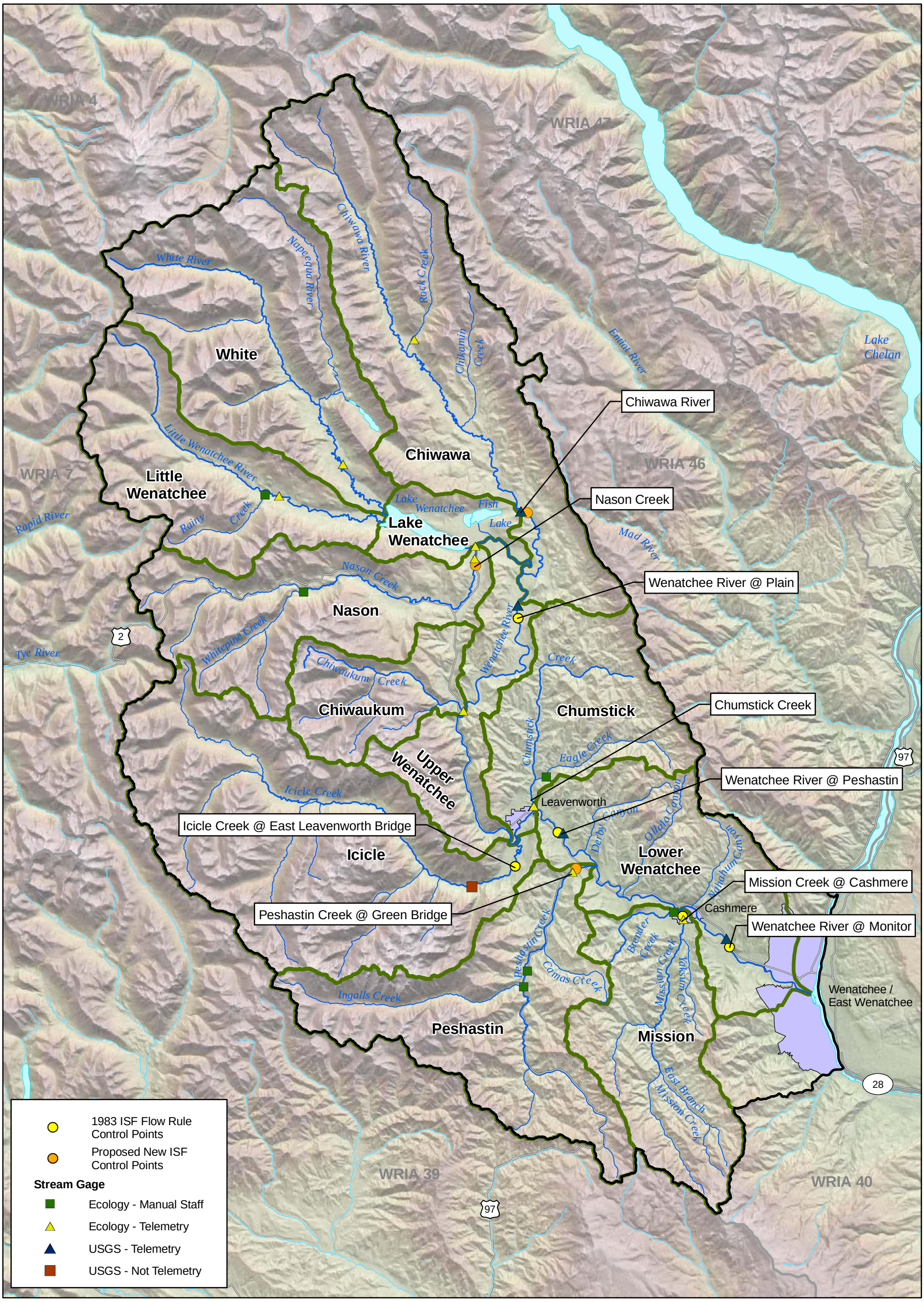
Golder Associates



LEGEND

- WRIA 45 Boundary
- WRIA Boundary
- Sub-Watershed Boundary
- Major Road
- Waterbody
- Watercourse
- Urban Area

0 5
Scale in Miles

Map Projection:
Washington State Plane,
North Zone, NAD 83, Feet

Source: Chelan County, USGS, WAGDA, WSDOE, WSDOT

N

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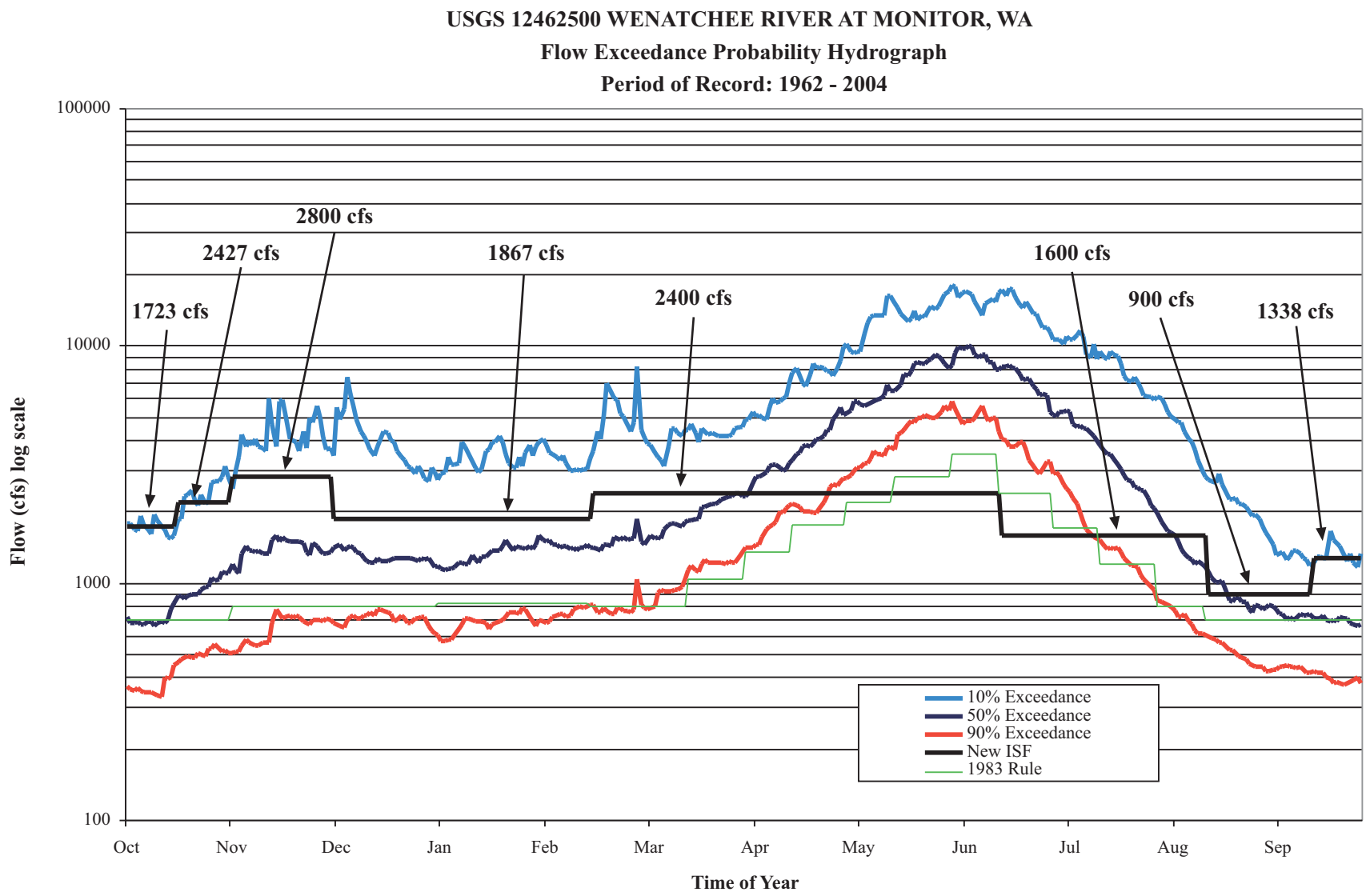
CURRENT AND PROPOSED ISF CONTROL POINTS - WRIA 45

Chelan/WRIA 45 Watershed Plan/WA

Drawn: KBD	Revison: 5	Date: Apr. 26, 2006	Figure: 4-1

0431284203F2R05.mxd

Golder Associates



Source: EES Consulting
Washington Department of Ecology
USGS

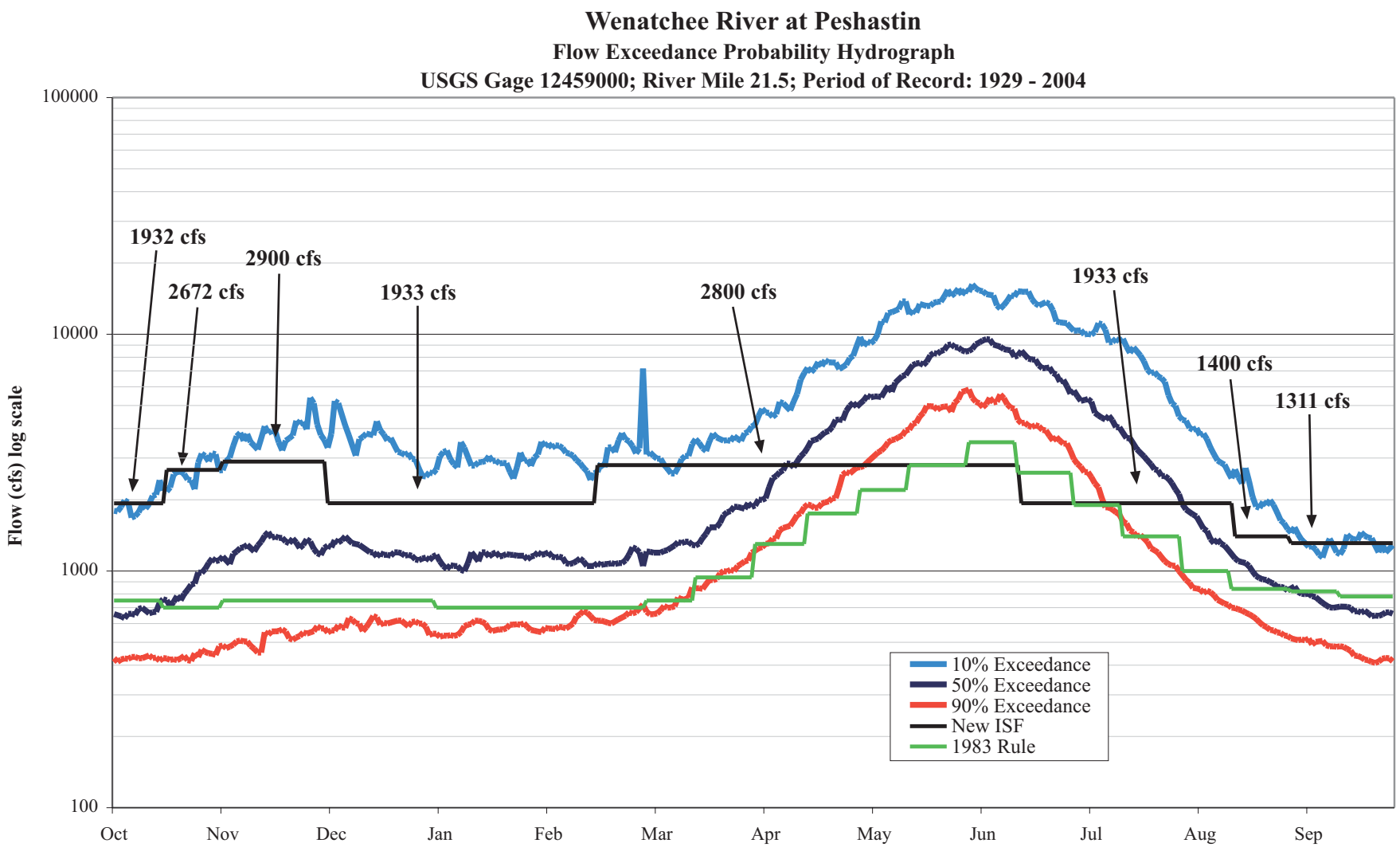
FIGURE **4-2**

PROPOSED MANAGEMENT FLOWS - WENATCHEE RIVER AT MONITOR

CHELAN/WRIA 45 WATERSHED PLAN/WA

0431284203fg02.fh11 | Mod: 03/29/06 | EL

Golder Associates



Source: EES Consulting
Washington Department of Ecology
USGS

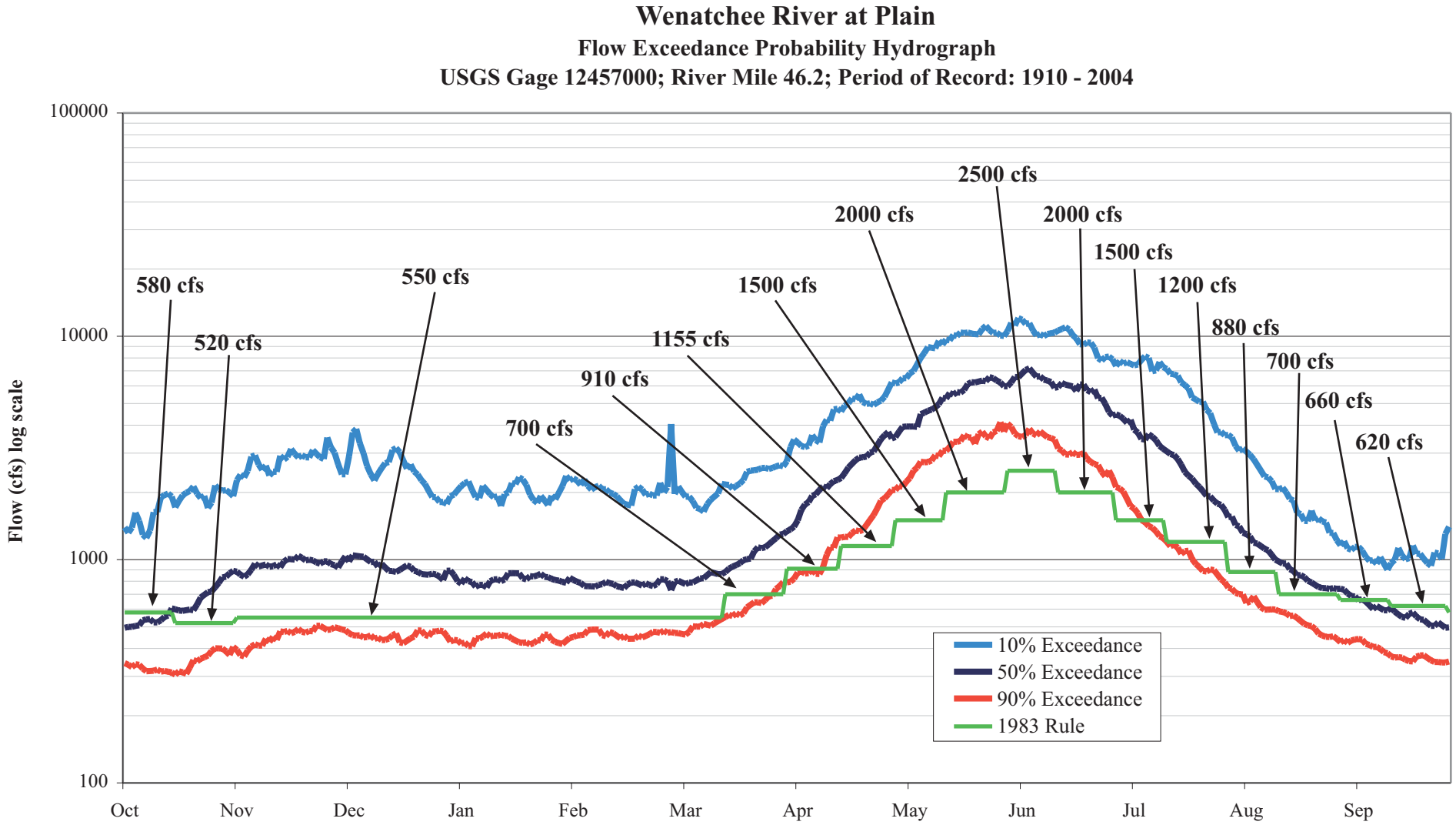
FIGURE **4-3**

PROPOSED MANAGEMENT FLOWS - WENATCHEE RIVER AT PESHASTIN

CHELAN/WRIA 45 WATERSHED PLAN/WA

0431284203fg03.fh11 | Mod: 03/29/06 | EL

Golder Associates



Source: Washington Department of Ecology
USGS

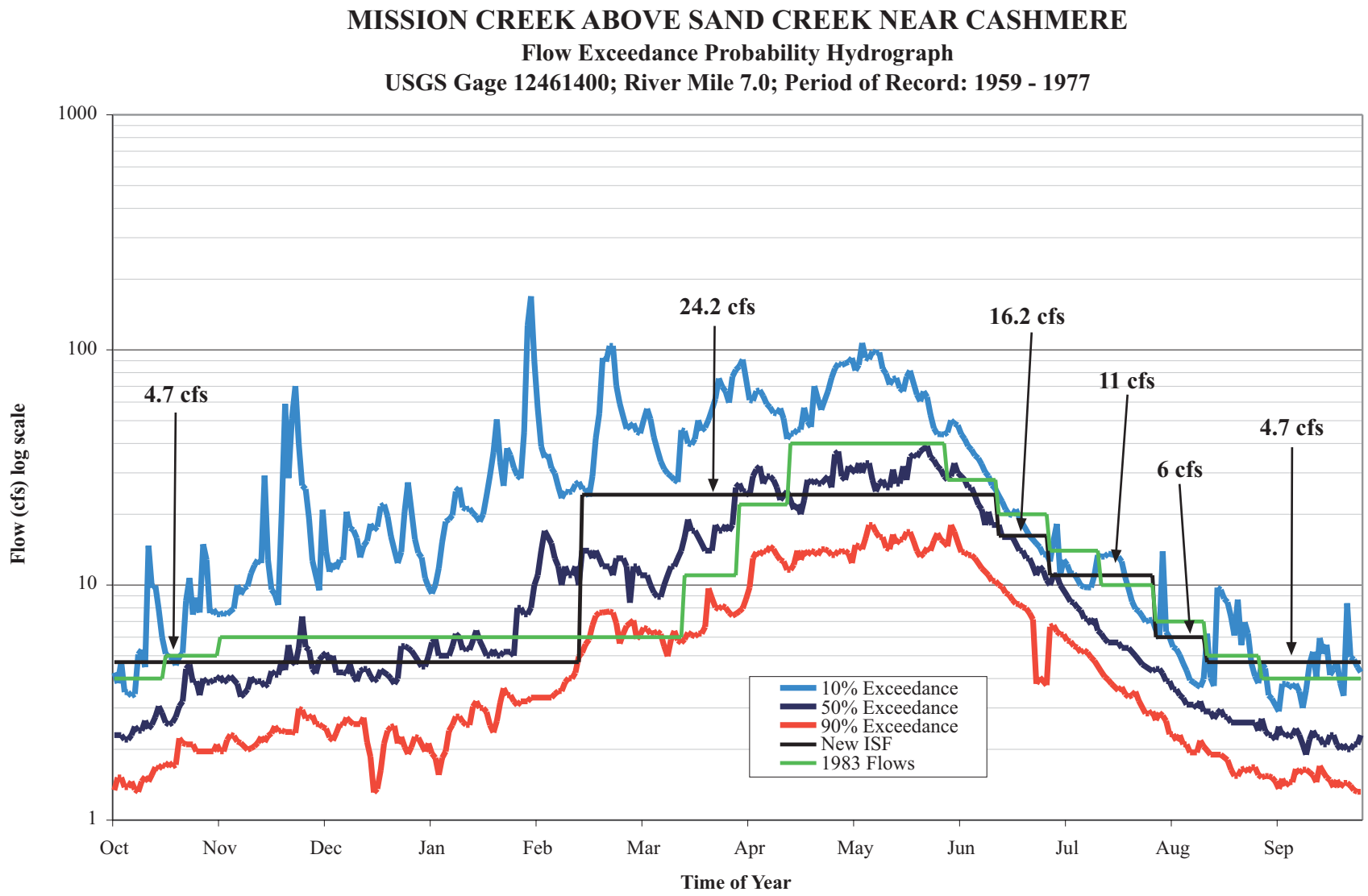
FIGURE **4-4**

EXISTING MANAGEMENT FLOWS - WENATCHEE RIVER AT PLAIN

CHELAN/WRIA 45 WATERSHED PLAN/WA

0431284203fg04.fh11 | Mod: 04/20/06 | EL

Golder Associates

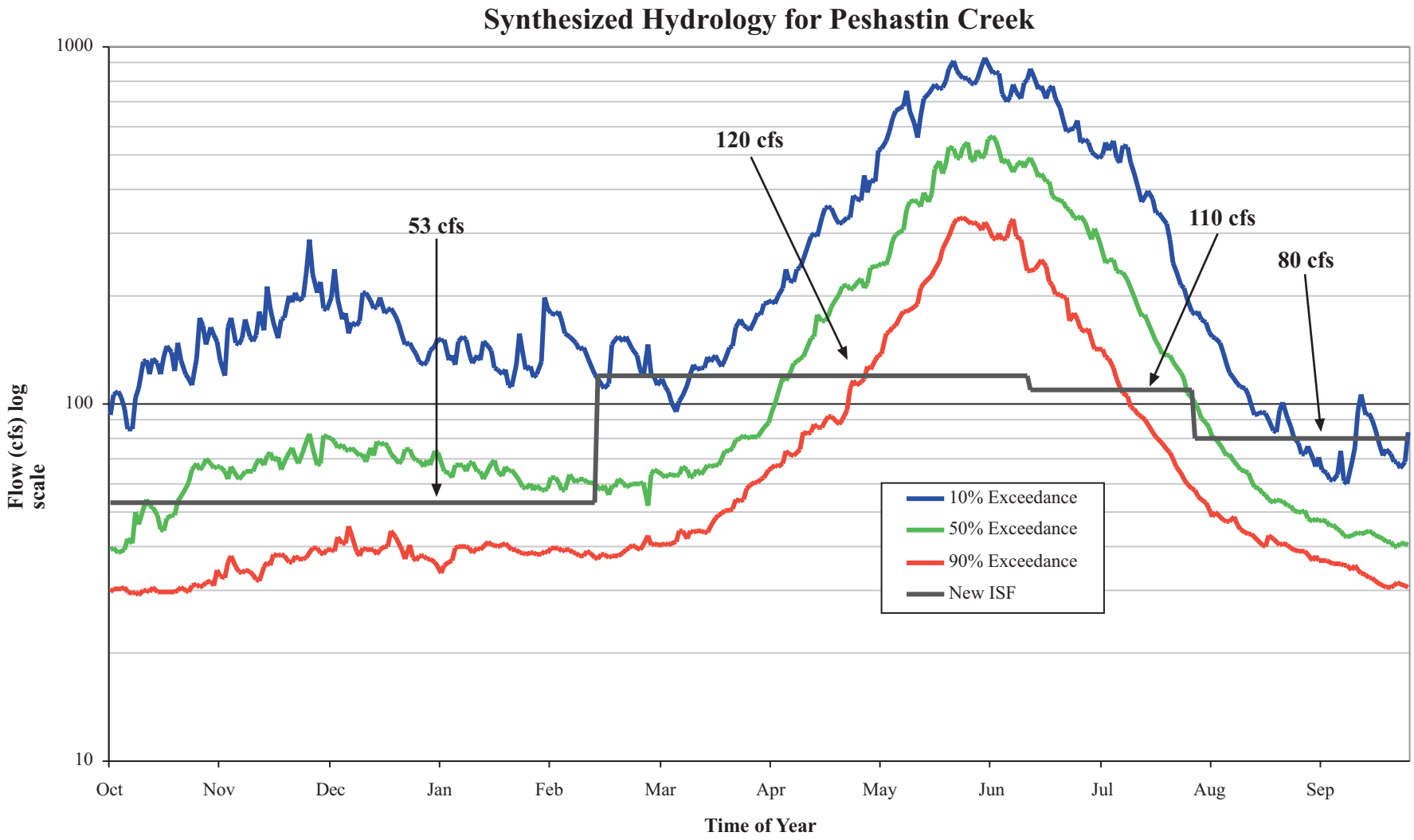


Source: Washington Department of Ecology
USGS

FIGURE **4-5**

PROPOSED MANAGEMENT FLOWS - MISSION CREEK ABOVE SAND CREEK NEAR CASHMERE

CHELAN/WRIA 45 WATERSHED PLAN/WA



Source: EES Consulting
USFS
Washington Department of Ecology

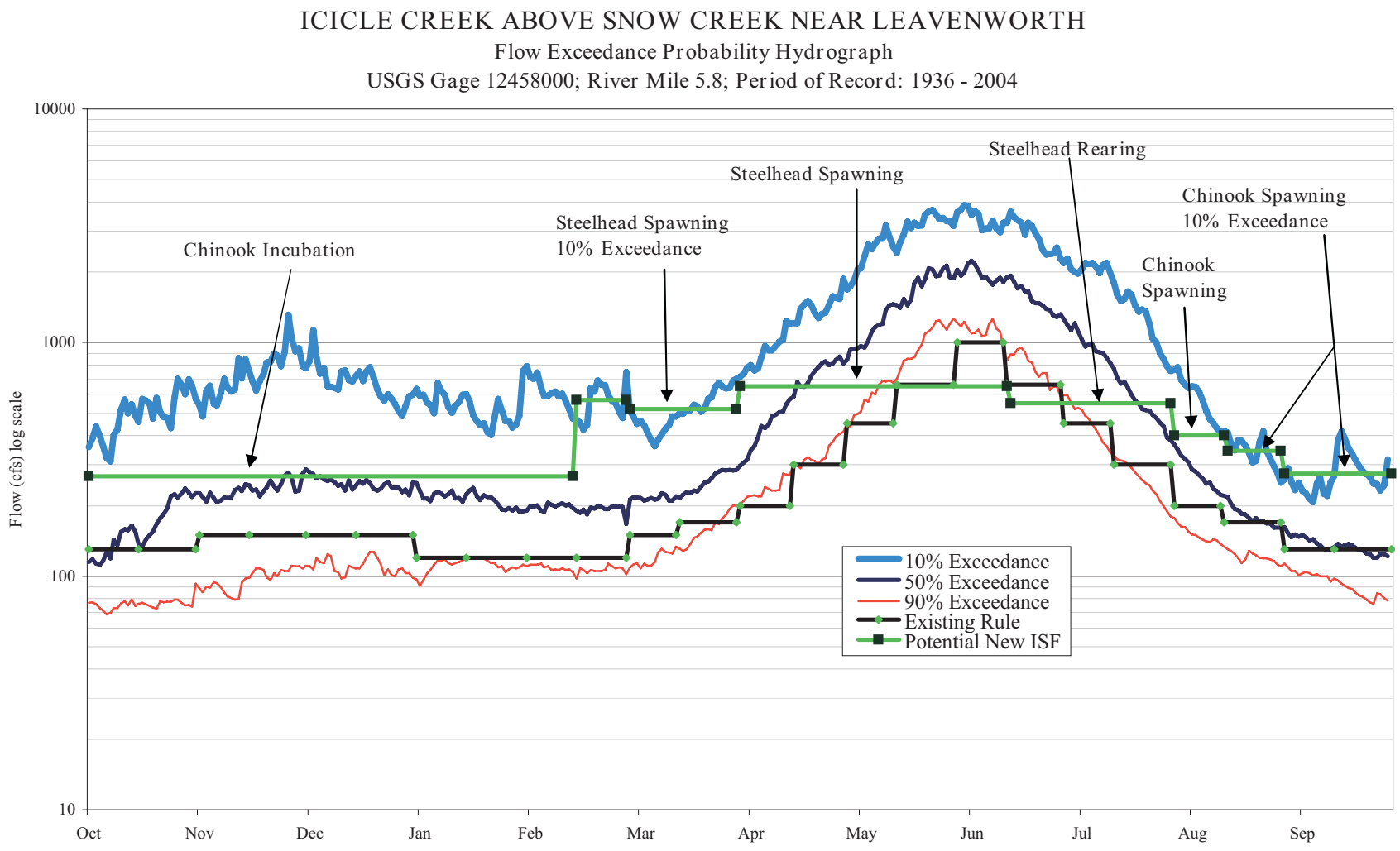
FIGURE **4-6**

PROPOSED MANAGEMENT FLOWS - PESHASTIN CREEK AT GREEN BRIDGE

CHELAN/WRIA 45 WATERSHED PLAN/WA

0431284203fg06.fh11 | Mod: 03/24/06 | EL

Golder Associates



Source: Washington Department of Ecology
US Bureau of Reclamation
USGS
USFS
EES Consulting

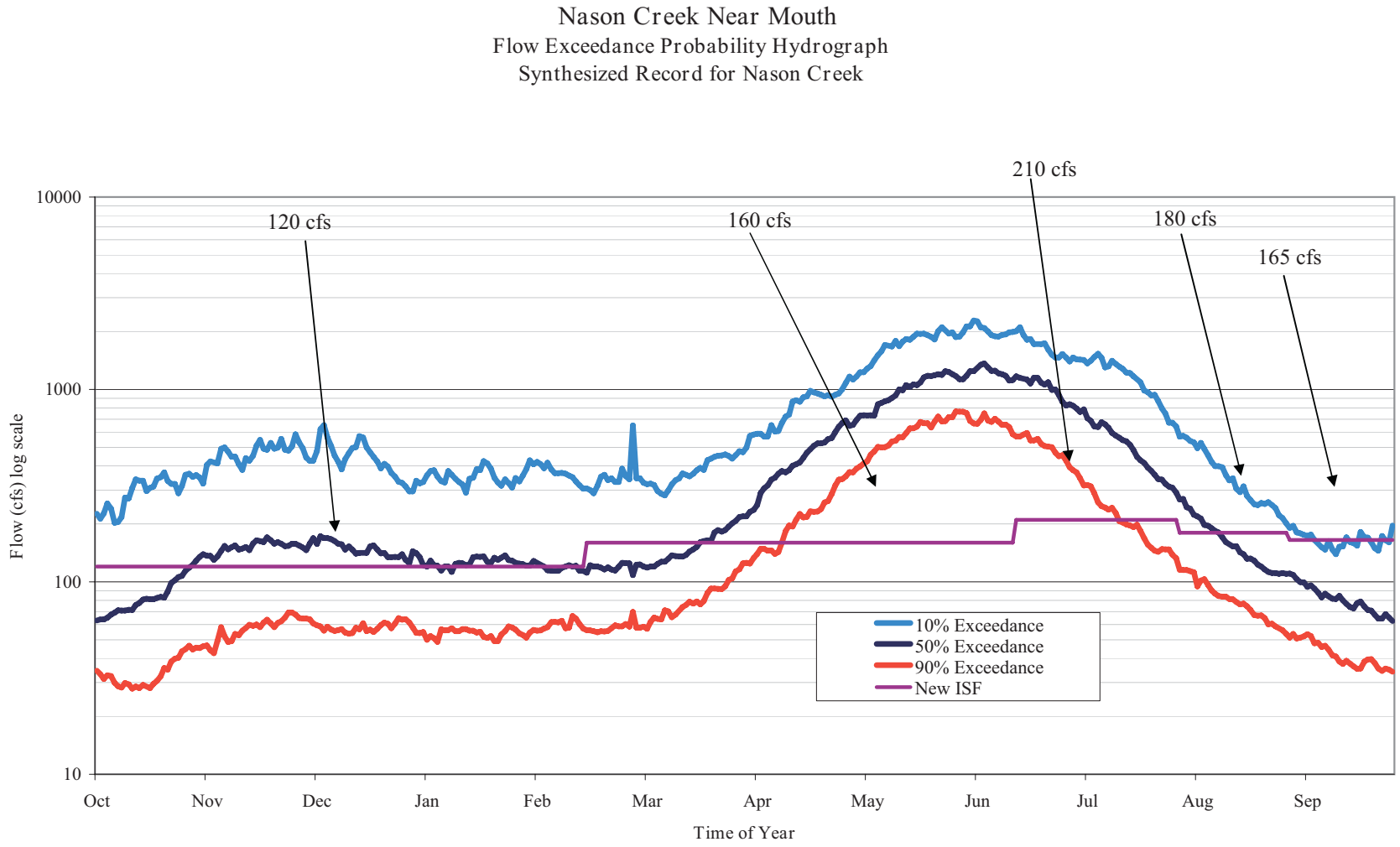
FIGURE **4-7**

PROPOSED MANAGEMENT FLOWS - ICICLE CREEK AT EAST LEAVENWORTH BRIDGE

CHELAN/WRIA 45 WATERSHED PLAN/WA

0431284203fg07.fh11 | Mod: 04/20/06 | EL

Golder Associates



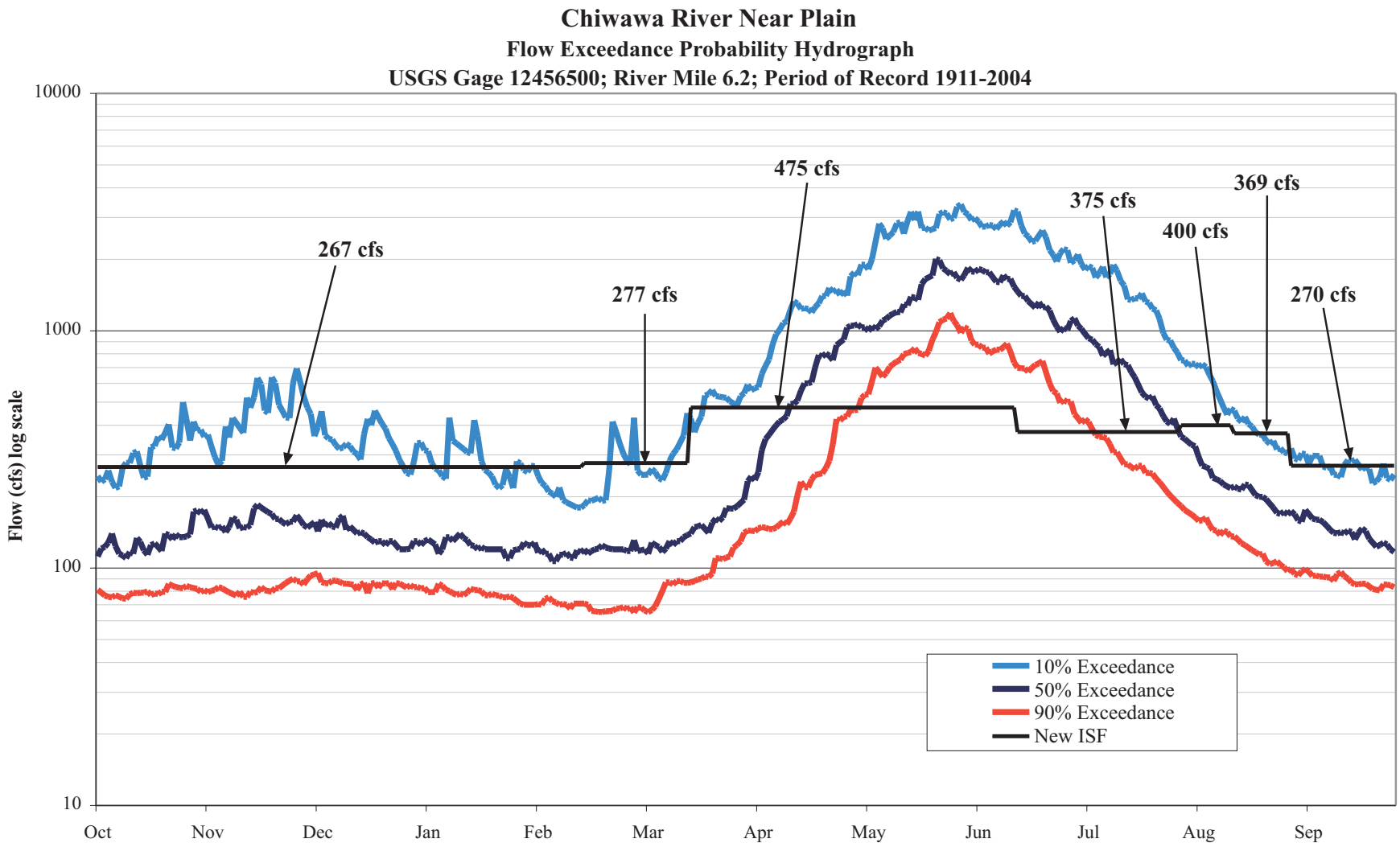
Source: Washington Department of Ecology
USFS
EES Consulting

FIGURE **4-8**

PROPOSED MANAGEMENT FLOWS - NASON CREEK NEAR MOUTH

CHELAN/WRIA 45 WATERSHED PLAN/WA

Golder Associates



Source: Washington Department of Ecology
USGS

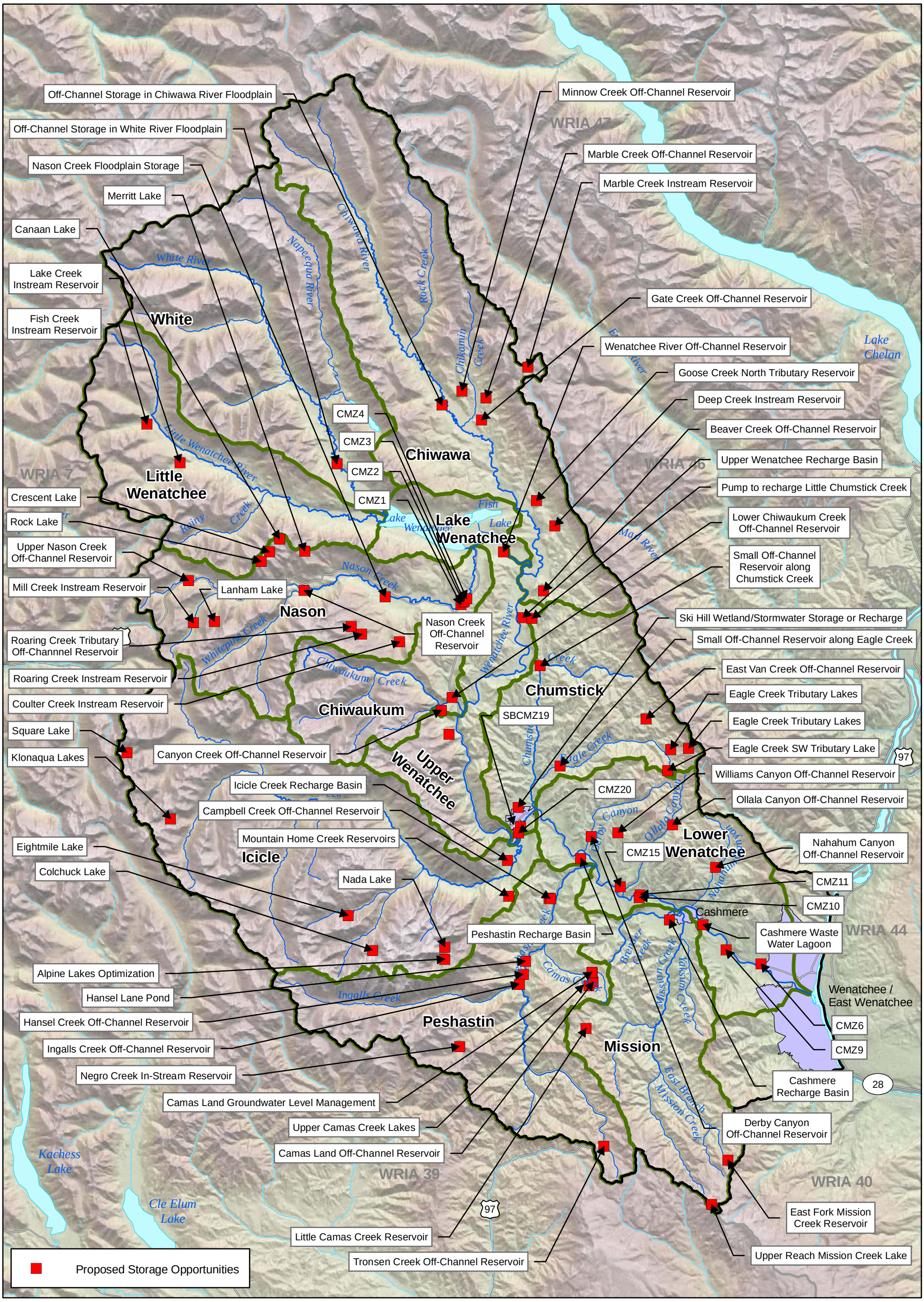
FIGURE **4-9**

PROPOSED MANAGEMENT FLOWS - CHIWAWA RIVER NEAR PLAIN

CHELAN/WRIA 45 WATERSHED PLAN/WA

0431284203fg01.fh11 | Mod: 03/29/06 | EL

Golder Associates



LEGEND

- WRIA 45 Boundary
- WRIA Boundary
- Sub-Watershed Boundary
- Major Road
- Waterbody
- Watercourse
- Urban Area

0 5
Scale in Miles

Map Projection:
Washington State Plane,
North Zone, NAD 83, Feet

Source: Chelan County, USGS, WAGDA, WSDOE, WSDOT, MWG (2006)

N

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PROPOSED STORAGE OPPORTUNITIES
WRIA 45

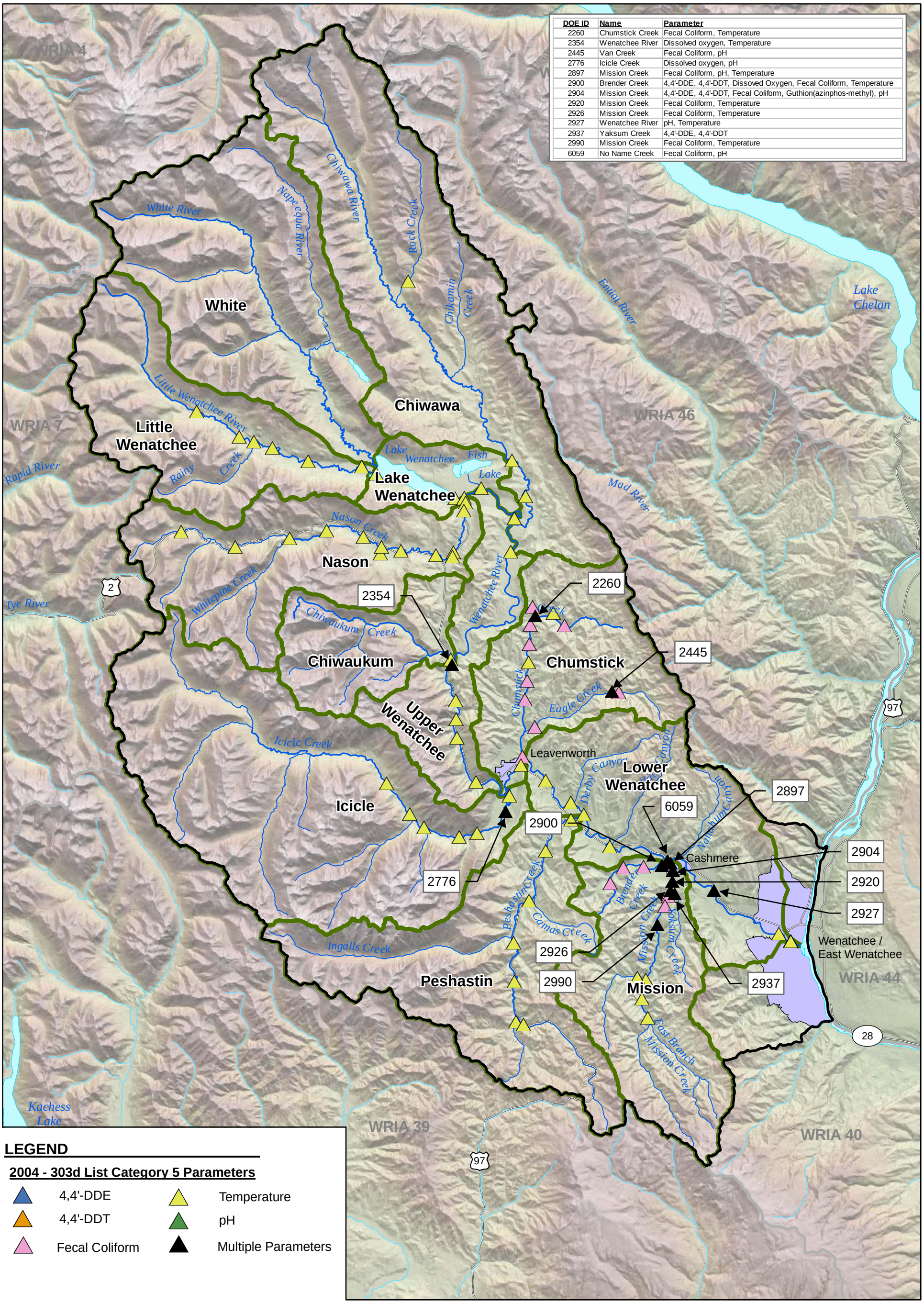
Chelan/WRIA 45 Watershed Plan/WA

Drawn: KBD	Revison: 4	Date: Apr. 26, 2006	Figure: 5-1

0431284203F14R04.mxd

Golder Associates

DOE ID	Name	Parameter
2260	Chumstick Creek	Fecal Coliform, Temperature
2354	Wenatchee River	Dissolved oxygen, Temperature
2445	Van Creek	Fecal Coliform, pH
2776	Icicle Creek	Dissolved oxygen, pH
2897	Mission Creek	Fecal Coliform, pH, Temperature
2900	Brender Creek	4,4'-DDE, 4,4'-DDT, Dissoved Oxygen, Fecal Coliform, Temperature
2904	Mission Creek	4,4'-DDE, 4,4'-DDT, Fecal Coliform, Guthion(azinphos-methyl), pH
2920	Mission Creek	Fecal Coliform, Temperature
2926	Mission Creek	Fecal Coliform, Temperature
2927	Wenatchee River	pH, Temperature
2937	Yaksum Creek	4,4'-DDE, 4,4'-DDT
2990	Mission Creek	Fecal Coliform, Temperature
6059	No Name Creek	Fecal Coliform, pH



LEGEND

2004 - 303d List Category 5 Parameters

- 4,4'-DDE
- 4,4'-DDT
- Fecal Coliform
- Temperature
- pH
- Multiple Parameters

Other Land Use Data

- WRIA 45 Boundary
- WRIA Boundary
- Sub-Watershed Boundary
- Major Road
- Waterbody
- Watercourse
- Urban Area

0 5
Scale in Miles

Map Projection:
Washington State Plane,
North Zone, NAD 83, Feet

Source: Chelan County, USGS, WAGDA, WSDOE, WSDOT

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2004 303(D) LISTINGS FOR WRIA 45 TMDL

Chelan/WRIA 45 Watershed Plan/WA

Drawn: AMN	Revison: 5	Date: Apr. 26, 2006	Figure: 7-1

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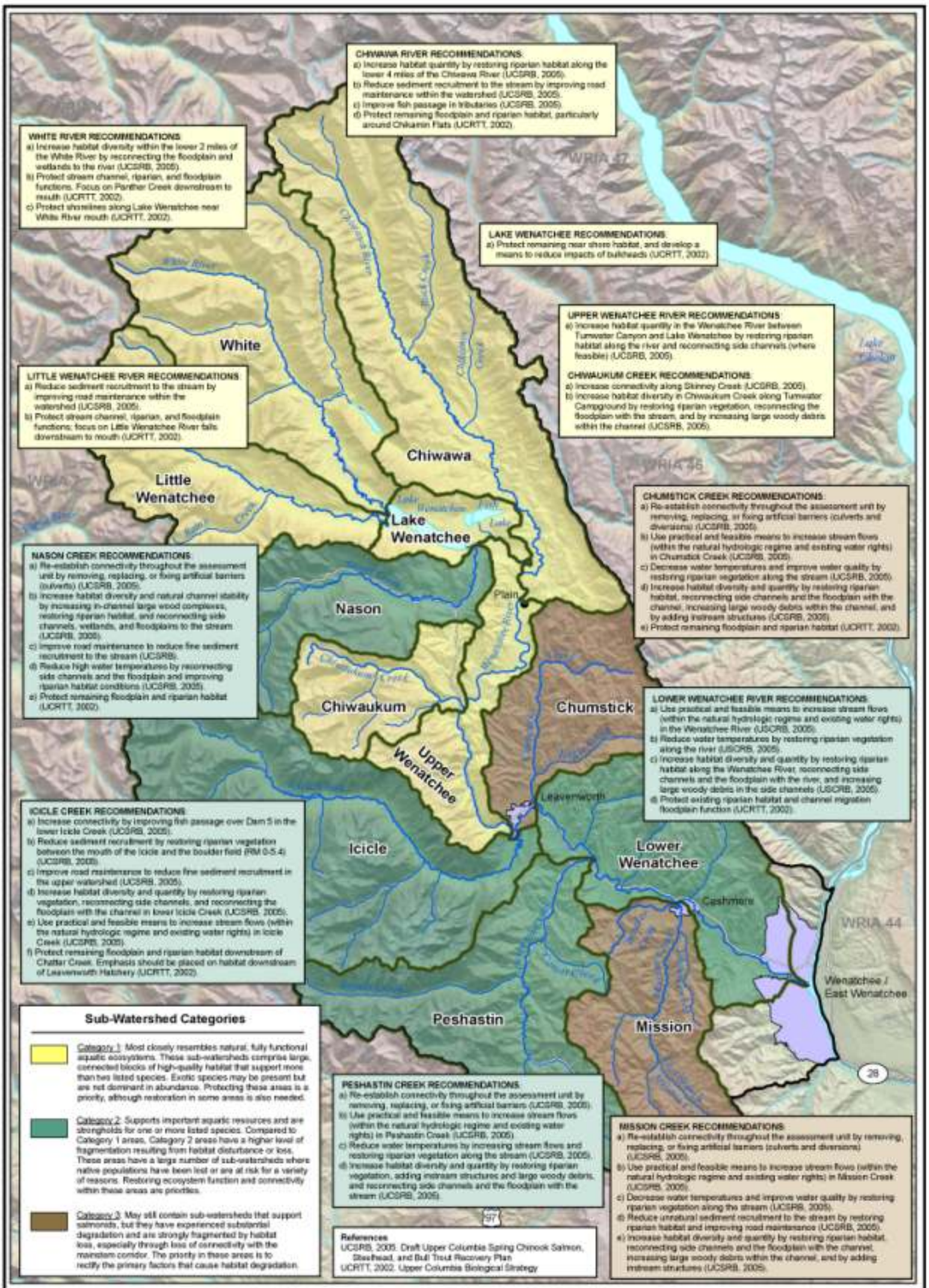
Golder Associates


CHIWAWA RIVER RECOMMENDATIONS:
a) Increase habitat quantity by restoring riparian habitat along the lower 4 miles of the Chiwawa River (UCSRB, 2005).
b) Reduce sediment recruitment to the stream by improving road maintenance within the watershed (UCSRB, 2005).
c) Improve fish passage in tributaries (UCSRB, 2005).
d) Protect remaining floodplain and riparian habitat, particularly around Chikamin Flats (UCRTT, 2002).
WHITE RIVER RECOMMENDATIONS:
a) Increase habitat diversity within the lower 2 miles of the White River by reconnecting the floodplain and wetlands to the river (UCSRB, 2005).
b) Protect stream channel, riparian, and floodplain functions. Focus on Panther Creek downstream to mouth (UCRTT, 2002).
c) Protect shorelines along Lake Wenatchee near White River mouth (UCRTT, 2002).
LAKE WENATCHEE RECOMMENDATIONS:
a) Protect remaining near shore habitat, and develop a means to reduce impacts of bulkheads (UCRTT, 2002).
UPPER WENATCHEE RIVER RECOMMENDATIONS:
a) Increase habitat quantity in the Wenatchee River between Tumwater Canyon and Lake Wenatchee by restoring riparian habitat along the river and reconnecting side channels (where feasible) (UCSRB, 2005).
CHIWAUKUM CREEK RECOMMENDATIONS:
a) Increase connectivity along Skinney Creek (UCSRB, 2005).
b) Increase habitat diversity in Chiwaukum Creek along Tumwater Campground by restoring riparian vegetation, reconnecting the floodplain with the stream, and by increasing large woody debris within the channel (UCSRB, 2005).
LITTLE WENATCHEE RIVER RECOMMENDATIONS:
a) Reduce sediment recruitment to the stream by improving road maintenance within the watershed (UCSRB, 2005).
b) Protect stream channel, riparian, and floodplain functions; focus on Little Wenatchee River falls downstream to mouth (UCRTT, 2002).
CHUMSTICK CREEK RECOMMENDATIONS:
a) Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts and diversions) (UCSRB, 2005).
b) Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Chumstick Creek (UCSRB, 2005).
c) Decrease water temperatures and improve water quality by restoring riparian vegetation along the stream (UCSRB, 2005).
d) Increase habitat diversity and quantity by restoring riparian habitat, reconnecting side channels and the floodplain with the channel, increasing large woody debris within the channel, and by adding instream structures (UCSRB, 2005).
e) Protect remaining floodplain and riparian habitat (UCRTT, 2002).
NASON CREEK RECOMMENDATIONS:
a) Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts) (UCSRB, 2005).
b) Increase habitat diversity and natural channel stability by increasing in-channel large wood complexes, restoring riparian habitat, and reconnecting side channels, wetlands, and floodplains to the stream (UCSRB, 2005).
c) Improve road maintenance to reduce fine sediment recruitment to the stream (UCSRB).
d) Reduce high water temperatures by reconnecting side channels and the floodplain and improving riparian habitat conditions (UCSRB, 2005).
e) Protect remaining floodplain and riparian habitat (UCRTT, 2002).
LOWER WENATCHEE RIVER RECOMMENDATIONS:
a) Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in the Wenatchee River (USCRB, 2005).
b) Reduce water temperatures by restoring riparian vegetation along the river (USCRB, 2005).
c) Increase habitat diversity and quantity by restoring riparian habitat along the Wenatchee River, reconnecting side channels and the floodplain with the river, and increasing large woody debris in the side channels (USCRB, 2005).
d) Protect existing riparian habitat and channel migration floodplain function (UCRTT, 2002).
ICICLE CREEK RECOMMENDATIONS:
a) Increase connectivity by improving fish passage over Dam 5 in the lower Icicle Creek (UCSRB, 2005).
b) Reduce sediment recruitment by restoring riparian vegetation between the mouth of the Icicle and the boulder field (RM 0-5.4) (UCSRB, 2005).
c) Improve road maintenance to reduce fine sediment recruitment in the upper watershed (UCSRB, 2005).
d) Increase habitat diversity and quantity by restoring riparian vegetation, reconnecting side channels, and reconnecting the floodplain with the channel in lower Icicle Creek (UCSRB, 2005).
e) Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Icicle Creek (UCSRB, 2005).
f) Protect remaining floodplain and riparian habitat downstream of Chatter Creek. Emphasis should be placed on habitat downstream of Leavenworth Hatchery (UCRTT, 2002).
Sub-Watershed Categories
Category 1: Most closely resembles natural, fully functional aquatic ecosystems. These sub-watersheds comprise large, connected blocks of high-quality habitat that support more than two listed species. Exotic species may be present but are not dominant in abundance. Protecting these areas is a priority, although restoration in some areas is also needed.
Category 2: Supports important aquatic resources and are strongholds for one or more listed species. Compared to Category 1 areas, Category 2 areas have a higher level of fragmentation resulting from habitat disturbance or loss. These areas have a large number of sub-watersheds where native populations have been lost or are at risk for a variety of reasons. Restoring ecosystem function and connectivity within these areas are priorities.
Category 3: May still contain sub-watersheds that support salmonids, but they have experienced substantial degradation and are strongly fragmented by habitat loss, especially through loss of connectivity with the mainstem corridor. The priority in these areas is to rectify the primary factors that cause habitat degradation.
PESHASTIN CREEK RECOMMENDATIONS:
a) Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (UCSRB, 2005).
b) Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Peshastin Creek (UCSRB, 2005).
c) Reduce water temperatures by increasing stream flows and restoring riparian vegetation along the stream (UCSRB, 2005).
d) Increase habitat diversity and quantity by restoring riparian vegetation, adding instream structures and large woody debris, and reconnecting side channels and the floodplain with the stream (UCSRB, 2005).
MISSION CREEK RECOMMENDATIONS:
a) Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts and diversions) (UCSRB, 2005).
b) Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Mission Creek (UCSRB, 2005).
c) Decrease water temperatures and improve water quality by restoring riparian vegetation along the stream (UCSRB, 2005).
d) Reduce unnatural sediment recruitment to the stream by restoring riparian habitat and improving road maintenance (UCSRB, 2005).
e) Increase habitat diversity and quantity by restoring riparian habitat, reconnecting side channels and the floodplain with the channel, increasing large woody debris within the channel, and by adding instream structures (UCSRB, 2005).
References
UCSRB, 2005. Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan
UCRTT, 2002. Upper Columbia Biological Strategy
WRIA 47
WRIA 46
WRIA 45
WRIA 44
White
Little Wenatchee
Chiwawa
Lake Wenatchee
Nason
Chiwaukum
Chumstick
Upper Wenatchee
Icicle
Peshastin
Mission
Lower Wenatchee
Leavenworth
Cashmere
Wenatchee / East Wenatchee
Plain
97
28
LEGEND
WRIA 45 Boundary
WRIA Boundary
Sub-Watershed Boundary
Major Road
Waterbody
Watercourse
Urban Area
0
5
Scale in Miles
Map Projection: Washington State Plane, North Zone, NAD 83, Feet
Source: Chelan County, USGS, WAGDA, WSDOE, WSDOT, UCSRB, UCRTT
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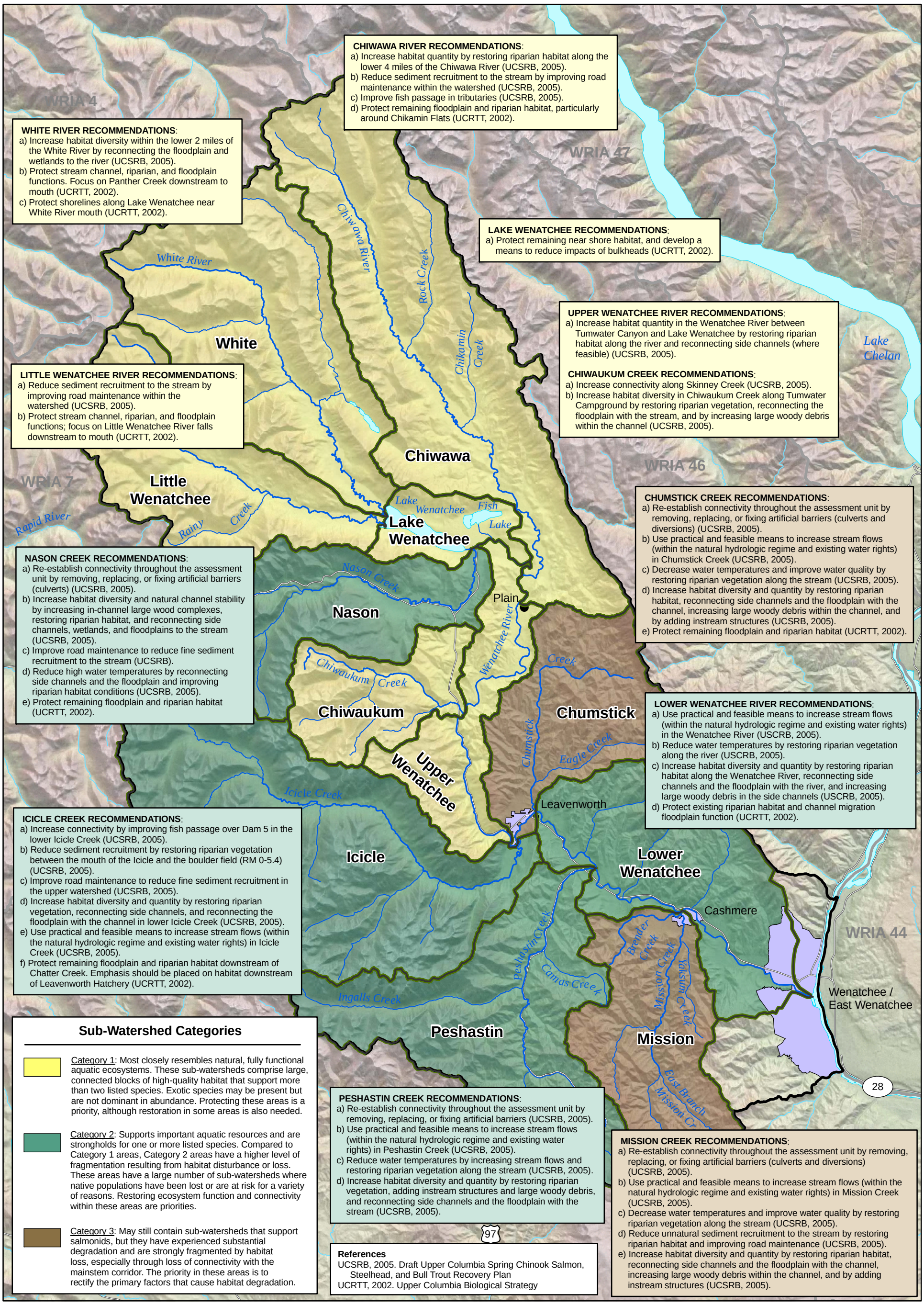
SUB-WATERSHED HABITAT RECOMMENDATIONS
Chelan/WRIA 45 Watershed Plan/WA
Drawn: KSD
Revision: 4
Date: Apr. 28, 2006
Figure: 8-1
Golder Associates



CHIWAWA RIVER RECOMMENDATIONS:
a) Increase habitat quantity by restoring riparian habitat along the lower 4 miles of the Chiwawa River (UCSRB, 2005).
b) Reduce sediment recruitment to the stream by improving road maintenance within the watershed (UCSRB, 2005).
c) Improve fish passage in tributaries (UCSRB, 2005).
d) Protect remaining floodplain and riparian habitat, particularly around Chikamin Flats (UCRTT, 2002).

WHITE RIVER RECOMMENDATIONS:
a) Increase habitat diversity within the lower 2 miles of the White River by reconnecting the floodplain and wetlands to the river (UCSRB, 2005).
b) Protect stream channel, riparian, and floodplain functions. Focus on Panther Creek downstream to mouth (UCRTT, 2002).
c) Protect shorelines along Lake Wenatchee near White River mouth (UCRTT, 2002).

LAKE WENATCHEE RECOMMENDATIONS:
a) Protect remaining near shore habitat, and develop a means to reduce impacts of bulkheads (UCRTT, 2002).

UPPER WENATCHEE RIVER RECOMMENDATIONS:
a) Increase habitat quantity in the Wenatchee River between Tumwater Canyon and Lake Wenatchee by restoring riparian habitat along the river and reconnecting side channels (where feasible) (UCSRB, 2005).

CHIWAUKUM CREEK RECOMMENDATIONS:
a) Increase connectivity along Skinney Creek (UCSRB, 2005).
b) Increase habitat diversity in Chiwaukum Creek along Tumwater Campground by restoring riparian vegetation, reconnecting the floodplain with the stream, and by increasing large woody debris within the channel (UCSRB, 2005).

LITTLE WENATCHEE RIVER RECOMMENDATIONS:
a) Reduce sediment recruitment to the stream by improving road maintenance within the watershed (UCSRB, 2005).
b) Protect stream channel, riparian, and floodplain functions; focus on Little Wenatchee River falls downstream to mouth (UCRTT, 2002).

CHUMSTICK CREEK RECOMMENDATIONS:
a) Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts and diversions) (UCSRB, 2005).
b) Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Chumstick Creek (UCSRB, 2005).
c) Decrease water temperatures and improve water quality by restoring riparian vegetation along the stream (UCSRB, 2005).
d) Increase habitat diversity and quantity by restoring riparian habitat, reconnecting side channels and the floodplain with the channel, increasing large woody debris within the channel, and by adding instream structures (UCSRB, 2005).
e) Protect remaining floodplain and riparian habitat (UCRTT, 2002).

NASON CREEK RECOMMENDATIONS:
a) Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts) (UCSRB, 2005).
b) Increase habitat diversity and natural channel stability by increasing in-channel large wood complexes, restoring riparian habitat, and reconnecting side channels, wetlands, and floodplains to the stream (UCSRB, 2005).
c) Improve road maintenance to reduce fine sediment recruitment to the stream (UCSRB).
d) Reduce high water temperatures by reconnecting side channels and the floodplain and improving riparian habitat conditions (UCSRB, 2005).
e) Protect remaining floodplain and riparian habitat (UCRTT, 2002).

LOWER WENATCHEE RIVER RECOMMENDATIONS:
a) Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in the Wenatchee River (USCRB, 2005).
b) Reduce water temperatures by restoring riparian vegetation along the river (USCRB, 2005).
c) Increase habitat diversity and quantity by restoring riparian habitat along the Wenatchee River, reconnecting side channels and the floodplain with the river, and increasing large woody debris in the side channels (USCRB, 2005).
d) Protect existing riparian habitat and channel migration floodplain function (UCRTT, 2002).

ICICLE CREEK RECOMMENDATIONS:
a) Increase connectivity by improving fish passage over Dam 5 in the lower Icicle Creek (UCSRB, 2005).
b) Reduce sediment recruitment by restoring riparian vegetation between the mouth of the Icicle and the boulder field (RM 0-5.4) (UCSRB, 2005).
c) Improve road maintenance to reduce fine sediment recruitment in the upper watershed (UCSRB, 2005).
d) Increase habitat diversity and quantity by restoring riparian vegetation, reconnecting side channels, and reconnecting the floodplain with the channel in lower Icicle Creek (UCSRB, 2005).
e) Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Icicle Creek (UCSRB, 2005).
f) Protect remaining floodplain and riparian habitat downstream of Chatter Creek. Emphasis should be placed on habitat downstream of Leavenworth Hatchery (UCRTT, 2002).

Sub-Watershed Categories

Category 1: Most closely resembles natural, fully functional aquatic ecosystems. These sub-watersheds comprise large, connected blocks of high-quality habitat that support more than two listed species. Exotic species may be present but are not dominant in abundance. Protecting these areas is a priority, although restoration in some areas is also needed.

Category 2: Supports important aquatic resources and are strongholds for one or more listed species. Compared to Category 1 areas, Category 2 areas have a higher level of fragmentation resulting from habitat disturbance or loss. These areas have a large number of sub-watersheds where native populations have been lost or are at risk for a variety of reasons. Restoring ecosystem function and connectivity within these areas are priorities.

Category 3: May still contain sub-watersheds that support salmonids, but they have experienced substantial degradation and are strongly fragmented by habitat loss, especially through loss of connectivity with the mainstem corridor. The priority in these areas is to rectify the primary factors that cause habitat degradation.

PESHASTIN CREEK RECOMMENDATIONS:
a) Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (UCSRB, 2005).
b) Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Peshastin Creek (UCSRB, 2005).
c) Reduce water temperatures by increasing stream flows and restoring riparian vegetation along the stream (UCSRB, 2005).
d) Increase habitat diversity and quantity by restoring riparian vegetation, adding instream structures and large woody debris, and reconnecting side channels and the floodplain with the stream (UCSRB, 2005).

MISSION CREEK RECOMMENDATIONS:
a) Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts and diversions) (UCSRB, 2005).
b) Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Mission Creek (UCSRB, 2005).
c) Decrease water temperatures and improve water quality by restoring riparian vegetation along the stream (UCSRB, 2005).
d) Reduce unnatural sediment recruitment to the stream by restoring riparian habitat and improving road maintenance (UCSRB, 2005).
e) Increase habitat diversity and quantity by restoring riparian habitat, reconnecting side channels and the floodplain with the channel, increasing large woody debris within the channel, and by adding instream structures (UCSRB, 2005).

References

UCSRB, 2005. Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan
UCRTT, 2002. Upper Columbia Biological Strategy

LEGEND

- WRIA 45 Boundary
- WRIA Boundary
- Sub-Watershed Boundary
- Major Road
- Waterbody
- Watercourse
- Urban Area

0 5
Scale in Miles

Map Projection:
Washington State Plane,
North Zone, NAD 83, Feet

Source: Chelan County, USGS, WAGDA, WSDOE, WSDOT, UCSRB, UCRTT

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SUB-WATERSHED HABITAT RECOMMENDATIONS

Chelan/WRIA 45 Watershed Plan/WA

Drawn: KBD	Revison: 4	Date: Apr. 26, 2006	Figure: 8-1

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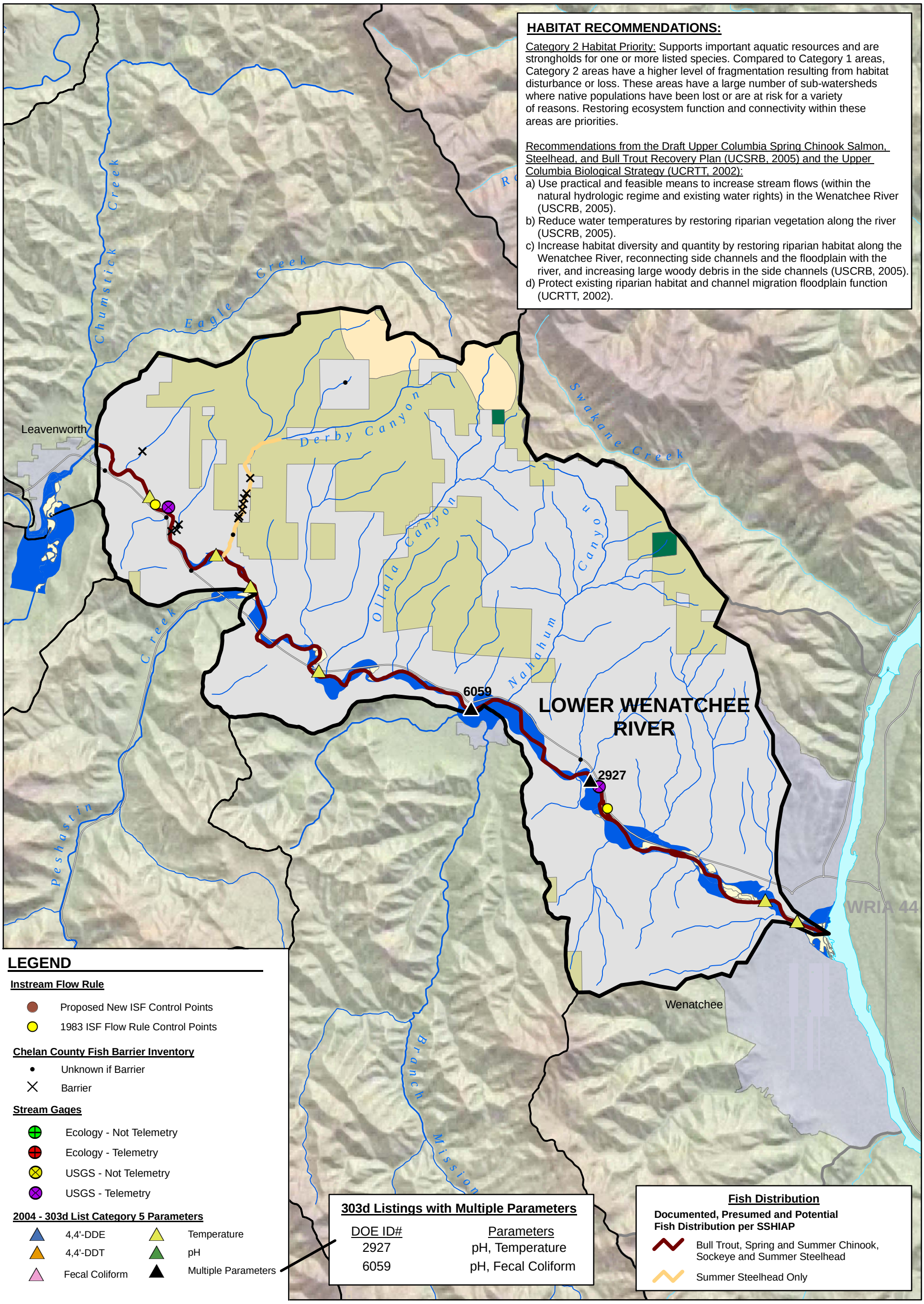

HABITAT RECOMMENDATIONS:

Category 2 Habitat Priority: Supports important aquatic resources and are strongholds for one or more listed species. Compared to Category 1 areas, Category 2 areas have a higher level of fragmentation resulting from habitat disturbance or loss. These areas have a large number of sub-watersheds where native populations have been lost or are at risk for a variety of reasons. Restoring ecosystem function and connectivity within these areas are priorities.

Recommendations from the Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) and the Upper Columbia Biological Strategy (UCRTT, 2002):

a) Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in the Wenatchee River (USCRB, 2005).
b) Reduce water temperatures by restoring riparian vegetation along the river (USCRB, 2005).
c) Increase habitat diversity and quantity by restoring riparian habitat along the Wenatchee River, reconnecting side channels and the floodplain with the river, and increasing large woody debris in the side channels (USCRB, 2005).
d) Protect existing riparian habitat and channel migration floodplain function (UCRTT, 2002).

LEGEND

Instream Flow Rule

- Proposed New ISF Control Points
- 1983 ISF Flow Rule Control Points

Chelan County Fish Barrier Inventory

- Unknown if Barrier
- Barrier

Stream Gages

- Ecology - Not Telemetry
- Ecology - Telemetry
- USGS - Not Telemetry
- USGS - Telemetry

2004 - 303d List Category 5 Parameters

- 4,4'-DDE
- 4,4'-DDT
- Fecal Coliform
- Temperature
- pH
- Multiple Parameters

303d Listings with Multiple Parameters

DOE ID#	Parameters
2927	pH, Temperature
6059	pH, Fecal Coliform

Fish Distribution

Documented, Presumed and Potential Fish Distribution per SSHIAP

- Bull Trout, Spring and Summer Chinook, Sockeye and Summer Steelhead
- Summer Steelhead Only

USFS Northwest Forest Plan

- Administrative Withdrawn Areas (Not for Harvest)
- USFS - Other
- Late Successional Reserves (Not for Harvest)
- Managed Late Successional Areas (Managed Harvest)
- MATRIX (Active Harvest)
- Congressionally Designated Wilderness

Other Land Use Data

- Channel Migration Zone
- Private Forestland
- WNF Roadless Areas
- Other Land Ownership

0 10,000
Scale in Feet

Map Projection: Washington State Plane, North Zone, NAD 83, Feet

Source: Chelan County Conservation District, Chelan County Department of Natural Resources, Normandeau, USFS, USGS, WDFW, WSDOT, WSDOE

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LOWER WENATCHEE RIVER SUB-WATERSHED

Chelan/WRIA 45 Watershed Plan/WA

Drawn: AMN	Revison: 5	Date: Apr. 26, 2006	Figure: 9-1

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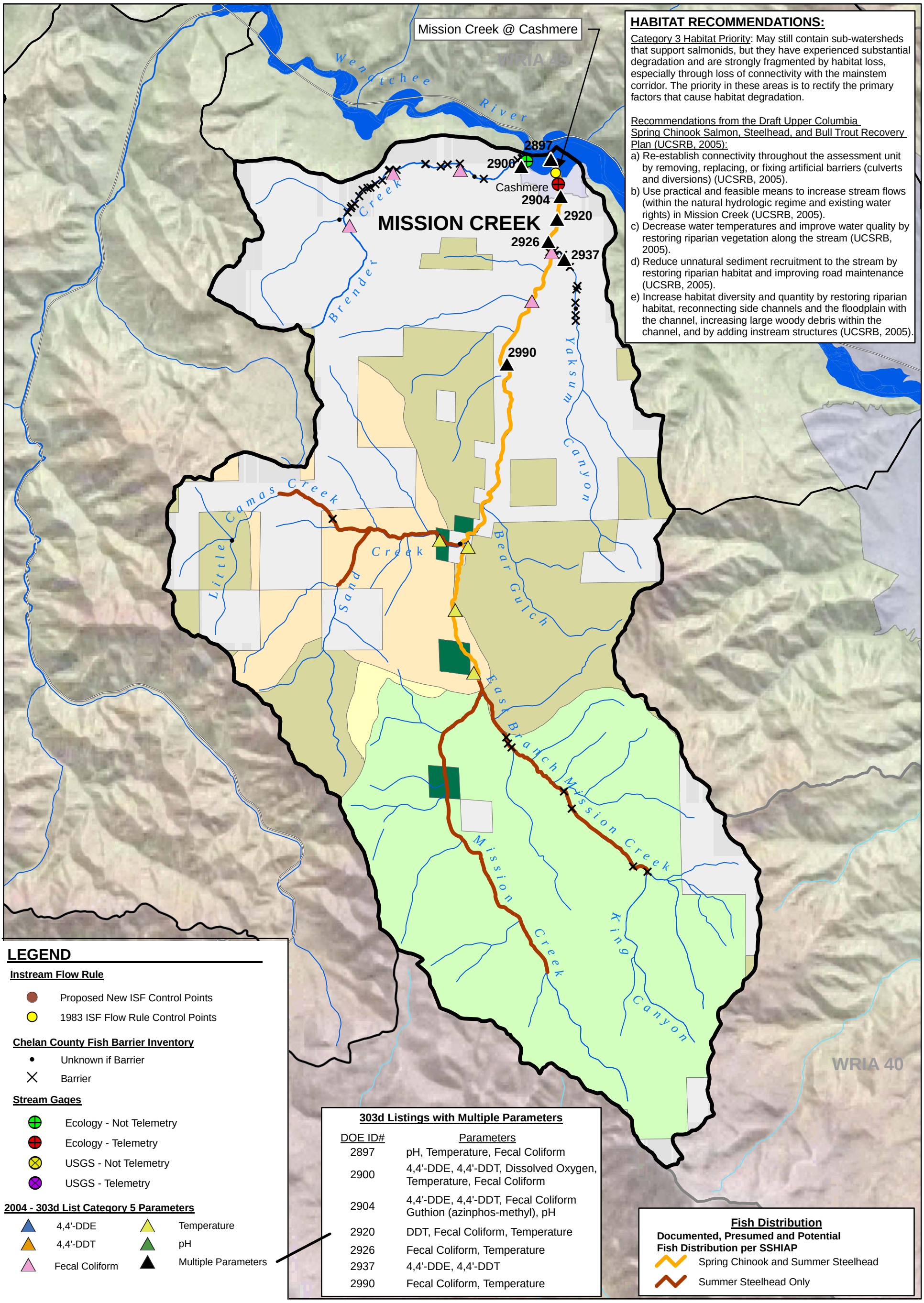
Golder Associates



HABITAT RECOMMENDATIONS:

Category 3 Habitat Priority: May still contain sub-watersheds that support salmonids, but they have experienced substantial degradation and are strongly fragmented by habitat loss, especially through loss of connectivity with the mainstem corridor. The priority in these areas is to rectify the primary factors that cause habitat degradation.

Recommendations from the Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005):

a) Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts and diversions) (UCSRB, 2005).
b) Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Mission Creek (UCSRB, 2005).
c) Decrease water temperatures and improve water quality by restoring riparian vegetation along the stream (UCSRB, 2005).
d) Reduce unnatural sediment recruitment to the stream by restoring riparian habitat and improving road maintenance (UCSRB, 2005).
e) Increase habitat diversity and quantity by restoring riparian habitat, reconnecting side channels and the floodplain with the channel, increasing large woody debris within the channel, and by adding instream structures (UCSRB, 2005).

LEGEND

Instream Flow Rule

- Proposed New ISF Control Points
- 1983 ISF Flow Rule Control Points

Chelan County Fish Barrier Inventory

- Unknown if Barrier
- Barrier

Stream Gages

- Ecology - Not Telemetry
- Ecology - Telemetry
- USGS - Not Telemetry
- USGS - Telemetry

2004 - 303d List Category 5 Parameters

- 4,4'-DDE
- 4,4'-DDT
- Fecal Coliform
- Temperature
- pH
- Multiple Parameters

303d Listings with Multiple Parameters

DOE ID#	Parameters
2897	pH, Temperature, Fecal Coliform
2900	4,4'-DDE, 4,4'-DDT, Dissolved Oxygen, Temperature, Fecal Coliform
2904	4,4'-DDE, 4,4'-DDT, Fecal Coliform Guthion (azinphos-methyl), pH
2920	DDT, Fecal Coliform, Temperature
2926	Fecal Coliform, Temperature
2937	4,4'-DDE, 4,4'-DDT
2990	Fecal Coliform, Temperature

Fish Distribution

Documented, Presumed and Potential Fish Distribution per SSHIAP

- Spring Chinook and Summer Steelhead
- Summer Steelhead Only

USFS Northwest Forest Plan

- Administrative Withdrawn Areas (Not for Harvest)
- USFS - Other
- Late Successional Reserves (Not for Harvest)
- Managed Late Successional Areas (Managed Harvest)
- MATRIX (Active Harvest)
- Congressionally Designated Wilderness

Other Land Use Data

- Channel Migration Zone
- Private Forestland
- WNF Roadless Areas
- Other Land Ownership

0 1.5
Scale in Miles

Map Projection: Washington State Plane, North Zone, NAD 83, Feet

Source: Chelan County Conservation District, Chelan County Department of Natural Resources, Normandeau, USFS, USGS, WDFW, WSDOT, WSDOE

N

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MISSION CREEK SUB-WATERSHED

Chelan/WRIA 45 Watershed Plan/WA

Drawn: KBD	Revison: 6	Date: Apr. 26, 2006	Figure: 9-2

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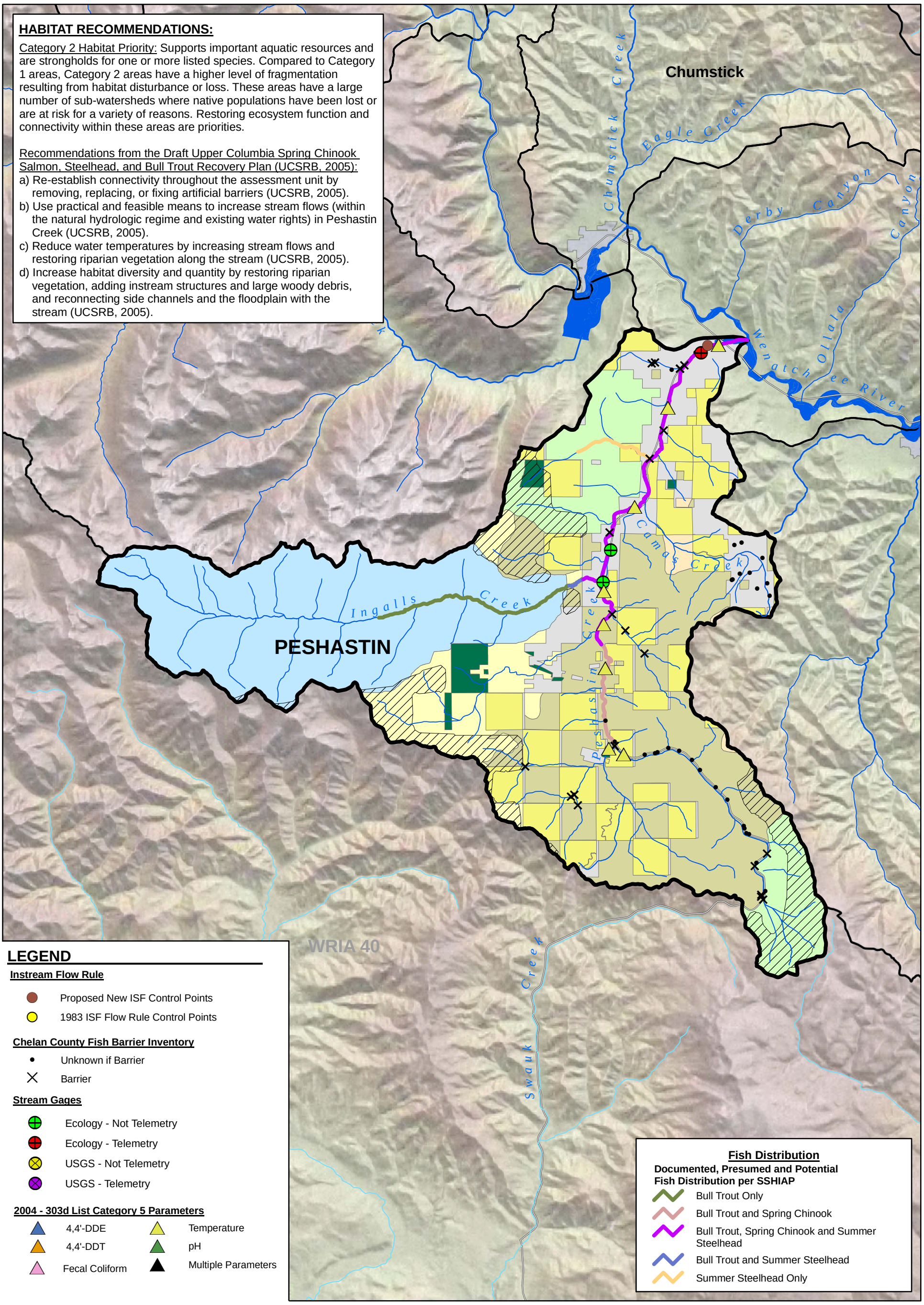
Golder Associates



HABITAT RECOMMENDATIONS:

Category 2 Habitat Priority: Supports important aquatic resources and are strongholds for one or more listed species. Compared to Category 1 areas, Category 2 areas have a higher level of fragmentation resulting from habitat disturbance or loss. These areas have a large number of sub-watersheds where native populations have been lost or are at risk for a variety of reasons. Restoring ecosystem function and connectivity within these areas are priorities.

