Upper Humptulips River Watershed Temperature Total Maximum Daily Load (Water Cleanup Plan)

Submittal Report

June 2001
Publication No. 01-10-022

Printed on Recycled Paper

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June 2001
Publication No. 01-10-022

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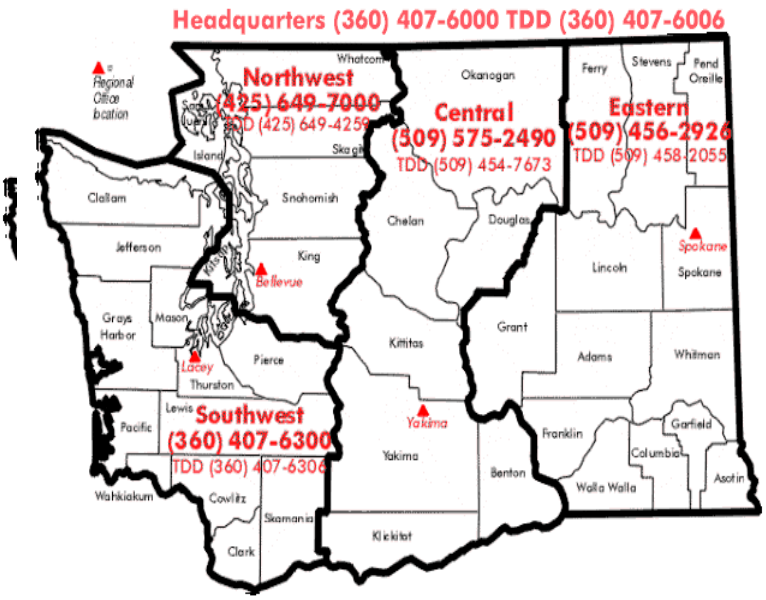

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Introduction

Section 303(d) of the federal Clean Water Act mandates that the state establish Total Maximum Daily Loads (TMDLs) for surface waters that do not meet standards after application of technology-based pollution controls. The U.S. Environmental Protection Agency (EPA) has promulgated regulations (40 CFR 130) and developed guidance (EPA, 1991) for establishing TMDLs.

Under the Clean Water Act, every state has its own water quality standards designed to protect, restore, and preserve water quality. Water quality standards consist of designated uses, such as cold water biota and drinking water supply, and criteria, usually numeric criteria, to achieve those uses. When a lake, river or stream fails to meet water quality standards after application of required technology-based controls, the Clean Water Act requires the state to place the water body on a list of "impaired" water bodies and to prepare an analysis called a **Total Maximum Daily Load (TMDL)**.

The goal of a TMDL is to ensure the impaired water will attain water quality standards. A TMDL includes a written, quantitative assessment of water quality problems and of the pollutant sources that cause the problem. The TMDL determines the amount of a given pollutant that can be discharged to the water body and still meet standards, the **loading capacity,** and allocates that load among the various sources. If the pollutant comes from a discrete source (referred to as a **point source**) such as an industrial facility's discharge pipe, that facility's share of the loading capacity is called a **wasteload allocation**. If it comes from a diffuse source (referred to as a **nonpoint source**) such as a farm, that facility's share is called a **load allocation**.

The TMDL must also consider seasonal variations and include a **margin of safety** that takes into account any lack of knowledge about the causes of the water quality problem or its loading capacity. The sum of the individual allocations and the margin of safety must be equal to or less than the loading capacity.

This TMDL is being established for heat (incoming solar radiation). The TMDL is designed to address impairments identified in the 1996 303(d) list due to surface water temperature increases on one water quality-limited segment of the Humptulips River located at the highway 101 bridge The 1998 303(d) list, which became available in January of 2000 also includes this segment. However, this TMDL sets allocation limits to protect over 300 additional miles of streams, above the 101 bridge, which are tributaries to the mainstem Humptulips, from becoming water quality-limited. This includes temperature exceedances detected in 1998 at 10 locations on 9 waterbodies that are not listed on the 303(d) list. These exceedances were detected during the East/West Humptulips Watershed Analysis (WA) and were not submitted for listing due to the fact that the TMDL was being performed concurrently with the WA. Because of the unique

and comprehensive approach used in the development of this non-point TMDL, more detail will be included in this submittal report than usual for better understanding. The appendices contain the entire technical assessment report and references to key chapters of the related Watershed Assessment.

The pollutant, Heat, considered in this TMDL is a major determinant of water quality that affects aquatic life. This factor varies naturally in its characteristics across the landscape (as a function of geology, topography and climate) as well as over time. The influence of this pollutant on water quality can also be significantly affected by changes associated with land use.

Table 1. Upper Humptulips Temperature Exceedances 1998

Waterbody	Monitoring Site	Temperature °C
Humptulips River @ 101 Bridge (WA22-1010) (NY74PY)	22A070 (ECY)	18
W.F. Humptulips above confluence	T3	23
E.F. Humptulips above confluence	T4	24
Furlough Creek	T8	18
Road.3610 Donkey Creek tributary	T11	19
Upper Donkey Creek wetland	T12	26
E.F. Humptulips @ Flatbottom Creek	T13	19
E.F. Humptulips @R.M. 15	USFS1	17
W.F. Humptulips @ R.M. 41 below Rainbow Creek	USFS3	21
W.F. Humptulips@ R.M. 45.3	USFS6	20
E.F. Humptulips across the river from junction of Roads 2200 & 2206	USFS16	17

The five elements of this TMDL as required by federal regulation and statute are summarized below:

Loading Capacity: The loading capacity for heat (or solar radiation) is based on effective shade levels in the riparian corridor needed to meet state water quality standards for temperature. Using information about each channel class (e.g. estimates of drainage area, active channel width, range of flows, etc.) effective shade targets can be developed. The channel classification system is used to assess stream reaches according to temperature groups, e.g. the dominant control(s) which influence water temperature, specifically shade, groundwater, or channel morphology. This approach leads to effective shade targets that recognize the variability in channel and riparian characteristics that occurs across the landscape. As such, these targets reflect the range of active channel widths within the TMDL area.

Load Allocations: Allocations in this TMDL are derived using effective shade. Thermal influx can be linked to source areas and, thus to actions (specifically riparian management) needed to address processes which influence water temperature.

Wasteload Allocation: There are no permitted discharges within the area covered by the TMDL, as such, the wasteload allocation is zero.

Margin of Safety: The margin of safety is represented by several elements:

- Allocations for effective shade contain an explicit margin of safety that is expressed as an unallocated portion of the loading capacity.

- Allocations for effective shade also contain an implicit margin of safety, specifically conservative assumptions were used for several of the parameters in the model such as groundwater temperature, and air temperature.

- The TMDL is intended to be adaptive in management implementation. This plan allows for future changes in loading capacities and surrogate measures (allocations) in the event that new information or scientifically valid reasons support alterations.

Seasonal Variation: Existing conditions for stream temperatures in the Humptulips area reflect seasonal variation. Water quality standards for temperature are exceeded between May and October. In addition, the data show that the highest seven-day average maximum water temperatures occur between mid-July and mid-August. This time frame is used as the critical period for development and analysis of allocations in the TMDL.

Background

This Upper Humptulips water quality assessment has been developed to address fisheries concerns within the watershed. The assessment uses information from a Watershed Analysis prepared by the U.S. Department of Agriculture -- Forest Service (USFS), Rayonier Timber Company, and the Washington Department of Natural Resources for the Upper Humptulips Watershed. These forested watersheds include Rayonier's commercial timberland in Grays Harbor county as well as public lands administered by the USFS -- Olympic National Forest. The plan area lies north of Hoquiam and northeast of Highway 101.

The plan area includes over 800 miles of streams that drain lands bordering the southwestern extent of the Olympic Mountains. Of the 800+ miles of streams 300 have been classified. Salmon, steelhead, and cutthroat trout occur throughout the Upper Humptulips watershed. Significant fish-bearing streams within the watershed include the East Fork Humptulips and West Fork Humptulips and key tributaries (Goforth Creek, Flatbottom Creek, Donkey Creek, and Chester Creek).

Excessive summer water temperatures in some of these streams reduce the quality of rearing habitat for chinook, chum and coho salmon as well as for steelhead and cutthroat trout. Primary watershed disturbance activities that contribute to surface water temperature increases include forest management within riparian areas, timber harvest in sensitive areas outside the riparian zone, and roads.

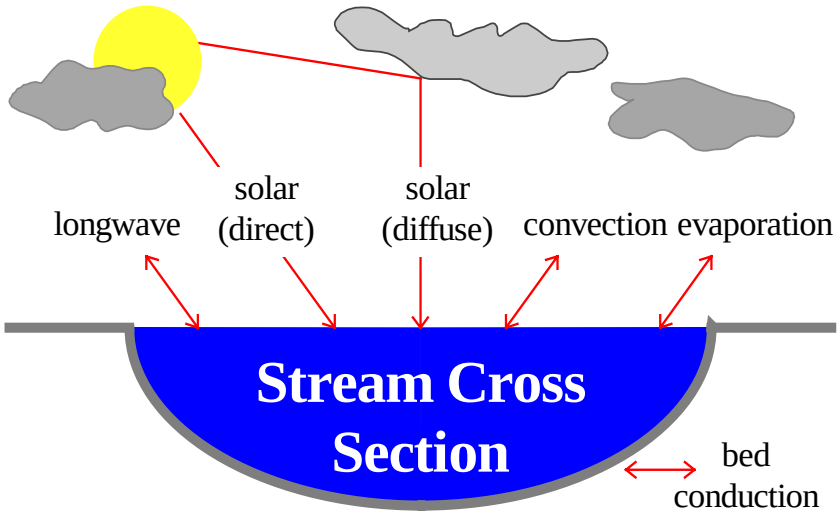
This TMDL is designed to address impairments due to surface water temperature increases on the listed water quality-limited segment located at the highway 101 Bridge in Gray's Harbor County in Water Resource Inventory Area (WIRA) 22. In addition, this TMDL sets allocation limits to protect other streams within the Upper Humptulips Watershed area from becoming water quality-limited. Landscape level TMDLs are useful in addressing systemic non-point pollution parameters such as temperature. They can lead to more complete understanding of conditions, and more importantly, can lead to more comprehensive management to improve conditions.

