Upper White Watershed Sediment and Temperature Total Maximum Daily Load (Water Cleanup Plan) for Aquatic Habitat

Detailed Implementation Plan

January 2006
Publication Number 05-10-038

Upper White Watershed Sediment and Temperature Total Maximum Daily Load (Water Cleanup Plan) for Aquatic Habitat

---

Detailed Implementation Plan

Prepared by:

Gary Ketcheson
U.S Forest Service
Mt. Baker-Snoqualmie National Forest

and

Kim McKee
Washington State Department of Ecology
Water Quality Program

January 2006
Publication Number 05-10-038

For additional copies of this document contact:

Department of Ecology
Publications Distribution Center
P.O. Box 47600
Olympia, WA 98504-7600

Telephone: (360) 407-7472

If you need this information in an alternate format, please contact us at 360-407-6270. If you are a person with a speech or hearing impairment, call 711 for relay service, or 800-833-6388 for TTY.

Table of Contents

Introduction 1

Purpose 5

The Approach 5

Pollution Sources and Corresponding Organizations 6

- Temperature 6
- Sediment 6

Pollution Sources and Organizational Responsibilities 7

- Federal Land - National Park Service 7
- Federal Land - USDA Forest Service 7
- Pierce County 14
- Private Forest Land 14
- Puyallup River Watershed Council 14
- Puyallup Tribe 15
- South Puget Sound Salmon Enhancement Group 15
- Washington State Department of Ecology 15
- Washington Department of Natural Resources 15

Management Roles, Activities, and Schedules 17

Performance Measures and Targets 19

Measuring Progress toward Goals 20

Implementation and Effectiveness Monitoring 22

- Federal Land - USDA Forest Service 22
- Federal Land - National Park Service 22
- Private Lands 23
- Pierce County 23
- Puyallup Tribe 23
- Tahoma Audubon 23
- Washington Department of Ecology 23

Adaptive Management 24

Enforcement 24

Reasonable Assurances 24

- Federal Forest Lands 24

Funding Opportunities 25

Literature Cited 27

List of Acronyms 28

Appendix A: Upper White and Greenwater Watershed Analysis A-29

Appendix B: Initial Implementation and Effectiveness Monitoring Plan B-33

Appendix C: Public Involvement and Response C-43

Public Meeting Notice C-48
The Problem C-48
How can you get involved? C-48

Appendix D: Implementation Tracking Sheets D-49

Appendix E: USDA Forest Service/Ecology Memorandum of Agreement E-55

Appendix F: Upper White River Electronic Documents F-67

Appendix G: Upper White River Temperature Load Allocations G-71

List of Figures

Figure 1. Upper White River Watershed 3

Figure 2. Culvert Removal from Slide Creek, Greenwater River..... 10

Figure 3. Expected Sequence of Activities to Restore Water Quality in the Upper White River 13

List of Tables

Table 1. Upper White River Watershed Section 303 (d) Listed and Impaired Segments 1

Table 2. Management and Regulatory Responsibilities in the Upper White River Watershed.... 6

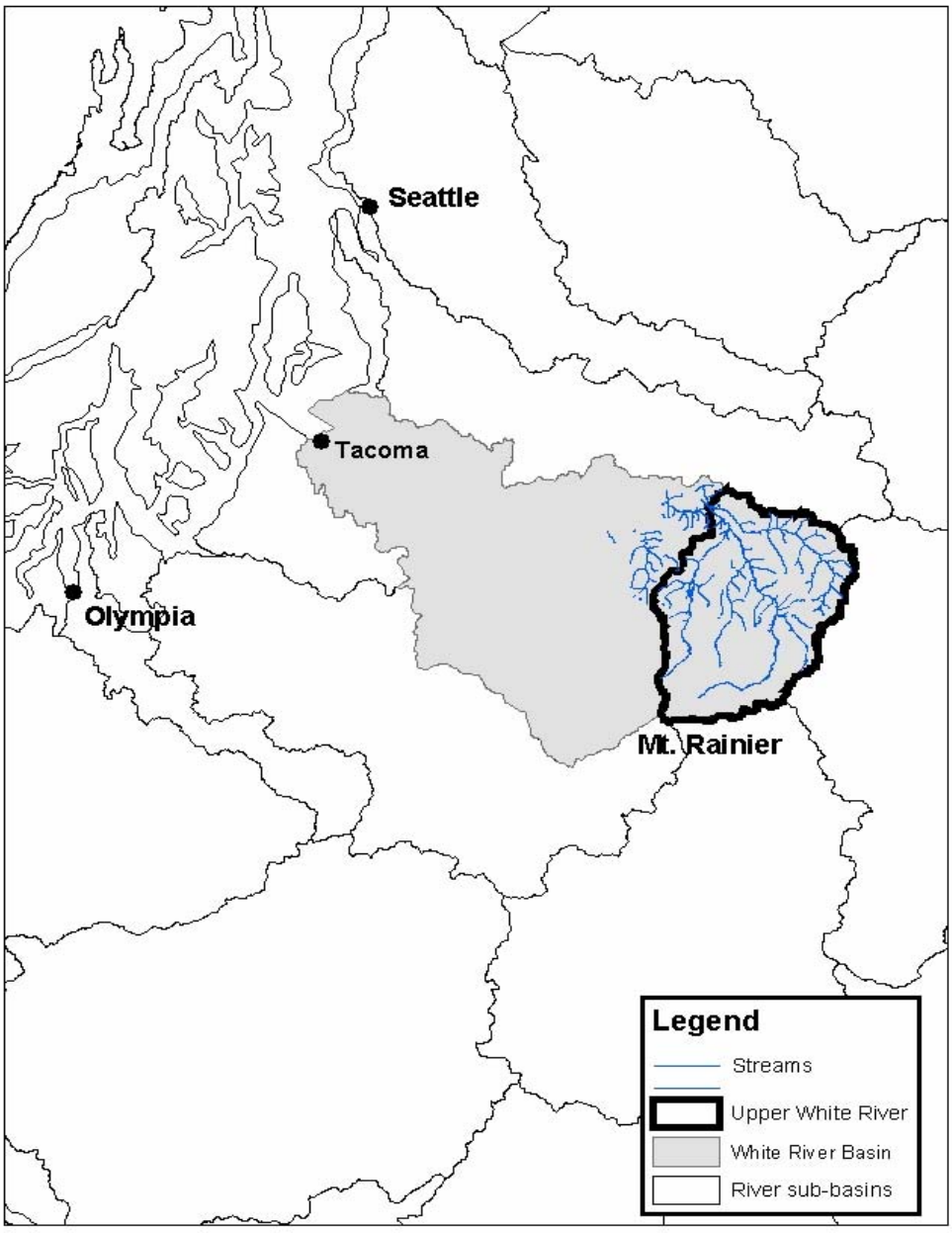
Table 3: Vegetation Disturbance Targets 9

Table 4: Partial List of Restoration Activities in the Upper White River..... 12

Table 5: Management Roles, Activities, and Schedules..... 17

Table 6: Upper White River Sediment Targets..... 20

Table 7. Upper White River Management Related Sediment..... 21



Upper White River Vicinity Map

Figure 1: Upper White Vicinity Map

Introduction

Section 303(d) of the 1972 Clean Water Act (CWA), as amended, requires the identification and placement of water bodies (rivers, streams, and lakes) that do not meet state water quality standards on the 303(d) list. Water quality limited water bodies must be identified by the United States Environmental Protection Agency (EPA) or by the state agency delegated this authority by EPA. In the state of Washington, EPA has delegated this responsibility to the Washington State Department of Ecology (Ecology). Ecology prepares an updated 303(d) list every two years.

Section 303 of the CWA mandates that Total Maximum Daily Loads (TMDLs) be developed for the parameters(s) causing beneficial use impairment for all 303(d) listed water bodies. A TMDL is the waste load allocation for point sources of pollution and the load allocation for non-point sources of pollution including natural background levels. In addition, a TMDL identifies a margin of safety to allow for uncertainty in the waste load determination and proposed treatments. The TMDL defines the amount of pollution allowed without exceeding water quality standards and impairing beneficial uses. However, TMDL assessments do not necessarily prescribe specific actions needed to meet the allocated loads.

Ecology is the responsible agency for establishing TMDLs in Washington State. The settlement agreement of a lawsuit brought on behalf of the Northwest Environmental Advocates and Northwest Environmental Defense Center requires Ecology to complete TMDLs for all water bodies identified on the 1996 303(d) list by 2013. A portion of the Greenwater River was one of more than 650 water bodies included in the settlement. Ecology updated the 303(d) list in 1998 - impaired segments for the Upper White River are shown in Table 1.

Table 1. Upper White River Watershed Section 303 (d) Listed and Impaired Segments

Listed Segments						
Water Body	**1996 WBID**	**1998 WBID**	**Parameter**	**Location**	**1996 List**	**1998 List**
Greenwater River	WA-10-1046	IT88EW	Temperature	T19N R9E Sec11, Sec 23, Sec 31	X	X

Unlisted / Impaired Segments				
Water Body	**Parameter**	**River Mile**	**Location**	**Impaired**
Unnamed (Brush, 10.0125)	Temperature	0.2	T19N R9E Sec 11	X
Straight Creek (10.0132)	Temperature	0.3	T19N R10E Sec22	X
Whistler Creek (10.0136)	Temperature	0.4	T19N R10E Sec24	X
Pyramid Creek (10.0143)	Temperature	0.4	T19N R10E Sec25	X
West Fork White (10.0086)	Temperature	4.3	T18N R9E Sec4	X
Greenwater River (10.0122)	Sediment	0.0 - 0.6	T19N R9E Sec 3,4,10, 21	X
Unnamed (Brush, 10.0125)	Sediment	0.0	T19N R9E Sec11	X
Twenty-eight Mile Creek (10.0129)	Sediment	0.0	T19N R10E Sec21	X
Slide Creek (10.0130)	Sediment	0.0	T19N R10E Sec21	X
Pyramid Creek (10.0143)	Sediment	0.0	T19N R10E Sec25	X
West Fork White (10.0086)	Sediment	0.0	T19N R9E Sec23	X
Eleanor Creek (10.0258)	Sediment	0.0	T18N R9E Sec14	X
Lightning Creek (10.0252)	Sediment	0.0	T18N R9E Sec6	X
Minnehaha Creek (10.0300)	Sediment	0.0	T18N R9E Sec5	X

The Mt. Baker-Snoqualmie National Forest (MBS), Ecology, and EPA conducted a TMDL study of the Upper White River, including the Greenwater River, during 2002 and 2003 (Figure 1). The study addressed both temperature and sediment in all water bodies of the Upper White River from the confluence of the Greenwater and White rivers. The TMDL study and input from responsible government agencies, forest landowners, and local residents formed the basis for the *Mt. Baker-Snoqualmie National Forest, Upper White Watershed Sediment and Temperature TMDL for Aquatic Habitat, Submittal Report* (Ketcheson et al. 2003). EPA approved the Submittal Report in August 2003.

The next step in the TMDL process is development of a detailed plan that outlines the framework for achieving water quality standards. This document is the detailed implementation plan (DIP) for the Upper White River. It includes specific actions to be taken, a monitoring plan, reasonable assurances, and how success will be measured. This DIP relies heavily on the findings of the *Upper White and Greenwater Watershed Analysis (Mt. Baker-Snoqualmie National Forest, 2000), Mt. Baker-Snoqualmie National Forest, Upper White Watershed Sediment and Temperature TMDL for Aquatic Habitat Submittal Report* (Ketcheson et al. 2003) referred to in this document as the *Upper White TMDL, Mt. Baker-Snoqualmie National Forest Roads Analysis (Mt. Baker-Snoqualmie National Forest 2003), Puyallup River Ecosystem Diagnosis and Treatment* (Pierce County 2002), and the *Upper Puyallup Watershed Characterization and Action Plan* (Upper Puyallup Watershed Committee 2002).

Participants in the preparation of this DIP include U.S. Environmental Protection Agency; Mt. Baker-Snoqualmie National Forest; Puyallup River Watershed Council, Pierce County; Pierce Conservation District; Washington Departments of Natural Resources, Fish and Wildlife and Ecology; Puyallup Tribe of Indians; and Tahoma Audubon. Review and input to the DIP was also obtained from the public.

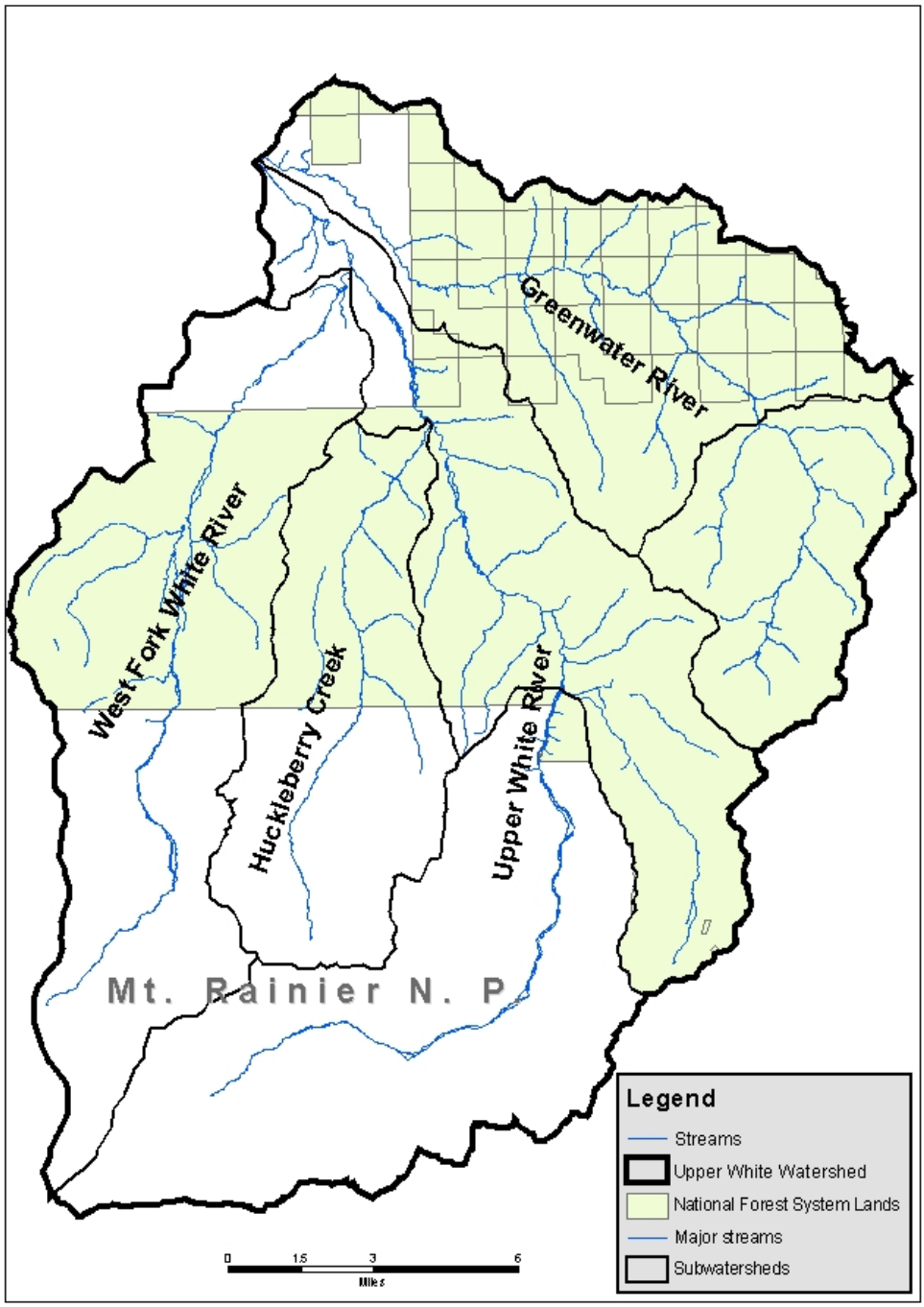


Figure 2: Upper White River Watershed

This implementation plan emphasizes actions consistent with current management direction on federal and private lands in the watershed that are intended to protect aquatic resources and beneficial uses, and improve water quality conditions. The MBS manages national forest system (NFS) lands within the Upper White River drainage according to direction provided in the 1994 record of decision (ROD) for amendments to Forest Service and Bureau of Land Management planning documents within the range of the Northern Spotted Owl (USDA Forest Service and USDI Bureau of Land Management 1994), also known as the Northwest Forest Plan (NWFP). This plan amends the Mt. Baker-Snoqualmie Land and Resource Management Plan (LRMP) (USDA Forest Service 1990). Land allocations, and standards and guidelines in the ROD use an ecosystem approach to manage for healthy forest ecosystems that provide habitat to support robust populations of native species. The aquatic conservation strategy (ACS), a major component of the ROD, is designed to maintain and restore the ecological health of aquatic ecosystems at the watershed or landscape scale to protect fish and other riparian-dependent species and resources.

The Washington State forest practices rules (FPR) is the regulatory tool for Clean Water Act compliance of forest management activity in Washington State. Private lands within the Upper White River fall under the jurisdiction of these rules.

The Upper White TMDL suggests that management under the NWFP and measures developed for NFS lands in this DIP, existing measures within Mt. Rainier National Park, forest and fish requirements under FPR on private forestlands, and voluntary measures by non-forestry private landowners should move the watershed toward conditions that will meet water quality standards. Adaptive management will be used to make changes to the management approach should monitoring show that conditions are not proceeding in the desired direction.

The MBS recognizes the Upper White River detailed implementation plan (DIP) as the water quality restoration plan (WQRP) for NFS lands in the watershed. Given that the purpose and protocols of the DIP and WQRP are similar, both Ecology and the MBS recognize the efficiency in combining these efforts.

Purpose

Several documents, including those cited above, have identified a number of water quality-related issues in the Upper Puyallup River and the Upper White River. Water quality of the Upper White River (Figure 1) may be impairing beneficial uses, especially the White River Spring Chinook salmon and bull trout populations. For these reasons and to fulfill Clean Water Act requirements for impaired water bodies, Ecology and the Mt. Baker-Snoqualmie National Forest completed a TMDL assessment for the Upper White River (Ketcheson et al. 2003). The next step to that TMDL is to prepare an implementation plan to set the conditions for recovery of water quality in the watershed. The purpose of the DIP is to outline a framework for achieving water quality standards. It includes a monitoring plan, measures of success, and reasonable assurances that the actions will be undertaken.