Recommendations from the Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005):

a) Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (UCSRB, 2005).
b) Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Peshastin Creek (UCSRB, 2005).
c) Reduce water temperatures by increasing stream flows and restoring riparian vegetation along the stream (UCSRB, 2005).
d) Increase habitat diversity and quantity by restoring riparian vegetation, adding instream structures and large woody debris, and reconnecting side channels and the floodplain with the stream (UCSRB, 2005).

LEGEND

Instream Flow Rule

- Proposed New ISF Control Points
- 1983 ISF Flow Rule Control Points

Chelan County Fish Barrier Inventory

- Unknown if Barrier
- Barrier

Stream Gages

- Ecology - Not Telemetry
- Ecology - Telemetry
- USGS - Not Telemetry
- USGS - Telemetry

2004 - 303d List Category 5 Parameters

- 4,4'-DDE
- 4,4'-DDT
- Fecal Coliform
- Temperature
- pH
- Multiple Parameters

USFS Northwest Forest Plan

- Administrative Withdrawn Areas (Not for Harvest)
- USFS - Other
- Late Successional Reserves (Not for Harvest)
- Managed Late Successional Areas (Managed Harvest)
- MATRIX (Active Harvest)
- Congressionally Designated Wilderness

Other Land Use Data

- Channel Migration Zone
- Private Forestland
- WNF Roadless Areas
- Other Land Ownership

0 2.5
Scale in Miles

Map Projection: Washington State Plane, North Zone, NAD 83, Feet

Source: Chelan County Conservation District, Chelan County Department of Natural Resources, Normandeau, USFS, USGS, WDFW, WSDOT, WSDOE

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This figure was originally produced in color. Reproduction in black and white may result in loss of information

PESHASTIN CREEK SUB-WATERSHED

Chelan/WRIA 45 Watershed Plan/WA

Drawn: AMN	Revison: 5	Date: Apr. 26, 2006	Figure: 9-3

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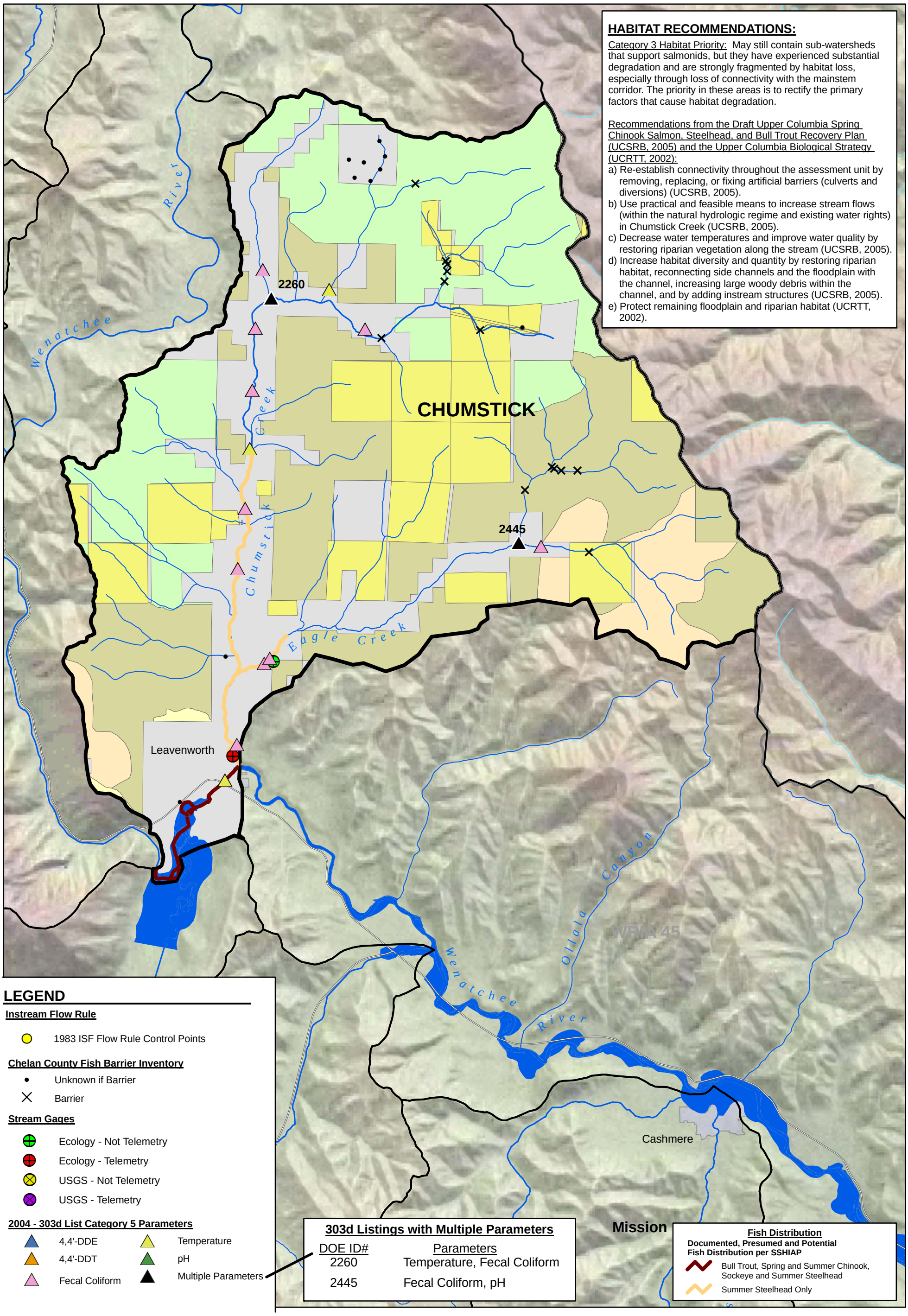
Golder Associates



HABITAT RECOMMENDATIONS:

Category 3 Habitat Priority: May still contain sub-watersheds that support salmonids, but they have experienced substantial degradation and are strongly fragmented by habitat loss, especially through loss of connectivity with the mainstem corridor. The priority in these areas is to rectify the primary factors that cause habitat degradation.

Recommendations from the Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) and the Upper Columbia Biological Strategy (UCRTT, 2002):

a) Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts and diversions) (UCSRB, 2005).
b) Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Chumstick Creek (UCSRB, 2005).
c) Decrease water temperatures and improve water quality by restoring riparian vegetation along the stream (UCSRB, 2005).
d) Increase habitat diversity and quantity by restoring riparian habitat, reconnecting side channels and the floodplain with the channel, increasing large woody debris within the channel, and by adding instream structures (UCSRB, 2005).
e) Protect remaining floodplain and riparian habitat (UCRTT, 2002).

LEGEND

Instream Flow Rule

- 1983 ISF Flow Rule Control Points

Chelan County Fish Barrier Inventory

- Unknown if Barrier
- Barrier

Stream Gages

- Ecology - Not Telemetry
- Ecology - Telemetry
- USGS - Not Telemetry
- USGS - Telemetry

2004 - 303d List Category 5 Parameters

- 4,4'-DDE
- 4,4'-DDT
- Fecal Coliform
- Temperature
- pH
- Multiple Parameters

303d Listings with Multiple Parameters

DOE ID#	Parameters
2260	Temperature, Fecal Coliform
2445	Fecal Coliform, pH

Fish Distribution

Documented, Presumed and Potential Fish Distribution per SSHIAP

- Bull Trout, Spring and Summer Chinook, Sockeye and Summer Steelhead
- Summer Steelhead Only

USFS Northwest Forest Plan

- Administrative Withdrawn Areas (Not for Harvest)
- USFS - Other
- Late Successional Reserves (Not for Harvest)
- Managed Late Successional Areas (Managed Harvest)
- MATRIX (Active Harvest)
- Congressionally Designated Wilderness

Other Land Use Data

- Channel Migration Zone
- Private Forestland
- WNF Roadless Areas
- Other Land Ownership

0 1.5
Scale in Miles

Map Projection: Washington State Plane, North Zone, NAD 83, Feet

Source: Chelan County Conservation District, Chelan County Department of Natural Resources, Normandeau, USFS, USGS, WDFW, WSDOT, WSDOE

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CHUMSTICK CREEK SUB-WATERSHED

Chelan/WRIA 45 Watershed Plan/WA

Drawn: AMN	Revison: 6	Date: Apr. 26, 2006	Figure: 9-4

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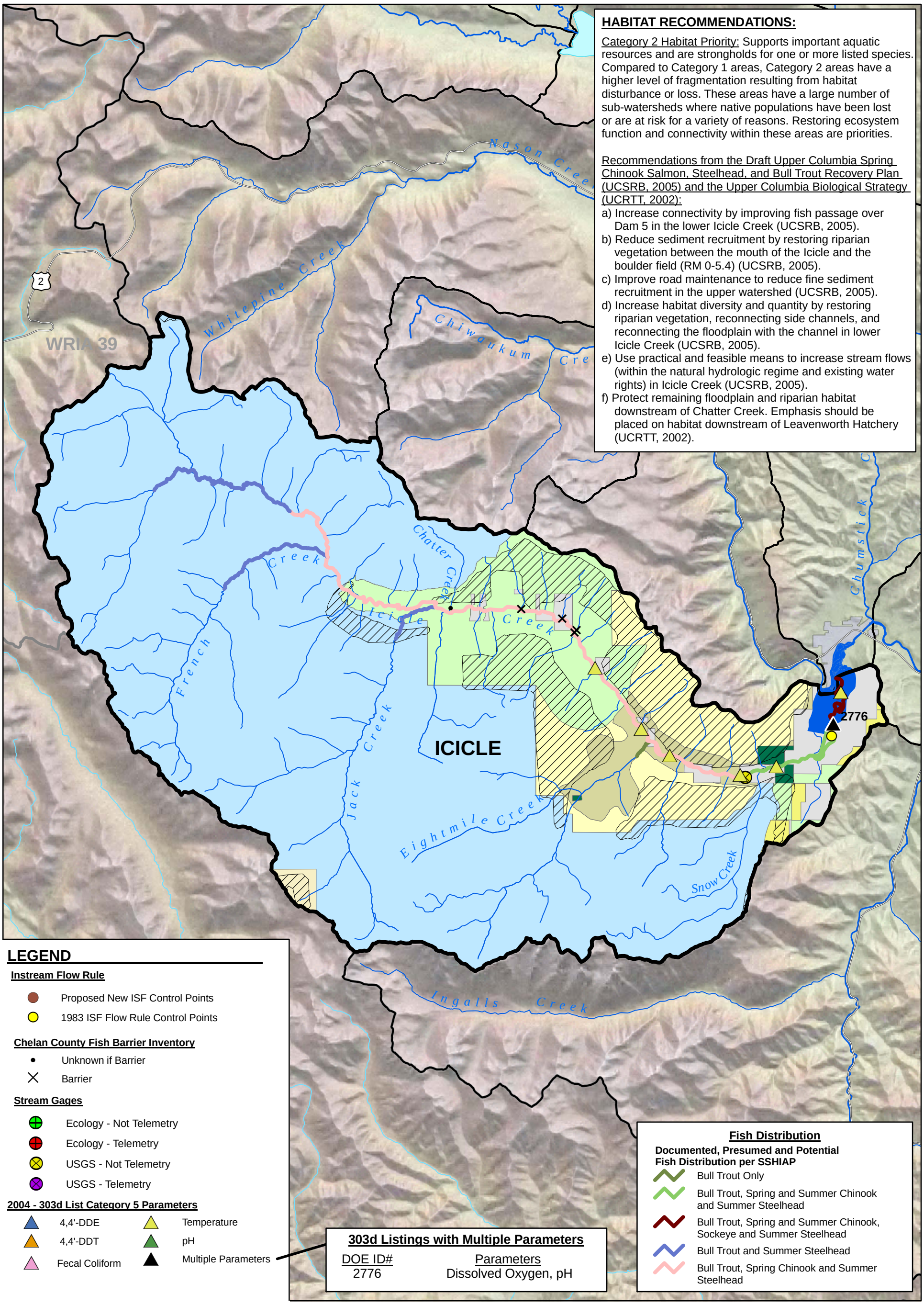

HABITAT RECOMMENDATIONS:

Category 2 Habitat Priority: Supports important aquatic resources and are strongholds for one or more listed species. Compared to Category 1 areas, Category 2 areas have a higher level of fragmentation resulting from habitat disturbance or loss. These areas have a large number of sub-watersheds where native populations have been lost or are at risk for a variety of reasons. Restoring ecosystem function and connectivity within these areas are priorities.

Recommendations from the Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) and the Upper Columbia Biological Strategy (UCRTT, 2002):

a) Increase connectivity by improving fish passage over Dam 5 in the lower Icicle Creek (UCSRB, 2005).
b) Reduce sediment recruitment by restoring riparian vegetation between the mouth of the Icicle and the boulder field (RM 0-5.4) (UCSRB, 2005).
c) Improve road maintenance to reduce fine sediment recruitment in the upper watershed (UCSRB, 2005).
d) Increase habitat diversity and quantity by restoring riparian vegetation, reconnecting side channels, and reconnecting the floodplain with the channel in lower Icicle Creek (UCSRB, 2005).
e) Use practical and feasible means to increase stream flows (within the natural hydrologic regime and existing water rights) in Icicle Creek (UCSRB, 2005).
f) Protect remaining floodplain and riparian habitat downstream of Chatter Creek. Emphasis should be placed on habitat downstream of Leavenworth Hatchery (UCRTT, 2002).

LEGEND

Instream Flow Rule

- Proposed New ISF Control Points
- 1983 ISF Flow Rule Control Points

Chelan County Fish Barrier Inventory

- Unknown if Barrier
- Barrier

Stream Gages

- Ecology - Not Telemetry
- Ecology - Telemetry
- USGS - Not Telemetry
- USGS - Telemetry

2004 - 303d List Category 5 Parameters

- 4,4'-DDE
- 4,4'-DDT
- Fecal Coliform
- Temperature
- pH
- Multiple Parameters

303d Listings with Multiple Parameters

DOE ID#	Parameters
2776	Dissolved Oxygen, pH

Fish Distribution

Documented, Presumed and Potential Fish Distribution per SSHIAP

- Bull Trout Only
- Bull Trout, Spring and Summer Chinook and Summer Steelhead
- Bull Trout, Spring and Summer Chinook, Sockeye and Summer Steelhead
- Bull Trout and Summer Steelhead
- Bull Trout, Spring Chinook and Summer Steelhead

USFS Northwest Forest Plan

- Administrative Withdrawn Areas (Not for Harvest)
- USFS - Other
- Late Successional Reserves (Not for Harvest)
- Managed Late Successional Areas (Managed Harvest)
- MATRIX (Active Harvest)
- Congressionally Designated Wilderness

Other Land Use Data

- Channel Migration Zone
- Private Forestland
- WNF Roadless Areas
- Other Land Ownership

0 2.5
Scale in Miles

Map Projection: Washington State Plane, North Zone, NAD 83, Feet

Source: Chelan County Conservation District, Chelan County Department of Natural Resources, Normandeau, USFS, USGS, WDFW, WSDOT, WSDOE

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ICICLE CREEK SUB-WATERSHED

Chelan/WRIA 45 Watershed Plan/WA

Drawn: AMN	Revison: 5	Date: Apr. 26, 2006	Figure: 9-5

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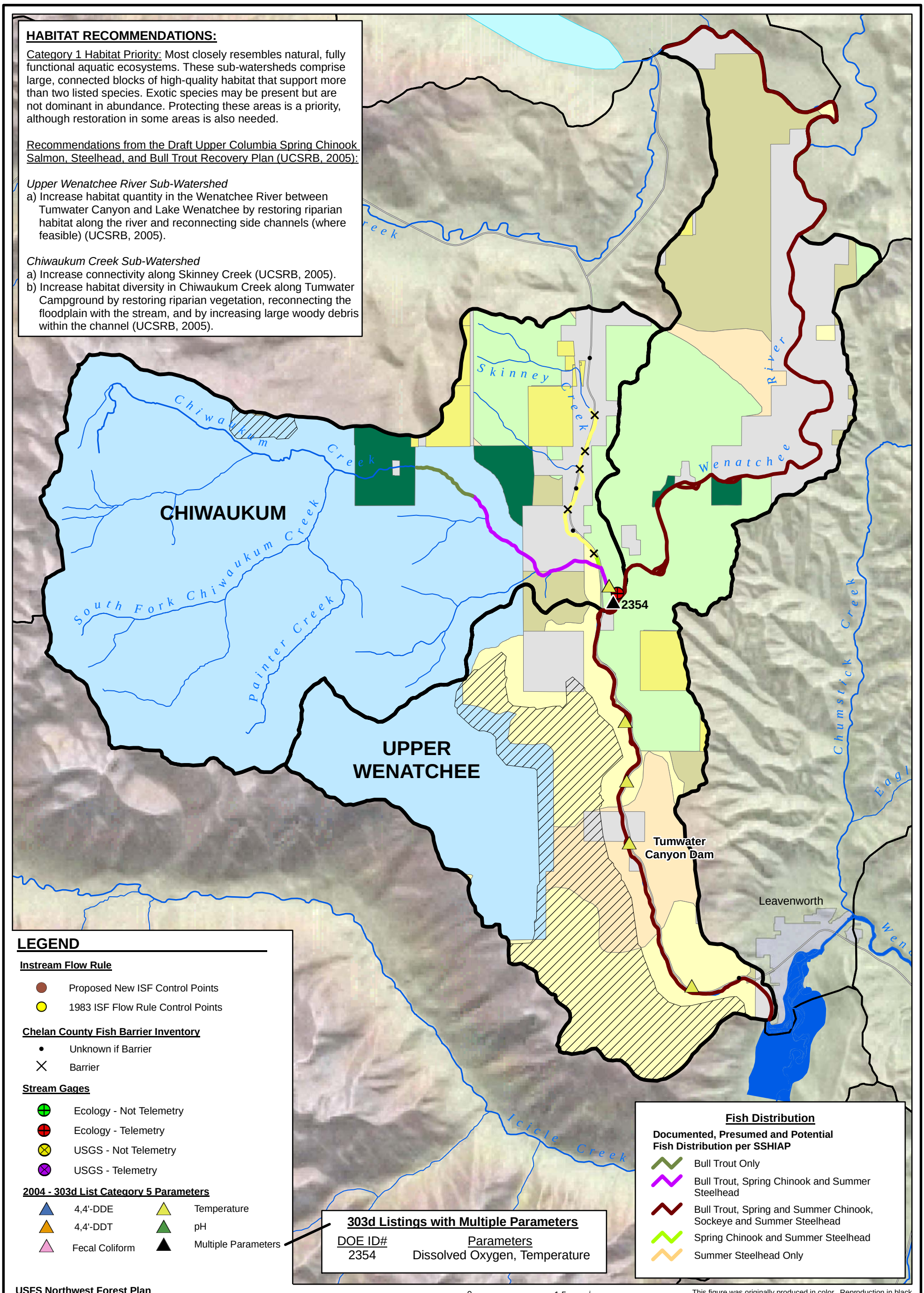
Golder Associates



UPPER WENATCHEE RIVER AND CHIWAUKUM CREEK SUB-WATERSHEDS

Chelan/WRIA 45 Watershed Plan/WA

Drawn: AMN	Revison: 5	Date: Apr. 26, 2006	Figure: 9-6

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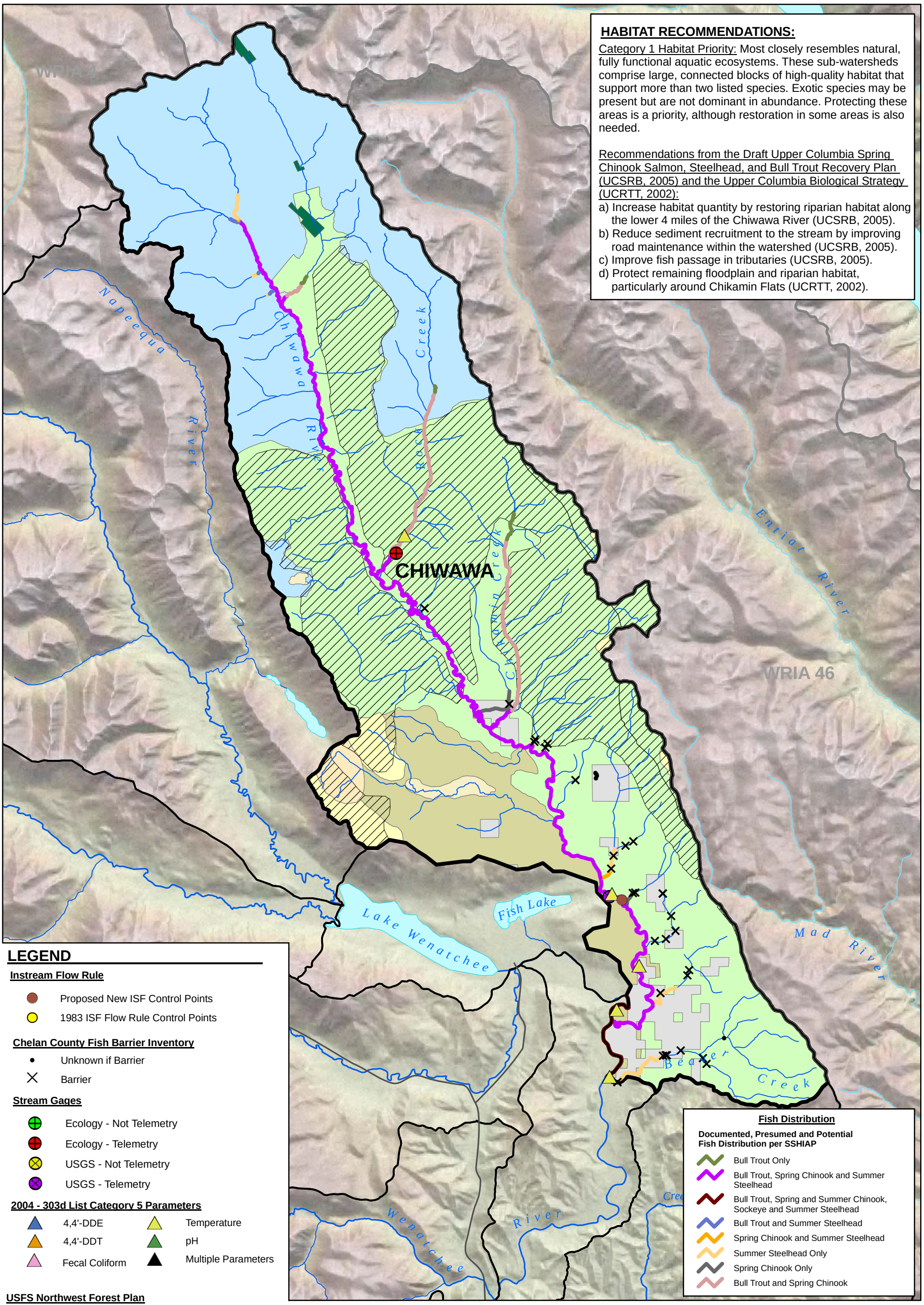

HABITAT RECOMMENDATIONS:

Category 1 Habitat Priority: Most closely resembles natural, fully functional aquatic ecosystems. These sub-watersheds comprise large, connected blocks of high-quality habitat that support more than two listed species. Exotic species may be present but are not dominant in abundance. Protecting these areas is a priority, although restoration in some areas is also needed.

Recommendations from the Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) and the Upper Columbia Biological Strategy (UCRTT, 2002):

a) Increase habitat quantity by restoring riparian habitat along the lower 4 miles of the Chiwawa River (UCSRB, 2005).
b) Reduce sediment recruitment to the stream by improving road maintenance within the watershed (UCSRB, 2005).
c) Improve fish passage in tributaries (UCSRB, 2005).
d) Protect remaining floodplain and riparian habitat, particularly around Chikamin Flats (UCRTT, 2002).

LEGEND

Instream Flow Rule

- Proposed New ISF Control Points
- 1983 ISF Flow Rule Control Points

Chelan County Fish Barrier Inventory

- Unknown if Barrier
- Barrier

Stream Gages

- Ecology - Not Telemetry
- Ecology - Telemetry
- USGS - Not Telemetry
- USGS - Telemetry

2004 - 303d List Category 5 Parameters

- 4,4'-DDE
- 4,4'-DDT
- Fecal Coliform
- Temperature
- pH
- Multiple Parameters

USFS Northwest Forest Plan

- Administrative Withdrawn Areas (Not for Harvest)
- USFS - Other
- Late Successional Reserves (Not for Harvest)
- Managed Late Successional Areas (Managed Harvest)
- MATRIX (Active Harvest)
- Congressionally Designated Wilderness

Other Land Use Data

- Channel Migration Zone
- Private Forestland
- WNF Roadless Areas
- Other Land Ownership

0 1.5
Scale in Miles

Map Projection: Washington State Plane, North Zone, NAD 83, Feet

Source: Chelan County Conservation District, Chelan County Department of Natural Resources, Normandeau, USFS, USGS, WDFW, WSDOT, WSDOE

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CHIWAWA RIVER SUB-WATERSHED

Chelan/WRIA 45 Watershed Plan/WA

Drawn: AMN	Revison: 5	Date: Apr. 26, 2006	Figure: 9-7

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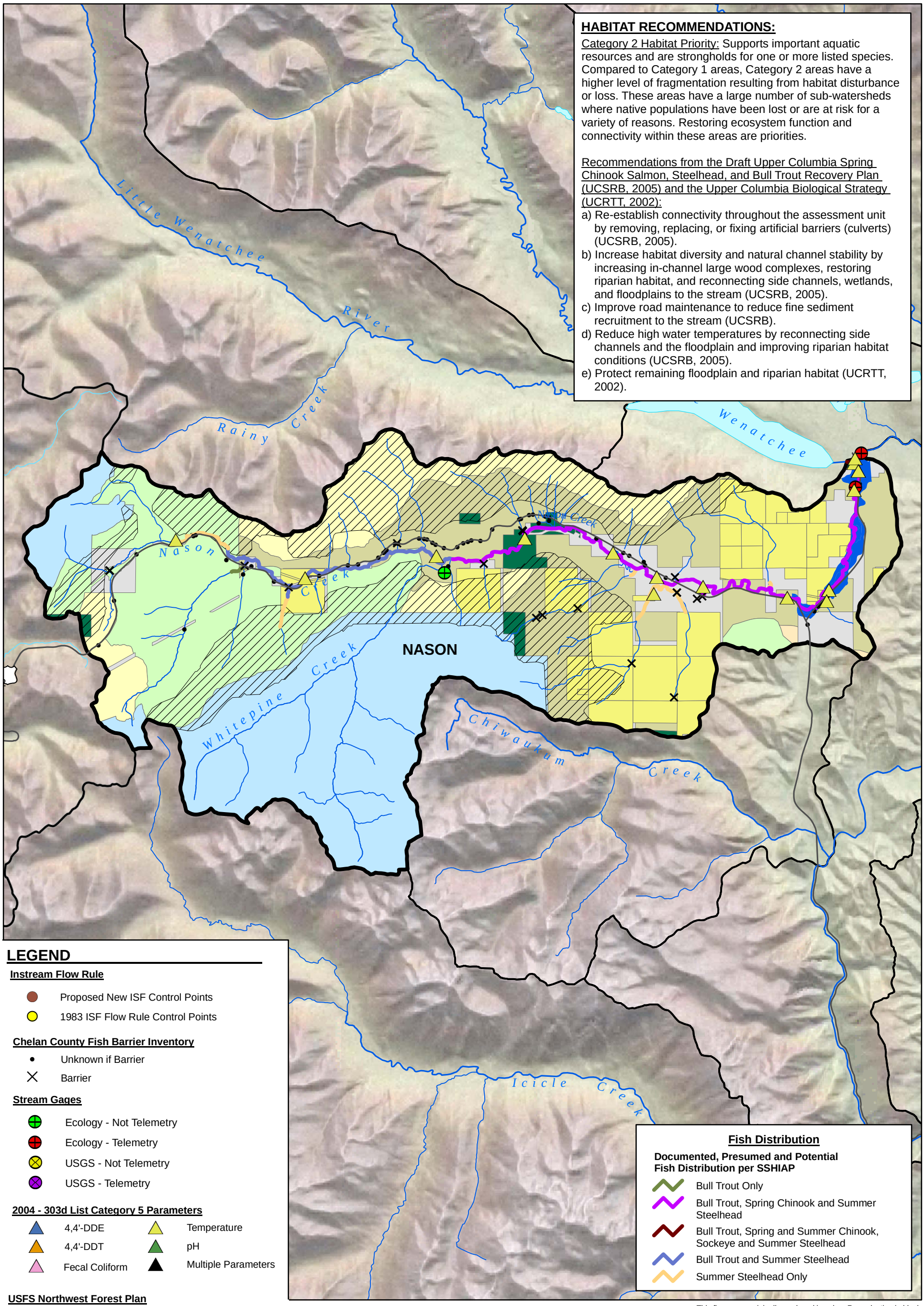

HABITAT RECOMMENDATIONS:

Category 2 Habitat Priority: Supports important aquatic resources and are strongholds for one or more listed species. Compared to Category 1 areas, Category 2 areas have a higher level of fragmentation resulting from habitat disturbance or loss. These areas have a large number of sub-watersheds where native populations have been lost or are at risk for a variety of reasons. Restoring ecosystem function and connectivity within these areas are priorities.

Recommendations from the Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) and the Upper Columbia Biological Strategy (UCRTT, 2002):

a) Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers (culverts) (UCSRB, 2005).
b) Increase habitat diversity and natural channel stability by increasing in-channel large wood complexes, restoring riparian habitat, and reconnecting side channels, wetlands, and floodplains to the stream (UCSRB, 2005).
c) Improve road maintenance to reduce fine sediment recruitment to the stream (UCSRB).
d) Reduce high water temperatures by reconnecting side channels and the floodplain and improving riparian habitat conditions (UCSRB, 2005).
e) Protect remaining floodplain and riparian habitat (UCRTT, 2002).

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NASON CREEK SUB-WATERSHED

Chelan/WRIA 45 Watershed Plan/WA

Drawn: AMN	Revison: 5	Date: Apr. 26, 2006	Figure: 9-8

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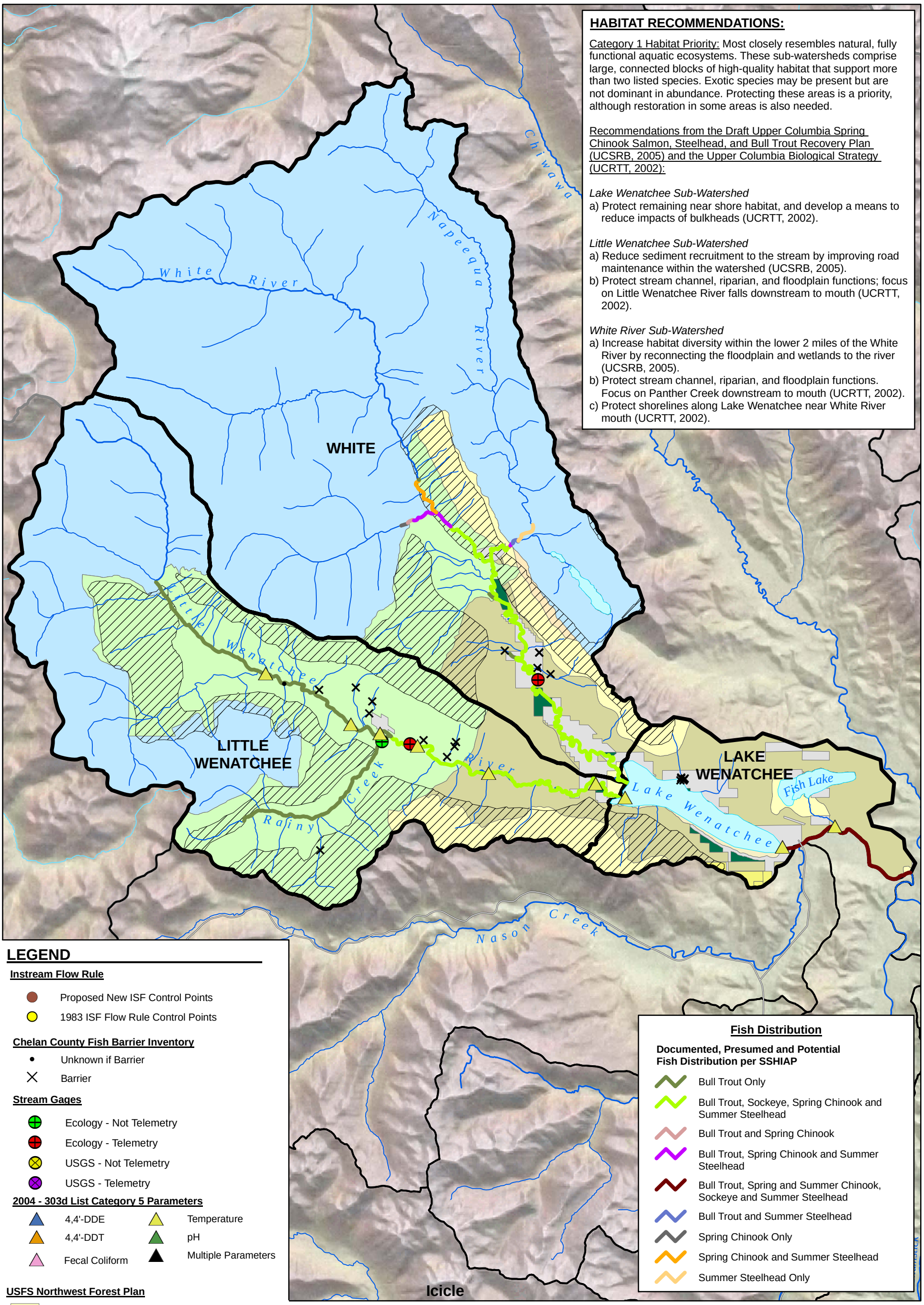
Golder Associates



HABITAT RECOMMENDATIONS:

Category 1 Habitat Priority: Most closely resembles natural, fully functional aquatic ecosystems. These sub-watersheds comprise large, connected blocks of high-quality habitat that support more than two listed species. Exotic species may be present but are not dominant in abundance. Protecting these areas is a priority, although restoration in some areas is also needed.

Recommendations from the Draft Upper Columbia Spring Chinook Salmon, Steelhead, and Bull Trout Recovery Plan (UCSRB, 2005) and the Upper Columbia Biological Strategy (UCRTT, 2002):

Lake Wenatchee Sub-Watershed

a) Protect remaining near shore habitat, and develop a means to reduce impacts of bulkheads (UCRTT, 2002).

Little Wenatchee Sub-Watershed

a) Reduce sediment recruitment to the stream by improving road maintenance within the watershed (UCSRB, 2005).
b) Protect stream channel, riparian, and floodplain functions; focus on Little Wenatchee River falls downstream to mouth (UCRTT, 2002).

White River Sub-Watershed

a) Increase habitat diversity within the lower 2 miles of the White River by reconnecting the floodplain and wetlands to the river (UCSRB, 2005).
b) Protect stream channel, riparian, and floodplain functions. Focus on Panther Creek downstream to mouth (UCRTT, 2002).
c) Protect shorelines along Lake Wenatchee near White River mouth (UCRTT, 2002).

LEGEND

Instream Flow Rule

- Proposed New ISF Control Points
- 1983 ISF Flow Rule Control Points

Chelan County Fish Barrier Inventory

- Unknown if Barrier
- Barrier

Stream Gages

- Ecology - Not Telemetry
- Ecology - Telemetry
- USGS - Not Telemetry
- USGS - Telemetry

2004 - 303d List Category 5 Parameters

- 4,4'-DDE
- 4,4'-DDT
- Fecal Coliform
- Temperature
- pH
- Multiple Parameters

USFS Northwest Forest Plan

- Administrative Withdrawn Areas (Not for Harvest)
- USFS - Other
- Late Successional Reserves (Not for Harvest)
- Managed Late Successional Areas (Managed Harvest)
- MATRIX (Active Harvest)
- Congressionally Designated Wilderness

Other Land Use Data

- Channel Migration Zone
- Private Forestland
- WNF Roadless Areas
- Other Land Ownership

0 2.5
Scale in Miles

Map Projection: Washington State Plane, North Zone, NAD 83, Feet

Source: Chelan County Conservation District, Chelan County Department of Natural Resources, Normandeau, USFS, USGS, WDFW, WSDOT, WSDOE

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LAKE WENATCHEE, WHITE RIVER AND LITTLE WENATCHEE RIVER SUB-WATERSHEDS

Chelan/WRIA 45 Watershed Plan/WA

Drawn: AMN	Revison: 5	Date: Apr. 26, 2006	Figure: 9-9

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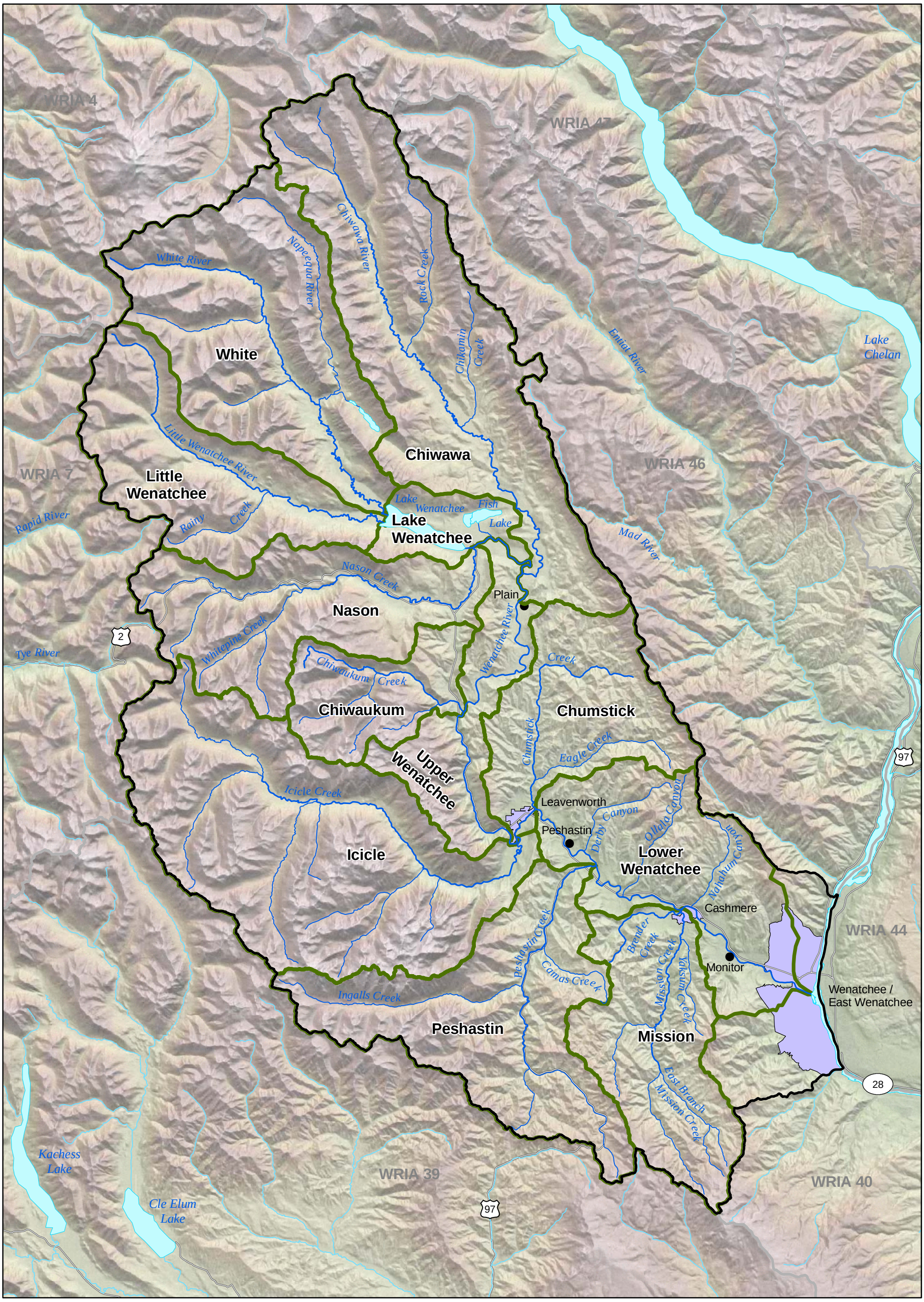

LEGEND

- WRIA 45 Boundary
- WRIA Boundary
- Sub-Watershed Boundary
- Major Road
- Waterbody
- Watercourse
- Urban Area

0 5

Scale in Miles

Map Projection:
Washington State Plane,
North Zone, NAD 83, Feet

Source: Chelan County, USGS, WAGDA, WSDOE, WSDOT

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WENATCHEE WATERSHED OVERVIEW

Chelan/WRIA 45 Watershed Plan/WA

Drawn: KBD	Revison: 4	Date: Apr. 26, 2006	Figure: ES-1

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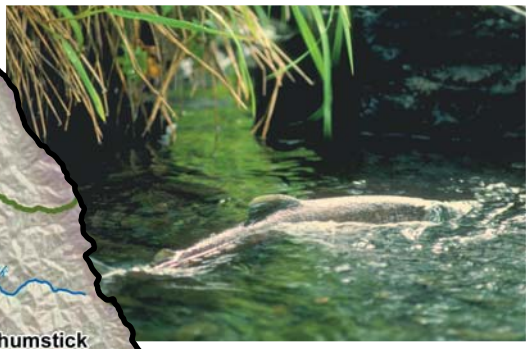
Final

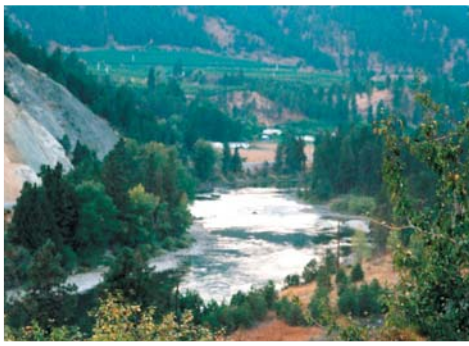
Wenatchee Watershed Management Plan

Volume II - Appendices

Developed by

The WRIA 45 Planning Unit





April 26, 2006

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APPENDIX A

CURRENT AND FORECASTED WATER USE BY SUB-WATERSHED IN WRIA 45

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1.0 INTRODUCTION

The water quantity component of watershed planning under Chapter 90.82 RCW requires, among other things, estimates of reserved rights, and estimates of current and future surface water and groundwater use. Estimates of current and projected water use for Water Resource Inventory Area (WRIA) 45 have previously been presented at a US Census Bureau Census County Division (CCD) scale (MWG, 2003; Montgomery Watson Harza, 2003). However population density and water usage are highly variable within the Wenatchee Watershed, therefore an assessment of water use at a sub-watershed scale was deemed necessary to support water allocation and availability decisions. This appendix presents current and estimated future water use on a sub-watershed scale. Where possible, data from previous watershed studies were used. However, adjustments were made as water use estimates were developed and additional or updated data became available.

Population and water use estimates are limited by the quantity and quality of the available data. Furthermore, most data sources do not quantify the error inherent in their data collection systems. Therefore, during this evaluation, significant effort has been made to document the source and ultimate function of all data that are used, as well as any limitations associated with the data. The goal in making these water use estimates is to better track data in a form that is useable for future watershed planning.

This appendix is organized into the following sections:

Population: This section describes population distribution in the watershed in terms of types of water users and population projections from Chelan County and others used to estimate future water demand.

Current and Future Water Use: This section presents the methodology used to estimate water use for population groups in WRIA 45 and current and future (2025) water use estimates by sub-watershed.

Water Budget: This section presents a budget of water allocated and used by various user classes within each sub-watershed, and compares the allocations to instream flows.

1.1 Population

This section presents data used to divide the population into water service types (Group A, Group B, and exempt well served) and water use groups (part-time or full-time use) and the estimated percent increase in population on a Census County Division (CCD) scale.

1.1.1 Current Population Divisions for Water Use Estimates

When estimating water use and water use impacts two aspects of use are important: how a residence is provided with water, and how much water that residence uses.

Estimates of “how” a residence is served were completed by dividing population into Group A, Group B, or exempt well served populations. Group A water systems are those that regularly serve either 15 or more residential connections or 25 or more people per day for 60 or more days per year. Group B water systems are those that serve fewer than 15 residential connections and fewer than 25 people per day, or 25 or more people per day for fewer than 60 days per year. Exempt wells do not require a permit from the Department of Ecology (Ecology) and are generally used for domestic purposes, including stock water and small-scale irrigation.

Estimates of "how much" water a population uses were completed by division into full-time and part-time populations. Because the density of part-time use vacation homes is high in WRIA 45 and the volume of water use by part-time residents is expected to be lower annually than full-time residents. Full-time use includes any population that uses water for more than half of the year. Part-time use is assumed to use water for less than half of the year.

Table A-1 presents these population distributions by sub-watershed. A description of each column is presented below. Three sources of data were used to develop these population divisions: parcel data from the Chelan County assessor's database (Chelan County, 2005), population data from the U.S. Census Bureau (year 2000), and connections served data from the Washington State Department of Health in-house water system tracking database (Nicodemus, personal communication, 2005).

Total Population Estimate, 2005 Parcel Data

Chelan County assessor data (obtained on June 6, 2005) describing individual parcel characteristics was used to estimate total population. Parcel data was converted to total population by multiplying the number of parcels by an assumed number of households (shown below) and then by a mean household size of 2.62 people (2000 U.S. Census Bureau reported mean household size for Chelan County). Parcels were selected as residential parcels if they had the following characteristics. Assumed household size for each parcel type is also shown.

1) a primary or secondary land use field value of:

- All other residential – Assumed 1 household,
- Household 2-4 units – Assumed 3 households,
- Mobile home parks/courts – Assumed 1 household,
- Multi-units 5 or more – Assumed 5 households,
- Residential hotels – condominium – Assumed 1 household,
- Single family units - Assume 1 household,
- Vacation and cabin – Assume 1 household; and

2) an improvement value (actual data label of "Building A") of greater than or equal to $5,000.

Full-Time Population Estimate, 2000 Census

Full-time population was estimated from 2000 U.S. Census Bureau data. Census data is reported in blocks, which vary in size according to population density. A city the size of Cashmere contains 85 blocks. The census blocks were then aggregated by sub-watershed. There is error associated with the aggregation process, as census blocks may cross sub-watershed boundaries. In these cases, Chelan County parcel coverage was used to determine the number of residential parcels within block boundaries for each sub-watershed. The source data resolution meets National Map Accuracy Standards for 1:100,000 scale maps.

It was expected that parcel data would result in a larger total population per sub-watershed than census data. However, in the Mission, Lower Wenatchee and Little Wenatchee estimated full-time population was greater than estimated total population. This could be due to errors in the assessors database, errors in the assumptions of people per household or households per parcel for that sub-watershed, among other things.

Part-Time Population Estimate

Part-time population was calculated as the difference between total population (from parcel data) and full-time population (census data).

Residential Population Serviced by Group A/B Systems

Populations served by Group A and B water systems were obtained from a query completed by the Department of Health (DOH) of their in-house water system tracking database (Nicodemus, personal communication, 2005). The query selected the following service types:

- Full-time Single Family Residences (Occupied >= 180 Days a Year),
- Multi-family Residential Buildings (Apartments, Condos, Barracks, Dorms, etc.),
- Full-time Residential Units (Occupied >= 180 Days a Year),
- Part-time Residential Units (Occupied < 180 Days a Year), and
- Part-time Single Family Residences (Occupied < 180 Days a Year).

The number of residences was then multiplied by a mean household size of 2.62 people to calculate population. Four water suppliers (Chiwawa Communities Association, City of Leavenworth, Chelan County PUD NO. 1 – Dryden, and the City of Cashmere) provided in-house estimates of population served (MWG, 2003; personal communication, June, 2005), and these data were used in place of DOH query results.

Two adjustments were made to Group A and B population estimates.

1. The City of Cashmere straddles the Mission and Lower Wenatchee sub-watershed; therefore the population served by this system (part of the Group A Population column) is divided between these two sub-watersheds with 36% residing in the Lower Wenatchee sub-watershed and 64% in the Mission sub-watershed.

2. The population of the City of Leavenworth resides primarily in the Chumstick sub-watershed; however, the water supply originates in the Icicle sub-watershed. The population estimates for Leavenworth are reported under Chumstick; however, estimates of water use and water budgets are reported under Icicle.

Residential Populations Served by Exempt Wells

The population served by exempt wells was calculated as the difference between total population from 2005 parcel data and the total population served by Group A and Group B water systems. An exception is for Mission, Little Wenatchee, and Lower Wenatchee watersheds where “Full-time” population was greater than “Total Population”; in these cases “Full-time” population was used rather than total population.

1.1.2 Population Projections

Population projections were reported by Chelan County for Urban Growth Areas (UGAs) and non-UGA (rural) portions of the Cashmere and Leavenworth–Lake Wenatchee CCD. These projections were based, in turn, on “high growth” population projections reported by the Office of Financial Management. This population and growth data is shown in Table A-2.

Existing and estimated population for the year 2000 and 2025 for the Cashmere and Leavenworth–Lake Wenatchee CCD, and the UGAs within those CCDs, were reported in the Chelan County Comprehensive Plan (2000). Non-UGA population was calculated as the difference between the Total population and the UGA designated population. Two exceptions to that reporting exist:

- Chelan County indicated that the projected Non-UGA population of the Leavenworth-Lake Wenatchee CCD should be larger than reported with an increase of 1,020 people between 2000 and 2025. This resulted in a larger total projected (2025) population for the Leavenworth-Lake Wenatchee CCD than that reported in the Comprehensive Plan (Chelan County Planning, personal communication, 2005).

- A future UGA in the vicinity of Peshastin and Dryden in the Cashmere CCD is anticipated based on a Memorandum of Understanding (Chelan County, 2002) between Chelan County and the cities of Wenatchee, Chelan, Cashmere, Leavenworth and Entiat regarding the allocation of the Office of Financial Management population projections. This UGA is assumed to follow the boundaries of the future Peshastin Water District Service area and is reported as having a current population of 436 and projected 2025 population of 1100 (percent increase of 6.09%). This MOU did not change the total projection in the watershed, but rather changed the distribution of population among existing UGA and non-UGA areas.

An average annual increase in population of 1.18% and 4.34% between 2000 and 2025 was calculated for Non-UGA and UGA sub-watershed areas respectively in the Leavenworth-Lake Wenatchee CCD. The average annual population increase in Non-UGA areas of the Cashmere CCD was estimated to be 1.16% over the 25-year period. A small portion of the Wenatchee CCD extends into WRIA 45. The 1.16% annual growth factor was also used to estimate 2025 rural water use in this area. These rates have been applied to rural areas within each sub-watershed to estimate water use in 2025. The increase of UGA residing populations in the Cashmere CCD was calculated to be 3.97% for the Cashmere UGA and 6.09% for the future UGA (called Peshastin in the table).

1.2 Estimated Current and Future Domestic and Municipal Water Use

Domestic and municipal water use was estimated for the year 2002 and projected to 2025 using Chelan County population growth rates (previously discussed). The results, grouped by sub-watershed and use type, are presented in Table A-3. These water use estimates represent total water use (consumptive and non-consumptive) for all municipal and domestic uses (includes household, commercial, industrial, etc.). Because the ratio of consumptive vs. non-consumptive use can vary widely (20% to 50%) in urban and rural areas no attempt to estimate the "consumptive only portion" of total water use for the watershed or sub-watersheds was made as part of this analysis.

The following steps occurred to reach current and projected water use estimates.

<u>1) Estimate of the Number of Connections served by Use Type</u>

Population by sub-watershed and use group was presented previously in Table A-1. However, application of water demands directly to previously presented population estimates would not capture other municipal and domestics uses, especially commercial uses (such as hotels or campgrounds), which are expected to be significant in sub-watersheds of WRIA 45. In order to capture this, the DOH in-house water system database was queried to capture additional water use connections not directly associated with population. The additional groups included in water use estimates are

- Recreational Services (Campsites, RV sites, Standpipes, etc.), and

- Other Non-residential Services (Institutional, Industrial, Commercial, or Agricultural).

Recreational service connections were added to the "Part-time" water use group. Other Non-residential service connections were added to the "Full-time" Use group.

The method of estimating the number of exempt wells was described in Section 1.1. (the difference between total population (from parcel data) and population served by Group A or Group B water systems). Those estimates are reported directly in Table A-3 as a number of connections.

In addition, where individual water purveyors exist they are notated separately in Table A-3. Several water suppliers reported population-served estimates in the Watershed Assessment and these data were used in place of DOH query results. The purveyors are: Chiwawa Communities Association, City of Leavenworth, Chelan County PUD NO. 1 – Dryden, and the City of Cashmere. The type of data supplied varies, with some purveyors only reporting the number of connections served and others reporting the ADD and MDD.

Population was converted to equivalent residential units, or number of connections using the following assumptions:

- There are 2.62 people per connection/household, based on the mean Chelan County household size of 2.62 (Washington State Office of Financial Management, 2000); and

- One household is equivalent to one water service connection.

2) Convert Connections to Demand

The following assumptions were used to convert the number of connections to a demand for both current and future water use estimates.

- Average day demand (ADD) is equal to the total annual demand allocated evenly to each day of the year. Maximum day demand (MDD) is the day of the year having the highest water demand.

- Average Day Demand per full-time household is 380 gpd (MWG, 2003).

- Average Day Demand per part-time household is 95 gpd (MWG, 2003).

- Max Day Demand is 2.5 times Average Day Demand (MWG, 2003).

- All exempt well supplied households use water at full-time household rates of 380 gpd.

3) Project Future Water Use

Two sources of data were used to provide an estimate of how water use will change between 2002 and 2025:

Chelan County Population Projections: Projected percent increases in population from Chelan County's use of the Office of Financial Management (OFM) "high" Total Resident Population projection for each of two Census County Divisions (CCDs), the Lake Wenatchee-Leavenworth CCD and the Cashmere CCD (Section 1.1.2 and Table A-2). Population projections provide an estimate of

how water use will grow in the absence of large changes in water use (such as a large new industrial user or conservation).

Purveyor supplied projected water use: Purveyor supplied water use projections include all uses (not just residential) and therefore, where available were used in place of water use projections based on population. The Cities of Leavenworth and Cashmere (Urban Growth Areas) have water system plans for their service areas that included estimates of total future water use (including all uses - residential, commercial, industrial, etc.).

- City of Cashmere: Water use and equivalent residential unit (ERU) projections were reported in the City of Cashmere Comprehensive Water System Plan (RH2 Engineering, 2004) for the year 2021. These were further extended to 2025 using a total water use growth rate of 1% per year, and used in place of population projections in estimating future water use. These projections include residential, industrial public and commercial uses in the UGA and therefore are considered more accurate than population projections when considering total future water use. This results in a percent increase in water use of approximately 1.0% annually.

- The City of Leavenworth: The City of Leavenworth Water System Plan (2002) provided a projected water use and total number of equivalent residential units (ERUs) for the year 2020 which was extended to 2025 using a compounded growth rate of 3.4% (Varela and Associates, 2002). This estimate was used directly in water use estimates for 2025. ERUs include both residential and commercial uses in the UGA reported as an equivalent number of single family dwellings (an ERUS). Therefore this projected water use includes all uses within the UGA.

4) Adjustments to water use spatial distribution:

The City of Cashmere and City of Leavenworth both cross sub-watershed boundaries. Therefore adjustments were made in the presentation of their current and projected water demands.

- The City of Cashmere straddles both the Mission sub-watershed (64%) and the Lower Wenatchee sub-watershed (36%) therefore the number of connections (and therefore water demand) was divided with 64% applied to the Mission sub-watershed and 36% applied to the Lower Wenatchee sub-watershed.

- The City of Leavenworth's water source is obtained from the Icicle sub-watershed while the population primarily lives in the Chumstick sub-watershed. Therefore population (Table A-1) reports the City of Leavenworth's population in the Chumstick. However, water use estimates report the City of Leavenworth's use in the Icicle.

1.3 Water budget

The intent of the water budget is to present the scale of major human water uses as compared to stream flow in each sub-watershed of WRIA 45, and for the WRIA overall, for periods of limited water availability. The water budget is presented in Table A-5, compare water use (both groundwater and surface water use) and surface water flows directly. Any delays of impacts to stream flow from demands met by ground water are not directly represented in this data; ground water storage has not been assessed to this extent. This assessment should not be interpreted as a hydrologic water balance. Components of and Table A-5 include:

Municipal and Domestic Day Demand: Municipal water use is represented by ADD (average daily demand in a year) and MDD (the day of the year having the highest water demand) for 2002 and 2025. ADD and MDD are the total demand calculated for all municipal and domestic water use types within a sub-watershed as shown in Table A-3. This represents the total municipal and domestic water delivered to residences in the watershed based on the population and water use estimates made in the previous sections. It also represents municipal water delivered for commercial and industrial use within water service areas.

Flow: Flow was calculated as the monthly average of the daily 10, 50, and 90 % exceedance flows for September over the period of record. Low flow is represented by the 90% exceedance flow, average flow is represented by the 50% exceedance flow, and high flow is represented by the 10% exceedance flow. An exceedance flow represents the flow that has a percent chance of being equaled or exceeded in any one day based on available measured or modeled data. No flow data was available from the Chiwaukum, Chumstick, and Little Wenatchee sub-watersheds. The following exceedance data was used to represent each sub-watershed.

- Chiwawa Sub-watershed: Chiwawa River Near Plain, USGS Gage 12456500; River Mile 6.2; Period of Record 1911-2002 (Figure 4-9)

- Icicle Sub-watershed: Icicle Creek above Snow Creek near Leavenworth, USGS 12458000 , Period of Record: 1936 – 2003 (Figure 4-7)

- Lake Wenatchee Sub-watershed: Wenatchee at Plain, USGS Gage 12457000; River Mile 46.2; Period of Record: 1910 – 2002 (Figure 4-4)

- Lower Wenatchee Sub-watershed: Wenatchee at Monitor, USGS Gage 12462500; River Mile 7.0; Period of Record: 1962 – 2002 (Figure 4-2)

- Mission Sub-watershed: Mission Creek above Sand Creek near Cashmere, USGS Gage 12461400; River Mile 7.0; Period of Record: 1959 – 1977 (Figure 4-5)

- Nason Sub-watershed: Nason Creek Synthesized Hydrology from Nason Creek Correlation (Figure 4-8)

- Peshastin Sub-watershed: Peshastin Creek at Green Bridge Synthesized Hydrology from Peshastin Creek (Figure 4-6)

- Upper Wenatchee Sub-watershed: Wenatchee at Peshastin, USGS 12459000; River Mile 21.5; Period of Record: 1929 – 2002 (Figure 4-3)

- White Sub-watershed: White River near Plain, USGS Gage 12454000; River Mile 6.4; Period of Record: 1954 – 1983

The remaining fields in the water budget were estimated using instantaneous allowable rates for water rights (Qi) obtained from the Technical Assessment (MWG, 2003). Using water rights data as representative of use assumes that the full water right is used consumptively. Permits, certificates and claims reported in the water rights database may be duplicative and indicate higher than actual irrigation use. The following fields use water rights data in the water budget.

Irrigation permits, certificates and claims. A permit, certificate or claim was included if the first Purpose of Use was irrigation.

Fish Propagation: A permit, certificate or claim was included if the first Purpose of Use was Fish Propagation.

Water Right Applications: Includes applications for all purposes of use.

CIR: Crop Irrigation Requirement represents the estimated consumptive irrigation use of crops in WRIA 45 as reported in the Technical Assessment (MWG, 2003). Reported for total watershed water budget only.

2.0 REFERENCES

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TABLES

TABLE A-1

Current WRIA 45 Population by Water Use Type[5]

Sub-Watershed	Total Population Estimate 2005 Parcel Data [2]	Full-Time Population Estimate 2000 Census [3]	Estimated Part Time Population [9]	Population Serviced by Group A Systems [4]	Population Serviced by Group B Systems [5]	Population Served by Exempt Wells [6]
Chiwaukum	31	20	11	0	13	18
Chiwawa	1,098	406	692	812	60	225
Chumstick [8]	5,133	3,665	1,468	3228	123	1,782
Icicle [8]	1,127	723	404	0	73	1,053
Lake Wenatchee	1,404	206	1,198	401	123	880
Little Wenatchee [10]	-	3	-	0	0	3
Lower Wenatchee [7,10]	7,040	7,886	-	2455	521	4,910
Mission [7,10]	3,382	3,895	-	2093	241	1,561
Nason	1,066	144	922	566	113	388
Peshastin	1,095	865	230	351	55	689
Upper Wenatchee	2,269	624	1,645	1336	68	865
White	194	72	122	18	8	168
Total	23,839	18,509	6,692	11,260	1,399	12,542

NOTES:
PWS = Public Water System; ADD = Average Day Demand; MDD = Maximum Day Demand; mgd = million gallons per day; AF/yr = acre-feet per year; DOH - Department of Health
(1) This table builds on data presented in the Phase 2 - Level 1 Technical Assessment (MWG, 2003). The purpose of this table is to present estimates of the population of part-time and full-time residential water users and the population of Group A, B, and exempt well water users.
(2) Total Population was estimated using parcel data from the Chelan County Assessors database (June 6, 2005). Database query results include all full-time and part-time residential parcels. This estimate assumes that one residential parcel is equivalent to one household unit, and one water service connection, unless noted otherwise. Population is calculated by multiplying the number of parcels by 2.62 (U.S. Census reported average population per household). Parcel types included: All other residential, Household 2-4 units (assume 3 units per parcel), Mobile home parks/courts, Multi-units 5 or more (assume 5 units per parcel), Single family units, Vacation and cabin, and Residential Hotels - Condominiums. Only parcels with an improvement value of $5,000 or greater are considered. Primary and Secondary land use types are identified in the Assessor's database. Errors in the assessor's database are possible (Chelan County Planning, personal communication, 2005).
(3) 2000 census data is used to estimate the total full-time population in the watershed. Full-time indicates WRIA 45 is used as the permanent residence.
(4) Group A served population obtained from DOH in-house database DOH (Nicodemus, personal communication, 2005) and includes both full time and part-time single-family and residential units serviced by Group A PWS. To obtain population, the number of connections is multiplied by 2.62 (average people per household, U.S. Census, 2000). Data for the following water suppliers was used in place of DOH reported data: City of Leavenworth, Chiwawa Communities Assoc., City of Cashmere, Chelan County PUD No. 1.
(5) Group B served population obtained from DOH in-house database DOH (Nicodemus, personal communication, 2005) and includes both full time and part-time residences serviced by Group B PWS. To obtain population the number of connections is multiplied by 2.62 (average people per household, U.S. Census, 2000).
(6) Population served by exempt wells are calculated as the difference between columns labeled "Total Population Estimate from 2005 Parcel Data" and the sum of columns "Population served by Group A Water Systems" and "Population served by Group B Water Systems". This calculation assumes that DOH recorded Group A and Group B water systems do not include residences or residential groups served by exempt wells. Where census population is larger than parcel estimated population the total population from Census data is used in place of parcel estimated population - this applies to Mission, Lower Wenatchee, and Little Wenatchee Sub-watersheds.
(7) The City of Cashmere is split between the Mission and Lower Wenatchee Sub-watersheds; therefore the population reportedly served by the City of Cashmere WSP (MWG, 2003) is divided across these two sub-watersheds with approximately 36% residing in the Lower Wenatchee sub-watershed and 64% in the Mission Sub-watershed.
(8) The City of Leavenworth population is located primarily in the Chumstick Sub-watershed; however their water supply originates in the Icicle. Therefore calculations of population for the City of Leavenworth are included in the Chumstick, while water use estimates or water budgets for the City of Leavenworth are listed under the Icicle sub-watershed.
(9) Part-time population is calculated as the difference between columns labeled "Total Population Estimate from 2005 Parcel Data" and "Full Time Population Estimate from 2005 Parcel Data". Part-time indicates this is not the permanent residence and that the resident resides in the WRIA less than half the year.
(10) In the Mission, Lower Wenatchee, and Little Wenatchee census data indicates a larger population than the Total Population estimate from parcel data. This could be due to mis-identification of parcels in the assessor's database, errors in population data, or a greater number of people per connection than that estimated for Chelan County. In these cases, census data was used to represent total population in the sub-watershed, rather than parcel data.

UGA and Rural Population by CCD [1]

Statement of Intent: Projections in this table are used to provide population growth rates for Rural Areas only and are not used to forecast water use in urban areas.

Leavenworth-Lake Wentachee CCD	2000 Population [2]	2025 Population [3]	Population Change 2025-2000	Annual Percent Increase in Population [6]
UGA	2432	5071	2639	4.34%
Non-UGA	3470	4490	1020 [4]	1.18%
TOTAL	**5902**	**9561 [4]**	**3569**	**2.48%**
Cashmere CCD				
Cashmere UGA	3694	7360	3666	3.97%
Future UGA (Peshastin) [5]	436	1100	664	6.09%
Non-UGA	6694	8632	1938	1.16%
TOTAL	**10824**	**17092**	**6268**	**2.32%**

Notes:
UGA - Urban Growth Area, CCD - County Census Division, OFM - Office of Financial Management
(1) Population data is based on several sources of data; Office of Financial Management Projections, Chelan County's distribution of those projections to UGAs, and any additional data which became available subsequent to those publications.
(2) 2000 population totals and UGA populations are from the Chelan County Comprehensive Plan. Non-UGA portions of total population were calculated as the difference between the total population in the CCD and the Year 2000 UGA reported population.
(3) Projected 2025 population totals and projected UGA totals are based on the projected population change provided in the Chelan County Comprehensive Plan (which is based on OFM projections). Non-UGA projected population is calculated as the difference between the Total and UGA projected population.
(4) Projected 2025 population totals for the Leavenworth - Lake Wenatchee CCD is larger than OFM reported projections for Chelan County due to higher non-UGA projections provided by Chelan County. The projected Non-UGA population change (2000 to 2025) reported for the Leavenworth - Lake Wenatchee CCD is 1020 persons (Chelan County Planning, personal communication, 2005).
(5) Future Peshastin UGA boundary is assumed to be the Peshastin Water District's future service area. 2025 projected population was reported in a Memorandum of Understanding between Chelan County and the cities of Wenatchee, Chelan, Cashmere, Leavenworth and Entiat on allocation of OFM population projections (July 22, 2002).
(6) Annual percent increase is calculated as the average percent change in population for each growth area over 25 years.

TABLE A-3

Estimated Current and Future Municipal and Domestic Water Use (5)

			2002							2025					
				ADD		MDD		Annual [7]			ADD		MDD		Annual [7]
Sub-Watershed	Notes	Type	Total Number of Connections or ERUs	mgd	cfs	mgd	cfs	AF/yr	Applied Annual Percent Increase [8]	Total Number of Connections or ERUs	mgd	cfs	mgd	cfs	AF/yr
Chiwaukum	1	Part-Time	28	0.003	0.004	0.007	0.010	3	1.18%	36	0.003	0.005	0.008	0.013	4
Chiwaukum	2	Full-Time	8	0.003	0.005	0.008	0.012	3	1.18%	10	0.004	0.006	0.010	0.015	4
Chiwaukum	3	Connections with Exempt Wells	7	0.003	0.004	0.007	0.010	3	1.18%	9	0.003	0.005	0.008	0.013	4
Chiwawa	1	Part-Time	3	0.000	0.000	0.001	0.001	0	1.18%	4	0.000	0.001	0.001	0.001	0
Chiwawa	2	Full-Time	298	0.113	0.175	0.283	0.438	127	1.18%	379	0.144	0.223	0.360	0.556	161
Chiwawa	3	Connections with Exempt Wells	86	0.033	0.051	0.082	0.126	37	1.18%	109	0.042	0.064	0.104	0.161	47
Chiwawa	10	Chiwawa Communities Association	309	0.055	0.085	0.138	0.213	62	1.18%	393	0.070	0.108	0.175	0.270	78
Chumstick	1	Part-Time	1	0.000	0.000	0.000	0.000	0	1.18%	1	0.000	0.000	0.000	0.000	0
Chumstick	2	Full-Time	141	0.054	0.083	0.134	0.207	60	1.18%	179	0.068	0.105	0.170	0.263	76
Chumstick	3	Connections with Exempt Wells	680	0.258	0.400	0.646	0.999	290	1.18%	864	0.328	0.508	0.821	1.270	368
Icicle	1	Part-Time	3	0.000	0.000	0.001	0.001	0	1.18%	4	0.000	0.001	0.001	0.001	0
Icicle	2	Full-Time	47	0.018	0.028	0.045	0.069	20	1.18%	60	0.023	0.035	0.057	0.088	25
Icicle	3	Connections with Exempt Wells	402	0.153	0.236	0.382	0.591	171	1.18%	511	0.194	0.300	0.485	0.751	218
Icicle	9	City of Leavenworth	2,028	1.011	1.564	2.528	3.911	1,133		4,714	2.195	3.396	5.693	8.490	2,461
Lake Wenatchee	1	Part-Time	257	0.024	0.038	0.061	0.094	27	1.18%	327	0.031	0.048	0.078	0.120	35
Lake Wenatchee	2	Full-Time	129	0.049	0.076	0.123	0.190	55	1.18%	164	0.062	0.096	0.156	0.241	70
Lake Wenatchee	3	Connections with Exempt Wells	336	0.128	0.198	0.319	0.494	143	1.18%	427	0.162	0.251	0.406	0.627	182
Little Wenatchee	3	Connections with Exempt Wells	1	0.000	0.001	0.001	0.002	0	1.18%	1	0.001	0.001	0.001	0.002	1
Lower Wenatchee	1	Part-Time	174	0.017	0.026	0.041	0.064	19	1.16%	220	0.021	0.032	0.052	0.081	23
Lower Wenatchee	2	Full-Time	488	0.185	0.287	0.464	0.717	208	1.16%	618	0.235	0.363	0.587	0.908	263
Lower Wenatchee	3	Connections with Exempt Wells	1,874	0.712	1.102	1.780	2.755	798	1.16%	2,373	0.902	1.395	2.255	3.488	1,011
Lower Wenatchee	4	City of Cashmere (36%)	819	0.364	0.563	0.910	1.408	408		1,000	0.447	0.691	0.763	1.728	501
Lower Wenatchee	10	Chelan County PUD NO. 1 - Dryden	64	0.017	0.026	0.043	0.066	19	1.16%	81	0.022	0.033	0.763	0.083	24
Lower Wenatchee	6	Peshastin Water District/Full-Time	243	0.092	0.143	0.231	0.357	104	6.09%	583	0.222	0.343	0.554	0.858	249
Lower Wenatchee	6	Peshastin Domestic Water Association/Part-Time	17	0.002	0.002	0.004	0.006	2	1.16%	22	0.002	0.003	0.005	0.008	2
Lower Wenatchee	6	Peshastin Domestic Water Association/Full-Time	56	0.021	0.033	0.053	0.082	24	1.16%	71	0.027	0.042	0.067	0.104	30
Mission	1	Part-Time	2	0.000	0.000	0.000	0.001	0	1.16%	3	0.000	0.000	0.001	0.001	0
Mission	2	Full-Time	144	0.055	0.085	0.137	0.212	61	1.16%	182	0.069	0.107	0.173	0.268	78
Mission	3	Connections with Exempt Wells	596	0.226	0.350	0.566	0.876	254	1.16%	754	0.287	0.444	0.717	1.109	321
Mission	4	City of Cashmere (64%)	1,455	0.647	1.001	1.618	2.503	725		1,777	0.794	1.229	1.357	3.072	890
Nason	1	Part-Time	193	0.018	0.028	0.046	0.071	21	1.18%	245	0.023	0.036	0.058	0.090	26
Nason	2	Full-Time	162	0.062	0.095	0.154	0.238	69	1.18%	206	0.078	0.121	0.196	0.303	88
Nason	3	Connections with Exempt Wells	148	0.056	0.087	0.141	0.218	63	1.18%	188	0.071	0.111	0.179	0.276	80
Peshastin	1	Part-Time	88	0.008	0.013	0.021	0.032	9	1.16%	111	0.011	0.016	0.026	0.041	12
Peshastin	2	Full-Time	49	0.019	0.029	0.047	0.072	21	1.16%	62	0.024	0.036	0.059	0.091	26
Peshastin	6	Valley Hi Community Club, Inc/Part-Time	24	0.002	0.004	0.006	0.009	3	1.16%	30	0.003	0.004	0.007	0.011	3
Peshastin	6	Valley Hi Community Club, Inc./Full-Time	105	0.040	0.062	0.100	0.154	45	1.16%	133	0.051	0.078	0.126	0.195	57
Peshastin	3	Connections with Exempt Wells	263	0.100	0.155	0.250	0.387	112	1.16%	333	0.127	0.196	0.316	0.490	142

TABLE A-3

Estimated Current and Future Municipal and Domestic Water Use (5)

			2002							2025					
				ADD		MDD		Annual [7]			ADD		MDD		Annual [7]
Sub-Watershed	Notes	Type	Total Number of Connections or ERUs	mgd	cfs	mgd	cfs	AF/yr	Applied Annual Percent Increase [8]	Total Number of Connections or ERUs	mgd	cfs	mgd	cfs	AF/yr
Upper Wenatchee	1	Part-Time	62	0.006	0.009	0.015	0.023	7	1.18%	79	0.007	0.012	0.019	0.029	8
Upper Wenatchee	2	Full-Time	41	0.016	0.024	0.039	0.060	17	1.18%	52	0.020	0.031	0.049	0.077	22
Upper Wenatchee	3	Connections with Exempt Wells	330	0.125	0.194	0.314	0.485	141	1.18%	419	0.159	0.246	0.398	0.616	179
Upper Wenatchee	6	Ponderosa Community Club, Inc./Part-Time	457	0.043	0.067	0.109	0.168	49	1.18%	581	0.055	0.085	0.138	0.213	62
Upper Wenatchee	6	Ponderosa Community Club, Inc./Full-Time	125	0.048	0.073	0.119	0.184	53	1.18%	159	0.060	0.093	0.151	0.233	68
White	1	Part-Time	12	0.001	0.002	0.003	0.004	1	1.18%	15	0.001	0.002	0.004	0.006	2
White	2	Full-Time	25	0.010	0.015	0.024	0.037	11	1.18%	32	0.012	0.019	0.030	0.047	14
White	3	Connections with Exempt Wells	64	0.024	0.038	0.061	0.094	27	1.18%	81	0.031	0.048	0.077	0.120	35
WRIA 45 TOTAL			**12,844**	**4.82**	**7.46**	**12.05**	**18.65**	**5,405**		**18,602**	**7.092**	**10.972**	**17.662**	**27.431**	**7,950**

NOTES:
This table builds on data presented in the Phase 2 - Level 1 Technical Assessment (MWG, 2003)
ADD = Average Day Demand; MDD = Maximum Day Demand; mgd = million gallons per day; AF/yr = acre-feet per year; DOH - Department of Health; ERU - Equivalent Residential Unit or User
(1) Part Time Connections obtained from DOH Database request (Nicodemus, personal communication, 2005). Includes Group A and B purveyors and water use classifications of single family part-time, part-time residential units, and recreational services (e.g. camp sites, RV parks). ADD calculated as the number of connections times 95 gpd/connections (i.e. 380/4, assuming use occurs only half of the year and at half the rate of average residential water production). MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45).
(2) Full-Time connections obtained from DOH Database request (Nicodemus, personal communication, 2005) includes Group A and B purveyor and water use classifications of single family full-time, full-time residential units, multi-family residential buildings, commercial and industrial, industrial and any other non-residential services. ADD calculated as number of connections times 380 gpd/connection. MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45 as presented in the Technical Assessment). 380 GPD REPRESENT THE TOTAL USE (CONSUMPTIVE AND NONCONSUMPTIVE) AND IS THE AVERAGE WATER PRODUCTION FACTOR REPORTED FOR WRIA 45 (MWG, 2003). THIS USAGE RATE IS NOT A REQUIREMENT BUT AN ASSUMPTION TO ENABLE CALCULATION OF RESIDENTIAL WATER USE FOR THE WATERSHED PLAN.
(3) Exempt Well Connections are calculated as the Total Number of Residential Parcels minus the total group A and group B residential connections (full and part-time) from the DOH database (Nicodemus, personal communication, 2005). Parcel data obtained from Chelan County Assessors database (June 6, 2005). Assumes that one residential parcel is equivalent to one household unless otherwise noted. Parcel types with a primary or secondary land use of the following types were included: All other residential, Household 2-4 units (assume 3 units) , Mobile home parks/courts, Multi-units 5 or more (assume 5 units) , Single family units, Vacation and cabin, and Residential Hotels - Condominiums. Only parcels with an improvement value of $5,000 or greater are considered. Errors in the assessor's database are possible (Chelan County Planning, personal communication, 2005). The following assumptions are implicit in this calculation: data obtained from the Department of Health classifying Group A and Group B water systems do not include any systems served by exempt wells; Assumes all exempt well connections are full time (conservative). ADD calculated as number of connections times 380 gpd/connection (average water production factor for WRIA 45 as presented in the Technical Assessment). MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45 as presented in the Technical Assessment).
(4) Data obtained from Cashmere Comprehensive Water System Plan (3/2004), 2025 data is based on 2021 projections in WSP and an applied linear growth rate in water use between 2021 and 2025. Future use projections assume the "no conservation" scenario. The City of Cashmere is divided over two sub-watersheds, the Lower Wenatchee and the Mission, therefore the water use is divided across these two sub-watersheds with approximately 36% of the use in the Lower Wenatchee and 64% of the use in the Mission.
(5) Water Use reported in this table is for all water uses including residential indoor and outdoor, commercial, industrial, institutional, etc.
(6) Connections (part-time and full time) data obtained from DOH (Nicodemus, personal communication, 2005) from an in-house database. ADD calculated as number of connections times 380 gpd/connection (average water production factor for WRIA 45 as presented in the Technical Assessment). MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45 as presented in the Technical Assessment).
(7) Average day demand converted to AF/yr by multiplying by 1,121.
(8) Percent Increase based on Cheland County data (see Table A-2). The percent increase is applied to all residential and non-residential water use types (e.g. commercial, industrial).
(9) Data obtained from City of Leavenworth Water System Plan Final Draft, November, 2002 (Varela and Associates, 2002). Plan reported a 3.4% population growth rate (compounded). This rate was used to project 2020 population estimates in the WSP from 2020 to 2025. Current "Total Number of Connections or ERUs" represents estimate from the year 2000 (not 2002). City of Leavenworth water source obtained from Icicle Sub-watershed; however the majority of the population resides in the Chumstick Sub-watershed.
(10) Connections data obtained from DOH (Nicodemus, personal communication, 2005) from an in-house database. ADD obtained from Technical Assessment. MDD calculated as ADD times 2.5.
(11) In the Lake Wenatchee Sub-watershed, connections with exempt wells include many residences that are served directly from Lake Wenatchee. While the amount of water used is the same, the source is surface rather than groundwater.

Revision Notes:
7/20/05: The water usage for exempt well connections was incorrectly calculated using PT usage rates. All exempt well connections now use FT rates (380 mgd/connection)

Table A-4

Snapshot Water Budget for WRIA 45 Sub-Watersheds [11]

	Sub-watersheds	2002 M&D Water Use (cfs)		2025 M&D Water Use (cfs)		Flows (cfs)			Irrigation Permits and Certs. Qi (cfs) [6,9]	Irrigation Claims Qi (cfs) [7,9]	W.R. Apps. Qi (cfs) [8]	W.R. for Comm/ Industrial	W.R. for Fish Propagation	Estimated CIR [10]
		MDD [1]	ADD [2]	MDD [1]	ADD [2]	10% [3]	50% [4]	90% [5]						
Leavenworth-Lake Wenatchee CCD	Chiwaukum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1	0.0	0.0	0.0	
	Chiwawa	0.8	0.3	1.0	0.4	273.8	146.2	89.0	34.4	34.1	0.1	0.0	33.0	
	Chumstick	1.2	0.5	1.5	0.6	0.0	0.0	0.0	17.4	3.9	6.7	0.0	0.5	
	Icicle	4.6	1.8	9.3	3.7	259.0	134.7	93.1	261.3	11.7	1.0	0.0	53.4	
	Lake Wenatchee	0.8	0.3	1.0	0.4	1050.3	598.0	390.7	1.1	3.7	18.4	0.0	0.0	
	Little Wenatchee	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Nason	0.5	0.2	0.7	0.3	165.3	82.1	42.3	3.5	7.6	1.1	0.0	0.0	
	Upper Wenatchee	0.9	0.4	1.2	0.5	1289.8	719.6	468.4	3.2	5.9	0.0	0.0	0.0	
	White	0.1	0.1	0.2	0.1	599.3	277.3	191.4	1.6	24.4	0.1	0.0	0.0	
SUBTOTAL		9.0	3.6	14.9	6.0				322.9	91.4	27.4	0.0	86.9	
Cashmere CCD	Lower Wenatchee	5.5	2.2	7.3	2.9	1337.8	727.8	414.6	258.0	176.4	7.2	3.5	37.5	
	Mission	3.6	1.4	4.4	1.8	4.3	2.2	1.5	8.8	31.6	0.1	0.9	0.0	
	Peshastin	0.7	0.3	0.8	0.3	74.2	43.8	34.1	4.8	63.7	18.8	0.0	0.0	
SUBTOTAL		9.7	3.9	12.5	5.0				271.6	271.7	26.1	4.4	37.5	
Total - WRIA 45		**18.7**	**7.5**	**27.4**	**11.0**	**1337.8**	**727.8**	**414.6**	**594.5**	**363.1**	**53.5**	**4.4**	**124.4**	**45.6**

NOTES:
W.R. - Water Right, Apps - Application, Certs - Certificates, CCD - County Census Division, Qi - Instantaneous Water Right, cfs - cubic feet per second
(1) Municipal and Domestic Demand (M&D) is reported as max day demand (MDD, high use) for all water supply groups (group A, group B, exempt, etc.) for both 2002 and 2025. Max Day Demand is the day of the year having the highest water demand.
(2) Municipal and Domestic Demand is reported as average day demand (ADD, medium use) for all water supply groups (group A, group B, exempt, etc.) for both 2002 and 2025. Average Day Demand represents an average daily demand in a year.
(3) 10% flow (or high flow) represents the flow that has a 10% chance of being equaled or exceeded in any one year. The 10% flow is the average September 10% exceedance flow.
(4) 50% flow (or average flow) represents the flow that has a 50% chance of being equaled or exceeded in any one year. The 50% flow is the average September 50% exceedance flow.
(5) 90% flow (or low flow) represents the flow that has a 90% chance of being equaled or exceeded in any one year. The 90% flow is the average September 90% exceedance flow. (September generally has the lowest 90% exceedance flow).
(6) Irrigation Permits and Certificates obtained from the Technical Assessment (MWG, 2003). Instantaneous Water Rights were selected when the first purpose of use is for Irrigation.
(7) Irrigation Claims obtained from the Technical Assessment (MWG, 2003). Instantaneous Water Rights were selected when the first purpose of use is for Irrigation.
(8) Water Right Applications instantaneous quantities obtained from the Technical Assessment (MWG, 2003). Includes applications for all purposes of use.
(9) Irrigation permits, certificates and claims may be duplicative and indicate higher than actual irrigation use.
(10) Crop Irrigation Requirement represents the estimated consumptive irrigation use of crops in WRIA 45. Reported for total watershed only (MWG, 2003).
(11) The comparison shows water use (both groundwater and surface water use as represented by water rights) and surface water flows. Groundwater storage has not been assessed as part of this snapshot water budget. Water use estimates assume that all irrigation permits, certificates and claims are put to full use (although some claims may be duplicative). Flow estimates are representative of the range of flows occurring in the sub-watershed in September, a "low flow" month. This results in a water budget that is representative of the range of natural flow and municipal and domestic water use conditions that could occur in the summer months. However othe water uses (irrigation, commercial/industrial, and fish uses) may be conservative.