Water Temperature and Solar Radiation

Stream temperature is an expression of heat energy per unit volume, or an indicator of the rate of heat exchange between a stream and its environment (Figure 1). In terms of water temperature increases, the principle source of heat energy is solar radiation directly striking the stream surface (Brown, 1970). Energy is acquired by a stream system when

the heat entering the stream is greater than the heat leaving the stream. When there is a net addition of heat energy to the stream, the water temperature will increase.

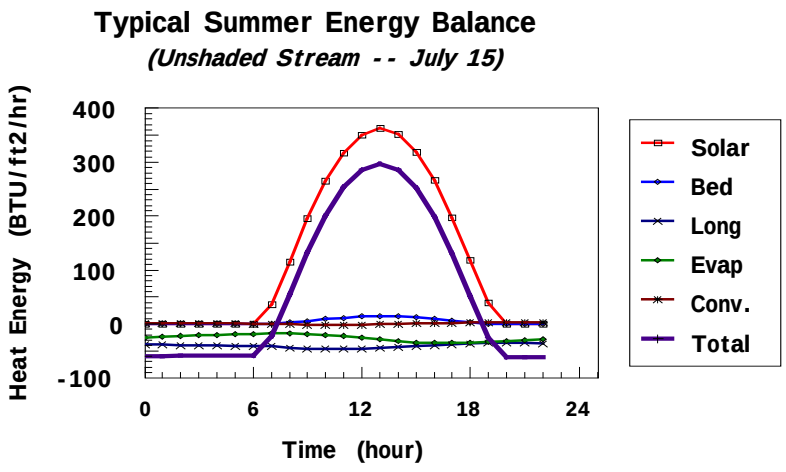
Figure 1. Heat Transfer Processes that Affect Water Temperature



As discussed in many studies (Brown 1969, Beschta et al 1987) the daily profile for water temperature increases typically follows the same pattern as solar radiation delivered to an unshaded stream (Figure 2). Other processes, such as longwave radiation and convection, also introduce energy into the stream, but at much smaller amounts when compared to solar radiation.

This TMDL uses information from the East Fork and West Fork Humptulips River Watershed Analysis (WA) prepared by a co-operative effort between the Olympic National Forest, Rayonier Timber Company, and The Washington Department of Natural Resources. The WA covers the tributaries and main stem of the East and West Forks of the Humptulips River above the Highway 101 bridge. The WA area includes over 300 miles of streams that and 800+ drainage miles that drain USFS and private timberlands bordering the southern extent of the Olympic Mountains. After passing the highway 101 bridge the Humptulips Rivers flows south approximately 15 miles and empties directly into the northern edge of Gray's Harbor.

Figure 2. Typical Summer Energy Balance for an Unshaded Stream



Temperature conditions in the Watershed Analysis area are influenced by a variety of factors that include shade, groundwater flow, and channel morphology. The geomorphic channel units (GCUs), described in the Stream Channel Assessment of the Watershed Analysis Report *(Module E)*, have been used to classify segments based on channel morphology, geology, and location within the drainage system. These GCUs represent a starting point to then group stream reaches by the dominant control(s) that affect water temperature (e.g. shade, groundwater flow, and channel morphology).

Rather than individually list stream segments for all 300 plus stream miles, information in the TMDL is grouped based on sediment transport properties, channel type, and stream order. There are five sediment transport regimes and 11 channel types described in the WA which apply to all streams in the Watershed Assessment area (both perennial and intermittent). Principle drainages within the WA area include:

WRIA 22 => East Fork / West Fork Humptulips, Goforth Creek, Flatbottom Creek, Donkey Creek, and Chester Creek.

Riparian Area Management and Timber Harvest

Management activities can increase the amount of solar radiation delivered to a stream system, notably by harvesting riparian shade trees. The Humptulips area has experienced a long history of forestland management, stemming back to the early twentieth century. This has resulted in degradation of the watershed condition.

Riparian vegetation can effectively reduce the total daily solar radiation load. Without riparian shade trees and shrubs, most incoming solar energy would be available to heat the stream. Harvest of riparian area trees can result in loss of shade. Limited work has been done to estimate the amount of shade loss due to source activities. The Upper Humptulips Watershed Analysis summarized causes for not meeting target shade requirements. The report indicated that approximately 59 percent of the stream miles assessed met the shade target. Of the remainder, 13 percent were too wide to be fully shaded and 28 percent did not meet the shade target because of riparian condition.

Applicable Criteria

Within the state of Washington, water quality standards are published pursuant to Chapter 90.48 of the Revised Code of Washington (RCW). Authority to adopt rules, regulations, and standards necessary to protect the environment is vested with the Department of Ecology. Under the federal Clean Water Act, the EPA Regional Administrator must approve the water quality standards adopted by the state (Section 303(c)(3)). Through adoption of these water quality standards, Washington has designated certain characteristic uses to be protected and the criteria necessary to protect these uses [Washington Administrative Code (WAC), Chapter 173-201A]. These standards were last adopted in November 1997.

This TMDL is designed to address impairments of characteristic uses caused by high temperatures and polluting material, such as sediment. These waters have temperature criteria assigned to protect the characteristic uses. Class *"AA"* waters are those located on public lands administered by the Olympic National Forest. Waters downstream of the National Forest are designated as Class *"A"*. The characteristic uses of Class A and AA waters that are designated for protection in the TMDL area streams are as follows:

> *"Characteristic uses. Characteristic uses shall include, but not be limited to, the following:*
>
> *(i) Water supply (domestic, industrial, agricultural).*
>
> *(ii) Stock watering.*
>
> *(iii) Fish and shellfish:*
>
> *Salmonid migration, rearing, spawning, and harvesting.*
>
> *Other fish migration, rearing, spawning, and harvesting.*
>
> *Clam and mussel rearing, spawning, and harvesting.*
>
> *Crayfish rearing, spawning, and harvesting.*
>
> *(iv) Wildlife habitat.*
>
> *(v) Recreation (primary contact recreation, sport fishing, boating, and aesthetic enjoyment).*
>
> *(vi) Commerce and navigation."*
>
> WAC 173-201A-030(2)

The water quality standards describe criteria for temperature and polluting material such as sediment for the protection of characteristic uses. Streams in the TMDL area are designated either as Class AA or as Class A.

For Class AA waters:

> *"Temperature shall not exceed 16.0°C…due to human activities. When natural conditions exceed 16.0°C…, no temperature increases will be allowed which will raise the receiving water temperature by greater than 0.3°C."*

"Incremental increases resulting from nonpoint activities shall not exceed 2.8°C."
WAC 173-201A030(1)(c)(iv)

For Class A waters:

"Temperature shall not exceed 18.0°C…due to human activities. When natural conditions exceed 18.0°C…, no temperature increases will be allowed which will raise the receiving water temperature by greater than 0.3°C."

"Incremental increases resulting from nonpoint activities shall not exceed 2.8°C."
WAC 173-201A-030(2)(c)(iv)

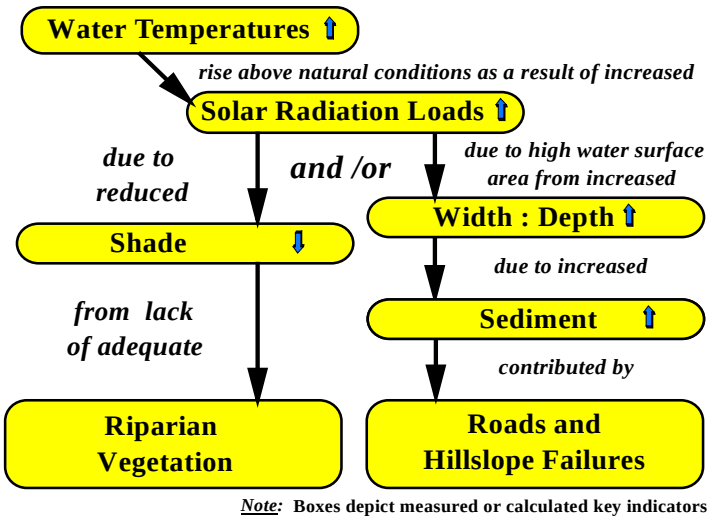
Finally, the applicable water quality standard for sediment states:

"deleterious material concentrations shall be below those which may adversely affect characteristic water uses ..."
WAC 173-201A-045(1)(c)(vii)

Surrogate Measures Used to Meet Criteria

Although a loading capacity for heat energy can be derived, it is of limited value in guiding management activities needed to solve identified water quality problems. Instead, the TMDL uses *"other appropriate measures"* (or surrogates) as provided under EPA regulations [40 CFR §130.2(i)]. The specific surrogates used are percent effective shade and sediment delivery. The relationship of water temperature increases to these surrogates is described in Figure 3.