The Approach

This detailed implementation plan (DIP) addresses two pollutants: temperature and sediment. It builds on the summary implementation strategy (SIS) from the TMDL assessment. Stream water temperature affects aquatic life in several ways, spanning a range of influences from minor changes in habits such as feeding and migration, to direct mortality. Water temperature varies naturally across landscapes as a function of geology, topography, and climate, and across time varying from daily to seasonally and longer. Changes in watershed processes and vegetation through land use can significantly affect factors influencing stream temperature. Restoring and maintaining stream potential shade and a near-natural sediment regime is important for restoring the channel dynamics that create quality aquatic habitats. A diversity of habitats is essential to the recovery of threatened Chinook salmon and bull trout.

This DIP identifies actions needed to address not only the temperature impairments in three Greenwater River segments listed on the 1996 and 1998 303(d) list (Upper White TMDL Table 2.7 and Figure 2.3), but also other impairments identified during the TMDL assessment (Upper White TMDL Table 2.8 and Figure 2.4). The TMDL uses percent effective shade as a surrogate for thermal loading to set pollutant load allocations. The potential effective shade results when the system potential land cover conditions are reached. These conditions are postulated from historic distributions of several stages within the potential vegetation zones. The target shade condition for national forest system lands (NFSL) in the Upper White River is the effective shade at system potential land cover conditions. This DIP describes how these conditions will be evaluated and monitored and what actions may be used in addition to riparian reserve management to achieve the potential shade targets.

Sediment is also a highly variable constituent of stream systems. Sediment is a key element of channels that influences channel form and aquatic habitat. In unmanaged watersheds, stream channels achieve a state of dynamic equilibrium that balances stream energy with the sediment supply. Aquatic organisms adapt to these stream dynamics. Management activities in a watershed that alter the sediment supply cause changes in the stream dynamics. Changes in the balance of sediment and energy create changes in channel characteristics that place stresses on aquatic organisms. Sediment can physically impact fish and other organisms and can cause mortality of certain life stages. The Upper White TMDL used a partial sediment budget to identify management related sources of sediment. Targets are based on the elimination of

management-related sediment delivery to streams. This DIP details actions by sub-watersheds that will reduce and eventually eliminate management sediment inputs.

Adaptive management will also be employed to document implementation actions and determine success toward meeting implementation goals by the affected implementation parties. After a sufficient percentage of implementation measures have been put in place, effectiveness monitoring will be performed to assess whether load allocation reductions have been realized.

Pollution Sources and Corresponding Organizations

Temperature

The specific pollutant is heat (incoming solar radiation). Heat is manifested as stream or water temperature, which is measured and regulated under water quality standards. High stream temperatures occur during the summer when streams are exposed to the greatest seasonal sun energy and stream flow is generally low. Management activities that reduce shade or result in wider streams (increasing exposure of the water to solar radiation) have a profound influence on stream temperature.

Sediment

Sediment can affect beneficial uses in a number of ways from direct physical injury or mortality, to indirect affects on habitat characteristics and stream temperature. Sediment may enter a stream during catastrophic events from landslides and stream channel avulsion or lateral migration; or sediment sources may be more chronic such as road drainage and denuded campsites.

Table 2 lists shade-altering and sediment-producing activities that are significant in the Upper White River, and the organizations with a role in managing or regulating those activities.

Table 2. Management and Regulatory Responsibilities in the Upper White River Watershed

Activity	*Management Responsibility*	*Regulatory Responsibility*
Road Construction/ Maintenance	U.S. Forest Service, Hancock Company, Mt. Rainier National Park, Washington State Department of Transportation	Washington State Departments of Natural Resources, Washington State Department of Ecology
Riparian Silviculture/ Timber Harvest	U.S. Forest Service, Hancock Company	Washington State Departments of Natural Resources, Washington State Department of Ecology
Recreation – Developed and dispersed; road and off-road	U.S. Forest Service, Hancock Company, Mt. Rainier National Park	Washington State Department of Fish and Wildlife (wildlife and fish issues)

Pollution Sources and Organizational Responsibilities

Ninety-two percent of the Upper White River is in federal ownership. The remainder of the watershed is in private ownership, most of which is managed by the Hancock Company. The town of Greenwater and Alta Crystal Resort make up the remaining small amount of private land. There are several other organizations and non-landowner entities with interest in the Upper White River. This section provides information for organizations with interest, direct or indirect, in the implementation of the Upper White River detailed implementation plan.

Federal Land - National Park Service

The National Park Service manages the 235,600 acre Mt. Rainier National Park to preserve the unique physical and biological characteristic of the park. The massive Emmons Glacier is the dominant source of the White River, draining 70,400 acres of the park.

Federal Land - USDA Forest Service

The Forest Service (FS) is the designated management agency for meeting federal Clean Water Act requirements on national forest system (NFS) lands within the state of Washington. This authority is set forth in the Memorandum of Agreement between the USDA Forest Service – Region 6 and Ecology for meeting responsibilities under federal and state water quality regulations (USDA and WDOE 2000). Under this agreement, the Forest Service will ensure that all waters on NFS lands meet or exceed water quality standards, laws and regulations, and that activities on NFS lands are consistent with the level of protection of the Washington Administrative Code relevant to state and federal water quality requirements.
The Forest Service consults on projects with the U.S. Fish and Wildlife Service and NOAA Fisheries to implement the Endangered Species Act (ESA). Within the Upper White River two fish species are listed under ESA as threatened: White River spring Chinook salmon; and bull trout. The White River is a target watershed for the recovery of spring Chinook (Washington Department of Fish and Wildlife et al., 1996). In addition to spring chinook and bull trout, tailed frogs were incorporated into the TMDL as indicator species to link watershed process recovery with habitat recovery and aquatic beneficial use support. Implementation strategies and monitoring designs will strive to demonstrate improved conditions for these species.

Restoration priorities within the Upper White River will target protection of refugia habitat first and restoration of degraded habitats second. Priority areas for Chinook salmon are lower Silver Creek/Silver Springs, the lower Greenwater River, and the mouth of Huckleberry Creek while Silver Springs is the priority area for bull trout. Current land allocations and associated management activities will assure no further degradation of habitat for these species.

The Mt. Baker-Snoqualmie National Forest manages lands under its jurisdiction within the Upper White River according to direction set forth in pertinent management documents. The MBS Land and Resource Management Plan was signed in 1990 (MBS 1990) and amended in 1994 by the Record of Decision for Amendments to the Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl (USDA and

USDI 1994), also known as the Northwest Forest Plan (NWFP). These two documents establish forest-wide goals and objectives, forest-wide standards and guidelines, a system of management areas and land allocations, and area and allocation specific standards and guidelines for management of the MBS.

The purpose of the NWFP is to move National Forest Management, in the range of the Northern Spotted Owl, into a more ecosystem and science-based approach. The objectives are to meet requirements of existing laws and regulations; maintain a healthy forest ecosystem, including riparian areas and waters, with habitat that will support populations of native species (particularly those associated with late-successional and old-growth forests); and maintain a sustainable supply of timber and other forest products that will help maintain the stability of local and regional economies on a predictable long-term basis.

The NWFP allocates lands within the National Forest into:

Matrix – to be managed under general forest management. Timber and other management are subject to restrictions that apply through Forest Plan standards and guidelines.

Late-Successional Reserves – to be managed to protect and enhance conditions of late-successional forest ecosystems, which serve as habitat for late-successional and old-growth species. Limited forest stand management is permitted.

Riparian Reserves – management areas around streams, wetlands, ponds, lakes, and unstable or potentially unstable areas. Riparian Reserves overlay all other management areas, and the Riparian Reserves standards and guidelines apply wherever Riparian Reserves occur. This is a key component to establishing and maintaining the needed shade levels.

The Crystal Mountain Ski Area has operated under a master development plan established in 1992 on 4350 acres. The permit area is managed primarily for winter sports, but is becoming a more year-round recreation destination. Crystal Mountain Ski Area will begin implementing activities under a new master development plan in 2005.

Finally, the Huckleberry Land Exchange (USDA Forest Service 2001) created a new land allocation for elk forage. Up to 2340 acres within the Greenwater River that the Forest Service acquired in the land exchange will be evaluated for long-term management for elk forage.

A major component of the NWFP is the Aquatic Conservation Strategy (ACS), designed to maintain and restore the ecological health of aquatic ecosystems at the watershed scale in order to protect habitat for fish and other riparian-dependent species and resource. Priority is placed on maintaining and protecting the best habitats, and restoring degraded habitat with the greatest potential for recovery. There are several components to the ACS:

Riparian Reserves: lands along streams, around lakes and wetlands, and unstable and potentially unstable areas where activities are designed to maintain and restore the ecological health and aquatic ecosystems. Riparian reserves are key to restoring shade in the watershed.

Key Watersheds: a system of refugia watersheds that are considered crucial to at-risk fish species and stocks, and for maintaining high water quality. Activities to protect and restore aquatic habitat in Key Watersheds are higher priority than similar activities in other watersheds. The Upper White River is part of the White River Key Watershed.

Watershed Analysis: an assessment of the geomorphic and ecological processes operating in a watershed. Watershed analysis provides the basis for monitoring and restoration programs, and the foundation from which the Riparian Reserves can be delineated.

Watershed Restoration: a comprehensive, long-term program to restore watershed health and aquatic ecosystems. These efforts are also critical to restoring shade.

Implementation of the Northwest Forest Plan

Restoration of stream temperatures and sediment regimes in the Upper White River rests heavily on implementation of the NWFP standards and guidelines, and specifically, on the Aquatic Conservation Strategy. Riparian reserves have been delineated using the default values from the NWFP, and with minor exceptions (Crystal Mountain Ski Area), will be managed to maximize shade and large wood recruitment. As a key watershed, restoration activities in the Upper White River will be of higher priority than in non-key watersheds across the forest.

Eighty-nine percent of the Upper White River is wilderness or Late-Successional Reserve. This means that the majority of the watershed will progress to a late-seral or old growth condition, with likely more late-seral forest than historically existed in the watershed. All riparian reserves will return to late-seral forest conditions.

Upslope vegetation conditions have affected the peak flows, at least in the Greenwater (Ketcheson et al. 2003). With a return to older vegetation, effects on rain-on-snow peak flows are expected to diminish. Based on vegetation disturbance modeling from the watershed analysis (Mt. Baker-Snoqualmie National Forest 2000), vegetation disturbance levels are projected to drop below levels of concern in all National Forest sub-watersheds by 2019 (Table 3).

Table 3: Vegetation Disturbance Targets

Sub-Watershed	*Year vegetation disturbance projected to drop below 12 percent on NFS lands in all drainage areas*
Upper White River	2017
Huckleberry Creek	2011
West Fork White River	2013
Greenwater River	2019

The Upper White and Greenwater Watershed Analysis identify a number of management needs and specify several recommendations (Appendix A).

Road Management

The Forest Plan and the Upper White and Greenwater Watershed Analysis identified roads as a major resource concern. Roads Analysis identified which roads are of greatest risk to water resources. The MBS has been aggressively treating roads for more than a decade to minimize or eliminate the risk of road failures and sediment-laden runoff to streams (Figure 2). With nearly 2700 miles of roads, this is a task-in-progress. A number of roads have been decommissioned and many miles of roads have been treated in the watershed since the mid 1980s. These treatments were "opportunistic," where Kuntson-Vandenberg funds (KV dollars, funds collected

through timber sales to facilitate reforestation and other renewable resource work) were available to treat roads associated with timber sales. In the early years of the NWFP, watershed restoration funding allowed additional road stabilization and decommissioning. Watershed restoration and KV funds have run out for the MBS, and funding now is sought from other sources. In order to best utilize funding and address road stabilization and decommissioning in the Upper White River, an access and travel management (ATM) plan needs to be completed for the area. This plan (recommended in the watershed analysis) will validate access needs and resource concerns through public involvement and provide the basis under the National Environmental Policy Act (NEPA) for road management in the watershed.

Priorities for road treatments will be set using the watershed analysis, roads analysis and ATM, and the Upper White River Watershed TMDL. The sediment budget information in the TMDL will be scaled to sub-watersheds to assist in setting treatment priorities.

Watershed Restoration

The MBS has been active in watershed and aquatic habitat restoration in the watershed since the mid-1980s. Restoration activities range from road closure and decommissioning, hillslope stabilization, road cutslope and streambank stabilization, road relocation, culvert replacement, and in-stream structures. The understanding of what restoration activities are appropriate and effective has evolved such that what was done in the 1980s is not being done now. A channel relocation project is proposed for the Greenwater River that will re-establish some of the channel geometry that has been lost due to channel changes resulting from high sediment loads and increased peak flows.

Figure 3: Culvert Removal from Slide Creek, Greenwater River

The Upper White and Greenwater Watershed Analysis (Mt. Baker-Snoqualmie National Forest, 2000) made several recommendations for restoration (Appendix A). These include storm proofing and/or decommissioning problem roads, exploring opportunities for riparian treatments to promote better shade and bank stability, evaluating the potential to introduce large wood into the channel system, and working with the public through information and education programs to reduce impacts of recreation activities in the watershed. This implementation plan will strive to implement those recommendations.

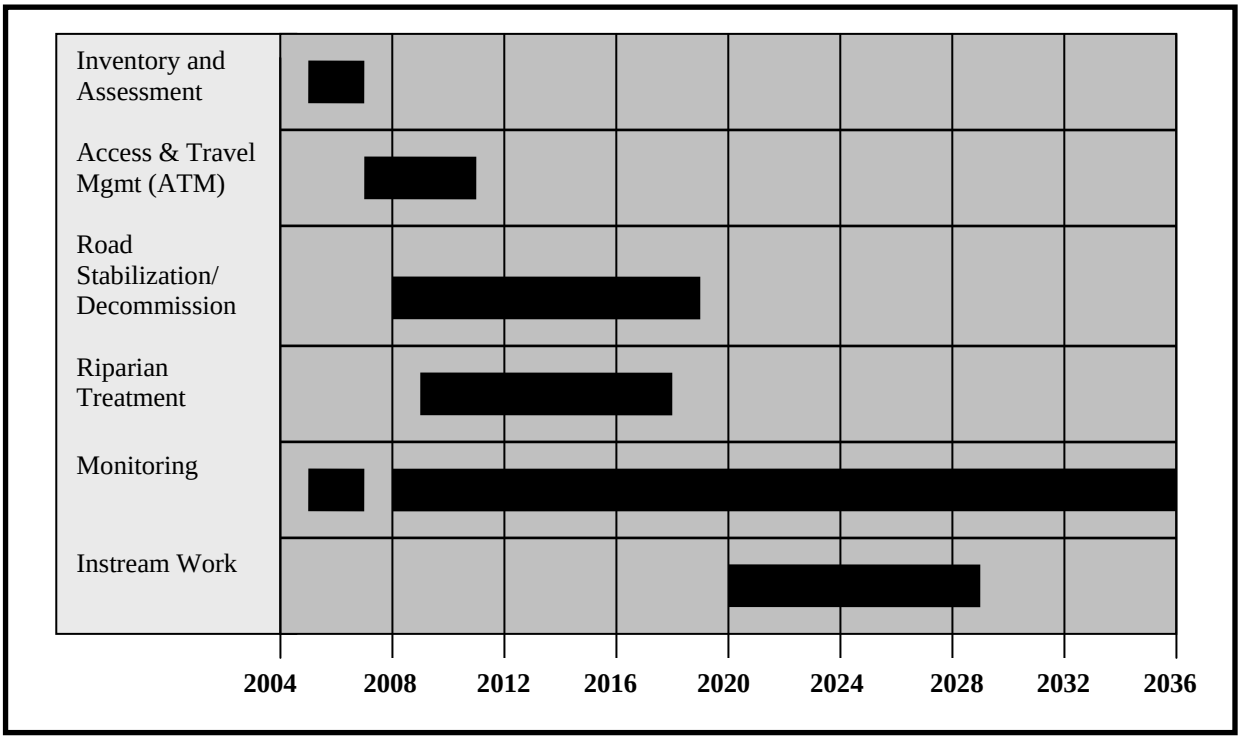
Recent Restoration Activities

Table 4 is a partial list of watershed restoration activities in the Upper White River watershed since 1994. The emphasis has been on treating roads using KV dollars. In-stream fish habitat structures were intended to improve pool habitat and retain gravels. These had limited success, and the design of large wood structures for streams has changed dramatically in the last decade.

Table 4: Partial List of Restoration Activities in the Upper White River

Project Year	*Project Name*	*Road/Stream Name*	*Beginning Milepost*	*Ending Milepost*	*Miles Treated*
1995	Road Decommissioning	7160340 Decommission	0.0	0.25	0.25
		7160510 Decommission	0.0	0.2	0.2
		7250310 Decommission	0.15	0.75	0.6
		7251610 Decommission	0.0	0.75	0.75
		7176 spur Decommission	0.0	0.05	0.05
	Road Upgrade I	7200000	0.0	6.49	6.49
	Road Upgrade II	7174000	0.0	6.48	6.48
		7174510	0.0	0.07	0.07
		7176000	0.0	2.5	2.5
		7190410	0.0	3.1	3.1
1996	White River Road Decommissioning	7315210 Decommission	0.0	0.5	0.50
		7315410 Decommission	0.0	0.9	0.90
1998	Road 70 Relocation	7000000 Reconstruct	3.50	7.09	3.59
		7000000 Decommission	3.54	6.44	2.90
		7020000 Decommission	0.0	0.07	0.07
		7012240 Reconstruct	0.43	0.69	0.26
2002	White River KV	7010410 Decommission	0.0	0.95	0.95
		7010510 Decommission	0.0	0.8	0.80
		7160310 Decommission	0.7	1.15	1.08
		7160510 Decommission	0.0	0.2	0.20
		7300213 Decommission	0.0	1.3	1.30
		7300223 Decommission	0.0	0.12	0.12
		7320000 Decommission	2.3	5.0	2.70
		7320230 Decommission	0.0	1.0	1.00
		7400904 Upgrade	0.0	0.4	0.40
		7400904 Decommission	0.4	1.35	0.95
		7500110 Decommission	0.0	0.48	0.48
		7500145 Decommission	0.0	1.2	1.20
		7500210 Decommission	0.0	0.85	0.85
		7500226 Decommission	0.0	0.35	0.35
		7500301 Decommission	0.0	2.7	2.70
		7510104 Decommission	0.0	0.25	0.25
		7510210 Decommission	0.0	0.85	0.85
		7500550 Decommission	0.0	1.10	1.10
		7500246 Decommission	0.0	0.2	0.20
		7500243 Decommission	0.0	0.03	0.03
		7500241 Decommission	0.0	0.2	0.20
2003	Pyramid Creek	Culvert to pipe arch	9.85	9.95	0.10
2004	Project Name	7020 Culvert removal	0.10	0.10	
		7021000 Decommission	0.0	3.0	3.00
		7021110 Decommission	0.0	1.5	1.50
		7021210 Decommission	0.0	0.2	0.20

Restoring water quality (temperature and channel morphology) to the Upper White River will take a strategy using aggressive action to "protect the best," stabilize upslope areas and roads, and facilitate channel processes (wood recruitment, scour control, floodplain connectivity). A general sequence of actions is desired (Figure 3). The MBS will be looking for partners to help accomplish these activities. Monitoring will be essential for assuring the treatments are indeed moving conditions in the watershed toward the goals.