Wenatchee River Instream Flow Studies
Appendix B

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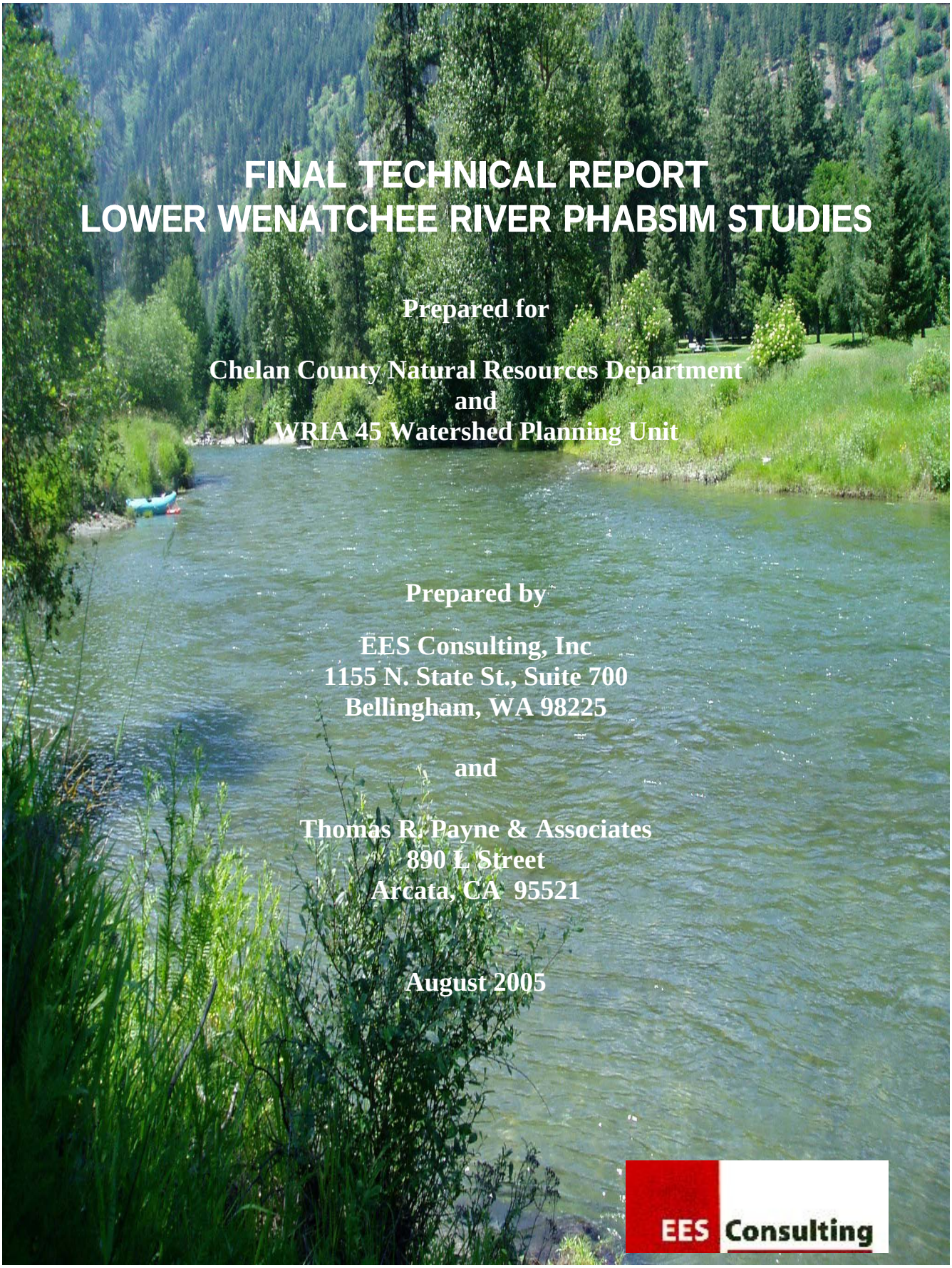
Final Lower Wenatchee River PHABISM Report (54pp)	EES Consulting, Bellingham, Washington
Instream Flow Assessment of Icicle Creek, Washington (40pp)	U.S. Bureau of Reclamation
Chiwawa WUA Graphs, (2pp)	Washington Department of Ecology
Nason WUA Graphs, (2pp)	Washington Department of Ecology
WRIA 45 Toe-Widths, (1pp)	Washington Department of Ecology
Fish Periodicity Graphs:	
Lower Mainstem (1pp)	Washington State Conservation Commission
Icicle Creek (1pp)	Washington State Conservation Commission
Chiwawa Creek (1pp)	Washington State Conservation Commission
Nason Creek (1pp)	Washington State Conservation Commission
Peshastin Creek (1pp)	Washington State Conservation Commission
Mission Creek (1pp)	Washington State Conservation Commission



FINAL TECHNICAL REPORT
LOWER WENATCHEE RIVER PHABSIM STUDIES

Prepared for

Chelan County Natural Resources Department
and
WRIA 45 Watershed Planning Unit

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Special thanks are due to the people who assisted in various ways on this study. Local landowners were very cooperative in allowing field teams access to their property for study purposes. The staff at Chelan County Department of Natural Resources has been extremely helpful in many ways, particularly with landowner approvals, field and technical support, and coordinating communication with committees and involved parties.

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EXECUTIVE SUMMARY

The Lower Wenatchee River PHABSIM study focuses on the habitat, hydrologic, and instream flow needs of anadromous salmonids. Fisheries resources of primary concern in the Lower Wenatchee River are commercial and game fish including Chinook salmon, steelhead trout, and bull trout.

The study area is subdivided into the Main Wenatchee River Instream Flow Study Area and the Peshastin Creek Study Area. The Main Lower Wenatchee River Study Area encompasses the mainstem river from RM 0.0 at the mouth of the Wenatchee River at the Columbia River, to River Mile (RM) 27 at the lower end of Tumwater Canyon near Leavenworth. The Lower Wenatchee River was segmented into 4 distinct reaches, based on river morphology and hydrology. Thirty-five transects were selected for intensive study in the mainstem Wenatchee River.

The Peshastin Creek Study Area extends from its mouth at RM 17.9 on the Wenatchee River, upstream to RM 5. Peshastin Creek was not segmented due to the homogeneous nature of the stream. Habitat in Peshastin Creek was represented by 9 transects located near RM 2.2.

The Lower Wenatchee River Instream Flow Study was conducted using the Physical Habitat Simulation (PHABSIM) modeling approach, which is commonly referred to as the U.S. Fish and Wildlife Service Instream Flow Incremental Method (IFIM).

A principal product of PHABSIM is the Weighted Usable Area (WUA) chart, which is a quantifiable index of habitat value, relative to flow. The modeled flow range in the mainstem Wenatchee River is from 220 cfs to 10,000 cfs. The modeled flow range for Peshastin Creek is 11 cfs to 425 cfs. This document reports WUA results for rearing salmonids including chinook salmon, steelhead trout, and bull trout. WUA results for spawning salmonids are reported for Chinook salmon, and steelhead trout. This report is organized into five main sections, 1.0 Introduction, 2.0 Methodology, 3.0 Results, 4.0 Hydrology, and 5.0 References. The methodology, results, and hydrology are contained in the main body of the text and supporting technical data is located in the appendices.

PHABSIM ASSESSMENT
GLOSSARY OF TERMS

Anadromous	Going upstream to spawn, usually from salt to fresh water.
Calibration flow	Measured flow used to evaluate model (RHABSIM, PHABSIM) performance.
EESC	EES Consulting, Inc. Primary consultant for Wenatchee River PHABSIM study
Freshet	A sudden rise in the level of a stream, or a flood due to heavy rains or the rapid melting of snow and ice.
HABSIM	The Weighted Usable Area Habitat Simulation in RHABSIM.
HSC	Habitat Suitability Criteria- Values for depth, velocity, substrate and cover that reflect the likelihood that fish will use a particular range for each factor. HSC unique for each species and life stage of concern.
HYDSIM	The hydraulic model in RHABSIM.
IFIM	Instream Flow Incremental Methodology
PHABSIM	Physical Habitat Simulation System
RCW	Revised Code of Washington
Redd	Most salmonids deposit their eggs in nests called redds. Redds are dug in the streambed substrate by the female. Most redds occur in predictable areas and are easily identified by an experienced observer by their shape, size, and color (lighter than surrounding areas because rocks have been overturned and biofilm and silt have been cleaned away).
RHABSIM	Analysis and integration of physical stream measurements and habitat preference criteria require the use of a group of computer programs developed by the US Fish and Wildlife Service. DTA uses RHABSIM, developed by Tom Payne and Associates of Arcata, CA.
Stream Reach	A subset of the study area that is distinguished from other reaches for stated reasons.
Study Area	The portion of a river or stream that will be addressed in the study.
Study Site	A particular area within a Reach where transects are grouped.
VAF	Velocity Adjustment Factors (VAF) are a measure of how well the model simulates velocities using a three velocity set regression data set. A VAF between 0.90 and 1.10 is considered good. A VAF between 0.85 and 0.90 or between 1.10 and 1.15 is considered to be fair. A VAF between .80 and .85 or 1.15 and 1.20 is marginal, while a VAF below 0.80 or above 1.20 is considered poor.
WDFW	Washington Department of Fish and Wildlife
WDOE	Washington Department of Ecology
WSE	Water surface elevation
WUA	Habitat quantification is expressed as an index called Weighted Useable Area (WUA), and is given in habitat per 1,000 linear ft of stream.

1.0 INTRODUCTION

1.1 Authority

EES Consulting, Inc. (EESC) and Thomas R. Payne and Associates (TRPA) are conducting this study under contract to Chelan County, for the WRIA 45 Planning Unit. This study is undertaken as part of the WRIA 45 Watershed planning process administered by the Washington Department of Ecology (RCW 90.82).

This report is organized into five main sections; 1.0 Introduction, 2.0 Methodology and Approach, 3.0 Results, 4.0 Hydrology, and 5.0 References. The methodology, results, and hydrology are contained in the main body of the text and supporting technical data is located in the appendices.

1.2 Background

The primary purposes of the WRIA 45 watershed planning are to:

- Facilitate the establishment of instream flows to protect aquatic resources
- Provide a mechanism for coordinated water resources management for out-of-stream needs.

This report presents the study methodology and results for discussion of instream needs for the Lower Wenatchee River and Peshastin Creek.

1.3 Study Objectives

Study objectives for the Lower Wenatchee River PHABSIM Study are:

- Quantify the relationship between stream flow and available aquatic habitat for appropriate salmonid species and life stages for the Lower Wenatchee River.
- Quantify the relationship between stream flow and available aquatic habitat for appropriate salmonid species and life stages for Peshastin Creek.
- Provide a well-documented, scientific basis to serve as a decision-making tool for instream flow evaluations. Specifically, the areas of interest are the mainstem Wenatchee River from its mouth at the Columbia River, upstream to Tumwater Canyon at River Mile (RM) 27 and Peshastin Creek from its mouth at the Wenatchee River, upstream to RM 5.0 (Figure 1.3-1).

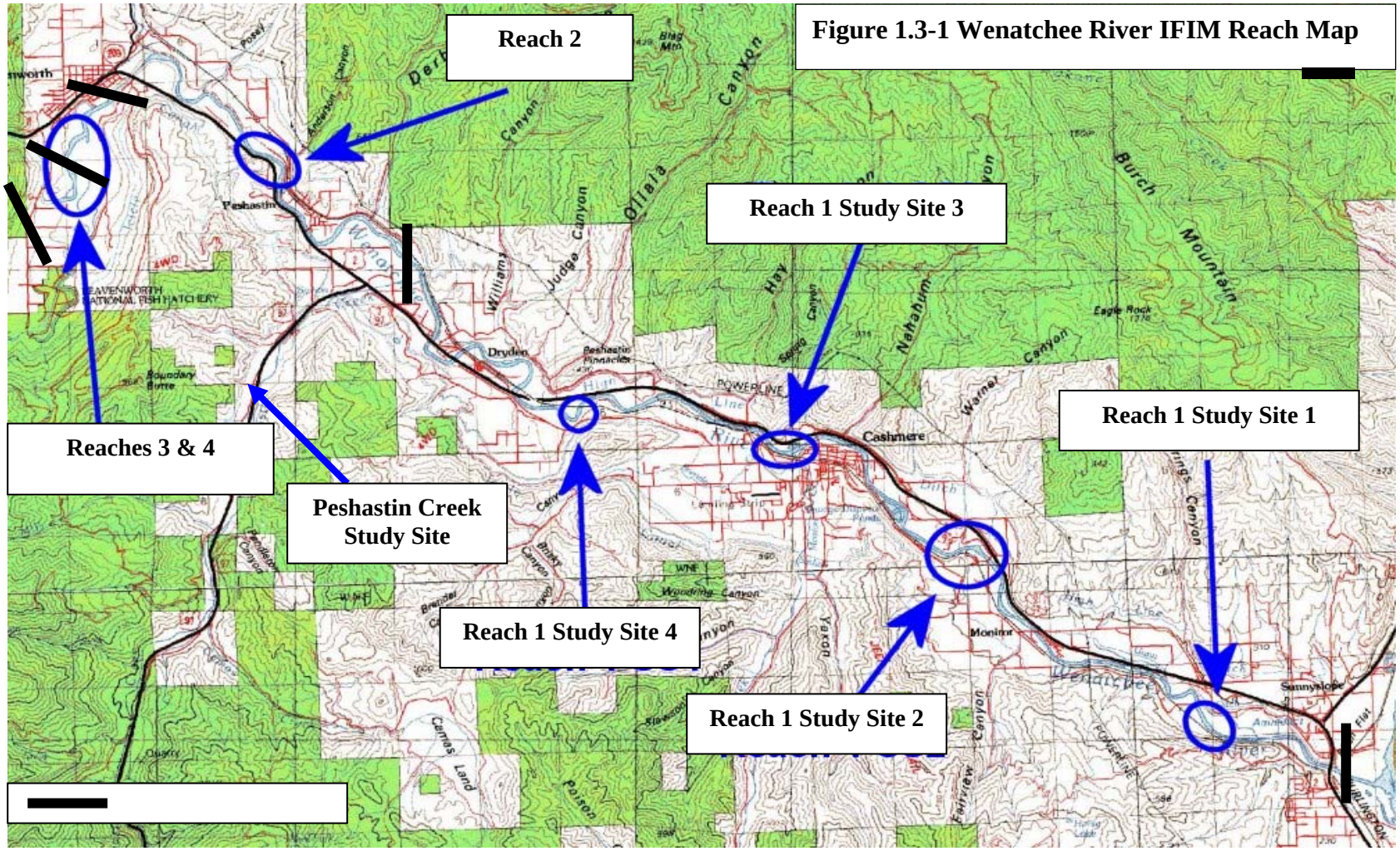

Figure 1.3-1 Wenatchee River IFIM Reach Map

1.4 Wenatchee River Watershed

Originating as rainfall and snowmelt on the eastern flank of the Cascade Mountains in North Central Washington, the Wenatchee River flows 54 miles to the southeast from Lake Wenatchee to the Columbia River in Chelan County, Washington. The drainage area of the Wenatchee River and its tributaries is approximately 1,371 square miles. The Wenatchee River Basin study area extends from RM 27, near the town of Leavenworth, downstream to the confluence with the Columbia River. The two largest tributaries in this reach are the Icicle River and Peshastin Creek, which join the Wenatchee River at RM 25.6 and RM 17.9, respectively. The gradient of the Wenatchee River within the study area is moderate to low, averaging about 0.36% from Tumwater Canyon downstream to the confluence with the Columbia. Although the overall gradient is somewhat moderate, several high-gradient rapids can be found within this river segment.

The topography, hydrology, and land use in the Wenatchee watershed are diverse. In the mountainous headwaters, much of the area is managed park and forest land with glaciers and snow fields on the higher peaks and dense coniferous forests covering the mid-elevation slopes. The headwater streams are generally steep, continuous cascades with boulder and cobble substrate. The mid and upper river segments generally wind through constricted valley floors and flow over cobble and gravel riffles interspersed with short, boulder strewn cascades. The Lower Wenatchee River flows through a valley of fertile orchards, with occasional small towns along the river. The banks of the river are mainly covered with boulders and cobble, and in some areas, riprap has been constructed.

2.0 METHODOLOGY AND APPROACH

2.1 Overview of PHABSIM Methodology

Unless otherwise noted, PHABSIM study procedures follow the WDFW/WDOE Updated Instream Flow Guidelines (April, 2004). The PHABSIM methodology is based on the premise that stream-dwelling fish are more often found in a certain range of depths, velocities, substrates, and cover types, depending upon the species and life stage, and that the availability of these preferred habitat conditions varies with stream flow. PHABSIM is designed to quantify potential physical habitat available for each life stage of interest, for a target fish species, at various levels of stream discharge, using a series of modeling programs initially developed by the U.S. Fish and Wildlife Service. Major components of the methodology include: (1) study site and transect selection; (2) transect weighting; (3) field collection of hydraulic data; (4) hydraulic simulation to determine the spatial distribution of combinations of depths and velocities with respect to substrate and cover under a variety of discharges; and (5) habitat simulation, using habitat suitability criteria, to generate an index of change in habitat relative to change in discharge. The product of the habitat simulation is expressed as Weighted Usable Area (WUA) for a range of simulated stream discharges.

It is important to recognize that the product of a PHABSIM analysis is not a set value but a range of values to be used as a tool for discussing and determining a range of stream flows that will meet the needs of all affected resources.

2.2 Stream Description

The Mainstem Wenatchee River Study Area extends from the confluence of the Wenatchee River at the Columbia River (RM 0.0), upstream to the lower end of Tumwater Canyon (RM 27.0). Chinook, sockeye, and coho salmon, as well as steelhead and bull trout utilize this area as a transportation corridor for upstream and downstream movement, migration, and juvenile rearing. Spawning and incubation of chinook and steelhead also occur in this reach

The Mainstem Wenatchee River Study Area includes only the Wenatchee River and its associated habitats (i.e., edge and mid-channel); it does not encompass any of the tributaries downstream of RM 27.0 or their associated habitats.

Within the Mainstem Wenatchee River Study Area, the river is primarily contained within a single channel. For short distances, the channel may split around islands or gravel bars and form distinct geomorphic features that exhibit habitat variations distinct from the main channel. In places river banks have been modified with riprap positioned along one or both banks to protect property and infrastructure from flood damage.

Differences in morphology and hydrology in the Wenatchee River are addressed by segmenting the river into four distinct reaches. Study reaches within the 27-mile study area of the Wenatchee River are differentiated by changes in hydrology, slope, and habitat type.

The Peshastin Creek Study Area extends from its mouth to RM 5. Species of concern that utilize Peshastin Creek include chinook salmon, steelhead and bull trout. Segmenting was not required in Peshastin Creek due to the homogenous nature of the habitat.

2.3 Stream Reach Description

Reach 1: Columbia River to Peshastin Creek (RM 0.0 – 17.7). The majority of Reach 1 is characterized by moderate gradient and long, wide glides with short sections of riffles, rapids and pools. Side and split channel areas comprise approximately 25% of the river length. The upper end of this reach, downstream of Dryden Dam, is steeper, with more rapids and intermittent large pools. Peshastin Creek, at the upstream boundary of this segment, contributes significant inflow.

Reach 2: Peshastin Creek to Leavenworth (RM 17.7 – 24.3). A majority of Reach 2 is moderate gradient, with well-defined banks and fewer meanders and point bars than found in Reach 1. Long glides are the predominant habitat feature, with pools, riffles and rapids interspersed throughout the reach. The upper end of this reach (downstream of Leavenworth) is steeper with more rapids and runs than the lower portion. Although many small tributaries enter the mainstem in this reach, cumulative inflow is small relative to the flow in the river.

Reach 3: Leavenworth Park to Icicle Creek (RM 24.3 – 25.6). Reach 3 is differentiated from Reach 2 by a dramatically lower gradient and a wider, unconfined channel. Reach 3 has smaller substrate and more gravel bars and gravel banks than Reach 2. The habitat is predominantly very wide glides, riffles, and pools.

Reach 4: Icicle Creek to Tumwater Canyon (RM 25.6 – 27.0). The majority of the habitat in Reach 4 is similar to the glide, pool, and riffle habitat in Reach 3. The major feature that distinguishes the two reaches is that Reach 4 lies upstream of the significant additional stream flow contributed by the Icicle River. Upstream of RM 26.3, the river narrows and steepens, with the habitat changing to fast glides, deep runs, and minor rapids.

2.4 Physical Habitat Surveys

Physical habitat surveys were conducted with a low elevation, aerial video survey of the Wenatchee River from the mouth to Tumwater Canyon and in Peshastin Creek from the mouth to Ingalls Creek. The purpose of the video was to obtain an overview of the river and determine the frequency of various types of fish habitat found within the study area.

The aerial video was used to characterize habitat types throughout the Lower Wenatchee River and Peshastin Creek. Areas with a variety of habitat types located in a relatively short distance were noted as possible locations for transect placement. With the habitat types in hand, the entire length of the Wenatchee River from the Icicle Road bridge to the Columbia River was surveyed on foot or via raft to ground truth the initial habitat typing from the video. Where appropriate, habitat types were changed to match what was observed on the ground. A frequency distribution of habitat types forms the basis for transect selection and transect weighting. Details of the habitat frequency analysis are described in Section 2.6.

This information in conjunction with ground-truthing surveys, hydrology, and topographic considerations, was used to segment the Wenatchee River into study reaches and aid in the selection and placement of transects.

2.5 Transect Selection

Study sites and transects were selected to best represent the variety of habitat types within the Lower Wenatchee River. EESC selected 35 transects within the four study reaches between RM 0.0 and RM 27.0 on the mainstem Wenatchee River. Nine transects in one study reach were selected on Peshastin Creek. The study sites and transects were approved by representatives of the WDOE and WDFW during site visits on April 9 and 21, 2004. Figures 2.5-1 through 2.5-7 show locations of study sites and transect locations throughout the Lower Wenatchee River Study area and Peshastin Creek.

Table 2.5 -1 Transect locations on the Wenatchee River and Peshastin Creek

System	Reach No.	Reach Locations	No. Transects	Transect Locations
Wenatchee River	1	RM 0.0 - 17.7	4	RM 3.0 – 3.2
			6	RM 7.3 – 7.5
			7	RM10.2 – 10.5
			3	RM 13.8 – 13.9
	2	RM 17.7 – 24.3	6	RM 21.1 – 21.6
	3	RM 24.3 – 25.6	4	RM 24.9 – 25.3
	4	RM 25.6 – 27.0	5	RM 25.9 – 26.2
Peshastin Creek	1	RM 0.0 – 5.0	9	RM 2.1 – 2.2

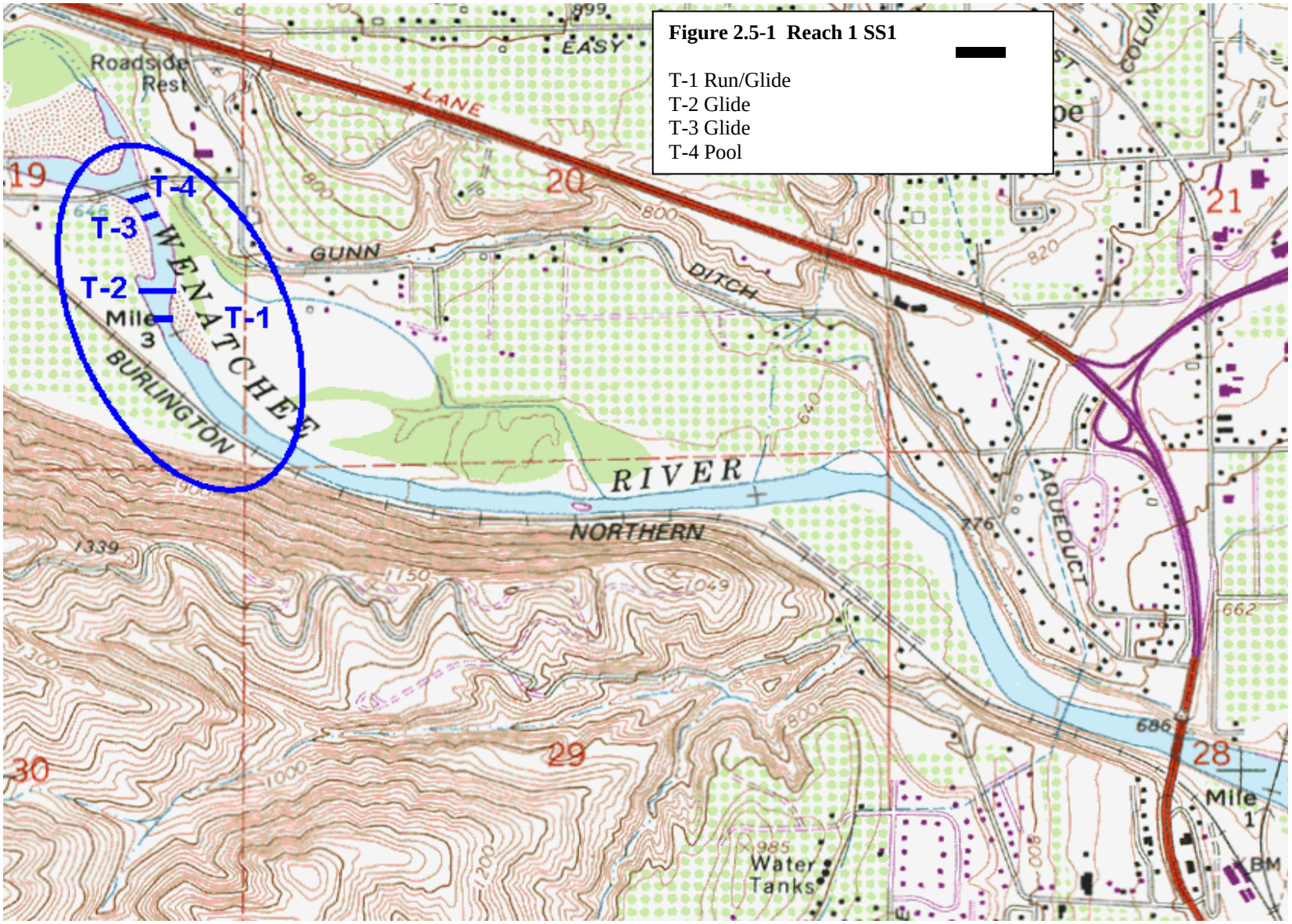
Figure 2.5-1 Reach 1 SS1
T-1 Run/Glide
T-2 Glide
T-3 Glide
T-4 Pool
T-4
T-3
T-2
T-1
Mile 3
Roadside Rest
EASY
4 LANE
GUNN
DITCH
WENATCHEE
RIVER
BURLINGTON
NORTHERN
AQUEDUCT
Water Tanks
Mile 1
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28
29
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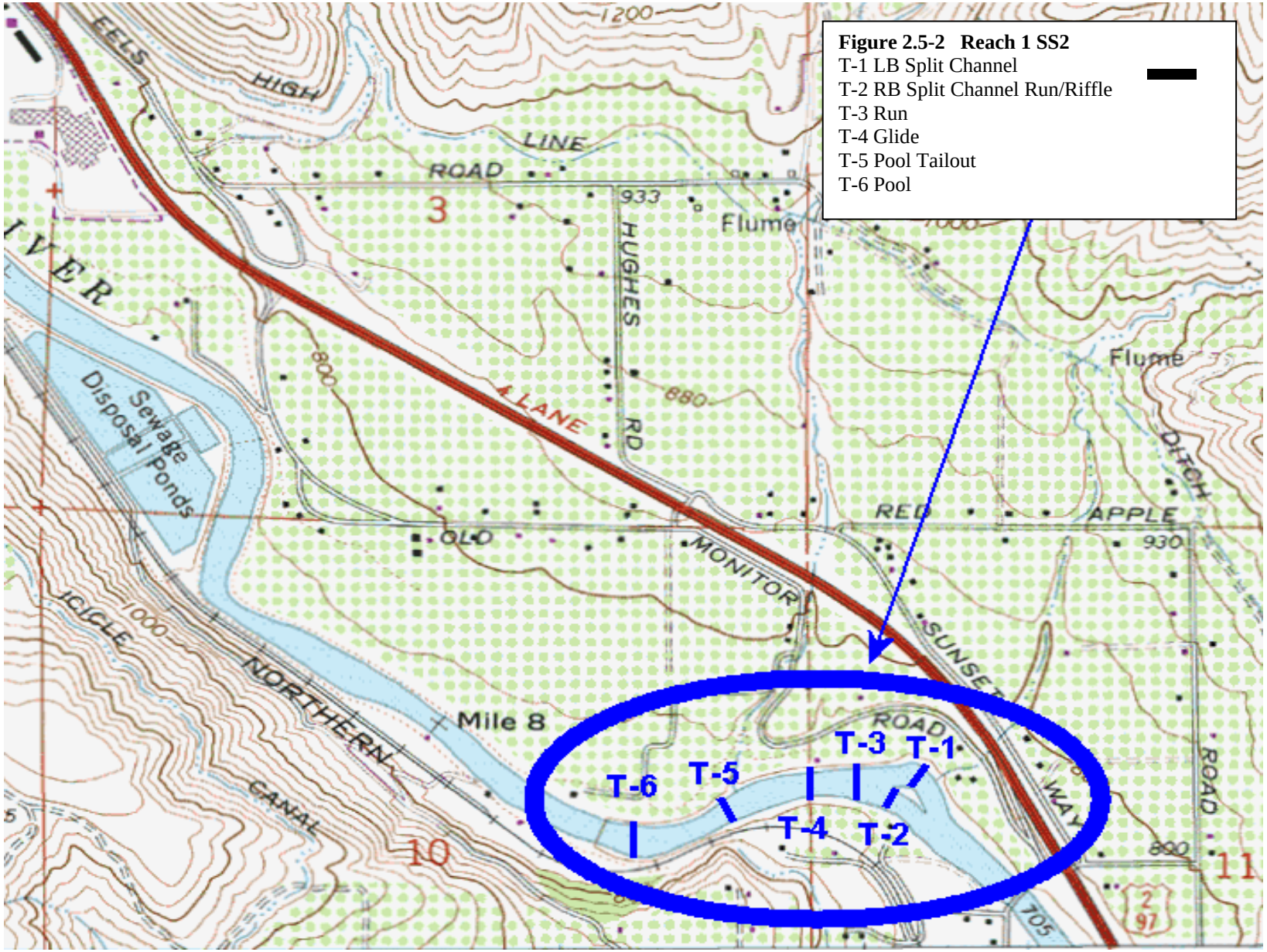


Figure 2.5-2 Reach 1 SS2
T-1 LB Split Channel
T-2 RB Split Channel Run/Riffle
T-3 Run
T-4 Glide
T-5 Pool Tailout
T-6 Pool
T-1
T-2
T-3
T-4
T-5
T-6
Mile 8
Sewage Disposal Ponds
Flume
Flume
HIGH
LINE
ROAD
HUGHES
RD
4 LANE
MONITOR
RED
APPLE
ROAD
SUNSET
WAY
ROAD
DITCH
OLD
ICICLE
NORTHERN
CANAL
1200
1000
800
880
933
930
890
705
3
10
11

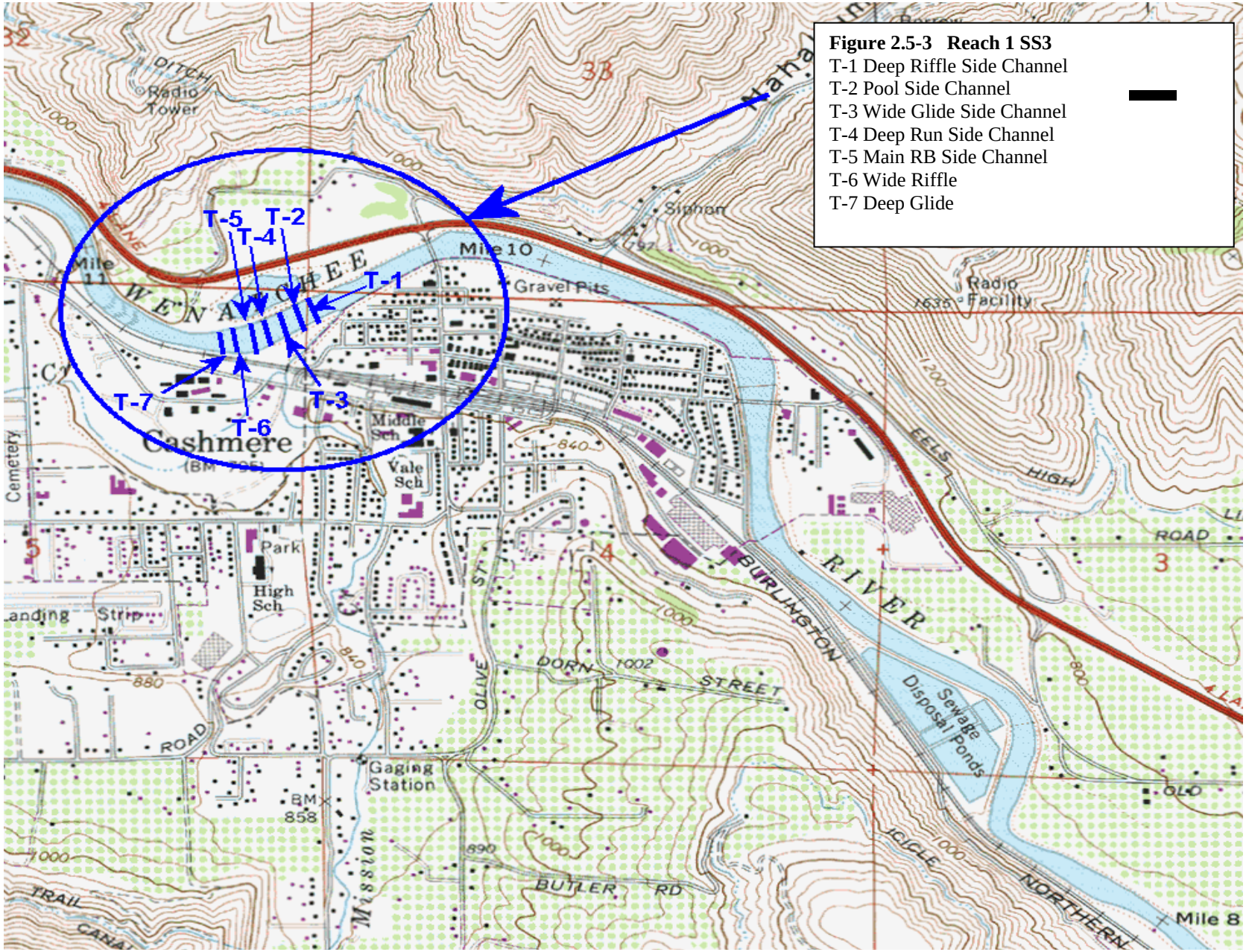


Figure 2.5-3 Reach 1 SS3
T-1 Deep Riffle Side Channel
T-2 Pool Side Channel
T-3 Wide Glide Side Channel
T-4 Deep Run Side Channel
T-5 Main RB Side Channel
T-6 Wide Riffle
T-7 Deep Glide

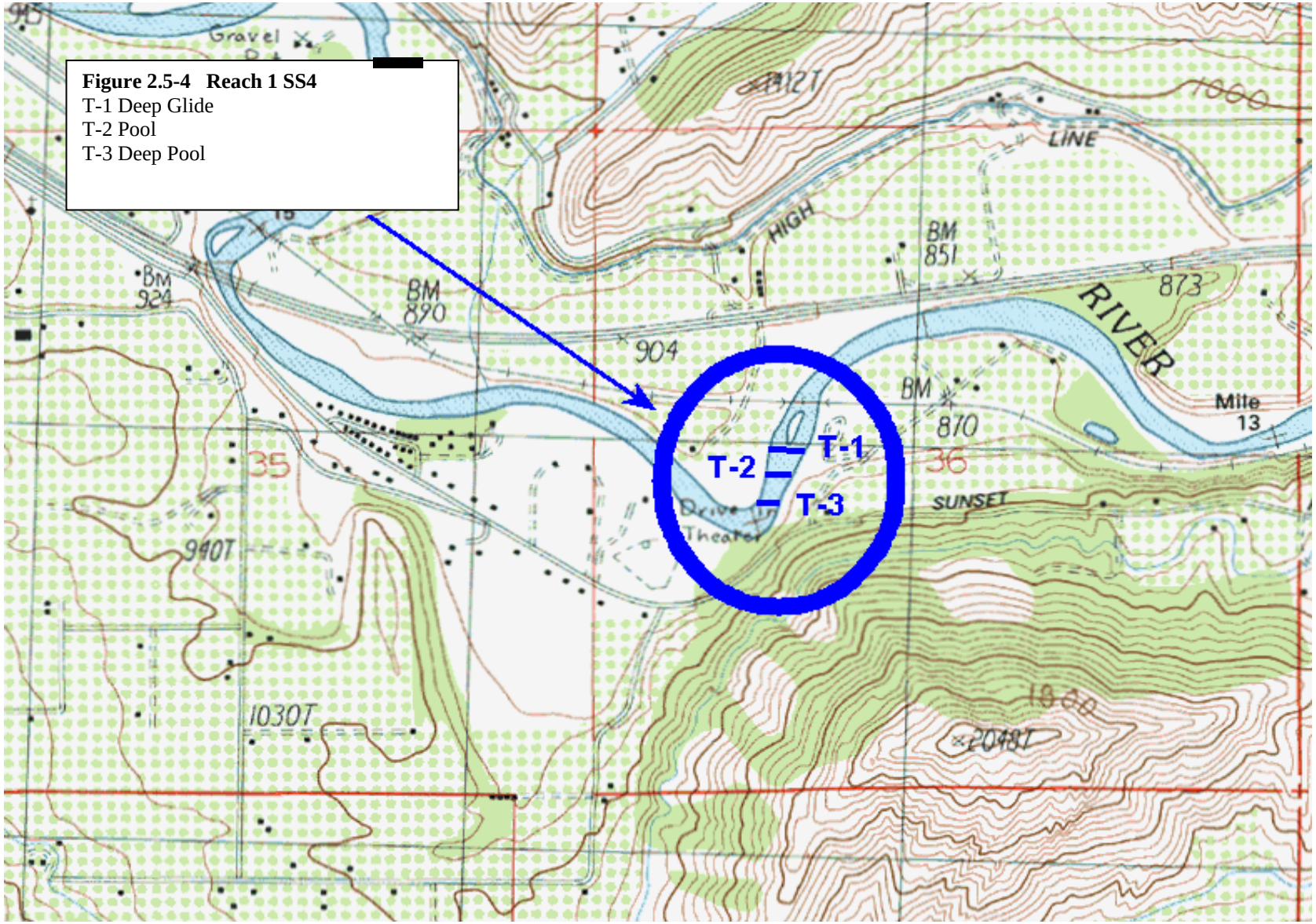


Figure 2.5-4 Reach 1 SS4
T-1 Deep Glide
T-2 Pool
T-3 Deep Pool

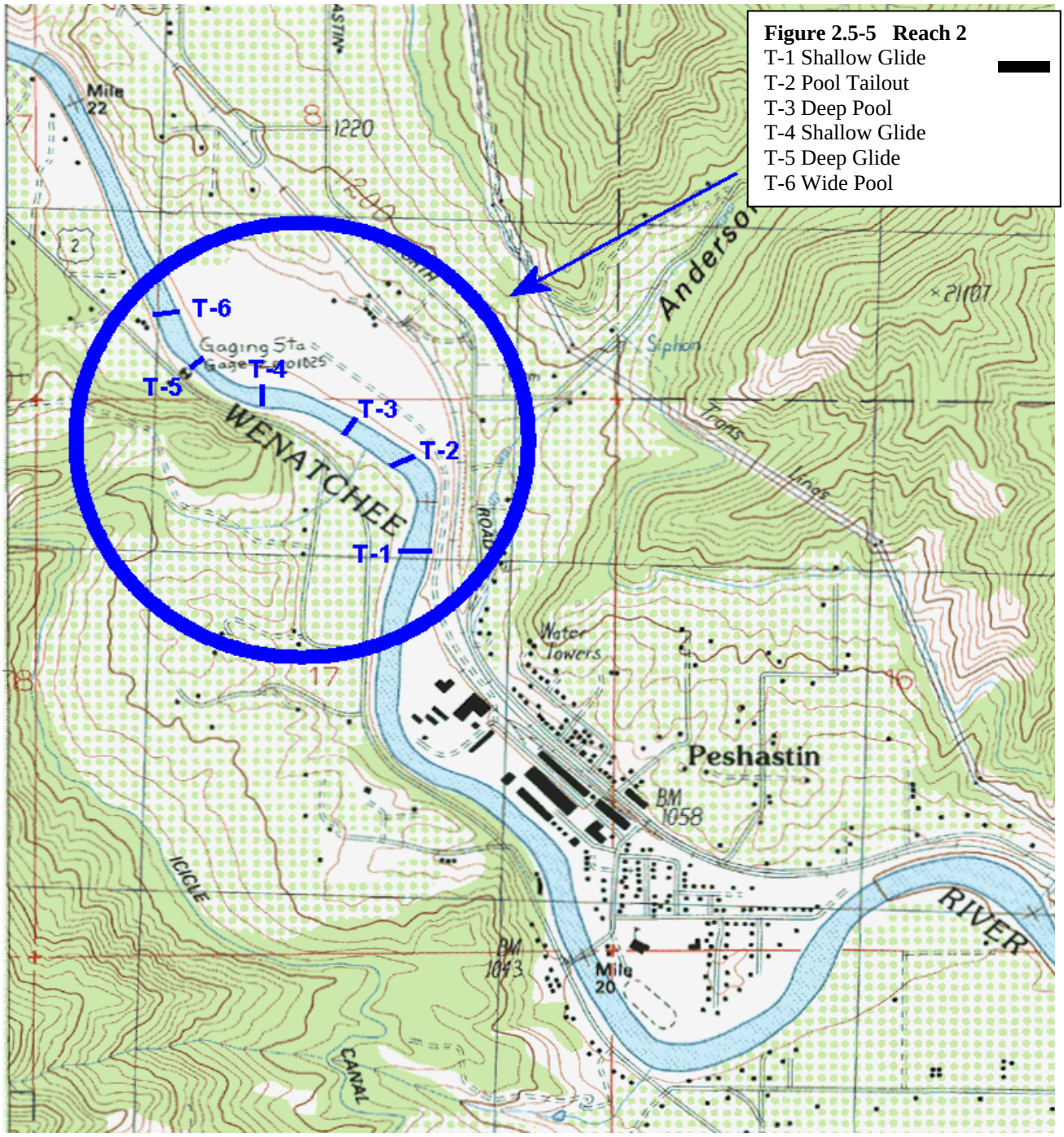


Figure 2.5-5 Reach 2
T-1 Shallow Glide
T-2 Pool Tailout
T-3 Deep Pool
T-4 Shallow Glide
T-5 Deep Glide
T-6 Wide Pool
T-6
T-5
T-4
T-3
T-2
T-1
WENATCHEE
Mile 22
1220
Gaging Sta
Siphon
Trans Lines
Water Towers
Peshastin
BM 1058
ICICLE
RIVER
BM 1043
Mile 20
CANAL
ROAD

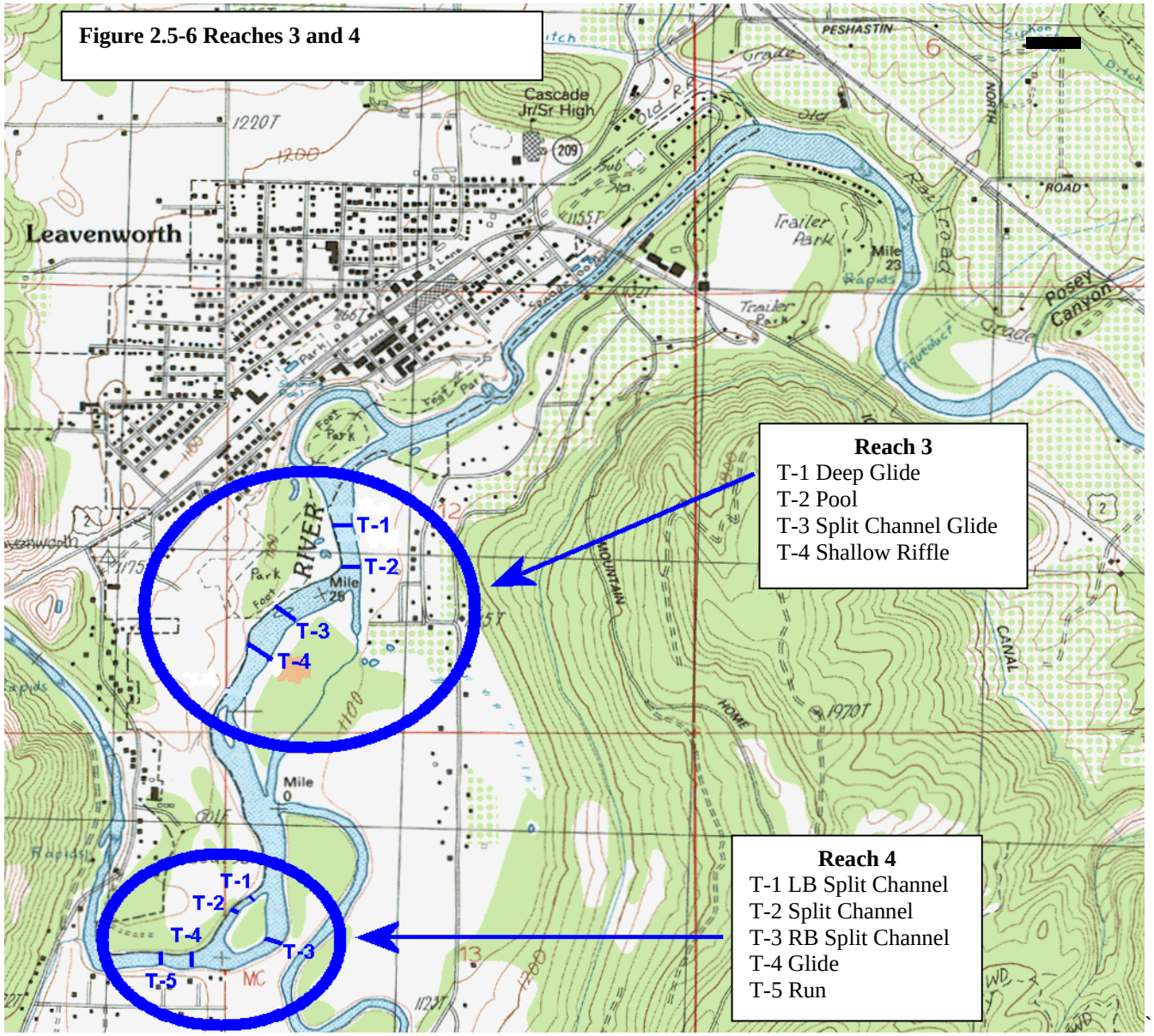


Figure 2.5-6 Reaches 3 and 4

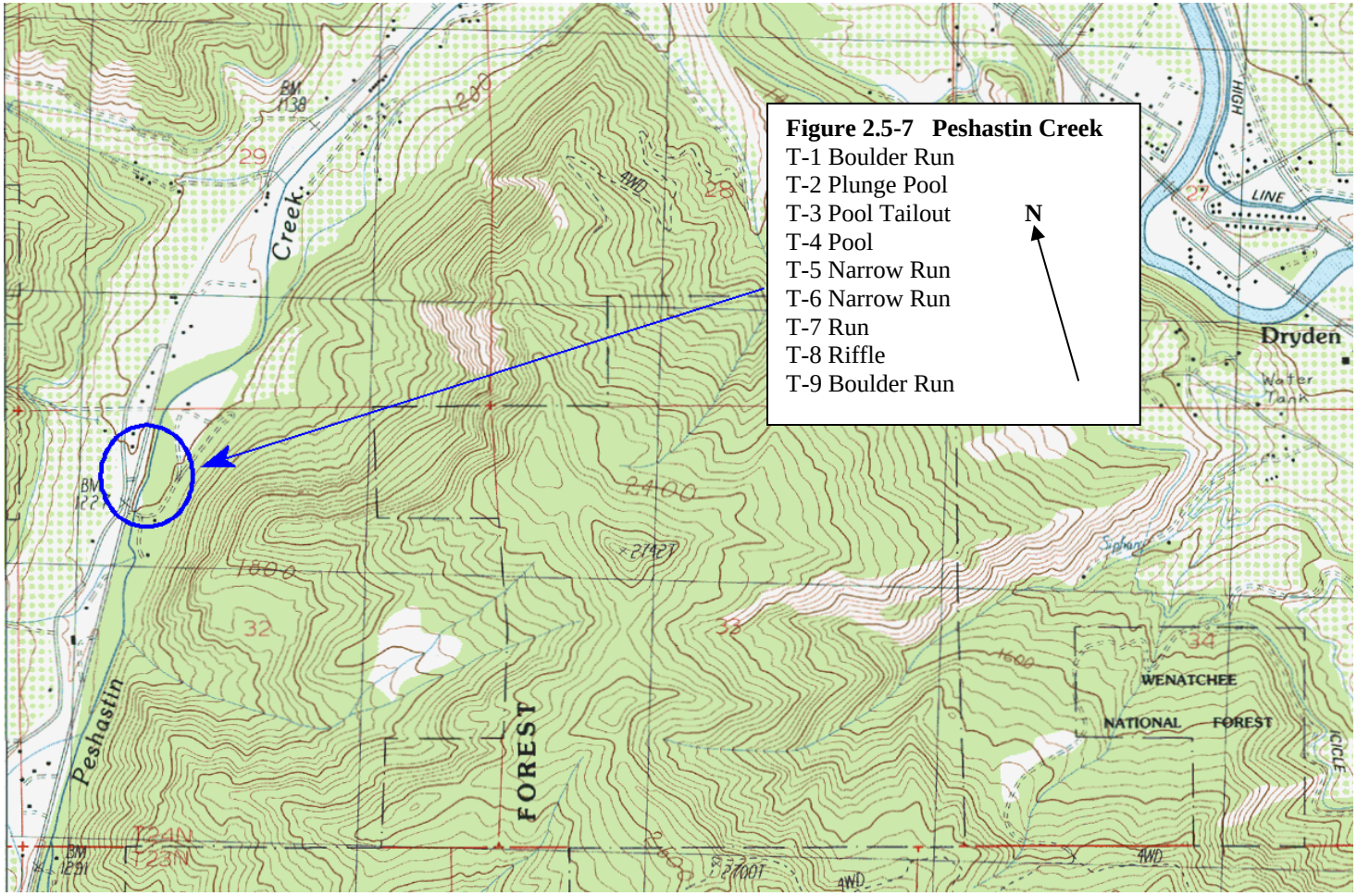


Figure 2.5-7 Peshastin Creek
T-1 Boulder Run
T-2 Plunge Pool
T-3 Pool Tailout
T-4 Pool
T-5 Narrow Run
T-6 Narrow Run
T-7 Run
T-8 Riffle
T-9 Boulder Run
N
Dryden
Water Tank
Creek
Peshastin
FOREST
WENATCHEE
NATIONAL FOREST
LINE
HIGH
4WD
T24N
T23N

2.6 Transect Weighting

Weighting for each transect was accomplished in two steps. The first involved classification of the various habitat types present in the study reach. These classifications were derived from study of the low altitude aerial video, river inspection, and ground truthing.

The second step involved a frequency analysis to determine the proportion of each habitat type in each study reach. Frequencies of habitat types for the Lower Wenatchee River and Peshastin Creek were calculated from the low-elevation aerial video. EESC analyzed the low-altitude videotape using the following procedures. The video was viewed in an upstream direction and the tape image was "frozen" on the screen at exactly 5-second intervals according to a screen-generated stop watch. The habitat type that lined up with an index marker drawn horizontally across the center of the monitor screen was tallied according to the established habitat classifications shown in Table 2.6-1. A total of 518 observation points were made on the Lower Wenatchee River from the video tape.

Transect weighting (Table 2.6-2) is based on the frequency of habitat types in the Lower Wenatchee River that are represented by the selected transects. Transects were weighted empirically, using results from the habitat frequency analysis and professional judgment. Transect weighting for Peshastin Creek was accomplished using the same methodology as the Mainstem Wenatchee River. A total of 145 observations were made from the videotape for Peshastin Creek. Table 2.6-3 shows transect weighting for the 9 transects on Peshastin Creek.

Table 2.6-1 Macrohabitat Type Coding and Descriptions		
Code	**Habitat Name**	**Habitat Description**
1	Backwater/Eddy Pool	Upstream of flow obstruction or on channel margins where flow decelerates. Slower velocity and deeper, non-turbulent flow with a strong hydraulic control. Often fine particles due to reduced shear stress. Water surface slope <1%.
2	Lateral pool	Pool formed on the margin of the stream as a result of a structural element, substrate composition, or thalweg location. (Generally at least 2 of the pool perimeter interfaces with adjacent habitat units.)
3	Plunge pool	Flow at head is vertical passing over an obstruction; fast, turbulent often with a bubble plume down the center
4	Glide	Smooth generally unbroken surface, generally laminar flow, moderate to shallow depth, often smaller substrates. Often doubles as a pool tailout
5	Riffle	Topographic cross-over between pool and bar in pool-riffle morphology; spans the channel; particles are usually fairly well-sorted; water surface slope 1-4%
6	Depositional riffle	Shallow with moderate velocities (less than run), lateral bottom profile is usually uniform, surface is broken but not turbulent like a run, gradient $\leq$ 4%. Poorly sorted substrate upstream of obstructions.
7	Boulder garden	Coarse planar bed in which the largest particles (boulder size) rise well above bankfull water depth creating flow irregularities; insufficient flow convergence to create pools or riffle; water surface slope 1-4% but mostly less then 2.5% Note that boulder gardens have some overlap and are a subset of riffle habitats
8	Chute	All the flow is concentrated in a narrow area. Flow is fast to very fast.
9	Rapid	Water (rough, turbulent surface, usually with standing wave at the hydraulic jump that occurs at the bottom as the flow rapidly decelerates into a pool, though it could merge into a riffle; water surface slope 2.5-4%.
10	Cascade	Tumbling, turbulent flow with pronounced vertical drops causing a stepped gradient, substrate often boulders and cobble. Gradient is 8-20% and total vertical drop within unit is at least 2 ft.
11	Braided channel	One or more divisions of the stream channel separated by islands of substrate not well vegetated
12	Split channel	Flow is approximately evenly split between islands; height of the islands exceeds bankfull elevation; water slope varies dependent upon the type of mesohabitat occupying each of the splits.
13	Side channel	Small channel relative to main channel; may or may not have flow at time of survey; includes remnant flood terrace side channels that can often be vegetated.

Table 2.6-2 Wenatchee River Transect Weighting

Reach	Study Site	Transect No.	Transect Description	Transect Weight	River Mile
1	1	1	Run/glide 400' DS of T-2	7.40%	3.0
		2	Wide, shallow, faster glide	9.45%	3.1
		3	Glide 200'-300' below T-4	7.10%	3.1
		4	Pool just below Sleepy Hollow Br.	2.37%	3.2
	2	1	LB split channel US Old Monitor Bridge	1.98%	7.3
		2	RB split channel glide/run	1.97%	7.3
		3	Faster glide/run above diversion on RB	7.41%	7.4
		4	Wide glide w/spawning bar on RB	7.10%	7.4
		5	Glide/pool tailout, 200' DS of T-6	7.10%	7.5
		6	Large Pool	2.37%	7.5
	3	1	LB side channel, deep riffle	2.59%	10.2
		2	LB side channel, pool	2.59%	10.3
		3	LB side channel, wide glide	2.59%	10.4
		4	LB side channel, deep run	2.59%	10.5
		5	Main RB side channel, DS of T-6	10.34%	10.5
		6	Wide, shallow riffle with large substrate	7.70%	10.5
		7	Narrow, deep glide, large substrate	5.51%	10.6
	4	1	Deep glide above complex split channel	7.10%	13.8
		2	Mid pool, gravel bar on RB	2.37%	13.8
		3	Deep pool, back water on both sides	2.37%	13.9
			Total transect Weight for Reach 1	100%	
2	1	1	Shallow glide 500' downstream of T-2	20.83%	21.1
		2	Pool tail out	20.83%	21.2
		3	Deeper pool, center fast, eddies in sides	5.56%	21.3
		4	Shallow glide above run	18.76%	21.4
		5	Deep glide under USGS cableway	20.83%	21.5
		6	Wide Pool 400' above T-5	13.19%	21.6
			Total transect Weight for Reach 2	100%	
3	1	1	Wide, glide, 300' downstream of T-2	28.00%	24.9
		2	Wide pool 300' downstream of T-3	24.00%	24.9
		3	Split channel glide, 300' DS of T-3	16.00%	25.0
		4	Wide shallow glide/riffle	32.00%	25.2
			Total transect Weight for Reach 3	100%	
4	1	1	LB split channel – glide	8.00%	25.9
		2	LB split channel – glide/run	8.00%	25.9
		3	Large RB split channel – glide	16.00%	25.9
		4	Glide above channel split	43.00%	26.1
		5	Run/glide 300' upstream of T-4	25.00%	26.2
			Total transect Weight for Reach 4	100%	

Table 2.6-3 Peshastin Creek Transect Weighting			
Transect No.	**Description**	**Transect Weight**	**River Mile**
1	Boulder Run	21.4%	2.1
2	Plunge Pool in center 1/3	12.7%	2.1
3	Tailout of Pool	0.7%	2.1
4	Pool	12.7%	2.2
5	Narrow Run	8.6%	2.2
6	Narrow Run	8.6%	2.2
7	Medium-width Run	8.6%	2.2
8	Riffle	5.4%	2.2
9	Wide Boulder Run	21.3%	2.2
	Total Transect Weight	100%	

2.7 Field Methods

2.7.1 Mainstem Wenatchee River

The field methods and hydraulic analysis for the mainstem Wenatchee River followed the 1-velocity method as described in Payne (2003). This method uses one set of velocity measurements and a water surface elevation (WSE), usually at the high flow, and two additional stage discharge points as input to the PHABSIM model to generate hydraulic simulations for the desired range of flows. The EESC/TRPA field team obtained a high flow set of hydraulic calibration measurements at each transect. Measurements included depths and velocities at close intervals across the transect and water surface elevations at each transect at each of the three flows.

Mid-channel depth and velocity distributions at the calibration flow were measured using an acoustic doppler current profiler (ADCP) mounted on a small trimaran boat and side tied to an inflatable raft. The ADCP uses acoustic pulses to measure water velocities and depths across the channel. According to an extensive evaluation conducted by the U.S. Geological Survey (USGS), "ADCP's can be used successfully for data collection under a variety field conditions" (USGS 1996). ADCP hydraulic measurements are made from a boat by moving the ADCP across the channel while it collects vertical-velocity profile and channel-depth data. The ADCP tracks the distance traveled from the point of origin so each depth and velocity measurement is coordinated with a horizontal distance on the transect. Measurements are taken at close intervals across the transect and at multiple levels in the water column. The ADCP is connected by cable to a power source and a radio modem that is linked to a laptop computer on shore. The computer is used to program the instrument, monitor its operation, and collect and store the data.

Because the ADCP will not measure in depths less than approximately 1.5 feet, shallow depth measurements near shore and other locations were taken manually using either a Price AA meter or a Swoffer brand, propeller-type velocity meter mounted on a standard top-set USGS wading rod. Manually measured velocities were taken at sixth tenths of the depth when depths were less than 2.5 feet and at two tenths and eight tenths of the depth when depths equaled or exceeded 2.5 feet or when the expected velocity profile was altered by an obstruction immediately upstream.

An auto level was used to measure headpin elevations, water surface elevations (WSE), hydraulic controls and above water bed elevations along each transect. All measurements were referenced relative to a temporary benchmark. Bed elevations below the water surface were obtained by subtracting measured depths taken during velocity calibration from the water surface elevations for that particular transect. Except when surveying the bed profile, the surveyor attempted to measure elevations to the nearest .01 feet.

Substrate and cover were measured visually during a low-flow period in September. In the deeper portions of pool, transects substrate was measured with the aid of a mask and snorkel. Cover and substrate codes are shown in Appendix A and are according to the revised Washington State Resource Agency Instream Flow Guidelines (WDFW/WDOE, 2004).

2.7.2 Peshastin Creek

Field data was collected at all Peshastin Creek transects at a high, middle, and low flow for model calibration purposes. Generally all field data was taken using the standard procedures described in Trihey and Wegner (1981) and Bovee (1982). Not all transects used the same benchmark. Head pin elevations, hydraulic slopes, stage of zero flow, water surface elevations (WSE) and above-water channel cross-sections were measured using a Topcon auto level and stadia rod, using standard survey techniques. The surveyor tied these features to the transect benchmark to the nearest 0.01 feet. Below water channel cross-sections were determined by subtracting measured depths from the WSE at the middle flow. Depths at high flow measurement locations that were not present at the middle flow measurement were subtracted from the high flow WSE.

Depth and velocity distributions at the three calibration flows was measured using a digital, Swoffer brand, propeller-type velocity meter mounted on a standard top-set wading rod. Velocity was measured at sixth tenths of the depth when depth was less than 2.5 feet and at two tenths and eight tenths of the depth where depths equaled or exceeded 2.5 feet, or when flow was influenced by an upstream obstruction. The rules for placement of verticals along the transect were closely followed. If there was uncertainty about whether a vertical was warranted, the vertical was usually placed at that point. In addition to stationing, notes were taken regarding the position of the top-set rod base plate relative to the substrate it was touching so that the meter could be placed in the exact position at succeeding calibration flows. These notes on substrate also revealed if bed shift had occurred since the previous calibration measurement; comparison of bed elevations during discharge measurements also indicated whether substantial sediment had been added or removed. Temporary staff gage levels and the time of day were recorded at the beginning and end of each transect measurement to note changes in stage.

Substrate was classified using a three-digit code representing the most abundant particle size, the second-most abundant particle size, and the percentage of the most abundant particle size. For example, a code of 73.7 would mean that the most abundant substrate was large cobble (6 to 12-inch diameter), that small gravel (0.5 to 1.5-inch diameter) was the second-most abundant substrate, and that large cobble represented 70 percent of the cell area.

2.8 Affected Species and Life Stages

Fisheries resources of primary concern in the Lower Wenatchee River and Peshastin Creek are commercial and game fish that include chinook salmon, steelhead trout, and bull trout. All of these species utilize the study area during some part of their life cycle. Figures 2.8-1 and 2.8-2 present the life-stage timing of salmonids in the Lower Wenatchee River and Peshastin Creek, respectively.

Anadromous fish use the Wenatchee River in a variety of ways. Adults of all species use the lower river as an upstream migration corridor to the spawning grounds in the upper Wenatchee. Salmonid fry and smolts use the river as a downstream migration corridor on their journey towards the sea. Migration of salmonids was not addressed in this study.

The Wenatchee River and Peshastin Creek provide spawning and rearing habitat important to the fresh water survival of the affected salmonids. Spawning steelhead trout and chinook salmon can often be found in reaches that offer good habitat. Analysis of spawning habitat in this study targeted steelhead trout and chinook salmon. Rearing salmonid species include steelhead trout, bull trout and chinook salmon. All of these species can be found year round in both the Lower Wenatchee River and Peshastin Creek.

2.9 Habitat Suitability Criteria

Salmonid species are not found randomly in streams and rivers, but rather have an affinity for particular ranges of depth, velocity, cover and substrate. Occurrence of fish due to these habitat parameters varies with species and life stage. In PHABSIM studies the range of each of these parameters are commonly referred to as fish preference criteria or a Habitat Suitability Criteria (HSC).

HSC for the Lower Wenatchee PHABSIM study for chinook salmon and steelhead were recommended by the Washington Department of Ecology and Washington Department of Fish and Wildlife (WDFW/WDOE, 2004). In the case of chinook and steelhead, Washington state data from many studies across the state have been combined to form a robust data set. In the absence of site-specific data for each PHABSIM study, this Washington “standard” criteria is recommended.

Figure 2.8-1
Lower Mainstem Wenatchee River
RM 0.0 to RM 25.6 (Tumwater Canyon)

Species	Lifestage	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
Spring Chinook	Spawning												
	Incubation												
	Rearing												
	In-migration												
Summer Chinook	Spawning												
	Incubation												
	Rearing												
	In-migration												
Steelhead	Spawning												
	Incubation												
	Rearing												
	In-migration												
Bull Trout	Spawning												
	Incubation												
	Rearing												

Based on:
Andonaegui, C., 2001. *Salmon, Steelhead and Bull Trout Habitat Limiting Factors for the Wenatchee Subbasin (WRIA 45) and Portions of WRIA 40 within Chelan County (Squilchuck, Stemilt and Colockum Drainages).* Washington State Conservation Commission.
Comments from: USFS (Cam Thomas, Cindy Raekes), WDFW (Andrew Murdoch, Bob Vadas, Mark Cookson), USFWS (Kate Terrell) and NOAA-Fisheries (Dale Bambrick)

Key:
Black indicates periods of heaviest use
Grey indicates periods of moderate use
Blank areas indicate periods of little or no use

Figure 2.8-2. Peshastin Creek Fish Periodicity

Species	Lifestage	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
Spring Chinook	Spawning												
	Incubation												
	Rearing												
Summer Chinook	Spawning	**NOT PRESENT**											
	Incubation												
	Rearing												
Steelhead	Spawning												
	Incubation												
	Rearing												
Bull Trout	Spawning												
	Incubation												
	Rearing												

Based on:

Andonaegui, C., 2001. *Salmon, Steelhead and Bull Trout Habitat Limiting Factors for the Wenatchee Subbasin (WRIA 45) and Portions of WRIA 40 within Chelan County (Squilchuck, Stemilt and Colockum Drainages).* Washington State Conservation Commission.

Comments from: USFS (Cam Thomas, Cindy Raekes), WDFW (Andrew Murdoch, Bob Vadas, Mark Cookson), USFWS (Kate Terrell) and NOAA-Fisheries (Dale Bambrick)

Key:

Black indicates periods of heaviest use

Grey indicates periods of moderate use

Blank areas indicate periods of little or no use

Prior to the current study, the bull trout HSC base data contained relatively fewer observations. Confidence in the Washington "standard" criteria for bull trout was not as strong as for other species. As an adjunct study to the Lower Wenatchee PHABSIM study; EESC, WDFW, and WDOE embarked on a cooperative study to collect bull trout spawning and rearing data in the Chiwawa drainage, a tributary to the upper Wenatchee River basin. The data was collected from September through November 2004 and significantly increased the number of bull trout observations used for Washington criteria. Based on the analysis of the data gathered for this study, and additional spawning data gathered on the Mad River, Washington HSC were revised for both spawning and rearing bull trout. The revised Washington bull trout rearing criteria was used to generate the WUA information for the Lower Wenatchee PHABSIM study.

The HSC tables used for the Lower Wenatchee PHABSIM study are contained in Appendix A to this report.

2.10 Data Compilation Methods

The ADCP interfaces directly with a laptop computer when collecting data. Software provided by the manufacturer of the ADCP is used to record and display the data as it is being collected. This same program is used to output a text file containing all the detail of a transect including the depth, velocity, distance, and error checking values for each vertical and bin along the transect. Verticals are columns looking straight down from the water surface to the river bottom. Velocity data taken at incremental depths are called bins.

A conversion utility from RHABSIM (Riverine Habitat Simulation) reads the text file from the ADCP software and converts it into a format that was imported into a spreadsheet. This utility screens out errors and converts bins of velocities into mean column velocities (average velocity for the one vertical). Three summary columns are created; distance, depth, and velocity.

Since the ADCP and the boat were incapable of taking readings in very shallow depths, manual depth and velocity data were manually entered into the spreadsheet. The summary ADCP data were integrated between the left and right banks of the manual data. The substrate and cover codes were entered alongside the depth and velocity data. Using a true water surface elevation entered by the user, depths were converted into elevations. A total discharge for the transect is generated. At this point, the data for each transect was subjected to a final check for errors and corrected. The corrected data files were then converted into a format readable by RHABSIM. RHABSIM read the file, and the completed data deck was ready for hydraulic modeling.

2.11 Data Analysis

2.11.1 Hydraulic Modeling

Analysis and integration of physical stream measurements and habitat preference criteria require the use of a group of the PHABSIM computer programs. There are two main programs in the RHABSIM library: the hydraulic model (called IFG-4) and the habitat model (called HABTAT). The IFG-4 hydraulic simulation model predicts depth of flow and mean column velocities across the stream transect as a function of discharge. A log-log regression analysis is used to develop

stage-discharge relationships at each transect and to predict velocity/discharge relationships at each habitat cell. Interpolation and extrapolation with the regression equations allows modeling of flows between and beyond the measured discharges. The resulting simulated hydraulic information is then input to the HABTAT program.

The HABTAT program integrates the simulated hydraulic information from IFG-4 with habitat suitability criteria (i.e., preference curves) and quantifies habitat availability over a range of flows for the specified target species and life stages. Habitat quantification is expressed as an index called Weighted Useable Area (WUA), and is given in units of habitat per 1,000 linear ft of stream.

Riverine Habitat Simulation (RHABSIM), a series of programs developed by Thomas R. Payne and Associates of Arcata, California, allows direct input of Acoustic Doppler Current Profiler (ADCP) data, and is an extensive conversion of the PHABSIM hydraulic and habitat simulation system developed by the USFWS. RHABSIM was used by EESC and Payne and Associates for the Lower Wenatchee River modeling.

2.11.2 Hydraulic Modeling Procedures

The Lower Wenatchee River PHABSIM data input files (decks) were compiled by Payne and Associates and calibrated using methods described in Payne (2003). All of the input decks were initially processed using the Problem Report subroutine of the Field Data Entry Module of RHABSIM. This program looks for errors in data placement and produces hard copy of the pertinent information needed to run the model, including transect weighting factors, slopes, stage of zero flow and Water Surface Elevation (WSE). EESC collected one set of velocity calibration measurements at each transect. In addition to the high flow calibration flow, WSE and discharges measured at two lower flows were used to generate the stage-discharge relationship.

In Washington State, a standard "three velocity set" regression model is normally used on all transects except where special circumstances required the use of alternate modeling methods. The three-velocity set models require that “verticals” (i.e., stations) be placed in exactly the same locations along the stream bed and that velocity measurements be taken at these stations at all the calibration flows.

It is not possible to do this when using the ADCP, since the placement of “verticals” is determined by boat speed, boat direction, and beginning point along the transect. As a result, “one velocity set” models were used. The “one velocity set” models use the velocities from one of the calibration flows for velocity modeling and employ the WSEs from the other calibration flows to develop the stage/discharge relationship.

After discussions on PHABSIM analysis with representatives from WDFW and WDOE, all parties agreed that a standard “three velocity set” methodology would be appropriate for Peshastin Creek and a “one velocity set” approach would be appropriate for Wenatchee River.

One of the goals of the hydraulic simulation is to have the model accurately reflect measured velocities and depths at calibration flows, while minimizing changes to the data. In this regard,

only minor changes were made to the IFIM decks in order for the model to more accurately predict cell velocities at the simulated flow. When calibrating one velocity set data decks, normally, two types of corrections can be made directly or indirectly to velocity data: 1) changes in the measured velocity; and, 2) changes in the Manning's N (roughness coefficient) for given cells. Changes were kept to a minimum and the decks were revised only when specific changes improved model performance.

One type of data change was a minor velocity adjustment (0.01 - 0.10 ft/sec) in some cells where there was depth but no measured velocity. The model "sees" a measured zero velocity as a blank and will attempt to fill that cell with a velocity based on a mass balance equation for the transect, taking into consideration slope, adjacent velocities, and calculated Manning's N values. Replacing a measured 0.00 with a velocity of 0.01 or 0.1 often corrects this problem. In addition, edge cells are often assigned high Manning's N values (i.e., the roughness coefficient) by the model. The high N values slow the velocity through these cells, giving an unrealistic simulation of velocities. In these instances the N values were manually reduced.

The range of extrapolation for simulated depths and velocities depends on the hydraulics of the channel and the accuracy of the velocity simulation, slope and Manning's N values in the case of one velocity set calibrations. Flows of interest were within the limits of acceptable extrapolation.

The range of extrapolation for simulated depths and velocities depends on the hydraulics of the channel and the spread between calibration flows. Velocity Adjustment Factors (VAF) are a measure of how well a three-flow regression model simulates velocities. A VAF between 0.90 and 1.10 is considered good. A VAF between 0.85 and 0.90 or between 1.10 and 1.15 is considered to be fair. A VAF between .80 and .85 or 1.15 and 1.20 is marginal, while a VAF below 0.80 or above 1.20 is considered poor. In the case of one velocity set models, the VAFs are actually adjustment factors of discharge, not velocities, and a wider range of values (between 0.10 and 10.0) is acceptable. A summary of VAFs and calibration details are presented in Tables 2 and 4 of Appendix B.

2.11.3 Measured Flows for Lower Wenatchee River

A single set of calibration flow data was developed from the field measurements. Actual measured flows for the Lower Wenatchee River and Peshastin Creek are shown in Table 2.11-1.

Table 2.11-1 Calibration Flows (cfs), Lower Wenatchee River and Peshastin Creek

	Low Flow	**Medium Flow**	**High Flow And Velocity Calibration**
Wenatchee River	670	1,400	3,700-4,200
Peshastin Creek	23	71	215

2.11.4 Model Performance

Only minor changes were made to the original input decks. Most revisions fell into three categories:

- Replacing a measured velocity of 0.0 ft/second with a velocity of 0.1 ft/second
- Changing the Manning's N value to either reduce or increase the velocities in the given cell
- Adjusting the bed elevations the stream margin cells slightly

Appendix B presents the summary of calibration details for the transects. Mean error (for both given and predicted discharges), ratio of measured vs. predicted discharges, and B coefficients were all within the acceptable limits for PHABSIM calibration.

Output from the hydraulic models was then used to determine changes in the Lower Wenatchee River water depths, velocities, surface area, and fish habitat throughout a range of flows from 220 cfs to 10,000 cfs.

After the hydraulic models were calibrated, transect weighting and lengths to simulate a 1,000 foot reach were added as shown in Table 2.6-1 and 2.6-2 for the rearing and spawning life stages. Final hydraulic model runs were made to produce input for the HABTAT habitat model.

3.0 RESULTS

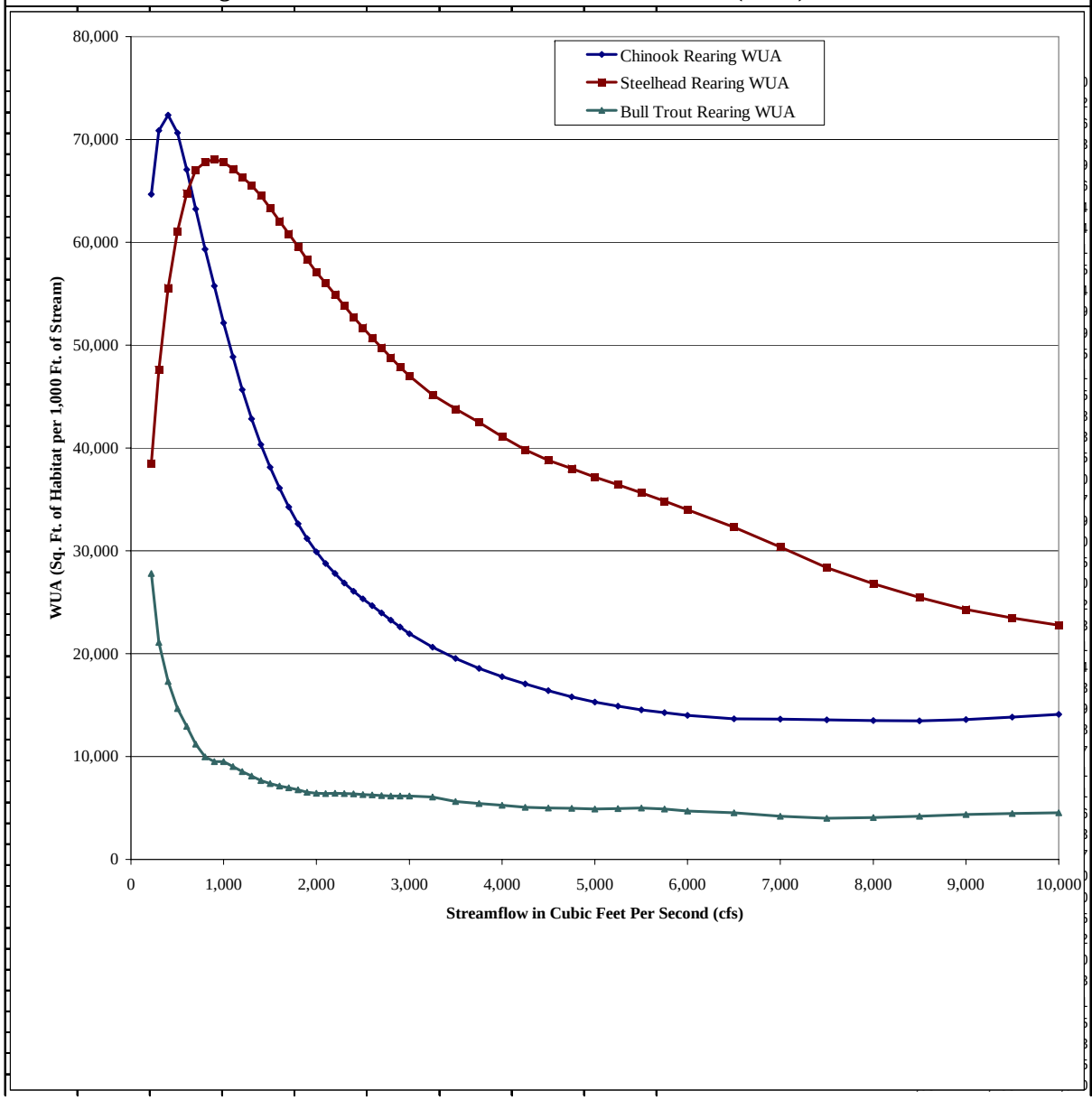
3.1 Weighted Usable Area Results

Within the HABTAT program, output from the hydraulic modeling is combined with habitat suitability criteria for depth, velocity, and substrate/cover for the target species life stages. The output from this model is expressed as Flow (Q) v, Weighted Usable Area (WUA), which is an index of available habitat per 1,000 lineal ft of stream for each species and life stage of concern.

Figures 3.1-1 to 3.1-8 show Wenatchee River Flow v WUA graphs for Reach 1 through 4 for rearing and spawning life stages. Tables 3.1-1 to 3.1-4 give tabular results of the Wenatchee River, Reach 1 to 4 WUA data.

Figures 3.1-9 and 3.1-10 show Peshastin Creek Flow v WUA graphs for rearing and spawning life stages. Peshastin Creek WUA results are also shown in Table 3.1-5.

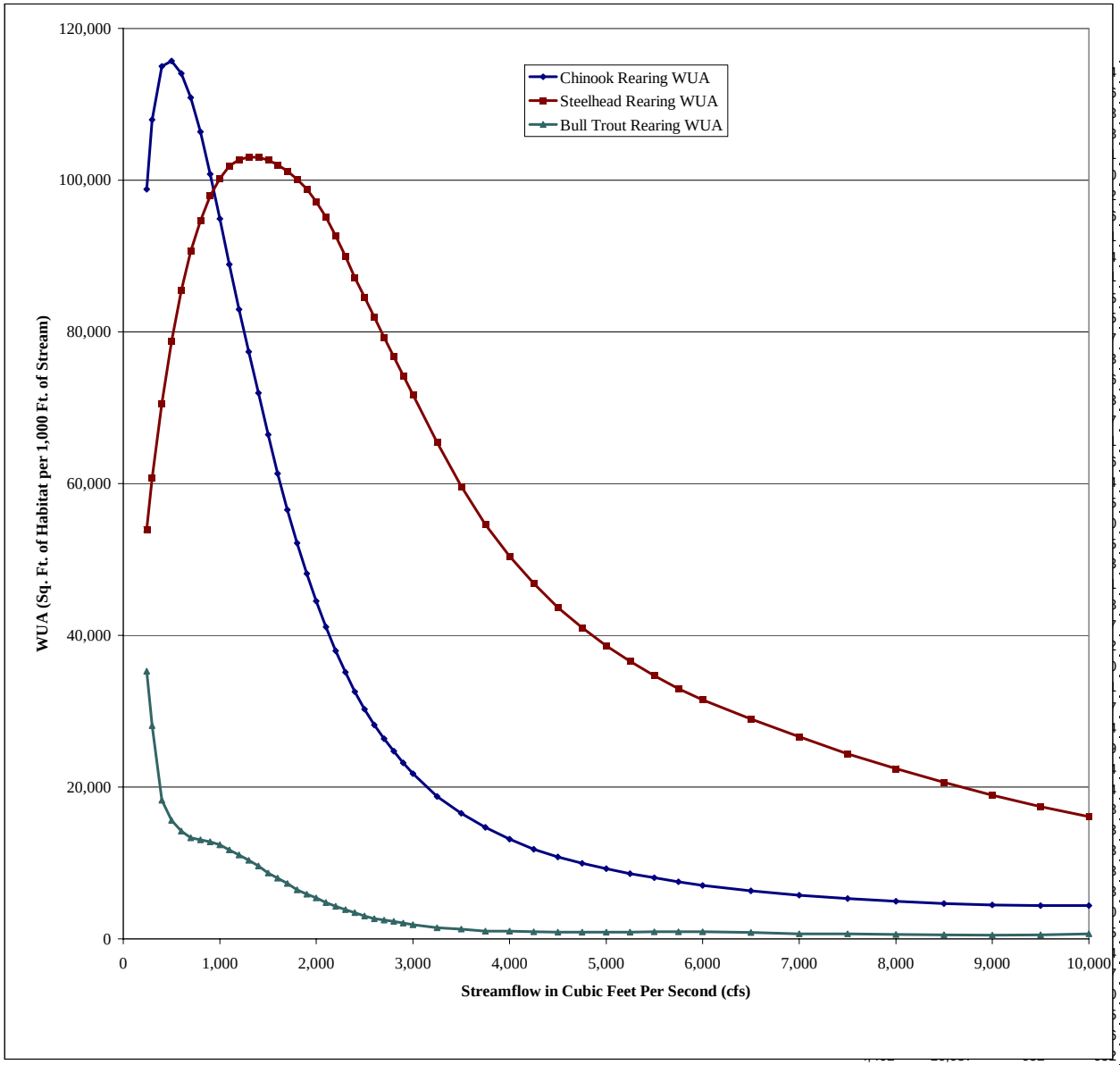
Figure 3.1-1 Wenatchee River Reach 1: Fish Habitat (WUA) vs. Flow.



Percent of Peak Habitat vs Flow

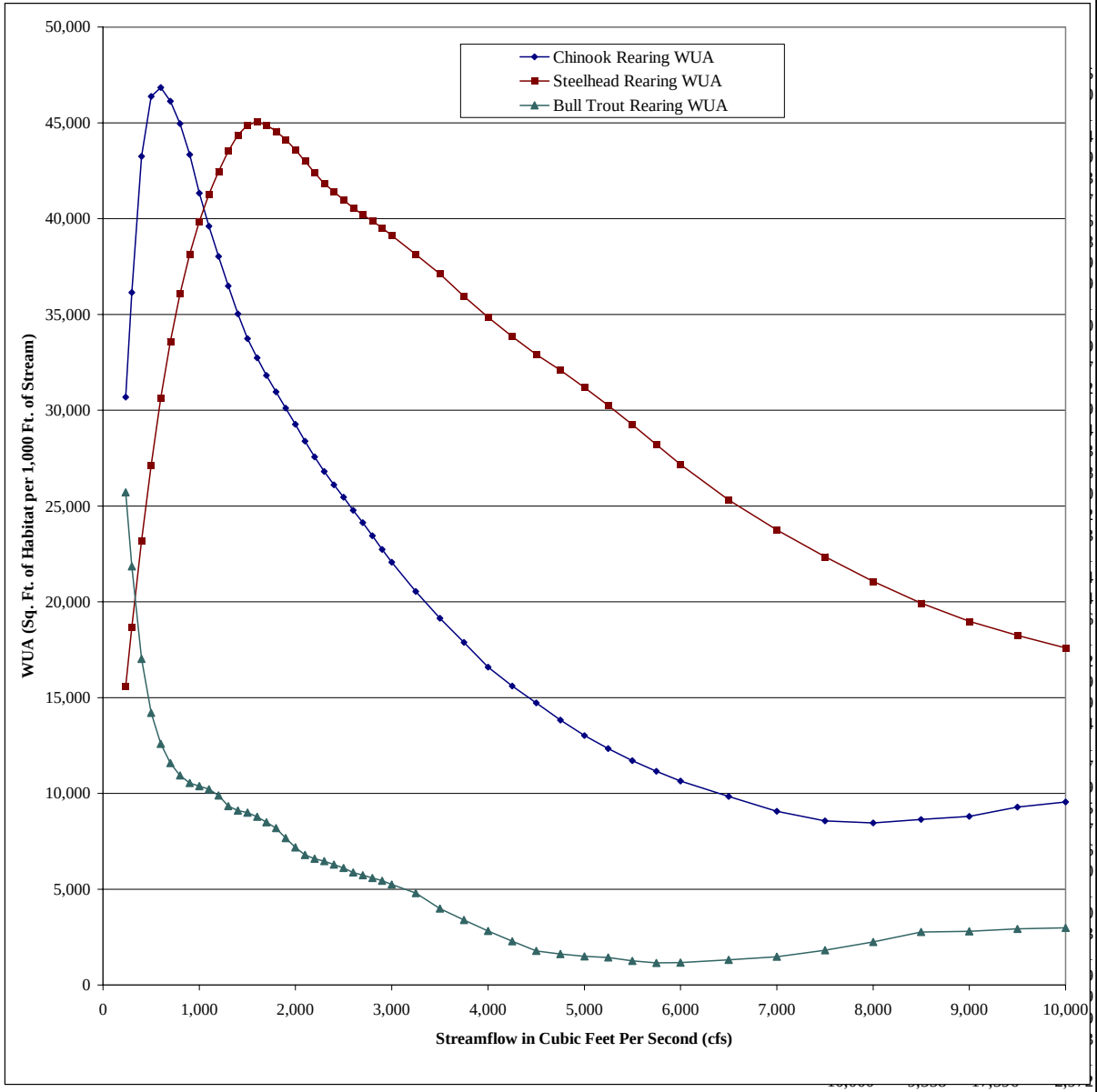
Flow	Chinook Rearing WUA	Steelhead Rearing WUA	Bull Trout Rearing WUA
220	89%	57%	**100%**
300	98%	70%	76%
400	**100%**	82%	62%
500	98%	90%	53%
600	93%	95%	47%
700	87%	99%	40%
800	82%	**100%**	36%
900	77%	**100%**	34%
1,000	72%	**100%**	34%
1,100	68%	99%	32%
1,200	63%	97%	31%
1,300	59%	96%	29%
1,400	56%	95%	28%
1,500	53%	93%	27%
1,600	50%	91%	26%
1,700	47%	89%	25%
1,800	45%	88%	24%
1,900	43%	86%	24%
2,000	41%	84%	23%
2,100	40%	82%	23%
2,200	38%	81%	23%
2,300	37%	79%	23%
2,400	36%	78%	23%
2,500	35%	76%	23%
2,600	34%	75%	23%
2,700	33%	73%	22%
2,800	32%	72%	22%
2,900	31%	70%	22%
3,000	30%	69%	22%
3,250	29%	66%	22%
3,500	27%	64%	20%
3,750	26%	62%	19%
4,000	25%	60%	19%
4,250	24%	59%	18%
4,500	23%	57%	18%
4,750	22%	56%	18%
5,000	21%	55%	18%
5,250	21%	54%	18%
5,500	20%	52%	18%
5,750	20%	51%	18%
6,000	19%	50%	17%
6,500	19%	47%	16%
7,000	19%	45%	15%
7,500	19%	42%	14%
8,000	19%	39%	15%
8,500	19%	37%	15%
9,000	19%	36%	16%
9,500	19%	34%	16%
10,000	19%	33%	16%

Figure 3.1-2 Wenatchee River Reach 2: Fish Habitat (WUA) vs. Flow.