Figure 3. Relationship of Water Temperatures to Surrogates



The *"Report of the Federal Advisory Committee on the Total Maximum Daily Load (TMDL) Program"* (FACA Report, July 1998) offers a discussion on the use of surrogate measures for TMDL development. The FACA Report indicates:

> *"When the impairment is tied to a pollutant for which a numeric criterion is not possible, or where the impairment is identified but cannot be attributed to a single traditional "pollutant," the state should try to identify another (surrogate) environmental indicator that can be used to develop a quantified TMDL, using numeric analytical techniques where they are available, and best professional judgment (BPJ) where they are not. The criterion must be designed to meet water quality standards, including the waterbody's designated uses. The use of BPJ does not imply lack of rigor; it should make use of the "best" scientific information available, and should be conducted by "professionals." When BPJ is used, care should be taken to document all assumptions, and BPJ-based decisions should be clearly explained to the public at the earliest possible stage.*
>
> *If they are used, surrogate environmental indicators should be clearly related to the water quality standard that the TMDL is designed to achieve. Use of a surrogate environmental parameter should require additional post-implementation verification that attainment of the surrogate parameter results in elimination of the impairment. If not, a procedure should be in place to modify the surrogate parameter or to select a different or additional surrogate parameter and to impose additional remedial measures to eliminate the impairment."*

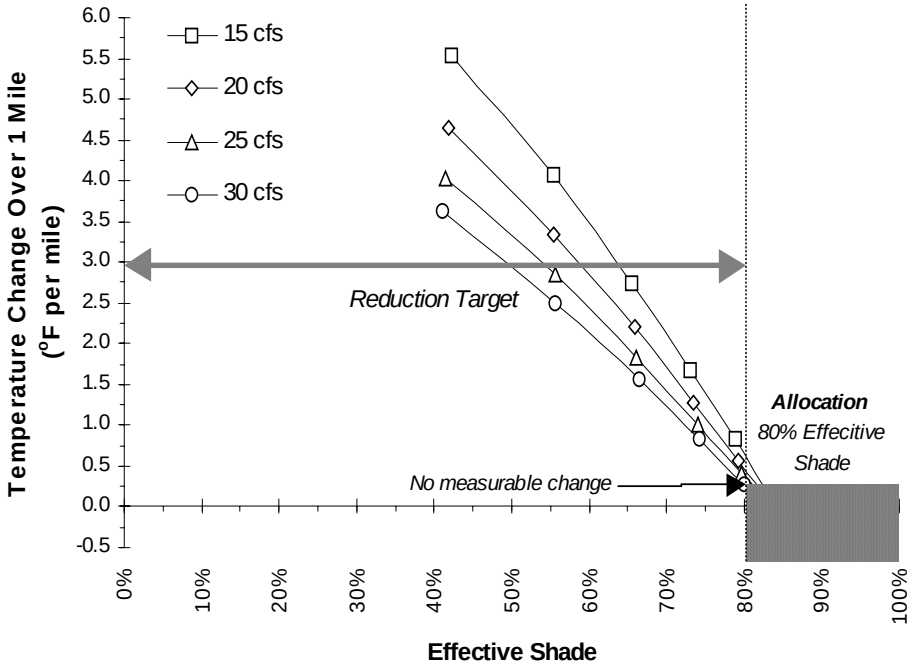
The concept regarding the effect of solar radiation loads on stream temperatures is illustrated in Figure 4. Information is presented in terms of the percent reduction of potential daily solar radiation load delivered to the water surface. This provides an alternative target (or *"other appropriate measure"*) which relates to stream temperatures, in this case, an 80% reduction in potential solar radiation delivered to the water surface.

Water Quality and Resource Impairments

As a result of measurements that show temperature criteria are exceeded, one stream segment on the upper Humptulips was included on the Washington 1996 Section 303(d) list. The Humptulips River at the Highway 101 bridge is still listed for exceeding temperature standards in the 1998 list (available since January of 2000).

While a simple TMDL addressing just impaired segments could be done, due to the wealth of information presented in the Humptulips WA, it is more time and resource efficient to deal with the whole watershed. Consequently, this TMDL uses broader resource functions and conditions to develop appropriate allocations across a diversity of local stream conditions and functions. In doing so, the TMDL allocations help guide better protection of existing conditions to prevent future impairments.

Figure 4. Effect of Solar Radiation Reduction (Effective Shade) on Water Temperature



Seasonal Variation

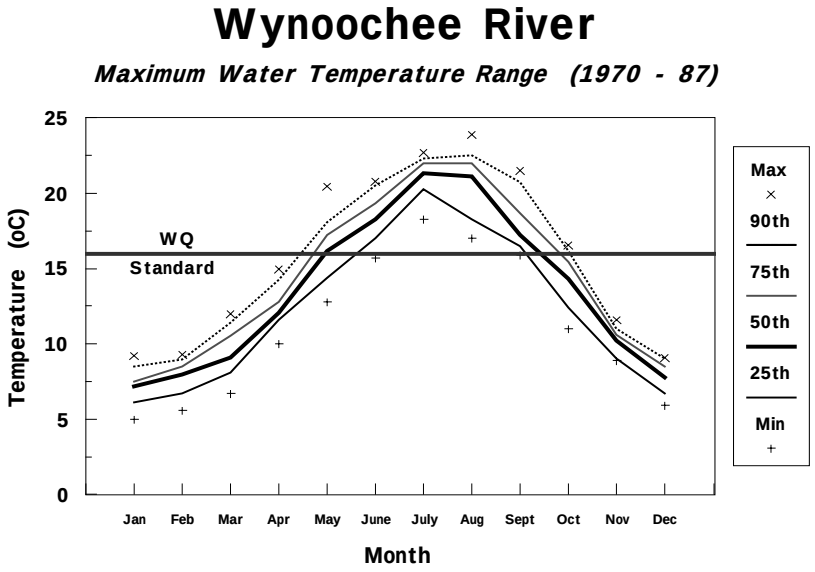
Clean Water Act (CWA) Section 303(d)(1) requires that TMDLs *"be established at level necessary to implement the applicable water quality standards with seasonal variations"*. The current regulation also states that determination of *"TMDLs shall take into account critical conditions for stream flow, loading, and water quality parameters" [40 CFR 130.7(c)(1)]*. Finally, Section 303(d)(1)(D) suggests consideration of normal conditions, flows, and dissipative capacity. This information is summarized in the following discussion.

Existing Conditions

Existing conditions for stream temperatures in the Upper Humptulips watershed reflect seasonal variation. Cooler temperatures occur in the winter, while warmer temperatures are observed in the summer. Historical data has been collected by the U.S. Geological Survey (USGS) of stream temperatures in the Wynoochee River. Figure 5 summarizes the distribution of highest daily maximum water temperatures for each month between 1970 and 1987. The data indicates that the highest seven-day average maximum water

temperatures occur between mid-July and mid-August. This time frame is used as the critical period for development and analysis of allocations in the TMDL.

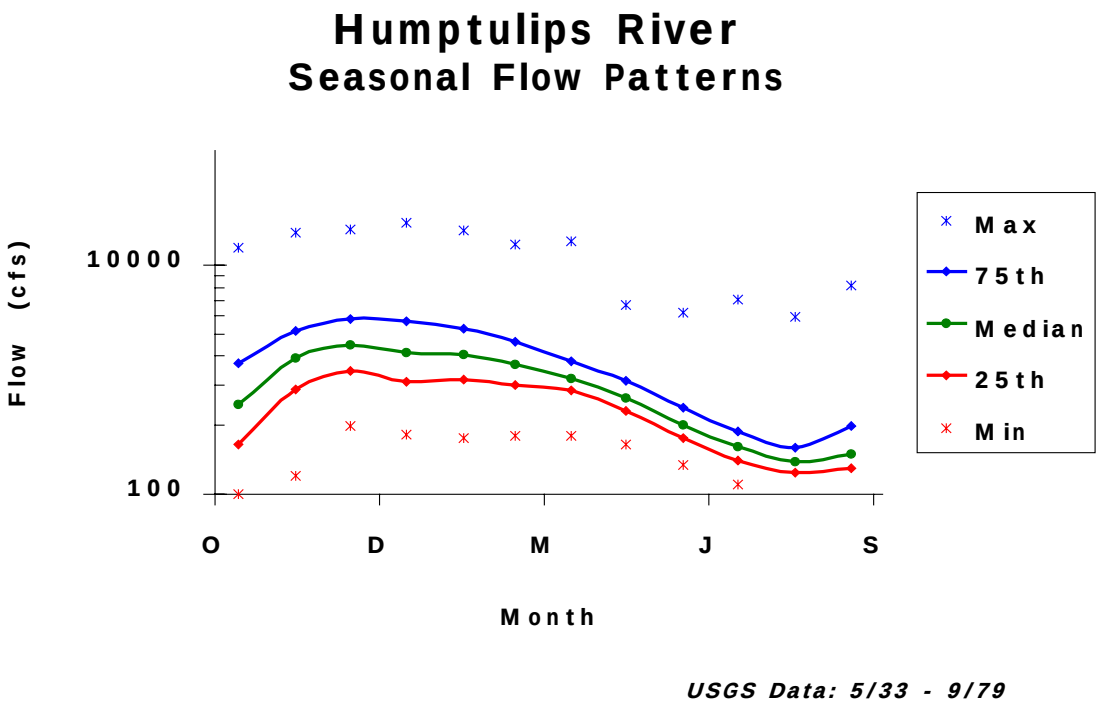
Figure 5. Seasonal Variation of Wynoochee Temperature Levels



Stream Flow

Monthly flow data is another way to describe seasonal variation that affects temperature. As illustrated in Figure 6 (shown by water year), flows decline through the summer reaching baseflow conditions in August, the same time we anticipate highest water temperatures. Flows then peak in December as a result of winter storm runoff. Because of the overlap between low flows and elevated temperatures, it is useful to know more about the pattern of low flows. The USGS data has also been used to describe the variation of 7Q2 (seven-day two-year average) values across the Upper Humptulips watershed area (Amerman and Orsborn, 1987). From this information, a relationship has been developed to estimate 7Q2 values for various stream types within the Upper Humptulips watershed. This value is important because it tends to coincide with the highest temperatures. In addition, high flows are significant in eroding channel erosion and sediment transport processes.

Figure 6. Flow Patterns for Humptulips River



Solar Radiation

Potential solar radiation varies throughout the year. The highest value occurs on the first day of summer when the earth's tilt towards the sun is greatest. Figure 7 illustrates the effect of seasonal variation on shadow length associated with different tree heights. As shown, shadows are shortest in mid-June. Figure 8 illustrates the effect of seasonal variation on maximum potential solar radiation. Mid-June is the period when solar radiation values are at their peak. As a result, mid-June can be used as a starting point for identifying the loading capacity for effective shade. This is the time that the water surface receives the maximum potential solar radiation and when riparian shade is least effective in reducing heat. This approach adds to the margin of safety because low flows and maximum water temperatures typically occur one to two months later.