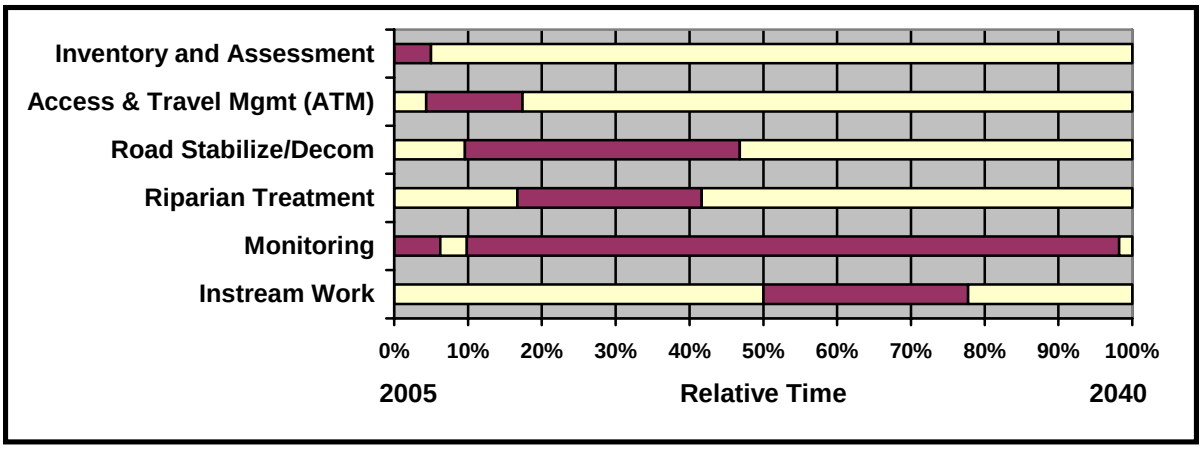


Figure 4: Expected Sequence of Activities to Restore Water Quality in the Upper White River

Pierce County

Pierce County led the effort to develop the Upper Puyallup Watershed Characterization and Action Plan. The Water Programs Division coordinates implementation of these watershed action plans, which are prepared in accordance with Washington Administrative Code Chapter 400-12, Local Planning and Management of Nonpoint Source Pollution, for the purposes of addressing nonpoint sources of water pollution. The county also regulates land use in unincorporated areas of the watershed primarily along the White River corridor and near the Town of Greenwater.

Private Forest Land

The Washington State Forest Practices Act (FPA) (RCW 76.09 has resulted in Forest Practices Rules (FPR) (WAC 222), administered by the Forest Practices Board and implemented by DNR. The FPR regulations that relate to water quality protection are co-managed with Ecology.

In 1999, various state and federal agencies, counties, some tribes, and the timber industry generated the Forest and Fish Report (USFWS et al. 1999) to address impacts of forest management activities on water quality, fish habitat, and six riparian-dependent amphibians. The state legislature approved new forest practices rules in 2000. In May 2001, the Forest Practices Board adopted these new rules, implementing the Forest and Fish Report.

In exchange for their support of the new forest practices rules, the timber industry was provided with the following "assurances": 1) development of TMDLs for 303(d) listed water bodies impacted primarily or solely by forest practices may be delayed until the year 2009; and 2) for TMDLs produced in mixed-use watersheds, implementation of the TMDL for those forest lands subject to the FPR will be through compliance with the FPR. If TMDL load allocations cannot be met through the FPR regulations, the adjustment of those management practices will be through the FPR adaptive management process.

While most of the timber harvest on private lands within the Upper White River preceded implementation of the Forest and Fish Report, future management will be under the new FPRs. As noted in the Upper White River TMDL, application of temperature and sediment load allocations will be accomplished on private forestlands through implementation of the Forest and Fish agreement.

Puyallup River Watershed Council

The Puyallup River Watershed Council is an organization of local, state, tribal, and federal governments, as well as educators, citizens, businesses, and environmental groups in the Puyallup River Basin. Its goal is to assist citizens in restoring, maintaining, and enhancing the environmental, economic, and cultural health of the watershed.

The Council has Executive, Water Resources, Historical and Cultural, Fish and Wildlife, and Education committees. It oversees implementation of the Upper Puyallup Watershed Characterization and Action Plan and addressing nonpoint pollution sources.

Puyallup Tribe

The Puyallup Tribe is actively involved with salmon management issues in the Puyallup watershed. The Tribe monitors anadromous fish populations and utilization in the White River Watershed.

South Puget Sound Salmon Enhancement Group

The South Puget Sound Salmon Enhancement Group (SPSSEG) was mandated by the state legislature in 1989 due to the multiple ESA listings of NW salmon stocks. The Washington Department of Fish and Wildlife provides some of the funding from the sale of sport and commercial licenses. Most of the funding comes from state and federal grants. The SPSSEG is a non-profit, non-regulatory organization committed to restoring South Puget Sound salmon populations through habitat restoration and public outreach and education. SPSSEG serves basically all streams and rivers that drain into south Puget Sound (Commencement Bay and south) and is directed by a nine-member volunteer board of directors. There are four full-time staff, one part-time accounts manager, and one AmeriCorps intern. The SPSSEG initially focused on enhancement projects such as remote site incubators, but now primarily does stream restoration and habitat enhancement projects.

Washington State Department of Ecology

The U.S. Environmental Protection Agency has delegated authority under the Clean Water Act to Ecology to establish and enforce water quality standards and administer the National Pollution Discharge Elimination System (NPDES) permit program. Under the 303(d) program, Ecology administers water quality listings, completes water quality assessments, develops water cleanup plans (TMDLs), and oversees the implementation of water cleanup plans. Ecology also performs effectiveness monitoring for completed TMDL projects and is responsible for enforcement and compliance related to Washington Administrative Code, Section 90-48 - Water Pollution Control.

Ecology also directs the local watershed planning program instituted under Executive Summary House Bill (ESHB) 2514 and the Salmon Recovery Program under ESHB 2496. The Upper Puyallup Watershed Committee has been very active in the watershed since it was formed to develop the Upper Puyallup Watershed Action Plan in 2000 (Upper Puyallup Watershed Committee 2002). The committee represents a diverse set of interests dedicated to fulfilling their role under the “Nonpoint Rule” (WAC 400-12). The committee has participated as an advisory committee member in the development of the White River TMDL, this current effort (DIP development), and in the development of TMDLs for the lower Puyallup River and South Prairie Creek (tributary of the Carbon River).

Washington Department of Natural Resources

The Washington State Department of Natural Resources has primary administrative and enforcement responsibilities for the Forest Practices Act (Ch. 76.09 RCW), which includes implementation of the 1999 "Forests and Fish Report." The Forests and Fish Report (ESHB

2091) was adopted by the state legislature to protect salmon listed under the federal Endangered Species Act and other fish. The resulting rules address forest roads, unstable slopes, riparian shading, and effectiveness monitoring. Implementation of these rules in the upper watershed should help the lower watershed meet water quality standards for temperature in the future.

Management Roles, Activities, and Schedules

Table 5 summarizes the agencies or organizations, their authority and responsibilities, likely funding sources, and status or schedule for implementation of the Upper White River Detailed Implementation Plan.

Table 5: Management Roles, Activities, and Schedules

Agency/Organization	*Authority/Responsibility*	*Funding Required*	*Status/Schedule*
Mt. Baker-Snoqualmie National Forest	Continue to implement the MBS Forest Plan as amended by the Northwest Forest Plan (the Aquatic Conservation Strategy) including: Road management; Watershed restoration; Riparian management; Recreation management; Ski Area management; Water quality implementation monitoring (Appendix B).	USFS and Partners	On-going
	Conduct and implement access and travel management plan (built from roads analysis).		2007-11
	Perform landslide inventories and repeat sediment budget assessments.		2015, 2025, 2035 and every ten years thereafter
	Meet obligations identified in 2000 Ecology/U.S Forest Service Memorandum of Agreement.		On-going
	Meet obligations identified in Washington Department of Fish and Wildlife/U.S. Forest Service Memorandum of Understanding for HPAs (revised 2005).		
Mt. Rainier National Park	Implement National Park Service management policies to preserve the unique physical and biological characteristic of the Park. This includes the characterization of the natural environment.	NPS Resources	2010
	Develop and implement an Integrated Long-Term Monitoring Program (LTEM).		2010
Pierce County	Implement county programs that utilize and protect county resources.	County Funds	On-going
	Pursue external funding sources for water quality and fish habitat improvement projects (Pierce County Conservation District).	CCWF, Section 319, SRF, SRFB	On-going

Agency/Organization	*Authority/Responsibility*	*Funding Required*	*Status/Schedule*
Puyallup River Watershed Council	Promote water quality education. Pursue external funding sources for water quality and fish habitat improvement projects. Assist with water quality implementation monitoring (Appendix B).	CCWF, Section 319, SRF or SRFB	On-going On-going On-going
Puyallup Tribe	Assist with water quality implementation monitoring (Appendix B). Monitor anadromous fish populations and utilization in the White River Watershed. Assist Forest Service, through sponsorship, to obtain various grants for implementation work.	Tribal Funds or Grant Funding	On-going On-going On-going
South Puget Sound Enhancement Group	Promote outreach and public education programs. Apply for grants to complete watershed and stream restoration and habitat enhancement projects.	Grant Funding	On-going On-going
Tahoma Audubon	Assist with water quality implementation monitoring (Appendix B).	Grant Funding	On-going
Town of Greenwater	Commission studies of the White River to develop measures to protect private property.	Local Funding	2015
Washington State Department of Ecology	Host adaptive management reviews. Report on implementation of Upper White River TMDL. Announce and orchestrate funding application cycles for the Centennial Clean Water Fund, Section 319 Fund, and Washington State Water Pollution Control Revolving Loan Fund Programs. Provide technical assistance to private forest landowners and for general nonpoint pollution control. Conduct TMDL effectiveness monitoring. Enforce state Water Pollution Control Act (RCW 90.48). Meet obligations identified in the 2000 Ecology/U.S Forest Service Memorandum of Agreement.	State Operating Funds	2010, 2015 and every five years thereafter Annual funding cycles On-going 2025 On-going On-going
Washington State Department of Fish and Wildlife	Meet obligations identified in Washington Department of Fish and Wildlife/U.S. Forest Service Memorandum of Understanding for HPAs (revised 2005).	State Operating Funds	On-going
Washington State Department of Natural Resources	Implement Forest Practice Rules in cooperation with private landowners to meet water quality standards. Enforce Forest Practice Rules.	State Operating Funds	On-going On-going

Funding abbreviations:

CCWF – Centennial Clean Water Fund
Section 319 – Clean Water Act Section 319 Nonpoint Source Fund
SRF – Washington State Water Pollution Control Revolving Loan Fund
SRFB – Salmon Recovery Funding Board

Performance Measures and Targets

The Upper White River TMDL (Ketcheson et al. 2003) addressed temperature through an assessment of system potential shade. That assessment utilized a GIS analysis to calculate system potential effective shade, taking into account many of the variables that influence shade (*i.e.,* aspect, topography, shade angle, channel width, vegetation conditions, and location). Shade curves were developed to facilitate the evaluation of existing shade conditions relative to system potential. These shade curves (See Appendix G) are to be used to evaluate progress toward system potential shade conditions. Any channel segment can be evaluated based on channel width, orientation, and vegetation type and condition.

The targets for shade in the TMDL (system potential) are expected to be achieved through implementation of the Northwest Forest Plan (Riparian Reserves) and the Washington Forest Practices Rules. The target for shade is anticipated to be met by 2040. All forest stands, except the elk forage units, will reach mid-seral stage by 2030.

A detailed analysis of existing and potential shade was conducted for the Greenwater River during the TMDL assessment. This occurred because the Greenwater River was the source of the 303(d) temperature listing. Similar assessments should be made for the other sub-watersheds in the Upper, the West Fork and mainstem White Rivers, and Huckleberry Creek. This will provide the means to assess the status and progress toward system potential shade conditions for the entire Upper White River watershed.

The sediment portion of the TMDL used a partial sediment budget to establish sediment reduction targets for each sub-watershed. As restoration activities proceed in the watershed progress will be made toward elimination of management-induced sediment. Forest re-growth will progress toward late-seral conditions on 89 percent of the National Forest System lands under the Northwest Forest Plan allocation of Late Successional Reserves.

Road treatments (storm proofing, drainage upgrading, and decommissioning) efforts will bring roads into compliance with WAC 222 standards for “stabilization.” Similar activities are occurring on private lands in the watershed under the Forest Practices Rules for Road Management and Abandonment Plans (RMAPs). Repeat sediment budget assessments, supplemented by monitoring, will determine the progress toward the target of no management-related sediment input into the Upper White River stream channels. All road treatments should be completed by 2019. Depending on peak flow events during the period 2020 and 2040, the channel network should stabilize and vegetation reestablish along a narrower channel network.

Management-related sediment reduction and other watershed restoration activities will result in a slow return toward channel dynamic equilibrium such that channels widened by an influx of chronic and episodic sediment from management activities will begin to stabilize mobile channel sediments and narrow the active channel to more pristine conditions. This change will enhance the effective shade over these channels and result in achievement of system potential shade and improved stream temperatures.

Measuring Progress toward Goals

Forest Service policy directs forests to develop Water Quality Restoration Plans (WQRPs) for waters listed on the State 303(d) lists (Lohrey et al. 1999). These plans address the sources of water quality impairment and set out a strategy to bring the impaired waters into compliance with water quality standards. The Mt. Baker-Snoqualmie National Forest considers this DIP to be the WQRP for National Forest System lands in the Upper White River.

Sediment reduction targets have previously been identified for the Upper White River and are shown in Table 6. Targets have been identified for each of the four major sub-watersheds over the next three decades.

Table 6: Upper White River Sediment Targets

	Average Annual Sediment Amount in Metric Tons per Year			Percent Reduction in Management Sediment by Decade		
Subwatershed	**Background**	**Background Plus 10%***	**Management Related**	**1 (2003 - 2012)**	**2 (2013 - 2022)**	**3 (2023 - 2032)**
Greenwater	11800	13000	36400	69	87	88
Upper White	552300	607500	8700	81	91	92
West Fork White	309500	340400	20600	88	95	96
Huckleberry	110600	121600	8500	87	95	96
Target Reduction in Anthropogenic Sediment (%)				**60-100**	**80-100**	**90-100**

* This is the third decade, metric tons per year target for sediment production.

(from Ketcheson et al., 2003).

The water quality MOA between Ecology and the Forest Service (USDA Forest Service and Washington Department of Ecology, 2000) requires annual reporting by the Forest Service concerning WQRPs and road stabilization. Therefore, work conducted under this DIP can be reviewed by the two agencies as part of the annual reporting requirements of the MOA (Appendix E).

Ecology will convene an annual meeting of the partners identified in this DIP to review progress toward achieving action items and to review any available water quality data. Participation of private landowners will also be requested. The purpose of this meeting will be to review implementation activities and data collected by any of the participants during the year, check to see that annual goals are being met or exceeded, and if not, identify alternative approaches to achieve implementation. If changes become necessary, the partners will work with the respective organization(s) to request a revised implementation approach.

The Greenwater River will be the priority area for treatments dealing specifically with shade. The TMDL identified areas along the middle and lower reaches of the Greenwater River where shade is well below system potential shade. Black et al. (2003) also found areas of higher temperatures associated with reduced canopy. They also noted a distinct temperature increase in the West Fork White River using relative thermal imagery. This zone is of particular interest to verify the increase and determine its cause. Assessments will be made, as part of the inventory and monitoring work, for the other sub-watersheds in the Upper White River to determine important areas to consider for shade treatments.

The TMDL assessment also identified individual drainage areas that are producing the most management-related sediment (Table 7). These areas will be targeted for sediment reduction

treatments. Specific priorities will be established through an analysis of the cost-benefit of treatments by drainage area.

Table 7. Upper White River Management Related Sediment

Sub-Watershed			
Greenwater River	*West Fork White River*	*Huckleberry Creek*	*Upper White River*
• Greenwater above Slide Creek • Pyramid Creek • Unnamed Tributary (c) • Slide Creek	• Lower West Fork White River	• Eleanor Creek • Middle Huckleberry Creek	• Minnehaha Creek • Lightning Creek

RMAPs for private lands are reviewed annually under the Forest Practices Rules. Although the TMDL targets for the Upper White River were developed for National Forest System lands, the annual review will look at the progress toward meeting FPR standards and how the targets are contributing to improvement of water quality conditions in the waters of the Upper White River.

Past temperature monitoring by Ecology, the Forest Service, tribes, and others has been well documented and analyzed (Schuett-Hames et al. 2004). Stream temperature monitoring will continue under this DIP to demonstrate the effectiveness of management and restoration activities and document compliance with state water quality standards for temperature. The effectiveness monitoring plan will identify monitoring locations that will fill gaps in our knowledge about temperature conditions of the watershed. The goals for shade targets are shown in Appendix G.