Percent of Peak Habitat vs Flow			
Flow	Chinook Rearing WUA	Steelhead Rearing WUA	Bull Trout Rearing WUA
245	85%	52%	**100%**
300	93%	59%	80%
400	99%	68%	52%
500	**100%**	76%	44%
600	99%	83%	40%
700	96%	88%	38%
800	92%	92%	37%
900	87%	95%	36%
1,000	82%	97%	35%
1,100	77%	99%	33%
1,200	72%	**100%**	31%
1,300	67%	**100%**	29%
1,400	62%	**100%**	27%
1,500	57%	**100%**	25%
1,600	53%	99%	23%
1,700	49%	98%	21%
1,800	45%	97%	18%
1,900	42%	96%	17%
2,000	38%	94%	15%
2,100	36%	92%	14%
2,200	33%	90%	12%
2,300	30%	87%	11%
2,400	28%	85%	10%
2,500	26%	82%	8%
2,600	24%	80%	8%
2,700	23%	77%	7%
2,800	21%	74%	7%
2,900	20%	72%	6%
3,000	19%	70%	5%
3,250	16%	64%	4%
3,500	14%	58%	4%
3,750	13%	53%	3%
4,000	11%	49%	3%
4,250	10%	45%	3%
4,500	9%	42%	3%
4,750	9%	40%	2%
5,000	8%	38%	2%
5,250	7%	35%	3%
5,500	7%	34%	3%
5,750	7%	32%	3%
6,000	6%	31%	3%
6,500	5%	28%	2%
7,000	5%	26%	2%
7,500	5%	24%	2%
8,000	4%	22%	2%
8,500	4%	20%	2%
9,000	4%	18%	1%
9,500	4%	17%	2%
10,000	4%	16%	2%

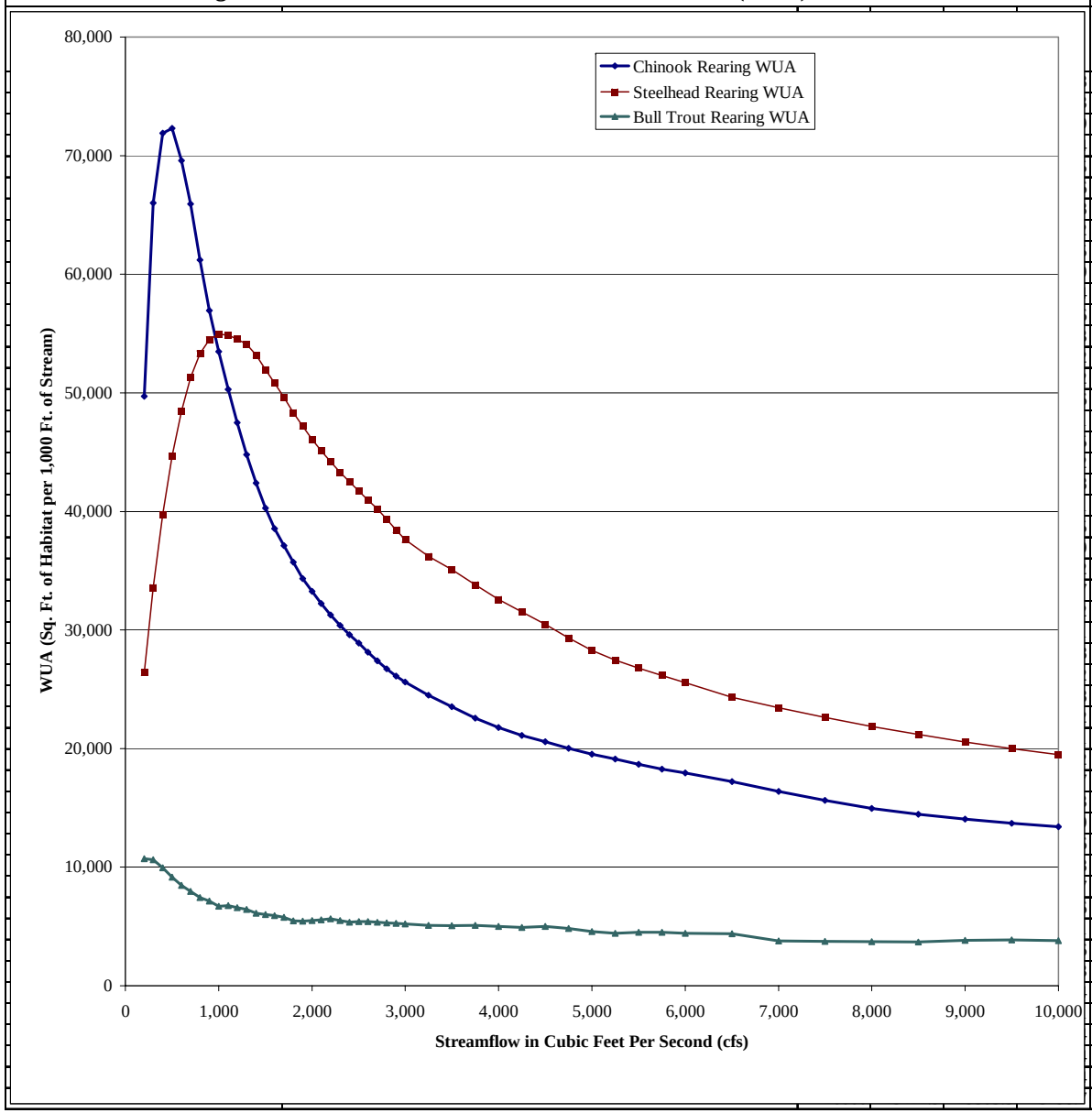
Figure 3.1-3 Wenatchee River Reach 3: Fish Habitat (WUA) vs. Flow.



Percent of Peak Habitat vs Flow

Flow	Chinook Rearing WUA	Steelhead Rearing WUA	Bull Trout Rearing WUA
235	65%	35%	**100%**
300	77%	41%	85%
400	92%	52%	66%
500	99%	60%	55%
600	**100%**	68%	49%
700	98%	75%	45%
800	96%	80%	43%
900	93%	85%	41%
1,000	88%	88%	40%
1,100	85%	92%	40%
1,200	81%	94%	38%
1,300	78%	97%	36%
1,400	75%	98%	35%
1,500	72%	**100%**	35%
1,600	70%	**100%**	34%
1,700	68%	**100%**	33%
1,800	66%	99%	32%
1,900	64%	98%	30%
2,000	62%	97%	28%
2,100	61%	95%	26%
2,200	59%	94%	26%
2,300	57%	93%	25%
2,400	56%	92%	24%
2,500	54%	91%	24%
2,600	53%	90%	23%
2,700	52%	89%	22%
2,800	50%	89%	22%
2,900	49%	88%	21%
3,000	47%	87%	20%
3,250	44%	85%	19%
3,500	41%	82%	16%
3,750	38%	80%	13%
4,000	35%	77%	11%
4,250	33%	75%	9%
4,500	31%	73%	7%
4,750	30%	71%	6%
5,000	28%	69%	6%
5,250	26%	67%	6%
5,500	25%	65%	5%
5,750	24%	63%	4%
6,000	23%	60%	5%
6,500	21%	56%	5%
7,000	19%	53%	6%
7,500	18%	50%	7%
8,000	18%	47%	9%
8,500	18%	44%	11%
9,000	19%	42%	11%
9,500	20%	40%	11%
10,000	20%	39%	12%

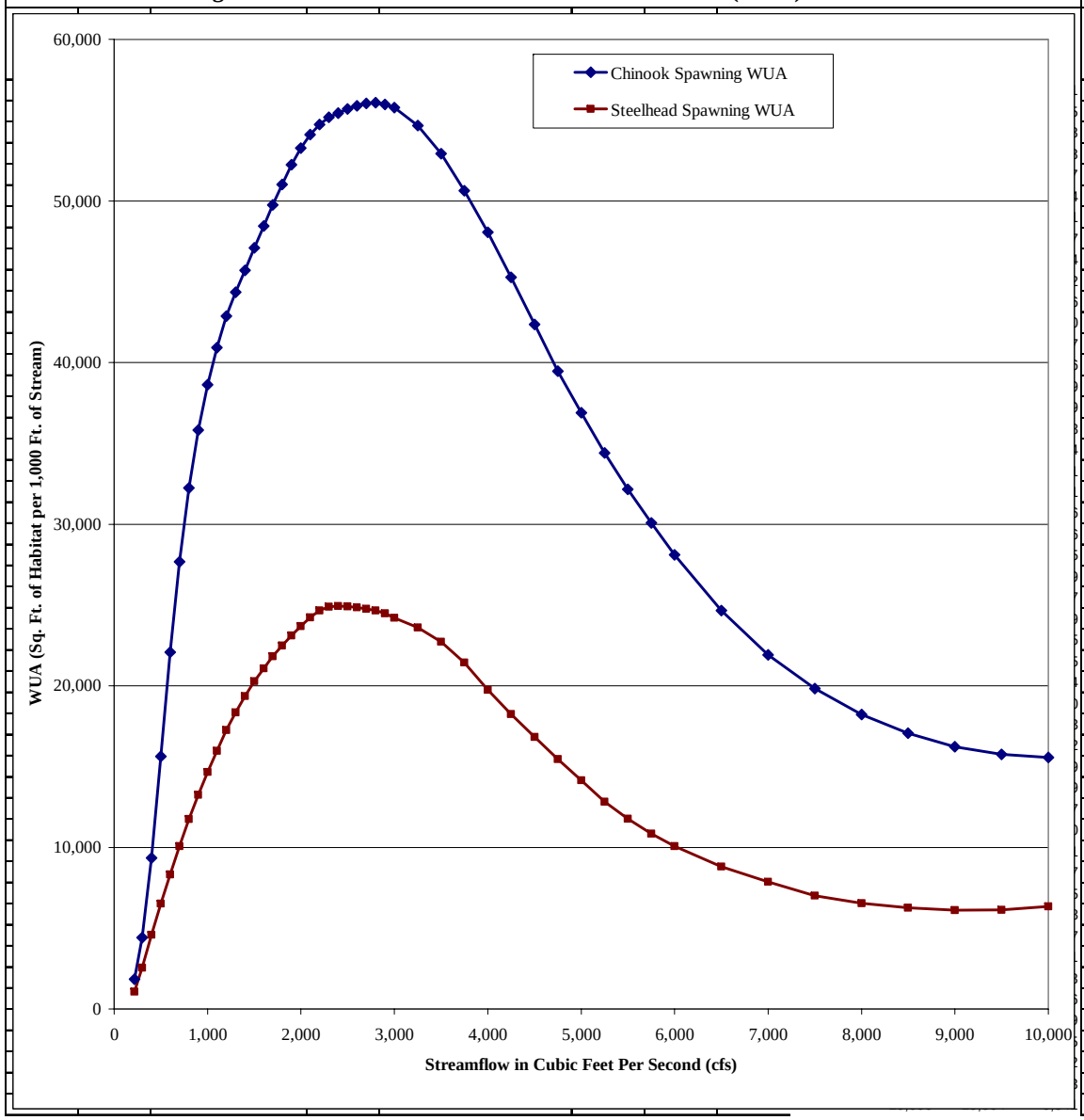
Figure 3.1-4 Wenatchee River Reach 4: Fish Habitat (WUA) vs. Flow.



Percent of Peak Habitat vs Flow

Flow	Chinook Rearing WUA	Steelhead Rearing WUA	Bull Trout Rearing WUA
200	69%	48%	**100%**
300	91%	61%	99%
400	99%	72%	93%
500	**100%**	81%	85%
600	96%	88%	79%
700	91%	93%	74%
800	85%	97%	69%
900	79%	99%	67%
1000	74%	**100%**	62%
1100	70%	**100%**	63%
1200	66%	99%	61%
1300	62%	98%	60%
1400	59%	97%	57%
1500	56%	95%	56%
1600	53%	92%	55%
1700	51%	90%	54%
1800	49%	88%	51%
1900	47%	86%	51%
2000	46%	84%	51%
2100	45%	82%	52%
2200	43%	80%	53%
2300	42%	79%	51%
2400	41%	77%	50%
2500	40%	76%	51%
2600	39%	75%	51%
2700	38%	73%	50%
2800	37%	72%	49%
2900	36%	70%	49%
3000	35%	68%	49%
3250	34%	66%	48%
3500	33%	64%	47%
3750	31%	62%	47%
4000	30%	59%	47%
4250	29%	57%	46%
4500	28%	55%	47%
4750	28%	53%	45%
5000	27%	51%	43%
5250	26%	50%	41%
5500	26%	49%	42%
5750	25%	48%	42%
6000	25%	46%	41%
6500	24%	44%	41%
7000	23%	43%	35%
7500	22%	41%	35%
8000	21%	40%	35%
8500	20%	39%	34%
9000	19%	37%	36%
9500	19%	36%	36%
10000	19%	35%	35%

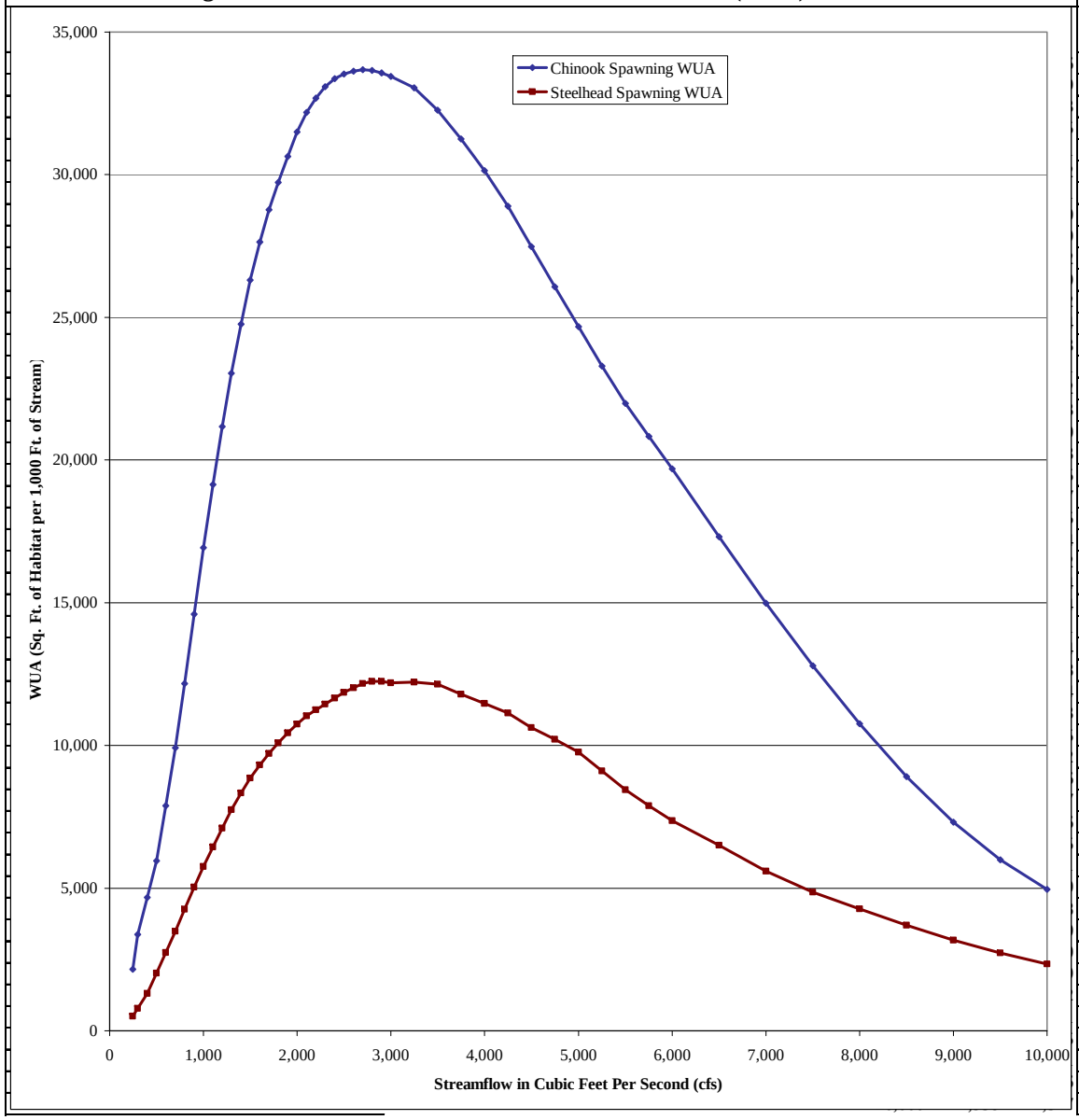
Figure 3.1-5 Wenatchee River Reach 1: Fish Habitat (WUA) vs. Flow.



Percent of Peak Habitat vs Flow

Flow	Chinook Spawning WUA	Steelhead Spawning WUA
220	3%	4%
300	8%	10%
400	17%	18%
500	28%	26%
600	39%	33%
700	49%	40%
800	57%	47%
900	64%	53%
1,000	69%	59%
1,100	73%	64%
1,200	76%	69%
1,300	79%	74%
1,400	82%	78%
1,500	84%	81%
1,600	86%	85%
1,700	89%	88%
1,800	91%	90%
1,900	93%	93%
2,000	95%	95%
2,100	96%	97%
2,200	98%	99%
2,300	98%	**100%**
2,400	99%	**100%**
2,500	99%	**100%**
2,600	**100%**	**100%**
2,700	**100%**	99%
2,800	**100%**	99%
2,900	**100%**	98%
3,000	99%	97%
3,250	97%	95%
3,500	94%	91%
3,750	90%	86%
4,000	86%	79%
4,250	81%	73%
4,500	76%	68%
4,750	70%	62%
5,000	66%	57%
5,250	61%	51%
5,500	57%	47%
5,750	54%	43%
6,000	50%	40%
6,500	44%	35%
7,000	39%	32%
7,500	35%	28%
8,000	33%	26%
8,500	30%	25%
9,000	29%	25%
9,500	28%	25%
10,000	28%	25%

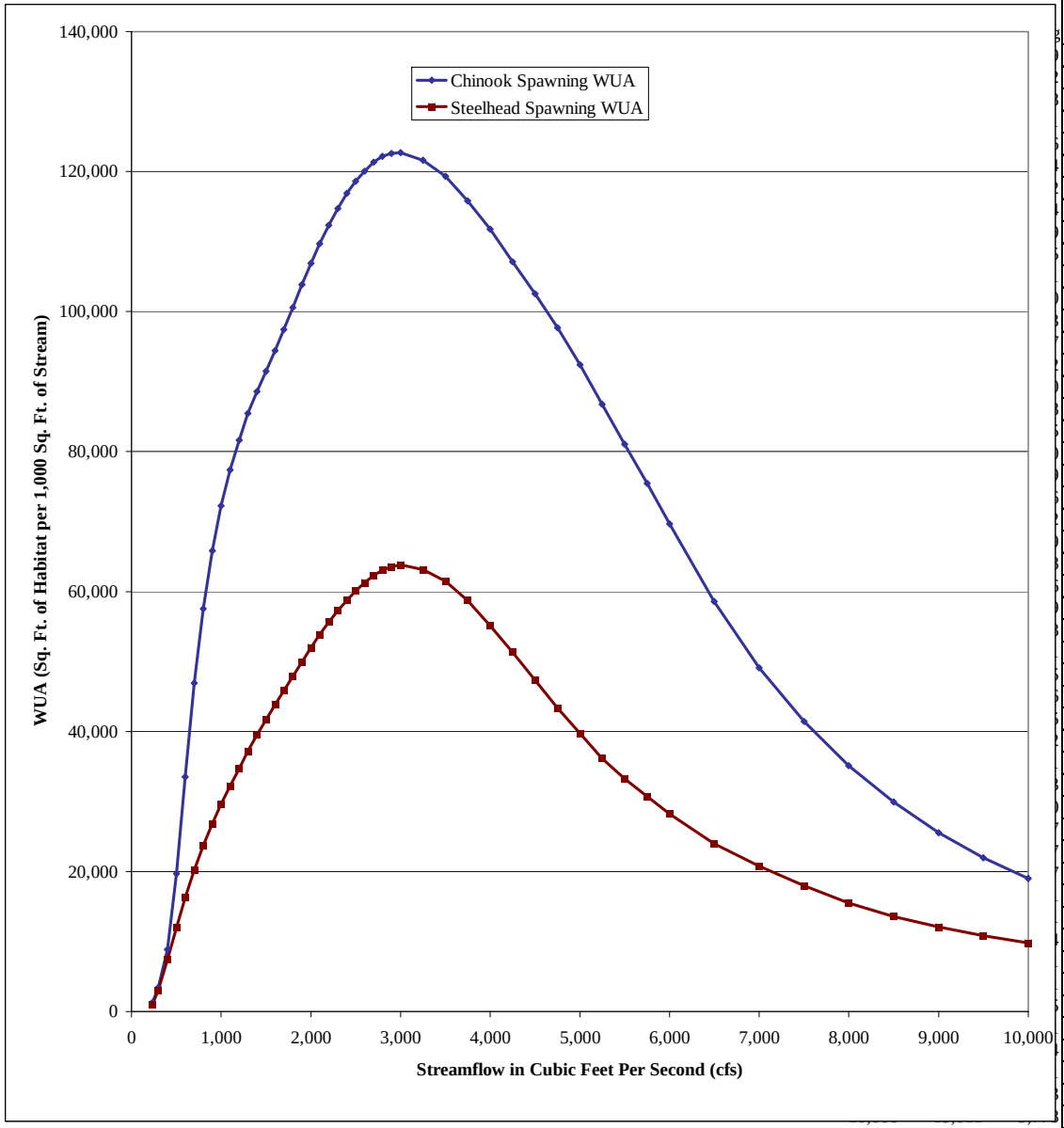
Figure 3.1-6 Wenatchee River Reach 2: Fish Habitat (WUA) vs. Flow.



Percent of Peak Habitat vs Flow

Flow	Chinook Spawning WUA	Steelhead Spawning WUA
245	6%	4%
300	10%	6%
400	14%	11%
500	18%	16%
600	23%	22%
700	29%	28%
800	36%	35%
900	43%	41%
1,000	50%	47%
1,100	57%	53%
1,200	63%	58%
1,300	68%	63%
1,400	74%	68%
1,500	78%	72%
1,600	82%	76%
1,700	85%	79%
1,800	88%	82%
1,900	91%	85%
2,000	94%	88%
2,100	96%	90%
2,200	97%	92%
2,300	98%	93%
2,400	99%	95%
2,500	**100%**	97%
2,600	**100%**	98%
2,700	**100%**	99%
2,800	**100%**	**100%**
2,900	**100%**	**100%**
3,000	99%	**100%**
3,250	98%	**100%**
3,500	96%	99%
3,750	93%	96%
4,000	89%	94%
4,250	86%	91%
4,500	82%	87%
4,750	77%	83%
5,000	73%	80%
5,250	69%	74%
5,500	65%	69%
5,750	62%	64%
6,000	58%	60%
6,500	51%	53%
7,000	45%	46%
7,500	38%	40%
8,000	32%	35%
8,500	26%	30%
9,000	22%	26%
9,500	18%	22%
10,000	15%	19%

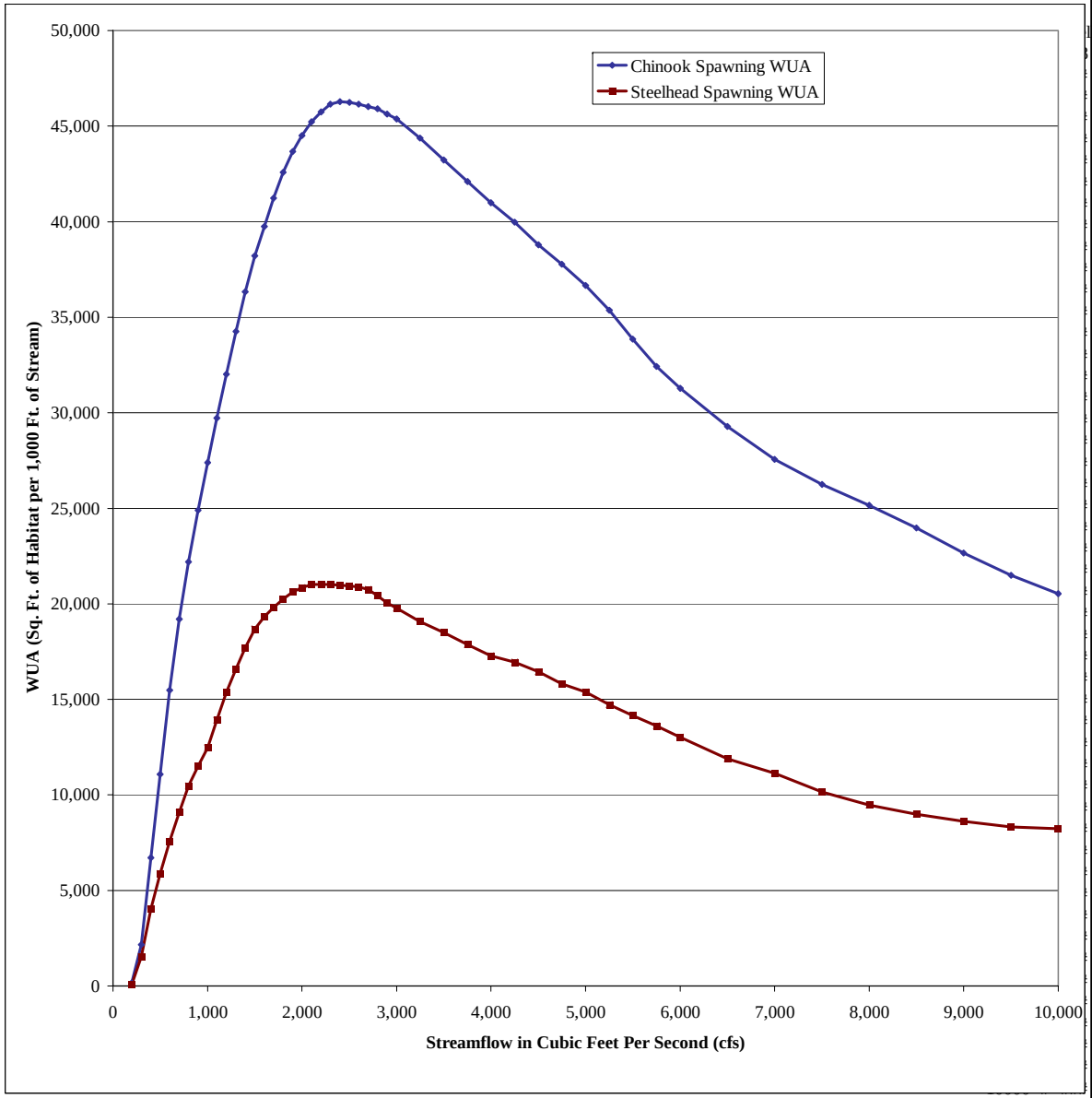
Figure 3.1-7 Wenatchee River Reach 3: Fish Habitat (WUA) vs. Flow.



Percent of Peak Habitat vs Flow

Flow	Chinook Spawning WUA	Steelhead Spawning WUA
235	1%	2%
300	3%	5%
400	7%	12%
500	16%	19%
600	27%	25%
700	38%	32%
800	47%	37%
900	54%	42%
1,000	59%	46%
1,100	63%	51%
1,200	67%	54%
1,300	70%	58%
1,400	72%	62%
1,500	75%	65%
1,600	77%	69%
1,700	79%	72%
1,800	82%	75%
1,900	85%	78%
2,000	87%	82%
2,100	89%	84%
2,200	92%	87%
2,300	93%	90%
2,400	95%	92%
2,500	97%	94%
2,600	98%	96%
2,700	99%	98%
2,800	100%	99%
2,900	100%	100%
3,000	100%	100%
3,250	99%	99%
3,500	97%	96%
3,750	94%	92%
4,000	91%	86%
4,250	87%	80%
4,500	84%	74%
4,750	80%	68%
5,000	75%	62%
5,250	71%	57%
5,500	66%	52%
5,750	62%	48%
6,000	57%	44%
6,500	48%	38%
7,000	40%	33%
7,500	34%	28%
8,000	29%	24%
8,500	24%	21%
9,000	21%	19%
9,500	18%	17%
10,000	15%	15%

Figure 3.1-8 Wenatchee River Reach 4: Fish Habitat (WUA) vs. Flow.



Percent of Peak Habitat vs Flow

Flow	Chinook Spawning WUA	Steelhead Spawning WUA
200	0%	0%
300	5%	7%
400	14%	19%
500	24%	28%
600	33%	36%
700	41%	43%
800	48%	50%
900	54%	55%
1,000	59%	59%
1,100	64%	66%
1,200	69%	73%
1,300	74%	79%
1,400	78%	84%
1,500	83%	89%
1,600	86%	92%
1,700	89%	94%
1,800	92%	96%
1,900	94%	98%
2,000	96%	99%
2,100	98%	**100%**
2,200	99%	**100%**
2,300	**100%**	**100%**
2,400	**100%**	**100%**
2,500	**100%**	**100%**
2,600	**100%**	99%
2,700	99%	99%
2,800	99%	97%
2,900	99%	95%
3,000	98%	94%
3,250	96%	91%
3,500	93%	88%
3,750	91%	85%
4,000	89%	82%
4,250	86%	81%
4,500	84%	78%
4,750	82%	75%
5,000	79%	73%
5,250	76%	70%
5,500	73%	67%
5,750	70%	65%
6,000	68%	62%
6,500	63%	57%
7,000	60%	53%
7,500	57%	48%
8,000	54%	45%
8,500	52%	43%
9,000	49%	41%
9,500	46%	40%
10,000	44%	39%

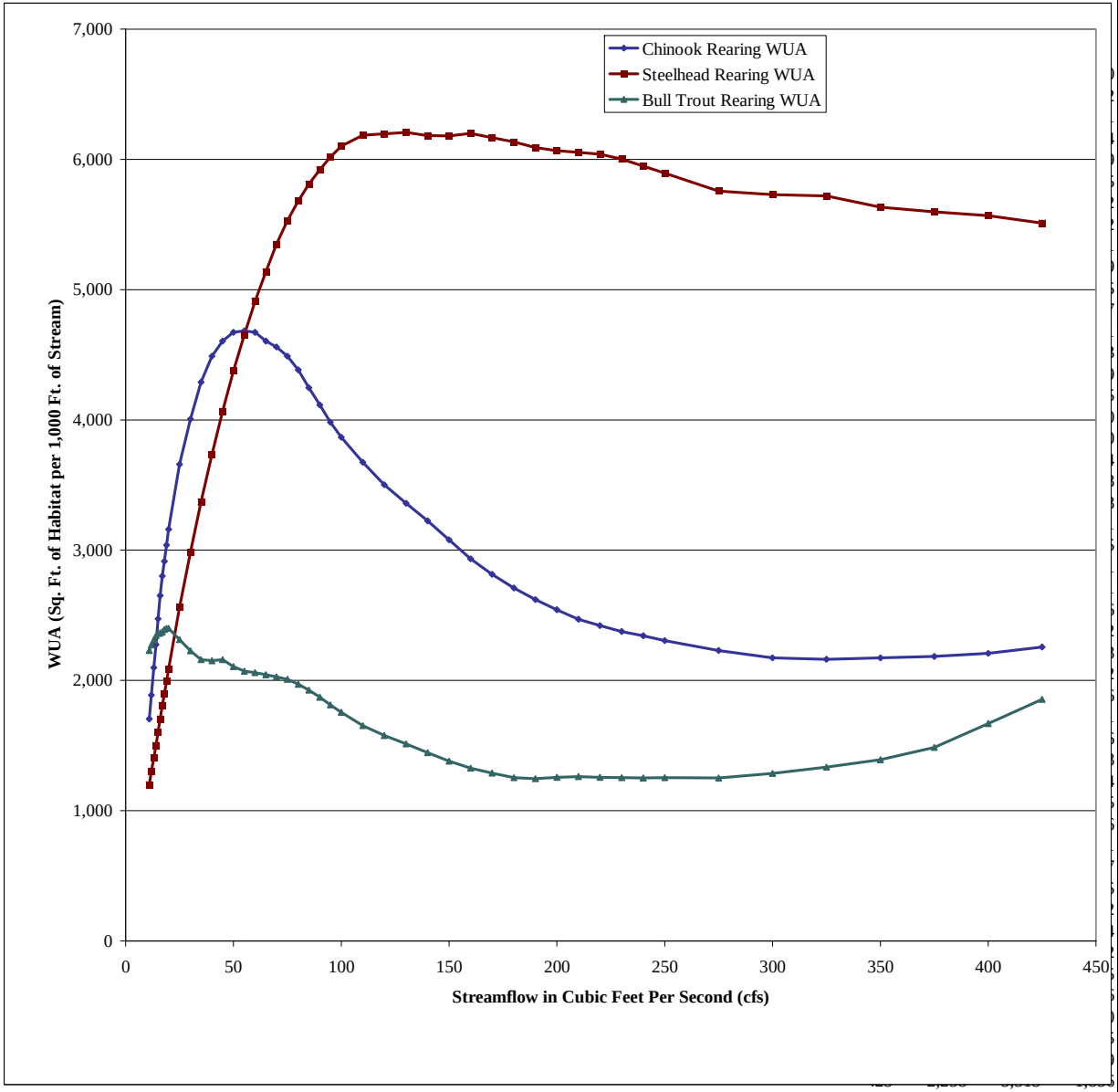
TABLE 3.1-1 WENATCHEE RIVER REACH 1 WEIGHTED USABLE AREA (WUA)										
	Chinook				Steelhead				Bull Trout	
Flow (cfs)	Rearing	% of Peak	Spawning	% of Peak	Rearing	% of Peak	Spawning	% of Peak	Rearing	% of Peak
220	64,675	89.38%	1,839	3.28%	38,502	56.57%	1,081	4.34%	27,790	100.00%
300	70,868	97.94%	4,421	7.88%	47,599	69.94%	2,555	10.25%	21,102	75.94%
400	72,356	100.00%	9,337	16.65%	55,561	81.64%	4,578	18.36%	17,306	62.27%
500	70,620	97.60%	15,631	27.88%	61,052	89.71%	6,508	26.10%	14,673	52.80%
600	67,082	92.71%	22,084	39.38%	64,763	95.16%	8,327	33.39%	12,929	46.53%
700	63,246	87.41%	27,663	49.33%	67,044	98.51%	10,084	40.44%	11,186	40.25%
800	59,317	81.98%	32,242	57.50%	67,803	99.63%	11,751	47.13%	9,974	35.89%
900	55,770	77.08%	35,813	63.87%	68,056	100.00%	13,257	53.17%	9,494	34.16%
1,000	52,180	72.12%	38,630	68.89%	67,803	99.63%	14,654	58.77%	9,491	34.15%
1,100	48,872	67.54%	40,917	72.97%	67,134	98.65%	15,962	64.02%	9,025	32.48%
1,200	45,676	63.13%	42,871	76.45%	66,346	97.49%	17,266	69.24%	8,534	30.71%
1,300	42,847	59.22%	44,358	79.11%	65,520	96.27%	18,360	73.63%	8,089	29.11%
1,400	40,341	55.75%	45,712	81.52%	64,538	94.83%	19,357	77.63%	7,679	27.63%
1,500	38,117	52.68%	47,097	83.99%	63,334	93.06%	20,286	81.36%	7,365	26.50%
1,600	36,084	49.87%	48,451	86.40%	62,072	91.21%	21,079	84.54%	7,141	25.70%
1,700	34,262	47.35%	49,745	88.71%	60,826	89.38%	21,829	87.54%	6,965	25.07%
1,800	32,641	45.11%	51,008	90.96%	59,610	87.59%	22,488	90.19%	6,768	24.36%
1,900	31,200	43.12%	52,240	93.16%	58,335	85.72%	23,104	92.66%	6,543	23.54%
2,000	29,912	41.34%	53,272	95.00%	57,108	83.91%	23,691	95.01%	6,425	23.12%
2,100	28,772	39.77%	54,111	96.50%	56,045	82.35%	24,221	97.14%	6,400	23.03%
2,200	27,788	38.40%	54,736	97.61%	54,919	80.70%	24,656	98.88%	6,417	23.09%
2,300	26,874	37.14%	55,173	98.39%	53,830	79.10%	24,896	99.85%	6,399	23.03%
2,400	26,076	36.04%	55,439	98.87%	52,743	77.50%	24,935	100.00%	6,360	22.89%
2,500	25,348	35.03%	55,691	99.32%	51,715	75.99%	24,909	99.90%	6,315	22.72%
2,600	24,653	34.07%	55,888	99.67%	50,707	74.51%	24,847	99.65%	6,260	22.53%
2,700	23,978	33.14%	56,025	99.91%	49,773	73.14%	24,759	99.29%	6,212	22.35%
2,800	23,264	32.15%	56,075	100.00%	48,790	71.69%	24,645	98.84%	6,173	22.21%
2,900	22,583	31.21%	55,963	99.80%	47,857	70.32%	24,475	98.15%	6,171	22.21%
3,000	21,923	30.30%	55,780	99.47%	46,993	69.05%	24,204	97.07%	6,164	22.18%
3,250	20,633	28.52%	54,660	97.48%	45,166	66.37%	23,610	94.69%	6,053	21.78%
3,500	19,549	27.02%	52,935	94.40%	43,786	64.34%	22,723	91.13%	5,639	20.29%
3,750	18,562	25.65%	50,627	90.29%	42,497	62.44%	21,432	85.95%	5,418	19.50%
4,000	17,767	24.56%	48,070	85.73%	41,100	60.39%	19,749	79.20%	5,277	18.99%
4,250	17,064	23.58%	45,275	80.74%	39,848	58.55%	18,249	73.19%	5,051	18.17%
4,500	16,412	22.68%	42,354	75.53%	38,814	57.03%	16,837	67.53%	5,001	17.99%
4,750	15,814	21.86%	39,470	70.39%	37,990	55.82%	15,460	62.00%	4,966	17.87%
5,000	15,304	21.15%	36,888	65.78%	37,183	54.64%	14,141	56.71%	4,883	17.57%
5,250	14,908	20.60%	34,410	61.37%	36,449	53.56%	12,827	51.44%	4,937	17.77%
5,500	14,549	20.11%	32,152	57.34%	35,641	52.37%	11,765	47.18%	4,990	17.96%
5,750	14,257	19.70%	30,076	53.64%	34,820	51.16%	10,838	43.47%	4,900	17.63%
6,000	13,992	19.34%	28,093	50.10%	33,998	49.96%	10,067	40.37%	4,705	16.93%
6,250	13,773	19.03%	26,304	46.91%	33,186	48.76%	9,399	37.69%	4,551	16.38%
6,500	13,663	18.88%	24,649	43.96%	32,296	47.46%	8,821	35.38%	4,532	16.31%
6,750	13,657	18.87%	23,198	41.37%	31,354	46.07%	8,325	33.39%	4,397	15.82%
7,000	13,647	18.86%	21,904	39.06%	30,355	44.60%	7,858	31.51%	4,200	15.11%
7,250	13,583	18.77%	20,786	37.07%	29,325	43.09%	7,400	29.68%	4,037	14.53%
7,500	13,577	18.76%	19,827	35.36%	28,378	41.70%	7,006	28.10%	4,003	14.40%
7,750	13,549	18.73%	18,968	33.83%	27,552	40.48%	6,722	26.96%	4,095	14.74%
8,000	13,498	18.66%	18,229	32.51%	26,794	39.37%	6,539	26.23%	4,061	14.61%
8,250	13,461	18.60%	17,598	31.38%	26,096	38.35%	6,389	25.62%	4,148	14.93%
8,500	13,474	18.62%	17,066	30.43%	25,459	37.41%	6,265	25.13%	4,215	15.17%
8,750	13,516	18.68%	16,613	29.63%	24,857	36.52%	6,177	24.77%	4,311	15.51%
9,000	13,598	18.79%	16,223	28.93%	24,301	35.71%	6,112	24.51%	4,353	15.67%
9,250	13,696	18.93%	15,934	28.42%	23,843	35.03%	6,096	24.45%	4,440	15.98%
9,500	13,822	19.10%	15,764	28.11%	23,453	34.46%	6,123	24.56%	4,455	16.03%
9,750	13,947	19.28%	15,649	27.91%	23,107	33.95%	6,213	24.92%	4,510	16.23%
10,000	14,084	19.46%	15,564	27.76%	22,753	33.43%	6,341	25.43%	4,520	16.27%

TABLE 3.1-2 WENATCHEE RIVER REACH 2 WEIGHTED USABLE AREA (WUA)										
	Chinook				Steelhead				Bull Trout	
Flow (cfs)	Rearing	% of Peak	Spawning	% of Peak	Rearing	% of Peak	Spawning	% of Peak	Rearing	% of Peak
245	98,823	85.40%	2,159	6.41%	53,988	52.39%	516	4.22%	35,244	100.00%
300	107,948	93.28%	3,377	10.03%	60,744	58.94%	789	6.45%	28,086	79.69%
400	114,996	99.37%	4,666	13.86%	70,582	68.49%	1,303	10.64%	18,268	51.83%
500	115,720	100.00%	5,956	17.69%	78,770	76.43%	2,015	16.46%	15,638	44.37%
600	114,085	98.59%	7,889	23.43%	85,443	82.91%	2,741	22.38%	14,211	40.32%
700	110,904	95.84%	9,913	29.44%	90,603	87.91%	3,482	28.44%	13,330	37.82%
800	106,360	91.91%	12,166	36.13%	94,660	91.85%	4,261	34.80%	13,032	36.98%
900	100,790	87.10%	14,594	43.34%	97,902	95.00%	5,030	41.08%	12,796	36.31%
1,000	94,930	82.03%	16,929	50.27%	100,205	97.23%	5,759	47.03%	12,411	35.22%
1,100	88,912	76.83%	19,146	56.86%	101,845	98.82%	6,442	52.61%	11,734	33.29%
1,200	82,950	71.68%	21,174	62.88%	102,719	99.67%	7,099	57.98%	11,061	31.38%
1,300	77,371	66.86%	23,047	68.44%	103,059	100.00%	7,742	63.23%	10,355	29.38%
1,400	71,927	62.16%	24,767	73.55%	102,993	99.94%	8,334	68.06%	9,595	27.22%
1,500	66,468	57.44%	26,305	78.12%	102,651	99.60%	8,853	72.30%	8,657	24.56%
1,600	61,328	53.00%	27,636	82.07%	102,031	99.00%	9,311	76.04%	8,003	22.71%
1,700	56,547	48.87%	28,771	85.44%	101,190	98.19%	9,712	79.32%	7,286	20.67%
1,800	52,160	45.07%	29,733	88.30%	100,132	97.16%	10,093	82.43%	6,473	18.37%
1,900	48,141	41.60%	30,644	91.00%	98,839	95.91%	10,440	85.27%	5,887	16.70%
2,000	44,516	38.47%	31,499	93.54%	97,154	94.27%	10,753	87.82%	5,391	15.29%
2,100	41,108	35.52%	32,182	95.57%	95,123	92.30%	11,035	90.12%	4,786	13.58%
2,200	37,961	32.80%	32,678	97.04%	92,670	89.92%	11,247	91.86%	4,294	12.18%
2,300	35,146	30.37%	33,087	98.26%	89,977	87.31%	11,445	93.47%	3,845	10.91%
2,400	32,572	28.15%	33,364	99.08%	87,186	84.60%	11,654	95.18%	3,430	9.73%
2,500	30,255	26.14%	33,536	99.59%	84,586	82.08%	11,852	96.80%	2,995	8.50%
2,600	28,208	24.38%	33,635	99.89%	81,943	79.51%	12,014	98.12%	2,673	7.59%
2,700	26,373	22.79%	33,674	100.00%	79,303	76.95%	12,174	99.43%	2,471	7.01%
2,800	24,732	21.37%	33,653	99.94%	76,720	74.44%	12,241	99.97%	2,298	6.52%
2,900	23,196	20.05%	33,565	99.68%	74,239	72.04%	12,244	100.00%	2,087	5.92%
3,000	21,777	18.82%	33,446	99.32%	71,722	69.59%	12,198	99.62%	1,872	5.31%
3,250	18,775	16.22%	33,044	98.13%	65,450	63.51%	12,214	99.75%	1,460	4.14%
3,500	16,537	14.29%	32,266	95.82%	59,652	57.88%	12,143	99.17%	1,301	3.69%
3,750	14,685	12.69%	31,253	92.81%	54,586	52.97%	11,795	96.33%	1,027	2.91%
4,000	13,134	11.35%	30,137	89.50%	50,441	48.94%	11,472	93.69%	1,014	2.88%
4,250	11,819	10.21%	28,894	85.80%	46,878	45.49%	11,136	90.95%	939	2.66%
4,500	10,777	9.31%	27,474	81.59%	43,694	42.40%	10,627	86.79%	894	2.54%
4,750	9,939	8.59%	26,070	77.42%	41,000	39.78%	10,216	83.44%	864	2.45%
5,000	9,238	7.98%	24,679	73.29%	38,650	37.50%	9,765	79.75%	878	2.49%
5,250	8,563	7.40%	23,288	69.16%	36,577	35.49%	9,101	74.33%	903	2.56%
5,500	8,058	6.96%	21,983	65.28%	34,690	33.66%	8,450	69.02%	943	2.68%
5,750	7,540	6.52%	20,821	61.83%	32,948	31.97%	7,888	64.42%	943	2.68%
6,000	7,047	6.09%	19,696	58.49%	31,490	30.56%	7,360	60.11%	933	2.65%
6,250	6,669	5.76%	18,500	54.94%	30,226	29.33%	6,914	56.46%	916	2.60%
6,500	6,329	5.47%	17,311	51.41%	28,978	28.12%	6,500	53.09%	820	2.33%
6,750	6,024	5.21%	16,141	47.93%	27,789	26.96%	6,033	49.27%	730	2.07%
7,000	5,754	4.97%	14,987	44.51%	26,621	25.83%	5,589	45.64%	685	1.94%
7,250	5,498	4.75%	13,869	41.19%	25,462	24.71%	5,202	42.49%	673	1.91%
7,500	5,298	4.58%	12,791	37.99%	24,360	23.64%	4,862	39.71%	664	1.88%
7,750	5,117	4.42%	11,752	34.90%	23,381	22.69%	4,556	37.21%	614	1.74%
8,000	4,941	4.27%	10,756	31.94%	22,449	21.78%	4,271	34.88%	587	1.66%
8,250	4,793	4.14%	9,798	29.10%	21,503	20.87%	3,993	32.61%	564	1.60%
8,500	4,655	4.02%	8,905	26.44%	20,606	19.99%	3,705	30.26%	540	1.53%
8,750	4,550	3.93%	8,079	23.99%	19,758	19.17%	3,428	28.00%	519	1.47%
9,000	4,474	3.87%	7,314	21.72%	18,935	18.37%	3,171	25.89%	475	1.35%
9,250	4,445	3.84%	6,599	19.60%	18,152	17.61%	2,936	23.98%	503	1.43%
9,500	4,393	3.80%	5,994	17.80%	17,426	16.91%	2,726	22.26%	536	1.52%
9,750	4,399	3.80%	5,462	16.22%	16,750	16.25%	2,532	20.68%	592	1.68%
10,000	4,402	3.80%	4,958	14.72%	16,087	15.61%	2,347	19.17%	652	1.85%

TABLE 3.1-3 WENATCHEE RIVER REACH 3 WEIGHTED USABLE AREA (WUA)										
	Chinook				Steelhead				Bull Trout	
Flow (cfs)	Rearing	% of Peak	Spawning	% of Peak	Rearing	% of Peak	Spawning	% of Peak	Rearing	% of Peak
235	30,676	65.48%	1,280	1.04%	15,592	34.61%	1,059	1.66%	25,705	100.00%
300	36,141	77.15%	3,406	2.78%	18,669	41.44%	3,052	4.79%	21,850	85.01%
400	43,241	92.30%	8,882	7.24%	23,200	51.50%	7,408	11.61%	17,021	66.22%
500	46,377	99.00%	19,663	16.03%	27,132	60.23%	11,981	18.78%	14,194	55.22%
600	46,847	100.00%	33,531	27.33%	30,650	68.04%	16,256	25.49%	12,589	48.97%
700	46,120	98.45%	46,921	38.25%	33,596	74.58%	20,184	31.64%	11,583	45.06%
800	44,947	95.94%	57,518	46.88%	36,068	80.07%	23,702	37.16%	10,937	42.55%
900	43,340	92.51%	65,835	53.66%	38,151	84.69%	26,804	42.02%	10,536	40.99%
1,000	41,324	88.21%	72,253	58.89%	39,848	88.46%	29,619	46.43%	10,378	40.37%
1,100	39,610	84.55%	77,366	63.06%	41,275	91.63%	32,225	50.52%	10,219	39.76%
1,200	38,016	81.15%	81,630	66.54%	42,461	94.26%	34,711	54.42%	9,889	38.47%
1,300	36,483	77.88%	85,448	69.65%	43,518	96.61%	37,180	58.29%	9,341	36.34%
1,400	35,028	74.77%	88,559	72.19%	44,367	98.49%	39,533	61.98%	9,110	35.44%
1,500	33,726	71.99%	91,492	74.58%	44,889	99.65%	41,677	65.34%	8,999	35.01%
1,600	32,738	69.88%	94,420	76.96%	45,047	100.00%	43,802	68.67%	8,777	34.15%
1,700	31,812	67.91%	97,413	79.40%	44,891	99.65%	45,840	71.87%	8,492	33.04%
1,800	30,945	66.05%	100,568	81.97%	44,554	98.91%	47,868	75.04%	8,179	31.82%
1,900	30,117	64.29%	103,862	84.66%	44,125	97.95%	49,915	78.25%	7,664	29.81%
2,000	29,271	62.48%	106,899	87.13%	43,591	96.77%	52,010	81.54%	7,173	27.91%
2,100	28,392	60.60%	109,724	89.44%	43,003	95.46%	53,879	84.47%	6,778	26.37%
2,200	27,560	58.83%	112,321	91.55%	42,383	94.09%	55,636	87.22%	6,580	25.60%
2,300	26,801	57.21%	114,705	93.50%	41,836	92.87%	57,302	89.84%	6,462	25.14%
2,400	26,104	55.72%	116,879	95.27%	41,397	91.90%	58,729	92.07%	6,283	24.44%
2,500	25,464	54.35%	118,592	96.67%	40,969	90.95%	60,078	94.19%	6,101	23.74%
2,600	24,783	52.90%	120,050	97.85%	40,562	90.04%	61,276	96.07%	5,874	22.85%
2,700	24,131	51.51%	121,359	98.92%	40,203	89.25%	62,309	97.69%	5,724	22.27%
2,800	23,447	50.05%	122,186	99.60%	39,878	88.53%	63,018	98.80%	5,576	21.69%
2,900	22,728	48.52%	122,599	99.93%	39,508	87.70%	63,551	99.63%	5,441	21.17%
3,000	22,070	47.11%	122,683	100.00%	39,119	86.84%	63,785	100.00%	5,242	20.39%
3,250	20,540	43.84%	121,633	99.14%	38,134	84.65%	63,126	98.97%	4,789	18.63%
3,500	19,129	40.83%	119,333	97.27%	37,103	82.37%	61,475	96.38%	3,989	15.52%
3,750	17,879	38.16%	115,812	94.40%	35,950	79.81%	58,742	92.09%	3,384	13.17%
4,000	16,595	35.42%	111,748	91.09%	34,843	77.35%	55,111	86.40%	2,821	10.97%
4,250	15,597	33.29%	107,096	87.29%	33,850	75.14%	51,323	80.46%	2,287	8.90%
4,500	14,727	31.44%	102,535	83.58%	32,914	73.07%	47,340	74.22%	1,769	6.88%
4,750	13,820	29.50%	97,661	79.60%	32,090	71.24%	43,337	67.94%	1,615	6.28%
5,000	13,013	27.78%	92,413	75.33%	31,190	69.24%	39,747	62.31%	1,487	5.78%
5,250	12,336	26.33%	86,758	70.72%	30,245	67.14%	36,157	56.69%	1,436	5.59%
5,500	11,709	24.99%	81,048	66.06%	29,240	64.91%	33,231	52.10%	1,260	4.90%
5,750	11,146	23.79%	75,468	61.51%	28,200	62.60%	30,711	48.15%	1,141	4.44%
6,000	10,648	22.73%	69,666	56.78%	27,159	60.29%	28,234	44.26%	1,170	4.55%
6,250	10,240	21.86%	63,934	52.11%	26,185	58.13%	25,960	40.70%	1,247	4.85%
6,500	9,845	21.01%	58,601	47.77%	25,306	56.18%	23,981	37.60%	1,313	5.11%
6,750	9,445	20.16%	53,665	43.74%	24,500	54.39%	22,281	34.93%	1,356	5.28%
7,000	9,071	19.36%	49,093	40.02%	23,755	52.73%	20,761	32.55%	1,481	5.76%
7,250	8,784	18.75%	45,012	36.69%	23,037	51.14%	19,320	30.29%	1,611	6.27%
7,500	8,569	18.29%	41,430	33.77%	22,356	49.63%	17,975	28.18%	1,819	7.07%
7,750	8,470	18.08%	38,129	31.08%	21,715	48.21%	16,676	26.14%	2,070	8.05%
8,000	8,463	18.07%	35,129	28.63%	21,067	46.77%	15,491	24.29%	2,239	8.71%
8,250	8,515	18.18%	32,418	26.42%	20,461	45.42%	14,440	22.64%	2,548	9.91%
8,500	8,635	18.43%	29,932	24.40%	19,931	44.24%	13,564	21.26%	2,769	10.77%
8,750	8,679	18.53%	27,677	22.56%	19,426	43.12%	12,766	20.01%	2,792	10.86%
9,000	8,801	18.79%	25,559	20.83%	18,973	42.12%	12,051	18.89%	2,803	10.90%
9,250	8,997	19.20%	23,648	19.28%	18,578	41.24%	11,402	17.88%	2,900	11.28%
9,500	9,289	19.83%	21,937	17.88%	18,234	40.48%	10,823	16.97%	2,931	11.40%
9,750	9,451	20.17%	20,412	16.64%	17,894	39.72%	10,285	16.12%	3,019	11.74%
10,000	9,558	20.40%	19,011	15.50%	17,596	39.06%	9,778	15.33%	2,972	11.56%

TABLE 3.1-4 WENATCHEE RIVER REACH 4 WEIGHTED USABLE AREA (WUA)										
	Chinook				Steelhead				Bull Trout	
Flow (cfs)	Rearing	% of Peak	Spawning	% of Peak	Rearing	% of Peak	Spawning	% of Peak	Rearing	% of Peak
200	49,691	68.72%	163	0.35%	26,397	48.04%	78	0.37%	10,726	100.00%
300	66,016	91.30%	2,163	4.67%	33,566	61.09%	1,544	7.35%	10,628	99.09%
400	71,887	99.42%	6,710	14.50%	39,747	72.34%	4,027	19.16%	9,940	92.67%
500	72,306	100.00%	11,086	23.95%	44,671	81.30%	5,886	28.00%	9,151	85.32%
600	69,587	96.24%	15,477	33.43%	48,449	88.18%	7,564	35.99%	8,471	78.97%
700	65,906	91.15%	19,198	41.47%	51,278	93.32%	9,080	43.20%	7,977	74.37%
800	61,211	84.66%	22,196	47.95%	53,308	97.02%	10,477	49.84%	7,431	69.28%
900	56,936	78.74%	24,899	53.79%	54,461	99.12%	11,502	54.72%	7,148	66.64%
1,000	53,488	73.98%	27,398	59.19%	54,945	100.00%	12,462	59.29%	6,690	62.37%
1,100	50,302	69.57%	29,735	64.24%	54,859	99.84%	13,912	66.19%	6,754	62.97%
1,200	47,473	65.66%	32,014	69.16%	54,523	99.23%	15,367	73.11%	6,588	61.42%
1,300	44,789	61.94%	34,253	74.00%	54,105	98.47%	16,596	78.95%	6,446	60.10%
1,400	42,381	58.61%	36,328	78.48%	53,184	96.79%	17,695	84.18%	6,123	57.08%
1,500	40,285	55.71%	38,218	82.56%	51,963	94.57%	18,675	88.85%	5,999	55.93%
1,600	38,557	53.33%	39,759	85.89%	50,812	92.48%	19,333	91.98%	5,918	55.18%
1,700	37,108	51.32%	41,239	89.09%	49,625	90.32%	19,804	94.21%	5,769	53.79%
1,800	35,715	49.39%	42,585	92.00%	48,334	87.97%	20,249	96.33%	5,467	50.97%
1,900	34,339	47.49%	43,680	94.36%	47,175	85.86%	20,616	98.08%	5,431	50.63%
2,000	33,254	45.99%	44,502	96.14%	46,085	83.87%	20,848	99.18%	5,492	51.21%
2,100	32,232	44.58%	45,220	97.69%	45,110	82.10%	21,020	100.00%	5,563	51.87%
2,200	31,264	43.24%	45,738	98.81%	44,210	80.46%	21,011	99.96%	5,650	52.67%
2,300	30,386	42.02%	46,161	99.72%	43,304	78.81%	21,012	99.96%	5,505	51.33%
2,400	29,598	40.93%	46,290	100.00%	42,507	77.36%	20,969	99.76%	5,362	49.99%
2,500	28,898	39.97%	46,245	99.90%	41,721	75.93%	20,932	99.58%	5,426	50.59%
2,600	28,127	38.90%	46,148	99.69%	40,937	74.51%	20,887	99.37%	5,418	50.51%
2,700	27,396	37.89%	46,026	99.43%	40,213	73.19%	20,748	98.71%	5,352	49.90%
2,800	26,728	36.97%	45,912	99.18%	39,351	71.62%	20,418	97.14%	5,297	49.39%
2,900	26,117	36.12%	45,643	98.60%	38,444	69.97%	20,044	95.36%	5,261	49.05%
3,000	25,624	35.44%	45,375	98.02%	37,625	68.48%	19,771	94.06%	5,210	48.57%
3,250	24,497	33.88%	44,372	95.86%	36,217	65.91%	19,068	90.71%	5,098	47.53%
3,500	23,526	32.54%	43,221	93.37%	35,085	63.85%	18,502	88.02%	5,075	47.31%
3,750	22,570	31.22%	42,109	90.97%	33,801	61.52%	17,870	85.01%	5,083	47.39%
4,000	21,767	30.10%	40,997	88.57%	32,587	59.31%	17,274	82.18%	4,998	46.60%
4,250	21,099	29.18%	39,970	86.35%	31,521	57.37%	16,950	80.64%	4,930	45.96%
4,500	20,580	28.46%	38,791	83.80%	30,466	55.45%	16,442	78.22%	4,991	46.54%
4,750	20,023	27.69%	37,768	81.59%	29,341	53.40%	15,813	75.23%	4,841	45.13%
5,000	19,529	27.01%	36,663	79.20%	28,272	51.45%	15,381	73.17%	4,562	42.53%
5,250	19,105	26.42%	35,370	76.41%	27,445	49.95%	14,725	70.05%	4,414	41.16%
5,500	18,664	25.81%	33,844	73.11%	26,775	48.73%	14,150	67.31%	4,499	41.94%
5,750	18,267	25.26%	32,424	70.05%	26,176	47.64%	13,618	64.79%	4,509	42.03%
6,000	17,950	24.82%	31,285	67.58%	25,544	46.49%	13,031	61.99%	4,421	41.22%
6,250	17,622	24.37%	30,235	65.32%	24,907	45.33%	12,426	59.12%	4,367	40.72%
6,500	17,209	23.80%	29,286	63.27%	24,337	44.29%	11,889	56.56%	4,397	40.99%
6,750	16,765	23.19%	28,407	61.37%	23,935	43.56%	11,488	54.65%	4,182	38.99%
7,000	16,379	22.65%	27,565	59.55%	23,458	42.69%	11,136	52.98%	3,776	35.20%
7,250	16,002	22.13%	26,884	58.08%	23,030	41.91%	10,645	50.64%	3,610	33.66%
7,500	15,642	21.63%	26,256	56.72%	22,621	41.17%	10,158	48.33%	3,756	35.02%
7,750	15,283	21.14%	25,707	55.54%	22,212	40.43%	9,794	46.60%	3,869	36.07%
8,000	14,969	20.70%	25,150	54.33%	21,856	39.78%	9,471	45.06%	3,712	34.60%
8,250	14,694	20.32%	24,573	53.09%	21,514	39.15%	9,235	43.94%	3,594	33.51%
8,500	14,462	20.00%	23,972	51.79%	21,203	38.59%	8,996	42.80%	3,677	34.29%
8,750	14,270	19.74%	23,289	50.31%	20,859	37.96%	8,802	41.87%	3,771	35.16%
9,000	14,058	19.44%	22,656	48.95%	20,554	37.41%	8,615	40.99%	3,842	35.82%
9,250	13,851	19.16%	22,027	47.58%	20,284	36.92%	8,437	40.14%	3,895	36.31%
9,500	13,709	18.96%	21,489	46.42%	19,999	36.40%	8,327	39.62%	3,860	35.99%
9,750	13,568	18.77%	21,005	45.38%	19,747	35.94%	8,265	39.32%	3,753	34.99%
10,000	13,412	18.55%	20,541	44.38%	19,503	35.50%	8,227	39.14%	3,799	35.42%

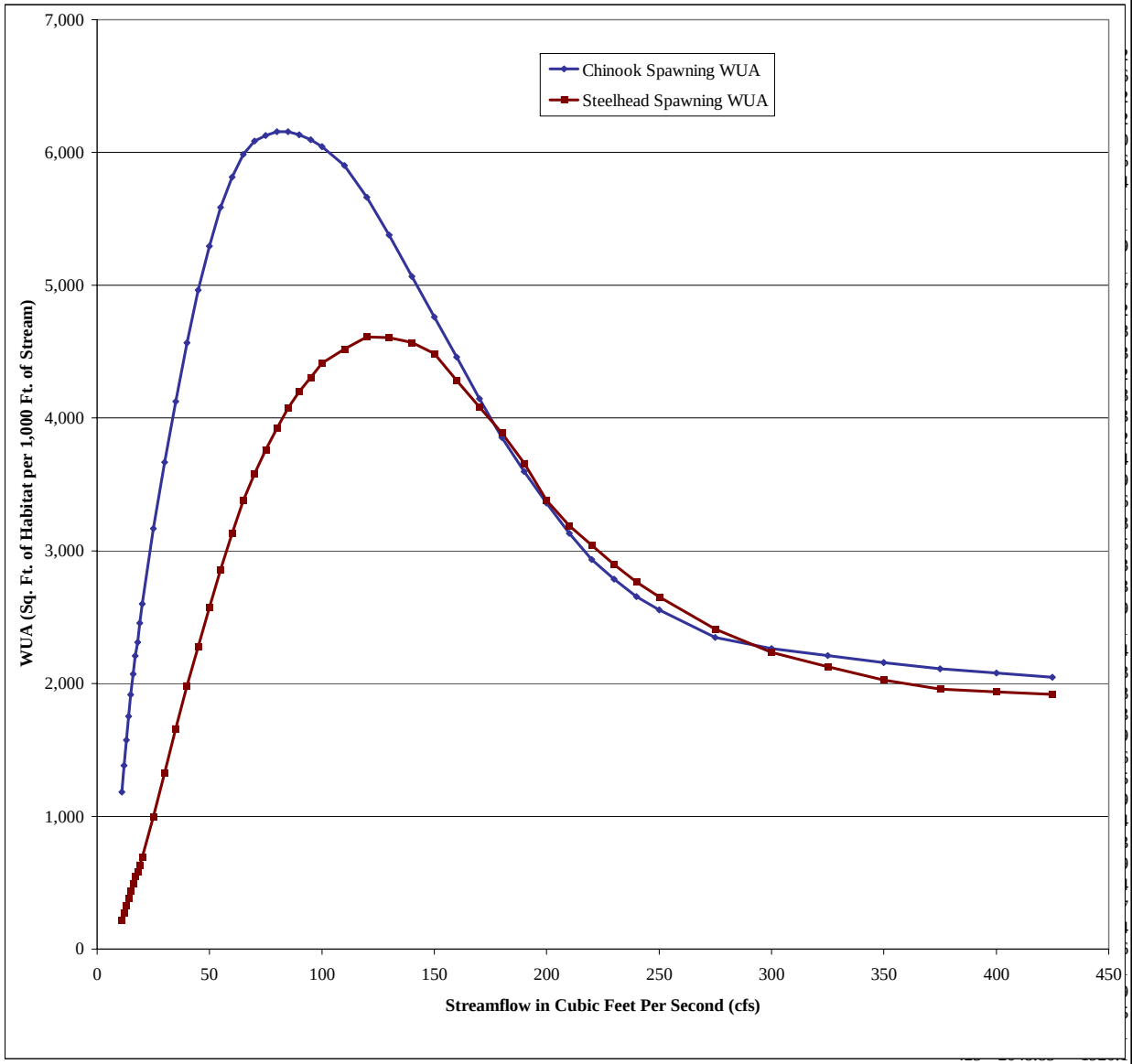
Figure 3.1-9 Peshastin Creek: Fish Habitat (WUA) vs. Flow.



Percent of Peak Habitat vs Flow

Flow	Chinook Rearing WUA	Steelhead Rearing WUA	Bull Trout Rearing WUA
11	36%	19%	93%
12	40%	21%	95%
13	45%	23%	96%
14	49%	24%	98%
15	53%	26%	98%
16	57%	27%	99%
17	60%	29%	99%
18	62%	31%	**100%**
19	65%	32%	**100%**
20	67%	34%	**100%**
25	78%	41%	96%
30	86%	48%	93%
35	92%	54%	90%
40	96%	60%	90%
45	98%	66%	90%
50	**100%**	70%	88%
55	**100%**	75%	86%
60	**100%**	79%	86%
65	98%	83%	85%
70	97%	86%	84%
75	96%	89%	84%
80	94%	92%	82%
85	91%	94%	80%
90	88%	95%	78%
95	85%	97%	75%
100	83%	98%	73%
110	78%	**100%**	69%
120	75%	**100%**	66%
130	72%	**100%**	63%
140	69%	**100%**	60%
150	66%	**100%**	58%
160	63%	**100%**	55%
170	60%	99%	54%
180	58%	99%	52%
190	56%	98%	52%
200	54%	98%	52%
210	53%	97%	53%
220	52%	97%	52%
230	51%	97%	52%
240	50%	96%	52%
250	49%	95%	52%
275	48%	93%	52%
300	46%	92%	54%
325	46%	92%	56%
350	46%	91%	58%
375	47%	90%	62%
400	47%	90%	69%
425	48%	89%	77%

Figure 3.1-10 Peshastin Creek: Fish Habitat (WUA) vs. Flow.



Percent of Peak Habitat vs Flow

Flow	Spawning WUA	Steelhead Spawning WUA
11	19%	5%
12	22%	6%
13	26%	7%
14	28%	8%
15	31%	10%
16	34%	11%
17	36%	12%
18	38%	13%
19	40%	14%
20	42%	15%
25	51%	22%
30	60%	29%
35	67%	36%
40	74%	43%
45	81%	49%
50	86%	56%
55	91%	62%
60	94%	68%
65	97%	73%
70	99%	78%
75	**100%**	81%
80	**100%**	85%
85	**100%**	88%
90	**100%**	91%
95	99%	93%
100	98%	96%
110	96%	98%
120	92%	**100%**
130	87%	**100%**
140	82%	99%
150	77%	97%
160	72%	93%
170	67%	89%
180	63%	84%
190	58%	79%
200	55%	73%
210	51%	69%
220	48%	66%
230	45%	63%
240	43%	60%
250	41%	58%
275	38%	52%
300	37%	48%
325	36%	46%
350	35%	44%
375	34%	42%
400	34%	42%
425	33%	42%

TABLE 3.1-5 PESHASTIN CREEK WEIGHTED USABLE AREA (WUA)										
	Chinook				Steelhead				Bull Trout	
Flow (cfs)	Rearing	% of Peak	Spawning	% of Peak	Rearing	% of Peak	Spawning	% of Peak	Rearing	% of Peak
11	1,705	36.40%	1,183	19.21%	1,200	19.33%	217	4.70%	2,230	92.87%
12	1,886	40.27%	1,383	22.47%	1,303	20.99%	271	5.87%	2,272	94.65%
13	2,099	44.81%	1,574	25.56%	1,405	22.63%	326	7.08%	2,311	96.26%
14	2,275	48.57%	1,752	28.46%	1,501	24.19%	384	8.32%	2,344	97.65%
15	2,472	52.76%	1,915	31.11%	1,603	25.83%	440	9.54%	2,359	98.24%
16	2,650	56.57%	2,072	33.66%	1,705	27.46%	494	10.72%	2,365	98.50%
17	2,801	59.79%	2,208	35.85%	1,806	29.08%	550	11.93%	2,372	98.79%
18	2,915	62.23%	2,311	37.53%	1,896	30.54%	580	12.58%	2,392	99.64%
19	3,039	64.87%	2,455	39.87%	1,992	32.10%	634	13.75%	2,401	100.00%
20	3,160	67.46%	2,601	42.24%	2,088	33.63%	691	14.99%	2,399	99.92%
25	3,659	78.12%	3,167	51.43%	2,560	41.24%	996	21.60%	2,315	96.42%
30	4,007	85.54%	3,668	59.57%	2,986	48.10%	1,328	28.80%	2,227	92.75%
35	4,290	91.58%	4,125	66.99%	3,371	54.31%	1,662	36.05%	2,161	89.99%
40	4,490	95.84%	4,567	74.17%	3,734	60.15%	1,985	43.04%	2,153	89.66%
45	4,607	98.34%	4,962	80.59%	4,068	65.52%	2,275	49.34%	2,159	89.92%
50	4,672	99.74%	5,295	85.99%	4,376	70.50%	2,573	55.79%	2,105	87.68%
55	4,685	100.00%	5,585	90.70%	4,655	74.98%	2,858	61.98%	2,070	86.22%
60	4,672	99.73%	5,814	94.43%	4,909	79.08%	3,130	67.89%	2,060	85.81%
65	4,606	98.33%	5,984	97.19%	5,137	82.75%	3,378	73.26%	2,044	85.13%
70	4,559	97.32%	6,086	98.84%	5,351	86.20%	3,580	77.65%	2,028	84.48%
75	4,491	95.86%	6,127	99.51%	5,531	89.10%	3,758	81.49%	2,008	83.65%
80	4,385	93.61%	6,157	100.00%	5,681	91.52%	3,921	85.03%	1,971	82.08%
85	4,247	90.65%	6,155	99.97%	5,810	93.59%	4,073	88.33%	1,925	80.16%
90	4,113	87.81%	6,132	99.59%	5,921	95.37%	4,198	91.03%	1,871	77.93%
95	3,983	85.03%	6,097	99.02%	6,018	96.94%	4,306	93.38%	1,811	75.43%
100	3,867	82.54%	6,043	98.15%	6,101	98.28%	4,414	95.72%	1,756	73.13%
110	3,677	78.48%	5,902	95.85%	6,186	99.64%	4,519	98.00%	1,652	68.83%
120	3,502	74.75%	5,662	91.95%	6,195	99.79%	4,611	100.00%	1,578	65.74%
130	3,360	71.72%	5,379	87.35%	6,208	100.00%	4,606	99.90%	1,512	62.99%
140	3,225	68.85%	5,066	82.28%	6,182	99.59%	4,570	99.10%	1,446	60.23%
150	3,080	65.74%	4,760	77.30%	6,181	99.56%	4,485	97.27%	1,381	57.51%
160	2,934	62.64%	4,458	72.40%	6,199	99.85%	4,281	92.84%	1,326	55.22%
170	2,814	60.07%	4,146	67.34%	6,166	99.32%	4,082	88.53%	1,288	53.64%
180	2,711	57.87%	3,854	62.60%	6,135	98.83%	3,888	84.33%	1,254	52.21%
190	2,621	55.96%	3,596	58.40%	6,091	98.12%	3,659	79.34%	1,245	51.86%
200	2,544	54.30%	3,361	54.58%	6,066	97.72%	3,380	73.30%	1,256	52.32%
210	2,470	52.73%	3,130	50.84%	6,053	97.50%	3,188	69.15%	1,261	52.52%
220	2,422	51.69%	2,934	47.65%	6,039	97.28%	3,042	65.98%	1,257	52.36%
230	2,375	50.70%	2,787	45.26%	6,001	96.67%	2,896	62.80%	1,255	52.26%
240	2,343	50.02%	2,654	43.10%	5,948	95.82%	2,766	59.99%	1,252	52.14%
250	2,306	49.24%	2,554	41.48%	5,894	94.94%	2,653	57.54%	1,254	52.24%
275	2,229	47.58%	2,347	38.12%	5,758	92.76%	2,412	52.30%	1,252	52.17%
300	2,174	46.41%	2,264	36.77%	5,729	92.29%	2,235	48.46%	1,285	53.53%
325	2,163	46.17%	2,211	35.90%	5,719	92.12%	2,126	46.11%	1,336	55.64%
350	2,172	46.37%	2,158	35.05%	5,634	90.76%	2,026	43.94%	1,390	57.90%
375	2,184	46.62%	2,111	34.28%	5,599	90.18%	1,958	42.47%	1,485	61.87%
400	2,208	47.13%	2,078	33.75%	5,569	89.71%	1,937	42.00%	1,669	69.50%
425	2,258	48.19%	2,049	33.28%	5,513	88.80%	1,920	41.64%	1,856	77.32%

4.0 HYDROLOGY

Several long-term gauges in the Wenatchee basin provide a good hydrological picture of the runoff patterns. Two USGS gauging stations, Wenatchee River at Monitor (No. 12462500) and Wenatchee River at Peshastin, (No.12459000) are located within the Wenatchee Study Reach 1 and Reach 2 at RM 7 and RM 21.5, respectively.

The WDOE has recently installed a network of gauging stations in the Wenatchee basin. Peshastin Creek at Green Bridge is one of the stations within the WDOE gauging network. Although the period of record is not long enough to provide useful statistics, these gauges will be of increasing importance as water resource issues are addressed in the coming years.

Streamflow from the mountainous regions of the Wenatchee basin is highest from May through July, averaging 150%-320% of mean annual flow (MAF) as snowmelt fills the streams for an extended period. September is generally the lowest flow month of the year with an average discharge of just 25%-30% of MAF. The timing and duration of the spring runoff is strongly influenced by snowpack, day length, air temperature, and wind. During the fall and winter months streamflow is influenced by fluctuating freezing levels and warm rainfall. Fall and winter flows are generally moderate, averaging approximately 40%-60% of MAF.

The annual hydrograph for the Wenatchee River at Monitor and Wenatchee River at Peshastin are presented in Figures 4-1 and 4-2. Mean monthly flows for Peshastin Creek are presented in Figure 4-3.

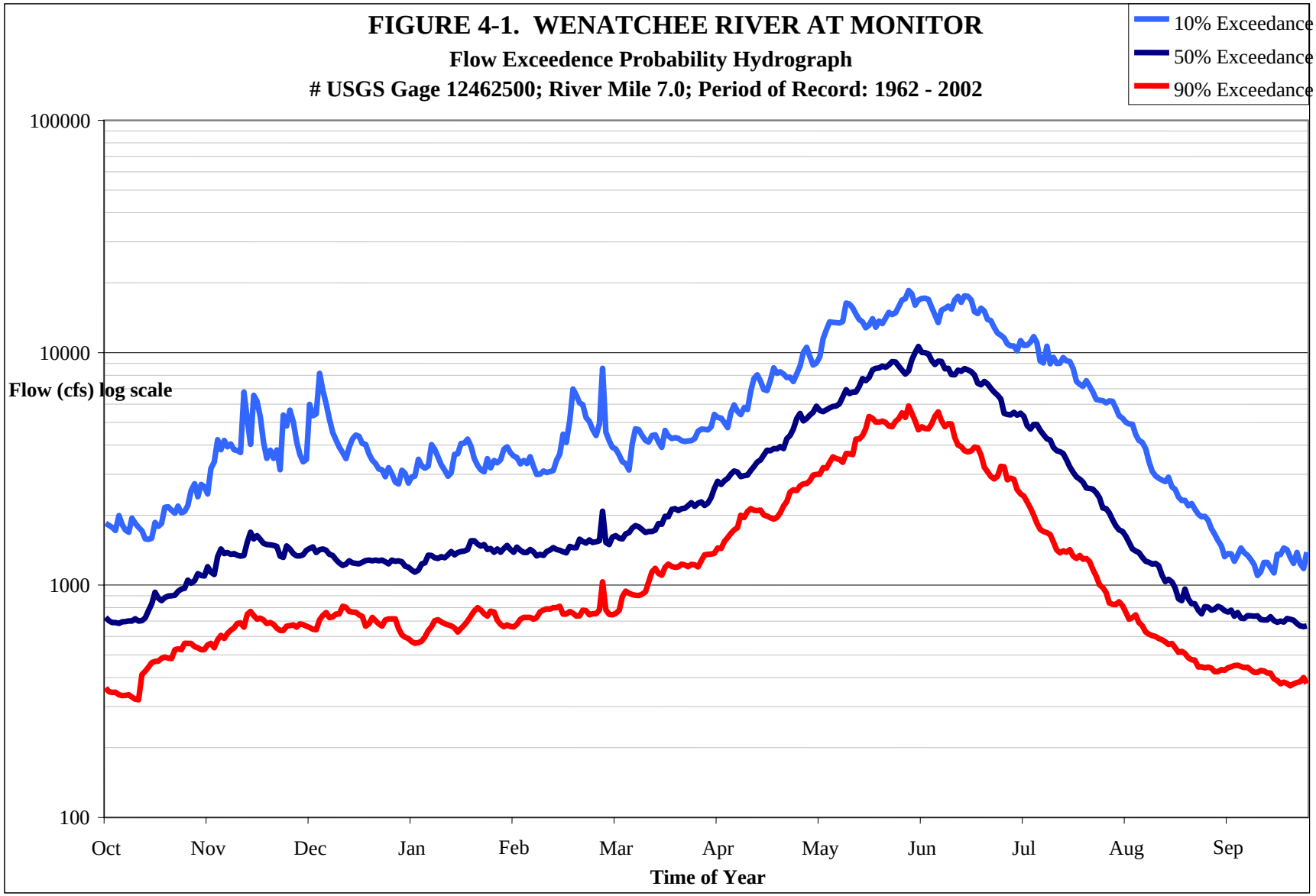


FIGURE 4-1. WENATCHEE RIVER AT MONITOR
Flow Exceedence Probability Hydrograph
USGS Gage 12462500; River Mile 7.0; Period of Record: 1962 - 2002
10% Exceedance
50% Exceedance
90% Exceedance
100000
10000
1000
100
Flow (cfs) log scale
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Time of Year

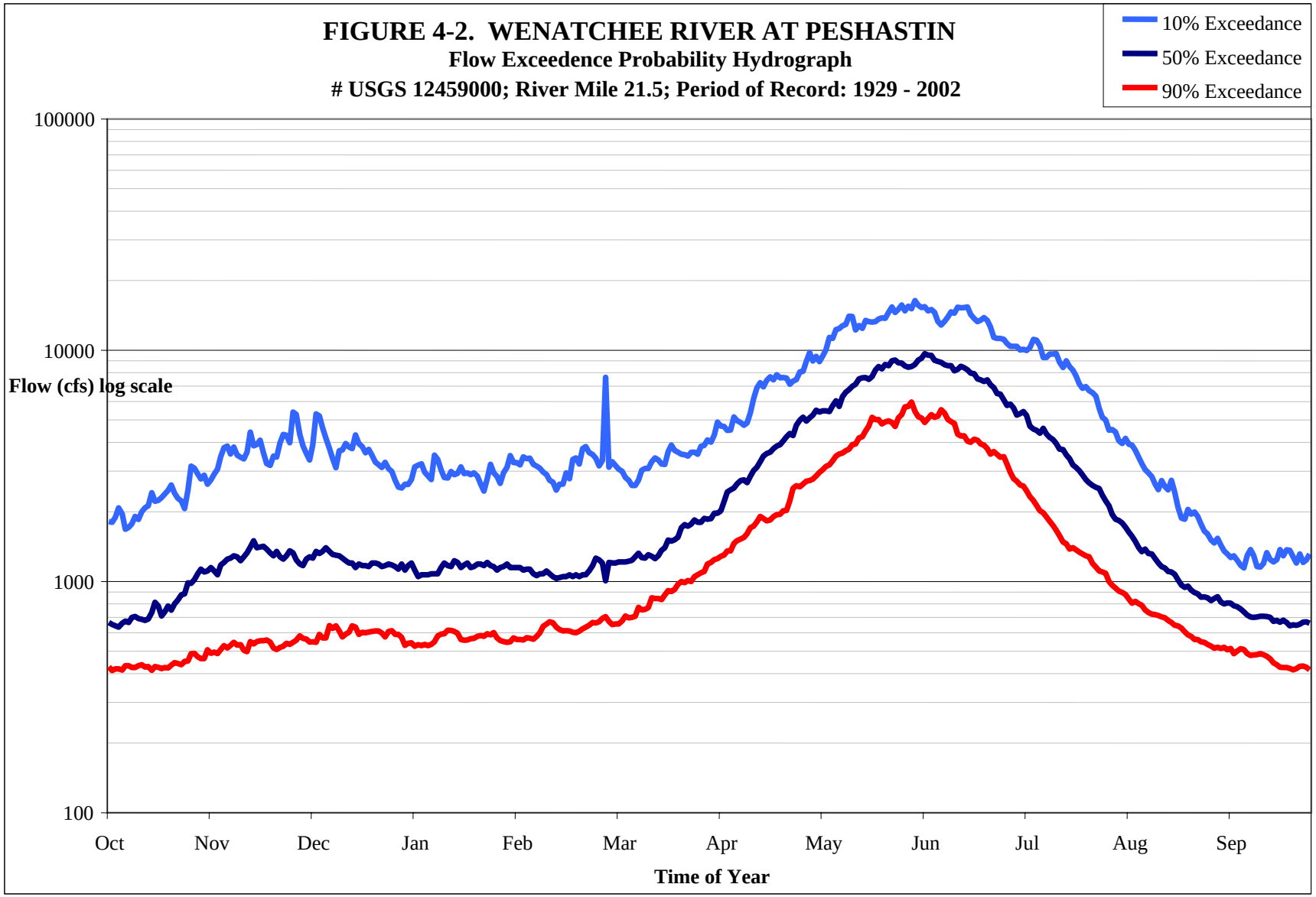


FIGURE 4-2. WENATCHEE RIVER AT PESHASTIN
Flow Exceedence Probability Hydrograph
USGS 12459000; River Mile 21.5; Period of Record: 1929 - 2002
10% Exceedance
50% Exceedance
90% Exceedance
100000
10000
1000
100
Flow (cfs) log scale
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Time of Year

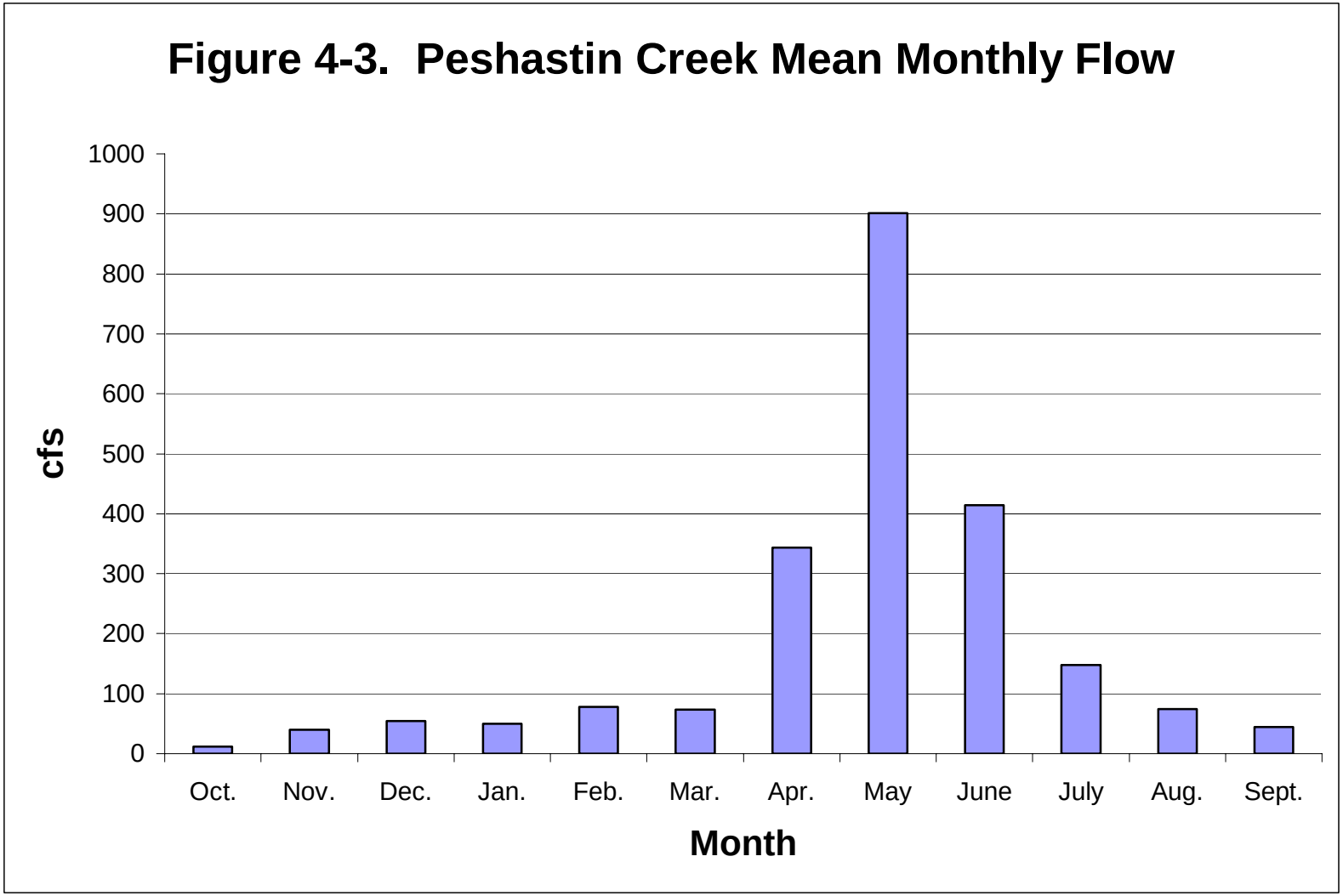


Figure 4-3. Peshastin Creek Mean Monthly Flow
1000
900
800
700
600
500
400
300
200
100
0
cfs
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Month

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APPENDIX A

SUBSTRATE CODES AND HABITAT SUITABILITY CRITERIA (HSC) FOR THE LOWER WENATCHEE PHABSIM STUDY

APPENDIX B

CALIBRATION DETAILS FOR THE LOWER WENATCHEE AND PESHASTIN PHABSIM MODELS

RECLAMATION

Managing Water in the West

Technical Memorandum

Instream Flow Assessment of Icicle Creek, Washington

U.S. Department of the Interior
Bureau of Reclamation

December 2005

Technical Memorandum

Instream Flow Assessment of Icicle Creek, Washington

Prepared by

Ron Sutton
Chelsie Morris

Acknowledgements

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Executive Summary

The purpose of this study was to characterize the relationship between stream flow and fish habitat on Icicle Creek, Washington, downstream from the Leavenworth National Fish Hatchery to its mouth at the Wenatchee River. The stream exhibits a very flat slope and is characterized by a meandering pattern. Peak flows occur during late spring and low flows occur during late summer and fall. Flows between 2000 and 2004 ranged from 58 cfs to 3,610 cfs. Chinook salmon, steelhead trout, and bull trout are federally listed species in the Wenatchee basin and were selected by the Wenatchee Watershed Planning Unit as the species of interest for this study. Rearing and spawning life stages of these species were addressed in this study.