Figure 7. Seasonal Variation of Shadow Lengths

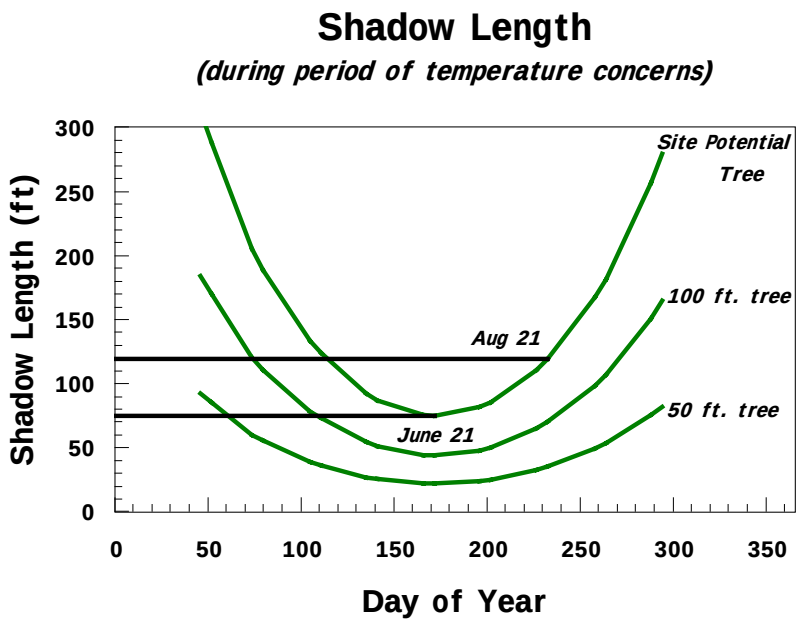
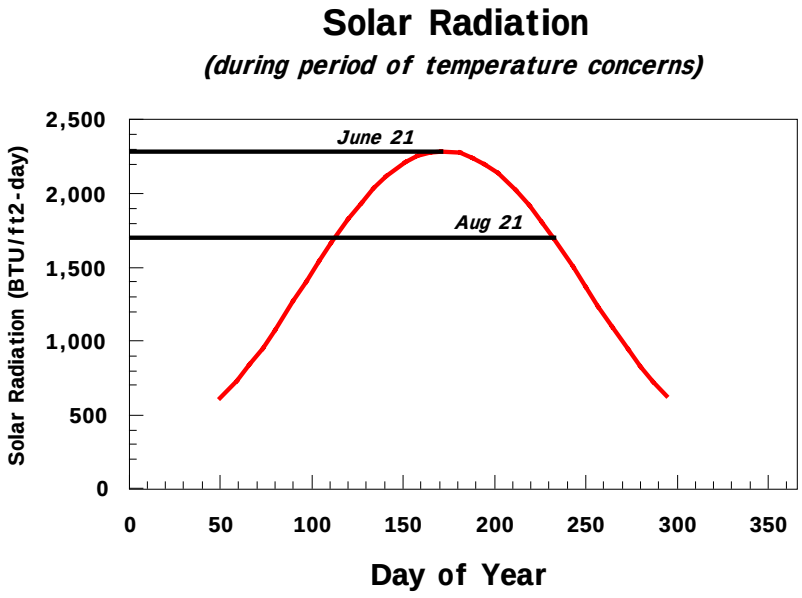


Figure 8. Seasonal Variation of Maximum Potential Solar Radiation



Critical Temperature Conditions

Estimates for streamflow, solar loading, and water quality parameters are taken into account in development of this TMDL. The analysis demonstrating the relationship of channel and riparian conditions to solar radiation loads requires a framework for identifying critical conditions. Based on historical data for the Wynoochee River (Figure 9), the critical period used for the analysis is mid-July. This represents the time frame for which solar radiation is highest when the earliest summer maximum water temperatures were observed. This timeframe is also consistent with water temperature monitoring data for the WA (Figure 10).

Figure 9. Wynoochee River Summer Water Temperatures

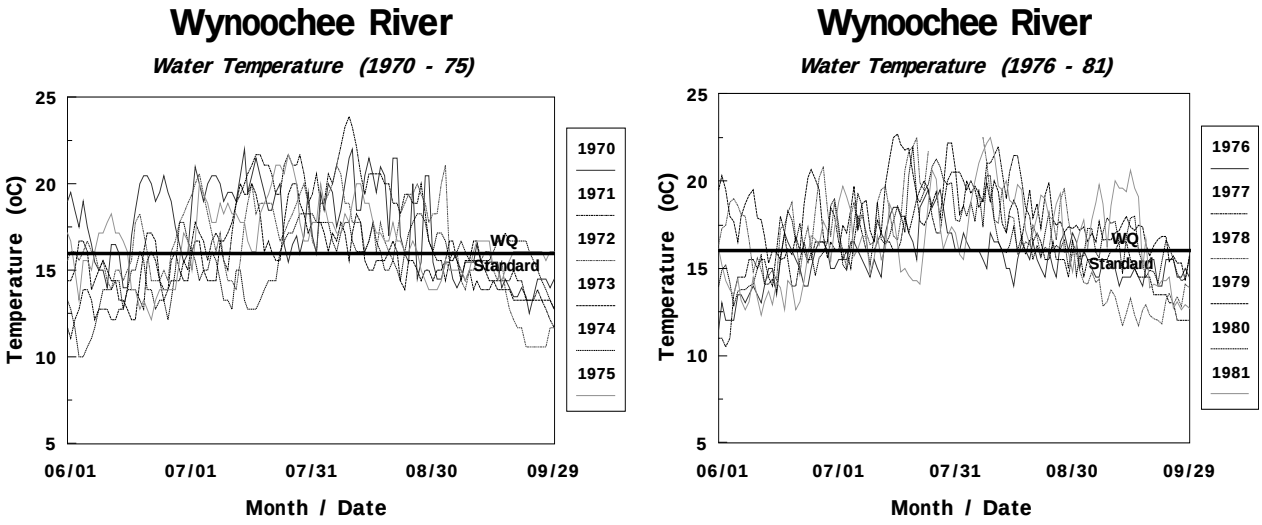
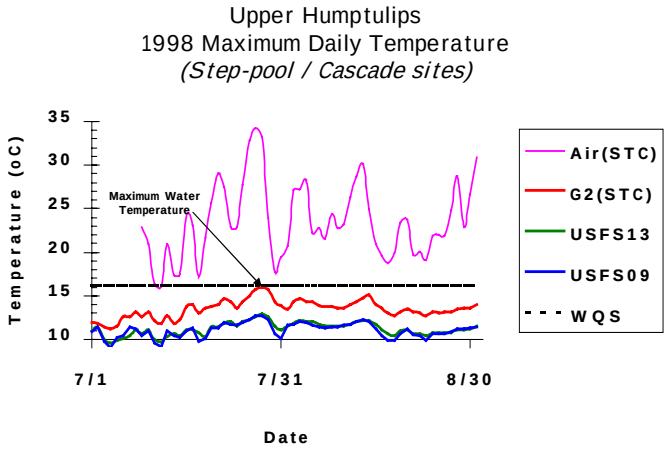
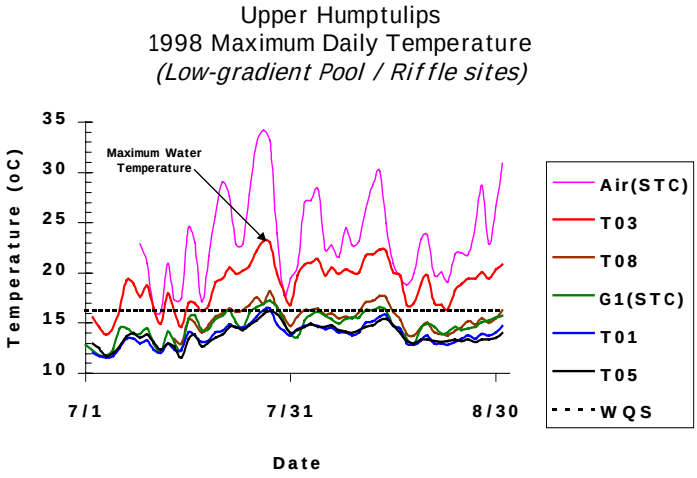


Figure 10. Upper Humptulips Area Summer Water Temperatures



Rayonier & USFS Data: 7/1/98 - 8/31/98

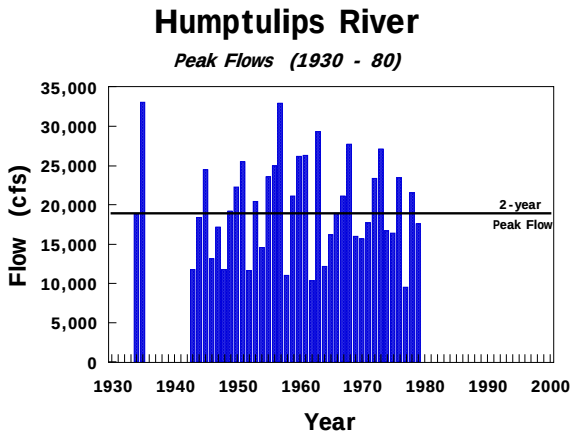


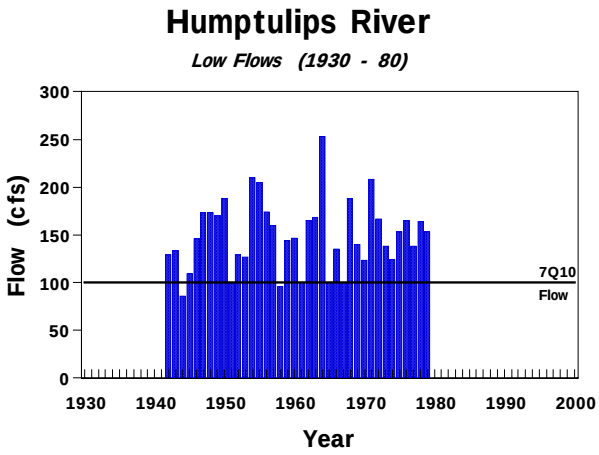
Rayonier & USFS Data: 7/1/98 - 8/31/98

Annual Variability

The annual variability of low flows affects maximum water temperatures observed in any given year. Figure 11 shows the variation in low flows for the Humptulips River.