Core monitoring sites in the watershed will be used to evaluate progress toward TMDL targets. These will consist of stream temperature and shade measurements, as well as channel morphology to assist in determining if sediment reductions are contributing to system potential conditions of channel width and shade. Core sites will be determined after the initial characterization of the systems. Core site and other monitoring data will also be evaluated every five years to assure that conditions are moving toward the goals and targets for the watershed.

Landslide inventories will be conducted every ten years, and after major storm events, to determine if sediment reductions are occurring. These inventories will be conducted using aerial photos and ground reviews. Availability of new aerial photo flights may constrain these inventories.

The response of the aquatic environment to management (or climatic) change may take many decades to detect. This plan attempts to monitor attributes that are likely to respond in a short time period, as well as some that respond more slowly. Monitoring data will be evaluated at five year intervals to assess the effectiveness of the TMDL implementation; however, it may be many intervals before actual change is documented. Monitoring is a long-term commitment.

Implementation and Effectiveness Monitoring

Implementation and effectiveness monitoring provides assurance that the control measures resulting from TMDL implementation achieve the desired and expected load reductions. An implementation and effectiveness monitoring proposal is shown in Appendix B, and while the details are in the attached plan, the overall strategy is provided below. The implementation monitoring plan will be updated annually with a plan of operation for the current year, which provides the specifics for monitoring that year (sites, parameters, frequency, analyses, and cost). Effectiveness monitoring is guided by the monitoring goals and objectives, major questions to be answered, the parameters useful in answering those questions, and the sites, techniques, and schedule for monitoring.

Federal Land - USDA Forest Service

The Mt. Baker-Snoqualmie National Forest has taken the lead on the TMDL assessment and is responsible for implementation of restoration projects on National Forest System lands. The Snoqualmie Ranger District will work closely with Ecology to coordinate monitoring efforts, build partnerships, conduct monitoring, and evaluate monitoring information. Existing partnerships in the Upper White River with federal, state and local governments, Indian tribes, and Tahoma Audubon will be utilized fully.

Effectiveness monitoring of watershed restoration activities aimed at improving watershed function and aquatic systems may take several years to show results that can be used to determine if objectives are being achieved. Depending on the attribute, measurable aquatic ecosystem response to treatments may take several to many decades. The effectiveness-monitoring plan recognizes this and establishes protocols with this in mind.

The Forest will develop project specific implementation and effectiveness monitoring for projects as they are implemented. The effectiveness-monitoring program provides the framework under which these plans will be prepared.

Every five years, the Forest will prepare a monitoring summary and assessment to share with Ecology and other parties. An evaluation of the monitoring program will be made at these intervals to determine if monitoring changes are warranted.

Federal Land - National Park Service

Mt. Rainier National Park (Park) personnel are preparing a long-term ecosystem monitoring program (LTEM). Certain aspects of this monitoring in the Park will provide valuable information concerning the stream ecology and temperature in the mainstem White and West Fork White Rivers and Huckleberry Creek. The Park will coordinate monitoring with the Upper White River TMDL implementation as opportunities arise and share monitoring data with the Forest Service and Ecology.

Private Lands

While no specific restoration treatments on private land will be undertaken as part of the Upper White River TMDL, the FPRs specify riparian shade levels for forest management and road standards (RMAPs) for minimizing sediment delivery to streams. RMAPs are reviewed annually and riparian shade could be assessed whenever new aerial photos become available. An adaptive management process is expected under the FPRs to evaluate whether goals are being met.

Pierce County

Pierce County is a valuable partner in efforts to restore water quality in the Upper White River. The county has prepared ecosystem diagnostic treatment (EDT) modeling for the Puyallup River basin, and will continue to use site-monitoring information from this effort to refine the output from the EDT model. We are using the model to evaluate what restoration will reap the most benefits for aquatic species. Monitoring information and EDT modeling will synergistically assist in evaluating if restoration objectives are being met.

Puyallup Tribe

The Puyallup Tribe fisheries department conducts monitoring throughout the Puyallup River basin. Some of the monitoring is in the Upper White River. The Puyallup Tribe is a partner in the restoration and monitoring of the Upper White River and the effectiveness-monitoring plan benefits from and includes the pertinent activities of the tribe.

Tahoma Audubon

The Tahoma Chapter of Audubon has been active in the Upper White River for many years. David Adams has been a participant in development of the framework, the TMDL assessment, and implementation plan. He has conducted monitoring and provided training and volunteers for monitoring. Tahoma Audubon will continue to assemble volunteers as needed for monitoring in the watershed.

Washington Department of Ecology

Ecology is responsible for determining, through effectiveness monitoring, the status of water bodies subsequent to development and implementation of a TMDL. Ecology has conducted considerable monitoring during the assessment period for the TMDL in the Upper White River, and will continue monitoring efforts as resources are available. Ecology will be active in securing resources to fulfill the monitoring needs and assist local partnerships to remain engaged. Ecology will engage in effectiveness monitoring after sufficient implementation actions have occurred.

Adaptive Management

Adaptive management is a response to addressing the uncertainties of natural resource management. It is a tool that allows resource managers to move forward without knowing all the consequences and outcomes of particular actions or sets of actions. The literature is full of studies that describe the effects of land management on resources, but not all the cause and effect mechanisms have been described. Much less literature describes the response of resources, and especially the biological communities to restorative treatments. The other confounding characteristic of natural resource management is that what works in one area will likely not work in all areas.

Analytical techniques used in setting TMDL targets and allocations for heat and sediment are imperfect and contain uncertainty. The TMDL process acknowledges these uncertainties and inaccuracies through the identification of the margin of safety. By prescribing a margin of safety, the implementation approach is assumed to error on the side of protection. As the restoration/management scenarios are implemented and monitored, additional information becomes available that must be used to refine the estimates and determine if the desired outcomes are achieved.

The TMDL process and implementation approach outlined in this DIP prescribe steps to track results, obtain additional base information, and ultimately refine TMDL assumptions, analyses, and management activities. As monitoring information comes available assessments of those data will be made, and if the data indicate the need for change, those changes will be made.

Progress in meeting action items will be documented using the checklists found in Appendix D. Efforts will be made to convey and new water quality data gathered by the partners for incorporation into Ecology's information management system. This will allow all data to be available to the public via internet access.

Enforcement

The Water Pollution Control Act (Chapter 90.48 RCW) provides broad authority to issue permits and regulations, and prohibits all unregulated discharges to water. The act clearly states that it is the policy of the state to maintain the highest possible standards to ensure the purity of all waters of the state and to require the use of all known, available, and reasonable means to prevent and control water pollution. Ecology is authorized under this act to control and prevent pollution, and to make and enforce rules, including water quality standards. The act also designates Ecology as the state water pollution control agency for all the purposes of the federal Clean Water Act.

Reasonable Assurances

Federal Forest Lands

Operational assurance that the management/restoration provisions that are needed to restore water quality in the Upper White River will be carried out falls within several regulatory tools. These are the Mt. Baker-Snoqualmie Forest land and resource management plan (prepared as

mandated by the National Forest Management Act of 1976) and the Ecology/USFS MOA. The northwest forest plan (NWFP) is a federal directive that amends individual forest plans with standards to protect late successional species in the range of the Northern Spotted owl. A major component of the NWFP is the aquatic conservation strategy, designed to restore and maintain ecological health of watersheds and aquatic ecosystems contained within them. This is to be accomplished using several tactics with the goal of maintaining the natural disturbance regime. The Mt. Baker-Snoqualmie National Forest adheres to agency responsibilities set forth in the Memorandum of Agreement between the USDA Forest Service, Region 6, and the Washington State Department of Ecology (Appendix E). This MOA designates the Forest Service as the water quality management agency responsible for meeting Clean Water Act requirements on national forest system lands and sets out a process for meeting certain water quality goals. These programs provide reasonable assurance for federal lands that is backed by federal mandate.

Funding Opportunities

The following is a list of commonly available funding sources at the time of this document. These represent potential sources for grants and other financial incentives, however, there are other sources of funds through federal programs of the Forest Service, National Science Foundation, and the U.S. Army Corps of Engineers, as well as Indian tribes and conservation groups that will or may provide assistance with the implementation of this plan. While these are generally stable sources of funding, funding sources change over time. New initiates, political interest, and legislation may create funding sources not available at this time. As new or additional sources become available, they will be pursued to accomplish the water quality goals in the Upper White River.

Centennial Clean Water Fund/Clean Water Act Section 319 Nonpoint Source Fund/Washington State Water Pollution Control Revolving Loan Fund. These funding sources are managed by Ecology through one combined application program. Funds are available to public entities and some not-for-profit organizations (Section 319 only) as grants or low-interest loans.

Grants require a 25 percent local match often in the form of cash or in-kind services. Grants may be used for education/outreach, technical assistance, specific water quality projects, or as seed money to establish various kinds of water quality related programs or program components. Grants may not be used for capital improvements to private property without an easement being given; but riparian fencing, riparian revegetation, and alternative stock water projects can be eligible for funding consideration.

Low-interest loans are available to public entities for all the above uses. They have also been used as “pass-through money” to provide low-interest loans to homeowners for septic system repair or agricultural best management practice implementation. Loan money can be used for a wide range of improvements to private property.

Salmon Recovery Funding. In 1999, the Washington State Legislature created the Salmon Recovery Funding Board (SRFB) composed of five citizens appointed by the Governor and five state agency directors. The board provides grant funds to protect or restore salmon habitat by funding habitat protection and restoration projects and supports related programs

and activities that produce sustainable and measurable benefits for fish and their habitat. It works closely with local watershed groups known as lead entities. SRFB has helped finance over 500 projects.

To be considered for funding assistance, the grant programs require that the proposed project will be operated and maintained in perpetuity for the purposes for which funding is sought. All projects require lead entity approval and must be a high priority in the lead entity strategy. Grants are awarded by the board based on a public, competitive process that weighs the merits of proposed projects against established program criteria.

Conservation Reserve Enhancement Program. This federal program provides incentives to restore and improve salmon and steelhead habitat on private land. This is a voluntary program to establish forested buffers along streams where streamside habitat is a significant limiting factor for salmonids. In addition to providing habitat, the buffers improve water quality and increase stream stability. Land enrolled in CREP is removed from production and grazing under 10-15 year contracts. In return, landowners receive annual rental, incentive, maintenance and cost share payments. The Pierce County Conservation District administers this program in conjunction with the U.S. Department of Agriculture, Natural Resource Conservation Service.

Emergency Watershed Protection. The U.S. Department of Agriculture, Natural Resource Conservation Service may purchase easements on floodplain lands and the right to conduct restoration activities, in exchange for limited future use by the landowner.

Forestry Riparian Easement Program. This voluntary program, administered through the Washington State Department of Natural Resources Small Forest Landowner Office, acknowledges the importance of small landowners and their contribution to protect wildlife habitat. The intent of the program is to help small forest landowners keep their land in forestry. The Forestry Riparian Easement Program partially compensates landowners for not cutting or removing qualifying timber under a 50-year easement. The landowner still owns property and retains full access, but has "leased" the trees and their associated riparian function to the state.

Riparian Open Space Program. This is a voluntary program administered by the Washington State Department of Natural Resources (DNR) to acquire (through purchase or donation) an interest in lands within unconfined avulsing channel migration zones (CMZs). The DNR may acquire the fee interest of the CMZ land or a permanent conservation easement over such lands.

U.S.D.A. Forest Service. Title II. The Secure Rural Schools and Community Self-Determination Act of 2000 allows 50 percent of all Title II project funds to be used for road maintenance or abandonment, and for the restoration of streams and watersheds. The overarching intent of Title II is to foster local creativity and innovation with regard to projects that participating counties and resource advisory committees (RAC) recommend. Projects are reviewed and ranked by the RAC. The RAC must submit project proposals not later than September 30 each year through fiscal year 2006.

Literature Cited

Black, B.W., A Haggland and G. Crosby. 2003. *Characterization of instream hydraulic and riparian habitat conditions and stream temperatures of the Upper White River Basin, Washington, using multispectral imaging systems*. U.S. Geological Survey. Water Resources Investigations Report 03-4022. Tacoma, Washington. 92p.

Ketcheson, Gary, Peter Leinenbach, Joanne Schuett-Hames, Tony Whiley, and Cindy James. 2003. *Mt. Baker-Snoqualmie National Forest, Upper White Watershed Sediment and Temperature TMDL for Aquatic Habitat. Submittal Report.* Washington Department of Ecology, Olympia, Washington. 107 pp. plus appendices.

Lohrey, M., P. Carroll, K. Gebhardt, D. Powers, K. Feigner, A. Puffer, B. Cleland, R. Davis. 1999. *Forest Service and Bureau of Land Management Protocol for Addressing Clean Water Act Section 303(d) Listed Waters: Version 2.0* USDA Forest Service. Portland, Oregon. 21 p.

Mt. Baker-Snoqualmie National Forest. 1990. *Land and Resource Management Plan; Mt. Baker-Snoqualmie National Forest.* Seattle, Washington. 395 p. + appendices

Mt. Baker-Snoqualmie National Forest. 2000. *Upper White and Greenwater Watershed Analysis.* Snoqualmie Ranger District, Enumclaw Office. Enumclaw, Washington.

Mt. Baker-Snoqualmie National Forest. 2003. *Mt. Baker-Snoqualmie National Forest Roads Analysis.* Unpublished document and database. Mt. Baker-Snoqualmie National Forest Supervisor's Office. Mountlake Terrace, Washington.

National Forest Management Act (NFMA) of 1976. Act of October 22, 1976. Public Law 94-588. 16 U.S.C. 472a, 476, 500, 513-516, 518, 521b, 528, 576b, 594-2, 1600-1602, 1604, 1608-1614.

Pierce County. 2002. Pierce County EDT online citizen's report. *Ecosystem Diagnosis and Treatment. Puyallup River Watershed, Upper White River Reach.* Pierce County Public Works and Utilities, Water Programs Division. Web site http://www.mobrand.com/citizens_report/Pierce/default.htm.

Schuett-Hames, Joanne, Clay Keown, and Cindy James. 2004. *Upper White Watershed Temperature Data Report:* 1989 to 2003. Publication No. 04-10-061. Washington Department of Ecology. Olympia, Washington. 8 p. + appendices

USDA Forest Service. 1990. *Land and Resource Management Plan*. Mt. Baker-Snoqualmie National Forest. USDA, Forest Service. Pacific Northwest Region, Mountlake Terrace, Washington.

USDA Forest Service. 2001. *Record of Decision and Forest Plan Amendment 16; Huckleberry Land Exchange*. Mt. Baker-Snoqualmie National Forest. Pacific Northwest Region, Mountlake Terrace, Washington.

USDA Forest Service and USDI Bureau of Land Management. 1994. *Record of Decision for Amendments to Forest Service and Bureau of Land Management planning documents within the range of the Northern Spotted Owl: Standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the Northern Spotted Owl.* Portland, Oregon. 74 p. + attachment.

USDA Forest Service and Washington State Department of Ecology. 2000. *Memorandum of Agreement between the USDA Forest Service, Region 6 and the Washington Department of Ecology for meeting responsibilities under federal and state water quality laws.* Washington Department of Ecology. Olympia, Washington. 31 p.

United States Fish and Wildlife Service, National Marine Fisheries Service, United States Environmental Protection Agency, Office of the Governor of the State of Washington, Washington State Department

of Natural Resources, Washington State Department of Fish and Wildlife, Washington State Department of Ecology, Colville Confederated Tribes, Washington State Association of Counties, Washington Forest Protection Association, Washington Farm Forestry Association. 1999. *Forest and Fish Report.*

Upper Puyallup River Watershed Committee. 2002. *Upper Puyallup Watershed Characterization and Action Plan.* Prepared for the Puyallup River Watershed Council. Published by Pierce County Public Works and Utilities, Environmental Services, Water Programs Division – Watershed Planning.

Upper White River Chinook TMDL Framework Team. 1998. *White River Spring Chinook Habitat Guidance. A water quality management approach for the Upper White River*: Version 1.0. Washington Department of Ecology. Olympia, Washington. 80 p.

Washington Department of Fish and Wildlife, Puyallup Indian Tribe, and Muckleshoot Indian Tribe. 1996. *Recovery Plan for White River Spring Chinook.* Washington Department of Fish and Wildlife. Olympia, Washington. 212p.

List of Acronyms

ACS	Aquatic Conservation Strategy
CWA	Clean Water Act
DIP	Detailed Implementation Plan
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESHB	Executive Summary House Bill
FPR	Forest Practice Rules
LRMP	Land and Resource Management Plan
MBS	Mt. Baker-Snoqualmie National Forest
NF	National Forest
NFS	National Forest System
NFSL	National Forest System Lands
NPDES	National Pollution Discharge Elimination System
NWEA	Northwest Environmental Advocates
NWEDC	Northwest Environmental Defense Center\
NWFP	Northwest Forest Plan
ROD	Record of Decision
SIS	Summary Implementation Strategy
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
WQRP	Water Quality Restoration Plan

Appendix A:
Upper White and Greenwater Watershed Analysis

Selected Findings and Recommendations

Upper White and Greenwater Watershed Analysis

Summary of findings and recommendations pertinent to the Upper White Watershed Sediment and Temperature TMDL for Aquatic Habitat

Finding		*Recommendation*
A combination of upslope harvest and riparian forest removal, and landslides from roads has led to increased peak flows and bank erosion creating wider stream channels, resulting in increased stream temperatures and degraded habitat.		Complete an ATM in the Greenwater and identify and decommission unneeded roads. Identify specific problem roads and develop solutions to chronic road-related sediment sources. Explore opportunities to reintroduce large wood into the channel network. Evaluate existing stream projects for effectiveness and maintenance needs. Evaluate opportunities for vegetation treatments in Riparian Reserves to accelerate streamside shade and bank stability.
Ease of access to water has allowed dispersed recreation to flourish in riparian areas, resulting in the loss of vegetation, downed large wood, soil compaction, and streambank disturbance.		
Sanitation at high use Dispersed Sites can translate into local or more widespread water quality issues.		Increase awareness of public and law enforcement concerning laws and regulations that protect public health and safety, but also resource values. Implement a law enforcement plan that would include education.
The recent land exchange in the Greenwater River greatly changes the share-cost road agreements in the area that contributed to maintenance and improvement. More of the financial burden falls on the FS.		Complete an ATM and implement road closure and decommissioning decisions. Identify highest risk areas on open road system and treat problem areas. Explore internal and external funding.
Road density is higher than desirable for preventing watershed cumulative effects.		Close or decommission roads no longer needed to minimize sediment delivery and runoff to streams.
Noxious weed infestations are altering aquatic habitat by changing the natural flora.		Fully implement BMPs from the MBS Noxious Weed EA.
Vegetation in the Upper White River is generally within the early- and mid-seral stages.		Explore opportunities for thinning stands to accelerate development of late successional stand characteristics.