The method used was the U.S. Fish and Wildlife Service (USFWS) Physical Habitat Simulation System (PHABSIM) application of the Instream Flow Incremental Methodology (IFIM). The PHABSIM method is based on the premise that stream dwelling fish prefer a certain range of depths, velocities, substrates and cover types, depending on the species and life stage, and that the availability of these preferred habitat conditions varies with flow. Weighted Usable Area (WUA) is the primary product of PHABSIM. Weighted usable area is an index of habitat availability or quantity for the selected species/life stage at each simulated flow. Weighted usable area was calculated for a range of flows between 20 and 800 cfs. Graphs and tables of WUA versus flow are presented for each life stage and species of interest. This technical information can be used by the Planning Unit as the basis for instream flow recommendations in Icicle Creek.

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Introduction

The Bureau of Reclamation (Reclamation) (in coordination with the WRIA 45 Instream Flow Subcommittee) conducted an instream flow study on Icicle Creek near Leavenworth, Washington during 2004 and 2005. The purpose of this study was to characterize the relationship between stream flow and fish habitat on Icicle Creek, downstream from the Leavenworth National Fish Hatchery to its mouth at the Wenatchee River. This technical information can be used by the Wenatchee Watershed Planning Unit as the basis for instream flow recommendations that will be included in the final Wenatchee Watershed Plan by April 2006.

Study Area

The Icicle Creek study area extended from its confluence with the Wenatchee River (RM 0.0) upstream to the Leavenworth National Fish Hatchery (RM 2.7) (Figure 1). This area of the stream exhibits a very flat slope and is characterized by a meandering pattern. Chinook salmon (*Oncorhynchus tschawytscha*), steelhead trout (*O. mykiss*), coho salmon (*O. kisutch*), and bull trout (*Salvelinus confluentus*) utilize this area as a transportation corridor for both upstream and downstream movement, migration, and juvenile rearing. This area is recognized as prime spawning and incubation habitat for spring Chinook salmon as well as steelhead trout. Adult spring Chinook salmon returning to the hatchery are targeted by both sport and tribal fishers in Icicle Creek from mid May through July.

Hydrology

Recent stream gage records (water years 2000-2004) for Icicle Creek were retrieved from the U.S. Geological Survey (USGS) gage located above Snow Creek (Figure 2). This gage does not record real-time information. Peak flows occur during late spring and low flows occur during late summer and fall. Flows during this period ranged from 58 cfs (11/1/02) to 3,610 cfs (6/15/02). During the study, stage and discharge data were recorded periodically in Icicle Creek at the East Leavenworth Road Bridge (Figure 3). This information could be used to develop a rating curve for Icicle Creek and allow flow estimates based on stage readings.

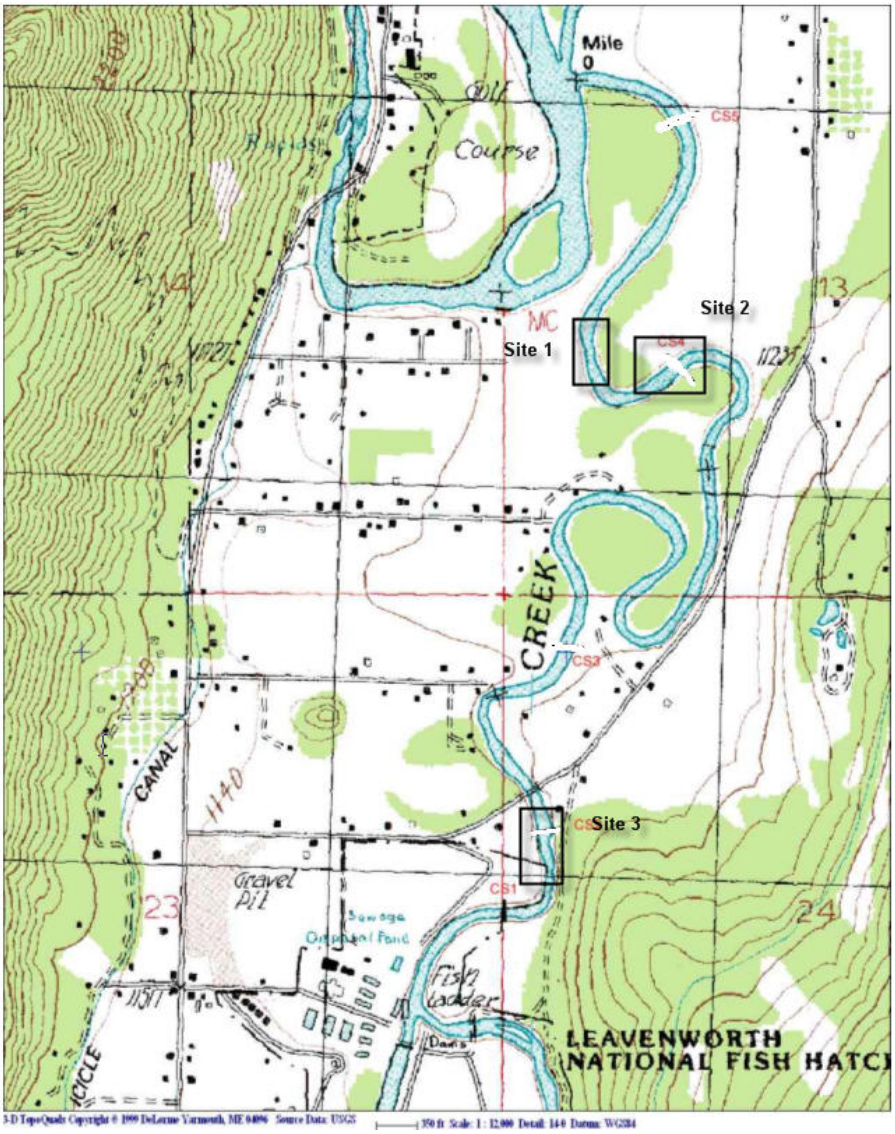


Figure 1. Study site locations on Icicle Creek for instream flow assessment.

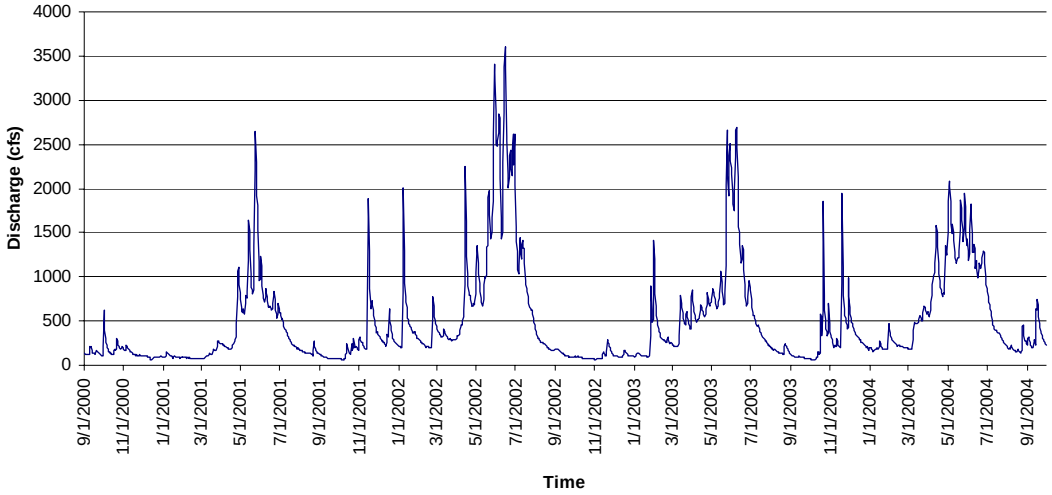


Figure 2. Recent Icicle Creek discharge records at USGS Gage number 12458000 located above Snow Creek near Leavenworth, Washington.

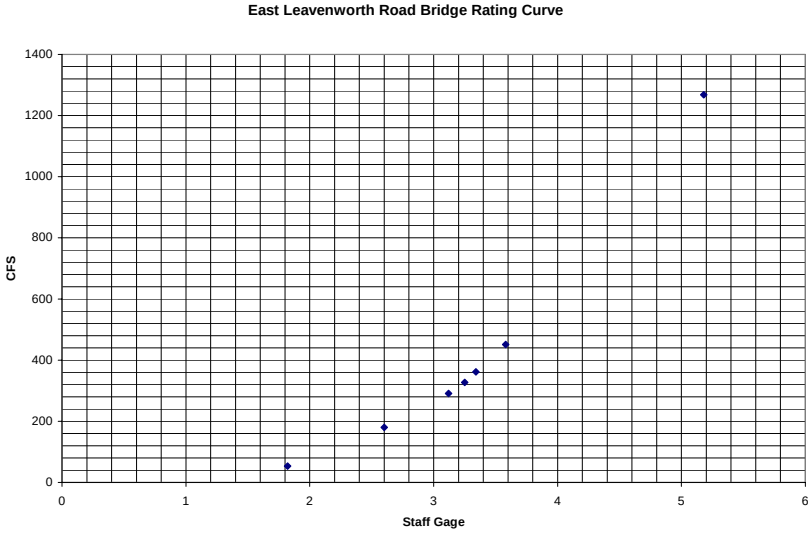
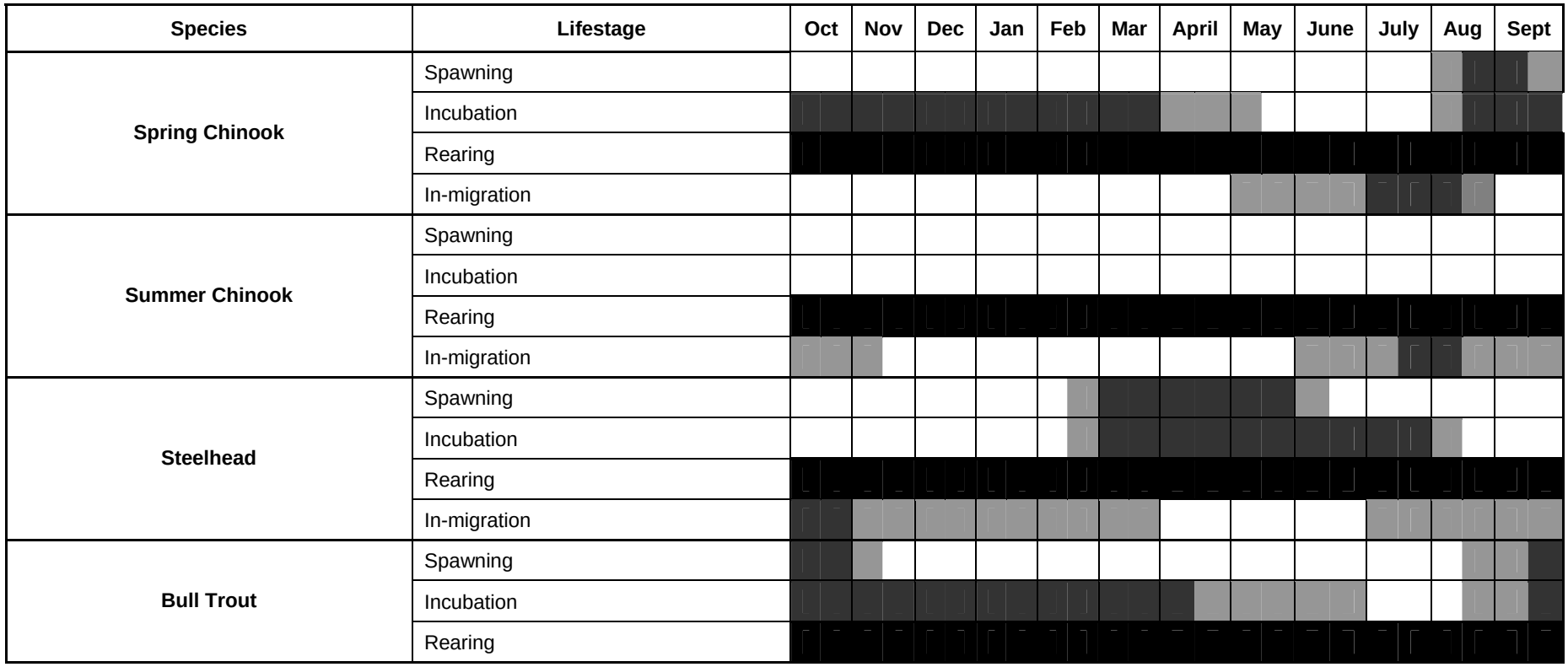


Figure 3. Stage-discharge relationship for Icicle Creek.

Affected Species and Life Stages

Chinook salmon, steelhead trout, and bull trout are federally listed species in the Wenatchee basin and were selected by the Planning Unit as the species of interest for this study. All of these species use Icicle Creek during some part of their life cycle. Figure 4 presents life-stage timing of salmonids in Icicle Creek. Anadromous fish use Icicle Creek in a variety of ways. Adults use the river as an upstream migration corridor to spawning grounds and Leavenworth Fish Hatchery. Salmonid fry and smolts use the river as a downstream migration corridor on their journey towards sea. Migration of salmonids was not addressed in this study. The analysis focused on spawning and rearing habitat for Chinook salmon, steelhead, and bull trout. Fish passage flows were not addressed.



Based on:

Andonaegui, C., 2001. *Salmon, Steelhead and Bull Trout Habitat Limiting Factors for the Wenatchee Subbasin (WRIA 45) and Portions of WRIA 40 within Chelan County (Squilchuck, Stemilt and Colockum Drainages).* Washington State Conservation Commission.

Comments from: USFS (Cam Thomas, Cindy Raekes), WDFW (Andrew Murdoch, Bob Vadas, Mark Cookson), USFWS (Kate Terrell) and NOAA-Fisheries (Dale Bambrick)

Key: Black indicates periods of heaviest use
Grey indicates periods of moderate use
Blank areas indicate periods of little or no use

Figure 4. Icicle Creek periodicity chart for selected fish species.

Methods

The method used to study Icicle Creek was the U.S. Fish and Wildlife Service (USFWS) Physical Habitat Simulation System (PHABSIM) application of the Instream Flow Incremental Methodology (IFIM). Generally, instream flow study procedures followed the Washington Department of Fish and Wildlife/Washington Department of Ecology (WDFW/WDOE) Instream Flow Guidelines (2004). The PHABSIM method is based on the premise that stream dwelling fish prefer a certain range of depths, velocities, substrates and cover types, depending on the species and life stage, and that the availability of these preferred habitat conditions varies with streamflow. With input from streamflow, substrate, and cover type measurements, PHABSIM quantifies habitat availability over a range of flows. It is important for the water manager to recognize that the result of the study is not a set value but a range of values to be used as a tool for determining relative amounts of habitat available at various stream flows.

PHABSIM requires hydraulic and habitat suitability data to determine the instream flow requirements for the species and/or life history stage of interest. Several hydraulic sub-models can be used with PHABSIM. Field data collection was designed to accommodate any of these models. The field methods and hydraulic analysis followed the conventional three-velocity method, or regression method, where full sets of depth and velocity data were collected at each station along the transects at the low, middle, and high flow calibration measurements. An additional calibration data set was collected in October, 2004. Water surface elevations (WSEs) were also taken at all calibration flows, and discharge measurements were made concurrently while collecting the depth and velocity information at each transect and calibration flow.

Reclamation's Technical Service Center (TSC) in Denver, Colorado, with assistance from Reclamation's Wenatchee Office and the Chelan County Conservation District, collected and compiled existing data and conducted the study. These tasks are briefly outlined below.

Transect Locations

Eleven transects were selected within three separate study sites on Icicle Creek (Figure 1) by the Wenatchee Instream Flow Subcommittee and were approved by participating resource agencies. The methodology for selecting these transects is discussed in the Draft Scoping Report prepared by EES Consulting, Inc. (2004). Transect location and descriptions are shown in Table 1 below.

Table 1. Transect descriptions for Icicle Creek instream flow assessment.

Reach	Study Site	No.	Description	River Mile
1	1	1	Riffle	0.2
		2	Glide	0.2
		3	Pool Tailout	0.2
		4	Pool	0.2
	2	1	Riffle	0.4
		2	Glide	0.4
		3	Pool Tailout	0.4
		4	Pool	0.4
	3	1	Glide	2.2
		2	Pool Tailout/glide	2.2
		3	Pool	2.4

Habitat Typing

Reclamation obtained an aerial video survey of Icicle Creek from EES Consulting. The video was used to generally characterize habitat types throughout Icicle Creek downstream from Leavenworth Fish Hatchery. In addition, Reclamation measured longitudinal lengths of each habitat type described by the transects in Table 1 (pool, pool tailout, glide, riffle) using kayaks and a laser rangefinder downstream from the boat ramp at RM 2.6 on August 17, 2005. The “cumulative-lengths” approach described by Bovee (1997) was used to determine proportions of different mesohabitat types in the Icicle Creek study area.

Depth, Velocity, and Water Surface Elevation Measurements

Field data were collected according to Bovee (1997) using standard surveying equipment at four discharges. Vertical elevations were established throughout each habitat type using a total station instrument (Bovee 1997). A benchmark was established at each study site (with rebar) and assigned the arbitrary elevation of 100.00 feet. All elevations were referenced to this benchmark and transects in each study site were "tied together" by surveying their relative elevation. Water surface elevations were measured to the nearest 0.01 ft near the water’s edge along each transect at all discharges. Channel cross sections were measured (vertical and horizontal) to the nearest 0.1 ft between headpins at each transect during high discharge. Below water channel cross sections were determined by subtracting measured depths from the WSE at the high flow. Discharge measurements at each transect were taken during each survey. A temporary staff gage was installed at each site so that fluctuations in WSE could be monitored during data collection.

Depth and velocity measurements in wadeable sections of each transect were made with a USGS topset wading rod and a Marsh McBirney Model 2000 current meter. Velocity was measured at sixth tenths of the depth when depth was less than 2.5 feet and at two tenths and eight tenths of the depth at depths greater than or equal to 2.5 feet. In deeper

sections, depth and velocity were made from a boat with similar equipment (i.e., 10-foot wading rod). Depths and mean column velocities were measured at various points along each transect. Stationing across transects was oriented with 0.0 on the left bank looking upstream for modeling purposes. Streambed elevations and water depths were measured to the nearest 0.1 ft. Water velocity was measured to the nearest 0.1 ft/sec. Velocity calibration sets were collected at four different time periods between October, 2004 and August, 2005 in an attempt to cover a range of flows. Velocities at the two pool transects at sites 2 and 3 were not measured in July, 2005 because shallow riffles prevented use of the available boat.

Substrate and Cover Codes

Washington agencies (WDFW/WDOE) have standard substrate and cover codes in their Instream Flow Guidelines Report (2004) (Table 2). These codes were used by Reclamation in the Icicle Creek study. Dominant and subdominant substrate types were recorded. Since PHABSIM can only accept one cover/substrate code, substrate codes were used where no cover was present and cover codes were used where cover was present, as suggested by Jim Pacheco (personal communication, 9/26/05). For the transects in this study, cover occurred primarily along the edges of the stream with silt and sand substrate. Substrate/cover codes used the format “ab.c”. For substrates, “a” was the code for the dominant particle size, “b” was the component code for the subdominant particle size, and “c” was tenths of cell area covered by the dominant (50% or greater) substrate type. For example, the code 46.8 indicated 80% medium gravel and 20% small cobble. Cover codes used the same format, but “a” and “b” were always 0 and “c” defined the type of cover. For example, 00.1 was an undercut bank, 00.2 was overhanging vegetation, etc.

Habitat Suitability Criteria (HSC)

Species habitat suitability criteria (HSCs) are required for PHABSIM analysis. Habitat suitability criteria, or curves, are interpreted using a suitability index (SI) on a scale of 0 to 1, with 0 being unsuitable and 1 being most utilized or preferred. Habitat suitability criteria that accurately reflect the habitat requirements of the species of interest are essential to developing meaningful and defensible instream flow recommendations. The recommended approach is to develop site-specific criteria for each species and life stage of interest. An alternative involves using existing curves and literature to develop suitability criteria for the species of interest. Limited site-specific HSC data are available in Icicle Creek and time and budgetary constraints precluded developing HSCs specific to Icicle Creek. Thus, Reclamation used the established spawning and rearing HSCs for Washington State (Jim Pacheco, personal communication, 9/26/05) and summarized in Appendix A, including updated bull trout criteria (EES Consulting 2005).

Table 2. Substrate and cover coding systems used for Icicle Creek instream flow study (derived from WDFW/WDOE Instream Flow Guidelines (2004).

Substrate Code	Description
1	Silt, clay, organic
2	Sand
3	Small gravel (0.1-0.5”)
4	Medium gravel (0.5-1.5”)
5	Large gravel (1.5-3”)
6	Small cobble (3-6”)
7	Large cobble (6-12”)
8	Boulder (>12”)
9	Bedrock

Cover Code	Description
0.1	Undercut
0.2	Overhang
0.3	Rootwad
0.4	Logjam/submerged brush pile
0.5	Log (s) parallel to bank
0.6	Aquatic vegetation
0.7	Short (<1’) terrestrial grass
0.8	Tall (>3’) dense grass
0.9	Vegetation beyond bank-full waters edge

Hydraulic Model Selection and Calibration

Reclamation used the USGS Windows version of PHABSIM (Waddle 2001) for the analysis of Icicle Creek data. PHABSIM has several submodels available for hydraulic simulations. These include STGQ (IFG4), WSP, and MANSQ (Waddle 2001), with STGQ being the most rigorous in terms of data requirements. The WSP model is used for backwaters (e.g., pools). Each hydraulic model requires multiple flow measurements to extend the predictive range. Depending on model performance, the predictive range may be restrictive or wide ranging (i.e., 0.1 to 10 times the measured discharges) (Waddle 2001). Field sampling was designed to collect data in formats suitable for application in any of the hydraulic models identified above. The following approach was used:

- Enter field data into appropriate format for water surface simulations
- Calibrate simulated WSEs using STGQ, MANSQ, or WSP (depending on site specific conditions) to measured WSEs
- Simulate a range of flows to predict WSEs
- Simulate depths and velocities for range of flows that occur during the irrigation season
- Calibrate velocities using velocity adjustment factors (VAF’s) and velocity regression (simulated within 0.2 ft/sec of measured velocities-Jim Pacheco, personal communication, 9/22/05)
- Evaluate simulation range based on VAF’s and other calibration sub-models

- Document acceptable range of simulations
- Conduct velocity simulation production run for applicable range of flows that may occur during the irrigation season.

Development of Flow vs. Habitat Functions

The TSC utilized the PHABSIM suite of programs developed by USGS to compute Weighted Usable Area (WUA) as a measure of available habitat. Weighted usable area (WUA) was calculated for each discharge of interest between 20 and 800 cfs. Weighted usable area is an index of habitat availability or quantity for the selected species/life stage at each simulated flow. After the hydraulic models were calibrated, transect weighting and lengths to simulate a 1,000 foot reach were added as shown in Table 4. Final hydraulic model runs produced input for the HABTAE habitat sub-model of PHABSIM. The WUAs for selected life stages and species were computed in HABTAE using the standard multiplicative computation option (Jim Pacheco, personal communication, 11/22/05) to multiply the depth, velocity, and substrate/cover HSC values at predicted hydraulic conditions, and cell surface area. The output from the HABTAE simulation was habitat area, expressed as WUA (ft^2/ 1000 ft). WUA versus flow relationships were computed for each study site separately and as a composite (all study sites combined). For presentation purposes, WUA was also normalized as a percentage of maximum habitat. It should be noted that there is a level of uncertainty associated with WUAs. Sources of uncertainty include errors in HSCs, hydraulic simulations, or selection of options to simulate microhabitat (e.g., geometric versus multiplicative means). Recognition that there is uncertainty in these sources is important in the interpretation and use of PHABSIM model results (Bovee et al. 1998).

Results

Transect weighting for habitat modeling was based on the proportions of habitat types in Icicle Creek. Individual study site transects were weighted empirically using results from the "cumulative-lengths" analysis (Table 3). Since Study Site 3 only included glide, pool tailout, and pool transects, weights were based on cumulative lengths of only these three habitat types at this site. Table 4 summarizes transect weights for each study site separately and as a composite (all study sites combined).

Table 3. Proportions of habitat types in Icicle Creek.

Habitat type	Cumulative length (ft)	Proportion (%)
Pool	6,497	46.9
Pool tailout	388	2.8
Riffle	1,912	13.8
Glide	5,064	36.5
Total	13,861	100

Table 4. Transect weights for each study site and composite (all transects).

Study Site 1 transect no.	Habitat Type	Weight (%)
1	Riffle	13.8
2	Glide	36.5
3	Pool Tailout	2.8
4	Pool	46.9
Study Site 2 transect no.		
1	Riffle	13.8
2	Glide	36.5
3	Pool Tailout	2.8
4	Pool	46.9
Study Site 3 transect no.		
1	Glide	42.40
2	Pool Tailout/glide	3.20
3	Pool	54.40
Composite transects numbered from downstream to upstream		
1	Riffle	6.90
2	Glide	12.16
3	Pool Tailout	0.93
4	Pool	15.63
5	Riffle	6.90
6	Glide	12.16
7	Pool Tailout	0.93
8	Pool	15.63
9	Glide	12.16
10	Pool Tailout/glide	0.93
11	Pool	15.63

Four sets of calibration flow data were developed from the field measurements. Actual measured flows surveyed in Icicle Creek are summarized in Table 5. The October, 2004 calibration data set was considered appropriate to use based on a comparison of cross sectional profiles among sample dates that showed very little change in stream channel morphology between October, 2004 and August, 2005. This was possibly a result of a drought and a subsequent unusually low spring (2005) peak flow that did not scour the channel.

Table 5. Calibration flows measured from lowest to highest at the Icicle Creek study sites.

Flows (cfs)	**Survey Dates**
47-59	August 16, 2005
178-195	July 6-7, 2005
240-244	October 26-27, 2004
327-362	June 14-15, 2005

Results of the PHABSIM analysis are summarized below. Photos and coordinates (NAD 83) of the study sites during the July, 2005 survey are shown in Figure 5.

Study Site 1- July, 2005- N 47º34'57.3"; W 120º39'29.5"

Study Site 2-July, 2005- N 47º34'25.3"; W 120º39'45.7"

Study Site 3-July, 2005- N 47º33'48.1"; W 120º40'03.4"

Figure 5. Photos of each study site in Icicle Creek, July, 2005.

Hydraulic WSE model calibration results are summarized in Table 6. The best WSE calibration occurred using STGQ (glides and riffles) and WSP (pools) sub-models. Simulated WSEs were within 0.05 ft of measured WSEs for all transects. The PHABSIM IFG4 input file with all 11 transects combined is located in Appendix B.

Multiple velocity calibration data sets were used as independent data sets for velocity modeling purposes. The velocity adjustment factor (VAF) is an index used by the velocity simulation model to adjust individual cell velocities/cell discharges. The VAF is the ratio of the flow requested for simulation and the flow calculated from velocity simulations. The VAF adjusts individual cell velocities by multiplying the VAF times the initial velocity to give a new velocity. Generally, the relationship between discharge and VAF is such that at simulated flows lower than the velocity calibration flows, the VAF is less than 1.0 and at simulated flows greater than the velocity calibration flow, VAF is greater than 1.0 (Waddle 2001). Table 7 presents VAFs for all transects over a range of simulated flows. The apparent "breaks" in VAF (i.e., occasional declines in VAF as flows increase) are due to using different velocity calibration sets to produce the velocity templates used for velocity simulation. Within the range of discharges for which a particular set of calibration velocity measurements were used to develop the velocity template, ascending VAF versus flow relationships indicated the expected outcome of velocity simulations. Although WDOE suggests an acceptable VAF range of 0.8-1.2 (Jim Pacheco, personal communication, 9/22/05), there is no basis for judging the "validity" or quality of the hydraulic simulations based strictly on the magnitude of the range in computed VAF values (i.e., no specific set of envelope values that the VAF should absolutely lie within) (Waddle 2001). The "shape" of the VAF versus discharge plot is a better indicator of model performance than the VAF magnitude. Based on this criterion, examination of Table 7 indicates that VAFs increase with discharge for each velocity calibration set, suggesting good model performance. Also, measured velocities across each transect closely matched simulated velocities at the calibration flows (i.e., within $\pm$ 0.2 ft/sec).

Table 6. Water surface elevation calibration results for Icicle Creek study sites.

Transect	Distance from next downstream transect (ft)	Water surface elevations (ft)											
		Measured	Simulated	Difference	Measured	Simulated	Difference	Measured	Simulated	Difference	Measured	Simulated	Difference
Study Site 1			47.0 cfs			178.2 cfs			244.4 cfs			358.6 cfs	
1	0	87.02	87.01	-0.01	87.53	87.56	0.03	87.73	87.71	-0.02	87.90	87.90	0.00
2	84	87.04	87.02	-0.02	87.51	87.56	0.05	87.73	87.71	-0.02	87.91	87.89	-0.02
3	250	87.68	87.68	0.00	88.18	88.18	0.00	88.43	88.43	0.00	88.62	88.62	0.00
4	56	87.69	87.68	-0.01	88.17	88.20	0.03	88.50	88.46	-0.04	88.65	88.67	0.02
Study Site 2			53.5 cfs			195.4 cfs			240.6 cfs			361.8 cfs	
1	0	91.07	91.06	-0.01	91.39	91.43	0.04	91.54	91.51	-0.03	91.67	91.67	0.00
2	105	91.41	91.40	-0.01	91.85	91.88	0.03	91.97	91.97	0.00	92.17	92.16	-0.01
3	56	91.44	91.44	0.00	91.88	91.88	0.00	92.05	92.05	0.00	92.22	92.22	0.00
4	38	91.44	91.44	0.00	91.89	91.89	0.00	92.05	92.06	0.02	92.24	92.24	0.00
Study Site 3			58.5 cfs			186.8 cfs			239.7 cfs			327.1 cfs	
1	0	90.41	90.41	0.00	91.08	91.10	0.02	91.35	91.30	-0.05	91.56	91.58	0.02
2	204	90.88	90.88	0.00	91.53	91.53	0.00	91.74	91.74	0.00	91.99	91.99	0.00
3	406	90.92	90.89	-0.03	91.51	91.56	0.05	91.83	91.78	-0.05	92.05	92.05	0.00

Table 7. Velocity adjustment factors for transects at each study site at simulated flows in Icicle Creek.

Flow (cfs)	Study Site 1 Transect Number				Flow (cfs)	Study Site 2 Transect Number				Flow (cfs)	Study Site 3 Transect Number		
	1	2	3	4		1	2	3	4		1	2	3
20	0.5	0.4	0.5	0.7	20	0.8	0.7	0.5	0.5	20	1.2	0.8	0.4
30	0.7	0.6	0.7	1.0	30	0.9	0.8	0.7	0.7	30	1.0	0.9	0.6
40	0.8	0.7	0.8	1.2	40	0.9	0.9	0.8	0.9	40	1.0	1.1	0.8
47.0*	0.9	0.7	0.8	1.4	50	0.9	1.0	1.0	1.1	50	0.9	1.2	1.0
50	0.4	0.4	0.5	0.5	53.5*	0.9	1.0	1.0	1.2	58.5*	0.9	1.2	1.1
60	0.5	0.4	0.6	0.5	60	0.7	0.6	0.5	0.3	60	1.0	0.6	0.3
70	0.5	0.5	0.6	0.6	70	0.7	0.6	0.5	0.3	70	1.0	0.6	0.3
80	0.6	0.5	0.6	0.7	80	0.7	0.7	0.6	0.4	80	1.0	0.7	0.4
90	0.6	0.6	0.7	0.7	90	0.7	0.7	0.6	0.4	90	1.0	0.7	0.4
100	0.6	0.6	0.7	0.8	100	0.7	0.7	0.6	0.4	100	1.0	0.7	0.4
120	0.7	0.7	0.8	0.9	120	0.8	0.8	0.7	0.5	120	1.0	0.8	0.5
140	0.8	0.8	0.8	1.0	140	0.8	0.8	0.8	0.6	140	1.0	0.9	0.6
160	0.8	0.8	0.9	1.1	160	0.8	0.9	0.9	0.7	160	1.0	0.9	0.6
178.2*	0.9	0.9	1.0	1.2	180	0.9	0.9	1.0	0.7	180	1.0	1.0	0.7
180	0.8	0.8	0.7	0.9	195.4*	0.9	1.0	1.1	0.8	186.8*	1.0	1.0	0.7
200	0.9	0.8	0.8	1.0	200	0.9	0.9	0.9	0.8	200	1.1	0.9	0.8
244.4*	1.0	0.9	0.8	1.1	240.6*	0.9	1.0	1.0	1.0	239.7*	1.1	1.0	0.9
250	0.8	0.8	0.8	0.9	250	0.9	0.9	0.8	0.8	250	1.0	0.9	0.8
300	0.9	0.9	0.9	1.0	300	0.9	1.0	0.9	0.9	300	1.0	1.0	0.9
350	0.9	1.0	1.0	1.1	350	1.0	1.0	1.0	1.0	327.1*	1.0	1.0	0.9
358.6*	1.0	1.0	1.0	1.1	361.8*	1.0	1.0	1.1	1.1	350	1.0	1.1	1.0
400	1.0	1.1	1.1	1.2	400	1.0	1.1	1.1	1.2	400	1.0	1.1	1.1
450	1.1	1.2	1.1	1.3	450	1.0	1.2	1.2	1.3	450	1.0	1.2	1.2
500	1.2	1.3	1.2	1.4	500	1.1	1.2	1.3	1.4	500	1.1	1.3	1.3
550	1.3	1.4	1.2	1.5	550	1.1	1.3	1.4	1.5	550	1.1	1.3	1.4
600	1.3	1.4	1.3	1.6	600	1.2	1.3	1.5	1.7	600	1.1	1.4	1.5
650	1.4	1.5	1.4	1.7	650	1.2	1.4	1.6	1.8	650	1.1	1.5	1.6
700	1.5	1.6	1.4	1.8	700	1.2	1.4	1.7	1.9	700	1.1	1.5	1.7
750	1.5	1.7	1.5	1.9	750	1.3	1.5	1.8	2.0	750	1.1	1.6	1.8
800	1.6	1.7	1.5	1.9	800	1.3	1.5	1.8	2.1	800	1.1	1.6	1.9

* Calibration flow

Figures 6-17 show WUA versus flow graphs for rearing and spawning life stages. Actual WUA values are presented in Tables 8-11.

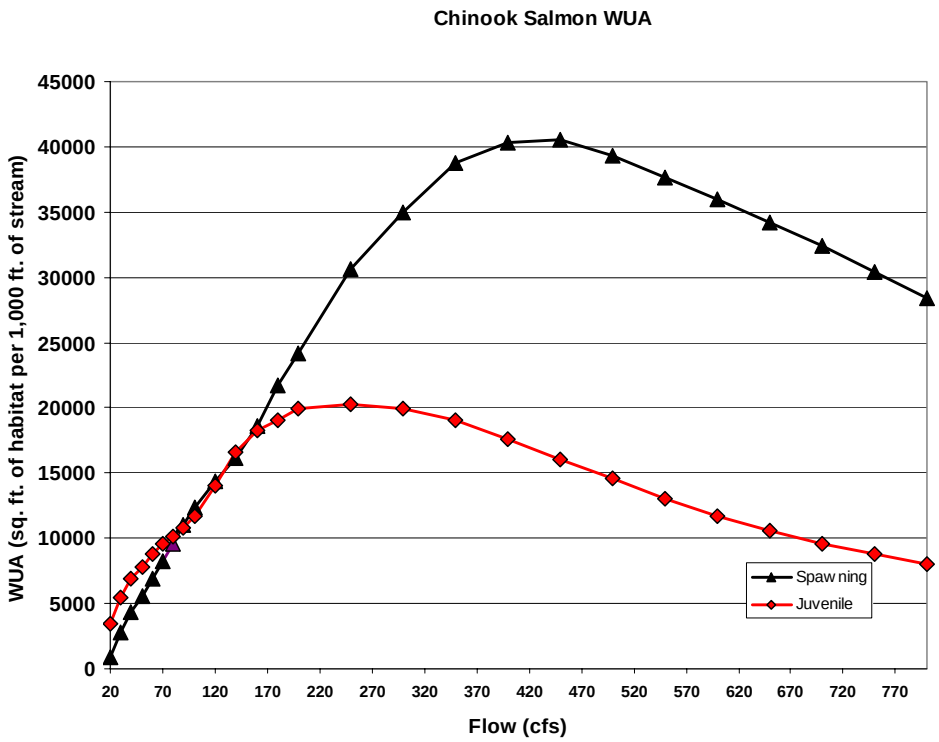


Figure 6. Weighted usable area versus flow relationships for Chinook salmon in Icicle Creek, Study Site 1.

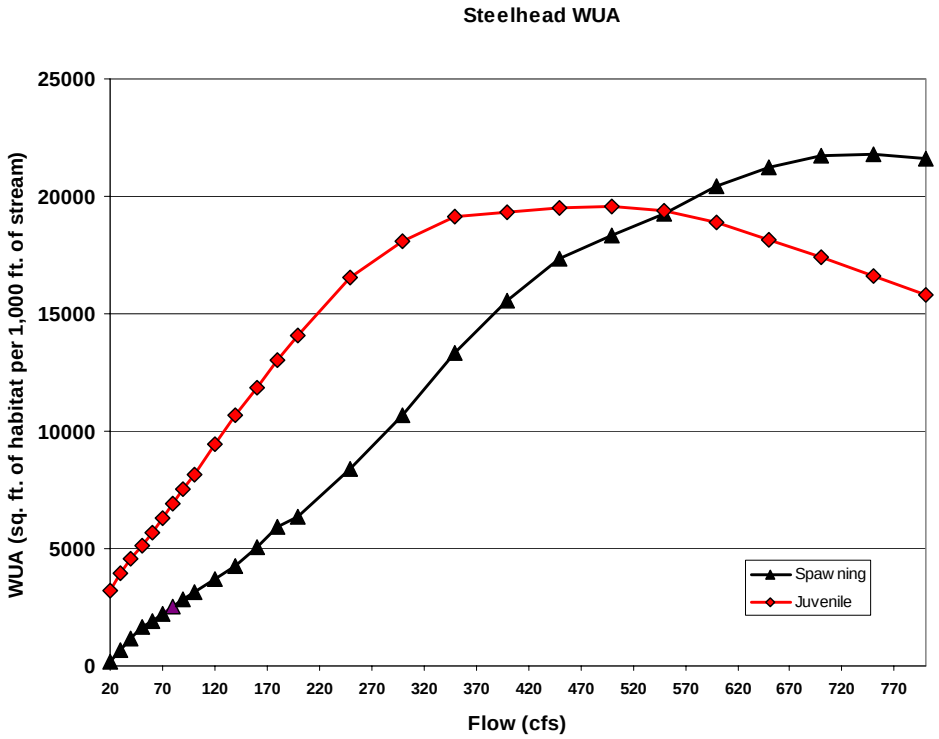


Figure 7. Weighted usable area versus flow relationships for steelhead in Icicle Creek, Study Site 1.

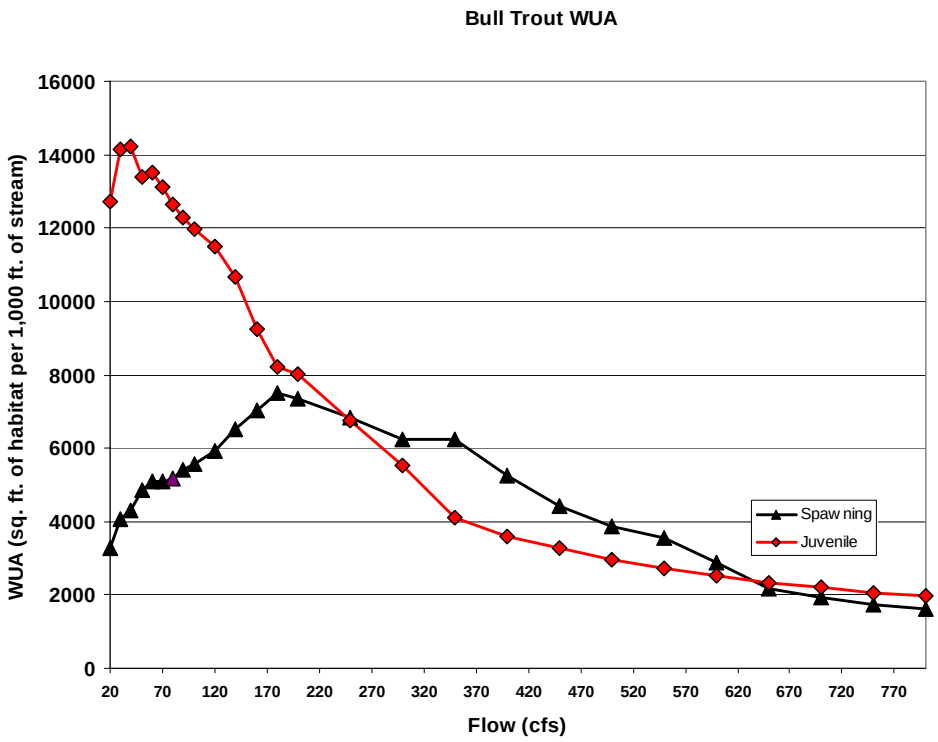


Figure 8. Weighted usable area versus flow relationships for bull trout in Icicle Creek, Study Site 1.

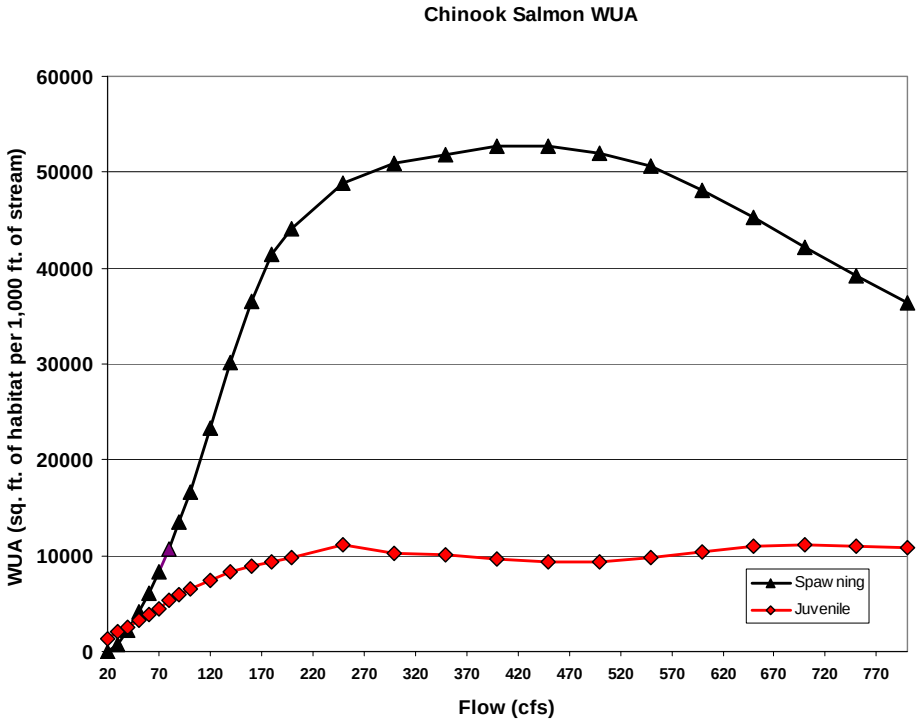


Figure 9. Weighted usable area versus flow relationships for Chinook salmon in Icicle Creek, Study Site 2.

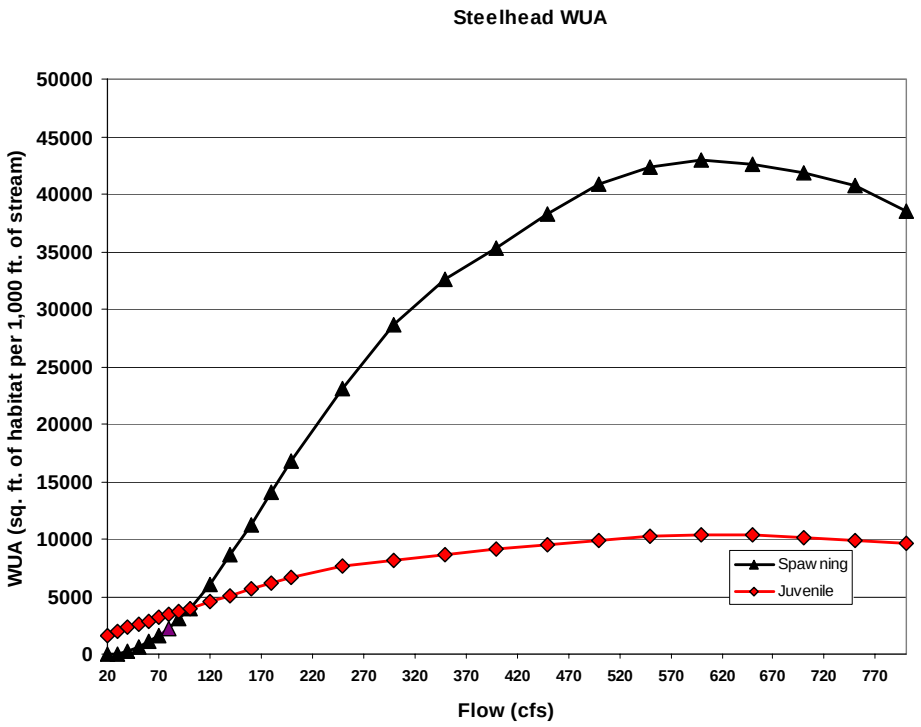


Figure 10. Weighted usable area versus flow relationships for steelhead in Icicle Creek, Study Site 2.

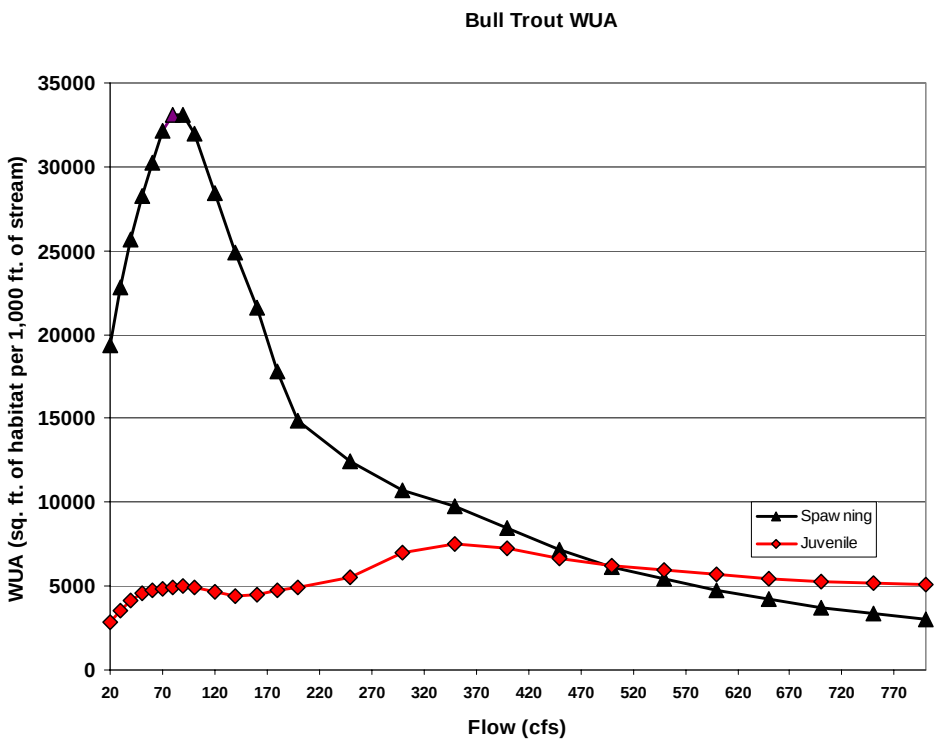


Figure 11. Weighted usable area versus flow relationships for bull trout in Icicle Creek, Study Site 2.

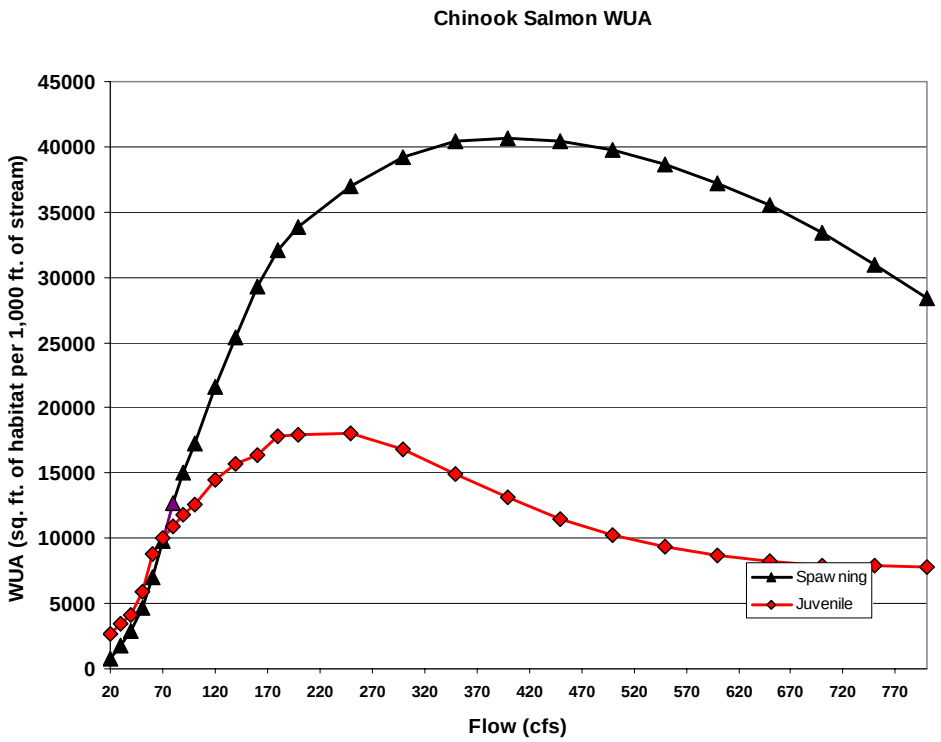


Figure 12. Weighted usable area versus flow relationships for Chinook salmon in Icicle Creek, Study Site 3.

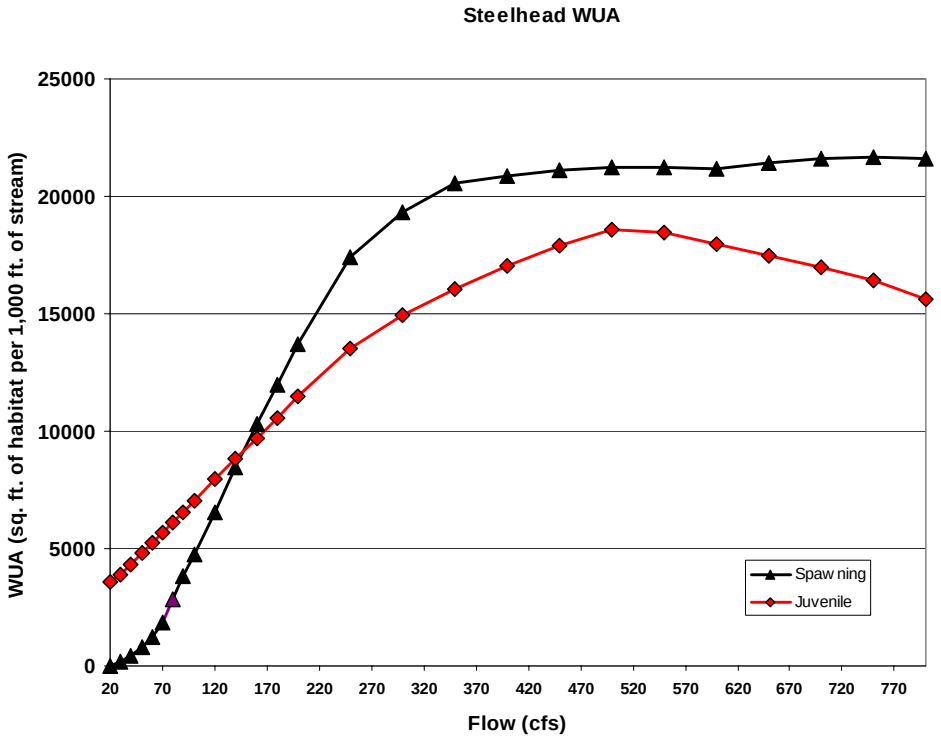


Figure 13. Weighted usable area versus flow relationships for steelhead in Icicle Creek, Study Site 3.

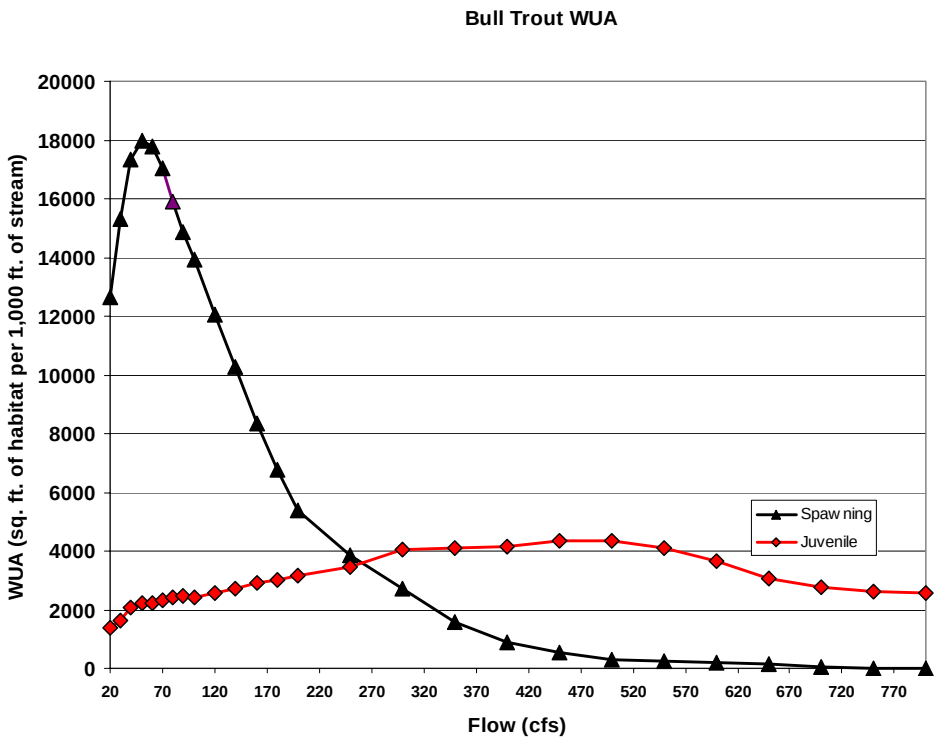


Figure 14. Weighted usable area versus flow relationships for bull trout in Icicle Creek, Study Site 3.

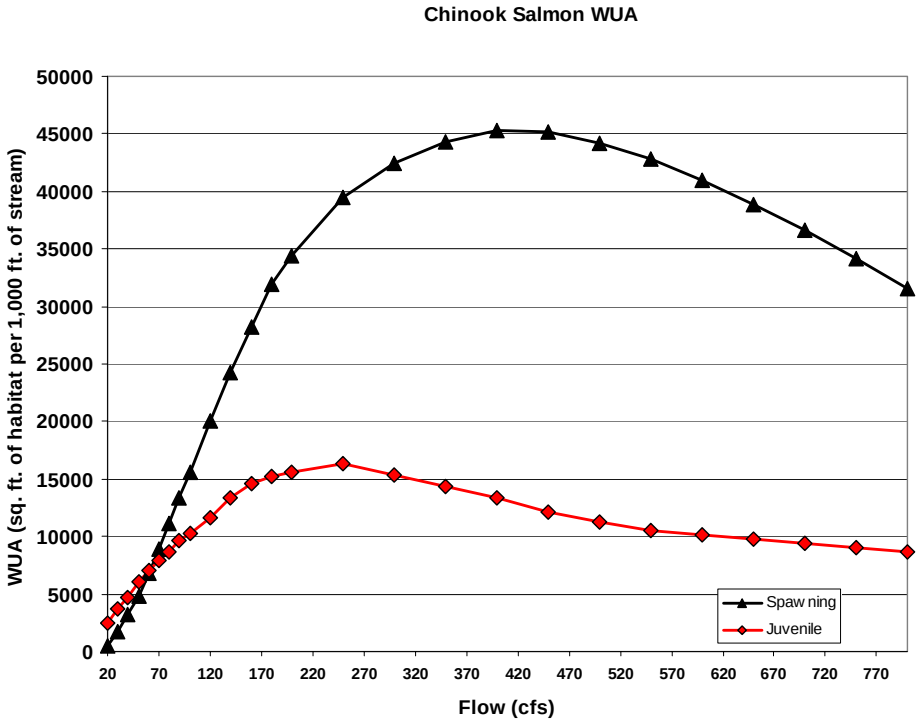


Figure 15. Weighted usable area versus flow relationships for Chinook salmon in Icicle Creek, Composite.

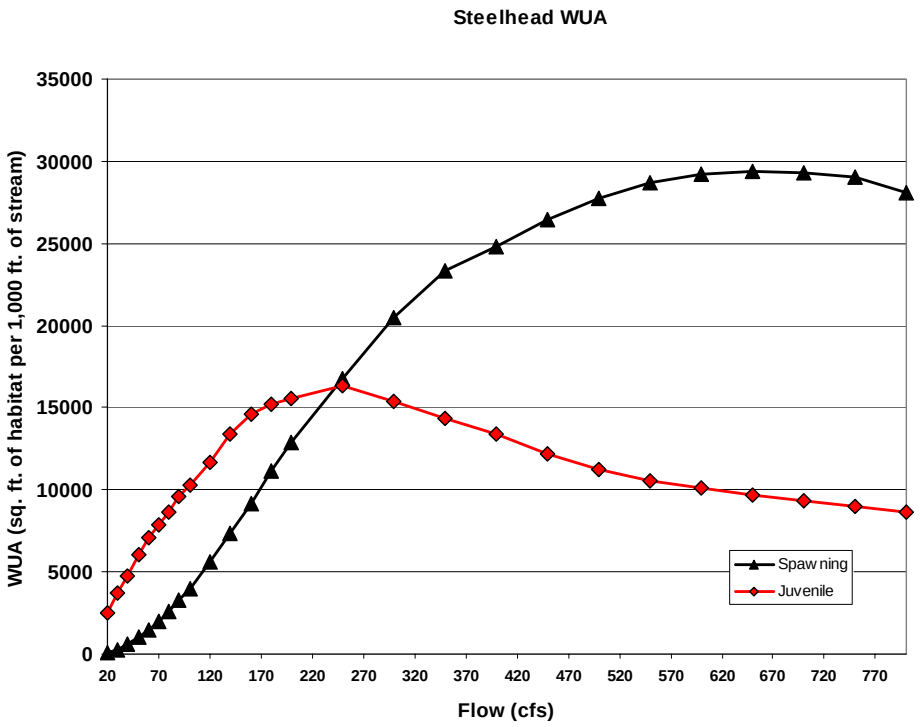


Figure 16. Weighted usable area versus flow relationships for steelhead in Icicle Creek, Composite.

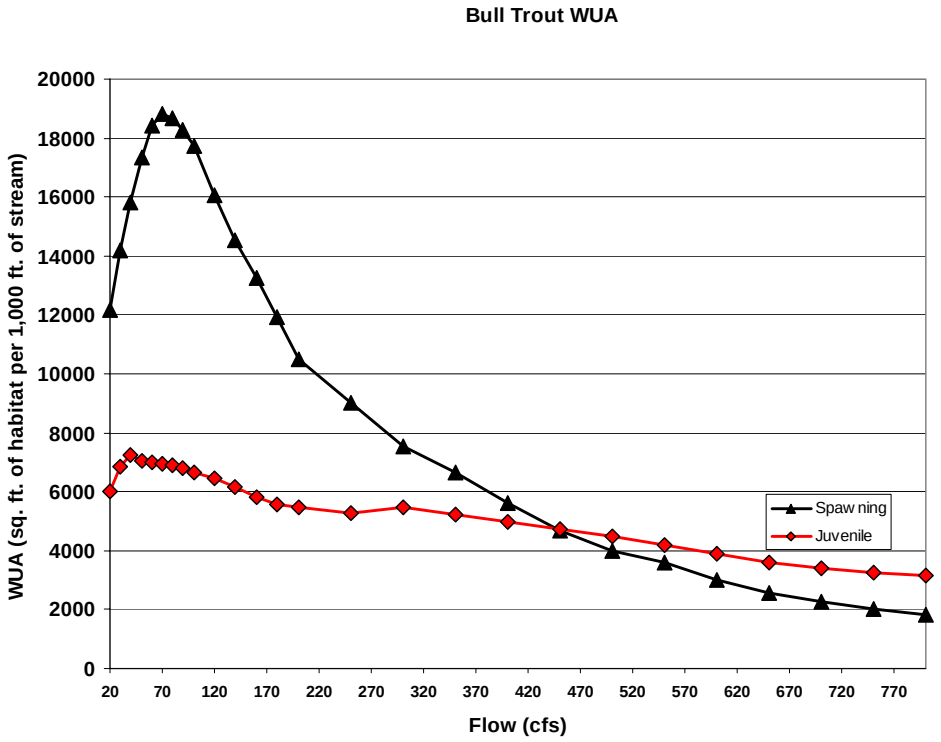


Figure 17. Weighted usable area versus flow relationships for bull trout in Icicle Creek, Composite.

Table 8. Weighted usable area (WUA) (ft^2/1,000 ft) versus flow in Icicle Creek, Study Site 1.

Flow (cfs)	Total Area	Chinook Salmon WUA		Percent of maximum WUA		Steelhead WUA		Percent of maximum WUA		Bull Trout WUA		Percent of maximum WUA	
		Spawning	Juvenile	Spawning	Juvenile	Spawning	Juvenile	Spawning	Juvenile	Spawning	Juvenile	Spawning	Juvenile
20	103,107	934	3,439	2.3	16.9	182	3,222	0.8	16.5	3,267	12,704	43.4	89.3
30	106,958	2,782	5,424	6.9	26.7	649	3,926	3.0	20.1	4,089	14,135	54.4	99.4
40	108,775	4,333	6,925	10.7	34.1	1,192	4,545	5.5	23.2	4,289	14,220	57.0	100.0
50	108,340	5,542	7,810	13.7	38.4	1,640	5,135	7.5	26.2	4,869	13,391	64.7	94.2
60	113,059	6,887	8,790	17.0	43.3	1,923	5,699	8.8	29.1	5,096	13,527	67.7	95.1
70	114,028	8,207	9,538	20.2	46.9	2,208	6,296	10.1	32.2	5,102	13,108	67.8	92.2
80	114,955	9,583	10,106	23.6	49.7	2,519	6,914	11.6	35.3	5,190	12,654	69.0	89.0
90	115,850	11,024	10,771	27.2	53.0	2,824	7,547	13.0	38.6	5,417	12,269	72.0	86.3
100	116,670	12,367	11,721	30.5	57.7	3,121	8,165	14.3	41.7	5,574	11,981	74.1	84.3
120	117,962	14,343	14,064	35.4	69.2	3,690	9,424	16.9	48.2	5,911	11,491	78.6	80.8
140	118,847	16,102	16,631	39.7	81.8	4,281	10,667	19.7	54.5	6,518	10,654	86.7	74.9
160	119,522	18,566	18,236	45.8	89.7	5,035	11,877	23.1	60.7	7,037	9,242	93.6	65.0
180	116,012	21,720	19,058	53.6	93.8	5,899	13,032	27.1	66.6	7,522	8,224	100.0	57.8
200	120,297	24,204	19,991	59.7	98.4	6,378	14,054	29.3	71.8	7,345	8,036	97.6	56.5
250	121,098	30,677	20,320	75.7	100.0	8,399	16,517	38.6	84.4	6,851	6,742	91.1	47.4
300	121,816	35,018	19,967	86.4	98.3	10,656	18,087	48.9	92.4	6,239	5,516	82.9	38.8
350	122,766	38,716	19,089	95.5	93.9	13,359	19,163	61.3	97.9	6,230	4,099	82.8	28.8
400	123,320	40,322	17,604	99.5	86.6	15,578	19,332	71.5	98.8	5,240	3,606	69.7	25.4
450	123,692	40,530	16,069	100.0	79.1	17,337	19,488	79.6	99.6	4,422	3,282	58.8	23.1
500	124,030	39,264	14,622	96.9	72.0	18,334	19,565	84.2	100.0	3,852	2,964	51.2	20.8
550	124,345	37,613	13,050	92.8	64.2	19,290	19,367	88.6	99.0	3,567	2,725	47.4	19.2
600	124,639	35,927	11,663	88.6	57.4	20,412	18,878	93.7	96.5	2,900	2,518	38.6	17.7
650	124,914	34,185	10,568	84.3	52.0	21,215	18,157	97.4	92.8	2,178	2,331	29.0	16.4
700	125,175	32,360	9,629	79.8	47.4	21,715	17,382	99.7	88.8	1,923	2,195	25.6	15.4
750	125,419	30,412	8,785	75.0	43.2	21,780	16,607	100.0	84.9	1,757	2,074	23.4	14.6
800	125,655	28,372	7,995	70.0	39.3	21,579	15,815	99.1	80.8	1,615	1,977	21.5	13.9

Table 9. Weighted usable area (WUA) (ft^2/1,000 ft) versus flow in Icicle Creek, Study Site 2.

Flow (cfs)	Total Area	Chinook Salmon WUA		Percent of maximum WUA		Steelhead WUA		Percent of maximum WUA		Bull Trout WUA		Percent of maximum WUA	
		Spawning	Juvenile	Spawning	Juvenile	Spawning	Juvenile	Spawning	Juvenile	Spawning	Juvenile	Spawning	Juvenile
20	103,289	21	1,411	0.0	12.6	0	1,662	0.0	15.9	19,353	2,826	58.5	37.4
30	110,897	780	2,017	1.5	18.0	47	1,984	0.1	19.0	22,819	3,566	68.9	47.2
40	118,633	2,263	2,587	4.3	23.1	256	2,288	0.6	21.9	25,708	4,190	77.7	55.4
50	126,993	4,152	3,216	7.9	28.7	632	2,583	1.5	24.8	28,224	4,554	85.2	60.2
60	127,722	6,113	3,867	11.6	34.5	1,100	2,873	2.6	27.5	30,254	4,715	91.4	62.4
70	128,293	8,265	4,511	15.7	40.3	1,627	3,160	3.8	30.3	32,129	4,824	97.0	63.8
80	128,775	10,697	5,293	20.3	47.3	2,277	3,438	5.3	33.0	33,107	4,939	100.0	65.3
90	129,212	13,455	6,001	25.5	53.6	3,051	3,720	7.1	35.7	33,105	4,975	100.0	65.8
100	129,747	16,582	6,570	31.4	58.7	3,922	4,001	9.1	38.4	31,985	4,923	96.6	65.1
120	130,749	23,316	7,406	44.2	66.2	6,107	4,563	14.2	43.7	28,399	4,683	85.8	61.9
140	131,538	30,079	8,293	57.0	74.1	8,641	5,110	20.1	49.0	24,911	4,397	75.2	58.2
160	132,176	36,473	8,908	69.2	79.6	11,284	5,632	26.2	54.0	21,611	4,514	65.3	59.7
180	132,725	41,423	9,369	78.6	83.7	14,086	6,122	32.8	58.7	17,795	4,741	53.7	62.7
200	133,099	44,048	9,769	83.5	87.3	16,846	6,610	39.2	63.4	14,822	4,942	44.8	65.4
250	133,827	48,870	11,195	92.7	100.0	23,082	7,613	53.7	73.0	12,484	5,517	37.7	73.0
300	134,430	50,978	10,302	96.7	92.0	28,613	8,160	66.5	78.2	10,754	6,981	32.5	92.3
350	134,955	51,762	10,060	98.2	89.9	32,539	8,634	75.7	82.8	9,807	7,560	29.6	100.0
400	135,430	52,651	9,665	99.9	86.3	35,302	9,122	82.1	87.5	8,510	7,252	25.7	95.9
450	135,773	52,727	9,340	100.0	83.4	38,216	9,518	88.9	91.2	7,194	6,640	21.7	87.8
500	136,087	52,025	9,365	98.7	83.7	40,893	9,938	95.1	95.3	6,141	6,237	18.5	82.5
550	136,378	50,654	9,775	96.1	87.3	42,386	10,306	98.6	98.8	5,449	5,935	16.5	78.5
600	136,634	48,103	10,433	91.2	93.2	42,997	10,431	100.0	100.0	4,732	5,719	14.3	75.7
650	136,873	45,261	10,933	85.8	97.7	42,557	10,312	99.0	98.9	4,194	5,479	12.7	72.5
700	137,100	42,228	11,100	80.1	99.2	41,856	10,084	97.3	96.7	3,702	5,275	11.2	69.8
750	137,315	39,231	10,984	74.4	98.1	40,786	9,837	94.9	94.3	3,375	5,155	10.2	68.2
800	137,520	36,317	10,846	68.9	96.9	38,459	9,645	89.4	92.5	3,043	5,084	9.2	67.2

Table 10. Weighted usable area (WUA) (ft^2/1,000 ft) versus flow in Icicle Creek, Study Site 3.

Flow (cfs)	Total Area	Chinook Salmon WUA		Percent of maximum WUA		Steelhead WUA		Percent of maximum WUA		Bull Trout WUA		Percent of maximum WUA	
		Spawning	Juvenile	Spawning	Juvenile	Spawning	Juvenile	Spawning	Juvenile	Spawning	Juvenile	Spawning	Juvenile
20	71,360	743	2,679	1.8	14.9	3	3,562	0.0	19.2	12,640	1,382	70.3	31.7
30	73,865	1,729	3,411	4.3	18.9	184	3,903	0.8	21.0	15,307	1,622	85.1	37.2
40	75,691	2,946	4,149	7.2	23.0	430	4,346	2.0	23.4	17,356	2,084	96.5	47.8
50	76,931	4,631	5,855	11.4	32.5	792	4,811	3.7	25.9	17,989	2,242	100.0	51.4
60	82,456	7,064	8,827	17.4	48.9	1,224	5,246	5.7	28.2	17,774	2,199	98.8	50.5
70	85,775	9,857	9,974	24.2	55.3	1,852	5,677	8.6	30.6	17,048	2,331	94.8	53.5
80	87,264	12,687	10,897	31.2	60.4	2,832	6,122	13.1	33.0	15,880	2,439	88.3	56.0
90	88,114	15,072	11,800	37.1	65.4	3,824	6,563	17.7	35.3	14,859	2,447	82.6	56.2
100	88,355	17,219	12,541	42.3	69.5	4,729	7,012	21.8	37.7	13,941	2,430	77.5	55.8
120	88,791	21,603	14,439	53.1	80.0	6,562	7,933	30.3	42.7	12,027	2,562	66.9	58.8
140	89,182	25,440	15,720	62.6	87.1	8,446	8,851	39.0	47.6	10,267	2,726	57.1	62.5
160	89,405	29,311	16,417	72.1	91.0	10,281	9,707	47.5	52.3	8,327	2,898	46.3	66.5
180	89,600	32,091	17,870	78.9	99.1	11,991	10,571	55.4	56.9	6,781	3,020	37.7	69.3
200	89,775	33,824	17,942	83.2	99.5	13,683	11,467	63.2	61.7	5,393	3,174	30.0	72.8
250	90,163	36,997	18,038	91.0	100.0	17,428	13,524	80.5	72.8	3,876	3,458	21.5	79.3
300	90,507	39,209	16,780	96.4	93.0	19,328	14,925	89.2	80.3	2,719	4,039	15.1	92.7
350	135,110	40,451	14,943	99.5	82.8	20,529	16,050	94.8	86.4	1,591	4,112	8.8	94.3
400	91,513	40,664	13,162	100.0	73.0	20,875	17,051	96.4	91.8	907	4,131	5.0	94.8
450	92,111	40,381	11,446	99.3	63.5	21,140	17,911	97.6	96.4	536	4,358	3.0	100.0
500	93,068	39,746	10,259	97.7	56.9	21,260	18,576	98.1	100.0	290	4,332	1.6	99.4
550	93,629	38,683	9,369	95.1	51.9	21,240	18,487	98.0	99.5	245	4,079	1.4	93.6
600	94,163	37,158	8,735	91.4	48.4	21,179	17,966	97.8	96.7	176	3,643	1.0	83.6
650	94,668	35,506	8,228	87.3	45.6	21,405	17,460	98.8	94.0	127	3,048	0.7	69.9
700	95,153	33,398	7,906	82.1	43.8	21,630	16,970	99.8	91.4	71	2,778	0.4	63.7
750	95,616	30,963	7,873	76.1	43.6	21,663	16,427	100.0	88.4	18	2,620	0.1	60.1
800	96,060	28,433	7,806	69.9	43.3	21,584	15,643	99.6	84.2	4	2,576	0.0	59.1

Table 11. Weighted usable area (WUA) (ft^2/1,000 ft) versus flow in Icicle Creek, composite of all sites.

Flow (cfs)	Total Area	Chinook Salmon WUA		Percent of maximum WUA		Steelhead WUA		Percent of maximum WUA		Bull Trout WUA		Percent of maximum WUA	
		Spawning	Juvenile	Spawning	Juvenile	Spawning	Juvenile	Spawning	Juvenile	Spawning	Juvenile	Spawning	Juvenile
20	93,122	536	2,493	1.2	15.2	63	2,760	0.2	17.3	12,177	6,013	64.7	82.9
30	98,455	1,715	3,719	3.8	22.7	283	3,251	1.0	20.4	14,193	6,871	75.4	94.7
40	102,564	3,169	4,760	7.0	29.1	606	3,719	2.1	23.3	15,816	7,257	84.1	100.0
50	106,249	4,853	6,038	10.7	36.9	1,030	4,186	3.5	26.2	17,340	7,034	92.1	96.9
60	109,816	6,794	7,062	15.0	43.1	1,462	4,652	5.0	29.1	18,430	7,013	97.9	96.6
70	111,322	8,938	7,887	19.7	48.2	1,964	5,102	6.7	31.9	18,817	6,942	100.0	95.7
80	112,228	11,128	8,683	24.6	53.1	2,570	5,561	8.7	34.8	18,687	6,896	99.3	95.0
90	112,901	13,420	9,598	29.6	58.6	3,286	6,012	11.2	37.6	18,260	6,793	97.0	93.6
100	113,466	15,606	10,324	34.5	63.1	3,987	6,466	13.6	40.5	17,756	6,647	94.4	91.6
120	114,442	20,064	11,694	44.3	71.5	5,612	7,399	19.1	46.3	16,063	6,463	85.4	89.1
140	115,167	24,209	13,389	53.5	81.8	7,384	8,339	25.1	52.2	14,548	6,177	77.3	85.1
160	115,708	28,264	14,626	62.4	89.4	9,180	9,225	31.2	57.8	13,266	5,820	70.5	80.2
180	116,109	31,936	15,190	70.6	92.8	11,112	10,078	37.8	63.1	11,908	5,567	63.3	76.7
200	116,397	34,356	15,591	75.9	95.3	12,864	10,876	43.7	68.1	10,516	5,465	55.9	75.3
250	117,038	39,437	16,366	87.1	100.0	16,782	12,676	57.1	79.4	9,038	5,293	48.0	72.9
300	117,624	42,445	15,408	93.8	94.1	20,458	13,824	69.6	86.6	7,553	5,460	40.1	75.2
350	118,239	44,317	14,348	97.9	87.7	23,341	14,652	79.4	91.7	6,643	5,224	35.3	72.0
400	118,780	45,263	13,377	100.0	81.7	24,762	15,202	84.2	95.2	5,609	4,992	29.8	68.8
450	119,197	45,192	12,170	99.8	74.4	26,432	15,635	89.9	97.9	4,658	4,728	24.8	65.1
500	119,701	44,187	11,256	97.6	68.8	27,742	15,961	94.3	99.9	3,994	4,461	21.2	61.5
550	120,080	42,859	10,551	94.7	64.5	28,667	15,970	97.5	100.0	3,588	4,188	19.1	57.7
600	120,438	41,007	10,098	90.6	61.7	29,174	15,695	99.2	98.3	3,021	3,906	16.1	53.8
650	120,766	38,875	9,721	85.9	59.4	29,411	15,187	100.0	95.1	2,540	3,580	13.5	49.3
700	121,076	36,574	9,347	80.8	57.1	29,300	14,648	99.6	91.7	2,245	3,387	11.9	46.7
750	121,379	34,120	9,020	75.4	55.1	28,999	14,102	98.6	88.3	2,032	3,253	10.8	44.8
800	121,648	31,514	8,666	69.6	53.0	28,116	13,461	95.6	84.3	1,844	3,165	9.8	43.6

Discussion

The results presented in this report summarize the hydrology and habitat in Icicle Creek. PHABSIM analysis of the data collected and compiled for this study resulted in graphs that illustrate the relation between WUA and discharge. The highest point on the curves represents the discharge at which habitat is optimized for the life stage of interest. It should be understood that WUAs do not address water availability in any way and even the unregulated flow may commonly exceed or be less than the discharge at which maximum WUA is available. The amount of WUA available, in terms of lost or gained, can be determined by comparing to a reference or unregulated streamflow condition. Typically, the maximum, percentiles, or inflections are chosen from these curves at the level of protection desired or at points above which greater amounts of flow only provide minor gains in usable habitat.

The actual habitat experienced by fish in any river depends on the flow regime of the river. The development of habitat conditions over a period of time is an integral part of the comparison of flow regimes and developing target flows for aquatic needs. Habitat time series analysis involves interfacing a time series of streamflow data with the functional relationship between streamflow and habitat (WUA) (Bovee et al. 1998). This computational process is done for each flow regime alternative and life stage. Flow and habitat duration statistics are developed that allow a direct comparison of the changes that occur in both flow and habitat under a range of conditions. The amount of WUA available, in terms of lost or gained, can be determined by comparing WUA for an alternative flow regime to a reference or unregulated stream flow condition. The decision point in PHABSIM is a comparison of flow regimes.

The natural hydrograph needs to be considered when developing flow targets. In drought years, summer flows that provide maximum possible habitat may not be attainable because of the hydrologic limits on the stream.

Finally, it should be noted that PHABSIM was designed as a tool to provide science-based linkage between biology and river hydraulics with results to be used in negotiations or mediated settlements (Arthaud et al. 2001).