Figure 11. Humptulips River Peak and Low Flow History





Technical Analysis

Under the current regulatory framework for development of TMDLs, identification of the loading capacity for pollutants is the first step. The loading capacity provides a reference for calculating the amount of pollutant reduction needed to bring a water into compliance with standards. By definition, TMDLs are the sum of the allocations *[40 CFR §130.2(i)]*. Allocations are defined as the portion of a receiving water's loading capacity that is allocated to point or nonpoint sources and natural background. EPA's current regulation defines loading capacity as *"the greatest amount of loading that a water can receive without violating water quality standards"*. Following is a summary of the extensive technical analysis that was done for this TMDL. The complete Technical Assessment Report (TAR) is found in Appendix A.

Landscape Scale Analyses

TMDL development for nonpoint sources presents some inherent challenges. Diffuse sources are often associated with watershed or landscape scale features and processes occurring over time. Consequently, water quality concerns associated with nonpoint source (NPS) pollutants require a different approach from traditional point source problems.

Landforms vary across the Upper Humptulips watershed. The headwaters originate in the steep Olympic Mountains. The streams then flow into gradually broadening glaciated river valleys. The influences of the geologic setting and associated physical processes that affect aquatic habitats have been captured in the Watershed Analysis by stratifying the landscape into *"geomorphic map units"* (GMUs). The Upper Humptulips has been divided into 17 GMUs. These GMUs have been further grouped into six categories that share similar erosional and channel forming processes. The GMU categories include:

- Glacial Erosional
- Fluvial Erosional Hillslopes
- Mass Wasting
- Glacial Depositional
- Fluvial Depositional
- Inner Gorge

GMU boundaries are determined by geology, geological history, and topographic relief. Summaries of characteristics for each GMU are found in the Watershed Analysis Report.

Channel Classification: Conditions in a stream are a function of channel morphology (e.g. source, transport, or response reaches). Methods exist to assess the condition of a stream, as well as departure from its potential (Rosgen, 1996). These methods, built around channel classification, are a useful starting point to develop specific TMDL surrogate measures for streams in the Upper Humptulips watershed area. Consequently,

a second lower level of stratification consists of classifying stream segments of the channel network within each of the GMUs.

For this TMDL there were 34 individual stream segment types developed within this system. Riparian management strategies are keyed to each of the stream types. A description of these can be found within the WA document. Additional details on channel characteristics, geology, morphology, large woody debris characteristics and recruitment processes, sediment delivery and processing mechanisms, riparian characteristics and biological community features are described in the WA. A summary table of the 34 types can also be found in Appendix C of this document.

Mechanistic Models

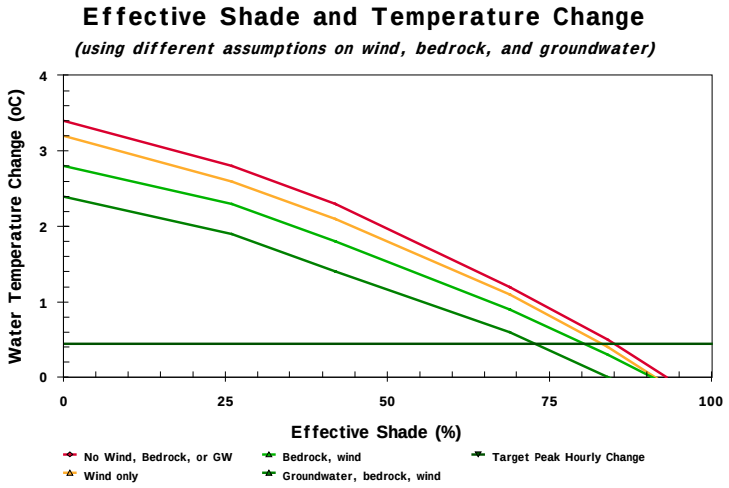
A loading capacity for heat (expressed as BTU/ft^2 per day) can be derived using mechanistic models. One of the most basic forms of these models is the fundamental equation applied by Brown (1969) for forest streams *(*Table 2*).*

Table 2. **Mathematical Relationship between Water Temperature and Heat**

$\Delta T = \Delta H * A / (V * \rho * c_p)$
where: ΔT = temperature change (°F / hour) ΔH = rate that heat is received (BTU / hour) A = surface area (ft^2) V = volume (ft^3) ρ = density of water (62.4 lb / ft^3) c_p = specific heat of water (BTU/ lb / F)

The calculation of water temperature by a mechanistic model follows the basic relationship described in Table 2. A mechanistic model is essentially bookkeeping of different heat transfer processes to determine potential water temperature changes. Using such an approach, a family of curves can be developed which describes different ΔH values designed to achieve a known temperature change. Figure 12 illustrates one such set of curves for a class of streams used in development of the Simpson Habitat Conservation Plan (HCP) area TMDL.

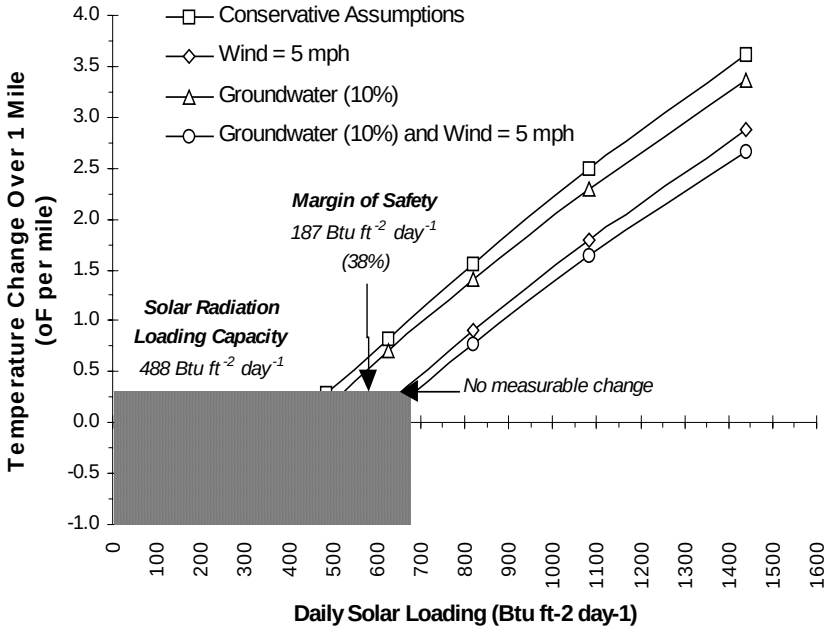
Figure 12. Simpson HCP Area Pool Riffle Channels



Other models have been developed based on a heat budget approach that estimates water temperature under different heat balance and flow conditions. Brown (1969) was the first to apply a heat budget to estimate water temperatures on small streams affected by timber harvest. Using mathematical relationships to describe heat transfer processes, the rate of change in water temperature on a summer day can be estimated. Relationships include both the total energy transfer rate to the stream (i.e. the sum of individual processes) and the response of water temperature to heat energy absorbed. Heat transfer processes considered in the analysis include solar radiation, longwave radiation, convection, evaporation, and bed conduction (Wunderlich 1972, Jobson and Keefer 1979, Beschta and Weatherred 1984, Sinokrot and Stefan 1993).

Figure 2 (Page 5) showed that solar radiation is the predominant energy transfer process that contributes to water temperature increases. A general relationship between solar radiation loads and stream temperature can be developed by quantifying heat transfer processes (Figure 13). In this example, average unit solar radiation loads greater than 675 BTU / ft^2 per day result in a noticeable increase in water temperature. This could represent a starting point to define a loading capacity (i.e. the greatest amount of loading that a water can receive without violating water quality standards).

Figure 13. General Relationship between Solar Radiation Loads and Water Temperature



A drawback to the use of mechanistic models, however, is the difficulty in determining solar radiation loads over each stream mile of a large watershed. The curves that result from numerical calculations are influenced by a number of factors. These include stream flow, channel width, upstream water temperature, wind speed, relative humidity, stream bed composition, and groundwater contribution. Higher stream flows, for example, result in higher allowable solar radiation loads when width:depth ratios are held constant. Likewise, narrower channels result in higher allowable loads when stream flows are held constant.

Natural Conditions

Another complication in using mechanistic models to develop allowable loads is that the result may be the identification of loading capacities that are not achievable. This occurs when the vegetative height associated with a mature riparian forest is not tall enough to shade the entire active channel. For instance, on June 21 the shadow length of a 170-foot tall Douglas fir at 1:00 p.m. (daylight time) is about 75 feet. This means that an active channel wider than 75 feet will not be completely shaded on that date. For such cases and for cases where the numeric criteria is naturally exceeded, the natural conditions clause of Washington's water quality standards is applied *[WAC 173-201A-070(2)]*. This means that where mature riparian vegetation will not fully shade the active channel, the temperature which results from shade achievable by a mature riparian forest becomes the standard. The loading capacity is then the solar load associated with these natural conditions.

To better quantify the linkage between solar loads associated with the natural conditions and the anticipated effect on water temperature, a discussion of diurnal variation is helpful. Diurnal variation in water temperature occurs naturally in stream systems. The magnitude of the temperature change (both diurnal range and peak hourly increase) has meaning for this TMDL because it is designed to decrease the pollutant load. Assessing the peak hourly change as a result of load reduction is much more straightforward than predicting attainment of an absolute water temperature. This approach incorporates natural conditions by looking at the change from a base temperature as opposed to making multiple site-specific evaluations to establish base temperatures.

In the absence of site-specific criteria modifications, this TMDL is developed by stratifying the landscape into temperature groups. From this framework, effective shade targets are identified for channel types within each temperature group.