Excerpts from Upper White and Greenwater Watershed Analysis Text

Shade

- Main concerns are in Silver Creek, lower West Fork, and most of Greenwater River. The West Fork is too broad to make many gains in shade, so tributaries are especially important.
- Temperature standards violations occurred in Pyramid, Straight, and Whistler, as well as much of the Greenwater. Burns, Slide, Forest, and the Upper Greenwater did not violate standards. A violation occurred in the West Fork via thermograph hand samples by FS in Mule Creek. Spot temperatures in Jim, Pinochle and Viola show a maximum of 55F.
- Need temperature recorder in Eleanor Creek.
- Tributaries to Upper White should be meeting standards (from stream surveys).

Large Woody Debris

- Analysis techniques may miss old forest types that are just off the stream channel – need some form of validation of forest ages along streams.
- In-stream levels are low and recruitment potential is low. Exceptions may be Viola and Pinochle, small tributaries to the Upper White River. Huckleberry and Eleanor Creeks have potential recruitment, but in-stream levels are low.

Riparian Structure/Bank Stability

- Map 2-12. Widespread areas of potential bank instability. (Suggests high need for intact riparian areas.)

Fine Sediment

- High in lower Greenwater, Eleanor, and Silver Creeks.
- Embeddedness is high in Viola Creek; fine sediment from pebble counts was low.
- Fire in Lightning Creek may be healing.

Appendix B:
Initial Implementation and Effectiveness Monitoring Plan

Introduction

This monitoring plan provides a framework for short- and long-term monitoring within the upper White River. Monitoring is a component of the *Detailed Implementation Plan for the Upper White Watershed Sediment and Temperature TMDL for Aquatic Habitat* (Ketcheson et al., 2003). This plan includes both an inventory/characterization program and a longer-term traditional monitoring program for the Upper White River Watershed. Considerable work is needed to validate the TMDL and develop the baseline information upon which monitoring data can then be interpreted. Specific monitoring sites and frequencies will be identified in annual monitoring plans developed by the participating parties.

The monitoring described here is broadly inclusive and attempts to identify parameters that are important for describing physical, chemical, and biological conditions in the watershed with enough accuracy and precision to be useful in detecting change. Considerable monitoring has been completed within the Upper White River, the Greenwater River in particular, as part of the data collection phase of the TMDL assessment (Schuett-Hames and Adams, 2003, and Schuett-Hames et al., 2004). Tables 2.5 and 2.6 in the Upper White River TMDL outline habitat parameters and linkages of those parameters to watershed processes.

Monitoring will be fully successful if it distinguishes between change from natural factors (climate, vegetation) and those changes brought about by management actions targeted at restoring water quality and aquatic habitat. The plan describes the initial suite of monitoring attributes. The set of attributes may change over time as warranted by review of the data. Certain attributes will no longer be useful; other attributes will be added, or the timing and frequency of some attributes changed, to best address monitoring questions or improve the understanding of other attributes.

The Upper White TMDL discusses sediment and temperature as impairing water quality and aquatic habitat. At a minimum, monitoring should show the trend in water quality and aquatic habitat to indicate whether water quality conditions are improving and eventually meeting stated standards. To be most useful, monitoring should demonstrate the effects of management on water quality and aquatic habitat.

The Upper White River TMDL identified spring Chinook salmon, bull trout, and tailed frogs as useful indicator species for measuring the success of TMDL implementation. Monitoring items within this DIP and in Tables 2.5 and 2.6 in the TMDL are intended to characterize conditions for these species and bring some understanding as to the success of the implementation in protecting and recovering these species.

This plan describes monitoring of sediment and temperature, and a number of other attributes that assist in interpreting the sediment and temperature data. Monitoring is a long-term commitment. The response of the aquatic environment to management (or climatic) change may take many decades to detect. This plan attempts to monitor attributes that are likely to respond in a short time period, as well as some that respond more slowly. Monitoring data will be evaluated at five year intervals to assess the effectiveness of the TMDL implementation; however, it may be many intervals before actual change is documented.

Monitoring Goal and Objectives

The goal of this monitoring is to:

Demonstrate the effectiveness of TMDL implementation for restoring water quality and aquatic habitat in the Upper White River Watershed.

While this remains the stated goal of this monitoring program, it may be unrealistic. A small body of evidence is emerging that indicates that even under highly controlled research conditions, decades of monitoring has not drawn a cause and effect relationship between forest management activities and certain in-stream attributes. The lessons from this research are that:

- Implementation monitoring is imperative and possibly the most useful.
- It is critical that we have the right monitoring tools to answer the questions asked.
- We haven't been asking the right questions, or not applying the right tools to answer the questions.

As this monitoring approach is implemented, the team must constantly seek out information from other monitoring programs to refine and possibly redirect the approach or parameters.

The two primary TMDL pollutants are heat (temperature) and sediment. The objectives of this program monitoring are:

Temperature

- Characterize stream temperature conditions in the watershed.
- Document the trends in stream temperature conditions relative to state water quality standards.
- Document changes in stream shade, especially where the TMDL identified it as low.

Sediment

- Document trends in surface and mass erosion in the watershed.
- Document effects of sediment on aquatic habitat parameters and channel geometry.

Baseline and Trend Monitoring

Baseline monitoring establishes the existing conditions. It is sometimes referred to as an inventory or assessment. In the context of the DIP, conditions in the Upper White River are known for areas that have been monitored, but there are many areas without monitoring data, and hence existing conditions are not known.

Several stations will be maintained to identify trends throughout the watershed. Trend monitoring is intended to capture changes in watershed parameters over a longer time period. The stations and parameters for trend monitoring will be determined after completion of the watershed characterization and relationships between parameters and among sub-watersheds are established.

Implementation Monitoring

Implementation monitoring asks the question "Did we do what we said we would do?" All subsequent monitoring relies on the answer to this question. If the answer to this question is unknown, then it is difficult, if not impossible, to demonstrate the effectiveness of an action. Implementation monitoring will be conducted on representative actions in the watershed. It will

not be possible to monitor implementation of all actions, but an attempt will be made to conduct enough implementation monitoring to assure that types of actions are being implemented as designed.

Effectiveness Monitoring

Effectiveness monitoring attempts to determine if the actions taken are having the desired effect. This monitoring requires careful consideration of the expected effect and where and when the effect will be measurable. This monitoring should be done close to the activity. It will not be possible to monitor all actions, but an attempt will be made to determine the effectiveness of types of activities. Effectiveness monitoring cannot be conducted without implementation monitoring, so these forms of monitoring will be performed for the same activities.

Implementation Monitoring Plan

Characterization Studies/Inventory

This section describes activities necessary to better describe the aquatic ecosystems of the upper White River so that long term monitoring data can be properly interpreted. The characterization studies and inventory would be accomplished in the first two years of this plan, provided adequate funding is obtained. An assessment of these study results will guide the long-term monitoring in the watershed.

Inventory

Questions:

- What is the condition of acquired roads?
- Do these roads contribute sediment to the stream network or otherwise influence ecosystem processes?

Roads acquired through the Huckleberry Land Exchange have not been inventoried for erosion and sediment problems or culvert conditions for water and fish passage. Some 200 miles of industry-built roads were acquired by the Forest, most of which are in the Greenwater River sub-watershed. This information is critical to developing an effective restoration program. The road inventory would include the Mt. Baker-Snoqualmie NF road risk assessment and condition surveys. Two persons working for 30 days should be able to complete the inventory.

Questions:

- What is the contribution of tributary streams to temperature problems in the mainstems?
- Are there thermal barriers in the system?

Stream temperature can be a barrier to fish migration. Initial temperature monitoring should include extensive monitoring within the sub-watersheds to determine the sources of stream heating, and specifically the forest boundary.

Suggested monitoring sites:

For temperature characterization: at stream mouth, additional sites at geomorphic breaks; tributaries. Stratify sampling using land management, stream type, and habitat type; disperse over space.

Greenwater - 10 probe locations

West Fork - 10 probe locations

Huckleberry - 2 probe locations

Upper White River - 3 probe locations

The Upper White TMDL used site potential shade as a surrogate for stream temperature. A detailed assessment of site potential shade was conducted for the Greenwater River using GIS vegetation and forest ecology plot tree information. Shade is an important factor in regulating stream temperatures. A set of points in the Greenwater will be selected to field validate the site conditions used in the shade model. Since thermal reach assessments will be conducted at the ten stream temperature monitoring sites, these will be used for the validation points. If this set does not provide an adequate array of sites for the model validation, an additional set of random points will be sampled.

Questions:

- How do basic processes of stream discharge and sediment transport, and water quality vary among the four sub-watersheds?
- What differences exist in macroinvertebrate assemblages among the sub-watersheds?
- What factors influence these differences?

Benthic communities respond to short-term flow changes. Variation in benthic communities among watersheds shows different dynamics within the system, natural or otherwise. In order to characterize the four sub-watersheds in the upper White River, streamflow and nutrients will be sampled in conjunction with macroinvertebrates. These characterizations will be compared to those developed for the western Cascades by Chuck Hawkins, Utah State University. An 85-percent match between existing and expected constitutes a reference condition.

Understanding some of the basic processes in the four sub-watersheds will assist in interpreting the benthic populations and reduce some of the noise in those data. This study proposes to develop some general discharge curves, conduct some basic sediment transport modeling, and characterize general water quality for the four sub-watersheds in the upper White River.

Stream Discharge Statistics

The Greenwater River has an active stream gauge, so only the other three sub-watersheds need to be instrumented. Staff gauges will be installed at the most stable and appropriate locations in the West Fork White River, upper White River, and Huckleberry Creek. Due to the size of these rivers, bridge sites may be required so that discharge measurements can be made using a cable mounted flow meter. Four to six flow measurements will be taken at varying stages to establish crude discharge curves and annual hydrographs, for comparison among sub-watersheds.

Sediment Transport

Stream substrate and cross section information will be used with one or more sediment transport equations to approximate when (under what flow conditions) bedload transport occurs in these watersheds. This information will assist in evaluating benthic invertebrate samples based on the types of flows encountered each year.

Water Quality

Some differences in observed invertebrate populations may be correlated with, if not directly dependent on, water quality. Water samples will be taken at the flow measurement sites, each time a flow measurement is taken. These samples will be analyzed for nutrients, alkalinity, turbidity, total settleable solids, pH, dissolve oxygen, and conductivity. Stream temperature will be taken at the site. Samples will be refrigerated or frozen until shipped to a recommended lab.

Estimated Cost of the Characterization Studies/Inventory:

Road inventory: 2 persons, 35 days (5 days for data entry) @ $200/day	$14,000
Stream temperature characterization: 50 thermographs @ $100/ea	5,000
Installation and reach surveys: 2 persons, 12 days @ $200/day	4,800
Retrieval and summarize: 1 person, 10 days @ $200/day	2,000
Discharge, sediment transport and water quality:	
Staff gauges, rebar, clamps, supplies	400
Laboratory analysis of six sets of samples at each of 4 sites	2,250
Shipping costs	800
Study design, installation of sites, 6 site visits for measurements and sample collection, discharge and sediment modeling, report preparation and general administration of studies.	18,000
Macroinvertebrates: 4 sites, 2 samples each @ $200/sample, 4 days	3,200
Total cost for studies/inventory (2-year period)	$50,450

Trend and Effectiveness Monitoring

Monitoring Questions

- Are we meeting water quality standards for temperature?
- Are stream temperature conditions improving; what are the long-term temperature trends?

Stream Temperature

Temperature will be a common measure at sites low in streams for long term trend monitoring. The number of sites for long term monitoring will be fewer than those used in the characterization study, and based on the results of that study. For planning purposes, no more than ten sites will be monitored for long-term trends and compliance with water quality standards.

Probable Monitoring Sites:

Greenwater - 3 probe locations

West Fork - 3 probe locations

Huckleberry - 2 probe locations

Mainstem White River - 2 probe locations

BMP Implementation and Effectiveness Monitoring will be conducted at project sites where project objectives include stream temperature improvement or where non-degradation is of concern. Pyramid and Midnight Creeks are expected to receive treatments. Include selected sites to monitor return of shade, including control sites (Mt. Rainier NP). Initial temperature monitoring should include intensive monitoring to determine the source of the stream temperature anomaly in West Fork White River between the Road 74 bridge crossing and the forest boundary. This work should take eight to ten days each year.

Crystal Mountain monitors temperature in Silver Creek as part of the master development plan. Mt. Rainier National Park may be monitoring stream temperature and could lower the number of sites under this plan by three (West Fork, Huckleberry and upper White).

Monitoring Questions

- What is the status and trend in streamside shade?
- Is shade correlated with stream temperature?

Shade Measurements

In addition to the stream temperature monitoring sites, a few additional sites with low shade throughout the watershed may be randomly selected for shade trend monitoring to document changes with growth of the riparian forest. A solar pathfinder will be used for shade measurements.

This effort should be around five days per year if all sites are measured in the same year. Shade would be measured every three years, and only until site potential shade levels are reached.

Monitoring Questions

- Are there physical barriers caused by sediment inputs?
- What are the effects of road closure on sediment production?
- What is the trend in mass erosion in the watershed?

Sediment

The Upper White River TMDL sediment assessment showed sediment from mass erosion associated with forest management and roads to be significant contributors of sediment to the Greenwater River, West Fork White River, and Huckleberry Creek. A partial sediment budget developed using an aerial photo landslide reconnaissance to demonstrate erosion and sediment conditions. Repeat sediment budgets will be conducted every ten years (as new photos are available).

Implementation monitoring will be conducted on road closure and decommissioning projects.

Effectiveness monitoring on selected projects will include erosion measurements and estimated sediment delivery to streams.

A field reconnaissance of channel sediment conditions will be used to locate any potential passage barriers posed by sediment deposits. A river steward would be useful for this.

This work will vary by year depending on the implementation schedule of restoration projects. For planning purposes, five days for two people per year would be an average.

Monitoring Questions

- What are the general conditions for aquatic species?
- What factors are influencing the composition and distribution of aquatic species?
- What conditions have prevailed from one sample period to the next?
- What is the trend in aquatic species in the watershed?
- Are there impacts from residential communities? Septic systems?

Macroinvertebrates

The objective of benthic invertebrate monitoring is to confirm what other monitoring may be telling us, by synthesizing those conditions that may not be measured using other parameters measured at points in time. Periodic sampling may miss time intervals when an actual impairment is occurring.

Benthic monitoring should be done at locations where conditions are expected to change due to management or restoration activities. Mainstems are not likely to show change. Pyramid Creek would be a priority for project effectiveness monitoring using invertebrates. The characterization of the benthic communities from the above studies will assist in determining the number of sites where continued monitoring will be done. Annual benthic monitoring could be accomplished through a relatively low-cost effort. Sample analysis is approximately $200 per sample for species identified to genus; 2-3 samples can be obtained per day.

Nutrients

Some nutrient sampling sites will be selected to measure effects of residential areas. This sampling will not be continuous unless a problem is discovered and remedial action is taken. Then effectiveness monitoring will continue.

Streamflow

Staff gauges and possibly crest stage recorders would be maintained in the sub-watersheds. Crest stages would be read once a year.

Annual monitoring budget:

Stream temperature: replacement thermographs @ $100/ea	200
Installation, retrieval and summarize:	1,600
10 sites; 1 person, 8 days@ $200/day	
Shade reach surveys: 2 persons, 10 days @ $200/day; once every three years	4,000
Sediment (project effectiveness): 2 persons, 5 days	2,000
Macroinvertebrates, nutrients, flow: 10 sites maximum	
2 people, 4 days; 10 samples/year @200/sample	3,200
Total Annual costs, for years when all the above occur	$11,000

Some years the cost will be closer to $5,000 since not all activities will be required.

Other Work that Would Help Guide Restoration Work in the Upper White River

Macroinvertebrate populations respond to changes in allocthonous input to the stream system. There are a number of known invasive plant infestations in the upper White River. These have the potential to change the character of the allocthonous input if infestations alter the composition of streamside communities. A survey of the channels in the watershed with the intent of mapping invasive plant communities within riparian areas would show whether this is a concern, and if so, where and how dramatic a problem it is. Should funding be available, an inventory of invasive species should be considered.

Biological surveys for bull trout and tailed frog distributions and within the Upper White River would greatly enhance implementation of restoration activities to protect these species.

The Upper White River could also be used to conduct water and erosion prediction project modeling (WEPP) as a pilot test for the Mt. Baker-Snoqualmie National Forest. The Forest proposes to conduct this modeling once training is attended and funding is secured. This modeling would be useful in validating/updating the sediment budget.

Literature Cited

Ketcheson, Gary, Peter Leinenbach, Joanne Schuett-Hames, Tony Whiley, and Cindy James. 2003. *Mt. Baker-Snoqualmie National Forest, Upper White Watershed Sediment and Temperature TMDL for Aquatic Habitat. Submittal Report.* Washington Department of Ecology, Olympia, WA. 107 pp. plus appendices.

Schuett-Hames, Joanne, Clay Keown, and Cindy James. 2004. *Upper White Watershed Temperature Data Report:* 1989 to 2003. Publication No. 04-10-061. Washington Department of Ecology. Olympia, WA. 8 p. + appendices

Schuett-Hames, Joanne and David S. Adams. 2003. *Upper White Watershed Spring Chinook Redd, Scour, and Cross-Section Assessments: 1995-2001.* Publication No. 03-10-071. Washington Department of Ecology. Olympia, WA. 30p.+appendices.