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Appendix A – Depth and Velocity Habitat Suitability Criteria for Icicle Creek

Chinook juveniles

Velocity (ft/sec)	Preference	Depth (ft)	Preference
0	0.09	0	0
0.35	0.26	0.45	0
0.45	0.93	1.35	0.5
0.7	1	1.55	0.8
1.15	0.9	2.2	1
1.25	0.75	99.99	1
2.3	0.08		
3.6	0		

Chinook spawning

Velocity (ft/sec)	Preference	Depth (ft)	Preference
0	0	0	0
0.5	0	0.5	0
1	0.9	1.2	1
1.75	1	3	1
2.25	1	3.5	0.5
4	0	4.5	0.07
		5	0

Steelhead juveniles

Velocity (ft/sec)	Preference	Depth (ft)	Preference
0	0.23	0	0
0.25	0.3	0.25	0
0.9	0.8	1.8	0.39
1.35	1	2.65	1
1.55	1	2.95	1
2.6	0.8	4.5	0.64
2.95	0.39	99.9	0.64
3.65	0.22		
5.5	0.16		
6	0		

Steelhead spawning

Velocity (ft/sec)	Preference	Depth (ft)	Preference
0	0	0	0
0.55	0	0.65	0
2.5	1	1.25	1
3.25	1	1.55	1
3.45	0.62	2.4	0.5
5	0	99.99	0.5

Bull trout juvenile/adult rearing

Velocity (ft/sec)	Preference	Depth (ft)	Preference
0	0.16	0	0
0.1	1	0.45	0
0.4	1	1.3	0.56
0.8	0.2	1.5	1
1.6	0.2	2	1
2.8	0	2.1	0.67
		2.9	0.67
		3	0

Bull trout spawning			
Velocity (ft/sec)	Preference	Depth (ft)	Preference
0	0.03	0	0
0.35	0.48	0.1	0
0.5	1	0.3	0.18
0.95	1	0.5	1
1.1	0.4	0.7	1
2	0.13	1.3	0.29
2.1	0	2.1	0.2
		2.2	0
Coho spawning			
Velocity (ft/sec)	Preference	Depth (ft)	Preference
0	0.4	0	0
0.25	0.4	0.45	0
1.05	1	1.15	0.75
1.8	0.81	2.05	1
2.65	0.29	3.25	0.09
3.9	0	4	0.01
		5	0