Temperature Groups

Temperature conditions in the analysis area are influenced by a variety of factors that include shade, groundwater flow, and channel morphology. The geomorphic channel units (GCUs), described in the Stream Channel Assessment of the Watershed Analysis Report *(Module E),* have been used to classify segments based on channel morphology, geology, and location within the drainage system. The channel classification system can be used to group stream reaches by the dominant control(s) which affect water temperature. Table 3 displays the channel types grouped based on these dominant controls. The channel types are grouped as source reaches, transport reached, or response reaches. Table 4 identifies seven groups and describes watershed process features that exert the greatest influence on water temperature in those channel classes. Dominant features include shade, groundwater, and channel morphology

Table 3. Groups Reflecting Dominate Process Affecting Water Temperature

Group	Features
	Source
	Source reaches are defined in the Stream Channel Assessment as those channels that occur in sediment source areas or that contribute a significant source of sediment from bank erosion. These are small to medium sized, high gradient streams in the Watershed Analysis area.
sd	*Slope Deposit.* This GCU includes steep gradient (> 8 percent) channels that occur adjacent to debris fans and deep-seated landslides. These channels function as sediment source and transport sites as a result of bank erosion and undercutting at the margin and toes of the fans and landslides. Large woody debris (LWD) helps to stabilize the channel and minimize bank erosion. Channel morphology is variable depending on the accumulation of sediment and LWD. Summer flows in these channels are likely derived from groundwater.
spc	*Step-pool / Cascade:* This GCU includes moderate to high gradient channels (4 percent to 20 percent) in moderately confined to confined valleys that occur in the upper portions of the drainage network. Channel morphology is characterized by step-pools and cascades formed by boulders, rocks, and LWD. LWD may form pools, especially in the lower-gradient channels, and create sediment storage sites behind log jams. Substrate is dominated by cobble, boulder, and bedrock.

Table 3 cont'd

Group	Features
	Transport
Transport reaches are defined in the Stream Channel Assessment as those channels that function as sediment transport zones. These range from small to large sized, mid-gradient streams in the Watershed Analysis area.	
tt	*Terrace Transition:* This GCU includes the moderate to high gradient (> 4 percent), confined channels that occur in a transition zone between the tops of glacial terraces and the valley floor. This GCU includes channels characterized by a series of steep cascades, chutes, or falls (some up to 50 feet high) that are usually formed in bedrock, but also occur on glacial outwash. The steep gradient zones may be interspersed with short, low-gradient pool / riffle zones where the channel flows across intermediate terraces. The large channels are eroded to the bedrock base level, but similar channels may continue to downcut and erode headward. The Terrace Transition classification was applied to all mixed steep and low gradient reaches that flow between the top of the highest terrace and the valley floor.
fpr	*Forced Pool / Riffle:* This GCU includes moderate gradient (2 percent to 4 percent), moderately confined channels that occur in the middle to upper portions of most tributaries and in the upper East Fork mainstem. Small pools formed by LWD or other obstructions are the dominant channel morphology. Flood plain development is limited along most of these segments by banks formed of consolidated material. Some channels, however, may have narrow, discontinuous flood plains. The substrate is dominated by cobble and gravel
brg	*Bedrock Gorge:* This GCU only occurs in the East and West Fork mainstems. It includes low-gradient (<2 percent) segments that are confined by steep bedrock walls, which rise 100 to 200 feet above the river bed. Rapids, glides, and trench pools formed by boulders and bedrock outcrops are the dominant channel features. Pools formed by LWD are rare, and LWD recruitment processes are limited. Most LWD in these channels is derived by fluvial transport from upstream. Retention of LWD is low because of high transport capacity in the confined channels.

Group	Features
Response	
Response reaches are defined in the Stream Channel Assessment as channels that are sensitive to sediment or flow changes. These range from small to large sized, low gradient streams in the Watershed Analysis area. Table C-6 identifies those GCUs which are in this category, specifically riverine wetland (rw), babbling brook (bb), hillslope confined (hsc), terrace confined (tc), low gradient pool / riffle (lgpr), and floodplain migration (fpm).	
bb	*Babbling Brook:* This GCU includes small (< 2.0 m bankfull width), unconfined and moderately-confined, low and moderate gradient (1 to 4 percent) brooks. They occur in small basins with low relief, most of which are located in the lower portion of the watershed. These segments would be classified in the low gradient pool / riffle GCU if they were larger, but babbling brook channels do not have enough flow and hydraulic power to form pools and riffles. Channel morphology is characterized by shallow glides with small pools that are occasionally formed around tree roots, shrubs, and wood debris. Substrate is dominated by sand, silt, and small gravel.
rw	*Riverine Wetland:* These areas are low gradient (<2%) streams within wetland valley bottoms. The channels are typically incised in fine organic and inorganic silt deposits. Stream flows are generally placid and low-velocity and the streams are frequently impounded by beaver dams.
hsc	*Hillslope Confined:* This GCU includes low gradient (< 2 percent) mainstem channels that are mostly confined by adjacent sideslopes. Glides and pools formed by boulders and rock outcrops are the dominant channel features. Short, wide riffles are present at the transitions between units, and the substrate is dominated by cobble and gravel. Some gravel patches occur in association with retention structures formed mostly by boulders and in some cases LWD. LWD recruitment processes are limited by the confined channel morphology, and pools formed by LWD are rare.
tc	*Terrace Confined:* This GCU includes the low gradient (< 2 percent) segments of the East and West Fork mainstems that are confined by glacial terraces. Steep walls composed of glacial deposits on one or both sides of the channel confine this GCU in a narrow valley. Pools and glides formed by lateral scour are the dominant channel morphology. Short riffles are present at the transitions between units, and the substrate is dominated by cobble and gravel. Undercutting of toe slopes by the river is a common source of sediment and LWD. LWD retention, however, is low because of the high transport capacity of this GCU.

Table 3 cont'd.

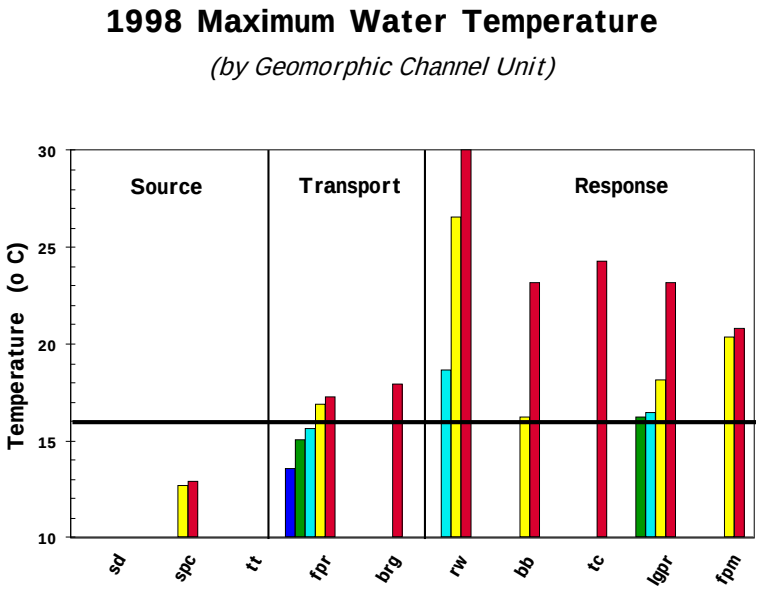
Group	Features
Response	
lgpr	*Low-gradient Pool / Riffle:* This GCU includes the moderately confined, low-gradient (<2 percent) channels in the East and West Fork mainstems and in the larger tributaries. Channel morphology typically consists of alternating pool and riffle units with occasional glides. Pools are formed by channel meandering and in-channel scour elements (i.e. LWD and bedrock outcrops). The stream bed material is predominantly gravel. The channels have narrow, often discontinuous flood plains that are punctuated by bedrock outcrops. Channel morphology in the Low-gradient Pool / Riffle GCU is similar to that of the Flood Plain Migration GCU, in the mainstem, except the frequency and extent of channel movement are reduced, resulting in fewer flood plain features (e.g. side channels, sloughs, and ponds).
fpm	*Flood Plain Migration:* This GCU includes the wide, unconfined, low-gradient (< 2 percent, most < 1 percent) channels that occur only in the East and West Fork mainstems. This GCU has extensive gravel bars and low flood plain expanses that are formed by sediment deposition during floods. Channel migration in response to changes in sediment supply and inputs of LWD is a common process leading to the formation of overflow channels, side channels, sloughs, and ponds on the gravel bars and flood plain. Channel morphology in this GCU is typically alternating pool and riffle units with occasional glides. Pools are formed by channel meandering and by in-channel scour elements (i.e. LWD and bedrock outcrops). The stream bed material is predominantly gravel. Overflow channels and side channels on adjacent gravel bars are common. Sloughs and ponds within the current flood plain are rare. Oxbow ponds and wetlands formed by post-glacial channel migration occur on higher terraces.

The 10 channel classes allow refinement of assumptions used to develop effective shade targets. Development of effective shade targets is then based on a better description of site specific conditions. In addition, actual data collected on streams in the Humptulips WA area is used to validate anticipated responses. Figure 14 depicts information collected in 1998 from sites representative of each temperature group. Maximum observations between July 1 and August 31 are shown. This corresponds with the seasonal time frame when maximum water temperatures occur.