Appendix C:
Public Involvement and Response

Public Involvement

Communication with the public at large and providing an opportunity for public awareness and input to the development of the *Upper White Watershed Sediment and Temperature Total Maximum Daily Load (Water Cleanup Plan) for Aquatic Habitat Detailed Implementation Plan* was accomplished in several different ways. One approach consisted of providing information about the Upper White River TMDL on the Internet; a second involved coordination and facilitation of an advisory committee to assist in the development of the detailed implementation plan (DIP); a third involved making a presentation at a public meeting where the DIP process and recommendations were explained; and a fourth was a formal review and comment period. Although it was envisioned that employing these approaches would generate a high level of participation, interest was primarily received from governmental and tribal entities.

Ecology maintains an internet site for its TMDL program. Web pages have been developed for many individual TMDL projects, and for the Upper White River. This information can be accessed at: http://www.ecy.wa.gov/programs/wq/tmdl/watershed/white_river/index.html. Materials on the Upper White River Basin Information page include: *Mt. Baker Snoqualmie National Forest - Upper White Watershed Sediment and Temperature TMDL for Aquatic Habitat - Submittal Report*; Focus Sheet: Upper White River at Risk: First Steps Toward Restoration; TMDL Guidance for Habitat in the Upper White River; Upper White Watershed Spring Chinook Redd, Scour, and Cross-Section Assessments: 1995 – 2001; United States Geological Survey Monitoring Report; Upper White Watershed Temperature Data Report: 1989-2003; and the draft DIP document. The information page also includes links to a basin map and contact information for Ecology's TMDL staff lead.

An advisory committee comprised of technical and non-technical staff from state and federal agencies (U.S. Environmental Protection Agency, Region X; U.S. Forest Service; Washington State Departments of Fish & Wildlife, Natural Resources, and Ecology), an Indian tribe (Puyallup Tribe of Indians), local government (Pierce County, Pierce County Conservation District), and environmental groups and interests (Puyallup River Watershed Council, Tahoma Audubon Society) provided feedback at major decision points associated with development of this document. This advisory committee met four times (October 5, 2003; July 14, 2004; September 9, 2004; November 23, 2004) at the City of Enumclaw Public Library.

On March 15, 2005, a public meeting notice was mailed to 137 individuals using a mailing list of interested parties generated earlier in the TMDL process. This notice provided information on the draft DIP public meeting, the availability of the draft DIP document itself, and the dates for the public review and comment period. Rather than hold a public meeting focusing only on the DIP, it was decided to make a presentation on the DIP in conjunction with the monthly meeting of the Puyallup River Watershed Council. Combining the Council's meeting with the DIP was thought to be a better approach for garnering citizen interest and attendance. This meeting was scheduled on March 23, 2005, at the city of Sumner's city hall. Twenty-five people were in attendance. The process employed and details of the DIP were presented. A question and answer session followed and thoughtful citizen interaction occurred. A copy of the meeting announcement is included at the end of this section.

Ecology held a public comment period on the draft *Upper White Watershed Sediment and Temperature Total Maximum Daily Load (Water Cleanup Plan) for Aquatic Habitat Detailed Implementation Plan* from March 15, 2005 to April 15, 2005. Formal public comments were accepted by mail and by email.

Response to Comments

Ecology received two formal comments during this review and comment period, one from Citizens for a Healthy Bay and the second from Joanne Schuett-Hames, author of the original TMDL. The comments are documented below, followed by a response (in italics) regarding how the comment was addressed.

Comment # 1. Received from Amy Bates, Commencement Baykeeper, on behalf of Citizens for a Healthy Bay, in a letter dated April 10, 2005.

Thank you for the opportunity to submit official public comment regarding the Upper White Watershed Sediment and Temperature Total Maximum Daily Load (Water Cleanup Plan) for Aquatic Habitat Draft Detailed Implementation Plan.

Citizens for a Healthy Bay (CHB) is a non-profit organization whose mission it is to clean up, restore and protect Commencement Bay, its supporting waterways and habitat. In fulfillment of this mission, CHB serves to represent the citizens who have expressed an interest in protecting Commencement Bay.

As the Puyallup River/ White River Watershed drains into Commencement Bay, and as CHB takes a systemic, watershed approach to water pollution prevention, we appreciate the opportunity to comment on this Draft Detailed Implementation Plan (DDIP). We believe that a sustainable DDIP depends upon the expertise and insight provided during the public comment process. In light of these factors, the following comments have been compiled.

Section: Federal Land – USDA Forest Service; Paragraph 3.

Statement – "The objectives are, to meet requirements of existing laws and regulations…"
Comment – Omit comma after "are" or replace with colon.

Section: Private Forest Land

Statement – "In exchange for their support of the new forest practices rules, the timber industry was provided with the following "assurances:" 1) development of TMDLs for 303(d) listed water bodies impacted primarily or solely by forest practices may be delayed until the year 2009…"
Comment – Postponing or delaying the 303(d) listing process for the benefit of private industry is contrary to the spirit and intent of the clean water act. We understand that private industries are impacted by this listing, however the delaying of the process may prolong (or cause) damage to critical areas. This willful postponement may also be contrary to anti-degradation efforts, and may impact protected species. This type of "assurance" should not be made without first assessing the area, determining the status, and ensuring that critical issues are addressed. In essence, TMDLs establishment should not be postponed without sound justification; a justification which should not be made solely upon economic factors.

Section: Private Lands

Statement – "While no specific restoration treatments on private land will be undertaken as part of the Upper White River TMDL, the FPRs specify riparian shade levels for forest management and road…"
Comment - Although no specific restoration treatments "will be undertaken" regarding private lands, a general plan of restoration/protection should be developed by the land owner.

The CWA mandates that 303(d) waters be identified, that TMDLs be established, and methods for clean-up clearly identified. Further, we understand that the purpose of the Upper White Watershed Sediment and Temperature TMDL DDIP is to clean up the historically degraded

waters, to create sustainable habitat for aquatic species, and to provide reduce the potential for further contamination. In light of these mandates, "assurances" to private agencies that this process will be delayed erodes the intent of the CWA. In addition, methods must be more clearly defined, clean up more aggressively attempted, and measures must be based upon best available science.

Thank you for the opportunity to comment on this draft DIP.

Response:

The focus of this TMDL is to address water quality impairments on federal timberlands in the Upper White Watershed managed by the U.S. Forest Service. Private timberland owners in the Upper White River Watershed were invited to participate but chose not to because private timberlands fall under the regulations approved in 2000 by the Washington State Legislature, known as the Forest and Fish Agreement. Ecology's Water Quality Program has deferred the requirement for TMDLs on private timberlands pending an assessment of the effectiveness of the Forest and Fish agreement, planned for completion in 2009. A decision on the 303(d) listing process, as it relates to private timberlands, will be made at that time.

While most of the timber harvest on private lands within the Upper White River preceded implementation of the Forest and Fish Report, current and future management are regulated under the new Forest Practice Rules. As noted in the Upper White River TMDL, application of temperature and sediment load allocations will be accomplished on private forestlands through implementation of the Forest and Fish agreement. We agree with your statement that land owners should develop a general plan for restoration/protection of their properties.

Comment #2. Received from Joanne Schuett-Hames via a telephone conversation on April 20, 2005.

Statement 1. Need to think about prioritizing implementation actions. Look at targets for spring Chinook, bull trout, and tailed frogs, all of which rely on cold temperatures. It is suggested that one link priority of actions to target species.

Statement 2. While the monitoring plan addresses temperature and sediment, it should be expanded to address key habitat parameters.

Statement 3. Use Black et al. (2003) for determining temperature priority areas.

Response:

The expected sequence of implementation activities is shown in Figure 3. Many actions will occur simultaneously. Specific locations are more difficult to determine outside of annual planning exercise. Additional text has been provided under Pollution Sources and Organizational Responsibilities.

The monitoring plan has been revised to address key habitat parameters and references to Tables 2.5 and 2.6 in the TMDL are now included. Biological surveys for bull trout and the tailed frog are recommended for additional work. Black et al. (2003) has been cited for treatments dealing specifically with shade.

Meeting Notice

Upper White River

from Ecology's Water Quality Program and the US Forest Service

Public Comment Period

March 15, 2005 to April 15, 2005

The Problem

The Upper White River has some water quality problems. Land management has changed the river in ways that threaten the health of native spring Chinook salmon, bull trout, and other aquatic species. The Greenwater River is on a list of waters that must be restored to meet state temperature standards. Other streams have also been identified as having problems for temperature and fish habitat.

The Department of Ecology, the U.S. Forest Service, and the U.S. Environmental Protection Agency completed a technical assessment and a summary implementation strategy in June 2003. This group has now developed a detailed implementation plan (DIP) to determine exactly who will work on cleaning up problems that have caused the water quality to become degraded.

How can you get involved?

There will be a public meeting to get your comments regarding the plan. It will be part of the Puyallup River Watershed Council's meeting on March 23, 2005 beginning at 5:00 p.m. in Sumner City Hall, 1104 Maple Street, Sumner, Washington.

There are several ways you can obtain a copy of the plan:

You may review a copy of the plan at: http://www.ecy.wa.gov/biblio/0510038.html

You may also review a hard copy at the Enumclaw Public Library, 1700 First Street, Enumclaw, WA, or Wapato Woolies Woolies, 58414 SR 410 E, Greenwater, WA. You may also request a copy by calling (360) 407-6295, after March 15, 2005.

The public comment period will be from March 15, 2005 until April 15, 2005.

Please submit your comments to Gary Ketcheson by email at gketcheson@fs.fed.us or by mail to:

Gary Ketcheson
US Forest Service
21905 64th Avenue W
Mountlake Terrace, WA 98043

If you have questions, please contact Gary at (425) 744-3421, or Kim McKee at (360) 407-6407.

If you have special accommodations needs or if you require this information in an alternate format, please contact us at 360-407-6270. If you are a person with a speech or hearing impairment, call 711 or 800-833-6388 for TTY.

March 2005 *05-10-039*

Original printed on recycled paper

Appendix D:
Implementation Tracking Sheets

Checklist 1. Implementation Monitoring Workplan Updates (USFS)

Year	Implementation Monitoring Plan		Achievement (Yes/No)
	Annual Meeting Held?	Updated Workplan Developed?	
2005			
2006			
2007			
2008			
2009			
2010			
2011			
2012			
2013			
2014			
2015			
2016			
2017			
2018			
2019			
2020			

Checklist 2. Sediment Budget Assessments (USFS)

Year	Sediment Budget Assessment Performed		Percent Achievement
	Goal	Result	
2015	1		
2025	1		
2035	1		
Every ten years thereafter			

Checklist 3. Landslide Inventory (USFS)

Year	Landslide Inventories Performed		Percent Achievement
	Goal	Result	
2020	1		
2030	1		
2040	1		
Every ten years thereafter	1		

Checklist 4. Adaptive Management Meetings (Ecology)

Year	Number of Meetings Held		Percent Achievement
	Goal	Result	
2010	1		
2015	1		
2020	1		
2025	1		
2030	1		
2035	1		
2040	1		

Checklist 5. Integrated Long-Term Monitoring Program (NPS)

Year	Plan Developed or Revised		Percent Achievement
	Goal	Result	
2010	1		
Updated every ten years thereafter	1		

Checklist 6. Conduct and Implement Access and Travel Management Plan (USFS)

Year	Plan Developed or Revised		Percent Achievement
	Goal	Result	
2011	1		
Reviewed/Updated every ten years thereafter	1		

Appendix E:
USDA Forest Service/Ecology Memorandum of Agreement

MEMORANDUM OF AGREEMENT
between the
USDA FOREST SERVICE, REGION 6
and the
WASHINGTON STATE DEPARTMENT OF ECOLOGY
for
MEETING RESPONSIBILITIES UNDER FEDERAL AND STATE WATER QUALITY LAWS

This MEMORANDUM OF AGREEMENT (hereafter referred to as "MOA"), together with Attachment A and documents referenced in Attachment B, is entered into by and between the U.S. Department of Agriculture Forest Service (hereinafter referred to as the Forest Service) and the Washington State Department of Ecology (hereinafter referred to as Ecology). This MOA represents the "Forest Service Pacific Northwest Region Water Quality Management Plan for Washington State." The Forest Service and Ecology agree that this MOA is the implementation plan for execution of this agreement and is a priority within their organizations. Timely implementation will prevent duplication of effort and provide coordination to meet Federal Clean Water Act (CWA) requirements and the goals of both agencies. The Forest Service and Ecology recognize that financial appropriations over which the agencies do not have total control are necessary to support these management commitments.

Nothing in this statewide MOA shall preclude individual National Forests from entering into agreements with Ecology regional offices to meet specific local needs. Any such local MOA shall fit within the parameters of this statewide MOA.

1. PURPOSE

The purpose of this MOA is to:

1.1 Recognize through this agreement that the Forest Service is the Designated Management Agency for meeting CWA requirements on National Forest System (NFS) lands. The Forest Service will ensure that all waters on NFS lands meet or exceed water quality laws and regulations and that activities on those lands are consistent with the level of protection of the Washington Administrative Code (WAC) relevant to state and federal water quality requirements.

1.2 Attain joint Ecology and Forest Service commitment to the responsibilities to be performed by each agency to accomplish water quality protection, management, and restoration on National Forest System (NFS) lands within the state of Washington.

1.3 Identify Forest Service policy, programs, and practices that assure attainment of CWA requirements of:

A. CWA Section 303 (Water quality laws and regulations and implementation plans).

B. CWA Section 313 (Federal facilities pollution control).

C. CWA Sections 319(b)(2)(f) and 319(k) (Nonpoint source management program) as amended in 1987 (PL-100-4), and Washington's Plan to Control Nonpoint Pollution.

D. Executive Order 13148 Greening the Government through Leadership in Environmental Management.

E. Clean Water Action Plan (CWAP) of 1998.

1.4 Encourage and enhance communication, coordination and working relationships between Ecology and the Forest Service, and lay out a process for dispute resolution.

2. AUTHORITIES

2.1 The U.S. Congress assigned the Forest Service the responsibility for managing the NFS lands. Forest Service cooperation and coordination with Ecology is consistent with that legislation.

2.2 The U.S. Environmental Protection Agency (EPA) delegated implementation of the CWA to the states. In the state of Washington, Chapter 90.48 Revised Code of Washington (RCW) gives Ecology authority and responsibility to protect and manage water quality.

2.3 Section 303(d) of the CWA lists water bodies and outlines a program for addressing water body segments having limitations on their quality that preclude them from meeting or exceeding standards designated for beneficial uses. These include both point and nonpoint sources. The Forest Service, as a Designated Management Agency, is responsible for addressing water bodies within NFS lands. Ecology is the lead agency for development of Total Maximum Daily Loads (TMDLs) for 303(d) listed water bodies.

2.4 Section 313 of the CWA requires the Forest Service to adhere to the goals set forth in the state surface water quality laws and regulations in the same manner and to the same extent as any nongovernmental entity.

2.5 Section 319 of the CWA requires states to develop nonpoint source pollution management programs to qualify for Federal grants to control nonpoint source pollution. This MOA is a component of that program.

2.6 An important component of the state surface water quality laws and regulations is the concept that nonpoint source pollution is best controlled by land use practices designed to prevent and mitigate water quality impacts. Best Management Practices (BMPs) for forest management on non-federal lands are codified in the state Forest Practices Rules (WAC 222). Rules marked with an asterisk are agreed to by Ecology because they pertain to water quality (see WAC 222-12-010 and RCW 90.48.420). BMPs are recognized as the primary mechanism to control nonpoint source pollution on NFS lands, and are prepared by the Forest Service as part of Forest Land Management Plans (LMP) and project level plans. Activities on National Forests are expected to meet or exceed the requirements that apply to non-federal lands. BMPs are also recognized as the primary mechanism to control nonpoint source pollution from activities such as recreation, mining, fish, wildlife and watershed restoration, livestock grazing, fire suppression, and other land management activities.

3. EXISTING POLICIES AND DIRECTION

3.1 Forest Service and Ecology recognize the contribution of existing direction, standards, and allocations included in: Northwest Forest Plan (NWFP); Interior Columbia Basin Ecosystem Management Project (ICBEMP); Implementation of Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and portions of California (PACFISH); Interim Strategies for Managing Fish-Producing Watersheds in Eastern

Oregon and Washington, Idaho, Western Montana, and portions of Nevada (INFISH); and Forest Service National Roads Management Policy.

3.2 Both agencies recognize the need to repair existing fish passage problems at road crossings and commit to assessing needs and implementing remediation of passage problems within the 15-year time frame used to implement WAC 222. Existing policy and direction is to repair fish passage problems currently limiting life stages of fish and which offer beneficial habitat gain. Near-term emphasis will be on the repair of crossings within and into key watersheds that restrict passage of multiple life stages of anadromous and resident salmonid species, including bull trout.

4. MUTUAL RESPONSIBILITIES

4.1 Cooperation and Problem Solving

Forest Service and Ecology will seek opportunities to coordinate and collaborate on management activities involving monitoring, water quality planning, and restoration with recognition that other agencies and tribes have a high level of interest and involvement in these efforts. The agencies will conduct joint reviews of project implementation areas with field staff to determine if BMPs are being implemented and if management effort [e.g., Water Quality Restoration Plans (WQPR), BMPs, etc.] are effective in protecting water quality. Ecology will take into consideration the objectives of other agencies and groups with whom the Forest Service must coordinate its efforts.

4.2 Roads: Collaborative Development and Implementation

Forest Service and Ecology agree that roads can be a significant component for addressing CWA needs. Both agencies will collaborate on the following key elements for road activities under this MOA:

A. Develop a prioritization process for road maintenance and stabilization activities. This process will include consideration of Key watersheds; 303(d) listed water bodies, and watersheds with Endangered Species Act (ESA) listed species. On-going efforts such as the Unified Watershed Assessment (UWA) and Watershed Restoration Action Strategy (WRAS), and federal salmon and bull trout restoration strategies, as specified in the NWFP and interim Pacfish-Infish-Biological Opinions, and state and federal recovery plans for listed species, will be considered in determination of high priority activities.

B. Review pre-established priorities for resource protection and road maintenance and stabilization on an annual basis at the statewide joint meeting.

C. Document achievement of the milestones and timelines included in Attachment A.

4.3 Preparation of Water Quality Restoration Plans (WQRPs) and TMDLs

Forest Service and Ecology will collaborate in addressing 303(d) listed water bodies. The Forest Service mechanism is outlined in the Forest Service and Bureau of Land Management Protocol for Addressing Clean Water Act Section 303(d) Listed Waters. Collaboration will include both point and nonpoint sources of pollution. Forest Service and Ecology ascribe to the Forests and Fish Report, Appendix M Assurances and Schedule M-2 Clean Water Act Section 303 Assurances. This report states that TMDL allocations for impaired waters caused by forest

practices are a low priority for development. However, Forest Service and Ecology recognize that it may be of mutual benefit to move forward with the collaborative development of TMDLs.