Appendix B – PHABSIM Input File for Icicle Creek

```
Icicle Creek Composite
Export from PHABSIM for Windows
IOC       0000000100010000100000
QARD  20.0
QARD  30.0
QARD  40.0
QARD  50.0
QARD  53.5
QARD  60.0
QARD  70.0
QARD  80.0
QARD  90.0
QARD 100.0
QARD 120.0
QARD 140.0
QARD 160.0
QARD 180.0
QARD 195.4
QARD 200.0
QARD 240.6
QARD 250.0
QARD 300.0
QARD 350.0
QARD 361.8
QARD 400.0
QARD 450.0
QARD 500.0
QARD 550.0
QARD 600.0
QARD 650.0
QARD 700.0
QARD 750.0
QARD 800.0
XSEC   1.0       0.0 1.0     84.20   0.00012
       1.0  0.0 92.0  8.2 90.9 12.4 88.4 16.1 87.9 17.4 87.5 18.5 87.3
       1.0 18.7 87.0 20.0 86.5 22.0 86.3 24.0 86.5 26.0 86.8 28.0 86.9
       1.0 30.0 87.0 32.0 87.1 34.0 87.1 36.0 87.1 38.0 87.0 40.0 87.1
       1.0 42.0 87.0 44.0 86.9 46.0 86.8 48.0 86.8 50.0 86.7 52.0 86.6
       1.0 54.0 86.6 56.0 86.5 58.0 86.4 60.0 86.3 62.0 86.3 64.0 86.2
       1.0 66.0 86.2 68.0 85.9 70.0 85.9 72.0 85.8 74.0 85.7 76.0 85.7
       1.0 78.0 85.5 80.0 85.5 82.0 85.3 84.0 85.2 86.0 85.2 88.0 85.1
       1.0 90.0 84.9 92.0 84.7 94.0 84.5 96.0 84.2 98.0 84.2100.0 84.2
       1.0102.0 84.2106.0 84.5110.0 84.7114.0 85.3118.0 85.5122.0 85.9
       1.0126.0 86.3130.0 86.7131.5 87.0133.0 87.2134.8 93.9
NS     1.0       0.9       0.9  1.0  0.7  1.0  0.2  1.0  0.2  1.0  0.4
NS     1.0  1.0  0.4  1.0 12.9      25.9      35.8      54.5      54.5
NS     1.0      45.7      54.8      54.8      45.5      45.7      45.7
NS     1.0      54.8      54.8      54.8      74.8      74.8      74.7
NS     1.0      74.5      74.8      74.8      74.8      74.8      74.8
NS     1.0      74.8      47.6      47.6      74.6      74.6      74.7
NS     1.0      74.7      74.8      74.9      76.9      76.9      76.9
NS     1.0      76.9      76.6      76.6      67.5      67.9      67.9
NS     1.0      67.9      67.9      67.9  1.0 67.9      67.9      67.9
NS     1.0      67.9      67.9      67.9       0.2       0.9
WSL    1.0      86.7      86.8      86.9      87.0      87.0      87.1
WSL    1.0      87.2      87.2      87.3      87.3      87.4      87.5
WSL    1.0      87.5      87.6      87.6      87.6      87.7      87.7
WSL    1.0      87.8      87.9      87.9      87.9      88.0      88.1
WSL    1.0      88.1      88.2      88.2      88.2      88.3      88.3
CAL1   1.0     87.90    361.80    358.60
VEL1   1.0               0.00 0.00 0.00 0.20 0.43 0.40 0.92 1.05 1.28
VEL1   1.0 1.24 1.24 1.19 1.24 1.28 1.40 1.35 1.40 1.55 1.56 1.56 1.33
VEL1   1.0 1.58 1.57 1.77 1.60 1.71 1.70 1.65 1.48 1.38 1.43 1.49 1.55
VEL1   1.0 1.62 1.81 1.79 1.93 1.77 1.88 1.97 1.79 1.99 2.05 2.11 1.87
VEL1   1.0 2.18 2.09 1.98 1.87 1.72 1.37 1.06 0.69 0.31 0.07
CAL2   1.0     87.73    240.60    244.40
VEL2   1.0                     0.00 0.03 0.00 0.83 0.72 0.82 0.79 0.90
VEL2   1.0 0.87 0.89 0.84 1.04 1.07 0.97 1.07 1.06 0.88 0.94 1.24 1.12
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VEL2   1.0 1.40 1.22 1.30 1.28 1.27 1.45 1.43 1.28 1.21 1.33 1.43 1.48
VEL2   1.0 1.41 1.49 1.61 1.66 1.60 1.54 1.59 1.63 1.60 1.35 1.57 1.44
VEL2   1.0 1.32 1.47 1.34 1.15 0.69 0.52 0.06 0.10 0.00 0.00
CAL3   1.0     87.53    195.40    178.20
VEL3   1.0                     0.00 0.35 0.35 0.83 0.81 0.83 0.70 0.71
VEL3   1.0 0.61 0.48 0.43 0.48 0.50 0.53 0.56 0.61 0.79 0.72 0.78 0.71
VEL3   1.0 0.83 0.95 0.94 0.91 0.89 0.97 1.09 1.05 1.06 1.14 1.09 1.31
VEL3   1.0 1.22 1.43 1.46 1.36 1.50 1.36 1.55 1.57 1.37 1.50 1.34 1.40
VEL3   1.0 1.13 1.18 0.96 0.78 0.62 0.02 0.14 0.08 0.00 0.00
CAL4   1.0     87.02     53.50     47.00
VEL4   1.0                                0.00 0.43 0.51 0.55 0.23 0.00
VEL4   1.0 0.00                0.00      0.00 0.00 0.06 0.08 0.19 0.23
VEL4   1.0 0.25 0.36 0.37 0.45 0.37 0.52 0.55 0.44 0.45 0.58 0.63 0.60
VEL4   1.0 0.72 0.70 0.68 0.79 0.78 0.71 0.74 0.57 0.58 0.47 0.49 0.30
VEL4   1.0 0.38 0.30 0.20 0.00 0.04 0.19 0.04 0.10 0.00
XSEC   2.0      69.0 1.0     84.70   0.00268
       2.0  0.0 91.6  3.1 90.4  5.4 88.8  9.0 87.8 10.0 87.9 11.4 87.5
       2.0 12.0 87.2 15.0 87.0 18.0 86.6 21.0 86.3 24.0 86.0 27.0 85.6
       2.0 30.0 85.7 33.0 85.2 36.0 85.2 39.0 85.4 42.0 85.6 45.0 85.6
       2.0 48.0 85.5 51.0 85.4 54.0 85.5 57.0 85.4 60.0 85.3 63.0 85.3
       2.0 66.0 85.3 69.0 85.4 72.0 85.4 75.0 85.4 78.0 85.3 81.0 85.2
       2.0 84.0 84.8 87.0 84.7 90.0 85.1 93.0 85.6 96.0 86.0 99.0 86.5
       2.0102.0 86.8105.0 87.2108.0 87.3111.0 87.4113.0 87.5114.0 87.7
       2.0115.2 87.9118.0 89.0119.3 90.5123.2 92.5
NS     2.0       0.9       0.9      11.9      22.9      22.9      21.8
NS     2.0      21.8      21.8      25.9      26.7      62.7      62.9
NS     2.0      65.6      56.6      56.6      76.8      76.8      56.9
NS     2.0      26.7      26.7      52.8      65.6      65.6      65.6
NS     2.0      65.6      65.6      56.8      56.8      56.6      56.6
NS     2.0      56.6      65.6      65.8      67.9      67.9      67.9
NS     2.0      67.9      67.9  1.0 67.9  1.0 67.9  1.0 67.9  1.0 67.9
NS     2.0  1.0 67.9       0.8       0.8       0.9
WSL    2.0      86.7      86.9      87.0      87.1      87.0      87.1
WSL    2.0      87.2      87.2      87.3      87.3      87.4      87.5
WSL    2.0      87.5      87.6      87.6      87.6      87.7      87.7
WSL    2.0      87.8      87.9      87.9      87.9      88.0      88.1
WSL    2.0      88.1      88.2      88.2      88.3      88.3      88.3
CAL1   2.0     87.91    361.80    385.10
VEL1   2.0                0.00 0.00 0.07 0.15 0.08 0.06 0.30 0.69 1.11
VEL1   2.0 1.74 2.00 1.71 1.73 1.29 0.88 0.62 0.59 1.09 1.37 1.71 1.93
VEL1   2.0 1.99 2.29 2.63 2.74 2.79 2.41 2.64 3.03 2.36 1.68 1.48 1.17
VEL1   2.0 1.05 0.93 0.74 0.43 0.20 0.05 0.00
CAL2   2.0     87.73    240.60    260.90
VEL2   2.0                0.00 0.00 0.00 0.03 0.15 0.13 0.03 0.13 0.40
VEL2   2.0 0.78 1.15 1.72 1.80 1.38 0.76 0.75 0.69 0.85 1.11 1.49 1.93
VEL2   2.0 2.09 2.06 2.14 2.43 2.66 2.07 2.00 2.66 1.77 1.25 0.79 0.56
VEL2   2.0 0.35 0.25 0.17 0.06 0.00 0.00
CAL3   2.0     87.51    195.40    178.20
VEL3   2.0                          0.00 0.08 0.12 0.13 0.13 0.09 0.05
VEL3   2.0 0.10 0.20 0.54 0.64 0.87 0.98 0.87 0.80 0.86 0.92 1.14 1.44
VEL3   2.0 1.68 2.00 2.08 2.62 2.42 1.74 1.99 2.17 1.08 0.61 0.27 0.08
VEL3   2.0 0.02 0.06 0.18 0.00 0.00
CAL4   2.0     87.04     53.50     50.90
VEL4   2.0                                0.00 0.08 0.11 0.06 0.05
VEL4   2.0 0.08 0.10 0.08 0.08 0.05 0.04 0.05 0.03 0.12 0.14 0.33 0.74
VEL4   2.0 0.98 1.21 2.17 1.43 1.95 0.42 0.87 0.45 0.45 0.02 0.13 0.20
VEL4   2.0
XSEC   3.0     121.6 1.0     85.40   0.00054
       3.0  0.0 94.0  2.2 93.7  3.6 88.6  4.5 88.0  5.0 88.2  7.0 87.7
       3.0  8.0 87.2 12.0 87.0 16.0 86.8 20.0 87.2 24.0 87.5 28.0 87.7
       3.0 32.0 87.6 36.0 87.3 40.0 87.1 44.0 86.9 48.0 86.8 52.0 86.9
       3.0 56.0 86.9 60.0 87.0 64.0 87.3 68.0 87.4 72.0 87.4 76.0 87.2
       3.0 80.0 87.1 84.0 86.8 88.0 86.5 92.0 86.1 96.0 85.8100.0 85.6
       3.0104.0 85.5108.0 85.4112.0 85.5116.0 85.7120.0 86.5124.0 86.5
       3.0128.0 86.9132.0 87.3136.0 87.7141.0 88.2141.5 88.2145.0 88.6
       3.0164.6 91.2171.7 95.3
NS     3.0       0.9       0.9       0.2       0.2       0.2       0.2
NS     3.0       0.2      42.8      43.6      43.8      43.8      45.8
NS     3.0      45.8      53.7      53.7      35.8      35.8      35.8
NS     3.0      35.8      35.8      54.5      54.7      54.8      54.8
NS     3.0      54.7      54.7      54.7      54.7      54.7      54.8
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NS     3.0      54.8      54.9      45.7      45.7      65.7      65.7
NS     3.0      56.8      65.9      64.8  1.0 54.9  1.0 54.9  1.0 67.9
NS     3.0      67.9      16.5
WSL    3.0      87.3      87.5      87.6      87.7      87.7      87.8
WSL    3.0      87.8      87.9      87.9      88.0      88.1      88.1
WSL    3.0      88.2      88.3      88.2      88.3      88.4      88.4
WSL    3.0      88.5      88.6      88.6      88.7      88.7      88.8
WSL    3.0      88.8      88.9      88.9      89.0      89.0      89.1
CAL1   3.0     88.62    361.80    365.20
VEL1   3.0           0.00 0.16 0.67 0.92 1.17 1.43 1.36 1.12 1.36 1.47
VEL1   3.0 1.45 1.11 1.18 1.05 1.03 1.07 0.99 1.10 1.12 1.34 1.57 1.44
VEL1   3.0 1.36 1.59 1.61 1.56 1.64 1.95 1.64 1.86 1.82 1.63 1.85 1.93
VEL1   3.0 1.92 1.72 1.45 1.00 0.54 0.00
CAL2   3.0     88.43    240.60    252.80
VEL2   3.0                0.18 0.23 0.24 0.27 1.60 1.55 1.61 1.20 1.09
VEL2   3.0 1.03 0.90 0.95 0.75 0.79 0.79 0.84 0.85 0.94 0.93 1.14 1.14
VEL2   3.0 1.58 1.50 1.44 1.43 1.60 1.61 1.26 1.55 1.63 1.68 1.74 1.67
VEL2   3.0 1.57 1.59 1.29 0.65 0.00
CAL3   3.0     88.18    195.40    171.70
VEL3   3.0                     0.00 0.45 0.91 0.88 0.74 0.64 0.58 0.44
VEL3   3.0 0.38 0.46 0.47 0.39 0.43 0.37 0.42 0.50 0.50 0.54 0.72 0.67
VEL3   3.0 1.11 1.18 1.15 1.20 1.36 1.23 1.29 1.24 1.23 1.26 1.32 1.33
VEL3   3.0 1.17 1.21 0.59 0.00 0.00
CAL4   3.0     87.68     53.50     51.30
VEL4   3.0                          0.00 0.00 0.08 0.11 0.27 0.00 0.00
VEL4   3.0 0.00 0.15 0.13 0.07 0.09 0.06 0.02 0.02 0.12 0.02 0.21 0.17
VEL4   3.0 0.47 0.60 0.65 0.56 0.59 0.97 0.67 0.75 0.65 0.64 0.64 0.60
VEL4   3.0 0.53 0.20 0.00
XSEC   4.0       9.3 1.0     85.40   0.00054
       4.0  0.0 94.5  8.3 91.0 14.0 88.5 15.0 88.2 19.0 87.2 24.0 87.3
       4.0 29.0 87.4 34.0 86.6 39.0 86.8 44.0 86.4 49.0 86.0 54.0 85.4
       4.0 59.0 85.1 64.0 84.9 69.0 84.8 74.0 85.0 79.0 84.9 84.0 84.9
       4.0 89.0 84.8 94.0 84.5 99.0 84.5104.0 84.6109.0 84.7114.0 84.7
       4.0119.0 84.6124.0 84.8129.0 84.9134.0 85.5139.0 86.2144.0 87.5
       4.0146.8 88.0147.0 87.7148.4 88.2150.2 88.7152.4 89.7156.8 94.1
NS     4.0       0.9       0.2  1.0  0.2       0.2      21.8      22.9
NS     4.0      22.9      23.9      22.9      22.9      22.9      21.9
NS     4.0      22.9      22.9      21.9      21.9      21.9      21.9
NS     4.0      21.9      22.9      25.9      25.9      24.7      24.7
NS     4.0      52.7      65.6      56.6      56.8  1.0 65.8  1.0 65.8
NS     4.0  1.0 56.8  1.0 65.5  1.0 65.5  1.0 65.5      11.9       0.9
WSL    4.0      87.4      87.5      87.6      87.7      87.7      87.8
WSL    4.0      87.8      87.9      87.9      88.0      88.1      88.1
WSL    4.0      88.2      88.3      88.2      88.3      88.5      88.4
WSL    4.0      88.6      88.6      88.7      88.7      88.8      88.9
WSL    4.0      88.9      89.0      89.1      89.1      89.2      89.2
CAL1   4.0     88.65    361.80    320.00
VEL1   4.0           0.00 0.00 0.61 0.90 0.75 0.62 0.55 0.71 0.69 0.68
VEL1   4.0 0.66 0.70 0.65 0.81 0.76 0.79 0.88 0.88 0.90 0.88 0.83 0.94
VEL1   4.0 0.82 0.69 0.86 0.74 0.77 0.62 0.37 0.28 0.19 0.00
CAL2   4.0     88.50    240.60    235.40
VEL2   4.0           0.00 0.21 0.42 0.48 0.47 0.48 0.47 0.46 0.44 0.47
VEL2   4.0 0.48 0.50 0.51 0.53 0.55 0.61 0.65 0.67 0.68 0.74 0.71 0.65
VEL2   4.0 0.65 0.70 0.58 0.66 0.55 0.33 0.00 0.00 0.00
CAL3   4.0     88.17    195.40    146.70
VEL3   4.0                0.00 0.43 0.48 0.38 0.27 0.28 0.29 0.31 0.34
VEL3   4.0 0.30 0.35 0.34 0.40 0.39 0.43 0.57 0.48 0.54 0.40 0.52 0.50
VEL3   4.0 0.49 0.51 0.41 0.47 0.37 0.31 0.01 0.00 0.00
CAL4   4.0     87.69     53.50     30.70
VEL4   4.0                     0.07 0.08 0.00 0.03 0.10 0.14 0.13 0.10
VEL4   4.0 0.08 0.07 0.05 0.08 0.11 0.10 0.13 0.12 0.20 0.13 0.32 0.14
VEL4   4.0 0.19 0.12 0.11 0.12 0.05 0.06      0.00
XSEC   5.0     156.3 1.0     90.20   0.00478
       5.0  0.0 98.7 10.0 91.7 11.0 91.5 12.3 91.1 15.0 90.8 20.0 90.9
       5.0 25.0 90.4 30.0 90.2 35.0 90.3 40.0 90.8 45.0 91.0 50.0 90.9
       5.0 55.0 91.0 60.0 91.0 65.0 91.0 70.0 90.9 75.0 90.9 80.0 91.0
       5.0 85.0 90.9 90.0 90.9 95.0 90.7100.0 90.6105.0 90.6110.0 90.4
       5.0115.0 90.4120.0 90.5125.0 90.3130.0 90.4135.0 90.3140.0 90.6
       5.0145.0 90.8150.0 90.9154.0 91.1155.0 91.2160.0 91.3162.5 91.4
       5.0163.5 91.5165.0 91.7165.2 91.9166.3 95.3177.8 97.5
NS     5.0       0.9       0.1       0.1      54.9      54.9      54.9
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NS     5.0      54.6      54.6      54.6  1.0 54.6  1.0 45.6  1.0 54.6
NS     5.0  1.0 54.6  1.0 53.8  1.0 53.8      53.8      53.8      54.9
NS     5.0      54.9      54.8      54.8  1.0 54.8  1.0 54.6  1.0 54.6
NS     5.0  1.0 54.6  1.0 45.8  1.0 45.8      45.9      45.9      45.8
NS     5.0      45.8      45.8      45.8      45.8      43.9      43.9
NS     5.0       0.2       0.1       0.1       0.9       0.9
WSL    5.0      90.8      90.9      91.0      91.0      91.1      91.1
WSL    5.0      91.1      91.2      91.2      91.2      91.3      91.3
WSL    5.0      91.4      91.4      91.4      91.4      91.5      91.5
WSL    5.0      91.6      91.7      91.7      91.7      91.8      91.8
WSL    5.0      91.8      91.9      91.9      92.0      92.0      92.0
CAL1   5.0     91.07     53.50     57.20
VEL1   5.0               0.00 0.15 0.51 0.73 1.00 0.74 0.29 0.13 0.28
VEL1   5.0 0.00 0.00 0.00 0.33 0.81 0.43 0.58 1.41 1.36 1.51 1.86 1.42
VEL1   5.0 1.75 1.45 1.51 1.43 1.69 1.01 0.69 0.41 0.00
VEL1   5.0
CAL2   5.0     91.39    195.40    212.30
VEL2   5.0           0.00 0.40 0.82 1.35 1.64 2.56 1.57 1.35 0.89 0.95
VEL2   5.0 0.62 0.30 0.82 1.02 1.61 1.97 1.97 2.65 2.93 2.42 2.77 2.51
VEL2   5.0 2.73 2.95 2.61 2.81 2.60 2.47 1.28 1.83 1.14 0.45 0.69 0.00
VEL2   5.0 0.00
CAL3   5.0     91.54    240.60    258.00
VEL3   5.0           0.00 0.50 0.99 1.87 2.35 2.60 1.78 1.27 0.98 0.93
VEL3   5.0 0.90 0.70 0.79 0.88 1.60 1.78 2.38 2.71 2.79 3.11 2.93 2.61
VEL3   5.0 3.07 2.77 3.00 2.66 3.33 3.40 1.89 1.83 1.70 1.57 0.51 0.25
VEL3   5.0 0.00
CAL4   5.0     91.67    361.80    387.80
VEL4   5.0      0.00 0.06 0.64 1.27 1.94 2.38 3.24 2.95 2.09 1.56 0.81
VEL4   5.0 0.66 0.50 0.23 0.47 1.46 1.95 2.97 3.46 3.53 3.54 3.53 3.63
VEL4   5.0 3.48 3.53 3.17 3.52 3.43 3.81 2.59 2.71 2.57 2.42 2.37 2.00
VEL4   5.0 1.55 0.00
XSEC   6.0      69.0 1.0     90.10   0.00090
       6.0  0.0 98.4  8.7 92.2 11.0 91.4 14.0 90.7 19.0 90.7 24.0 90.5
       6.0 29.0 90.5 34.0 90.9 39.0 90.8 44.0 90.6 49.0 90.4 54.0 90.5
       6.0 59.0 90.5 64.0 90.4 69.0 90.5 74.0 90.5 79.0 90.4 84.0 90.7
       6.0 89.0 90.5 94.0 90.2 99.0 90.1104.0 90.3109.0 90.3114.0 90.6
       6.0119.0 91.1124.0 91.2129.0 90.9134.0 90.7139.0 90.8144.0 90.6
       6.0149.0 90.6151.0 91.4152.0 92.0157.3 93.0160.1 93.9164.5 94.9
NS     6.0       0.9       0.2      58.8      58.8      58.8      53.8
NS     6.0      53.8      53.8      53.8      54.8      53.8      54.8
NS     6.0      53.9      53.9      53.9      52.9      52.9      52.9
NS     6.0      52.9      52.9      52.9      54.8      54.8      45.7
NS     6.0      45.7      45.7      45.9      45.9      45.9      45.9
NS     6.0  1.0 45.9  1.0 21.9      21.9       0.7       0.8       0.9
WSL    6.0      91.1      91.2      91.3      91.4      91.4      91.4
WSL    6.0      91.5      91.5      91.6      91.6      91.7      91.7
WSL    6.0      91.8      91.8      91.9      91.9      92.0      92.0
WSL    6.0      92.1      92.1      92.2      92.2      92.3      92.3
WSL    6.0      92.4      92.4      92.5      92.5      92.6      92.6
CAL1   6.0     91.41     53.50     53.50
VEL1   6.0           0.00 0.06 0.27 0.48 0.42 0.33 0.27 0.30 0.26 0.36
VEL1   6.0 0.35 0.45 0.43 0.66 0.52 0.42 0.63 0.65 0.76 0.91 0.70 0.80
VEL1   6.0 0.72 0.73 0.14 0.15 0.32 0.49 0.36 0.00
CAL2   6.0     91.85    195.40    195.40
VEL2   6.0           0.00 0.04 0.31 1.12 1.01 1.17 1.13 1.08 1.03 1.13
VEL2   6.0 1.14 1.01 1.20 1.25 0.90 1.13 1.23 1.39 1.18 1.39 1.39 1.33
VEL2   6.0 1.32 1.43 1.09 1.26 1.35 1.21 0.33 0.15
CAL3   6.0     91.97    240.60    240.60
VEL3   6.0           0.00 0.06 0.97 1.21 1.24 1.28 1.31 1.11 1.16 1.27
VEL3   6.0 1.18 1.49 1.27 1.36 1.28 1.13 1.27 1.39 1.60 1.78 1.53 1.73
VEL3   6.0 1.30 1.34 1.38 1.64 1.28 1.91 0.72 0.54 0.36
CAL4   6.0     92.17    361.80    361.80
VEL4   6.0      0.00 0.00 0.06 0.49 1.62 1.57 1.67 1.61 1.71 1.55 1.74
VEL4   6.0 1.78 1.67 1.56 1.57 1.42 1.77 1.88 1.92 1.84 1.69 1.93 1.89
VEL4   6.0 1.83 1.76 1.60 1.64 1.66 1.88 1.06 0.50 0.00
XSEC   7.0     121.7 1.0     88.80   0.00053
       7.0  0.0 96.8  5.7 92.2  6.5 91.9  7.0 91.4 10.0 90.4 15.0 89.0
       7.0 20.0 89.2 25.0 89.4 30.0 89.4 35.0 88.9 40.0 89.1 45.0 88.8
       7.0 50.0 88.8 55.0 88.8 60.0 88.8 65.0 89.0 70.0 89.0 75.0 89.1
       7.0 80.0 89.2 85.0 89.6 90.0 89.7 95.0 90.3100.0 91.0105.0 91.3
       7.0108.0 91.4110.0 91.4115.0 91.3120.0 91.1125.0 91.0130.0 90.9
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        7.0133.0 91.4134.5 91.9135.6 92.0136.0 92.2139.4 92.4144.4 95.5
        7.0156.6 97.4
NS      7.0       0.8      82.9      82.9      85.9      85.9      82.9
NS      7.0      28.9      23.5      34.5      54.5      46.7      63.7
NS      7.0      67.8      67.8      67.8      67.6      76.7      76.7
NS      7.0      67.7      67.7      65.8      56.8      56.9  1.0 56.9
NS      7.0  1.0 56.9  1.0 56.9  1.0 56.9  1.0 56.9  1.0 65.7  1.0 65.7
NS      7.0  1.0 65.7  1.0 12.7  1.0 12.7      12.7       0.2       0.8
NS      7.0       0.9
WSL     7.0      91.1      91.2      91.3      91.4      91.4      91.5
WSL     7.0      91.5      91.6      91.6      91.7      91.7      91.8
WSL     7.0      91.8      91.9      91.9      91.9      92.1      92.0
WSL     7.0      92.1      92.2      92.2      92.3      92.3      92.4
WSL     7.0      92.4      92.4      92.5      92.5      92.6      92.6
CAL1    7.0     91.44     53.50     50.90
VEL1    7.0                0.00 0.03 0.20 0.26 0.37 0.41 0.31 0.30 0.21
VEL1    7.0 0.23 0.24 0.25 0.31 0.26 0.28 0.27 0.28 0.28 0.25 0.19 0.00
VEL1    7.0 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
VEL1    7.0
CAL2    7.0     91.88    195.40    185.50
VEL2    7.0           0.00 0.11 0.22 0.46 0.57 0.74 0.69 0.77 0.85 0.83
VEL2    7.0 0.79 0.81 0.76 0.76 0.71 0.72 0.69 0.85 0.82 0.78 0.67 0.58
VEL2    7.0 0.55 0.51 0.43 0.42 0.48 0.65 0.30 0.00
VEL2    7.0
CAL3    7.0     92.05    240.60    232.30
VEL3    7.0           0.16 0.22 0.28 0.66 0.68 0.78 0.93 0.94 0.93 0.96
VEL3    7.0 0.87 0.90 0.89 0.95 0.94 0.83 0.91 0.84 1.00 0.79 0.78 0.80
VEL3    7.0 0.75 0.70 0.73 0.72 0.65 0.66 0.45 0.33 0.00
VEL3    7.0
CAL4    7.0     92.22    361.80    339.50
VEL4    7.0      0.00 0.21 0.32 0.42 0.73 0.88 0.95 1.02 1.26 1.20 1.47
VEL4    7.0 1.37 1.39 1.36 1.25 1.21 1.20 1.14 1.20 1.08 1.05 1.14 1.11
VEL4    7.0 1.10 1.10 0.86 0.83 0.87 0.96 0.80 0.58 0.19 0.00
VEL4    7.0
XSEC    8.0       9.3 1.0     88.80   0.00053
        8.0  0.0 97.4  7.2 92.0 11.7 91.2 12.0 91.4 13.7 90.1 18.7 88.6
        8.0 23.7 88.4 28.7 88.1 33.7 85.8 38.7 84.7 43.7 83.5 48.7 82.3
        8.0 53.7 81.7 58.7 81.2 63.7 82.2 68.7 82.7 73.7 84.7 78.7 87.2
        8.0 83.7 88.7 88.7 89.9 93.7 90.6 98.7 91.1103.7 91.3104.3 91.4
        8.0108.7 91.4113.7 91.3118.7 91.3123.7 91.4128.0 91.9129.3 92.2
        8.0144.7 96.0146.9 96.1
NS      8.0       0.7      88.9      88.9      88.9      88.9      22.9
NS      8.0      22.9      22.9      22.9      22.9      22.9      22.9
NS      8.0      22.9      22.9      27.9      27.9      62.9      62.9
NS      8.0      52.8      52.8      42.9      42.9      42.8  1.0 42.8
NS      8.0  1.0 42.8  1.0 42.6  1.0 24.7  1.0 24.7  1.0 24.7  1.0 12.9
NS      8.0       0.8       0.9
WSL     8.0      91.1      91.2      91.3      91.4      91.4      91.5
WSL     8.0      91.5      91.6      91.6      91.7      91.7      91.8
WSL     8.0      91.9      91.9      91.9      91.9      92.1      92.1
WSL     8.0      92.1      92.2      92.2      92.3      92.3      92.4
WSL     8.0      92.4      92.5      92.6      92.6      92.6      92.7
CAL1    8.0     91.44     53.50     15.20
VEL1    8.0                0.00 0.07 0.05 0.09 0.05 0.07 0.19 0.13 0.17
VEL1    8.0 0.14 0.12 0.04 0.03 0.05 0.00 0.09 0.06 0.05 0.06 0.00 0.00
VEL1    8.0      0.00 0.00
CAL2    8.0     91.89    195.40      0.00
VEL2    8.0
VEL2    8.0
VEL2    8.0
CAL3    8.0     92.05    240.60    230.70
VEL3    8.0      0.00 0.13 0.18 0.23 0.12 0.14 0.07 0.31 0.54 0.74 0.61
VEL3    8.0 0.76 0.69 0.59 0.36 0.44 0.29 0.09 0.01 0.10 0.07 0.02 0.05
VEL3    8.0 0.07 0.22 0.37 0.45 0.20
CAL4    8.0     92.24    361.80    318.50
VEL4    8.0      0.00 0.17 0.20 0.23 0.20 0.18 0.06 0.14 1.00 1.29 0.87
VEL4    8.0 1.00 0.63 0.88 0.31 0.19 0.34 0.26 0.27 0.41 0.56 0.55 0.05
VEL4    8.0 0.54 0.49 0.42 0.40 0.20 0.00
XSEC    9.0     156.3 1.0     89.30   0.00211
        9.0  0.0 96.8 13.0 93.3 24.0 91.6 24.3 91.1 24.5 89.6 30.0 89.4
        9.0 35.0 89.6 40.0 89.7 45.0 89.9 50.0 89.9 55.0 89.8 60.0 89.9
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       9.0 65.0 89.8 70.0 89.7 75.0 89.4 80.0 89.4 85.0 89.4 90.0 89.3
       9.0 95.0 89.5100.0 89.7105.0 89.9110.0 90.0115.0 90.4120.0 90.4
       9.0125.0 90.4130.0 90.6132.7 90.4134.3 91.1137.4 93.0141.5 98.1
NS     9.0       0.9       0.9      88.9      88.9      88.9      62.6
NS     9.0      34.9      45.6      45.6      53.7      53.7      54.6
NS     9.0      54.7      54.8      54.8      54.8      56.8      56.8
NS     9.0      56.8      56.8      54.8      54.8      54.8      62.8
NS     9.0      62.8  1.0 52.8  1.0 26.8  1.0 26.8       0.8       0.9
WSL    9.0      90.0      90.1      90.2      90.3      90.4      90.4
WSL    9.0      90.5      90.6      90.6      90.7      90.8      90.9
WSL    9.0      91.0      91.1      91.1      91.2      91.3      91.3
WSL    9.0      91.5      91.7      91.6      91.8      91.9      92.0
WSL    9.0      92.1      92.3      92.3      92.4      92.5      92.6
CAL1   9.0     90.41     53.50     58.50
VEL1   9.0                     0.43 0.67 0.30 0.17 0.49 0.89 1.79 1.76
VEL1   9.0 2.23 1.64 0.30 1.44 1.15 0.84 0.53 1.66 0.87 1.14 0.85 0.54
VEL1   9.0 0.59      0.00
CAL2   9.0     91.08    195.40    186.80
VEL2   9.0                0.00 1.23 1.78 1.58 1.21 0.94 0.99 1.21 1.08
VEL2   9.0 1.12 1.76 0.57 1.08 1.13 1.90 1.69 1.23 1.69 1.78 1.52 1.81
VEL2   9.0 1.34 1.34 0.67 0.00
CAL3   9.0     91.35    240.60    239.70
VEL3   9.0                0.00 0.75 1.74 1.46 1.27 1.05 1.20 1.20 1.74
VEL3   9.0 1.84 1.93 0.23 1.49 1.36 1.96 1.37 1.28 1.99 1.75 1.50 1.32
VEL3   9.0 1.54 1.14 0.57 0.00
CAL4   9.0     91.56    361.80    327.10
VEL4   9.0           0.00 0.00 0.64 1.69 1.94 1.77 1.71 1.73 1.62 1.76
VEL4   9.0 2.16 1.82 1.37 1.38 1.51 2.02 2.26 1.70 1.84 1.87 1.60 1.21
VEL4   9.0 1.19 1.24 0.62 0.11
XSEC  10.0     121.7 0.1     88.60   0.00015
      10.0  0.0 97.9  4.5 92.0  4.7 91.7  5.0 91.5  6.5 90.9  9.0 90.7
      10.0 14.0 90.4 19.0 90.4 24.0 89.8 29.0 89.3 34.0 89.2 39.0 89.2
      10.0 44.0 89.0 49.0 88.9 54.0 88.7 59.0 88.6 64.0 88.9 69.0 89.3
      10.0 74.0 89.7 79.0 89.7 84.0 89.6 89.0 89.4 94.0 89.3 99.0 89.4
      10.0104.0 89.6109.0 90.2114.0 90.6115.5 90.9117.6 91.5118.7 92.0
      10.0119.0 91.7122.5 95.8125.0 96.7
NS    10.0       0.9      12.9      12.9      12.9      25.8      25.8
NS    10.0      25.8      53.8      53.8      23.9      34.8      53.8
NS    10.0      54.8      54.8      43.8      45.8      53.8      53.8
NS    10.0      53.8      54.7      54.7      45.8      45.8      52.6
NS    10.0      56.8      56.8      56.8      56.8      21.9      21.9
NS    10.0  1.0 21.9       0.9       0.9
WSL   10.0      90.4      90.6      90.7      90.8      90.9      90.9
WSL   10.0      91.0      91.0      91.1      91.2      91.3      91.4
WSL   10.0      91.5      91.5      91.5      91.6      91.7      91.8
WSL   10.0      91.9      92.0      92.0      92.1      92.2      92.3
WSL   10.0      92.4      92.5      92.5      92.6      92.7      92.7
CAL1  10.0     90.88     53.50     46.20
VEL1  10.0                     0.00 0.14 0.09 0.10 0.25 0.28 0.37 0.45
VEL1  10.0 0.47 0.51 0.38 0.39 0.36 0.35 0.33 0.31 0.39 0.28 0.19 0.18
VEL1  10.0 0.10 0.06 0.08 0.00
CAL2  10.0     91.53    195.40    182.30
VEL2  10.0                0.00 0.04 0.07 0.30 0.52 0.66 0.81 0.94 1.05
VEL2  10.0 1.15 1.22 1.15 1.10 0.96 1.04 0.84 0.87 0.81 0.82 0.65 0.69
VEL2  10.0 0.50 0.51 0.29 0.15 0.00
CAL3  10.0     91.74    240.60    237.50
VEL3  10.0           0.00 0.07 0.11 0.14 0.46 0.59 0.83 0.97 0.91 1.29
VEL3  10.0 1.25 1.28 1.37 1.21 1.16 1.07 1.08 1.11 1.10 0.99 0.98 0.87
VEL3  10.0 0.73 0.55 0.36 0.32 0.27      0.00
CAL4  10.0     91.99    361.80    323.00
VEL4  10.0      0.00 0.02 0.18 0.28 0.38 0.65 0.88 0.84 1.11 1.25 1.44
VEL4  10.0 1.58 1.66 1.63 1.50 1.36 1.41 1.15 1.34 1.22 1.16 1.13 0.93
VEL4  10.0 0.79 0.60 0.56 0.42 0.28 0.00 0.00
XSEC  11.0     165.8 0.0     88.60   0.00015
      11.0  0.0 96.1  2.0 95.7  3.4 92.4  4.2 92.3  5.9 93.5  6.5 92.1
      11.0  7.0 90.9  9.8 90.9 11.5 88.4 14.0 86.7 17.0 89.0 20.0 85.0
      11.0 23.0 83.7 26.0 83.7 29.0 83.9 32.0 83.8 35.0 83.8 38.0 84.8
      11.0 41.0 85.4 44.0 85.9 47.0 86.3 50.0 86.8 53.0 87.1 56.0 87.7
      11.0 59.0 88.6 62.0 89.1 65.0 89.8 68.0 90.3 71.0 90.5 74.0 90.7
      11.0 76.0 90.9 77.0 91.0 78.8 91.4 80.0 92.1 82.1 93.9 86.8 94.9
NS    11.0       0.9       0.9       0.1      11.9      88.9      88.9
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NS    11.0      88.9      88.9      88.9      88.9      88.9      87.9
NS    11.0      87.6      82.9      82.9      87.9      87.9      76.8
NS    11.0      76.7      72.8      72.6      27.9      22.9      21.8
NS    11.0      25.8      25.8      25.6      21.9      21.9      21.7
NS    11.0      21.7      21.7      21.9      21.9      11.9      11.9
WSL   11.0      90.4      90.6      90.7      90.8      90.9      90.9
WSL   11.0      91.0      91.1      91.1      91.2      91.3      91.4
WSL   11.0      91.5      91.6      91.6      91.6      91.8      91.8
WSL   11.0      92.0      92.1      92.1      92.2      92.3      92.4
WSL   11.0      92.5      92.6      92.7      92.8      92.8      92.9
CAL1  11.0     90.92     53.50     43.80
VEL1  11.0                                0.00 0.02 0.04 0.05 0.06 0.05
VEL1  11.0 0.00 0.41 0.40 0.43 0.38 0.33 0.26 0.17 0.12 0.03 0.03 0.08
VEL1  11.0 0.06 0.14 0.11 0.16 0.17 0.05 0.00
CAL2  11.0     91.51    195.40      0.00
VEL2  11.0
VEL2  11.0
VEL2  11.0
CAL3  11.0     91.83    240.60    266.40
VEL3  11.0                                0.00 0.00 0.04 0.13 0.27 0.74
VEL3  11.0 1.75 1.45 1.63 1.65 1.31 1.12 0.84 0.62 0.39 0.22 0.01 0.10
VEL3  11.0 0.08 0.05 0.19 0.23 0.23 0.13 0.08 0.02 0.00
CAL4  11.0     92.05    361.80    322.50
VEL4  11.0                          0.00 0.10 0.20 0.20 0.05 0.25 1.10
VEL4  11.0 1.55 1.78 1.99 1.74 1.87 1.42 1.27 0.89 0.57 0.22 0.03 0.07
VEL4  11.0 0.23 0.23 0.15 0.37 0.37 0.34 0.06 0.03 0.00 0.00
ENDJ
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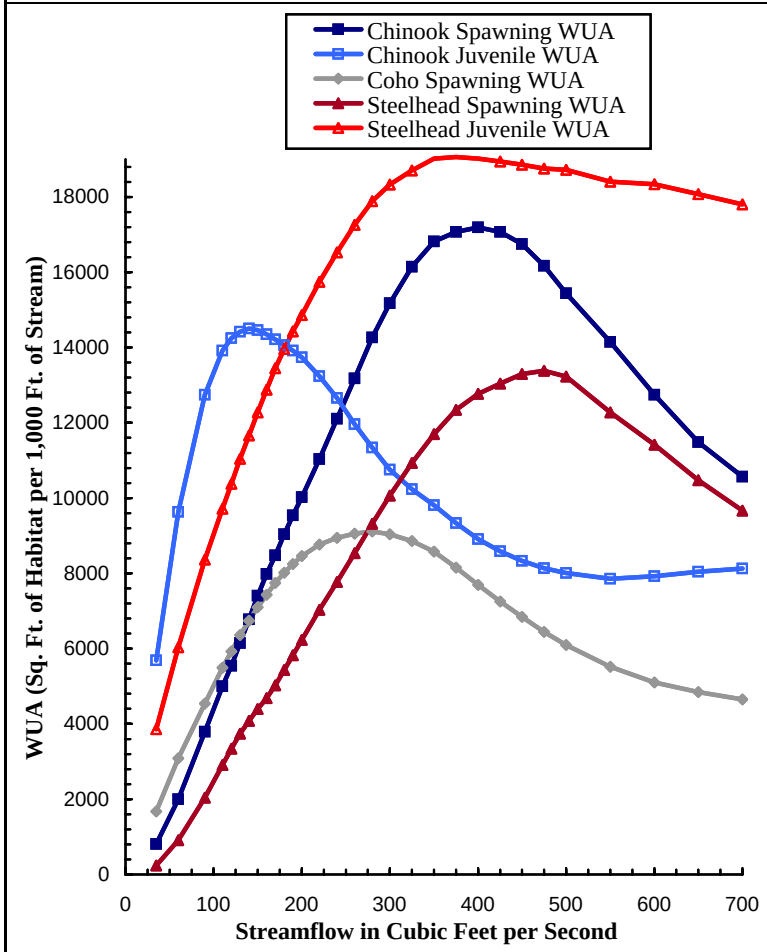
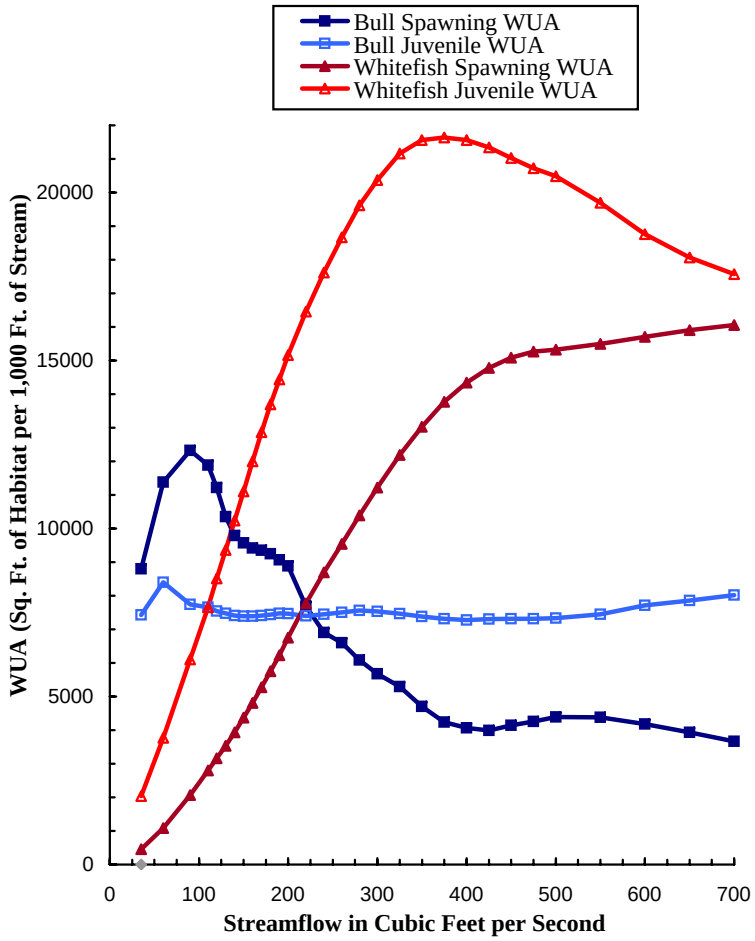
Chiwawa River at RM 7.0: Fish Habitat (WUA) vs Flow.



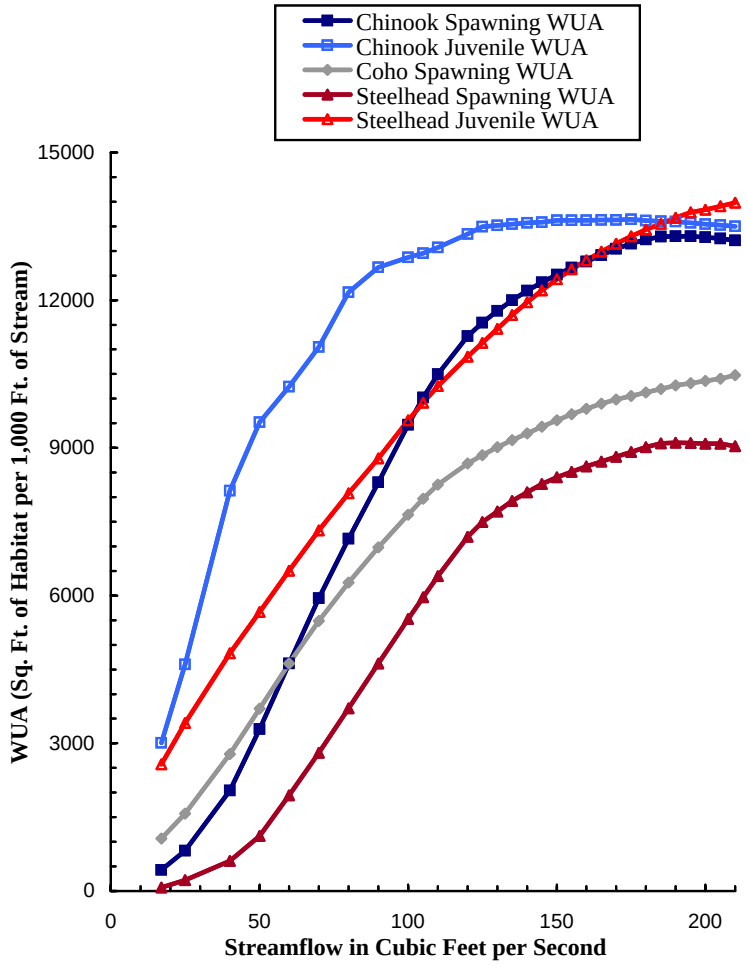
Flow (cfs)	Chinook Spawning WUA	Chinook Juvenile WUA	Coho Spawning WUA	Steelhead Spawning WUA	Steelhead Juvenile WUA	Percent of Peak Habitat vs Flow: Chinook Spawning WUA	Chinook Juvenile WUA	Coho Spawning WUA	Steelhead Spawning WUA	Steelhead Juvenile WUA
35	807	5685	1678	235	3859	5%	39%	18%	2%	20%
60	1994	9633	3084	914	6039	12%	66%	34%	7%	32%
90	3791	12740	4539	2044	8368	22%	88%	50%	15%	44%
110	4996	13913	5488	2909	9717	29%	96%	60%	22%	51%
120	5544	14250	5928	3339	10384	32%	98%	65%	25%	54%
130	6147	14421	6359	3736	11043	36%	99%	70%	28%	58%
140	6779	**14505**	6743	4079	11667	39%	**100%**	74%	30%	61%
150	7403	**14462**	7100	4394	12273	43%	**100%**	78%	33%	64%
160	7986	14353	7431	4683	12883	46%	99%	82%	35%	68%
170	8477	14217	7742	5021	13449	49%	98%	85%	38%	71%
180	9040	14060	8019	5430	13959	53%	97%	88%	41%	73%
190	9541	13919	8250	5825	14429	56%	96%	91%	44%	76%
200	10024	13738	8455	6228	14859	58%	95%	93%	47%	78%
220	11030	13236	8765	7029	15746	64%	91%	96%	53%	83%
240	12106	12655	8946	7774	16525	70%	87%	98%	58%	87%
260	13180	11965	9051	8538	17260	77%	82%	99%	64%	91%
280	14264	11341	**9110**	9319	17884	83%	78%	**100%**	70%	94%
300	15175	10758	9035	10069	18327	88%	74%	99%	75%	96%
325	16141	10234	8860	10929	18706	94%	71%	97%	82%	98%
350	16816	9809	8574	11698	**19014**	98%	68%	94%	87%	**100%**
375	17071	9333	8149	12346	**19056**	99%	64%	89%	92%	**100%**
400	**17191**	8910	7694	12766	**19015**	**100%**	61%	84%	95%	**100%**
425	17070	8585	7255	13041	18945	99%	59%	80%	97%	99%
450	16748	8328	6842	13292	18859	97%	57%	75%	99%	99%
475	16173	8138	6446	**13378**	18754	94%	56%	71%	**100%**	98%
500	15442	8012	6094	13224	18716	90%	55%	67%	99%	98%
550	14142	7856	5519	12277	18407	82%	54%	61%	92%	97%
600	12739	7927	5100	11416	18336	74%	55%	56%	85%	96%
650	11489	8045	4850	10477	18074	67%	55%	53%	78%	95%
700	10568	8129	4649	9668	17805	61%	56%	51%	72%	93%

Chiwawa River at RM 7.0: Fish Habitat (WUA) vs Flow.



Flow (cfs)	Bull Spawning WUA	Bull Juvenile WUA	Whitefish Spawning WUA	Whitefish Juvenile WUA	Percent of Peak Habitat vs Flow: Bull Spawning % WUA	Bull Juvenile % WUA	Whitefish Spawning % WUA	Whitefish Juvenile % WUA
35	8800	7425	453	2038	71%	88%	3%	9%
60	11378	**8401**	1083	3774	92%	**100%**	7%	17%
90	**12324**	7742	2071	6101	**100%**	92%	13%	28%
110	11882	7657	2796	7657	96%	91%	17%	35%
120	11222	7545	3159	8512	91%	90%	20%	39%
130	10355	7479	3534	9366	84%	89%	22%	43%
140	9795	7412	3933	10235	79%	88%	24%	47%
150	9569	7390	4369	11109	78%	88%	27%	51%
160	9423	7393	4811	11996	76%	88%	30%	55%
170	9351	7405	5275	12869	76%	88%	33%	59%
180	9251	7439	5755	13699	75%	89%	36%	63%
190	9068	7474	6233	14438	74%	89%	39%	67%
200	8889	7465	6752	15163	72%	89%	42%	70%
220	7685	7403	7774	16460	62%	88%	48%	76%
240	6905	7448	8693	17622	56%	89%	54%	81%
260	6604	7501	9547	18668	54%	89%	59%	86%
280	6087	7561	10393	19622	49%	90%	65%	91%
300	5674	7533	11216	20372	46%	90%	70%	94%
325	5291	7469	12191	21163	43%	89%	76%	98%
350	4709	7383	13030	**21559**	38%	88%	81%	**100%**
375	4236	7314	13767	**21639**	34%	87%	86%	**100%**
400	4063	7280	14342	**21565**	33%	87%	89%	**100%**
425	3994	7301	14783	21341	32%	87%	92%	99%
450	4143	7311	15083	21032	34%	87%	94%	97%
475	4259	7317	15268	20721	35%	87%	95%	96%
500	4392	7331	15327	20485	36%	87%	95%	95%
550	4377	7452	15496	19697	36%	89%	97%	91%
600	4182	7714	15701	18762	34%	92%	98%	87%
650	3937	7861	15907	18069	32%	94%	99%	84%
700	3667	8023	**16057**	17575	30%	96%	**100%**	81%

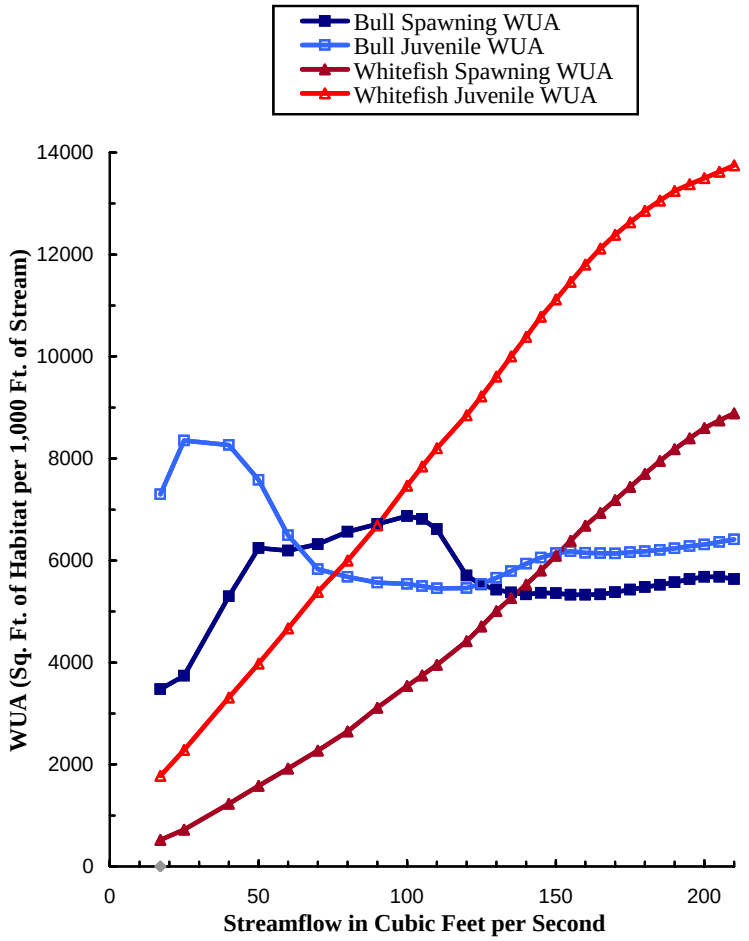
Nason Creek at RM 0.6: Fish Habitat (WUA) vs Flow.



Flow (cfs)	Chinook Spawning WUA	Chinook Juvenile WUA	Coho Spawning WUA	Steelhead Spawning WUA	Steelhead Juvenile WUA	Percent of Peak Habitat vs Flow: Chinook Spawning WUA	Chinook Juvenile WUA	Coho Spawning WUA	Steelhead Spawning WUA	Steelhead Juvenile WUA
17	428	3009	1065	72	2573	3%	22%	10%	1%	18%
25	817	4601	1574	220	3415	6%	34%	15%	2%	24%
40	2039	8131	2785	611	4829	15%	60%	27%	7%	35%
50	3292	9521	3704	1117	5667	25%	70%	35%	12%	41%
60	4618	10244	4619	1946	6504	35%	75%	44%	21%	47%
70	5947	11050	5486	2805	7327	45%	81%	52%	31%	52%
80	7153	12162	6268	3714	8079	54%	89%	60%	41%	58%
90	8302	12667	6980	4619	8790	62%	93%	67%	51%	63%
100	9467	12871	7641	5522	9561	71%	94%	73%	61%	68%
105	10024	12952	7968	5963	9918	75%	95%	76%	65%	71%
110	10499	13072	8256	6395	10253	79%	96%	79%	70%	73%
120	11268	13342	8685	7191	10851	85%	98%	83%	79%	78%
125	11544	13493	8849	7491	11131	87%	99%	84%	82%	80%
130	11783	13519	9015	7705	11419	89%	99%	86%	85%	82%
135	11996	13544	9157	7921	11701	90%	99%	87%	87%	84%
140	12192	13569	9293	8098	11956	92%	99%	89%	89%	86%
145	12358	**13584**	9429	8270	12202	93%	**100%**	90%	91%	87%
150	12517	**13620**	9561	8401	12425	94%	**100%**	91%	92%	89%
155	12660	**13625**	9681	8512	12629	95%	**100%**	92%	93%	90%
160	12785	**13620**	9795	8622	12811	96%	**100%**	93%	95%	92%
165	12914	**13629**	9896	8724	12988	97%	**100%**	94%	96%	93%
170	13044	**13629**	9980	8821	13148	98%	**100%**	95%	97%	94%
175	13151	**13641**	10056	8918	13297	99%	**100%**	96%	98%	95%
180	**13231**	**13615**	10128	9015	13433	**100%**	**100%**	97%	99%	96%
185	**13293**	**13601**	10196	**9095**	13553	**100%**	**100%**	97%	**100%**	97%
190	**13298**	**13595**	10266	**9107**	13671	**100%**	**100%**	98%	**100%**	98%
195	**13296**	13571	10312	**9098**	13784	**100%**	99%	98%	**100%**	99%
200	**13279**	13545	10357	**9084**	13840	**100%**	99%	99%	**100%**	99%
205	**13252**	13526	10408	**9083**	13906	**100%**	99%	99%	**100%**	99%
210	13213	13498	**10478**	9033	**13978**	99%	99%	**100%**	99%	**100%**

Updated 4/28/05 with new his curves and 2 attribute pcurve file JP

Nason Creek at RM 0.6: Fish Habitat (WUA) vs Flow.



Flow (cfs)	Bull Spawning WUA	Bull Juvenile WUA	Whitefish Spawning WUA	Whitefish Juvenile WUA	Percent of Peak Habitat vs Flow: Bull Spawning % WUA	Bull Juvenile % WUA	Whitefish Spawning % WUA	Whitefish Juvenile % WUA
17	3473	7299	521	1777	51%	87%	6%	13%
25	3738	**8352**	723	2287	54%	**100%**	8%	17%
40	5296	8263	1228	3312	77%	99%	14%	24%
50	6241	7579	1584	3979	91%	91%	18%	29%
60	6194	6497	1923	4667	90%	78%	22%	34%
70	6320	5831	2273	5386	92%	70%	26%	39%
80	6563	5677	2649	5998	95%	68%	30%	44%
90	6713	5564	3111	6691	98%	67%	35%	49%
100	**6874**	5540	3541	7470	**100%**	66%	40%	54%
105	6817	5500	3745	7847	99%	66%	42%	57%
110	6614	5450	3951	8199	96%	65%	44%	60%
120	5704	5460	4418	8850	83%	65%	50%	64%
125	5528	5539	4707	9216	80%	66%	53%	67%
130	5429	5662	5005	9607	79%	68%	56%	70%
135	5369	5793	5263	10000	78%	69%	59%	73%
140	5332	5937	5526	10388	78%	71%	62%	76%
145	5362	6056	5807	10780	78%	73%	65%	78%
150	5361	6140	6095	11118	78%	74%	69%	81%
155	5329	6181	6390	11463	78%	74%	72%	83%
160	5330	6151	6682	11804	78%	74%	75%	86%
165	5334	6143	6932	12117	78%	74%	78%	88%
170	5375	6136	7184	12390	78%	73%	81%	90%
175	5427	6160	7441	12632	79%	74%	84%	92%
180	5477	6179	7700	12857	80%	74%	87%	94%
185	5519	6207	7949	13061	80%	74%	89%	95%
190	5575	6241	8186	13245	81%	75%	92%	96%
195	5636	6280	8394	13379	82%	75%	94%	97%
200	5679	6312	8594	13498	83%	76%	97%	98%
205	5679	6363	8751	13620	83%	76%	99%	99%
210	5637	6416	8884	13749	82%	77%	**100%**	**100%**

Toe-Width Data for WRIA 45, (Measured 12/7/04 by Jim Pacheco)							
Stream Name	**Tributary to**	**Average Toe Width (in feet)**	**Toe-Width Flow for Fish Spawning and Rearing (in cfs)**				
			Chinook Spawning	*Coho & Chum Spawning*	*Steelhead Spawning*	*Steelhead Rearing*	*Salmon Rearing*
Mission Creek (0.5 miles past junkyard bridge)	Wenatchee River	10.7	25.7	12.3	24.2	4.7	4.2
Chumstick Creek (@ Church along Chumstick Hwy)	Wenatchee River	9.1	21.0	9.9	20.1	3.8	3.3

Toe-Width Method

The Toe-Width Method was developed by the Department of Fisheries (WDF), the Department of Game (WDG), and the U.S. Geological Service (USGS) in the 1970s at the request of the state legislature in response to the need to determine minimum instream flows for fish. After the legislature passed the Minimum Water Flows and Levels law in 1969 and the Water Resources Act of 1971, USGS collected water depths and velocities along transects over known spawning areas. WDF and WDG provided the criteria for salmon and steelhead spawning and rearing and the locations of the known spawning areas. After 9 years of data collection, USGS had measured 28 streams and rivers in eastern and western Washington. They had 84 study reaches with each reach consisting of 4 transects. They measured each transect at 8 to 10 different flows. USGS used the data from these 336 transects to calculate spawning and rearing flows for salmon and steelhead. Criteria for the needed spawning and rearing depths and velocities for each fish species and lifestage were used to calculate the square feet of habitat at each measured flow. These points of habitat quantity at different flows were connected to create a fish habitat versus streamflow relationship. Next, these fish habitat relationships were compared to many different variables in the watershed to determine if there were any correlations that could be used to avoid having to do so many flow measurements to calculate a spawning or rearing flow for a certain fish species. The toe-width was the only variable found to have a high correlation. The toe-width is the distance from the toe of one streambank to the toe of the other streambank across the stream channel. This width of the stream is used in a power function equation to derive the flow needed for spawning and rearing salmon and steelhead (Swift, 1976 and 1979).

Swift III, C. H. 1976. Estimation of Stream Discharges Preferred by Steelhead Trout for Spawning and Rearing in Western Washington. USGS Open-File Report 75-155. Tacoma, Washington.

Swift III, C. H. 1979. Preferred Stream Discharges for Salmon Spawning and Rearing in Washington. USGS Open-File Report 77-422. Tacoma, Washington.

How to use Toe-Widths to set instream flows

1. Determine fish present in the system and their periodicity
2. For each month determine the priority species/lifestage
3. Enter the toe-width flow of the priority species/lifestage as the calculated instream flow. This will be the starting number for instream flow discussions
4. Modify the calculated number through negotiations using hydrology and the daily flow analysis to reach a planning unit recommended instream flow.

Lower Mainstem Wenatchee River

RM 0.0 to RM 25.6 (Tumwater Canyon)

Species	Lifestage	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
Spring Chinook	Spawning												
	Incubation												
	Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	In-migration								▒	▒	■	■▒	
Summer Chinook	Spawning	■	▒										▒
	Incubation	■	■	■	■	■	■	■	▒				▒
	Rearing							▒■	■	■	▒		
	In-migration	▒	▒							▒	▒■	■▒	▒
Steelhead	Spawning					▒	■	■	■	▒			
	Incubation					▒	■	■	■	■	■	▒	
	Rearing	■	■	■	■	■	■	■	■	■	■	■	■
	In-migration	■	▒	▒	▒	▒	▒				▒	▒	▒
Bull Trout	Spawning												
	Incubation												
	Rearing	■	■	■	■	■	■	■	■	■	■	■	■

Based on:

Andonaegui, C., 2001. *Salmon, Steelhead and Bull Trout Habitat Limiting Factors for the Wenatchee Subbasin (WRIA 45) and Portions of WRIA 40 within Chelan County (Squilchuck, Stemilt and Colockum Drainages).* Washington State Conservation Commission.

Comments from: USFS (Cam Thomas, Cindy Raekes), WDFW (Andrew Murdoch, Bob Vadas, Mark Cookson), USFWS (Kate Terrell) and NOAA-Fisheries (Dale Bambrick)

Key:

Black indicates periods of heaviest use

Grey indicates periods of moderate use

Blank areas indicate periods of little or no use

Icicle Creek Fish Periodicity

Species	Lifestage	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
Spring Chinook	Spawning												
	Incubation												
	Rearing												
	In-migration												
Summer Chinook	Spawning												
	Incubation												
	Rearing												
	In-migration												
Steelhead	Spawning												
	Incubation												
	Rearing												
	In-migration												
Bull Trout	Spawning												
	Incubation												
	Rearing												

Based on:

Andonaegui, C., 2001. *Salmon, Steelhead and Bull Trout Habitat Limiting Factors for the Wenatchee Subbasin (WRIA 45) and Portions of WRIA 40 within Chelan County (Squilchuck, Stemilt and Colockum Drainages).* Washington State Conservation Commission.

Comments from: USFS (Cam Thomas, Cindy Raekes), WDFW (Andrew Murdoch, Bob Vadas, Mark Cookson), USFWS (Kate Terrell) and NOAA-Fisheries (Dale Bambrick)

Key:

Black indicates periods of heaviest use

Grey indicates periods of moderate use

Blank areas indicate periods of little or no use

Chiwawa River Fish Periodicity

Species	Lifestage	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
Spring Chinook	Spawning												
	Incubation												
	Rearing												
	In-migration												
Summer Chinook	Spawning	NOT PRESENT											
	Incubation												
	Rearing												
	In-migration												
Steelhead	Spawning												
	Incubation												
	Rearing												
	In-migration												
Bull Trout	Spawning												
	Incubation												
	Rearing												

Based on:

Andonaegui, C., 2001. *Salmon, Steelhead and Bull Trout Habitat Limiting Factors for the Wenatchee Subbasin (WRIA 45) and Portions of WRIA 40 within Chelan County (Squilchuck, Stemilt and Colockum Drainages).* Washington State Conservation Commission.

Comments from: USFS (Cam Thomas, Cindy Raekes), WDFW (Andrew Murdoch, Bob Vadas, Mark Cookson), USFWS (Kate Terrell) and NOAA-Fisheries (Dale Bambrick)

Key:

Black indicates periods of heaviest use

Grey indicates periods of moderate use

Blank areas indicate periods of little or no use

Nason Creek Fish Periodicity

Species	Lifestage	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
Spring Chinook	Spawning												
	Incubation												
	Rearing												
	In-migration												
Summer Chinook	Spawning	NOT PRESENT											
	Incubation												
	Rearing												
	In-migration												
Steelhead	Spawning												
	Incubation												
	Rearing												
	In-migration												
Bull Trout	Spawning												
	Incubation												
	Rearing												

Based on:

Andonaegui, C., 2001. *Salmon, Steelhead and Bull Trout Habitat Limiting Factors for the Wenatchee Subbasin (WRIA 45) and Portions of WRIA 40 within Chelan County (Squilchuck, Stemilt and Colockum Drainages).* Washington State Conservation Commission.

Comments from: USFS (Cam Thomas, Cindy Raekes), WDFW (Andrew Murdoch, Bob Vadas, Mark Cookson), USFWS (Kate Terrell) and NOAA-Fisheries (Dale Bambrick)

Key:

Black indicates periods of heaviest use

Grey indicates periods of moderate use

Blank areas indicate periods of little or no use

Peshastin Creek Fish Periodicity

Species	Lifestage	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
Spring Chinook	Spawning												
	Incubation												
	Rearing												
Summer Chinook	Spawning	NOT PRESENT											
	Incubation												
	Rearing												
Steelhead	Spawning												
	Incubation												
	Rearing												
Bull Trout	Spawning												
	Incubation												
	Rearing												

Based on:

Andonaegui, C., 2001. *Salmon, Steelhead and Bull Trout Habitat Limiting Factors for the Wenatchee Subbasin (WRIA 45) and Portions of WRIA 40 within Chelan County (Squilchuck, Stemilt and Colockum Drainages).* Washington State Conservation Commission.

Comments from: USFS (Cam Thomas, Cindy Raekes), WDFW (Andrew Murdoch, Bob Vadas, Mark Cookson), USFWS (Kate Terrell) and NOAA-Fisheries (Dale Bambrick)

Key:

Black indicates periods of heaviest use

Grey indicates periods of moderate use

Blank areas indicate periods of little or no use

Mission Creek Fish Periodicity

Species	Lifestage	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
Spring Chinook	Spawning												
	Incubation												
	Rearing												
	In-migration												
Summer Chinook	Spawning												
	Incubation												
	Rearing												
	In-migration												
Steelhead	Spawning												
	Incubation												
	Rearing												
	In-migration												
Bull Trout	Spawning	**NOT PRESENT**											
	Incubation												
	Rearing												

Based on:

Andonaegui, C., 2001. *Salmon, Steelhead and Bull Trout Habitat Limiting Factors for the Wenatchee Subbasin (WRIA 45) and Portions of WRIA 40 within Chelan County (Squilchuck, Stemilt and Colockum Drainages).* Washington State Conservation Commission.

Comments from: USFS (Cam Thomas, Cindy Raekes), WDFW (Andrew Murdoch, Bob Vadas, Mark Cookson), USFWS (Kate Terrell) and NOAA-Fisheries (Dale Bambrick)

Key:

Black indicates periods of heaviest use

Grey indicates periods of moderate use

Blank areas indicate periods of little or no use

Habitat
Appendix C

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Report	Prepared By
WRIA 45 Watershed Management Plan Final Draft Habitat Component (54pp) *The report and list of projects are current as of June 2005.*	Golder Associates Inc., Redmond, Washington
Wenatchee Subbasin Plan (3pp) *This is an excerpt from the Subbasin Plan, Section 2.5.1, Key Findings: Terrestrial, pages xviii – xxi.*	Northwest Power and Conservation Council (NPCC)

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WRIA 45 WATERSHED MANAGEMENT PLAN
FINAL DRAFT HABITAT COMPONENT

Submitted to:

WRIA 45 Planning Unit
and
Chelan County Natural Resources Program
316 Washington Street, Suite 401
Wenatchee, WA 98801

Submitted by:

Golder Associates Inc.
18300 NE Union Hill Road, Suite 200
Redmond, Washington 98052

June 30, 2005 043-1284-000.301

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1.0 INTRODUCTION

The habitat component of the Wenatchee Watershed Plan (Plan) builds upon existing research, reports and programs to develop and implement habitat improvement actions in Water Resource Inventory Area (WRIA) 45. The Wenatchee Watershed contains salmonid habitat that is important to the entire Columbia River region. The Upper Columbia Biological Strategy (Biological Strategy) states that, "the Wenatchee River is unique among sub-basins in the Upper Columbia Region in that it supports the greatest diversity of populations and overall abundance of salmonids, yet is facing the greatest risk of habitat loss and degradation. There are core populations of sockeye salmon, steelhead, bull trout, and both Spring and Summer Chinook salmon in the upper Wenatchee [watershed] that are relatively strong when compared to other populations in the Columbia sub-basin. The highest regional priority should be protection of this salmonid community," (UCRTT, 2002).

The habitat component of the Wenatchee Watershed Plan (Plan) has been structured to protect and enhance habitat for aquatic species throughout the Wenatchee Watershed by identifying actions that will improve overall habitat function and connectivity. The Plan emphasizes salmonid and aquatic habitat as specified in the Watershed Planning Act (RCW 90.82.100). However, as the entire watershed is linked together by the streams flowing through the valley, the WRIA 45 Planning Unit recognized early in the planning process that to only address habitat for salmonids and other fish where they live in valley bottoms would be short-sighted. Therefore, this habitat component considers upland habitat as it relates to aquatic processes to benefit species, both aquatic and terrestrial, with an emphasis on the protection and enhancement of habitat for endangered salmonids.

1.1 Goals and Intent

RCW 90.82.100 requires that the habitat component of a watershed plan be designed to "protect or enhance fish habitat in the management area." This will be accomplished in WRIA 45 through existing laws and ordinances, and through coordination with other ongoing activities in the watershed, such as 2496 Salmon Recovery. Beyond those requirements, the Planning Unit will use the habitat component as an opportunity to take a project-oriented, watershed-system scale approach to habitat improvement and to ensure watershed-wide local involvement and public education.

The WRIA 45 Planning Unit has catalogued and mapped habitat concerns and past habitat improvement projects in the watershed, as were identified in previous research and studies. These maps, coupled with biological priorities established by the Upper Columbia Biological Strategy (Biological Strategy) (UCRTT, 2002) and agreed upon by the Planning Unit, will be used to ensure that benefits to the entire watershed system are taken into account when habitat improvement projects are recommended and prioritized through this plan. Additionally, the habitat maps will be utilized as a public involvement and education tool to develop new habitat projects that address needs identified throughout the watershed.

The intention of the 2514 Watershed Plan is to build actions that treat the source of habitat degradation, as opposed to treating only the effects. Treatments of the cause of the problem (such as allowing a stream reach to access the floodplain, riparian plantings, best management practices, etc) are preferred over short-lived engineered treatments (such as bank stabilization) that may only function to move the problem further downstream. These improvements will be achieved through the habitat component's watershed-system scale approach. Overall, this habitat component of the Wenatchee Watershed Plan (2514 habitat component) provides the Planning Unit an opportunity to recommend projects for habitat protection, enhancement, and restoration that the local residents see as priorities in their sub-watershed, and make sense at the watershed-system scale.

Salmon Recovery planning under HB 2496 is being completed in the Upper Columbia region (including WRIA 45) concurrently with 2514 Watershed Planning. The 2514 habitat component has taken 2496 planning into consideration and will complement the Salmon Recovery Plan for WRIA 45 in a variety of ways:

- 2514 watershed planning is not specific only to listed species or aquatic species. Any habitat needs of terrestrial or aquatic species may be considered in the plan and addressed by plan actions. This plan adds local input to the breadth of habitat attributes addressed through various planning and regulatory processes in the watershed;
- The 2514 habitat component, in conjunction with the Upper Columbia Salmon Recovery Plan, will be used to suggest and prioritize *specific* projects based on priorities established primarily in the Upper Columbia Biological Strategy, as well as other documents;
- The 2514 habitat component includes local projects, recommended by local residents and landowners; and
- The 2514 habitat component is intended to complement and be consistent with, but not necessarily duplicate the actions recommended in the Salmon Recovery Plan. If actions from the Salmon Recovery and Watershed Plan are combined, they should paint a very clear picture of the status of and the needs for watershed habitat for many species, including listed salmonids.

1.2 Habitat Status and Information Sources

The Wenatchee Watershed provides habitat for a wide variety of terrestrial and aquatic species. Natural habitat characteristics vary widely throughout the watershed from the steep, forested mountains in the northwest to the shrub-steppe of the eastern watershed at the confluence of the Wenatchee and Columbia Rivers. Terrestrial species that inhabit the Wenatchee watershed and receive special attention through a variety of planning and regulatory processes include Peregrine falcon, Bald eagle, Northern Spotted owl, Marbled murrelet, lynx, Larch Mountain salamander, and other species that are threatened or endangered, or otherwise closely monitored through federal and state programs. The Washington Department of Natural Resources has completed a catalogued list of species and habitat types in the watershed recognized by its agency as priorities for management and preservation (WDFW, 2005).

The Wenatchee Watershed is home to a variety of aquatic species including the following salmonids: Spring and Summer Chinook, sockeye, steelhead, westslope cutthroat, and adfluvial bull trout (adfluvial bull trout spawn in the colder headwater tributaries and migrate within other Wenatchee sub-watersheds and the Columbia River). The documented, presumed, and potential distributions of anadromous salmonids in each of the sub-watersheds of the WRIA are illustrated in maps in this document as described by the Salmon and Steelhead Habitat Inventory and Assessment Project (SSHIAP) (WCC, 2001). The potential distribution of these species is an important consideration in determining which habitat improvement activities to implement.

Much of the planning, protection, and restoration/enhancement work in the watershed has focused on the needs of salmonids because of the federal Endangered Species Act listings of Upper Columbia River (including the Wenatchee) steelhead and Spring Chinook as endangered and bull trout as threatened in 1997, 1998, and 1999, respectively. All the fish stocks in the Wenatchee Watershed except Summer Chinook, and sockeye are classified as depressed in the WA DNR Salmonid Stock Inventory (SaSi) index. The watershed also supports resident westslope cutthroat trout. Coho salmon

were extirpated from the region in the early 1900s; there are efforts underway by the Yakama Nation to reintroduce them. Additional information regarding the status of aquatic habitat can be reviewed in the Limiting Factors Analysis (Andonaegui, 2001), the Upper Columbia Biological Strategy (UCRTT, 2002), Chelan County Lead Entity Strategy (Chelan County, 2004), the Wenatchee Subbasin Plan (2004), Washington Conservation Commission fish distribution data (SSHIAP) (WCC, 2001), and an assortment of other reports as detailed in the Wenatchee Phase II Habitat Completion Memo (Golder, 2005). [Placeholder for links to these documents on CD version of report]

The WRIA 45 Limiting Factors Analysis described habitat conditions in relation to aquatic habitat needs in the Wenatchee Watershed as follows, "Anadromous salmonid populations in the Wenatchee [watershed] are influenced by the following out-of-[watershed] impacts: degraded estuarine habitat, fish harvest, unfavorable ocean conditions, and the effects of seven Columbia River reservoirs and hydroelectric dams on smolt and adult migration. Spring and Summer Chinook, sockeye salmon, and steelhead trout must negotiate a 468 mile journey from the mouth of the Wenatchee River to the Pacific Ocean, once as smolts and again as adults. Within the [watershed], human alterations to the environment are exacerbating naturally limiting conditions by reducing habitat quality and quantity, thereby reducing a species' chances of successfully completing its life cycle. These alterations have primarily occurred in the lower gradient, lower reaches of sub-watersheds in the lower [part of WRIA 45] and include road building and placement, conversion of riparian habitat to agriculture and residential development, water diversion, reduced large woody debris (LWD) recruitment, and flood control efforts that include LWD removal, berm construction, and stream channelization," (Andonaegui, 2001).

Much more has been researched and written about the salmonid and terrestrial habitat conditions in the Wenatchee Watershed, and many of those documents were used to provide background data for this Watershed Plan. Priorities for aquatic habitat projects in the 2514 Watershed Plan are based primarily on the biological needs identified in the Upper Columbia Biological Strategy (UCRTT, 2002). These priorities were found to be consistent with the Wenatchee Subbasin Plan (NPPC, 2004) and the WRIA 45 Limiting Factors Analysis (Andonaegui, 2001).

Habitat improvement projects recommended in this chapter were developed through a combination of input provided at public meetings held in various locations across the watershed in early 2005, noted project needs from various local agencies, and the needs established by the Habitat Subcommittee of the Wenatchee Watershed Planning Unit. In early 2005, the Planning Unit requested information on planned or needed habitat projects from many entities and agencies working in the watershed. These proposed projects were catalogued and will be discussed in this plan.

1.3 Action Types: Protection and Restoration/Enhancement

The actions prescribed to address habitat issues fall into two categories: *Protection* and *Enhancement/Restoration*. Protection actions generally involve land acquisitions, conservation easements, or other methods to ensure that potential future activities or land uses will not interfere with habitat goals. Enhancement and restoration actions generally involve specific activities intended to improve or restore habitat for a target species, such as the removal of fish passage barriers, restoration of channel function, or reconnection of disconnected habitat areas. These terms are defined by the Planning Unit as follows:

- Restoration – Creating a specific functional condition that has the desired effect on a given species.

- Enhancement Actions – Actions that move toward creating the specific functional condition of restoration, without necessarily achieving all criteria necessary for restoration, or the complete creation of that condition.
- Protection – Prevention of future more active or invasive land use activities than the current land use.

Protection is only applicable in areas that have retained healthy, functioning habitat in a relatively pristine condition. Protection is more cost and time-effective in the long term than restoration or enhancement actions because a larger, on-the-ground activity is not required to *create* habitat. Where it is possible to protect functioning systems, protection is recommended over restoration/ enhancement actions. Actions to restore fish access to fully functioning protected areas are also a high priority. Throughout the watershed, there are areas where adequate stewardship is currently occurring. In these areas, continued maintenance is recommended before initiation of a new protection or restoration/enhancement action.

1.3.1 Public Outreach

Through the Limiting Factors Analysis, Subbasin Planning, Salmon Recovery Planning and Watershed Planning processes, a list of tools, or a "toolbox," was created for each Wenatchee sub-watershed based on the protection and restoration/enhancement needs of that sub-watershed. Not every tool in every toolbox is intended to be implemented in the sub-watershed. Additionally, specific tools are only applicable at appropriate locations. The tools range in application from instream, riparian, and upland areas, and include both policy and on-the-ground actions.

In January 2005 nine workshops were held throughout the watershed to gain an understanding of local residents' preferences for specific habitat improvement tools where they live. Workshops were held for the Chiwawa and Upper Wenatchee; Nason; Icicle; Chumstick; Peshastin; White, Little Wenatchee, and Lake Wenatchee; Mission, Brender, and Yaksum; Lower Wenatchee from Leavenworth to Dryden; and Lower Wenatchee from Dryden to Mouth sub-watersheds.

Each workshop provided residents an opportunity to identify locations in need of habitat improvement and propose specific projects. Many of these proposed projects need to be further researched for feasibility and benefits, but the workshops provided an invaluable opportunity for local residents to identify projects based on their familiarity with the area. For example, many landowners expressed a desire to complete riparian planting projects in specific locations. After the workshops, Chelan County Natural Resources applied for funding to complete these projects. The outcome of the funding applications is expected in late summer 2005.

At each workshop, the toolbox for the sub-watershed(s) being discussed was also introduced. Workshop attendees were asked to rank the appropriateness of each tool for their sub-watershed. While this ranking can be used as a general score of public acceptance, it is important to note that many tools are applicable only to isolated areas within each sub-watershed, or only under specific conditions. The ranking does not take this and other factors that affect applicability of tools to specific locations into account; it is intended to be used as a factor in weighing public acceptance of specific tools that could be used to address a habitat problem.

1.4 Watershed-wide Prioritization Framework

Effective planning for future habitat improvements requires prioritization of actions and projects both within sub-watersheds and across the Wenatchee watershed. This prioritization will allow effective

and efficient allocation of time and resources to optimize improvements. Prioritization will be based on the following:

- **Biological Needs** and **Sub-Watershed Categories**, as established in the Upper Columbia Biological Strategy (UCRTT, 2002);
- **Terrestrial Benefit**;
- **Community Acceptance**, determined via public outreach, initiated at public workshops held in January 2005; and
- **Cost and Benefits of Specific Projects**.

A prioritization framework will be used to select which proposed habitat projects to recommend for funding and implementation. This framework will utilize all of the above criteria with the goal of identifying projects that are biologically beneficial, feasible, have the greatest overall watershed benefit, enjoy community acceptance, and whose implementation represents an efficient use of funds and resources.

1.4.1 Biological Needs and Priorities

Prioritization of habitat projects will first consider the biological needs established for each sub-watershed in the Upper Columbia Biological Strategy (Biological Strategy) (UCRTT, 2002). The Biological Strategy considered sub-watershed habitat condition and relative location in the watershed to gauge effectiveness of habitat improvements in each sub-watershed and watershed-wide. This resulted in assignment of a "sub-watershed biological priority category" ranging from 1 to 3 to each sub-watershed. This category describes the watershed-wide benefit resulting from implementation of habitat actions in that sub-watershed. Descriptions of the biological priority category assigned to each sub-watershed, along with identified biological needs in each sub-watershed are shown in Figure 1. Descriptions of the categories are as follows:

Category 1 – These sub-watersheds represent systems that most closely resemble natural, fully functional aquatic ecosystems. In general, they support large, often continuous blocks of high-quality habitat and smaller drainages supporting multiple populations. Connectivity among smaller drainages and through the main sub-watershed stream corridor is good, and more than two species of federally listed fish are known to occur. Exotic species may be present but are not dominant. ***Protecting functioning ecosystems in these sub-watersheds is a priority.***

Category 2 – These sub-watersheds support important aquatic resources, often with smaller drainages classified as strongholds for one or more populations. The most important difference between Category 1 and Category 2 is an increased level of fragmentation that has resulted from habitat disturbance or loss. These sub-watersheds have a substantial number of smaller drainages where native populations have been lost or are at risk for a variety of reasons. At least one federally listed fish species can be found within each of these sub-watersheds. Connectivity among smaller drainages may still exist or could be restored within the watershed so that it is possible to maintain or rehabilitate life history patterns and dispersal. ***Restoring ecosystem functions and connectivity within these sub-watersheds are priorities.***

Category 3 – These sub-watersheds may still contain smaller drainages that support salmonids. In general, however, these smaller drainages have experienced substantial degradation and are strongly fragmented by extensive habitat loss, most notably through loss of connectivity with the mainstem corridor. At this time, the opportunities for restoring full expression of life histories for multiple

populations found within the sub-watershed are limited. ***The priority for funding in these sub-watersheds should be to rectify the primary factor that is causing the habitat degradation.***

In general, watershed-scale prioritization of projects should be accomplished in the following way:

- **Category 1** sub-watersheds should receive priority allocation of financial and management resources.
- Subsequent allocation of resources should be given to **Categories 2** and **3**, in that order, once refuge habitats (**Category 1**) for the target species are protected and secured. This does not mean, however, that specific actions should not occur in **Category 2** and **3** sub-watersheds until all activities in **Category 1** sub-watersheds are completed. Any projects within those sub-watersheds that increase the range, life history diversity, or age cohorts of one or more species would contribute to the overall strategy of making them more robust to disturbances outside and within the region.

Sub-watershed categories, and priorities of actions within each sub-watershed, are illustrated in Figure 1.

1.4.2 Terrestrial Benefit

Terrestrial benefit(s) of projects will be factored into the initial biological prioritization results (Section 1.4.1 above). A project with anticipated terrestrial benefits will rank higher than other projects in the same aquatic biological benefit category (above) without terrestrial benefits. For example, if two projects are proposed that provide the same biological benefit to a category 1 watershed, and one of those also provides habitat for birds, it will rank higher than the other.

1.4.3 Community Acceptance

Community acceptance of actions in the "toolbox" of proposed actions (as discussed in section 1.3.1) will be factored into the results from the prioritization above to result in a final prioritized list of projects.

It is likely that there will be a range of community acceptance for tools from the toolbox that can accomplish a similar biological objective. The results from the community acceptance analysis may also illustrate a need to find new proposed projects to address important biological priorities.

Community acceptance and support can be gauged by asking the following questions about each project:

1. Would the action/project enjoy broad community support?
2. Does the action/project address a specific need in the community?
3. Will the action/project lead to implementation of other actions/projects? (such as a demonstration project)
4. Does the action/project promote a voluntary, incentive-based approach?

Projects with positive answers to each question will rank higher than those that do not have support. Community opposition to a project may be reason enough to cancel a project or to find another means of achieving the same biological benefit. Community involvement in the habitat project planning

process was initiated at the January 2005 public workshops. The public will continue to be engaged throughout the planning process.

1.4.4 Project Cost and Feasibility

Project cost and feasibility are also extremely important factors in determining the order in which projects should be funded and implemented. Project cost and feasibility will be rated for each project based on answers to the following questions:

1. Does the project have landowner consent and support?
2. Is the project technically feasible? Does the intended site have the ability to achieve the desired environmental benefits?
3. Does the project have a high ecological benefit per dollar spent?
4. Does the project have a high likelihood of success? Would it be vulnerable to failure?
5. Does the project have a high likelihood of acquiring the needed funding? Is it already partially funded?
6. Does the project enable the success of other projects?

Projects with positive answers to these questions will receive a higher project cost and feasibility score, and therefore rank higher than projects that do not.

1.4.5 Overall Prioritization of Projects

As part of the habitat component of this watershed plan, a prioritization framework (consisting of the basic criteria discussed in this section) has been developed and potential habitat projects have been identified. The prioritization of these and other recommended projects will be an iterative process occurring in the months following the production of this document. An internal list of proposed projects will be maintained by Chelan County Natural Resources. The project list will be evolving regularly, and will be continually prioritized based on availability of funds, citizen interests, habitat needs, project feasibility, local and watershed-wide needs, and the foreseeable benefits of specific proposed projects.

2.0 WATERSHED-WIDE HABITAT ACTIONS

The WRIA 45 Planning Unit has chosen to address both aquatic and terrestrial habitat in this watershed plan. Based upon the watershed system-wide approach introduced above, the Planning Unit has developed a framework that recognizes both human activities and natural phenomena that have an effect on watershed health as a whole. Actions in this section pertain to forest roads, riparian and wetland health, noxious weeds, and other topics that affect the watershed as a whole.

An assortment of studies has been completed at a larger, watershed-wide scale to assess terrestrial and aquatic habitat needs. Those particularly relevant to this habitat component are:

- Chelan County Fish Barrier Inventory (Chelan County, 2001)
- Instream flow assessment (EES, 2005) (Golder, 2003) (Ecology, unpublished)
- Draft Wenatchee River Total Maximum Daily Load (TMDL) Study (Ecology, 2005)

2.1 Watershed-Wide Actions

WW-1 - The WRIA 45 Planning Unit supports implementation of the actions in the Wenatchee Subbasin Plan (Subbasin Plan sections 7.4 to 7.6 (NPCC, 2004)), and supports the Subbasin Plan approach to evaluation and monitoring of terrestrial ecosystems in the Wenatchee Watershed. The Planning Unit asks the co-planners and co-managers to seek funding from BPA and other sources for implementation of these actions.

WW-2 – The WRIA 45 Planning Unit members, both collectively and individually, intend to be involved in the public planning process for plans and projects. The Planning Unit will take an active role in disseminating information about public comment opportunities to its members. Additionally, the Planning Unit will provide public comment on watershed scale studies and plans when, by a vote of the Planning Unit, they are determined to be a priority of the Planning Unit and important to aquatic and overall watershed health.

WW-3 – The mainstem Wenatchee River provides habitat *important to the entire watershed* for many life stages of spring and summer Chinook, steelhead, and bull trout, and needs to be protected, enhanced, and restored. All remaining intact areas on the mainstem should be maintained. Where possible, floodplain function should be restored, particularly from the Mission Creek confluence downstream to the Columbia River confluence.

WW-4 – All property owners and managers in the watershed are encouraged to continue to cooperate in maintaining forest roads. Opportunities for inter-agency or multiple owner cooperation in roads management should continue to be supported.

Forest Roads Background Information for WW-4

The regulations that govern forest road maintenance depend upon ownership. The majority of forest lands in WRIA 45 are public and managed by the USFS. Other public forest lands are managed by WA DNR and the US BLM. Private industrial forest lands are regulated by WA DNR according to the rules of the Forest Practice Act. Small forest land owners are regulated under emergency rules for small forest landowners' road maintenance and abandonment planning, effective October 31, 2003. The emergency rules affect WAC 222-16, 222-20 and 222-24. These rules will remain in effect until permanent rules are adopted.

Roads on National Forest lands are currently managed under the National Road Policy originally passed in January, 2001. In general terms, this policy directed the Forest Service to identify the minimum road system that will provide safe access and travel to the public and allow for economic and efficient management, while minimizing to the extent practical the long-term ecological impacts roads cause to the environment. As a part of this policy, National Forests were directed to use science-based road analysis to help guide decisions on road management. The Okanogan and Wenatchee National Forests (OWNF) completed a Roads Analysis in December 2003 for high use roads on all National Forest Lands that accommodate two wheel drive passenger cars (approximately 20% of all roads on the Forests). The Roads Analysis was intended to do the following:

- "Addresses the effects of roads on biological, social, and economic factors,
- Identifies strategies and opportunities that move us closer toward the goal of an affordable and efficient road system that meets the needs of the public and the USDA Forest Service and also has a minimal impact on the environment, and
- Includes previously completed plans, analyses, and decisions," (OW National Forest Roads Analysis http://www.fs.fed.us/r6/wenatchee/planning/planmain.htm).

In the Wenatchee Watershed, 30 miles of passenger car accessible roads were recommended for major repair, 75 for minor repair, 59 to leave as is, and 9 for reduced maintenance (OWNF, 2003). No roads were recommended for stabilization or restoration to forest land. National Forest roads maintained for high clearance vehicles only (4 wheel drive), and roads in long-term storage (not driveable) make up approximately 80% of the roads in the Wenatchee watershed. Watershed analyses have been completed for portions of the lower Wenatchee watershed, the Doctor Bob Road system in the Icicle Watershed, and the White and Little Wenatchee River watersheds. Projects are currently under development that may permanently close and restore some roads in these sub-watersheds (Thomas, 2005).

On state and private forest lands, forest practices are conducted according to the state Forest Practice Rules (WAC 222). The Forest Practice Rules prescribe standards by which roads are to be maintained and/or abandoned. Assessments of the current situation and a plan for implementation for each forest area, called Road Maintenance and Abandonment Plans (RMAPs) are required to be in place by 2006, and are to be fully implemented by 2016 under the Forest Practice Rules (WAC 222-24).

WW-5 - Noxious weeds threaten aquatic and terrestrial ecosystems throughout the Wenatchee Watershed. The Planning Unit supports efforts toward noxious weed control and eradication.

WW–6 – A fish barrier inventory has been conducted in many areas of the watershed, however, data from the inventory does not always include consistent information about each barrier (i.e. whether it is a partial or full barrier, etc.). This information is needed. A method for updating the inventory should be established and funded. Also, the Chelan County fish barrier inventory should be integrated with fish barrier information collected by other land managers, such as the Forest Service.

WW-7 – [Placeholder - Recreational Fishery.] Information may be used from the anticipated Entiat white paper.

WW-9 - [Placeholder – Wetlands] – Does the Planning Unit want to make a statement regarding an overall approach to floodplain protection and restoration in the watershed?

OE-1 - [Placeholder – Outreach and Education] Efforts that are ongoing in the Wenatchee Watershed to improve or maintain habitat quality need to be encouraged and retained. Recognize and acknowledge achievements in the watershed that have accomplished habitat improvement or protection.

OE-2 – [Placeholder – Outreach and Education] Provide support of specific education and outreach programs in the watershed. Programs include: 4H Forestry Education Program, Kids in the Creek, Salmon Fest, Trout Unlimited education programs, Bird Fest, Chelan Douglas Land Trust field trips, Hatchery programs (LNFH, and friends of NW Hatcheries), existing noxious weed/native plant education programs, and others.

OE-3 – [Placeholder – Watershed Clean-Up.] This may move to the Public Outreach section of the Plan. This action may be implemented by the 4-H program or CCCD.

2.2 Other Watershed-Wide Projects and Proposed Actions

There are other watershed-wide habitat actions currently completed, ongoing, or proposed the Wenatchee Watershed. These include stream restoration and coho stock supplementation, and are detailed in Table 1. Table 1 also presents proposed projects in the Wenatchee Watershed, including riparian revegetation, restoration in reaches targeted by the TMDL study, and a songbird conservation project.

3.0 SUB-WATERSHED SCALE ACTIONS

For each sub-watershed, maps (Figures 2 through 10) have been created to illustrate documented, presumed, and potential salmonid species distribution. The maps also display locations of completed, ongoing and proposed aquatic habitat enhancement and protection projects. Projects on the maps include those that were collected by the Habitat Subcommittee as of June 30, 2005; additional projects are anticipated. These maps provide a watershed system perspective for evaluation of proposed projects; they are another tool to help prioritize and track projects based on potential fish distribution and the relationship to other projects. Salmonid distribution shown on these maps is documented, presumed, and potential distribution as reported by SSHIAP (WCC, 2001).

[Placeholder – Streambed elevation profiles, detailing fish distribution and physical parameters as related to elevation along the mainstem of each sub-watershed, are currently being produced by the Habitat Subcommittee and are anticipated in a future draft of this document.]

3.1 Lower Wenatchee Sub-Watershed (Tumwater to Confluence) - Category 2

3.1.1 Sub-Watershed Habitat Overview

The 68,128 acre Lower Wenatchee sub-watershed covers the area from below Tumwater Canyon downstream to the confluence with the Columbia River (RM 23.5 to RM 0). Land cover in the Lower Wenatchee sub-watershed is primarily forest (38.5% of the sub-watershed), followed by shrubland (29.6%), grasslands (16.4%), and orchards (11.6%) (MWG, 2003). A large portion of this sub-watershed is privately owned, especially riparian lands. Rural residential/resource zoning accounts for 63% of land use, followed by commercial forest (24%) and commercial agriculture (9%) as classified for zoning purposes (MWG, 2003). Impacts on habitat in the Lower Wenatchee sub-watershed are primarily related to railroad and road building, townships, orchards, and residential land development. The river is constrained by Highway 2 and the railroad in many places throughout this reach. The effects of these land use activities have resulted in a highly channelized stream, loss of riparian habitat and other specific effects as described below (Peven Consulting, 2004; WRIA 45 Habitat Subcommittee, 2003).

Native salmonid species in the Lower Wenatchee sub-watershed are sockeye salmon, spring and summer Chinook, steelhead, rainbow, and adfluvial bull trout. (Adfluvial bull trout spawn in the colder headwater tributaries and migrate within other Wenatchee sub-watersheds and the Columbia River.) Observed, presumed, and potential ranges of anadromous salmonid species are illustrated in Figure 2. This sub-watershed provides spawning and rearing habitat for Summer Chinook and steelhead, and serves as an important passage corridor for anadromous species, and is therefore critical to the health of anadromous fish in the entire Wenatchee Watershed.

Native vegetation in the Lower Wenatchee sub-watershed transitions from west to east as elevation decreases. Riparian areas, or those areas where vegetation is influenced by the proximity to water, are narrower on the east side of the sub-watershed than those to the west. Toward the east, this narrow riparian band changes quickly to upland vegetation. The Lower Wenatchee sub-watershed supports a diverse assortment of plants, including the following rare plant species: Seely's silene, clustered lady-slipper, pine broomrape, bulb-bearing water hemlock, longsepal globemallow, and a number of carex species.

3.1.2 Habitat Concerns in the Sub-watershed

The Biological Strategy (UCRTT, 2002) describes the following factors as impacting habitat condition in this sub-watershed:

- Land development, state highway and railroad affect channel migration, woody debris recruitment, and gravel recruitment;
- Riparian habitat and off-channel habitat have been significantly lost or degraded in this reach;
- Late summer instream flows are often critically low throughout this reach;
- Floodplain function has been impaired by development, causing extremes in the peaks and low points of the hydrograph;
- Stream temperatures often exceed standards[1], which are affected in part by riparian habitat loss and low instream flows; and
- The lower mainstem Wenatchee sub-watershed provides important habitat for many life stages of Spring and Summer Chinook, steelhead, and bull trout. The mainstem at this time is most vulnerable to riparian and instream habitat degradation. All remaining intact areas on the mainstem should be protected, and floodplain function should be restored, particularly from the Mission Creek confluence downstream to the Columbia River confluence.

The Lower Wenatchee Watershed Assessment (USFS, 1999b), completed by the US Forest Service, states that the lower watershed has seen an invasion of noxious plant species, including common knapweed, oxeye daisy, St. John's wort, and cheatgrass. These plants are persistent and "may displace native species indefinitely."

3.1.3 Historic and Ongoing Habitat Projects

Projects completed to date in the Lower Wenatchee sub-watershed have primarily involved riparian plantings and in-stream habitat. These projects are illustrated in Figure 2 along with documented, presumed, and potential salmonid species distribution. The symbols on the map illustrate the primary entity responsible for each project. Details about these projects can be found in Table 2.

An assortment of studies has been conducted in the Lower Mainstem Wenatchee to identify locations for potential habitat improvement. A FLIR (Forward Looking Infrared) temperature assessment was conducted in the watershed (Watershed Sciences, LLC 2002a; 2002b; 2003). The baseline temperature data are being used to help locate projects where key thermal refugia need to be protected, and to aid in understanding instream flow needs. A channel migration zone (CMZ) study has also been completed for the lower Wenatchee River (Jones & Stokes, 2004) to provide general guidance and specific details about the circumstances and methods most appropriate for salmon recovery actions within the lower Wenatchee River (and lower Nason Creek).

3.1.4 Proposed Projects and Actions

The CMZ study located 20 potential restoration, enhancement, or protection project needs along the lower 26 miles of the Wenatchee River from Leavenworth to the confluence with the Columbia (and

[1] This statement may also include a reference to naturally high temperatures. It will be updated based upon language in the temperature TMDL, which is currently in draft form.

9 other sites on Nason and Icicle Creeks). Three of these projects were funded by the 5th Round of the Salmon Recovery Funding Board. These projects are illustrated on Figure 2.

The remaining seventeen projects in the Lower Wenatchee identified by the CMZ study that are not funded to date are illustrated on Figure 2. In addition to the CMZ study projects, other habitat improvement projects have been proposed in the Mainstem Wenatchee sub-watershed, and are also detailed on Figure 2.

3.1.5 Biological Needs to be used for Prioritization of Lower Wenatchee Habitat Projects

Strategies recommended by the Biological Strategy for aquatic habitat in the Lower Wenatchee sub-watershed, in priority order are:

1) Protect existing riparian habitat and channel migration floodplain function.

2) Restore channel migration to normative function.

3) If restoration is not possible, improve fish access to oxbows and historical side channels.

4) Increase late summer flows.

Additionally, protection of existing riparian areas and channel migration floodplain function in the Lower Wenatchee should be given additional emphasis because of its watershed-wide benefit. The Biological Strategy states, "Recent research indicates that the mainstem Wenatchee River provides important habitat for many life stages of spring and summer Chinook salmon, steelhead, and bull trout. The mainstem at this time is most vulnerable to riparian and instream habitat degradation. All remaining intact areas on the mainstem should be protected, and flood plain function should be restored, particularly from the Mission Creek confluence downstream to the Columbia River confluence. This would require only passive restoration. Since this reach has the highest discharge in the [WRIA], the extent of riparian vegetation needed to restore flood plain function would be larger than the tributaries. Benefits of this action would be numerous to anadromous and inland salmonids, as well as a myriad of wildlife species," (UCRTT, 2002).

The proposed projects in this sub-watershed have been evaluated with respect to fulfilling these prioritized biological needs. The results indicate the types of projects that may are appropriate for the sub-watershed. Further information about prioritization of projects in this sub-watershed and across the watershed can be found in Section 4.

3.2 Upper Wenatchee (Lake Wenatchee to the mouth of Tumwater Canyon) including Chiwaukum Creek – Category 1

3.2.1 Sub-watersheds Habitat Overview

The 36,301 acre Upper Wenatchee and 32,012 acre Chiwaukum sub-watersheds cover the area from below Lake Wenatchee to the mouth of Tumwater Canyon (RM 54.2 to RM 23.5). Land cover in the Upper Wenatchee and Chiwaukum sub-watersheds is primarily forest (74%), with other areas being made up of mostly grasslands and some areas of bare rock, sand, and clay (MWG, 2003). The vast majority of the land in these subwatersheds is in commercial forest use (88%), as classified for zoning purposes (MWG, 2004). Impacts on habitat in the Upper Wenatchee and Chiwaukum sub-watershed are primarily related to the state highway, railroad, and private land development. The river is constrained by Highway 2 and suffers from reduced of large woody debris recruitment (UCRTT, 2002).

Native salmonid species in the Upper Wenatchee sub-watershed are sockeye salmon, spring and Summer Chinook, steelhead, rainbow, westlope cutthroat and adfluvial bull trout (adfluvial bull trout spawn in the colder headwater tributaries and migrate within other Wenatchee sub-watersheds and the Columbia River. This sub-watershed provides an important passage corridor for many species and important spawning habitat for Summer Chinook and steelhead. The Chiwaukum sub-watershed contains current and potential habitat for bull trout, Spring and Summer Chinook, and Summer Steelhead. Current and potential range of these anadromous species is illustrated in Figure 3. The reach from Lake Wenatchee to the Chiwawa River confluence is designated a Key Watershed in the Northwest Forest Plan. The Northwest Forest Plan defines Key Watersheds as, "A system of large refugia comprising watersheds that are critical to at-risk fish species and stocks and provide high quality water…and…Contribute directly to conservation of at-risk anadromous salmonids, bull trout, and resident fish species, and ensure that refugia are widely distributed across the landscape," (USFS, 1997).

The Upper Wenatchee contains habitat for a diverse assortment of plants, including the following rare plant species: Seely's silene, clustered lady-slipper, pine broomrape, bulb-bearing water hemlock, longsepal globemallow, and a number of carex species (USFS, 1999b). Mesic (mixed – not wet and not dry), and consequently more diverse forest types appear in the higher elevations of the Upper Wenatchee River and Chiwaukum Creek when compared against the Lower Wenatchee sub-watershed. Habitat also exists for a number of threatened or endangered or otherwise specially managed species including: gray wolf, peregrine falcon, grizzly bear, northern spotted owl, bald eagle, marbled murrelet, and lynx. The forest service has designated the Fish Lake area in the upper portion of the Upper Wenatchee sub-watershed as a "special interest area" because of the abundance of bogs and wetlands around the lake. The Fish Lake area has high species richness and contains a number of osprey nests, great blue heron rookeries, barred owl nests, aspen stands, and habitat for beaver, grouse, mollusks, and snag dependent species.

3.2.2 Habitat Concerns in the Sub-Watersheds

There are no urban areas within the Upper Wenatchee or Chiwaukum sub-watersheds although the small community of Plain is located along the Wenatchee River. Land in these sub-watersheds is primarily part of the Wenatchee National Forest. Most is managed for harvest. The Biological Strategy describes factors affecting habitat condition in these sub-watersheds to include:

- The state highway, railroad, and private land development affect woody debris recruitment, channel migration, and gravel recruitment;
- The state highway cut off a large oxbow near Nason Creek confluence;
- Historical log drives and resultant loss of wood recruitment has reduced channel complexity; and
- Fecal coliform and water temperatures are slightly elevated.

Additionally, the USFS Watershed Assessment describes that, at Tumwater Canyon, the Mainstem Wenatchee is affected by coarse sedimentation impacts from fire, and its proximity to State Highway 2, which reduces gravel and LWD recruitment (USFS, 1999b).

3.2.3 Historic and Ongoing Habitat Projects

There were two completed habitat projects identified in the Upper Wenatchee sub-watersheds as of June 30, 2005, both involving passage at Tumwater Dam (Table 3). These projects, USFS land use

designations and private forest lands, along with documented, presumed, and potential salmonid species distribution are illustrated in Figure 3.

3.2.4 Proposed Projects and Actions

There were no proposed habitat projects identified in the Upper Wenatchee or Chiwaukum sub-watersheds as of June 30, 2005.

3.2.5 Biological Needs to be Used for Prioritization of Upper Wenatchee and Chiwaukum Habitat Projects

Recommendations established in by the Biological Strategy for aquatic habitat in the Upper Wentachee sub-watershed (including the Chiwaukum sub-watershed), in priority order, are:

1) Protect remaining floodplain and riparian habitat;

2) Restore channel migration to resemble historical function;

3) If restoration is not possible, improve fish access to oxbows and historical side channels that have been cut off from the main channel;

4) Initiate public information efforts to discourage harassment of spawning Summer Chinook salmon;

5) Reduce non-point pollution from septic tanks and livestock; and

6) Initiate public information efforts to encourage protection of riparian habitat.

In Tumwater Canyon, specific recommendations from the Biological Strategy are to:

1) Protect existing riparian habitat, and
2) Address passage barriers at Skinney Creek near mouth.

Currently, there are no known proposed projects in the Chiwaukum and Upper Wenatchee sub-watersheds, although both rank as Category 1. This indicates a need for potential proposed projects that emphasize protection in this sub-watershed. Further information about prioritization of projects in this sub-watershed and across the watershed can be found in Section 4.

3.3 Mission Sub-Watershed – Category 3

3.3.1 Sub-watershed Habitat Overview

Mission Creek drains a 59,794 acre area and joins the Wenatchee River at Wenatchee RM 10.4. Land cover in the Mission sub-watershed is primarily forest (69.4%), followed by grasslands (15.1%) shrublands (10.7), and orchards (3.0%) (MWG, 2003). A large portion of this sub-watershed is used for commercial forest (77.4%), which is owned by private companies and the USFS. Rural residential/resource accounts for 19% of land use. Agriculture, as described for zoning purposes, accounts for less than 3% of the sub-watershed (MWG, 2003).

Native salmonid species in the Mission Creek sub-watershed are juvenile Spring Chinook and steelhead. Currently, use is limited in the sub-watershed. Documented, presumed, and potential

distribution of these fish is illustrated in Figure 4. At present, the Mission sub-watershed is not considered to contribute significantly to salmonid population abundance.

Elevation in the Mission Creek sub-watershed ranges from 795' to 6800'; there is a similarly wide range in habitat attributes in the sub-watershed. The lower elevations of the sub-watershed are "composed of bitterbrush, ponderosa pine, and ponderosa mixed with Douglas fir that are used extensively as winter habitat range for mule deer and a small herd of elk. The mid elevations are composed of Douglas and grand fir forests with interspersed south-facing slopes of ponderosa pine. The upper elevations are comprised of subalpine fir forest and subalpine and alpine meadows." Sandstone outcrops are common and create unique cliff habitats. In a few of the side canyons, such as Ragg Canyon, small wetlands occur and provide important and unique habitats (USFS, 1995).

3.3.2 Habitat Concerns in the Sub-Watershed

The Mission sub-watershed has been impacted primarily by floodplain restriction followed by agriculture, and other land use developments. In the very lower portion of the sub-watershed, urbanization has created many factors that may limit natural production of fish species (Peven Consulting, 2004).

The Upper Columbia Biological Strategy (UCRTT, 2002) describes factors affecting habitat condition in this sub-watershed to include:

- Low or non-existent flows with associated high instream temperatures in Lower Mission Creek disrupt distribution and abundance of native species, particularly in summer;
- Channelization of Mission, Brender, and Yaksum Creeks;
- Degraded water quality and loss of riparian habitat, road construction, urban/residential and agricultural development, especially in the floodplains, grazing and soil compaction have changed channel function;
- There are several culvert passage barriers; and
- Loss of channel sinuosity and floodplain function in the Mission Creek sub-watershed.

3.3.3 Historic and Ongoing Habitat Projects

Projects recently completed in the Mission sub-watershed have primarily involved fish passage. Fish passage projects have been completed by the US Forest Service and Chelan County Conservation District and are listed in Table 4. These and other projects completed or ongoing in the sub-watershed are illustrated in Figure 4 along with documented, presumed, and potential salmonid species distribution. The symbols on the map illustrate the primary entity responsible for each project.

3.3.4 Proposed Projects and Actions

There were no proposed habitat projects in the Mission sub-watershed as of June 30, 2005.

3.3.5 Biological Needs to be Used for Prioritization of Mission Sub-Watershed Habitat Projects

Recommendations established in the Biological Strategy (UCRTT, 2002) for aquatic habitat in the Mission sub-watershed, in priority order, are:

1) Increase stream flow;

2) Reduce nonpoint pollution from septic tanks and livestock; and

3) Other projects should be delayed until flow and water quality are addressed. (Other projects would address riparian health, off channel habitats, and in channel attributes.)

There are currently no proposed projects in the Mission sub-watershed. It was ranked as a category 3 by the Biological Strategy. Identification and implementation of projects in Category 1 and 2 watersheds should occur before there is a focus on finding additional projects in the Mission sub-watershed. This is consistent with recommendation 3 above, from the Biological Strategy. Further information about prioritization of projects in this sub-watershed can be found in Section 4.

3.4 Peshastin Sub-Watershed – Category 2

3.4.1 Sub-watershed Habitat Overview

The Peshastin sub-watershed drains an area of 86,291 acres and joins with the Wenatchee River at Wenatchee RM 17.9. Land cover in the Peshastin sub-watershed is primarily forest (69%), followed by grasslands (18.2%), and shrubland (5.9%) (MWG, 2003). Commercial forest is by far the most dominant land use in the sub-watershed (94.8%). Other land uses are rural residential/resource (4%) and a small amount of commercial agriculture (MWG, 2003).

Native salmonid species in the Peshastin Creek sub-watershed are Spring Chinook, steelhead, rainbow, adfluvial bull trout, and westlope cutthroat trout (adfluvial bull trout spawn in the colder headwater tributaries and migrate within other Wenatchee sub-watersheds and the Columbia River). Documented, presumed, and potential range of anadromous salmonid species is illustrated in Figure 5. This sub-watershed provides important bull trout and steelhead spawning and rearing habitat, both in the mainstem Peshastin and in Peshastin tributaries.

3.4.2 Habitat Concerns in the Sub-watershed

Including terrestrial species, there are five threatened and endangered species, and 35 species of concern in the Peshastin sub-watershed. Approximately 29% of the Peshastin sub-watershed is in the Alpine Lakes Wilderness and drains into Ingalls Creek, the largest tributary by water volume to the Peshastin. Much of Peshastin Creek is bounded and altered by highway construction and channel rerouting. Historically, mining was believed to have adversely affected [fish] production. In general, land use practices that have diminished fish productivity include road construction, orchards, irrigation, residential development, and historic mining.

In this sub-watershed, there is a low abundance and limited distribution of low elevation naturally functioning Ponderosa pine habitat. This alteration of Ponderosa pine habitat has resulted from timber harvest, fire suppression, and conversion to other uses. Increased access within the watershed from roads and land uses has increased disturbance to wildlife. Riparian habitat has been fragmented. There is also a low abundance and distribution of late-successional forest habitat (USFS, 1999a).

The Biological Strategy lists the following factors affecting habitat condition in this sub-watershed:

- Channel migration, riparian habitat, floodplain function, stream sinuosity, and gravel recruitment are severely impacted by the State highway;

- Low instream flows in lower Peshastin Creek impede upstream migration, reduce rearing habitat, and likely contribute to elevated water temperature; and
- Loss of riparian habitat resulting from land development and State highway reduces quantity and quality of spawning and rearing habitat.

3.4.3 Historic and Ongoing Habitat Projects

Projects completed to date in the Peshastin sub-watershed are listed in Table 5, and have involved fish barrier removal, instream habitat improvement, and off channel habitat development. Three projects in this sub-watershed have been funded by the Salmon Recovery Funding Board; others were completed by Longview Fibre and Chelan County Conservation District. These projects, as well as documented, presumed, and potential salmonid species distribution are illustrated in Figure 5. The symbols on the map illustrate the primary entity responsible for each project.

3.4.4 Proposed Projects and Actions

Currently, only one proposed project has been identified in the Peshastin sub-watershed, channel reconstruction through the CMZ study. It is illustrated in Figure 5.

3.4.5 Biological Needs to be used for Prioritization of Peshastin Habitat Projects

Recommendations established in the Biological Strategy in the Peshastin sub-watershed, in priority order, are:

1) Increase stream sinuosity and floodplain function from Ingalls Creek to mouth.

2) Restore flow from Camas Creek to mouth.

3) Other projects should be delayed until stream sinuosity and flows are addressed. (Other projects would address riparian health, degraded channel and floodplain restoration in mainstem Peshastin, and fish passage.)

There is only one proposed project in the Peshastin sub-watershed. As Peshastin Creek is a Category 2 sub-watershed, other proposed projects should be identified here, particularly those that address the top biological need, increasing stream sinuosity and floodplain function from Ingalls Creek to the mouth of Peshastin Creek. Further information about prioritization of projects in this sub-watershed and across the watershed can be found in Section 4.

3.5 Chumstick Sub-Watershed – Category 3

3.5.1 Sub-watershed Habitat Overview

The Chumstick sub-watershed drains 52,969 before meeting with the Wenatchee River at Wenatchee RM 23.5. Land cover in the Chumstick sub-watershed is primarily forest (75.2%), and grasslands (18.9%) (MWG, 2003). Commercial forestry accounts for 74.5% of land use in the sub-watershed, followed by rural resource lands (22.5%). The Leavenworth Urban Growth Area comprises 1,300 acres in the lower reaches of the sub-watershed. Summer steelhead is the only known salmonid species native to the Chumstick sub-watershed. Chumstick Creek may have supported coho salmon as well, although few records exist. Documented, presumed, and potential range of steelhead in the Chumstick is illustrated in Figure 6. (Note that bull trout, chinook, and sockeye also appear on Figure 6, but are located only on the mainstem Wenatchee River.)

3.5.2 Habitat Concerns in the Sub-watershed

This sub-watershed has been substantially degraded and is strongly fragmented. Brook trout, an introduced non-native species, now occurs in much of the Chumstick Creek drainage. The Chumstick sub-watershed does not support extensive anadromous fisheries habitat, and opportunities for fully restoring anadromous fisheries to this watershed are limited.

On land, most of the forest has been logged several times; large pine and Douglas fir were the primary trees removed. Effective fire suppression has altered species composition and stand densities. Fire exclusion has influenced both plant community structure and composition. Noxious weeds are prevalent in this sub-watershed. These include common knapweed, oxeye daisy, St. John's wort, dalmation toadflax, and Sulpher cinquefoil. These species have the potential to displace native species indefinitely (USFS, 1999a).

There are many species of special management concern that may reside in the Chumstick su-watershed. These "include 5 threatened and endangered species (gray wolf, peregrine falcon, grizzly bear, bald eagle, and northern spotted owl); 10 species of concern (e.g. tailed frog, olive-sided flycatcher, long-eared myotis; one sensitive species (northern goshawk); 2 survey and manage species (great grey owl, mollusks); 5 protection buffer species (e.g. white-headed woodpeaker, flammulated owl); and 8 management indicator species (e.g. primary cavity excavators, pine maren, mule deer). The [sub]watershed is included within the North Cascade grizzly bear recovery area. In 1999, eleven spotted owl activity areas were located within the [sub]watershed," (USFS, 1999a).

The Biological Strategy (UCRTT, 2002) describes factors affecting habitat condition in this sub-watershed to include:

- Private land development and high road density affects sediment delivery;
- Channel migration affected by state highway, the railroad, multiple water crossing structures, and private land development;
- Fecal coliform and water temperature levels are elevated, mostly a result of livestock and improper septic tanks;
- Passage is impeded at the North Road and numerous smaller culverts upstream; and
- Riparian habitat has been degraded or lost from Little Chumstick Creek to mouth.

3.5.3 Historic and Ongoing Habitat Projects

There have been many fish passage projects completed to date in the Chumstick sub-watershed, mostly by the Chelan County Conservation District. These and other projects completed in the sub-watershed are illustrated in Figure 6 and listed in Table 6. The symbols on the map illustrate the primary entity responsible for each project. Details about the projects can be found in Table 6.

3.5.4 Proposed Projects and Actions

Figure 6 shows the locations and primary responsible entity for each of the proposed projects in the Chumstick sub-watershed.

3.5.5 Biological Needs to be Used for Prioritization of Chumstick Habitat Projects

Recommendations established in the Biological Strategy for aquatic habitat in the Chumstick Creek sub-watershed, in priority order, are:

1) Restore passage for anadromous and inland fish. This should be done in a comprehensive, coordinated strategy, rather than a piecemeal approach;

2) Protect remaining floodplain and riparian habitat;

3) Increase stream flow;

4) Restore riparian habitat, primarily from Eagle Creek to Suntisch Canyon;

5) Reduce road densities;

6) Restore stream channel migration;

7) Reduce nonpoint pollution from septic tanks and livestock; and

8) Reduce fine sediment input from roads and some land management activities.

Three potential projects have been identified in Chumstick sub-watershed, which address its highest priority biological need, fish passage. Further information about prioritization of projects in this sub-watershed and across the watershed can be found in Section 4.

3.6 Icicle Sub-Watershed – Category 2

3.6.1 Sub-watershed Habitat Overview

The Icicle sub-watershed is the largest sub-watershed to the Wenatchee River, covering 136,916 acres. The Icicle joins the Wenatchee River at RM 25.6. Land cover in the Icicle is primarily forest (68.8%) and grasslands (13.1%) (MWG, 2003). Commercial forestry is by far the most dominant land use in the sub-watershed, accounting for 95.8% of land use. Other land uses are rural residential/resource, rural recreational, and rural waterfront. Native salmonid species are steelhead, cutthroat, redband, and bull trout (adfluvial bull trout spawn in the colder headwater tributaries and migrate within other Wenatchee sub-watersheds and the Columbia River). Spring Chinook currently spawn in the lower Icicle River but their origin is likely from hatcheries (Peven 1994). Documented, presumed, and potential range of these species is illustrated in Figure 7. This sub-watershed contains high quality aquatic and terrestrial habitat in the upper watershed above river mile 5.7, and is designated as a Key Watershed by the Northwest Forest Plan. Seventy-four percent of the Icicle sub-watershed is located within the Alpine Lakes Wilderness. Precipitation in the watershed ranges from 120 inches at the ridge of the crest to 20 inches at the mouth of the Icicle (USFS, 1995b).

There is a wide range of habitat variability throughout the sub-watershed, which can be understood by looking at the elevation and precipitation variation between the upper and lower sub-watershed. “There are eight rare plant species in the Icicle Creek Watershed: Smokey Mountain sedge, Wenatchee larkspyr, Ross’s avens, showy stickseed, long sepal golbemallow, rock willow, Oregon checkermallow, and Seely’s silene.” (USFS, 1995b).

3.6.2 Habitat Concerns in the Sub-watershed

The Leavenworth National Fish Hatchery (LNFH) located at River Mile 3.1, currently blocks salmonid migration past the hatchery to protect spring Chinook reared at the facility from a variety of diseases. Restoration of passage to provide access for bull trout and steelhead to the upper watershed is underway and partially complete[2]. On land, some noxious weeds in the Icicle sub-watershed are increasing at alarming rates. These include knapweed, oxeye daisy, and Dalmatian toadflax, (USFS, 1995b).

The Upper Columbia Biological Strategy describes factors affecting habitat condition in this sub-watershed to include:

- Land development downstream of Leavenworth hatchery has affected stream channel migration, recruitment of large woody debris, and off channel habitat;
- There are barriers to migration on Icicle Creek at Leavenworth Hatchery and possibly in the boulder field near Snow Creek;
- Water withdrawals on Icicle Creek (primarily between Rat Creek and the hatchery) likely contribute to low flows and high summer temperatures in lower Icicle Creek;
- The Icicle Road upstream of Chatter Creek at places may confine the stream channel and affect floodplain function; and
- The 1994 Rat Creek fire caused increased sedimentation and water temperature in the middle and lower Icicle drainage in the years immediately following the fire.

3.6.3 Historic and Ongoing Habitat Projects

Projects completed to date in the Icicle Creek sub-watershed include check dam removal in the historic river channel originally bypassed by the LNFH, studies of fish passage and evaluation of the channel migration zone near the confluence with the Wenatchee River. Information on the LNFH project can be found at: http://leavenworth.fws.gov/eis.htm. These projects are illustrated in Figure 7, along with documented, presumed, and potential salmonid species fish distribution. The symbols on the map illustrate the primary entity responsible for each project. Details about these projects can be found in Table 7.

3.6.4 Proposed Projects and Actions

Phase I of the Lower Wenatchee Channel Migration Zone (CMZ) study assessed four sites on the lower Icicle River, which may provide improvement in aquatic habitat if implemented. A project is needed to complete the next phase of that study. The location of the projects identified in Phase I, City of Leavenworth Projects, and other proposed projects in the Icicle sub-watershed, along with the primary responsible entity are illustrated in Figure 7.

3.6.5 Biological Needs to be Used for Prioritization of Icicle Habitat Projects

Recommendations established in the Biological Strategy for aquatic habitat in the Icicle Creek sub-watershed, in priority order, are:

[2] Precise language to be provided by the USFS detailing the purpose of the hatchery and the status of the ongoing enhancement project.

1) Protect remaining floodplain and riparian habitat downstream of Chatter Creek. Emphasis should be placed on habitat downstream of Leavenworth Hatchery.

2) Rectify human-made passage barriers.

3) Restore flow conditions on Icicle Creek downstream of Rat Creek.

4) Investigate the role of surface and well water withdrawals on instream flows and habitat use

5) Develop strategies with water users to reduce effects, if any.

6) Initiate public information efforts to discourage harassment of spawning salmonids.

7) Manage recreation areas to reduce impacts to riparian cover.

Projects have been proposed in the Icicle sub-watershed to address the first and fourth biological priority. Further information about prioritization of projects in this sub-watershed and across the watershed can be found in Section 4.

3.7 Nason Sub-Watershed – Category 2

3.7.1 Sub-watershed Habitat Overview

Nason Creek drains a 69,010 acre area and joins with the Wenatchee River at Wenatchee RM 53.6. Land cover in the Nason sub-watershed is primarily forest (76.6%). Other land cover types in the sub-watershed are grasslands (7.6%), transitional (5.8%), and shrubland (5.3%) (MWG, 2003). A large portion of this sub-watershed is privately owned, especially riparian lands. Commercial forest accounts for 91.5% of land use. Most other lands are used as rural residential/resource (7.7%).

Native salmonid species in the Nason Creek sub-watershed are Spring Chinook, steelhead, adfluvial bull trout, and westlope cutthroat trout (adfluvial bull trout spawn in the colder headwater tributaries and migrate within other Wenatchee sub-watersheds and the Columbia River). The documented, presumed and potential range of anadromous salmonid species in this sub-watershed is illustrated in Figure 8.

3.7.2 Habitat Concerns in the Sub-watershed

Primary salmonid limiting factors in the Nason sub-watershed are loss of floodplain, impaired riparian and existing floodplain function, fish passage, and sedimentation. This sub-watershed has been substantially constrained in lower reaches by the construction of the railroad and the state highway (Peven Consulting, 2004).

The Biological Strategy describes factors affecting habitat condition in the Nason sub-watershed to include:

- The state highway, railroad, and private land development affect woody debris recruitment, channel migration, and gravel recruitment; and
- Lower Nason Creek is on the State 303(d) list for water temperature.

3.7.3 Historic and Ongoing Habitat Projects

Longview Fibre has completed fish passage projects and Chelan County has conducted a study evaluating Nason Creek's channel migration zone for the lowest four miles, from Coles Corner to the confluence of the Wenatchee River. These projects and documented, presumed, and potential anadromous salmonid distribution are illustrated in Figure 8. The symbols on the map illustrate the primary entity responsible for each project. Details about these projects can be found in Table 8.

3.7.4 Proposed Projects and Actions

Figure 8 shows the locations and primary responsible entity for each of the potential projects identified in the Nason sub-watershed. Five projects on Nason Creek were identified through the Lower Wenatchee CMZ study. Four of these would improve aquatic habitat by creating hydraulic connection to side channels isolated by highway construction. The other would protect existing wetland habitat.

3.7.5 Biological Needs to be Used Prioritization of Nason Habitat Projects

Strategies recommended by the Biological Strategy for the Nason sub-watershed, in priority order, are:

1) Protect remaining floodplain and riparian habitat.
2) Restore channel migration and historic function.
3) If restoration is not possible, improve fish access to oxbows and historical side channels.
4) Initiate public information efforts to discourage harassment of spawning salmonids.

Projects have been proposed to address the first two biological needs in the Nason sub-watershed. Further information about prioritization of projects in this sub-watershed and across the watershed can be found in Section 4.

3.8 Chiwawa Sub-Watershed – Category 1

3.8.1 Sub-watershed Habitat Overview

The second largest sub-watershed to the Wenatchee, the Chiwawa, drains 126,271 acres before joining the Wenatchee at RM 58.6. Land cover in the Chiwawa sub-watershed is primarily forest (78.5%), followed by grasslands (6.2%), and bare rock, sand, or clay (5.5%) (MWG, 2003). Commercial forest accounts for 97% of land use, with the rest being made up of rural residential/resource, rural recreational/resource, and rural waterfront.

Native salmonid species in the Chiwawa sub-watershed are Spring Chinook, steelhead, adfluvial bull trout and westlope cutthroat trout (adfluvial bull trout spawn in the colder headwater tributaries and migrate within other Wenatchee sub-watersheds and the Columbia River). Documented, presumed, and potential range of these anadramous species is illustrated in Figure 9. The Chiwawa is designated as a Key Watershed by the Northwest Forest Plan. "Significant resource extraction (timber, mineral, and grazing), heavy recreational use, and excellent fish, wildlife, and rare plant values co-exist in this [sub-]watershed," (USFS, 1997). It provides critical spawning and rearing habitat for multiple species.

Elevation ranges in the Chiwawa sub-watershed from 9,082 feet above sea level in the headwaters to 1,880 feet at its confluence with the Wenatchee River. This elevation range allows the sub-watershed to support habitat for a wide variety of plant and animal species. "Rare plants occur all over the [sub-]watershed from the dry forests to high windswept rocky ridges. Candystick, five species of moonworts, Salish fleabane, longsepal globemallow, pine broomrape, and pygmy saxifrage occur in the [sub-]watershed, while another five species are suspected to occur," (USFS, 1997). Overall, the Chiwawa sub-watershed supports moderate to high-quality terrestrial habitat (USFS, 1997).

3.8.2 Habitat Concerns in the Sub-watershed

The Chiwawa sub-watershed is mainly forested land, most managed by the Wenatchee National Forest. The sub-watershed is generally in good condition, especially considering the resource-based land use activities that have occurred here.

The Biological Strategy describes factors affecting habitat condition in the Chiwawa sub-watershed to include:

- Most of this watershed is in public ownership and protected as a Wilderness Area or managed under standards in the Northwest Forest Plan. Habitat within these areas is generally in good condition;
- There is limited housing development in private parcels on the lower Chiwawa River. Loss of riparian vegetation in these reaches may influence water temperatures and hiding cover; and
- Water withdrawals in the lower Chiwawa River could potentially affect the amount of juvenile rearing habitat available in low flow years.[3]

3.8.3 Historic and Ongoing Habitat Projects

There were no completed or ongoing habitat projects identified in the Chiwawa sub-watershed as of June 30, 2005. Figure 9 shows USFS land use designations, private forestland, and documented, presumed, and potential salmonid species distribution in the Chiwawa sub-watershed.

3.8.4 Proposed Projects and Actions

There were no proposed projects identified in the Chiwawa sub-watershed as of June 30, 2005.

3.8.5 Biological Needs to be Used for Prioritization of Chiwawa Habitat Projects

Strategies recommended by the Biological Strategy for the Chiwawa sub-watershed, in priority order, are:

1) Protect remaining floodplain and riparian habitat, particularly around Chikamin Flats;

2) Investigate the role of surface and well water withdrawals on instream flows and habitat use. Develop strategies with water users to reduce effects, if any;

3) Initiate public information efforts to discourage harassment of spawning Spring Chinook salmon and bull trout; and

[3] This statement may be further developed after the instream flow study is completed.

4) Manage recreation areas to reduce or avoid impacts to riparian habitats.

No projects have been proposed in the Chiwawa sub-watershed, however it is rated as a Category 1 in the Biological Strategy. Lack of projects in this category 1 sub-watershed indicates a need for potential projects. Further information about prioritization of projects in this sub-watershed can be found in Section 4.

3.9 Upper Watershed (Lake Wenatchee, White, and Little Wenatchee Sub-Watersheds) – Category 1

3.9.1 Sub-watersheds Habitat Overview

The upper end of the Wenatchee Watershed contains three sub-watersheds: White, Little Wenatchee, and Lake Wenatchee. The Little Wenatchee and White Rivers flow into Lake Wenatchee, the outlet of which is the source of the Wenatchee River, at RM 54.2. The primary land cover of all three sub-watersheds is forest, which makes up 63.7% of the White, 84.3% of the Little Wenatchee, and 73.4% of the Lake Wenatchee. In the White, other land cover is primarily bare rock, sand, or clay (12.5%), and grasslands (11.1%). In the Little Wenatchee other land cover is transitional (4.7%), shrubland (4.3%), and grassland (3.4%). In the Lake Wenatchee, other land cover is predominantly water (18.6%).