Table 4. Groups for Identifying Targets to Address Water Temperature

Group	Features	GCU
Shade		
S-a	Small to medium sized pool riffle channels. Water temperature is driven by shade and low flows (poor water storage in these watersheds over glacial tills and shallow soils).	bb lgpr
S-b	Low gradient segments of the East and West Fork mainstems that are confined by adjacent sideslopes and glacial terraces. Channels of this group receive some topographic shading provided by confinement. Groundwater inputs are probable, but generally have limited influence on stream temperature. Heat advected from segments located upstream can also contribute to elevated water temperatures in these channels.	hsc tc
S-c	Large channels in the East and West Fork mainstems that are confined by steep bedrock walls that rise 100 to 200 feet above the river bed. These channel segments receive near topographic shade and the water is fast and deep. When elevated temperatures occur, it is typically through heat advected from segments located upstream.	brg
S-d	Small to medium sized forced pool riffle channels. These systems have moderate to low flows in summer with varying amounts of groundwater influence. Along the continuum, those with minimal groundwater influence are susceptible to elevated water temperatures with loss of shade. Those with significant amounts of groundwater influence are resistant to temperature changes.	fpr
Groundwater		
G-a	Small and medium sized moderate to high gradient confined channels. These are topographically shaded and are *"near"* the water source with substantial groundwater influence that shows as side seeps and springs. These systems are typically cool and are resistant to water temperature changes. Shade is a secondary influence, except during extreme low flow years.	sd spc tt
Channel Morphology		
C-a	Low gradient streams within wetland valley bottoms. Low velocity, placid flow sloughs are the dominant channel morphology. Beaver dams frequently create ponds in these channels and influence riparian vegetation composition. Low velocity and naturally open canopy cause this temperature group to rapidly respond to heat inputs.	rw
C-b	Medium to large channels affected by high sediment supply and multiple thread channels over at least some of their length. Temperatures in these systems are strongly influenced by channel pattern and open canopies. Current and past sediment supply, long residence times, and channel pattern make it unlikely that water temperatures here will change for decades.	fpm

Figure 14. Annual Maximum Water Temperature by Group

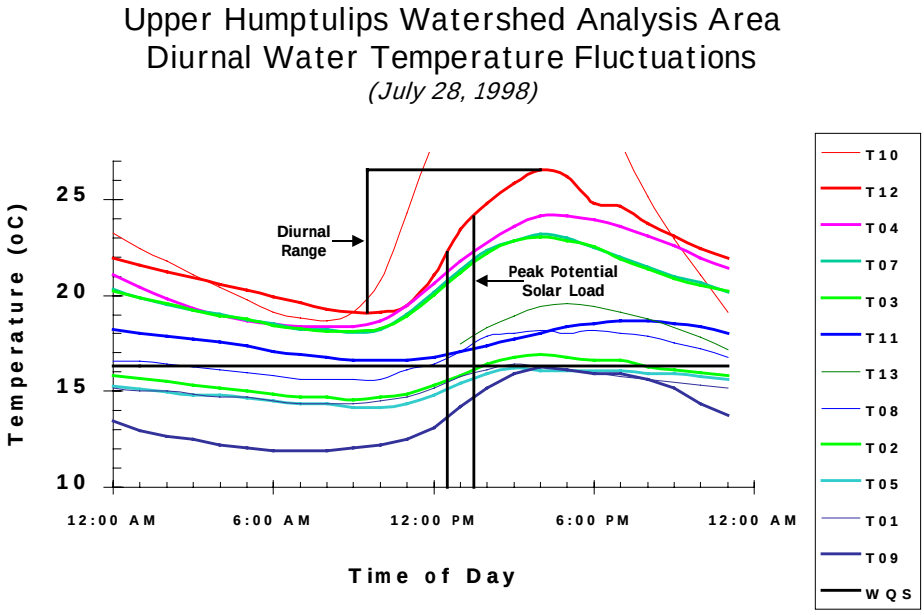


Peak Hourly Change

Development of loading capacities and allocations that focus on either maximum diurnal range or peak hourly water temperature increase is possible. An analysis can be constructed which evaluates solar radiation inputs and resultant water temperature change through a heat budget analysis. Figure 15 depicts the diurnal variation of the temperature group monitoring sites on July 28, 1998. July 28, 1998 corresponds to the date when the maximum water temperature was observed by the U.S. Forest Service over a five-year period in the Humptulips watershed.

Figure 15 shows both the diurnal change and peak hourly water temperature increase for each temperature group. A regression was performed to determine the peak hourly change target that corresponded to a maximum temperature of 16°C. Based on this relationship, the lowest peak hourly increase observed (0.50°C) is used to derive effective shade targets.

Figure 15. Temperature Group Summary - Diurnal Water Temperature Fluctuations



Loading Capacity

Identification of the loading capacity is an important step in developing TMDLs. The loading capacity provides a reference for calculating the amount of pollutant reduction needed to bring a water into compliance with water quality standards. By definition, a TMDL is the sum of the allocations. An allocation is defined as the portion of a receiving water's loading capacity that is assigned to a particular source. EPA defines the loading capacity as "the greatest amount of loading that a water can receive without violating water quality standards."

Effective Shade

Using information about each channel class (e.g. estimated drainage area, estimated active channel width, range of flows, etc.) effective shade targets can be developed. The channel classification system is used to assess stream reaches according to temperature groups. This approach leads to effective shade targets that recognize the variability in channel and riparian characteristics that occurs across the landscape. As such, these targets reflect the range of active channel widths and riparian vegetation heights by GCU within the WA area (Table 5).

Table 5. Summary of Effective Shade TMDL and Load Allocations for Upper Humptulips

Stream Order	Group	Estimated Active Channel Width *(m)*		Riparian Strategy	Length *(miles)*	Allocations *(Effective Shade as percent)*		
						TMDL	LA	MOS
Slope Deposit GCU								
sd(1)	G-a	1 - 2		Olympic Forest Plan	3.55	70%	98%	(28%)
sd(1)	G-a	1 - 2		Forest & Fish	0.55	70%	73%	(3%)
sd(2)	G-a	2 - 4		Olympic Forest Plan	2.12	69%	97%	(28%)
sd(2)	G-a	2 - 4		Forest & Fish	0.13	69%	72%	(3%)
Total for GCU					6.35			
Step Pool / Cascade GCU								
spc(1)	G-a	1 - 2		Olympic Forest Plan	54.50	70%	98%	(28%)
spc(1)	G-a	1 - 2		Forest & Fish	49.05	70%	73%	(3%)
spc(2)	G-a	2 - 4		Olympic Forest Plan	4.56	69%	97%	(28%)
spc(2)	G-a	2 - 4		Forest & Fish	7.27	69%	72%	(3%)
spc(3)	G-a	4 - 8		Olympic Forest Plan	0.38	70%	95%	(25%)
Total for GCU					115.76			
Terrace Transition GCU								
tt(1)	G-a	1 - 2		Olympic Forest Plan	34.98	70%	98%	(28%)
tt(1)	G-a	1 - 2		Forest & Fish	5.78	70%	73%	(3%)
tt(2)	G-a	2 - 4		Olympic Forest Plan	9.46	69%	97%	(28%)
tt(2)	G-a	2 - 4		Forest & Fish	3.48	69%	72%	(3%)
tt(3)	G-a	4 - 8		Olympic Forest Plan	3.31	70%	95%	(25%)
tt(3)	G-a	4 - 8		Forest & Fish	1.87	70%	73%	(3%)
tt(4)	G-a	8 – 12		Olympic Forest Plan	0.01	74%	90%	(16%)
tt(4)	G-a	8 – 12		Forest & Fish	0.35	74%	77%	(3%)
Total for GCU					59.24			

Notes:

[1] TMDL currently refers to temperature group. Development of allocations based on maximum active channel width for class. As new data and methods are developed to better estimate effective shade that results from specific riparian strategy for a particular channel class, the TMDL may be revised.

Table 5 (cont'd). Summary of Effective Shade TMDL and Load Allocations for Upper Humptulips

Stream Order	Group	Active Channel Width *(m)*		Riparian Strategy	Length *(miles)*	Allocations *(Effective Shade as percent)*		
						TMDL	LA	MOS
Forced Pool / Riffle GCU								
fpr(1)	S-d	1 - 2		Olympic Forest Plan	7.26	77%	98%	(21%)
fpr(1)	S-d	1 - 2		Forest & Fish	10.44	77%	79%	(2%)
fpr(2)	S-d	2 - 4		Olympic Forest Plan	11.50	76%	97%	(21%)
fpr(2)	S-d	2 - 4		Forest & Fish	8.48	76%	78%	(2%)
fpr(3)	S-d	4 - 8		Olympic Forest Plan	2.21	76%	95%	(19%)
fpr(3)	S-d	4 - 8		Forest & Fish	1.91	76%	78%	(2%)
fpr(4)	S-d	8 – 16		Forest & Fish	1.13	78%	80%	(2%)
Total for GCU					42.93			
Bedrock Gorge GCU								
brg(3)	S-c	4 - 8		Olympic Forest Plan	2.71	76%	95%	(19%)
brg(4)	S-c	8 - 16		Olympic Forest Plan	2.84	78%	90%	(12%)
brg(4)	S-c	8 – 16		Forest & Fish	0.83	78%	80%	(2%)
Total for GCU					6.38			
Riverine Wetlands GCU								
rw(1)	C-a	1 - 2		Olympic Forest Plan	3.14			
rw(1)	C-a	1 - 2		Forest & Fish	7.43			
rw(2)	C-a	2 - 4		Olympic Forest Plan	0.58			
rw(2)	C-a	2 - 4		Forest & Fish	1.19			
rw(3)	C-a	4 - 8		Olympic Forest Plan	0.25			
Total for GCU					12.59			

Notes:

[1] TMDL currently refers to temperature group. Development of allocations based on maximum active channel width for class. As new data and methods are developed to better estimate effective shade that results from specific riparian strategy for a particular channel class, the TMDL may be revised.