In the development of TMDLs, both agencies recognize the inherent limitation of models in development of load allocations given the natural variation and the complex nature of watersheds. Both agencies are committed to emphasizing meaningful implementation of on-the-ground solutions rather than "precise" modeling.

Forest Service developed WQRPs will be sent to the appropriate Ecology regional office and to Ecology headquarters for review and a determination of whether plan implementation is expected to result in meeting or exceeding state water quality laws and regulations. Ecology will provide an expeditious review and comments on WQRPs, but the Forest Service may implement activities consistent with a WQRP prior to formal approval of the plan by Ecology.

Where mutually agreed to, the Forest Service will develop TMDLs on National Forest System lands for submission to Ecology. Ecology will review these TMDLs and submit to EPA for review and approval.

4.4 **Annual Meeting**

Staff from the Forest Service and Ecology headquarters will meet at least annually to provide a forum for communication and to foster adaptive management. Ecology's Water Quality Program Manager (or designee) will initiate contact with the Forest Service Region 6 representative to set this meeting. Other governmental agencies will be invited to the annual meeting with agreement from both the Forest Service and Ecology. Suggested topics for the annual meeting include:

A. "Annual Forest Reports" for each National Forest.

B. Accomplishment of milestones within Attachment A, activities planned for implementation for the current year, and development of activities for the upcoming two years.

C. Forest Service and Ecology watershed planning efforts related to roads, water quality, watershed condition and endangered species recovery.

D. §303(d) listings.

E. WQRPs and TMDLs on NFS and adjacent lands, and discussion and agreement of lead for plan development.

F. Monitoring programs and results.

G. Review of Forest Service BMP implementation and effectiveness, with emphasis on successes and areas needing improvement in meeting water quality laws and regulations.

H. Review new BMPs presented and discussed during the Annual Meeting, including adaptive management under Forests and Fish Report, and new Forest Service initiatives, for subsequent certification by Ecology.

I. Review Forest Service activities to ensure water quality laws and regulations and requirements of Washington's Water Quality Management Plan to Control Nonpoint Pollution are being met.

J. Joint public involvement for appropriate projects.

K. Restoration funding priorities, with full recognition of priority criteria from other local, state, and federal agencies.

L. Updated contact lists.

M. Other topics as mutually agreed to and needed for coordination.

Ecology will certify new BMPs identified during the annual meeting. The timing and mechanism for certification will be negotiated between both parties.

4.5 **Adaptive Management**

Ecology and the Forest Service will continuously evaluate the effectiveness of their efforts and will share information from studies about forest practices so as to refine and adapt best management practices to obtain the best results for water quality and beneficial uses.

5. FOREST SERVICE RESPONSIBILITIES

5.1 The Forest Service will manage NFS lands to protect and maintain water quality so that water quality laws and regulations are met or exceeded, and will restore water-quality-limited water bodies within its jurisdiction to conditions that meet or surpass standards designated for beneficial uses. The Forest Service will maintain and restore water quality and watershed condition using an ecosystem approach on a watershed scale. The Forest Service will:

A. Implement site specific BMPs as specified in Forest Service R6 General Water Quality Best Management Practices document, and standards and guides within the NWFP, PACFISH, INFISH, ICBEMP, or other final direction that replaces interim guidance for the eastside of Washington to protect water quality and beneficial uses, and to meet or exceed the requirements of the CWA and state water quality laws and regulations, as contained in the state Forest Practices Rules (WAC 222).

B. Stabilize and maintain all roads on NFS lands to a level that meets the objectives established for roads in WAC 222-24-010 and following the implementation schedule in Attachment A. This MOA does not cover county roads, state roads, federal highways, or other roads on NFS lands for which the Forest Service does not have jurisdiction. Areas of jurisdiction will be clarified in annual meetings. Any needed clarifications may result in amendments to this MOA.

C. Complete an assessment of water quality effects generated by roads. This assessment could use the roads analysis process as outlined in the forthcoming Forest Service National Roads Management Policy, or separate assessment dealing solely with water quality. This analysis will identify issues, assess benefits, problems, safety, and risks associated with the road system, and describe actions and priorities for resolution.

D. Conduct monitoring as required in Forest Plans and WQRPs, in consultation with Ecology, to track the implementation of BMPs and their effectiveness in meeting water quality laws and regulations.

E. Take appropriate corrective action to remedy instances where state water quality laws and regulations are being violated on the NFS lands. Notify the appropriate Ecology regional office when water quality problems are noted on or near lands or water bodies administered by the Forest Service. Take appropriate "first response actions" in accordance with expertise and training, and notify local, state, and/or federal agencies with jurisdiction in an emergency situation (such as a spill).

F. Coordinate with Ecology in development and implementation of WQRPs and CWAP activities.

G. Prepare an annual forest report for each National Forest that describes accomplishment of activities including water quality monitoring information, WQRP activities, road-related and other watershed restoration accomplishments, and fish passage status report to address Attachment A. Forest Service MOA Responsible Official will submit annual Forest Service reports that include proposed road related schedule of proposed actions and accomplishments to the Ecology MOA Responsible Official with a copy sent to respective Ecology regional offices.

H. Utilize information included in such documents as Washington State's UWA and WRAS, Forest Service National Roads Management Policy and Analyses, Aquatic Conservation Strategies, Watershed Analyses, and state and federal recovery plans to focus road stabilization activities. Participate in local watershed planning efforts in order to maximize opportunities for joint funding of projects with local, state, tribal, and federal entities.

I. Assist with updates to Ecology's list of priority basins for water quality, the UWA and WRAS for program prioritization.

6. ECOLOGY RESPONSIBILITIES

6.1 Ecology is the lead agency responsible for ensuring that CWA requirements are met. Ecology will review Forest Service planning and implementation activities to ensure that water quality laws and regulations are being met or exceeded. Ecology will:

A. Coordinate with the Forest Service on CWAP activities including development of WQRPs.

B. Coordinate with the Forest Service to facilitate public participation in preparation of TMDLs developed for public ownership watersheds.

C. Develop TMDLs for impaired water bodies, or review and comment on Forest Service prepared TMDLs for submission to EPA, following acceptance by Ecology.

D. Work with EPA on appropriate listing and delisting of water bodies on the 303(d) list, including water bodies where TMDLs have been implemented. If effectiveness monitoring detects a downward trend despite implementation of all elements of the

WQRP, Ecology will work with the Forest Service to re-evaluate the elements and add any additional requirements to arrest the trend and meet water quality objectives.

E. Participate in monitoring efforts with Forest Service and other appropriate state and federal natural resource management agencies in preparation of monitoring plans, implementation of monitoring efforts and sharing of data and findings on a timely basis.

F. Provide technical assistance to the Forest Service, as appropriate. This assistance may include review and input on National Environmental Policy Act (NEPA) activities and documents, and input to interdisciplinary teams to help identify and develop alternatives and mitigation measures for proposed land management activities.

G. Notify local Forest Service offices of water quality problems noted on NFS lands and coordinate with the responsible Forest Service officials to obtain appropriate corrective action when management activities (past or present) result in lack of attainment of conditions specified in water quality laws and regulations.

H. Coordinate resolution of water quality management issues that arise between the Forest Service and state agencies pertaining to water quality regulatory responsibilities.

I. Ecology will request input from the Forest Service during preparation of 305(b) reports, 303(d) lists, water quality standards review processes, and nonpoint source management plans.

J. Certify Forest Service Best Management Practices for water quality related management activities. It is Ecology's responsibility to certify that general water quality BMPs and current Forest Plans are consistent with the CWA. The certification process requires the comparison of state BMPs and Forest Service BMPs, a process for designing and implementing BMPs, and a process for addressing differences between the two sets of BMPs. The underlying evaluation criterion will be whether or not implementation of Forest Service BMPs is likely to result in meeting or exceeding water quality laws and regulations.

6.2 The state BMPs for forest practices are the water quality related forest practices rules (WAC 222) promulgated by the Washington Forest Practices Board. Non-forestry BMPs are those developed and accepted by Ecology and other agencies, and may or may not be codified (such as BMPs in the Natural Resource Conservation Service's Field Office Technical Guide).

6.3 When Ecology determines that Forest Service BMPs meet or exceed state-adopted BMPs, Ecology will certify the included Forest Service BMPs in a letter to the Regional Forester from the Ecology Water Quality Program Manager or designee. Ecology and the Forest Service will cooperatively develop a process and timeline for review of BMPs and certification. The agencies will review progress at the first Annual Meeting.

6.4 When Ecology or the Forest Service determines through BMP effectiveness monitoring that Forest Service BMPs are providing less resource protection than the adopted or approved state BMPs, the Forest Service will review the BMPs for amendment. Any proposed amendments to the Forest Service BMPs will be reviewed for certification by Ecology.

6.5 Ecology may certify other non-forestry related Forest Service BMPs on a case-by-case basis. Examples of these types of activities are grazing, vegetation management, special uses, recreation, or other activities with a potential for affecting water quality.

7. RESPONSIBILITY AND COORDINATION

The Director of Ecology and the Region 6 Regional Forester are the responsible officials for ensuring implementation of this Agreement. The Director of Ecology hereby assigns the primary responsibility to coordinate implementation of Ecology aspects of this MOA to the Water Quality Program Manager. The Forest Service Region 6 Regional Forester hereby assigns the primary responsibility to implement this MOA to the Forest Service Region 6 Director of Natural Resources.

8. DISPUTE RESOLUTION

8.1 Both agencies are committed to work together to meet the requirements of the CWA and other requirements. Should disputes arise, they will be resolved at the most local level possible. The local offices of each agency (either the Ranger District or Supervisor's Office for the Forest Service, and the Regional Office for Ecology) will outline the issue, describing the background, including a problem statement, what the issue is, why the issue is not resolved, a description of alternatives examined describing pros and cons, and a recommendation. They may request assistance from the Forest Service Regional Office, Ecology Headquarters, or both.

8.2 If the above approach fails, the Forest Service Region 6 Director of Natural Resources and Ecology Water Quality Program Manager will assess the issue and describe a method(s) for resolution. They will meet with local staff for input and discussion.

8.3 Should the above approaches fail, the issue will be written up for the Region 6 Regional Forester and the Director of Ecology to discuss and resolve.

8.4 The Forest Service or Ecology may request assistance from other agencies or entities (such as EPA) at any step in the dispute resolution process.

9. ENFORCEMENT

Both agencies support the dispute resolution process; however, there may be times when conditions require immediate enforcement of water quality laws. Ecology reserves all of its authority to enforce state and federal laws concerning water quality, and nothing in this MOA shall be construed to limit that authority. Should the Forest Service fail to comply with state or federal laws concerning water quality, Ecology may use appropriate enforcement mechanisms under state or federal law to require compliance. This authority includes, but is not limited to, agency orders issued pursuant to RCW 90.48, and injunctive or other court-ordered relief, including penalties. When making a decision about enforcement, Ecology shall not be required to go through the dispute resolution process.

10. ADMINISTRATIVE

10.1 This MOA may be periodically revised, updated, or refined as necessary, by mutual written agreement by both the Forest Service and Ecology. This MOA will be reviewed, at a minimum of, every five years for amendment, renewal or termination by the Forest Service (USDA Forest Service Region 6 tracking number NFS 00-MU-11060000-025).

10.2 This MOA will remain in effect unless replaced by another MOA, terminated by mutual written consent of the parties, or canceled by 30 days' written notice from one party to the other party.

10.3 Both agencies are committed to acquiring the resources necessary to implement this MOA. Nothing in this MOA shall be construed to obligate either party to payment of money in excess of appropriations authorized by law and administratively available for the work. However, nothing in this MOA shall be construed as an agreement by either agency that lack of appropriations or funding excuses the other agency from compliance with any requirements of state or federal law.

10.4 This MOA will serve as the basis for any cooperative interagency job positions, or monitoring projects that may be established to help fulfill the commitments herein.

10.5 Nothing in this MOA detracts from obligations of any other MOA by either agency, or restricts either agency from participating in similar activities with other public or private agencies, organizations, or individuals.

10.6 This MOA is neither a fiscal nor a funds obligation document.

10.7 Pursuant to Section 22, Title 41, United States Code, no member of, or Delegate to, Congress shall be admitted to any share or part of this agreement, or any benefits that may arise therefrom.

10.8 We, the undersigned officials responsible for implementing this MOA, hereby commit the necessary resources to the extent possible to effectively implement all aspects of this MOA.

10.9 We understand that successful implementation of the MOA will: 1) satisfy state and federal nonpoint source pollution control requirements; 2) ensure water quality protection on NFS lands, and 3) will constitute the basis for continuing formal designation by Ecology of the Forest Service as the implementing agency for nonpoint source pollution control on lands under its jurisdiction.

10.10 This Memorandum of Agreement shall take effect immediately upon signing. All undesignated time frames will begin as of the date of signing.

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Harv Forsgren

Harv Forsgren
Regional Forester
Pacific Northwest Region

Date: November 21, 00

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

Tom Fitzsimmons
Director

Date: 11-21-00

Appendix F:
Upper White River Electronic Documents

The following documents are available via the worldwide web:

Upper White Watershed Sediment and Temperature TMDL for Aquatic Habitat -- Submittal Report. 2003.
http://www.ecy.wa.gov/biblio/0310032.html

Upper White Watershed Spring Chinook Redd, Scour, and Cross-Section Assessments: 1995 – 2001.
http://www.ecy.wa.gov/biblio/0310071.html

Upper White Watershed Temperature Data Report: 1989-2003.
http://www.ecy.wa.gov/biblio/0410061.html

Monitoring Report (USGS).
http://water.usgs.gov/pubs/wri/wri034022

Appendix G:
Upper White River Temperature Load Allocations

Calculated Load Capacity and Load Allocations (for Temperature) from Ketcheson et al., 2003.

Western Hemlock Effective Shade –Degrees from North - 0 and 180				
Bankfull Width (ft)	Early Seral	Mid Seral	Late Seral	Weighted Average Stand Condition
5	99%	100%	100%	100%
11	94%	99%	100%	99%
16	87%	96%	99%	98%
21	79%	94%	97%	96%
27	73%	89%	95%	93%
32	67%	83%	92%	89%
37	62%	78%	87%	83%
43	57%	73%	81%	78%
48	53%	69%	77%	74%
54	50%	65%	73%	70%
59	47%	62%	70%	67%
64	44%	59%	67%	64%
70	42%	56%	64%	61%
75	40%	54%	61%	58%
80	38%	52%	59%	56%
86	36%	50%	57%	54%
91	34%	48%	55%	52%
96	33%	46%	53%	50%
102	31%	44%	52%	49%
107	30%	43%	50%	47%
112	29%	41%	48%	46%
118	28%	40%	47%	44%
123	27%	39%	46%	43%
128	26%	37%	44%	42%
134	25%	36%	43%	40%
139	24%	35%	42%	39%
144	23%	34%	41%	38%
150	23%	33%	40%	37%
155	22%	32%	39%	36%
160	21%	32%	38%	35%
166	21%	31%	37%	35%
171	20%	30%	36%	34%
177	20%	29%	35%	33%
182	19%	28%	35%	32%
187	19%	28%	34%	31%
193	18%	27%	33%	31%
198	18%	27%	33%	30%
203	17%	26%	32%	29%
209	17%	25%	31%	29%
214	17%	25%	31%	28%
219	16%	24%	30%	28%
225	16%	24%	29%	27%

Appendix G (Continued)

Western Hemlock Effective Shade - Degrees from North - 45, 135, 225, 315				
Bankfull Width (ft)	Early Seral	Mid Seral	Late Seral	Weighted Average Stand Condition
5	99%	100%	100%	100%
11	94%	99%	100%	99%
16	87%	96%	99%	98%
21	79%	94%	97%	96%
27	71%	89%	95%	94%
32	65%	83%	93%	89%
37	60%	78%	88%	84%
43	55%	73%	84%	80%
48	51%	69%	80%	76%
54	47%	65%	76%	72%
59	44%	62%	73%	69%
64	41%	59%	70%	65%
70	39%	56%	67%	62%
75	36%	53%	64%	60%
80	35%	51%	61%	57%
86	33%	49%	59%	55%
91	31%	46%	57%	53%
96	30%	45%	55%	51%
102	28%	43%	53%	49%
107	27%	41%	51%	47%
112	26%	40%	49%	45%
118	25%	38%	48%	44%
123	24%	37%	46%	42%
128	23%	36%	45%	41%
134	23%	34%	44%	40%
139	22%	33%	42%	39%
144	21%	32%	41%	37%
150	20%	31%	40%	36%
155	20%	30%	39%	35%
160	19%	30%	38%	34%
166	19%	29%	37%	33%
171	18%	28%	36%	33%
177	18%	27%	35%	32%
182	17%	27%	34%	31%
187	17%	26%	33%	30%
193	16%	25%	33%	29%
198	16%	25%	32%	29%
203	16%	24%	31%	28%
209	15%	24%	30%	28%
214	15%	23%	30%	27%
219	15%	23%	29%	26%
225	14%	22%	29%	26%

Appendix G (Continued)

Western Hemlock Effective Shade – Degrees from North - 90 and 270				
Bankfull Width (ft)	Early Seral	Mid Seral	Late Seral	Weighted Average Stand Condition
5	99%	100%	100%	100%
11	96%	99%	100%	100%
16	88%	98%	99%	99%
21	75%	96%	98%	97%
27	63%	92%	97%	96%
32	55%	83%	96%	93%
37	49%	73%	92%	86%
43	44%	66%	87%	79%
48	40%	60%	81%	71%
54	37%	55%	74%	65%
59	34%	51%	67%	60%
64	32%	48%	62%	56%
70	30%	45%	58%	52%
75	28%	42%	55%	49%
80	26%	40%	52%	47%
86	25%	38%	49%	45%
91	24%	36%	47%	43%
96	23%	35%	45%	41%
102	22%	33%	43%	39%
107	21%	32%	42%	38%
112	20%	31%	40%	36%
118	19%	30%	39%	35%
123	18%	29%	37%	34%
128	18%	28%	36%	33%
134	17%	27%	35%	32%
139	16%	26%	34%	31%
144	16%	25%	33%	30%
150	15%	25%	32%	29%
155	15%	24%	31%	28%
160	14%	23%	30%	27%
166	14%	23%	30%	27%
171	14%	22%	29%	26%
177	13%	21%	28%	25%
182	13%	21%	28%	25%
187	13%	20%	27%	24%
193	12%	20%	26%	24%
198	12%	19%	26%	23%
203	12%	19%	25%	23%
209	11%	19%	25%	22%
214	11%	18%	24%	22%
219	11%	18%	24%	21%
225	11%	17%	23%	21%