Native species in these sub-watersheds are sockeye, Spring Chinook, steelhead, rainbow, westlope cutthroat and bull trout (adfluvial full trout spawn in the colder headwater tributaries and migrate within other Wenatchee sub-watersheds and the Columbia River). The White and Little Wenatchee sub-watersheds are also designated as Key Watersheds by the Northwest Forest Plan, and provide critical spawning and rearing habitat for multiple species. In the Little Wenatchee, bull trout numbers above the waterfalls are extremely low. The Lake Wenatchee sub-watershed is a necessary adult holding and juvenile rearing area for sockeye salmon and bull trout. Current and potential range of anadromous salmonid species in these sub-watersheds is illustrated in Figure 10.

Important terrestrial habitat contributions of these sub-watersheds include habitat for "rare plant species, disjunct plant species, and species endemic to the Wenatchee Mountains [which] occur within these watersheds," (USFS, 1998). There are a wide range of plant communities, with smaller unique communities in pockets. Rare plants include candystick (*Allotropa virgata)*, lance-leaved moonwart *(Botrychium lanceolatum)*, Smoky Mountain sedge *(Carex proposita)*, Seely's silene *(Silene seelyi)*, and others, (USFS, 1998).

The watershed is located at an important point along the Cascade Range and provides connectivity for terrestrial wildlife for species moving north-south and east-west. "From a landscape scale/range-wide status of many species, it is important to maintain the integrity of the White River and Little Wenatchee watershed," (USFS, 1998). "The wildlife species of particular importance in this watershed include: northern spotted owl, gray wolf, grizzly bear, bald eagle, waterfowl, mountain goat, and wolverine," (USFS, 1998). Pine marten have also been found in the watershed, (USFS, 1998). Some National Forest land in these sub-watersheds has been designated as "Riparian Reserve," which protects it from harvest, and protects stream water quality and riparian function.

3.9.2 Habitat Concerns in the Upper Watershed

These sub-watersheds are primarily forest land, most of which is congressionally designated as wilderness. Much of the sub-watersheds' habitat is in a near-reference condition (USFS, 1998).

Habitat problems in these sub-watersheds are generally related to the *threat* of development, as opposed to actions that have occurred. Protection is important in these sub-watersheds.

The Upper Columbia Biological Strategy (RTT, 2003) describes factors affecting habitat condition in the White River sub-watershed to include:

- Past riparian harvest and log drives have altered woody debris accumulations and channel morphometry; and
- Habitat is intact and continuous, but development pressures place a critical need to protect and maintain stream channel and floodplain integrity.[4]

The Biological Strategy describes factors affecting habitat condition in the Little Wenatchee sub-watershed to include:

- Past riparian harvest and log drives below the waterfalls may have affected stream channel morphometry and function;
- Habitat above the waterfalls is intact and relatively pristine: essentially need to protect and maintain stream channel and floodplain integrity; and
- The lower Little Wenatchee is on the state 303(d) list for temperature.

The Biological Strategy describes factors affecting habitat condition in the Lake Wenatchee sub-watershed to include:

- Shoreline development. Bulkheads change the dynamics of nearshore wave action, affecting invertebrate production, gravel disposition, and habitat use.

The White and Little Wenatchee Watershed Assessment (USFS, 1998) describes factors affecting terrestrial habitat to include:

- The control of fires in the higher elevations has caused an advance of shrubs and conifers into meadows;
- Sheep grazing of the high meadows maintained the grasses/forbs at an early successional stage;
- Roads and trails have affected habitat, particularly riparian, meadows, and ridges;
- A few smaller drainages have a high level of roads; although their linkage to the watershed and affect on aquatic health is unknown.

3.9.3 Historic and Ongoing Habitat Projects

Projects completed to date in the White and Little Wenatchee sub-watersheds have involved land acquisition and/or transfer facilitated by the Chelan-Douglas Land Trust and the Washington Department of Fish and Wildlife for habitat protection, and restoration projects by the US Forest Service in the upper mainstem White River drainage. These projects and documented, presumed, and potential salmonid species distribution are illustrated in Figure 10. The symbols on the map illustrate the primary entity responsible for each project. Details about these projects can be found in Table 10.

[4] There may be a need to include information here that was not included in the Biological Strategy. This will be decided by the Habitat Subcommittee in a later draft.

3.9.4 Proposed Projects and Actions

Figure 10 shows the locations and primary responsible entity for each of the proposed projects in the White, Little Wenatchee and Lake Wenatchee sub-watersheds. Table 10 provides additional project detail.

3.9.5 Biological Needs to be Used for the Prioritization of White, Little Wenatchee, and Lake Wenatchee Habitat Projects

Strategies recommended by the Biological Strategy for the White River sub-watershed, in priority order, are:

1) Protect stream channel, riparian and floodplain function: focus on Panther Creek downstream to mouth;

2) Restore wetland complexes that connect to stream channel;

3) Protect shorelines along Lake Wenatchee near White River mouth;

4) Initiate public information efforts to discourage harassment of spawning Spring Chinook, sockeye salmon, and bull trout; and

5) Manage recreation areas to reduce impacts to riparian cover.

Strategies recommended by the Biological Strategy for the Little Wenatchee sub-watershed, in priority order, are:

1) Protect stream channel, riparian, and floodplain function: focus on Little Wenatchee River falls downstream to mouth;

2) Address road impacts on the drainage, emphasis on Rainy Creek and Little Wenatchee between Hidden Creek and Fir Creek;

3) Restore wetland complexes that connect to stream channel;

4) Manage recreation areas to reduce impacts to riparian cover; and

5) Initiate public information efforts to discourage harassment of spawning salmonids.

Strategies recommended by the Biological Strategy for Lake Wenatchee are to protect remaining nearshore habitat and develop a means to reduce impacts of bulkheads.

The proposed projects in these sub-watersheds have been evaluated with respect to fulfilling these prioritized biological needs. The results indicate types of projects that may need to be proposed in each sub-watershed. Further information about prioritization of projects in these sub-watershed and across the watershed can be found in Section 4.

4.0 NEXT STEPS IN WATERSHED-WIDE PROJECT PRIORITIZATION

The sub-watershed discussion in Section 3 introduced biological needs in each sub-watershed in WRIA 45 as established in the Biological Strategy. The Biological Strategy also assigned categories to each sub-watershed in order to determine where the best use of habitat improvement resources might be spent on a watershed scale. This section considers biological needs together with other criteria important in determining where and when to implement habitat projects, and builds the framework of a watershed-wide habitat project prioritization.

4.1 Fulfilling Biological Needs in Each Sub-Watershed

Through this planning effort, proposed projects from throughout the watershed have been catalogued into a database maintained by Chelan County Natural Resources. This internal proposed project list will be ever changing as new ideas are developed, so all information is not reported here. These proposed projects were sorted to determine which biological need they address.

Tables 11-13 show the biological needs for sub-watersheds in categories 1, 2, and 3, and the projects identified that may address them. These tables can be used to identify high priority biological needs for which projects have not yet been developed. The tables are intended to be used both as a public outreach tool and as a project prioritization tool. Note that no projects have been identified in any of the Category 1 sub-watersheds except White River. Identification of potential projects in these sub-watersheds should be the next immediate step in implementation of the habitat component of this Watershed Plan.

4.2 Community Outreach and Other Factors

As was stated in Section 1, other factors to be used for prioritization of projects are: terrestrial benefits, community acceptance, and costs and benefits of specific projects. The Watershed Planning Unit understands the importance of community support and acceptance in both the implementation and long term support of habitat improvement projects. The public outreach process was initiated with community meetings in January 2005, and the public will continue to be engaged as additional project ideas are developed.

Community acceptance, along with relative project cost and benefit will be used to rank projects for implementation.

4.3 Project Implementation

The working list of proposed project ideas on file with the County will be maintained, updated, modified, and consulted as necessary to determine where and when specific projects should be implemented and identify priority projects for grant funding.

5.0 METHODS FOR MEASURING PROGRESS TOWARD GOALS

This section contains strategies for understanding and documenting the effectiveness of salmon recovery actions toward goals in both the Salmon Recovery Plan and the Habitat Component of the Wenatchee Watershed Plan. Section 5.1 details effectiveness monitoring specific to the Wenatchee Watershed. It has been excerpted from the Biological Strategy. Section 5.2, excerpted from the Upper Columbia Salmon Recovery Plan, contains Upper Columbia-wide strategies for adaptive management.

5.1 Effectiveness Monitoring

5.1.1 Indicator Watersheds

Effectiveness monitoring prescriptions for indicator watersheds as reported in the Biological Strategy (UCRTT, 2002) are as follows:

Mainstem Upper Wenatchee River

- Monitor stream channel sinuosity, width/depth ratio, and riparian coverage from fixed stations on a periodic schedule. Continue ariel reconnaissance.
- Survey side channels and oxbows for presence of juvenile salmonids.
- Monitor selected water quality parameters at fixed stations set periodicity.

Mainstem Lower Wenatchee River

- Monitor stream channel sinuosity, width/depth ratio, riparian coverage, and both gravel and LWD recruitment from fixed stations on a periodic schedule. Begin aerial reconnaissance.

Peshastin

- Monitor stream channel sinuosity, width/depth ratio, riparian coverage, and both gravel and LWD recruitment from fixed stations on a periodic schedule. Begin aerial reconnaissance.

Icicle Creek

- Monitor stream channel sinuosity, width/depth ratio, riparian coverage, and both gravel and LWD recruitment from fixed stations on a periodic schedule. Begin aerial reconnaissance.
- Monitor stream flows.
- Monitor public awareness at high use areas, such as campgrounds.
- Monitor adult passage and spawning throughout watershed.

Chiwawa

- Monitor stream channel sinuosity, width/depth ratio, riparian coverage, and both gravel and LWD recruitment from fixed stations on a periodic schedule. Begin aerial reconnaissance.

- Monitor public awareness at high use areas, such as campgrounds.

Nason

- Monitor stream channel sinuosity, width/depth ratio, riparian coverage, and both gravel and LWD recruitment from fixed stations on a periodic schedule. Begin aerial reconnaissance.
- Monitor public awareness at high use areas, such as campgrounds.
- Survey side channels and oxbows for presence of juvenile salmonids.

5.1.2 Non-Indicator Watersheds

Effectiveness monitoring criteria for non-indicator watersheds are as follows:

Mission Creek

- Monitor water flow and quality at selected locations.

Chumstick Creek

- Monitor selected water quality parameters at fixed stations and set periodicity.
- Monitor adult passage and spawning success throughout watershed.

5.2 Monitoring and Adaptive Management

The following has been excerpted from the Draft Upper Columbia Salmon Recovery Plan (UCRTT, 2005).

Monitoring is needed to assess if actions recommended in this plan achieve their desired effects. There is a risk that the recommended actions identified in this plan may not be adequate to ensure long-term viability of the listed species. To manage that risk, this plan includes critical research, monitoring, and evaluation (RME) to assess the possibility that onsite and offsite actions will have the predicted results.

Research and monitoring are designed to test implementation, validation, status/trend, and effectiveness. Implementation monitoring determines if planned actions were implemented as intended and whether all implementation objectives are on schedule. Validation monitoring determines whether the fundamental ecological assumptions underlying the recovery plan are true. Prominent among these assumptions are the effects of specific environmental conditions on survival and abundance of listed fish species embodied in the EDT model. Status/trend monitoring determines the current conditions (status) of the populations and their habitats and their changes over time. Effectiveness monitoring focuses on whether the recovery actions changed the environment and/or the VSP parameters of listed fish species as predicted by the plan.

A final area of evaluation addresses conditions outside the ESUs (downstream from the mouth of the Yakima River). Factors in this area will have a significant effect on the success of recovery of Chinook and steelhead in the Upper Columbia Basin. These factors include commercial harvest, sport and tribal harvest, conditions in the mainstem Columbia River (including hydroelectric operations), and conditions in the estuary and ocean including short and longer term cycles in ocean conditions. The regional RME program developed under the FCRPS Biological Opinion will measure status, trends, and effectiveness of actions in this area.

5.2.1 Implementation Monitoring

Recovery actions implemented within the Upper Columbia Basin will be monitored to assess whether the actions were carried out as planned. This will be carried out as an administrative review and will not require environmental or biological measurements.

Implementation monitoring will address the types of actions implemented, how many were implemented, where they were implemented, and how much area or stream length was affected by the action. Indicators for implementation monitoring will include visual inspections, photographs, and field notes on numbers, location, quality, and area affected by the action. Success will be determined by comparing field notes with what was specified in the plans or proposals (detailed descriptions of engineering and design criteria). Thus, design plans and/or proposals will serve as the benchmark for implementation monitoring. Any deviations from specified engineering and design criteria will be described in detail.

5.2.2 Status/Trend Monitoring

The status and trend of spring Chinook, steelhead, and bull trout and their habitats will be monitored throughout the Upper Columbia Basin following the guidelines in the Upper Columbia Monitoring Strategy (Hillman, 2004). Within each subbasin, status/trend sampling sites will be selected according to the U.S. Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP) design, which is a spatially-balanced, site-selection process developed for aquatic systems and recommended within the Upper Columbia Monitoring Strategy. This approach has been used successfully within the Wenatchee subbasin (under the Upper Columbia Monitoring Strategy) and in the Okanogan subbasin (under the Okanogan Basin Monitoring and Evaluation Program). The Upper Columbia Monitoring Strategy describes in detail the approach, indicators, and protocols needed to assess status and trends of listed fish species and their habitats in the Upper Columbia Basin. This strategy will be updated annually as new information becomes available.

5.2.3 Effectiveness Monitoring

To the extent possible, effectiveness of recovery actions will be monitored using the Before-After-Control-Impact (BACI) design with stratified random sampling, as described in the Upper Columbia Monitoring Strategy (Hillman 2004). The Upper Columbia Monitoring Strategy describes in detail the approach, indicators, and protocols needed to assess effectiveness of habitat restoration classes. It is critically important to coordinate these effectiveness monitoring programs with status/trend monitoring and effectiveness monitoring within the Hydro sector.

5.2.4 Research

As noted earlier, unknown aspects of environmental conditions vital to salmonid survival are termed "critical uncertainties." In this plan, critical uncertainties are a major focus of research. Critical uncertainty research targets specific issues that constrain effective recovery plan implementation. This includes evaluations of cause-and-effect relationships between fish, limiting factors, and actions that address specific threats related to limiting factors. Listed below are research actions that are needed to assess the effects of the uncertainties on recovery of listed fish species in the Upper Columbia Basin. Research actions address both in-basin and out-of-basin factors and are not all inclusive.

5.2.4.1 Harvest

- Evaluate innovative techniques (e.g., terminal fisheries and tangle nets) to improve access to harvestable stocks and reduce undesirable direct and indirect impacts to naturally produced Upper Columbia stocks.
- Evaluate appropriateness of stocks used in weak-stock management.
- Develop better methods to estimate harvest of naturally produced fish and indirect harvest mortalities in freshwater and ocean fisheries.

5.2.4.2 Hatchery

- Assess the interactions between hatchery and naturally produced fish.
- Determine relative performance (survival and productivity) and reproductive success of hatchery and naturally produced fish in the wild.
- Assess if hatchery programs increase the incidence of disease and predation on naturally produced fish.
- Examine the feasibility and need of steelhead kelt reconditioning.

5.2.4.3 Hydro Project

- Evaluate if passage through hydroelectric projects affects reproductive success of listed fish species.
- Assess baseline survival estimates for juvenile listed fish species as they pass hydroelectric projects.
- Assess the effects of hydroelectric operations on juvenile and sub-adult bull trout survival.
- Assess the effects of temporary powerhouse shutdowns on the incubation success of steelhead in spawning gravels in the Chelan tailrace.

5.2.4.4 Habitat

- Implement selected restoration projects as experiments.
- Increase understanding of estuarine ecology of Upper Columbia stocks.
- Increase genetic research to identify genotypic variations in habitat use.
- Increase understanding of linkages between physical and biological processes so managers can predict changes in survival and productivity in response to selected recovery actions.
- Examine relationships between habitat indicators and landscape variables.
- Examine fluvial geomorphic processes to better understand their effects on habitat creation and restoration.
- Examine water balance and surface/groundwater relations.
- Test assumptions and sensitivity of EDT model runs.

- Evaluate nutrient enrichment benefits and risks using fish from hatcheries or suitable analogs.
- Assess population structure and size of bull trout in the Upper Columbia Basin.
- Assess the presence of bull trout in the Lake Chelan and Okanogan subbasins and upstream of Entiat Falls in the Entiat subbasin.
- Assess the effectiveness and feasibility of using fish transfers and artificial propagation in bull trout recovery.
- Examine migratory characteristics and reproductive success of bull trout.
- Describe the genetic makeup of bull trout in the Upper Columbia Basin.

5.2.4.5 Ecological Interactions

- Determine the effects of exotic species on recovery of salmon and trout and of the feasibility to eradicate or control their numbers.
- Examine consumption rates of fish (especially exotics) that feed on listed fish species.
- Determine the interactions and effects of shad on Upper Columbia stocks in the lower Columbia River.
- Determine the significance of marine mammal predation on Upper Columbia stocks and alternatives for management in the Columbia River mainstem and estuary.
- Assess the occurrence of resident bull trout populations and their interactions with migrant (fluvial and adfluvial) populations.
- Determine the effects of brook trout and bull trout interactions (competition, predation, and hybridization).
- Evaluate the interactions of bull trout with spring Chinook and steelhead.

5.2.5 Data Management

Because the indicators and protocols recommended in this plan are from the Upper Columbia Monitoring Strategy, this plan will incorporate the data dictionary and infrastructure being developed for that program. The data management program is being developed by the Bureau of Reclamation, Spatial Dynamics, Inc., and Commonthread, Inc., with input from State, Federal, and Tribal agencies and consultants. The data dictionary is a data management tool that provides a comprehensive conceptual framework based on the monitoring indicators and data collection protocols. The data dictionary will also include a geodatabase (incorporating an ArcHydro Geodatabase Model) that will host GIS work (landscape classification information). The data dictionary will be used to develop field forms that crews will fill out during data collection.

The primary database will be held temporarily at the NOAA Fisheries Science Center in Seattle and will contain summarized data and portals to raw data collected within each subbasin. Ultimately, the database will be maintained within the Upper Columbia region. The data management program will automatically summarize the raw data, thereby reducing processing errors. Data will be uploaded only by authorized personnel, who have user access. Data can be retrieved (downloaded) by anyone.

Trained field crews will collect and record data onto field forms generated by the data dictionary. A monitoring supervisor will review data forms each day to make sure that all required information was

collected. In addition, quality control will include a review for outliers, missing data, and other anomalies. Data will then be entered into the data management program by the authorized user. Compiled data will be double-check for accuracy by a second person (this will reduce recording errors). Data will be analyzed following the protocols developed in the data dictionary. Each year an annual report describing the results of the past years' work will be made available to technical/scientific staff representing different agencies, decision-makers, stakeholders, and the public.

5.2.6 Adaptive Management

Adaptive management has been defined in Washington State law as "reliance on scientific methods to test the results of actions taken so that the management and related policy can be changed promptly and appropriately" (RCW 79.09.020). It is described as a cycle occurring in four stages: identification of information needs; information acquisition and assessment (monitoring); evaluation and decision-making; and continued or revised implementation of management actions. Adaptive management is captured in the sequence: "hypothesis statement," "monitor," "evaluate," and "respond."

This plan has identified information needs and suitable monitoring programs. Evaluation will occur at three levels (Figure 8.1):

- **Scientific Evaluation**—An evaluation of available information by independent scientists to assess the strengths and weaknesses of the actions.
- **Public Evaluation**—An evaluation of available information by the public to assess socio-economic factors.
- **Decision-Making Evaluation**—An evaluation of available information by decision-makers, who determine what alternatives and management actions are needed when "triggers" are reached.

The purpose for evaluation is to interpret information gathered from monitoring and research, assess deviations from targets or anticipated results (hypothesis), and recommend changes in policies or management actions where appropriate. Input from both independent scientists, stakeholders, and the general public are required. These groups will annually provide feedback to decision makers (policy forum), who have the responsibility to change policies or management actions.

The primary missing elements in this recovery plan are threshold levels that trigger management changes. These triggers must be measurable over a period short enough to allow for timely management changes or, at a minimum, soon enough to serve as an early warning of ineffective or unforeseen adverse impacts. When a performance metric (e.g., VSP parameter or habitat indicator) reaches the triggering threshold, a management response is required. Three general management responses are possible: (1) predefined mandatory responses; (2) mandatory, but circumstance-specific responses; and (3) responses made as a result of newly discovered opportunities. During the first few years of recovery plan implementation, it is expected that most of the management response triggers will be of types 2 and 3 because of the large uncertainties associated with implementation of a new program.

Before a complete adaptive management plan for the Upper Columbia Basin can be put into effect, threshold values for performance standards must be developed for each objective included in this plan. Natural resource specialists (modelers, ecologists, hydrologists, geomorphologists, etc.) should

be retained in the near future to identify basin-specific response triggers and management responses needed in the event of failure to make adequate progress toward the objective.

5.2.7 Check-In Schedule

The Upper Columbia Salmon Recovery Board with NOAA Fisheries and the USFWS will conduct mid-point evaluations, or "check-ins," in years 1, 3, 5, 8, 12, and every fourth year thereafter, following implementation. The first *Check-In Report*, submitted one year after the plan is implemented, will primarily address progress made towards obtaining funding, initiating studies, developing priorities, and other programmatic issues. To the extent possible, it will also provide updates to adult fish returns (spawners), abundance and abundance trends, and juvenile fish survival. Later reports will detail research and monitoring results. If necessary, these results will be used to "adaptively" modify the recovery plan.

It is important that the public and the agencies have confidence in the recommended recovery actions and in the science that supports the actions. Accordingly, the Upper Columbia Salmon Recovery Board, working through the Policy Forum and technical workgroups, will obtain independent scientific review of its 3-, 5-, 8-, and 12-year evaluation reports. Beyond the 12-year check-in, independent scientific review will be under the discretion of the Upper Columbia Salmon Recovery Board and the Policy Forum.

5.2.8 Consistency with Other Monitoring Programs

An important aspect of this recovery plan is that it uses existing monitoring programs to evaluate the status/trend and effectiveness of recovery actions within the Upper Columbia Basin. Specifically, this plan incorporates by reference the Upper Columbia Monitoring Strategy (Hillman 2004), the Okanogan Basin Monitoring and Evaluation Program, and the Draft Monitoring and Evaluation Plan for PUD Hatchery Programs (Murdoch and Peven 2005). The former two address status/trend and effectiveness monitoring of habitat actions, while the latter addresses status/trend and effectiveness of hatchery actions. The PUDs currently have monitoring programs identified in their HCPs and Biological Opinions to address hydroproject actions. Actions implemented in areas downstream from the ESUs will be addressed within the Action Agencies/NOAA Fisheries RME Program for the FCRPS Biological Opinion. This plan encourages these programs to continue.

The development of other regional monitoring programs may result in modifications to the monitoring programs used in the Upper Columbia Basin. These other programs, in various states of development, include the Bull Trout Recovery Monitoring and Evaluation Program being developed by the Recovery Monitoring and Evaluation Technical Group (RMEG), the Collaborative, Systemwide Monitoring and Evaluation Project (CSMEP), and the Pacific Northwest Aquatic Monitoring Partnership (PNAMP). As these programs develop more fully, they will provide guidance on valid sampling and statistical designs, measuring protocols, and data management. This information may be used to refine and improve the existing monitoring and evaluation programs in the Upper Columbia Basin. The intent is to make monitoring and evaluation programs more consistent throughout the Columbia Basin and Pacific Northwest.

5.2.9 Coordination

Many entities have been or will be implementing recovery actions within the Upper Columbia Basin. In addition, monitoring programs implemented within the Upper Columbia region include:

- Upper Columbia Monitoring Strategy,
- Okanogan Basin Monitoring and Evaluation Program,
- Action Agencies/NOAA Fisheries RME Program,
- Draft Monitoring and Evaluation Plan for PUD Hatchery Programs,
- Washington Salmon Recovery Funding Board Program,
- HCPs Monitoring Programs,
- Coho Reintroduction Monitoring Program,
- PACFISH/INFISH Monitoring Program,
- Pacific Northwest Interagency Regional Monitoring Program,
- USFWS, USGS, and BOR monitoring programs, and
- WDFW and Department of Ecology monitoring programs.

It is critical that these programs be coordinated to reduce redundancy, increase efficiency, and minimize costs.

In 2004, the Upper Columbia Regional Technical Team (UCRTT) and its monitoring subcommittee began the process of coordinating monitoring activities in the Upper Columbia Basin. The UCRTT holds annual meetings with entities conducting monitoring activities within the Upper Columbia Basin with the purpose of coordinating activities and sharing information. The UCRTT is working to enhance coordination between the Upper Columbia Monitoring Strategy, the Okanogan Basin Monitoring and Evaluation Program, and other monitoring programs in the Upper Columbia Basin. These efforts have been beneficial and this plan encourages the process established by the UCRTT to continue.

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TABLES

Completed, Ongoing, and Proposed Projects

Lead Funding Source	Supplemental Funding Source	Project Name	Description	Sponsoring Program/Participating Agencies	Target Species	Cost	Funding Date	Start Date	End Date	Project Type (water quantitiy, water quality, aquatic habitat, terrestrial habitat)	Primary Limiting Factor (passage, flow, aquatic habitat, riparian, terrestrial, wetlands, water quality)	Other Limiting Factors	Objective (Protection, Restoration, Enhancement, Study)	Project Status (Proposed, Initiated, or Completed)	Date Provided
TABLE 1 - Wenatchee Watershed-Wide Completed, Ongoing, and Proposed Projects															
		Meadow Creek Burn Recovery		Evergreen State College, Cascade High School										Completed	4/4/2005
SRFB		Jon Small Off-Channel Rearing Pond		Icicle Valley Chapter of Trout Unlimited	salmonids	$134,170 + $62,091 match	1999				aquatic habitat		Enhancement	Completed	4/4/2005
SRFB		Harrimen Stream Restoration Project		Chelan County, Salmon Recovery Funding Board	bull trout, chinook, sockeye, steelhead, coho, cutthroat	$192,900	5/15/2000		12/31/2001		habitat		restoration	Completed	4/4/2005
		Camas Meadows Natural Areas Preserve		Washington Department of Natural Resources/Natural Areas Program									protection	Completed	4/4/2005
		Coho Supplementation in Mid-Columbia O&M/M&E	Yakama Nation Coho Supplementation	Yakama Indian Nation, Bonneville Power Administration		$432,556	1998		2000				reintroduction	Completed	4/4/2005
SRFB		Beebe Springs Restoration	Increase sinuosity of stream in former channelized area. Create meandering areas in a 1/5-mile area. Maximize opportunities for spawning and rearing habitat for spring Chinook and steelhead	Lake Chelan Sportsman Association	salmonids	$84,092 + $14,840 match	2004				aquatic habitat		Enhancement	Completed	4/4/2005
(Upper Columbia Community Salmon Fund - SRFB/NFWF)		Wenatchee Riparian Revegetation	This project will identify opportunites for riparian restoration throughout the Wenatchee Watershed. This project is currently being developed and will identify locations with willing landowners and will have planting perscriptions for each area.	Chelan County	fish, terrestrial						riparian		restoration	Proposed (more detail coming soon)	4/19/2005
NFWF		Wenatchee Valley Neotropical Migratory Songbird Conservation Project	This project protects species rich neotropical migratory songbird habitat from development through placing conservation easements on private land. It brings together provate-public partnerships that supplement regulatory protection with voluntary private conservation schemes. the project emphasizes conservation within high priority designated conservation areas where opportunities exist (i.e. where landowners are receptive). It implements the "Conservation Strategy for Lnadbirds of the Wast-Slope of the Cascade MOuntains in Oregon and Washington," prepared for Oregon-Washington Partners in Flight.	CDLT	terrestrial	$250,000					terrestrial		Protection, Study (to identify and prioritize), monitoring	Initiated	4/19/2005
WDOE		Target Reach Restoration	Restore riparian vegetation in 303(d) listed stream sections	CCCD	salmonids	est. $53,000					water quality (temperature)		Restoration	Initiated	4/19/2005
TABLE 2 - Completed, Ongoing, and Proposed Projects in the Lower Wenatchee Sub-Watershed															
		CMZ 1 - preserve riparian and backchannel	Preserve existing riparian valley flat backchannel habitats. Remover park facilities within 200 fe of the main channel and initiate riparian enhancement planting.								riparian, aquatic habitat		Protection, Enhancement	Completed	4/4/2005
		Dryden Dam Passage Plans	Tumwater Falls/Dryden Dams Passage Plans	Bonneville Power Administration		$123,692 for both	1983		1987		passage		Enhancement	Completed	4/27/2005
		Dryden Dam Passage		Chelan County Public Utility District, Bonneville Power Administration		$1,445,200	1985		1986		passage		Enhancement	Completed	4/27/2005
		Riverside Park		Department of Natural Resources/ALEA		$59,000 (ALEA share)	1989		1991					Completed	4/27/2005
SRFB		Blackbird Island Habitat Development	Placement of critical in-stream habitat including rocks, logs, rootwads and aquatic vegetation to help restore a ½ mile section of high quality off-channel salmon and steelhead spawning and rearing habitat. Excavate a ½ mile of old river terrace and relic stream channel to a depth that will allow groundwater percolation and flow to enter and fill the old channel until exiting via surface water flows to the mainstem Wenatchee River.	Chelan County Commissioners	salmonids	$57,132 + $13,000 match	1988				aquatic habitat		Enhancement	Completed	4/4/2005
SRFB		FLIR Assessment – Lower Wenatchee	A FLIR flight is proposed to map the stream temperature during the low-flow, high temperature period. Data collected from this study will provide valuable Baseline temp. data, and information about the location and extent of use of thermal refugia by salmonids in this stretch of the Wenatchee. Future projects include protection of land around key thermal refugia as well as protection and restoration of in-stream flows currently being identified by the Wenatchee Watershed Planning Effort.	Chelan County	salmonids	$52,317 + $13,000 match	2001				aquatic habitat		Study	Completed	4/4/2005
SRFB		Jones-Shotwell Diversion Enhancement	Diversion improvement, screen replacement, enhancement of off-channel refugia on lower Wenatchee River.	Chelan County Conservation District	salmonids	$257,044 + $46,047 match	2004				aquatic habitat		Enhancement	Completed	4/4/2005
SRFB		Wenatchee Instream Flow Habitat Project	Technical work under Phase 3 is currently underway and will be complete by March 2005. This application would be used to evaluate alternatives and develop flow recommendations for Nason, Chiwawa, Icicle, Peshastin, Chumstick, Mission and the lower Mainstem Wenatchee.	Chelan County	salmonids	$170,000 + $30,000 match	2004				flow		Study	Completed	4/4/2005
SRFB		Chelan County Fish Barrier Inventory	Assess physical barriers that interrupt adult and juvenile salmonid migration. Identify problem culverts within the Wenatchee and Entiat watersheds, evaluate effectiveness of barrier removal in terms or restored access to fish habitat and create a ranking of recommended project areas.	Chelan County Commissioners	salmonids	$75,000 + no match	1988				passage		Study	Completed	4/4/2005
SRFB		Lower Wenatchee Channel Migration Zone Study	Identify historic and current channel migration rates, factors affecting migration rates, means to restore floodplain function and appropriate types and locations of restoration initiatives in order to regulate development in hazardous zones and help ensure the protection of properly functioning habitat on the lower mainstem Wenatchee River.	Chelan County Commissioners	salmonids	$173,142 + $60,000 match	2000		2004		aquatic habitat		Study	Completed	4/4/2005

Completed, Ongoing, and Proposed Projects

Lead Funding Source	Supplemental Funding Source	Project Name	Description	Sponsoring Program/Participating Agencies	Target Species	Cost	Funding Date	Start Date	End Date	Project Type (water quantitiy, water quality, aquatic habitat, terrestrial habitat)	Primary Limiting Factor (passage, flow, aquatic habitat, riparian, terrestrial, wetlands, water quality)	Other Limiting Factors	Objective (Protection, Restoration, Enhancement, Study)	Project Status (Proposed, Initiated, or Completed)	Date Provided
		Storm Drain Project		Chelan County Conservation District, City of Leavenworth, City of Cashmere							water quality			Completed	4/27/2005
		Tumwater Falls Passage Plans	Tumwater Falls/Dryden Dams Passage Plans	Bonneville Power Administration		$123,692 for both	1983		1987		passage		Enhancement	Completed	4/27/2005
		Improve the Tumwater Dam Passage	Improve the Tumwater Dam Passage	Bonneville Power Administration		$1,425,900	1985		1986		passage		Enhancement	Completed	4/27/2005
		CCCD riparian revegetation on Wenatchee River (#2)	This is the location of a riparian revegetation project implemented in 2001 along the Wenatchee River by a private landowner with assistance from the CD in 2001. The location is approximately in the middle of 1,200 linear feet of a riparian revegetation site. The first attachment is a photo of this site a year after installation of plants and irrigation.	CCCD	salmonids				2004		riparian		Enhancement	Completed	4/4/2005
		CCCD habitat improvement and riparian revegetation on Wenatchee (#1)	This is a location of an in stream habitat improvement and riparian revegetation project conducted by Chelan County (see second and third photo attachments) in 2004 on the Wenatchee River. This project resulted from a flood in 1996 that nearly took out the Sleepy Hollow Road and bridge. Chelan County Public Works did some emergency work to save the road immediately after the flood and as a condition of the in stream work permit, they were required to put some habitat features (rock "barbs" and log/root wads anchored to large boulders between and in the bards. There are two rock barbs and about 8 log/root wads) in the river and reestablish riparian vegetation on the bank. The CD was/is responsible for the plantings.	CCCD/NRCS	salmonids				2001		riparian, aquatic habitat		Enhancement	Completed	4/4/2005
		Wenatchee Foothills Trail		Chelan Douglas Land Trust										Completed	4/4/2005
		Wenatchee Wastewater Treatment Plant Improvements		Department of Ecology/Water Quality Program			2004 Fiscal Year				water quality		Enhancement	Completed	add 4/27
SRFB		Gagnon CMZ Project Feasibility: study hydrogeomorphic feasibility of off-channel creation (CMZ 10)	This project was identified in the Channel Migration Zone Study which was funded in the 2nd Round. Grant would fund hydorgeomorphic feasibility study and design of off-channel creation project.	Chelan County	salmonids	$82,450 + $14,550 match	2004				Aquatic habitat		Study	Initiated	4/4/2005
SRFB		Dryden Fish Enhancement CMZ Project: study potential creation of off-channel rearing habitat (CMZ 15)	Lower Wenatchee River at Dryden. Create off-channel rearing habitat for spring Chinook, (bull trout) and summer steelhead. Create prime, high quality, year-round rearing habitat, predator escape cover and high flow refuge areas by establishing perennial year-round stream flow and unhindered fish access to an existing but normally dry high water overflow floodplain channel through channel excavation to groundwater and through the placement of several rock and log habitat structures in the new channel.	Chelan County PUD	salmonids	$146,000 + $34,000 match	2004				aquatic habitat		Enhancement	Initiated	4/4/2005
SRFB		Irwin CMZ Project Feasibility: backchannel creation, riparian enhncement, and avulsion barrier. (CMZ 19)	This project was identified in the Channel Migration Zone Study which was funded in the 2nd Round. Grant would fund hydorgeomorphic feasibility study and design of off-channel creation project.	Chelan County	salmonids	$82,450 + $14,550 match	2004				aquatic habitat		Study	Initiated	4/4/2005
		CMZ 11 - hydraulic connection and preserve riparian	Conceptual drawing in CMZ study. Create a hydraulic connection from the main channel to the existing borrow pit/wetland habitats to restore high flows. Excavate borrow pits as needed to create high and low-flow habitat. Preserve existing valley flat-forested riparian habitat.								aquatic habitat	hydraulic connection, in-channel habitat, riparian	Restoration, Enhancement	Proposed	4/4/2005
		CMZ 12 - preserve valley flat, floodplain riparian, and backchannel	Preserve existing active valley flat and floodplain conifer woodland riparian habitat. Preserve existing high-flow backchannel.								aquatic habitat	backchannel, floodplain	Protection	Proposed	4/4/2005
		CMZ 13 - hydraulic connection and riparian enhancement	Create a hydraulic connection from the main channel to the existing borrow pit/wetland habitats. Excavate borrow pits to groundwater to create low-flow backchannel habitat. Riparian enhancement planting of the active valley flat immediately adjacent to the main channel.								aquatic habitat	hydraulic connection, in-channel habitat, riparian	Restoration, Enhancement	Proposed	4/4/2005
		CMZ 14 - riparian buffer planting	Enhancement planting of the riparian buffer adjacent (+ or - 200 feet) to the main channel. Preserve the existing land use beyond the buffer area.								riparian	riparian	Enhancement	Proposed	4/4/2005
		CMZ 16 - riparian planting	Riparian enhancement planting of the valley flat to restore a forested valley flat habitat.								aquatic habitat	riparian, backchannel	Enhancement	Proposed	4/4/2005
		CMZ 18 - road retirement and riparian planting	Retire access road, followed by riparian enhancement planting of the valley flat to restore a forested valley flat habitat.								riparian	riparian	Protection	Proposed	4/4/2005
		CMZ 19a -hydraulic connection with backchannel	Conceptual drawing in CMZ study. Create a hydraulic connection with the backchannel pond habitat and the main channel through either installating a culvert or excavating the existing berm. Design the culvert size and elevation to allow high and low-flow events to connect with restored backchannel habitats. Ensure protection of existing WDFW boat ramp and parking facilities.								aquatic habitat	backchannel, riparian	Restoration, Enhancement	Proposed	4/4/2005
		CMZ 2 - backchannel creation and riparian enhancement and preservation	Conceptual drawing in CMZ study. Backchannel creation on the low alluvial terrace (former orchard), at the downstream end of the site to create high and low-flow backchannel habitat. Riparian enhancement planting at the low alluvial terrace in association with backchannel construction to create floodplain hardwood woodland habitat. Preservation of existing riparian forest within the active valley flat. Preservation of existing high-flow backchannels. Riparian enhancement planting in high-terrace pasture areas to create additional floodplain hardwood within the active valley flat.								aquatic habitat	backchannel, riparian, floodplain	Restoration, Enhancement	Proposed	4/4/2005
		CMZ 20 - backchannel creation and riparian enhancement	Conceptual drawing in CMZ study. Backchannel creation within the low terrace island with a connection to the Wenatchee River main channel. Riparian enhancement planting within the high terrace active valley flat and adjacent to the Icicle Creek main channel. Preserve existing riparian valley flat backchannel habitats.								aquatic habitat	backchannel	Restoration, Enhancement	Proposed	4/4/2005

Completed, Ongoing, and Proposed Projects

Lead Funding Source	Supplemental Funding Source	Project Name	Description	Sponsoring Program/Participating Agencies	Target Species	Cost	Funding Date	Start Date	End Date	Project Type (water quantitiy, water quality, aquatic habitat, terrestrial habitat)	Primary Limiting Factor (passage, flow, aquatic habitat, riparian, terrestrial, wetlands, water quality)	Other Limiting Factors	Objective (Protection, Restoration, Enhancement, Study)	Project Status (Proposed, Initiated, or Completed)	Date Provided
		CMZ 3 - preservation of existing floodplain hardwoods and backchannel habitats.	Preservation of existing floodplain hardwood woodland and backchannel habitats. Bank stabilization using plantings immediately upstream of the backchannel inlet to stabilize current bank erosion.								aquatic habitat	backchannel, riparian, bank stabilization	Protection	Proposed	4/4/2005
		CMZ 4 - preservation of active valley flat habitat.	Preservation of active valley flat habitat. Riparian enhancement planting of the sparsely vegetate lateral bar to enhance existing shrub floodplain and promote establishment of floodplain hardwood woodland.								aquatic habitat	floodplain, riparian	Protection, Enhancement	Proposed	4/4/2005
		CMZ 5 - riparian planting, backchannel creation, hydraulic connection, and preservation of riparian.	Riparian enhancement planting of the active valley flat immediately adjacent to the main channel within the park facilities to promote the regeneration of hardwood trees and a shrub understory. Backchannel creation with a hydraulic connection to the backbar channel located immediately downstream of the park facilities and upstream of the utility line crossing. Creating this backchannel would provide high and low flow habitats. Hydraulic connection to oxbow habitats described in Action Site 6 via culvert construction under SR 2 and the restoration of existing backchannel located at the downstream end of the oxbow outflow. Preservation of floodplain hardwood woodland riparian valley flat habitats along SR 2.								aquatic habitat	riparian, backchannel, floodplain	Protection, Enhancement	Proposed	4/4/2005
		CMZ 6 - hydraulic connection of oxbows, channel enhancement	Hydraulic connection of the oxbow habitats via culvert or bridge construction under SR 2 to restore high and low-flow hydraulics to the abandoned oxbow (backchannel) and valley flat habitat. Enhancement of existing drainage channel connected to the Wenatchee River and located at the downstream end of the oxbow outflow within the valley flat associated with Action Site 5. Design the channel form and elevation to allow high and low-flow events to connect with restored oxbow habitats.								aquatic habitat	backchannel, riparian	Restoration, Enhancement	Proposed	4/4/2005
		CMZ 7 - stabilize and preserve backchannel	Stabilize backchannel inlet to reduce the current need for maintenance dredging. Preserve high-flow backchannel habitat; install LWD downstream of the diversion structure to provide immediate instream habitat complexity during high flow events. Preserve floodplain woodland riparian valley flat habitats.								aquatic habitat	backchannel, in channel habitat, riparian	Protection	Proposed	4/4/2005
		CMZ 8 - hydraulic connection of backchannels and riparian restoration	Hydraulic connection to the backchannel habitats described in Action Site 9 via culvert construction under the Burlington Northern Railroad ballast. Design the culvert size and elevation to allow high and low-flow events to connect with restored oxbow habitats. Preservation of floodplain hardwood woodland riparian valley flat habitats along the main channel.								aquatic habitat	backchannel, riparian	Protection	Proposed	4/4/2005
		CMZ 9 - hydraulic connection of backchannel habitats and riparian restoration	Hydraulic connection of the backchannel habitats to the main channel via culvert construction under the Burlington Northern Railroad ballast (Action Site 8). Design the culvert size and elevation to allow high and low-flow events to connect with restored oxbow habitats. Restoration of floodplain hardwood woodland riparian valley flat habitats along the main channe								aquatic habitat	backchannel, riparian	Restoration, Enhancement	Proposed	4/4/2005
		Habitat Improvements near golf course	This project has not been defined in detail, but there is interest in developing ways to improve habitat along the mainstem Wenatchee River at the Leavenworth Golf Course. The property is owned by the City of Leavenworth and is leased to the golf course. Potential projects may includ BMPs, riparian, public outreach.	City of Leavenworth, golf course	salmonids						aquatic		enhancement	Proposed	4/19/2005
		Kayak,whitewater course with habitat improvements	This project would be located on the mainstem Wenatchee River along City of Leavenowrth property (near Blackbird Island). There is a desire among the recreation community to create a whitewater park and provide fish habitat improvements at the same time.	City of Leavenworth, American Whitewater, local recreation	salmonids (1st target may be recreation)								enhancement associated with recreation project	Proposed	4/19/2005
		Wetland Enhancement on Fish and Wildlife Property	This project would be located near the confluence of Icicle Creek and the Wenatchee River and would provide off channel habitat.	City of Leavenworth, WDFW	salmonids						wetlands		Enhancement	Proposed	4/19/2005
		CAO Update	Critical Areas Ordinance Update	City of Leavenworth	aquatic, terrestrial						riparian		Protection	Initiated	4/19/2005
		UGA Critical Areas Master Plan	Development of a UGA Critical Areas Master Plan	City of Leavenworth	aquatic, terrestrial						terrestrial		Protection	Proposed	4/19/2005
TABLE 3 - Completed, Ongoing, and Proposed Projects in the Upper Wenatchee and Chiwaukum Sub-Watersheds															
		Tumwater Falls Passage Plans	Tumwater Falls/Dryden Dams Passage Plans	Bonneville Power Administration		$123,692 for both	1983		1987		passage		Enhancement	Completed	4/27/2005
		Improve the Tumwater Dam Passage	Improve the Tumwater Dam Passage	Bonneville Power Administration		$1,425,900	1985		1986		passage		Enhancement	Completed	4/27/2005

Completed, Ongoing, and Proposed Projects

Lead Funding Source	Supplemental Funding Source	Project Name	Description	Sponsoring Program/Participating Agencies	Target Species	Cost	Funding Date	Start Date	End Date	Project Type (water quantitiy, water quality, aquatic habitat, terrestrial habitat)	Primary Limiting Factor (passage, flow, aquatic habitat, riparian, terrestrial, wetlands, water quality)	Other Limiting Factors	Objective (Protection, Restoration, Enhancement, Study)	Project Status (Proposed, Initiated, or Completed)	Date Provided
TABLE 4 - Completed, Ongoing, and Proposed Projects in the Mission Sub-Watershed															
		Little Camas Creek Culvert Replacement	Little Camas Creek Culvert Replacement	USFS	Chinook						passage		enhancement	Completed	4/4/2005
WDOE, EPA 319 Grant		Lower Mission Creek Planting Project	Vegetative component of an emergency flood control project in lower Mission Creek for three property owners.	CCCD, Cashmere Middle School Recycling Club	salmonids				1996		riparian		Restoration	Completed	4/19/2005
WDOE, EPA 319 Grant		Brender Creek Revegetation	Restoration planting downstream of culvert through Evergreen Dr from Sunset Hwy to mouth of No Name Creek.	CCCD, Cashmere Middle School Recycling Club	salmonids				1996		riparian		Restoration	Completed	4/19/2005
WA Conservation Committsion, Trout Unlimited, Private Landowners		Brender Creek Sediment Pond	Final phase of channel stabilization and sediment settling pond project. Addresses off-channel habitat, high sedimentation from Brender Creek, flood control, and riparian restoration. Partners contributed both services and assistance, such as engineering, design, technical assistance, permitting, construction oversight, plants and labor, in additions to cost share for construction equipment.	CCCD, Trout Unlimited, NRCS, WDFW, Private Landowners	salmonids				1997		aquatic (sedimentation)		Restoration	Completed	4/19/2005
WDOE - Supplemental Watershed Planning		Fecal Coliform Source Analysis	Study and identification of target reaches within streams on 303(d) list for fecal coiform exceedences.	CCCD, WWPU	salmonids	est $30,000					water quality		Study	Completed	4/19/2005
		Wier for fish habitat and surface water withdrawal	1 of 3 Mission Creek log weir project that the CD completed in 1996. These structures were installed to create both fish habitat and a location for surface water withdrawal for orchardists	CCCD	salmonids				1996		passage			Completed	4/4/2005
		Wier for fish habitat and surface water withdrawal	1 of 3 Mission Creek log weir project that the CD completed in 1996. These structures were installed to create both fish habitat and a location for surface water withdrawal for orchardists	CCCD	salmonids				1997					Completed	4/4/2005
		Wier for fish habitat and surface water withdrawal	1 of 3 Mission Creek log weir project that the CD completed in 1996. These structures were installed to create both fish habitat and a location for surface water withdrawal for orchardists	CCCD	salmonids				1998					Completed	4/4/2005
SRFB		Brender Creek Habitat Development	Create a salmonid rearing pond and step pools to connect upstream to a sedimentation pond that collects unusually heavy soil runoff from Brender Creek. Reopen ½ mile of unavailable tributary habitat and create a high quality half acre in-channel salmon and steelhead pond for summer and overwintering of juveniles.	Chelan County Commissioners	salmonids	$43,931 + $3K match	1988				aquatic habitat		Enhancement	Completed	4/4/2005
		Upper Sand Creek Culvert Replacement	Upper Sand Creek Culvert Replacement	USFS	Chinook						passage		enhancement	Completed	4/4/2005
		Lower Sand Creek Culvert Replacement	Lower Sand Creek Culvert Replacement	USFS	Chinook						passage		Enhancement	Completed	4/4/2005
Coastal Protection and USFWS Partners Program		Mission Creek Streambank Project	Streambank stabilization, fish habitat improvement, erosion control	CCCD	steelhead	est. $60,000					water quality (temperature)		Restoration	Initiated	4/19/2005
TABLE 5 - Completed, Ongoing, and Proposed Projects in the Peshastin Sub-Watershed															
BOR		Wenatchee Watershed Habitat Restoration Identification and Prioritization Analysis	This project will identify priority areas for in-stream restoration projects and protection opportunities. The details of this project are still being developed.	BOR	salmonids						aquatic		Restoration, enhancement, protection	Proposed	4/19/2005
Longview Fibre		Remove blocking culvert	Remove blocking culvert in T22 R18E S21	Longview Fibre	fish						passage		enhancement	Completed	4/4/2005
Longview Fibre		Remove blocking culvert	Remove one of four blocking culverts in T27 R17E S31	Longview Fibre	fish						passage		enhancement	Completed	4/4/2005
Longview Fibre		Remove blocking culvert	Remove blocking culvert in T23 R17E S23	Longview Fibre	fish						passage		enhancement	Completed	4/4/2005
Longview Fibre		Made blocking culvert into bridge	Made blocking culvert into bridge at T23 R17 S23	Longview Fibre	fish						passage		enhancement	Completed	4/4/2005

Completed, Ongoing, and Proposed Projects

Lead Funding Source	Supplemental Funding Source	Project Name	Description	Sponsoring Program/Participating Agencies	Target Species	Cost	Funding Date	Start Date	End Date	Project Type (water quantitiy, water quality, aquatic habitat, terrestrial habitat)	Primary Limiting Factor (passage, flow, aquatic habitat, riparian, terrestrial, wetlands, water quality)	Other Limiting Factors	Objective (Protection, Restoration, Enhancement, Study)	Project Status (Proposed, Initiated, or Completed)	Date Provided
		CCCD instream sturcture on Mill Creek	This is the location of an in stream project that was implemented in 2004 on Mill Creek, a tributary to Peshastin Creek, by the CD. It involved installing a new fish screen on the irrigation diversion and fish passage structures (6) to allow for passage past the diversion point. The old screen was not compliant with current WDFW standards and just below the diversion point the stream had down cut approximately 4' and was a fish passage barrier. Attachments 4 and 5 (completed project3 and 4) show this project after completion.	CCCD/Chelan County	fish				2004		passage		Enhancement	Completed	4/4/2005
WA Conservation Commission		Riparian Restoration	Streambank buffer restoration projects with two landowners through the Conservation Reserve Enhancement Program (CREP).	CCCD	fish	est. $4,000			2001		riparian		Restoration	Completed	4/19/2005
SRFB		Peshastin Creek Fish Barrier Removal	Build a fish passage structure at Peshastin Irrigation District diversion structure on lower Peshastin Creek. Structure will allow access to spawning and rearing habitat for steelhead, bull trout and spring Chinook.	Chelan County	salmonids	$70,000 + $255,000 match	2004				passage		Enhancement	Completed	4/4/2005
SRFB		Peshastin Irrigation Dam / Fish Barrier	Build a fish passage structure at Peshastin Irrigation District diversion structure on lower Peshastin Creek. Structure will allow access to 29.5 km of spawning and rearing habitat for steelhead, bull trout and spring Chinook.	Chelan County Commissioners	salmonids	$100,000 + no match	1998				passage		Enhancement	Initiated	4/4/2005
SRFB		Peshastin Creek Off-Channel Development	Develop an off-channel stream/pond system and riparian vegetation within the Peshastin Creek bypass channel parallel to Peshastin Creek. Project will provide critical summer and overwintering habitat for steelhead, bull trout and spring Chinook.	Chelan County Commissioners	salmonids	$22,264 + no match	1988				aquatic habitat		Enhancement	Initiated, then Discont	4/4/2005
		CMZ 17 - Peshastin Creek channel reconnection, riparian planting	Conceptual drawing in CMZ study. Reconnecting Peshastin Creek to its historic valley flat and natural channel. Riparian enhancement planting of the valley flat to restore a forested valley flat habitat. Removing and relocating fill material from the active valley flat.								aquatic habitat	floodplain, riparian	Restoration, Enhancement	Proposed	4/4/2005
TABLE 6 - Completed, Ongoing, and Proposed Projects in the Chumstick Sub-Watershed															
		Fish passage on Chumstick	1 of 8 fish passage projects on Chumstick. These culverts were identified by the NRCS as being fish passage barriers and were replaced in 2001 by the CD.	CCCD/NRCS	salmonids						passage		Enhancement	Completed	4/4/2005
		Phase I Fish passage on Chumstick	1 of 8 fish passage projects on Chumstick. These culverts were identified by the NRCS as being fish passage barriers and were replaced in 2001 by the CD.	CCCD/NRCS	salmonids						passage		Enhancement	Completed	4/4/2005
		Phase I Fish passage on Chumstick	1 of 8 fish passage projects on Chumstick. These culverts were identified by the NRCS as being fish passage barriers and were replaced in 2001 by the CD.	CCCD/NRCS	salmonids						passage		Enhancement	Completed	4/4/2005
		Phase I Fish passage on Chumstick	1 of 8 fish passage projects on Chumstick. These culverts were identified by the NRCS as being fish passage barriers and were replaced in 2001 by the CD.	CCCD/NRCS	salmonids						passage		Enhancement	Completed	4/4/2005
		Phase I Fish passage on Chumstick	1 of 8 fish passage projects on Chumstick. These culverts were identified by the NRCS as being fish passage barriers and were replaced in 2001 by the CD.	CCCD/NRCS	salmonids						passage		Enhancement	Completed	4/4/2005
		Phase I Fish passage on Chumstick	1 of 8 fish passage projects on Chumstick. These culverts were identified by the NRCS as being fish passage barriers and were replaced in 2001 by the CD.	CCCD/NRCS	salmonids						passage		Enhancement	Completed	4/4/2005
		Phase I Fish passage on Chumstick	1 of 8 fish passage projects on Chumstick. These culverts were identified by the NRCS as being fish passage barriers and were replaced in 2001 by the CD.	CCCD/NRCS	salmonids						passage		Enhancement	Completed	4/4/2005
		Phase I Fish passage on Chumstick	1 of 8 fish passage projects on Chumstick. These culverts were identified by the NRCS as being fish passage barriers and were replaced in 2001 by the CD.	CCCD/NRCS	salmonids						passage		Enhancement	Completed	4/4/2005
BOR - design only		McDevitt Diversion Project	This project proposes to address an approximately 2 foot barrier and unscreened diversion associated with irrigation withdrawal on the lower Chumstick Creek. BOR is doing the design work ($29, 326) Current construction estimate is for $17,000. Funding has not been secured for construction.	Bureau of Reclamation (BOR)	Spring chinook, steelhead	design $29,326 const. Est. $17,000					passage		Restoration	Initiated	4/19/2005
		Phase II Fish Passage on Chumstick	Fish passage on Chumstick	CCCD/NRCS	salmonids						passage		Enhancement	Proposed	4/4/2005
		Phase II Fish Passage on Chumstick	Fish passage on Chumstick	CCCD/NRCS	salmonids						passage		Enhancement	Proposed	4/4/2005
		Phase II Fish Passage on Chumstick	Fish passage on Chumstick	CCCD/NRCS	salmonids						passage		Enhancement	Proposed	4/4/2005
		Phase II Fish Passage on Chumstick	Fish passage on Chumstick	CCCD/NRCS	salmonids						passage		Enhancement	Proposed	4/4/2005
		Phase II Fish Passage on Chumstick	Fish passage on Chumstick	CCCD/NRCS	salmonids						passage		Enhancement	Proposed	4/4/2005
		Phase II Fish Passage on Chumstick	Fish passage on Chumstick	CCCD/NRCS	salmonids						passage		Enhancement	Proposed	4/4/2005
		Phase II Fish Passage on Chumstick	Fish passage on Chumstick	CCCD/NRCS	salmonids						passage		Enhancement	Proposed	4/4/2005
		Phase II Fish Passage on Chumstick	Fish passage on Chumstick	CCCD/NRCS	salmonids						passage		Enhancement	Proposed	4/4/2005
		Phase II Fish Passage on Chumstick	Fish passage on Chumstick	CCCD/NRCS	salmonids						passage		Enhancement	Proposed	4/4/2005
		Phase II Fish Passage on Chumstick	Fish passage on Chumstick	CCCD/NRCS	salmonids						passage		Enhancement	Proposed	4/4/2005
SRFB		Final Phase Chumstick Culvert Replacement	The overall goal of this project is to enhance and improve salmonid migration throughout the Chumstick drainage. These projects, coupled with the replacement of a large culvert on Highway 209/North Road (funded by Bonneville Power Administration) will provide access to 78 Sq. miles for anadromous and resident fish.	Chelan County Conservation District	salmonids	$273,100 + $70,000 match	2001				passage		Enhancement	Proposed	4/4/2005

Completed, Ongoing, and Proposed Projects

Lead Funding Source	Supplemental Funding Source	Project Name	Description	Sponsoring Program/Participating Agencies	Target Species	Cost	Funding Date	Start Date	End Date	Project Type (water quantitiy, water quality, aquatic habitat, terrestrial habitat)	Primary Limiting Factor (passage, flow, aquatic habitat, riparian, terrestrial, wetlands, water quality)	Other Limiting Factors	Objective (Protection, Restoration, Enhancement, Study)	Project Status (Proposed, Initiated, or Completed)	Date Provided
SRFB		Chumstick Creek Fish Barrier - North Road #1	Replace an existing round culvert on North Road to create a natural creek bed and resting pools at intermittent locations to facilitate fish migration. Existing culvert precludes fish passage durin low flow due to the steep gradient and inadequate water depth and at other times due to high velocities and excessive length of pipe.	Chelan County Commissioners	salmonids	$42,000 + $170,000 match	1988				passage		Enhancement	Proposed	4/4/2005
SRFB		Chumstick Creek Barrier Removal - North Road #2	Replace an existing culvert on North Road that precludes fish passage with a large diameter counter-sunk pipe allowing ESA-listed threatened and endangered salmonids and other migratory fish species to access .78 miles of quality spawning and rearing habitat in the Chumstick Creek watershed.	Chelan County Public Works	salmonids	$370,372 + $501,400 match	2000				passage		Enhancement	Proposed	4/4/2005
		Chumstick Groundwater Study and Water Balance	There is a need for a ground water study of the entire Chumstick drainage area in order that a proper water balance can be completed. Antidotal reports of longtime residents tell of extensive historical salmon runs in the lower portions of the Creek. Parts of the creek go dry.												4/19/2005
		Chumstick - Titus Mitigation Site Development	Wetland restoration as mitigation for the Chumstick-Titus Road construction. This would be 1:1 mitigation somewhere in the Wenatchee Watershed.	City of Leavenworth	terrestrial						wetlands		Study (site development), then enhancement.	Proposed	4/19/2005
TABLE 7 - Completed, Ongoing, and Proposed Projects in the Icicle Sub-Watershed															
SRFB		Wetland and Riparian Complex Acquisition	CDLT seeks to acquire and protect the wetland and riparian complex at the mouth of the Icicle and Wenatchee Rivers. This 50-acre site is one of the most important salmonids spawning and rearing areas in the region and contributes to habitat used by endangered spring Chinook, endangered steelhead, threatened bull trout, fall Chinook, cutthroat trout, and the most important remaining run of Columbia Basin sockeye salmon. There is development pressure in the area, and it will continue to be more expensive and potentially unavailable in the future.	Chelan-Douglas Land Trust	salmonids	$1,337,800 + $250,000 match	2001				aquatic habitat		protection	Completed	4/4/2005
SRFB		Icicle Creek Reach Level Analysis	Perform a reach-level assessment of the lower reach of Icicle Creek, which extends from the confluence with the Wenatchee River to the Leavenworth National Fish Hatchery (2.8 river miles). This reach is utilized by chinook, steelhead, sockeye, and bull trout, and is the focus of coho reestablishment efforts by the Yakama Nation. We propose to perform an assessment of lower Icicle Creek and synthesize data obtained together with existing information to develop a restoration and protection strategy for the reach. Completion of the assessment, and a restoration and protection strategy will facilitate coordinated efforts to restore floodplain functior in the lower Icicle. This was done on the lowest reach of Icicle Creek, just below the Hatchery down to the mouth.	Icicle Valley Chapter of Trout Unlimited	salmonids	$40,375 + $7,125 match	2002				aquatic habitat		Study	Completed	4/4/2005
		LNH Icicle Creek Restoration Project	The final engineering reviews of Phase II are underway, funding and permits are being secured and plans for work to proceed are in place for this summer. As directed in the Environmental Impact Statement (EIS) completed in January of 2002, this project provides fish passage and habitat improvements while protecting downstream neighbors from flooding, supporting a very important Yakama Indian Tribal Fishery, and maintaining existing Leavenworth National Fish Hatchery operations	U.S. Fish and Wildlife Service, U.S. Forest Service	salmonids	$5,700,000 +		2003	ongoing		aquatic habitat		restoration	Initiated	4/4/2005
		CMZ Site #21 - Possible restoration or enhancement opportunities.	This site was identified in Phase 1 of the CMZ Study using aerial photo interpretation. Ponderosa pine woodland at confluence of Icicle Creek and Wenatchee River warrants preservation and may provide site for future instream structure installation for in-channel habitat enhancement. Additional study is needed determine restoration/enhancement opportunities.	Chelan County NRP	aquatic, terrestrial						riparian		Study	Proposed	4/19/2005
		CMZ Site #22 - Possible restoration or enhancement opportunities.	This site was identified in Phase 1 of the CMZ Study using aerial photo interpretation. Wooded areas provide good riparian function. More detailed onsite studies are needed to determine these areas' role as high flow refugia.	Chelan County NRP	aquatic, terrestrial						riparian		Study	Proposed	4/19/2005
		CMZ Site #23 - Possible restoration or enhancement opportunities.	This site was identified in Phase 1 of the CMZ Study using aerial photo interpretation. Wooded areas provide good riparian function and constitute existing high flow refugia. Additional study is needed determine restoration/enhancement opportunities.	Chelan County NRP	aquatic, terrestrial						riparian		Study	Proposed	4/19/2005

Completed, Ongoing, and Proposed Projects

Lead Funding Source	Supplemental Funding Source	Project Name	Description	Sponsoring Program/Participating Agencies	Target Species	Cost	Funding Date	Start Date	End Date	Project Type (water quantitiy, water quality, aquatic habitat, terrestrial habitat)	Primary Limiting Factor (passage, flow, aquatic habitat, riparian, terrestrial, wetlands, water quality)	Other Limiting Factors	Objective (Protection, Restoration, Enhancement, Study)	Project Status (Proposed, Initiated, or Completed)	Date Provided
		CMZ Site #24 - Possible restorationor enhancement opportunities.	This site was identified in Phase 1 of the CMZ Study using aerial photo interpretation. Active floodplain immediately downstream of fish hatchery provides high flow structure and may provide a good site for instream structure placement, riparian plantings and off-channel habitat creation. Additional study is needed determine restoration/enhancement opportunities.	Chelan County NRP	aquatic						aquatic		Study	Proposed	4/19/2005
		Icicle Floodplain Protection	Protect Icicle Creek floodplain through acquisitions and/or conservation easements.	CDLT (others?)	fish, terrestrial						riparian, floodplain		Protection	Proposed	4/19/2005
		City of Leavenworth fish screen	Install fish screen at the intake point for the City of Leavenworth intake point for the water treatment plant.	City of Leavenworth	salmonids						aquatic		enhancement	Proposed	4/4/2005
BOR		Wenatchee Watershed Habitat Restoration Identification and Prioritization Analysis	This project will identify priority areas for in-stream restoration projects and protection opportunities. The details of this project are still getting developed.	BOR	salmonids						aquatic		Restoration, enhancement, protection	Proposed	4/19/2005
TABLE 8 - Completed, Ongoing, and Proposed Projects in the Nason Sub-Watershed															
Longview Fibre		Made blocking culvert into bridge	Made blocking culvert into bridge at T26 R16E S13	Longview Fibre	salmonids						passage		enhancement	Completed	4/4/2005
Longview Fibre		Remove blocking culvert	Remove one of four blocking culverts in T27 R17E S31	Longview Fibre	salmonids						passage		enhancement	Completed	4/4/2005
Longview Fibre		Remove blocking culvert	Remove one of four blocking culverts in T27 R17E S31	Longview Fibre	salmonids						passage		enhancement	Completed	4/4/2005
Longview Fibre		Remove blocking culvert	Remove one of four blocking culverts in T27 R17E S31	Longview Fibre	salmonids						passage		enhancement	Completed	4/4/2005
		CMZ Nason 1 - hydraulic connection of oxbows and riparian restoration	Hydraulic connection of the oxbow habitats via culvert construction under SR 207; and the enhancement of the oxbow channel to provide high-flow and low-flow habitat, and increase current valley flat hydraulic capacity. Restoration of riparian forest into the active valley flat.								aquatic habitat	backchannel, riparian	Restoration, Enhancement	Proposed	4/4/2005
		CMZ Nason 2 - hydraulic connection of oxbows and riparian restoration	Conceptual drawing in CMZ study. Hydraulic connection of the oxbow habitats via culvert construction under SR 207; and the enhancement of the oxbow channel to provide high-flow and low-flow habitat, and increase current valley flat hydraulic capacity. Restoration of riparian forest into the active valley flat.								aquatic habitat	backchannel, riparian	Restoration, Enhancement	Proposed	4/4/2005
		CMZ Nason 3 - hydraulic connection of oxbows and riparian restoration	Conceptual drawing in CMZ study. Hydraulic connection of the oxbow habitats via culvert construction under SR 207; and the enhancement of the oxbow channel to provide high-flow and low-flow habitat, and increase current valley flat hydraulic capacity. Restoration of riparian forest into the active valley flat.								aquatic habitat	backchannel, riparian	Restoration, Enhancement	Proposed	4/4/2005
		CMZ Nason 4 - hydraulic connection of oxbows and riparian restoration.	Hydraulic connection of the oxbow habitats via culvert construction under SR 207; and the enhancement of the oxbow channel to provide high-flow and low-flow habitat, and increase current valley flat hydraulic capacity. Restoration of riparian forest into the active valley flat.								aquatic habitat	backchannel, riparian	Restoration, Enhancement	Proposed	4/4/2005
		CMZ Nason 5 - wetland habitat preservation.	Preserve wetland habitats and possibly used for wetland mitigation projects in the future								wetlands	wetlands	Protection	Proposed	4/4/2005
BOR		Wenatchee Watershed Habitat Restoration Identification and Prioritization Analysis	This project will identify priority areas for in-stream restoration projects and protection opportunities. The details of this project are still getting developed.	BOR	fish						aquatic		Restoration, enhancement, protection	Proposed	4/19/2005
TABLE 9 - Completed, Ongoing, and Proposed Projects in the Chiwawa Sub-Watershed															
Chelan County		Beaver Creek Culvert Replacement	Replace culvert with a 20 foot modular bridge unit to oprn up habitat for spring chinook and steelhead (possibly bull trout) on Beaver Creek. This project is located on Chiwawa Loop Rd, mailpost 0.0, Section 12, T26N R17. This project will take place at RM 0.3 on Beaver Creek.	Chelan County Public Works	salmonids	est. $90,000					passage		Restoration	Initiated	4/27/2005

Completed, Ongoing, and Proposed Projects

Lead Funding Source	Supplemental Funding Source	Project Name	Description	Sponsoring Program/Participating Agencies	Target Species	Cost	Funding Date	Start Date	End Date	Project Type (water quantitiy, water quality, aquatic habitat, terrestrial habitat)	Primary Limiting Factor (passage, flow, aquatic habitat, riparian, terrestrial, wetlands, water quality)	Other Limiting Factors	Objective (Protection, Restoration, Enhancement, Study)	Project Status (Proposed, Initiated, or Completed)	Date Provided
TABLE 10 - Completed, Ongoing, and Proposed Projects in the Upper Watershed (Lake Wenatchee, White, and Little Wenatchee Sub-Watersheds)															
		Little Wenatchee, Nason, Rainey/L.wenatchee	Check cam's email/Cindy Raekas	USFS	salmonids									Completed	4/4/2005
CDLT		Acquisition of 37 acres	Acquisition of 37 acres in the White River watershed from Glenn Martin by CDLT. Parcel is #27169440000.	Chelan Douglas Land Trust	fish, terrestrial		2005	2005	2005		riparian	aquatic habitat, terrestrial habitat	protection	completed	4/4/2005
CDLT/WDFW		Acquisition	Acquisition	Washington Department of Fish and Wildlife and Chelan Douglas Land Trust	fish, terrestrial						riparian	aquatic habitat, terrestrial habitat	protection	completed	4/4/2005
CDLT/WDFW		Acquisition	Acquisition	Washington Department of Fish and Wildlife and Chelan Douglas Land Trust	fish, terrestrial						riparian	aquatic habitat, terrestrial habitat	protection	completed	4/4/2005
CDLT		Acquisition of 20 acres	Acquisition of 20 acres in the White River watershed from Glenn Martin by CDLT. Parcel is #271616110050	Chelan Douglas Land Trust	fish, terrestrial		2005	2005	2005		riparian	aquatic habitat, terrestrial habitat	protection	completed	4/4/2005
CDLT/WDFW		Acquisition of 240 acres	Acquisition of 240 acres by the CDLT and WDFW from Longview Fibre. Parcel is #281632000050	Washington Department of Fish and Wildlife and Chelan Douglas Land Trust	fish, terrestrial						riparian	aquatic habitat, terrestrial habitat	protection	completed	4/4/2005
CDLT/WDFW		Acquisition of 27 acres	Acquisition of 27 acres from Jo M. Levin by CDLT and WDFW. Parcel is #271604310000	Washington Department of Fish and Wildlife and Chelan Douglas Land Trust	fish, terrestrial						riparian	aquatic habitat, terrestrial habitat	protection	completed	4/4/2005
CDLT/WDFW		Acquisition of 40 acres	Acquisition of 40 acres from WICO by CDLT and WDFW. Parcel is #271609140000	Washington Department of Fish and Wildlife and Chelan Douglas Land Trust	fish, terrestrial						riparian	aquatic habitat, terrestrial habitat	protection	completed	4/4/2005
CDLT/WDFW		Acquisition of 38 acres	Acquisition of 38 acres from WICO by CDLT and WDFW. Parcel is #27160940050	Washington Department of Fish and Wildlife and Chelan Douglas Land Trust	fish, terrestrial						riparian	aquatic habitat, terrestrial habitat	protection	completed	4/4/2005
CDLT/WDFW		Acquisition of 21 acres	Acquisition of 21 acres from Christy Collins by CDLT and WDFW. Parcel is #271610300050	Washington Department of Fish and Wildlife and Chelan Douglas Land Trust	fish, terrestrial						riparian	aquatic habitat, terrestrial habitat	protection	completed	4/4/2005
CDLT/WDFW		Acquisition of 21 acres	Acquisition of 21 acres from Christy Collins by CDLT and WDFW. Parcel is #271610300050	Washington Department of Fish and Wildlife and Chelan Douglas Land Trust	fish, terrestrial						riparian	aquatic habitat, terrestrial habitat	protection	completed	4/4/2005
CDLT/WDFW		Acquisition of 2.5 acres	Acquisition of 2.57 acres from WICO by CDLT and WDFW.	Washington Department of Fish and Wildlife and Chelan Douglas Land Trust	fish, terrestrial						riparian	aquatic habitat, terrestrial habitat	protection	completed	4/4/2005
CDLT/WDFW		Acquisition of 50 acres	Acquisition of 50 acres from Walter E. Williams by CDLT and WDFW. Parcel is #271615220050	Washington Department of Fish and Wildlife and Chelan Douglas Land Trust	fish, terrestrial						riparian	aquatic habitat, terrestrial habitat	protection	completed	4/4/2005
SRFB		White River Floodplain Restoration	Reestablish off channel habitat access for salmon and steelhead in an old oxbow at the end of the Sears Creek Road along the White River. Obliteration of the road and removal of two culverts will reestablish fish access into .5 miles of off channel habitat and allow the floodplain to functio naturally in this area during high flows.	Eastern Washington Regional Fisheries Enhancement Group, Salmon Recovery Funding Board, Chelan-Douglas Land Trust	bull trout, chinook, cutthroat, sockeye, steelhead	$50,000 + $90,000 match	1999		10/15/2004		passage		Enhancement	Completed	4/4/2005
		White R. Logjam		USFS					2004					Completed	4/4/2005
		White R. Oxbow Restoration Project		USFS					2002					Completed	4/4/2005
		White R. Spur Roads Project		USFS					2004					Completed	4/4/2005
		White River Floodplain Protection	Protect White River floodplain through acquisitions and/or conservation easements.	CDLT (other, depending on location)	fish, terrestrial						riparian, floodplain		Protection	Proposed	4/19/2005
		White River Habitat Improvement	Restoration and habitat improvement projects in the White River	CDLT (USFS, others?)	fish, terrestrial						riparian		Restoration/Enhanc ment	Proposed	4/19/2005
		Closure of White and Little Wenatchee Rivers to motorized water craft	There is some public interest in closing the White and Little Wenatchee Rivers to motorized water craft, especially when fish are spawning. The high speeds of jet skis and other motorized vehicles exacerbates the bank erosion problem as well.		fish						aquatic		Protection	Proposed	4/19/2005
		Lake Wenatchee Fish Pen Waste	The concentration of fish pens with the resultant concentration of fish food and fish waste is resulting in continued concern by local residents concerning water quality in Lake Wenatchee, especially at the northwest end of the lake (many residents take their dirinking water directly fror the lake).		salmonids						water quality		enhancement, protection	Proposed	4/19/2005
BOR		Wenatchee Watershed Habitat Restoration Identification and Prioritization Analysis	This project will identify priority areas for in-stream restoration projects and protection opportunities. The details of this project are still being developed.	BOR, USFS, Chelan County	salmonids						aquatic		Restoration, enhancement, protection	Proposed	4/19/2005

TABLE 11

Proposed Wenatchee Habitat Projects - Biological Needs in Category 1 Sub-Watersheds

Chiwawa River Sub-Watershed

Biological Priorities	*Project Name*
1) Protect remaining floodplain and riparian habitat, particularly around Chikamin Flats.	
2) Investigate the role of surface and well water withdrawals on instream flows and habitat use. Develop strategies with water users to reduce effects, if any.	No Projects Identified
3) Initiate public information efforts to discourage harassment of spawning spring chinook salmon and bull trout.	
4) Manage recreation areas to reduce or avoid impacts to riparian habitats.	

Mainstem Upper Wenatchee River (Lake Wenatchee to Tumwater

Biological Priorities	*Project Name*
1) Protect remaining floodplain and riparian habitat.	
2) Restore channel migration to resemble historical function.	No Projects Identified
3) If restoration is not possible, improve fish access to oxbows and historical side channels that have been cut off from the mainstem.	
4) Initiate public information efforts to discourage harassment of spawning summer chinook salmon.	
5) Reduce nonpoint pollution from septic tanks and livestock.	
6) Initiate public information efforts to encourage protection of riparian habitat.	
UNRATED	Beaver Creek Culvert Replacement

Mainstem Middle Wenatchee (Tumwater Canyon)

Biological Priorities	*Project Name*
1) Protect existing riparian habitat.	
2) Address passage barriers at Skinney Creek near mouth.	No Projects Identified

Little Wenatchee Sub-Watershed

Biological Priorities	*Project Name*
1) Protect stream channel, riparian and floodplain functions: focus on Little Wenatchee River falls downstream to mouth.	
2) Address road impacts in the drainage, emphasis on Rainy Creek and Little Wenatchee between Hidden Creek and Fir Creek.	No Projects Identified
3) Restore wetland complexes that connect to stream channel.	
4) Manage recreation areas to reduce impacts to riparian cover.	
5) Initiate public information efforts to discourage harassment of spawning salmonids.	

White River Sub-Watershed

Biological Priorities	*Project Name*
1) Protect stream channel, riparian and floodplain functions. Focus on Panther Creek dodwnstream to mouth.	Wenatchee Watershed Habitat Restoration Identification and Prioritization Analysis
	White River Floodplain Protection
2) Restore wetland complexes that connect to stream channel.	White River Habitat Improvement
3) Protect shorelines along Lake Wenatchee ner White River mouth.	
4) Initiate public information efforts to discourage harassment of spawning spring chinook, sockeye salmon, and bull trout.	
5) Manage recreation areas to reduce impacts to riparian cover.	
UNRATED	Closure of White and Little Wenatchee Rivers to motorized water craft

Lake Wenatchee Sub-Watershed

Biological Priorities	*Project Name*
1) Protect remaining near shore habitat, and develop a means to reduce impacts of bulkheads.	
UNRATED	Lake Wenatchee Fish Pen Waste

In regards to Biological Needs: Category 1 sub-watersheds should receive priority allocation of financial and management resources. Subsequent allocation of resources should be given to Categories 2 and 3, in that order, once refuge habitats (Category 1) for the target species are protected and secured. This does not mean, however, that specific actions should not occur in Category 2 and 3 sub-watersheds until all activities in Category 1 sub-watersheds are completed. Any projects within those sub-watersheds that increase the range, life history diversity, or age cohorts of one or more species would contribute to the overall strategy of making them more robust to disturbances outside and within the region. Sub-watershed categories, and priorities of actions within each sub-watershed, are illustrated in Figure 1.

TABLE 12

Proposed Wenatchee Habitat Projects - Biological Needs in Category 2 Sub-Watersheds

*Mainstem Lower Wenatchee River Sub-Watershed (Tumwater to Mouth)	
Biological Priorities	***Project Name***
1) Protect existing riparian habitat and channel migration floodplain function.	CMZ 2 - backchannel creation and riparian enhancement and preservation
	CMZ 3 - preservation of existing floodplain hardwoods and backchannel habitats.
	CMZ 20 - backchannel creation and riparian enhancement
	CMZ 11 - hydraulic connection and preserve riparian
	CMZ 5 - riparian planting, backchannel creation, hydraulic connection, and preservation of riparian.
	CMZ 7 - stabilize and preserve backchannel
	CMZ 12 - preserve valley flat, floodplain riparian, and backchannel
	CMZ 4 - preservation of active valley flat habitat.
2) Restore channel migration to normative function.	Dryden Fish Enhancement CMZ Project: study potential creation of off-channel rearing
	Gagnon CMZ Project Feasibility: study hydrogeomorphic feasibility of off-channel creation (CMZ 10)
	CMZ 6 - hydraulic connection of oxbows, channel enhancement
	Irwin CMZ Project Feasibility: backchannel creation, riparian enhncement, and avulsion barrier. (CMZ 19)
	CMZ 19a -hydraulic connection with backchannel
	CMZ 9 - hydraulic connection of backchannel habitats and riparian restoration
	CMZ 13 - hydraulic connection and riparian enhancement
	CMZ 14 - riparian buffer planting
	CMZ 16 - riparian planting
	CMZ 8 - hydraulic connection of backchannels and riparian restoration
	CMZ 18 - road retirement and riparian planting
	Habitat Improvements near golf course
	Wetland Enhancement on Fish and Wildlife Property
	Wetland Enhancement on Fish and Wildlife Property
3) If restoration is not possible, improve fish access to oxbows and historical side channels.	
4) Increase late summer flows.	
UNRATED	Kayak,whitewater course with habitat improvements
	CAO Update
	UGA Critical Areas Master Plan

Peshastin Creek Sub-Watershed	
Biological Priorities	***Project Name***
1) Increase stream sinuosity and floodplain function from Ingalls Creek to mouth.	CMZ 17 - Peshastin Creek channel reconnection, riparian planting
2) Restore flow from Camas Creek to mouth.	
3) Other projects should be delayed until stream sinuosity and flows are addressed.	
UNRATED	Wenatchee Watershed Habitat Restoration Identification and Prioritization Analysis

Icicle Creek Sub-Watershed	
Biological Priorities	***Project Name***
1) Protect remaining floodplain and riparian habitat downstream of Chatter Creek. Emphasis should be placed on habitat downstream of Leavenworth Hatchery.	CMZ Site #21
	CMZ Site #22
	CMZ Site #23
	CMZ Site #24
	Icicle Floodplain Protection
	Wenatchee Watershed Habitat Restoration Identification and Prioritization Analysis
2) Rectify human-made passage barriers.	
3) Restore flow conditions on Icicle Creek downstream of Rat Creek.	
4) Investigate the role of surface and well water withdrawals on instream flows and	Fish Screen
5) Develop strategies with water users to reduce effects, if any.	
6) Initiate public information efforts to discourage harassment of spawning salmonids.	
7) Manage recreation areas to reduce impacts to riparian cover.	

Nason Creek Sub-Watershed	
Biological Priorities	***Project Name***
1) Protect remaining floodplain and riparian habitat.	CMZ Nason 5 - wetland habitat preservation.
2) Restore channel migration to historical function.	CMZ Nason 1 - hydraulic connection of oxbows and riparian restoration
	CMZ Nason 2 - hydraulic connection of oxbows and riparian restoration
	CMZ Nason 3 - hydraulic connection of oxbows and riparian restoration
	CMZ Nason 4 - hydraulic connection of oxbows and riparian restoration.
	Wenatchee Watershed Habitat Restoration Identification and Prioritization Analysis
3) If restoration is not possible, improve fish access to oxbows and historical side channels.	
4) Initiate public information efforts to discourage harassment of spawning salmonids.	

In regards to Biological Needs: Category 1 sub-watersheds should receive priority allocation of financial and management resources. Subsequent allocation of resources should be given to Categories 2 and 3, in that order, once refuge habitats (Category 1) for the target species are protected and secured. This does not mean, however, that specific actions should not occur in Category 2 and 3 sub-watersheds until all activities in Category 1 sub-watersheds are completed. Any projects within those sub-watersheds that increase the range, life history diversity, or age cohorts of one or more species would contribute to the overall strategy of making them more robust to disturbances outside and within the region. Sub-watershed categories, and priorities of actions within each sub-watershed, are illustrated in Figure 1.

*Although the Lower Mainstem Wenatchee River is a Category 2 sub-watershed, the Biological Strategy states, "Recent research indicates that the mainstem Wenatchee River provides important habitat for many life stages of spring and summer chinook, steelhead, and bull trout. The mainstem at this time is the most vulnerable to riparian and instream habitat degradation. All remaining intact areas on the mainstem should be protected, and flood plain function should be restored, particularly from the Mission Creek confluence downstream to the Columbia River confluence. This would require only passive restoration," (UCRTT, 2003).

TABLE 13

Proposed Wenatchee Habitat Projects - Biological Needs in Category 3 Sub-Watersheds

Chumstick Sub-Watershed	
Biological Priorities	***Project Name***
1) Restore passage for anadromous and inland fish. This should be done in a comprehensive, coordinated strategy, rather than a piecemeal approach.	McDevitt Diversion Project
	North Road Culvert - Chumstick Creek Fish Barrier
	Phase 2 Chumstick Culvert Replacements
2) Protect remaining floodplain and riparian habitat.	
3) Increase stream flow.	
4) Restore riparian habitat, primarily from Eagle Creek to Suntisch Canyon.	
5) Reduce road densities.	
6) Restore stream channel migration.	
7) Reduce nonpoint pollution from septic tanks and livestock.	
8) Reduce fine sediment input from roads and some land management activities.	
UNRATED	Chumstick Groundwater Study and Water Balance

Mission Sub-Watershed	
Biological Priorities	***Project Name***
1) Increase instream flows.	
2) Reduce nonpoint pollution from septic tanks and livestock.	
3) Other projects should be delayed until flow and water quality are addressed.	Mission Creek Streambank Project

In regards to Biological Needs: Category 1 sub-watersheds should receive priority allocation of financial and management resources. Subsequent allocation of resources should be given to Categories 2 and 3, in that order, once refuge habitats (Category 1) for the target species are protected and secured. This does not mean, however, that specific actions should not occur in Category 2 and 3 sub-watersheds until all activities in Category 1 sub-watersheds are completed. Any projects within those sub-watersheds that increase the range, life history diversity, or age cohorts of one or more species would contribute to the overall strategy of making them more robust to disturbances outside and within the region. Sub-watershed categories, and priorities of actions within each sub-watershed, are illustrated in Figure 1.

FIGURES

EXCERPT FROM THE WENATCHEE SUBBASIN PLAN, SECTION 2.5.1

Northwest Power and Conservation Council (NPCC). 2004. Wenatchee Subbasin Plan. Prepared for the Northwest Power and Conservation Council. Lead organizations: Chelan County and the Yakama Nation. Pages xviii – xxi.

2.5.1 Key Findings: Terrestrial

The terrestrial assessment viewed the subbasin from a perspective of key and major vegetative communities. Three community types were identified as focal habitat for this evaluation include: ponderosa pine, shrubsteppe and riparian ecosystems. Within each of these focal habitats, representative species that are directly associated with these vegetative communities are identified for monitoring.

Factors Affecting Ponderosa Pine Habitat

- Repeated timber harvest removed large diameter ponderosa pine and snags, and left the understory. This has resulted in accelerated successional advancement and increased the Douglas fir component.
- Urban and residential development has contributed to loss and degradation of properly functioning ecosystems.
- Fire suppression/exclusion has contributed towards habitat degradation, particularly declines in characteristic herbaceous and shrub understory from increased density of small shade-tolerant trees. High risk of loss of remaining ponderosa pine overstories from stand-replacing fires due to high fuel loads in densely stocked understories.
- Historically, extensive grazing by domestic sheep may have altered understory composition, resulting in loss of forbs and a decrease in shrub densities.
- Overgrazing has resulted in lack of recruitment of sapling trees, particularly pines.
- Invasion of exotic plants has altered understory conditions and increased fuel loads.
- Fragmentation of remaining tracts has negatively impacted species with large area requirements
- Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird), exotic nest competitors (European starling), and domestic predators (cats), and may be subject to high levels of human disturbance.
- The timing (spring/summer versus fall) of restoration/silviculture practices such mowing, thinning, and burning of understory removal may be especially detrimental to singleclutch species.
- Spraying insects that are detrimental to forest health may have negative ramifications on lepidopterans (butterflies) and other non-target bird species.

Factors Affecting Shrubsteppe Habitat

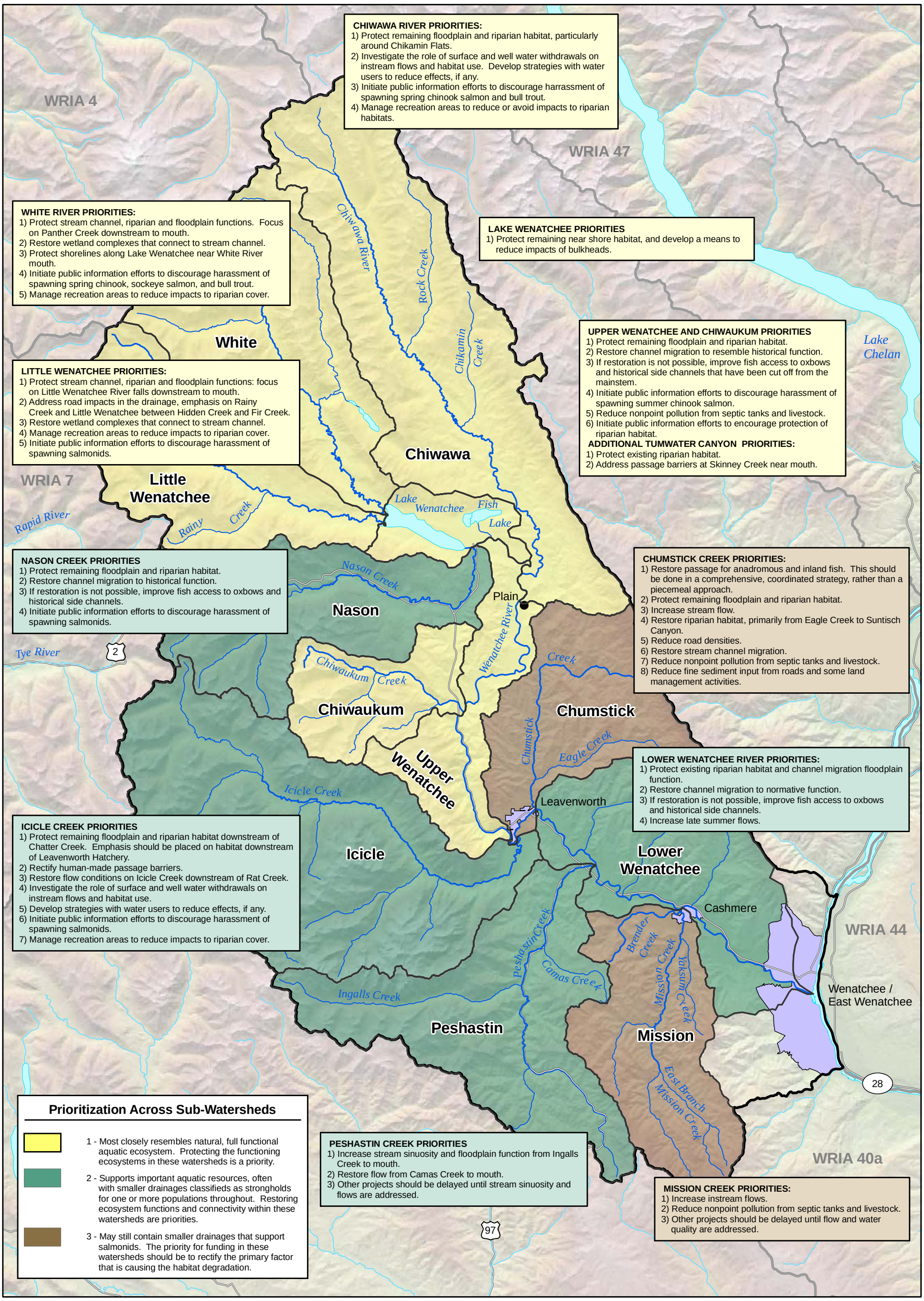
- Permanent habitat conversions of shrubsteppe/grassland habitats (e.g., approximately 60 percent of shrubsteppe in Washington to other uses (e.g., agriculture, urbanization). Significant acreage of shrubsteppe habitat continues to be converted to residential development between Wenatchee and Monitor (USFS 1999b).

- Fragmentation of remaining tracts of moderate to good quality shrubsteppe habitat
- Degradation of habitat from intensive grazing and invasion of exotic plant species, particularly annual grasses such as cheatgrass and woody vegetation such as Russian olive
- Degradation and loss of properly functioning shrubsteppe/grassland ecosystems resulting from the encroachment of urban and residential development and conversion to agriculture. Best sites for healthy sagebrush communities (deep soils, relatively mesic conditions) are also best for agricultural productivity; thus, past losses and potential future losses are great. Most of the remaining shrubsteppe in Washington is in private ownership with little long term protection (57%).
- Loss of big sagebrush communities to brush control (may not be detrimental relative to interior grassland habitats)
- Conversion of Conservation Reserve Program (CRP) lands back to cropland
- Loss and reduction of cryptogamic crusts, which help maintain the ecological integrity of shrubsteppe/grassland communities
- High density of nest parasites (brown-headed cowbird) and domestic predators (cats) may be present in hostile/altered landscapes, particularly those in proximity to agricultural and residential areas subject to high levels of human disturbance.
- Agricultural practices that cause direct or indirect mortality and/or reduce wildlife productivity. There are a substantial number of obligate and semi-obligate avian/mammal species; thus, threats to the habitat jeopardize the persistence of these species.
- Fire management, either fire suppression (USFS 1999b), which has resulted in succession of vegetation communities, or overuse of fire, both of which have lead to loss of shrubsteppe
- Much of the low-elevation shrubsteppe vegetation is currently dominated by cheatgrass and other nonnative plants (USFS 1999b). Invasion and seeding of crested wheatgrass and other introduced plant species reduces wildlife habitat quality and/or availability.

Factors Affecting Riparian Wetland Habitat

- Loss of habitat due to numerous factors including riverine recreational developments, inundation from impoundments, cutting and spraying of riparian vegetation for eased access to water courses, gravel mining, etc
- Habitat alteration from 1)hydrological diversions and control of natural flooding regimes (e.g., dams) resulting in reduced stream flows and reduction of overall area of riparian habitat, loss of vertical stratification in riparian vegetation, and lack of recruitment of young cottonwoods, ash, willows, etc., and 2)stream bank stabilization which narrows stream channel, reduces the flood zone, and reduces extent of riparian vegetation
- Habitat degradation from conversion of native riparian shrub and herbaceous vegetation to invasive exotics such as reed canary grass, purple loosestrife, perennial pepperweed, salt cedar, and indigo bush
- Fragmentation and loss of large tracts necessary for area-sensitive species
- Hostile landscapes, particularly those in proximity to agricultural and residential areas, may have high density of nest parasites (brown-headed cowbird), exotic nest competitors (European starling), and domestic predators (cats), and be subject to high levels of human disturbance.

- High energetic costs associated with high rates of competitive interactions with European starlings for cavities may reduce reproductive success of cavity-nesting species such as Lewis' woodpecker, downy woodpecker, and tree swallow, even when outcome of the competition is successful for these species
- Recreational disturbances (e.g., offroad recreational vehicles (ORVs)), particularly during nesting season, and particularly in high-use recreation areas



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LEGEND

- WRIA 45 Boundary
- WRIA Boundary
- Sub-Watershed Boundary
- Major Road
- Waterbody
- Watercourse
- Urban Area

0 5
Scale in Miles

Map Projection:
Washington State Plane,
North Zone, NAD 83, Feet
Source: Chelan County, USGS, WAGDA, WSDOE, WSDOT, Wenatchee Biological Strategy

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SUB-WATERSHED HABITAT PRIORITIES

Chelan/WRIA 45 Watershed Plan/WA

Drawn: KAV	Revison: 4	Date: June 30, 2005	Figure: 1

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Golder Associates

Recommendations from Wenatchee Biological Strategy:
1) Protect existing riparian habitat and channel migration floodplain function.
2) Restore channel migration to normative function.
3) If restoration is not possible, improve fish access to oxbows and historical side channels.
4) Increase late summer flows.

Chumstick Creek Barrier Removal - North Road #2
Wetland and Riparian Complex Acquisition
CMZ 18 - road retirement and riparian planting
Dryden Dam Passage
Dryden Dam Passage Plans
Dryden Fish Enhancement CMZ Project: study potential creation of off-channel rearing habitat (CMZ 15)
CMZ 11 - hydraulic connection and preserve riparian
Gagnon CMZ Project Feasibility: study hydrogeomorphic feasibility of off-channel creation (CMZ 10)
CCCD riparian revegetation on Wenatchee River (#2)
Jones-Shotwell Diversion Enhancement
CMZ 7 - stabilize and preserve backchannel
CMZ 5 - riparian planting, backchannel creation, hydraulic connection, and preservation of riparian.
CMZ 3 - preservation of existing floodplain hardwoods and backchannel habitats.
CMZ 16 - riparian planting
CMZ 14 - riparian buffer planting
CMZ 12 - preserve valley flat, floodplain riparian, and backchannel
CMZ 13 - hydraulic connection and riparian enhancement
Storm Drain Project
Riverside Park
Lower Mission Creek Planting Project
CMZ 9 - hydraulic connection of backchannel habitats and riparian restoration
CMZ 8 - hydraulic connection of backchannels and riparian restoration
CMZ 6 - hydraulic connection of oxbows, channel enhancement
CMZ 4 - preservation of active valley flat habitat.
CCCD habitat improvement and riparian revegetation on Wenatchee (#1)
CMZ 2 - backchannel creation and riparian enhancement and preservation

Leavenworth
Wenatchee
WRIA 46
WRIA 44
Chumstick Creek
Eagle Creek
Roaring Creek
Derby Canyon
Swakane Creek
Olalla Canyon
Nahahum Canyon
Peshastin Creek
Branch
Mission Creek

Projects

Chelan County Fish Barrier Inventory
- Unknown if Barrier
- Barrier (No barriers on county land on mainstem Mission Creek)

Habitat Projects
- Chelan County Conservation District Habitat Projects
- CMZ Projects
- SRFB Funded Projects
- BPA Projects
- DNR Projects
- Text — Completed or Ongoing Projects
- Text — Proposed Projects

****Barrier coverage provided by Chelan County does not include Forest Service Land and has not been QA'd.

Fish Distribution

Fish Distribution - SSHIAP
- Bull Trout, Spring and Summer Chinook, Sockeye and Summer Steelhead
- Summer Steelhead Only

LEGEND

USFS Northwest Forest Plan
- Administrative Withdrawn Areas (Not for Harvest)
- USFS - Other
- Late Successional Reserves (Not for Harvest)
- Managed Late Successional Areas (Managed Harvest)
- MATRIX (Active Harvest)
- Congressionally Designed Wilderness

Other Land Use Data
- Channel Migration Zone
- Private Forestland
- WNF Roadless Areas
- Other Land Ownership

0 10,000
Scale in Feet

Map Projection: Washington State Plane, North Zone, NAD 83, Feet

Source: Chelan County Conservation District, Chelan County Department of Natural Resources, Normandeau, USFS, USGS, WDFW, WSDOT, WSDOE

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Lower Wenatchee Sub-Watershed: Fish Distribution and Habitat Projects

Chelan/WRIA 45 Watershed Plan/WA

Drawn: ATB	Revison: 4	Date: June 30, 2005	Figure: 2

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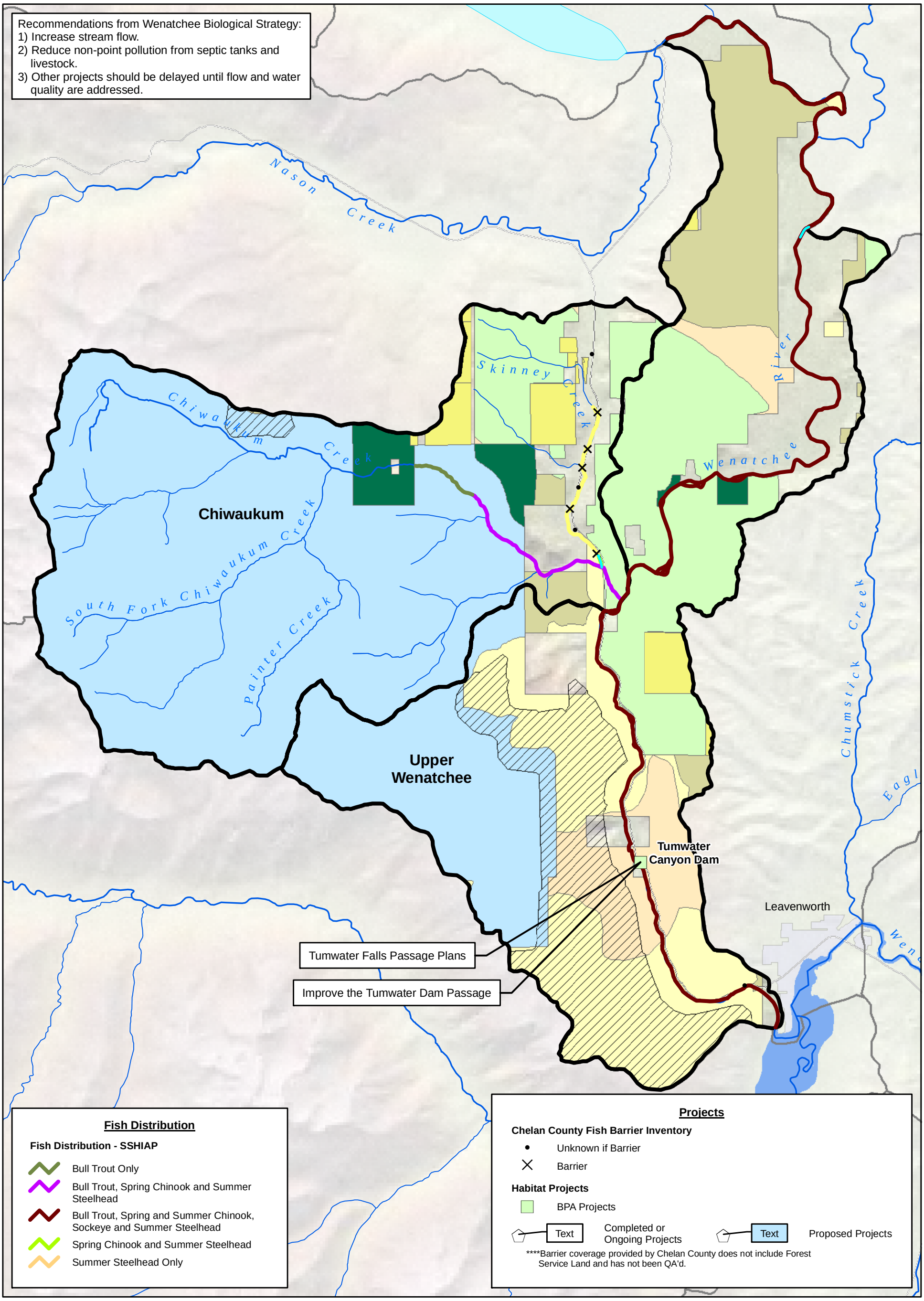

LEGEND

USFS Northwest Forest Plan

- Administrative Withdrawn Areas (Not for Harvest)
- USFS - Other
- Late Successional Reserves (Not for Harvest)
- Managed Late Successional Areas (Managed Harvest)
- MATRIX (Active Harvest)
- Congressionally Designed Wilderness

Other Land Use Data

- Channel Migration Zone
- Private Forestland
- WNF Roadless Areas
- Other Land Ownership

0 1.5
Scale in Miles

Map Projection: Washington State Plane, North Zone, NAD 83, Feet

Source: Chelan County Conservation District, Chelan County Department of Natural Resources, Normandeau, USFS, USGS, WDFW, WSDOT, WSDOE

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Upper Wenatchee and Chiwaukum Sub-Watersheds: Fish Distribution and Habitat Projects

Chelan/WRIA 45 Watershed Plan/WA

Drawn: ATB	Revison: 4	Date: June 30, 2005	Figure: 3

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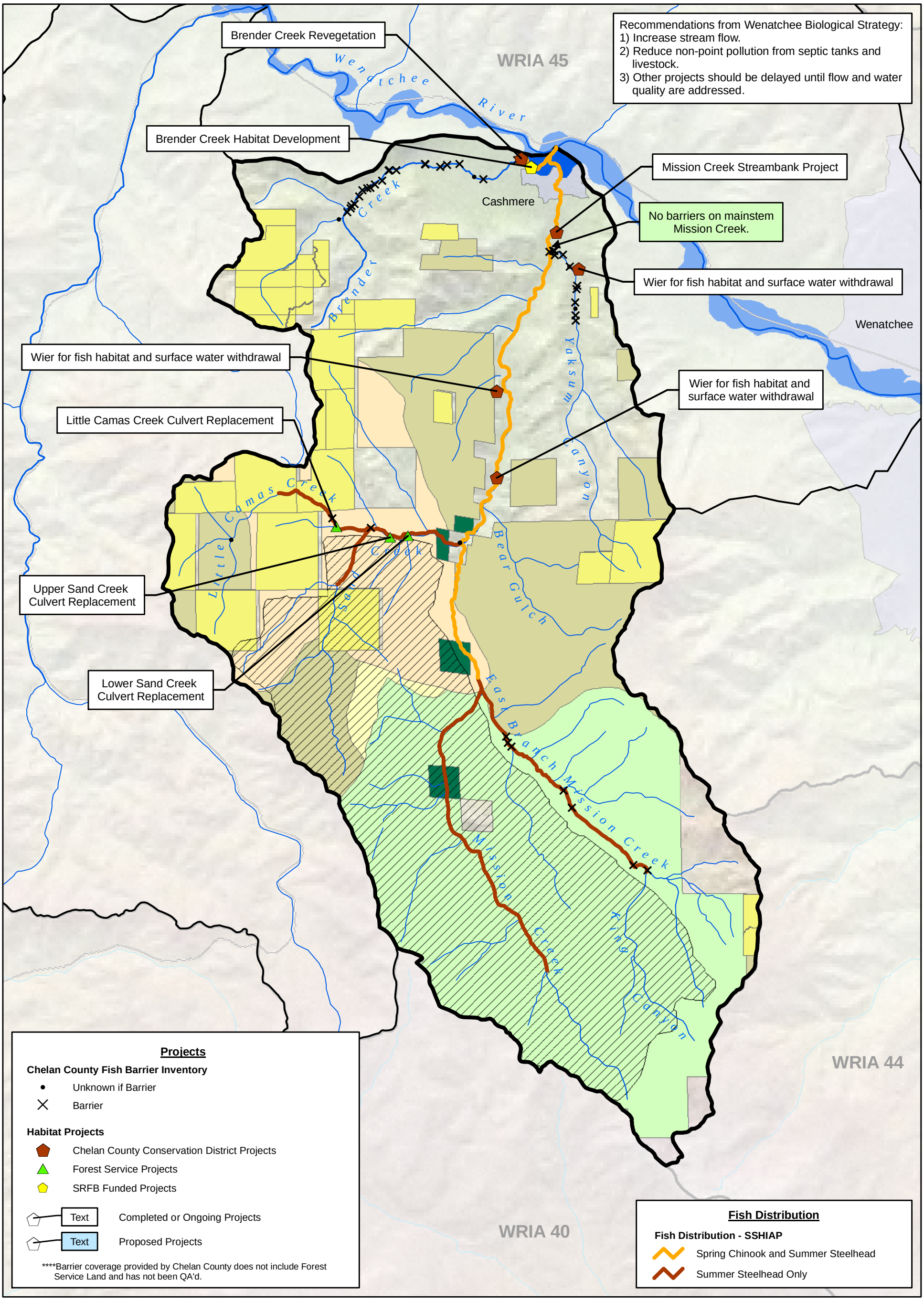

LEGEND

USFS Northwest Forest Plan

- Administrative Withdrawn Areas (Not for Harvest)
- USFS - Other
- Late Successional Reserves (Not for Harvest)
- Managed Late Successional Areas (Managed Harvest)
- MATRIX (Active Harvest)
- Congressionally Designed Wilderness

Other Land Use Data

- Channel Migration Zone
- Private Forestland
- WNF Roadless Areas
- Other Land Ownership

0 1.5
Scale in Miles

Map Projection: Washington State Plane, North Zone, NAD 83, Feet

Source: Chelan County Conservation District, Chelan County Department of Natural Resources, Normandeau, USFS, USGS, WDFW, WSDOT, WSDOE

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Mission Sub-Watershed: Fish Distribution and Habitat Projects

Chelan/WRIA 45 Watershed Plan/WA

Drawn: ATB	Revison: 4	Date: June 30, 2005	Figure: 4

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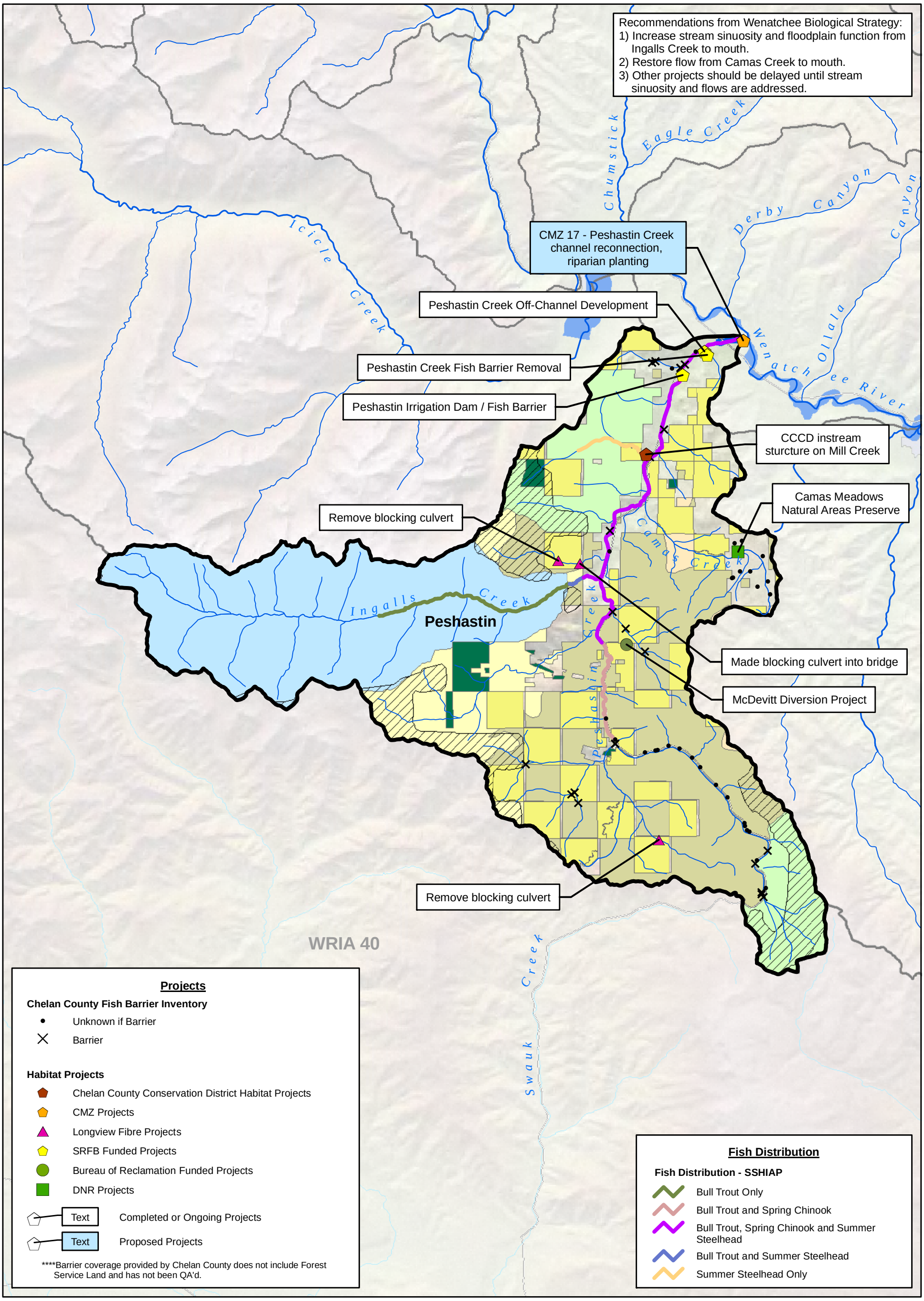
Golder Associates



LEGEND

USFS Northwest Forest Plan

- Administrative Withdrawn Areas (Not for Harvest)
- USFS - Other
- Late Successional Reserves (Not for Harvest)
- Managed Late Successional Areas (Managed Harvest)
- MATRIX (Active Harvest)
- Congressionally Designed Wilderness

Other Land Use Data

- Channel Migration Zone
- Private Forestland
- WNF Roadless Areas
- Other Land Ownership

0 2.5
Scale in Miles

Map Projection: Washington State Plane, North Zone, NAD 83, Feet

Source: Chelan County Conservation District, Chelan County Department of Natural Resources, Normandeau, USFS, USGS, WDFW, WSDOT, WSDOE

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Peshastin Sub-Watershed: Fish Distribution and Habitat Projects

Chelan/WRIA 45 Watershed Plan/WA

Drawn: ATB	Revison: 4	Date: June 30, 2005	Figure: 5

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Golder Associates

Recommendations from Wenatchee Biological Strategy:
1) Restore passage for anadromous and inland fish. This should be done in a comprehensive, coordinated strategy, rather than a piecemeal approach.
2) Protect remaining floodplain and riparian habitat.
3) Increase stream flow.
4) Restore riparian habitat, primarily from Eagle Creek to Suntisch Canyon.
5) Reduce road densities.
6) Restore stream channel migration.
7) Reduce nonpoint pollution from septic tanks and livestock.
8) Reduce fine sediment input from roads and some land management activities.

Wenatchee River
Chumstick Creek
Eagle Creek
Ollala Canyon
Wenatchee River
Leavenworth
WRIA 46
WRIA 45

Phase II Fish Passage on Chumstick
Phase I Fish passage on Chumstick
Phase II Fish Passage on Chumstick
Phase I Fish passage on Chumstick
Storm Drain Project
Kayak,whitewater course with habitat improvements
CMZ 19a -hydraulic connection with backchannel
Irwin CMZ Project Feasibility: backchannel creation, riparian enhncement, and avulsion barrier. (CMZ 19)
Irwin CMZ Project Feasibility: backchannel creation, riparian enhncement, and avulsion barrier. (CMZ 19)
CMZ 20 - backchannel creation and riparian enhancement
Wetland Enhancement on Fish and Wildlife Property
Blackbird Island Habitat Development
Habitat Improvements near golf course

Projects

Chelan County Fish Barrier Inventory
- Unknown if Barrier
- Barrier

Habitat Projects
- Chelan County Conservation District - Chumstick Culverts
- CMZ Projects
- SRFB Funded Projects
- City of Leavenworth Projects
- Text — Completed or Ongoing Projects
- Text — Proposed Projects

****Barrier coverage provided by Chelan County does not include Forest Service Land and has not been QA'd.

Fish Distribution

Fish Distribution - SSHIAP
- Bull Trout, Spring and Summer Chinook, Sockeye and Summer Steelhead
- Summer Steelhead Only

LEGEND

USFS Northwest Forest Plan
- Administrative Withdrawn Areas (Not for Harvest)
- USFS - Other
- Late Successional Reserves (Not for Harvest)
- Managed Late Successional Areas (Managed Harvest)
- MATRIX (Active Harvest)
- Congressionally Designed Wilderness

Other Land Use Data
- Channel Migration Zone
- Private Forestland
- Other Land Ownership

0 1.5
Scale in Miles
Map Projection: Washington State Plane, North Zone, NAD 83, Feet
Source: Chelan County Conservation District, Chelan County Department of Natural Resources, Normandeau, USFS, USGS, WDFW, WSDOT, WSDOE

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Chumstick Sub-Watershed: Fish Distribution and Habitat Projects

Chelan/WRIA 45 Watershed Plan/WA

Drawn: ATB	Revison: 4	Date: June 30, 2005	Figure: 6

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Golder Associates

Recommendations from Wenatchee Biological Strategy:
1) Protect remaining floodplain and riparian habitat downstream of Chatter Creek. Emphasis should be placed on habitat downstream of Leavenworth Hatchery.
2) Rectify human-made passage barriers.
3) Restore flow conditions on Icicle Creek downstream of Rat Creek.
4) Investigate the role of surface and well water withdrawals on instream flows and habitat use.
5) Develop strategies with water users to reduce effects, if any.
6) Initiate public information efforts to discourage harassment of spawning salmonids.
7) Manage recreation areas to reduce impacts to riparian cover.

Nason Creek
Whitepine Creek
Chiwaukum Creek
Chumstick Creek
WRIA 39
2
Chatter Creek
Icicle Creek
French Creek
Jack Creek
Eightmile Creek
Snow Creek
Ingalls Creek
Icicle

CMZ Site #23 - Possible restoration or enhancement opportunities.

CMZ Site #21 - Possible restoration or enhancement opportunities.

CMZ Site #22 - Possible restoration or enhancement opportunities.

Icicle Creek Reach Level Analysis

City of Leavenworth fish screen

LNFH Icicle Creek Restoration Project, including check dam removal.

CMZ Site #24 - Possible restorationor enhancement opportunities.

Projects

Chelan County Fish Barrier Inventory
- Unknown if Barrier
- Barrier

Habitat Projects
- CMZ Projects
- Chelan County NRP Projects
- City of Leavenworth Projects
- Leavenworth National Fish Hatchery Projects
- Text — Completed or Ongoing Projects
- Text — Proposed Projects

****Barrier coverage provided by Chelan County does not include Forest Service Land and has not been QA'd.

Fish Distribution

Fish Distribution - SSHIAP
- Bull Trout Only
- Bull Trout, Spring and Summer Chinook and Summer Steelhead
- Bull Trout, Spring and Summer Chinook, Sockeye and Summer Steelhead
- Bull Trout and Summer Steelhead
- Bull Trout, Spring Chinook and Summer Steelhead

LEGEND

USFS Northwest Forest Plan
- Administrative Withdrawn Areas (Not for Harvest)
- USFS - Other
- Late Successional Reserves (Not for Harvest)
- Managed Late Successional Areas (Managed Harvest)
- MATRIX (Active Harvest)
- Congressionally Designed Wilderness

Other Land Use Data
- Channel Migration Zone
- Private Forestland
- WNF Roadless Areas
- Other Land Ownership

0 1.5
Scale in Miles

Map Projection: Washington State Plane, North Zone, NAD 83, Feet

Source: Chelan County Conservation District, Chelan County Department of Natural Resources, Normandeau, USFS, USGS, WDFW, WSDOT, WSDOE

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Icicle Sub-Watershed: Fish Distribution and Habitat Projects

Chelan/WRIA 45 Watershed Plan/WA

Drawn: ATB	Revison: 4	Date: June 30, 2005	Figure: 7

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Golder Associates

Recommendations from Wenatchee Biological Strategy:
1) Protect remaining floodplain and riparian habitat.
2) Restore channel migration to historical function.
3) If restoration is not possible, improve fish access to oxbows and historical side channels.
4) Initiate public information efforts to discourage harassment of spawning salmonids.

Little Wenatchee River
Rainy Creek
Lake Wenatchee
Fish Lake
Nason Creek
Nason
Whitepine Creek
Chiwaukum Creek
Icicle Creek

Remove blocking culvert
Made blocking culvert into bridge
CMZ Nason 1 - hydraulic connection of oxbows and riparian restoration
CMZ Nason 2 - hydraulic connection of oxbows and riparian restoration
CMZ Nason 3 - hydraulic connection of oxbows and riparian restoration
CMZ Nason 4 - hydraulic connection of oxbows and riparian restoration.
CMZ Nason 5 - wetland habitat preservation.

Projects

Chelan County Fish Barrier Inventory
- Unknown if Barrier
- Barrier

Habitat Projects
- Longview Fibre Projects
- CMZ Projects
- Text — Completed or Ongoing Projects
- Text — Proposed Projects

****Barrier coverage provided by Chelan County does not include Forest Service Land and has not been QA'd.

Fish Distribution

Fish Distribution - SSHIAP
- Bull Trout Only
- Bull Trout, Spring Chinook and Summer Steelhead
- Bull Trout, Spring and Summer Chinook, Sockeye and Summer Steelhead
- Bull Trout and Summer Steelhead
- Summer Steelhead Only

LEGEND

USFS Northwest Forest Plan
- Administrative Withdrawn Areas (Not for Harvest)
- USFS - Other
- Late Successional Reserves (Not for Harvest)
- Managed Late Successional Areas (Managed Harvest)
- MATRIX (Active Harvest)
- Congressionally Designed Wilderness

Other Land Use Data
- Channel Migration Zone
- Private Forestland
- WNF Roadless Areas
- Other Land Ownership

0 11,000
Scale in Feet

Map Projection: Washington State Plane, North Zone, NAD 83, Feet
Source: Chelan County Conservation District, Chelan County Department of Natural Resources, Normandeau, USFS, USGS, WDFW, WSDOT, WSDOE

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Nason Sub-Watershed: Fish Distribution and Habitat Projects

Chelan/WRIA 45 Watershed Plan/WA

Drawn: ATB	Revison: 4	Date: June 30, 2005	Figure: 8

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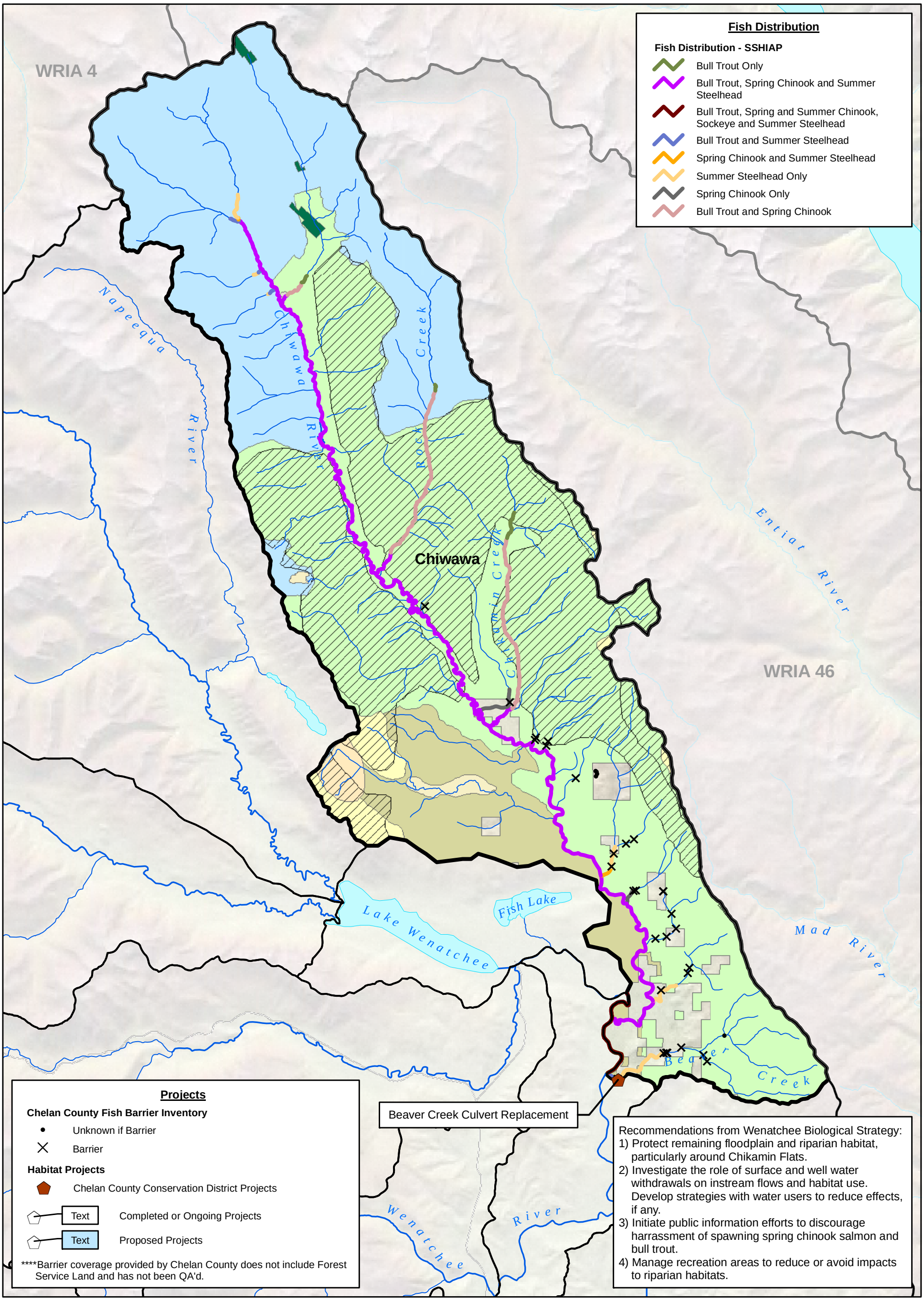
Golder Associates



LEGEND

USFS Northwest Forest Plan

- Administrative Withdrawn Areas (Not for Harvest)
- USFS - Other
- Late Successional Reserves (Not for Harvest)
- Managed Late Successional Areas (Managed Harvest)
- MATRIX (Active Harvest)
- Congressionally Designed Wilderness

Other Land Use Data

- Channel Migration Zone
- WNF Roadless Areas
- Other Land Ownership

0 1.5
Scale in Miles

Map Projection: Washington State Plane, North Zone, NAD 83, Feet

Source: Chelan County Conservation District, Chelan County Department of Natural Resources, Normandeau, USFS, USGS, WDFW, WSDOT, WSDOE

N

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Chiwawa Sub-Watershed: Fish Distribution and Habitat Projects

Chelan/WRIA 45 Watershed Plan/WA

Drawn: ATB	Revison: 4	Date: June 30, 2005	Figure: 9

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Recommendations from Wenatchee Biological Strategy:

Lake Wenatchee Sub-Watershed

1) Protect remaining near shore habitat, and develop a means to reduce impacts of bulkheads.

Little Wenatchee Sub-Watershed

1) Protect stream channel, riparian and floodplain functions: focus on Little Wenatchee River falls downstream to mouth.
2) Address road impacts in the drainage, emphasis on Rainy Creek and Little Wenatchee between Hidden Creek and Fir Creek.
3) Restore wetland complexes that connect to stream channel.
4) Manage recreation areas to reduce impacts to riparian cover.
5) Initiate public information efforts to discourage harassment of spawning salmonids.

White River Sub-Watershed

1) Protect stream channel, riparian and floodplain functions. Focus on Panther Creek downstream to mouth.
2) Restore wetland complexes that connect to stream channel.
3) Protect shorelines along Lake Wenatchee near White River mouth.
4) Initiate public information efforts to discourage harassment of spawning spring chinook, sockeye salmon, and bull trout.
5) Manage recreation areas to reduce impacts to riparian cover.

White R. Oxbow Restoration Project

White R. Logjam

White R. Spur Roads Project

Acquisition of 240 acres

Acquisition of 240 acres

Acquisition of 240 acres

Acquisition of 40 acres

Acquisition of 38 acres

Acquisition of 21 acres

Acquisition of 50 acres

Acquisition of 2.5 acres

Lake Wenatchee Fish Pen Waste

Acquisition of 27 acres

Acquisition of 20 acres

White River Floodplain Restoration

White

Little Wenatchee

Chiwawa River

Napeequa River

White River

Little Wenatchee River

Rainy Creek

Nason Creek

Lake Wenatchee

Fish Lake

Fish Distribution

Fish Distribution - SSHIAP

- Bull Trout Only
- Bull Trout, Sockeye, Spring Chinook and Summer Steelhead
- Bull Trout and Spring Chinook
- Bull Trout, Spring Chinook and Summer Steelhead
- Bull Trout, Spring and Summer Chinook, Sockeye and Summer Steelhead
- Bull Trout and Summer Steelhead
- Spring Chinook Only
- Spring Chinook and Summer Steelhead
- Summer Steelhead Only

Projects

Chelan County Fish Barrier Inventory

- Unknown if Barrier
- Barrier

Habitat Projects

- Chelan-Douglas Land Trust/WDFW Acquisitions
- Forest Service Projects
- SRFB Funded Projects
- Other Proposed Projects

Text — Completed or Ongoing Projects

Text — Proposed Projects

****Barrier coverage provided by Chelan County does not include Forest Service Land and has not been QA'd.

LEGEND

USFS Northwest Forest Plan

- Administrative Withdrawn Areas (Not for Harvest)
- USFS - Other
- Late Successional Reserves (Not for Harvest)
- Managed Late Successional Areas (Managed Harvest)
- MATRIX (Active Harvest)
- Congressionally Designed Wilderness

Other Land Use Data

- Channel Migration Zone
- Private Forestland
- WNF Roadless Areas
- Other Land Ownership

0 2.5

Scale in Miles

Map Projection: Washington State Plane, North Zone, NAD 83, Feet

Source: Chelan County Conservation District, Chelan County Department of Natural Resources, Normandeau, USFS, USGS, WDFW, WSDOT, WSDOE

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Upper Watershed (Lake Wenatchee, White, and Little Wenatchee sub-watersheds): Fish Distribution and Habitat Projects

Chelan/WRIA 45 Watershed Plan/WA

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