Appendix G (Continued)

Pacific Silver Fir Effective Shade –Degrees from North - 0 and 180				
Bankfull Width (ft)	Early Seral	Mid Seral	Late Seral	Weighted Average Stand Condition
5	99%	100%	100%	100%
11	93%	99%	100%	98%
16	86%	96%	99%	95%
21	78%	93%	97%	92%
27	71%	88%	96%	86%
32	66%	82%	93%	81%
37	61%	77%	88%	76%
43	56%	72%	83%	71%
48	52%	68%	78%	67%
54	49%	64%	75%	63%
59	46%	61%	71%	60%
64	43%	58%	68%	57%
70	41%	55%	65%	54%
75	39%	53%	63%	52%
80	37%	51%	60%	50%
86	35%	49%	58%	48%
91	33%	47%	56%	46%
96	32%	45%	55%	44%
102	31%	43%	53%	42%
107	29%	42%	51%	41%
112	28%	40%	50%	39%
118	27%	39%	48%	38%
123	26%	38%	47%	37%
128	25%	37%	46%	36%
134	24%	35%	44%	34%
139	24%	34%	43%	33%
144	23%	33%	42%	32%
150	22%	32%	41%	31%
155	21%	32%	40%	31%
160	21%	31%	39%	30%
166	20%	30%	38%	29%
171	20%	29%	37%	28%
177	19%	28%	37%	28%
182	19%	28%	36%	27%
187	18%	27%	35%	26%
193	18%	26%	34%	26%
198	17%	26%	34%	25%
203	17%	25%	33%	24%
209	16%	25%	32%	24%
214	16%	24%	32%	23%
219	16%	24%	31%	23%
225	15%	23%	31%	22%

Appendix G (Continued)

Pacific Silver Fir Effective Shade - Degrees from North - 45, 135, 225, 315				
Bankfull Width (ft)	Early Seral	Mid Seral	Late Seral	Weighted Average Stand Condition
5	99%	100%	100%	100%
11	93%	99%	100%	98%
16	86%	96%	99%	95%
21	77%	93%	98%	92%
27	70%	87%	96%	86%
32	64%	82%	94%	80%
37	58%	77%	90%	75%
43	53%	72%	86%	70%
48	49%	68%	82%	66%
54	46%	64%	78%	62%
59	43%	61%	75%	59%
64	40%	58%	72%	56%
70	38%	55%	69%	53%
75	35%	52%	66%	50%
80	34%	50%	63%	48%
86	32%	47%	61%	46%
91	30%	45%	59%	44%
96	29%	43%	57%	42%
102	28%	42%	55%	40%
107	26%	40%	53%	39%
112	25%	39%	51%	37%
118	24%	37%	49%	36%
123	24%	36%	48%	34%
128	23%	35%	47%	33%
134	22%	33%	45%	32%
139	21%	32%	44%	31%
144	20%	31%	43%	30%
150	20%	30%	42%	29%
155	19%	30%	40%	28%
160	19%	29%	39%	28%
166	18%	28%	38%	27%
171	18%	27%	37%	26%
177	17%	27%	36%	25%
182	17%	26%	36%	25%
187	16%	25%	35%	24%
193	16%	25%	34%	24%
198	15%	24%	33%	23%
203	15%	23%	32%	22%
209	15%	23%	32%	22%
214	14%	22%	31%	22%
219	14%	22%	30%	21%
225	14%	21%	30%	21%

Appendix G (Continued)

Pacific Silver Fir Effective Shade – Degrees from North - 90 and 270				
Bankfull Width (ft)	Early Seral	Mid Seral	Late Seral	Weighted Average Stand Condition
5	99%	100%	100%	100%
11	96%	99%	100%	99%
16	87%	97%	99%	97%
21	73%	95%	98%	95%
27	62%	90%	97%	87%
32	53%	79%	96%	77%
37	47%	71%	94%	68%
43	42%	64%	89%	61%
48	39%	58%	84%	56%
54	36%	54%	78%	51%
59	33%	50%	73%	48%
64	31%	46%	66%	45%
70	29%	44%	61%	42%
75	27%	41%	57%	40%
80	26%	39%	54%	38%
86	24%	37%	52%	36%
91	23%	35%	49%	34%
96	22%	34%	47%	33%
102	21%	32%	45%	31%
107	20%	31%	43%	30%
112	19%	30%	42%	29%
118	18%	29%	40%	28%
123	18%	28%	39%	27%
128	17%	27%	38%	26%
134	16%	26%	37%	25%
139	16%	25%	36%	24%
144	15%	24%	35%	23%
150	15%	24%	34%	23%
155	14%	23%	33%	22%
160	14%	22%	32%	21%
166	14%	22%	31%	21%
171	13%	21%	30%	20%
177	13%	21%	30%	20%
182	12%	20%	29%	19%
187	12%	20%	28%	19%
193	12%	19%	28%	18%
198	12%	19%	27%	18%
203	11%	18%	26%	18%
209	11%	18%	26%	17%
214	11%	18%	25%	17%
219	10%	17%	25%	16%
225	10%	17%	24%	16%

Appendix G (Continued)

Mountain Hemlock Effective Shade –Degrees from North - 0 and 180				
Bankfull Width (ft)	Early Seral	Mid Seral	Late Seral	Weighted Average Stand Condition
5	95%	100%	100%	100%
11	84%	98%	99%	97%
16	73%	94%	97%	93%
21	65%	91%	95%	88%
27	58%	85%	91%	82%
32	52%	79%	86%	76%
37	47%	74%	80%	71%
43	43%	69%	75%	66%
48	39%	65%	71%	63%
54	36%	62%	67%	59%
59	34%	58%	64%	56%
64	32%	56%	61%	53%
70	30%	53%	58%	51%
75	28%	51%	56%	48%
80	26%	48%	54%	46%
86	25%	46%	51%	44%
91	24%	44%	50%	42%
96	23%	43%	48%	41%
102	22%	41%	46%	39%
107	21%	39%	45%	37%
112	20%	38%	43%	36%
118	19%	37%	42%	35%
123	18%	36%	40%	34%
128	18%	34%	39%	33%
134	17%	33%	38%	31%
139	16%	32%	37%	30%
144	16%	31%	36%	30%
150	15%	30%	35%	29%
155	15%	30%	34%	28%
160	14%	29%	33%	27%
166	14%	28%	32%	26%
171	14%	27%	31%	26%
177	13%	27%	31%	25%
182	13%	26%	30%	24%
187	13%	25%	29%	24%
193	12%	25%	29%	23%
198	12%	24%	28%	23%
203	12%	23%	27%	22%
209	11%	23%	27%	22%
214	11%	22%	26%	21%
219	11%	22%	26%	21%
225	11%	22%	25%	20%

Appendix G (Continued)

Mountain Hemlock Effective Shade - Degrees from North - 45, 135, 225, 315				
Bankfull Width (ft)	Early Seral	Mid Seral	Late Seral	Weighted Average Stand Condition
5	95%	100%	100%	100%
11	83%	98%	99%	97%
16	72%	95%	97%	93%
21	62%	91%	95%	88%
27	55%	84%	91%	81%
32	48%	78%	86%	75%
37	43%	73%	81%	70%
43	39%	68%	76%	65%
48	36%	64%	72%	61%
54	33%	60%	68%	57%
59	31%	57%	65%	54%
64	28%	54%	62%	51%
70	27%	51%	59%	48%
75	25%	48%	56%	45%
80	24%	46%	54%	43%
86	22%	44%	51%	41%
91	21%	42%	49%	39%
96	20%	40%	47%	38%
102	19%	39%	45%	36%
107	18%	37%	44%	35%
112	18%	36%	42%	33%
118	17%	34%	40%	32%
123	16%	33%	39%	31%
128	16%	32%	38%	30%
134	15%	31%	37%	29%
139	14%	30%	35%	28%
144	14%	29%	34%	27%
150	14%	28%	33%	26%
155	13%	27%	32%	25%
160	13%	26%	32%	25%
166	12%	26%	31%	24%
171	12%	25%	30%	23%
177	12%	24%	29%	23%
182	11%	24%	28%	22%
187	11%	23%	28%	22%
193	11%	23%	27%	21%
198	10%	22%	26%	21%
203	10%	22%	26%	20%
209	10%	21%	25%	20%
214	10%	21%	25%	19%
219	9%	20%	24%	19%
225	9%	20%	24%	18%

Appendix G (Continued)

Mountain Hemlock Effective Shade – Degrees from North - 90 and 270				
Bankfull Width (ft)	Early Seral	Mid Seral	Late Seral	Weighted Average Stand Condition
5	97%	100%	100%	100%
11	81%	99%	99%	98%
16	62%	96%	98%	96%
21	49%	94%	96%	90%
27	41%	83%	94%	78%
32	36%	74%	88%	69%
37	31%	65%	79%	61%
43	28%	59%	71%	55%
48	25%	54%	64%	50%
54	23%	49%	59%	46%
59	22%	46%	54%	43%
64	20%	43%	51%	40%
70	19%	40%	48%	38%
75	17%	38%	45%	35%
80	16%	36%	43%	34%
86	15%	34%	41%	32%
91	15%	33%	39%	30%
96	14%	31%	37%	29%
102	13%	30%	36%	28%
107	13%	29%	34%	27%
112	12%	28%	33%	26%
118	12%	26%	32%	25%
123	11%	26%	31%	24%
128	11%	25%	30%	23%
134	10%	24%	29%	22%
139	10%	23%	28%	21%
144	10%	22%	27%	21%
150	9%	22%	26%	20%
155	9%	21%	26%	19%
160	9%	20%	25%	19%
166	8%	20%	24%	18%
171	8%	19%	24%	18%
177	8%	19%	23%	17%
182	8%	18%	22%	17%
187	8%	18%	22%	17%
193	7%	18%	21%	16%
198	7%	17%	21%	16%
203	7%	17%	20%	15%
209	7%	16%	20%	15%
214	7%	16%	20%	15%
219	6%	16%	19%	14%
225	6%	15%	19%	14%

Appendix G (Continued)

Subalpine Fir Effective Shade –Degrees from North - 0 and 180				
Bankfull Width (ft)	Early Seral	Mid Seral	Late Seral	Weighted Average Stand Condition
5	95%	100%	100%	99%
11	84%	98%	98%	95%
16	73%	95%	95%	90%
21	65%	91%	92%	82%
27	58%	85%	86%	76%
32	52%	80%	80%	70%
37	47%	75%	75%	65%
43	43%	70%	71%	60%
48	39%	66%	67%	56%
54	36%	62%	63%	53%
59	34%	59%	60%	50%
64	32%	56%	57%	47%
70	30%	53%	54%	45%
75	28%	51%	52%	42%
80	26%	49%	49%	40%
86	25%	47%	47%	39%
91	24%	45%	45%	37%
96	23%	43%	44%	35%
102	22%	42%	42%	34%
107	21%	40%	40%	32%
112	20%	39%	39%	31%
118	19%	37%	38%	30%
123	18%	36%	36%	29%
128	18%	35%	35%	28%
134	17%	34%	34%	27%
139	16%	33%	33%	26%
144	16%	32%	32%	25%
150	15%	31%	31%	25%
155	15%	30%	30%	24%
160	14%	29%	30%	23%
166	14%	28%	29%	22%
171	14%	28%	28%	22%
177	13%	27%	27%	21%
182	13%	26%	27%	21%
187	13%	26%	26%	20%
193	12%	25%	25%	20%
198	12%	24%	25%	19%
203	12%	24%	24%	19%
209	11%	23%	24%	18%
214	11%	23%	23%	18%
219	11%	22%	23%	18%
225	11%	22%	22%	17%

Appendix G (Continued)

Subalpine Fir Effective Shade - Degrees from North - 45, 135, 225, 315				
Bankfull Width (ft)	Early Seral	Mid Seral	Late Seral	Weighted Average Stand Condition
5	95%	100%	100%	99%
11	83%	98%	98%	95%
16	72%	95%	95%	89%
21	62%	91%	92%	82%
27	55%	85%	85%	75%
32	48%	79%	80%	68%
37	43%	74%	75%	63%
43	39%	69%	70%	58%
48	36%	65%	66%	54%
54	33%	61%	62%	50%
59	31%	58%	59%	47%
64	28%	55%	55%	44%
70	27%	52%	52%	41%
75	25%	49%	50%	39%
80	24%	47%	48%	37%
86	22%	45%	45%	35%
91	21%	43%	43%	34%
96	20%	41%	42%	32%
102	19%	39%	40%	31%
107	18%	38%	38%	29%
112	18%	36%	37%	28%
118	17%	35%	35%	27%
123	16%	34%	34%	26%
128	16%	32%	33%	25%
134	15%	31%	32%	24%
139	14%	30%	31%	24%
144	14%	29%	30%	23%
150	14%	29%	29%	22%
155	13%	28%	28%	22%
160	13%	27%	27%	21%
166	12%	26%	27%	20%
171	12%	25%	26%	20%
177	12%	25%	25%	19%
182	11%	24%	25%	19%
187	11%	24%	24%	18%
193	11%	23%	23%	18%
198	10%	22%	23%	17%
203	10%	22%	22%	17%
209	10%	21%	22%	17%
214	10%	21%	21%	16%
219	9%	21%	21%	16%
225	9%	20%	20%	15%

Appendix G (Continued)

Subalpine Fir Effective Shade – Degrees from North - 90 and 270				
Bankfull Width (ft)	Early Seral	Mid Seral	Late Seral	Weighted Average Stand Condition
5	97%	100%	100%	99%
11	81%	99%	99%	97%
16	62%	97%	97%	92%
21	49%	94%	95%	80%
27	41%	85%	87%	68%
32	36%	75%	76%	59%
37	31%	67%	68%	52%
43	28%	60%	61%	47%
48	25%	54%	55%	43%
54	23%	50%	51%	39%
59	22%	47%	47%	37%
64	20%	44%	44%	34%
70	19%	41%	42%	32%
75	17%	39%	39%	30%
80	16%	37%	37%	29%
86	15%	35%	35%	27%
91	15%	33%	34%	26%
96	14%	32%	32%	25%
102	13%	30%	31%	23%
107	13%	29%	30%	22%
112	12%	28%	29%	22%
118	12%	27%	27%	21%
123	11%	26%	26%	20%
128	11%	25%	26%	19%
134	10%	24%	25%	19%
139	10%	24%	24%	18%
144	10%	23%	23%	17%
150	9%	22%	23%	17%
155	9%	21%	22%	16%
160	9%	21%	21%	16%
166	8%	20%	21%	15%
171	8%	20%	20%	15%
177	8%	19%	20%	15%
182	8%	19%	19%	14%
187	8%	18%	19%	14%
193	7%	18%	18%	13%
198	7%	17%	18%	13%
203	7%	17%	17%	13%
209	7%	17%	17%	12%
214	7%	16%	17%	12%
219	6%	16%	16%	12%
225	6%	16%	16%	12%

Appendix G (Continued)

Douglas Fir Effective Shade			
Bankfull Width (ft)	Degrees from North - 0 and 180	Degrees from North - 45, 135, 225, 315	Degrees from North - 90 and 270
5	100%	100%	100%
11	99%	100%	100%
16	98%	98%	99%
21	96%	96%	98%
27	94%	94%	96%
32	90%	90%	94%
37	84%	85%	88%
43	79%	81%	81%
48	75%	77%	74%
54	71%	73%	67%
59	68%	70%	62%
64	64%	67%	57%
70	62%	64%	54%
75	59%	61%	51%
80	57%	58%	48%
86	55%	56%	46%
91	53%	54%	44%
96	51%	52%	42%
102	49%	50%	40%
107	48%	48%	39%
112	46%	46%	37%
118	45%	45%	36%
123	44%	43%	35%
128	42%	42%	33%
134	41%	41%	32%
139	40%	39%	31%
144	39%	38%	31%
150	38%	37%	30%
155	37%	36%	29%
160	36%	35%	28%
166	35%	34%	27%
171	34%	33%	27%
177	34%	33%	26%
182	33%	32%	25%
187	32%	31%	25%
193	31%	30%	24%
198	31%	30%	24%
203	30%	29%	23%
209	29%	28%	23%
214	29%	28%	22%
219	28%	27%	22%
225	28%	27%	21%

Appendix G (Continued)

Grand Fir Effective Shade			
Bankfull Width (ft)	Degrees from North - 0 and 180	Degrees from North - 45, 135, 225, 315	Degrees from North - 90 and 270
5	100%	100%	100%
11	100%	100%	100%
16	99%	99%	99%
21	98%	98%	99%
27	97%	97%	98%
32	94%	95%	97%
37	90%	92%	95%
43	85%	88%	92%
48	80%	84%	87%
54	76%	80%	82%
59	73%	77%	76%
64	69%	73%	71%
70	67%	70%	65%
75	64%	67%	60%
80	62%	65%	57%
86	60%	63%	54%
91	58%	60%	51%
96	56%	58%	49%
102	54%	56%	47%
107	53%	55%	45%
112	51%	53%	44%
118	49%	51%	42%
123	48%	50%	41%
128	47%	48%	39%
134	46%	47%	38%
139	44%	46%	37%
144	43%	44%	36%
150	42%	43%	35%
155	41%	42%	34%
160	40%	41%	33%
166	40%	40%	32%
171	39%	39%	32%
177	38%	38%	31%
182	37%	37%	30%
187	36%	36%	29%
193	35%	35%	29%
198	35%	35%	28%
203	34%	34%	28%
209	33%	33%	27%
214	33%	32%	27%
219	32%	32%	26%
225	32%	31%	26%