Table 5 (cont'd). Summary of Effective Shade TMDL and Load Allocations for Upper Humptulips

Stream Order	Group	Active Channel Width *(m)*	Riparian Strategy	Length *(miles)*	Allocations *(Effective Shade as percent)*		
					TMDL	LA	MOS
Babbling Brook GCU							
bb(1)	S-a	1 - 2	Olympic Forest Plan	2.92	83%	98%	(15%)
bb(1)	S-a	1 - 2	Forest & Fish	2.17	83%	85%	(2%)
bb(2)	S-a	2 - 4	Olympic Forest Plan	0.82	82%	97%	(15%)
bb(2)	S-a	2 - 4	Forest & Fish	0.85	82%	84%	(2%)
bb(3)	S-a	4 - 8	Olympic Forest Plan	0.26	81%	95%	(14%)
Total for GCU				7.02			
Hillslope Confined GCU							
hsc(4)	S-b	8 - 16	Olympic Forest Plan	0.97	82%	90%	(8%)
Total for GCU				0.97			
Terrace Confined GCU							
tc(3)	S-b	4 - 8	Olympic Forest Plan	1.09	81%	95%	(14%)
tc(5)	S-b	16 – 32	Forest & Fish	8.74	81%	83%	(2%)
tc(6)	S-b	> 32	Forest & Fish	0.02	79%	81%	(2%)
Total for GCU				9.85			

Notes:

[1] TMDL currently refers to temperature group. Development of allocations based on maximum active channel width for class. As new data and methods are developed to better estimate effective shade that results from specific riparian strategy for a particular channel class, the TMDL may be revised.

Table 5 (cont'd). Summary of Effective Shade TMDL and Load Allocations for Upper Humptulips

Stream Order	Group	Active Channel Width *(m)*		Riparian Strategy	Length *(miles)*	Allocations *(Effective Shade as percent)*		
						TMDL	LA	MOS
Low Gradient Pool / Riffle GCU								
lgpr(1)	S-a	1 - 2		Olympic Forest Plan	0.87	83%	98%	(15%)
lgpr(1)	S-a	1 - 2		Forest & Fish	2.97	83%	85%	(2%)
lgpr(2)	S-a	2 - 4		Olympic Forest Plan	7.26	82%	97%	(15%)
lgpr(2)	S-a	2 - 4		Forest & Fish	5.22	82%	84%	(2%)
lgpr(3)	S-a	4 - 8		Olympic Forest Plan	4.48	81%	95%	(14%)
lgpr(3)	S-a	4 - 8		Forest & Fish	4.82	81%	83%	(2%)
lgpr(4)	S-a	8 – 16		Olympic Forest Plan	1.73	82%	90%	(8%)
lgpr(4)	S-a	8 – 16		Forest & Fish	6.84	82%	84%	(2%)
lgpr(5)	S-a	16 - 32		Forest & Fish	7.10	81%	83%	(2%)
Total for GCU					41.24			
Flood Plain Migration GCU								
fpm(2)	C-b	2 - 4		Olympic Forest Plan	0.17	84%	97%	(13%)
fpm(3)	C-b	4 - 8		Olympic Forest Plan	10.86	84%	95%	(11%)
fpm(4)	C-b	8 – 16		Olympic Forest Plan	9.40	84%	90%	(6%)
fpm(5)	C-b	16 - 32		Forest & Fish	5.46	83%	85%	(2%)
Total for GCU					25.89			

Notes:

[1] TMDL currently refers to temperature group. Development of allocations based on maximum active channel width for class. As new data and methods are developed to better estimate effective shade that results from specific riparian strategy for a particular channel class, the TMDL may be revised.

Load Allocations

Once the Loading Capacity has been developed, then contributing sources can be allocated their fair contribution. This TMDL is designed to address impairments due to surface water temperature increases on one water quality-limited segment located at the Highway 101 bridge. In addition to the listed Section 303(d) waters, this TMDL also applies to other potential water quality impairments from heat for all streams in Upper Humptulips watershed. In developing the allocations, this TMDL has benefited from portions of the analysis used in preparation of the East/West Humptulips WA. Allocations in the TMDL are designed to achieve properly functioning aquatic systems in the Upper Humptulips watershed. There is a data gap in the area between Rayonier's land and the 101 bridge. The streams in this section have not been classified. They should fall into types found in the channel classification, but further assessment is necessary to verify this. The relative contribution of these streams is small and should not significantly effect the temperature at the 101-bridge.

Regulatory Framework: Under the current regulatory framework for development of TMDLs, flexibility is allowed for specifying allocations in that *"TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure"*. This TMDL does use other measures to fulfill requirements of Section 303(d). Although a loading capacity for heat can be derived [e.g. BTU/ft^2 per day], it is of limited value in guiding management activities needed to solve identified water quality problems.

Allocation Development: Allocations in this TMDL are derived using effective shade. These measures can be linked to specific source areas, and thus to actions (specifically riparian management) needed to solve problems which cause water temperature increases.
The TMDL develops load allocations for each channel class in Upper Humptulips area, then summarizes them into ten separate groups. Streams within each group share common characteristics that relate to potential input of pollutants into those streams and point towards possible management strategies.

Effective Shade Allocations Effective shade targets can be developed for each temperature group using a quantitative analysis of heat transfer processes. The model used to aid in the development of the shade targets was HeatSource version 5.6 which provided estimates for various components of a heat budget (e.g. solar radiation, etc). The Watershed Analysis Report discusses information about each channel class that is used to develop estimates of basin area, size of the active channel, slope, etc. Reasonable assumptions can be defined for key factors that affect water temperature, e.g. stream depth, groundwater. A heat budget analysis is then developed based on these assumptions to identify effective shade targets for each channel class.

The heat budget analysis used July 28 as the critical day. This is based on an analysis of stream temperature monitoring data from the Upper Humptulips Watershed. A wind speed of five miles per hour was used across the landscape based on sparse meteorological data that is available. To estimate conduction, a value of 75% was assumed to represent bedrock conditions. Assumptions for base flow, average width:depth ratio, groundwater flow, and groundwater temperature are summarized in the Technical Assessment Report *(Appendix B).* Groundwater flow rates are based on water yield and inflow estimates described in the Technical Assessment Report. For several channel types, the percent inflow was increased to account for the effect of intergravel flow. This was based on patterns observed in reviewing stream temperature data. Groundwater temperature was also based on patterns observed in the stream monitoring data. Values assumed used the coolest water temperature for that group on the warmest day in 1997. The assumed groundwater temperatures are actually higher than a standard 10°C used in other modeling efforts which provides some margin of safety.

Load allocations were made for all channel classes with the exception of the Riverine Wetland (RW). These areas are low gradient (<2%) streams within wetland valley bottoms. The channels are typically incised in fine organic and inorganic silt deposits. Stream flows are generally placid and low-velocity and the streams are frequently impounded by beaver dams. The RW are historically non-forested, consisting of some hardwoods, Hemlock, Devil's Club, and Huckleberry. It is difficult to predict what the optimum plant species composition and site-potential shade should be and what effect restoring the composition to pre-European conditions would have on temperature. Due to the wet soils these areas will not support a dense riparian forest. In addition, the channel length of these segments is a very small portion of the total channel length which contributes to the mainstem Humptulips River. The most appropriate methods for dealing with potential elevated temperatures in these sections are by the use of monitoring and adaptive management.

Margin of Safety

The Clean Water Act requires that each TMDL be established with a margin of safety (MOS). The statutory requirement that TMDLs incorporate a margin of safety is intended to account for uncertainty in available data or in the actual effect controls will have on loading reductions and receiving water quality. A margin of safety is expressed as unallocated assimilative capacity or it can be conservative analytical assumptions used in establishing the TMDL (e.g., derivation of numeric targets, modeling assumptions or effectiveness of proposed management actions).

The margin of safety may be implicit, as in conservative assumptions used in calculating the loading capacity, WLAs, and LAs. The margin of safety may also be explicitly stated as an added, separate quantity in the TMDL calculation. In any case, assumptions should

be stated and the basis behind the margin of safety documented. The margin of safety is not meant to compensate for a failure to consider known sources.

Assumptions

Effective Shade*:* Development of effective shade allocations results from an analysis of processes that affect water temperature and from information about the approach toward riparian management based on land ownership. Table 6 summarizes uncertainties associated with development of effective shade targets. Adjustments that were made to account for these uncertainties are also described.

Table 6. **Supporting Information for Margin of Safety - Effective Shade**

Uncertainties in TMDL	Adjustments to Account for Uncertainties
Natural conditions of upstream ambient water temperature regimes for some segments may be above state criteria of 16°C.	Focus analysis on identifying heat input and effective shade targets to achieve a peak hourly temperature increase of 0.50°C which serves as a numeric interpretation of the *"natural conditions"* clause in Washington's water quality standards. As new data and methods are developed to better describe *"natural conditions"*, the peak hourly temperature increase target may be refined.
Maximum water temperatures can occur over a range of days that vary from mid-July to mid-August.	Effective shade allocations are based on shadows cast on June 21 when shade angle and solar radiation are at their peak.
Very little information exists regarding factors that affect water temperature in the Upper Humptulips area, particularly wind speed, relative humidity, stream-bed composition, and groundwater contribution.	Once the WQRP is in place, monitoring of water temperature will continue with a focus on temperature group patterns. Information from this network will support modifications to assumptions, as warranted.

Allocations for effective shade on federal land contain an explicit margin of safety that is expressed as an unallocated portion of the loading capacity. In many cases, this portion is unallocated because of other factors in the Riparian Reserves, which applies to that

particular channel class. Considerations include providing for slope stability or future recruitment of large wood.

In addition, allocations for effective shade on federal lands also contain an implicit margin of safety, specifically the point of measurement for the Riparian Conservation Reserve (RR). These buffer widths, identified in the WQRP and in the load allocations, were determined by identifying the primary zones adjacent to each channel class where the functional interactions with the riparian forest are most pronounced.

Riparian buffers function in several ways that affect stream temperature. Direct shading of streams is not the only function that riparian buffers provide. These buffers can increase ground water storage from rain events thus allowing groundwater to perfuse into the stream over a longer period resulting in a cooling of the stream. They also shade the ground near the stream and decrease the temperature of near surface ground water. Recent studies (Chen et al, 1999; Dong et al, 1998; Ledwith, 1996) have shown that buffers effect microclimate factors such as air temperature proximal to the stream. Ledwith (1996) showed a 6.5° C increase between a 0 meter buffer and a 150 meter buffer with the greatest change occurring in the first 30 meters where it changed 1.0 °C per 10 meters. This TMDL set loads based upon shade; the load allocations are the same for Federal and FFR lands. The buffer width and composition for Federal lands in this project is established by the Olympic National Forest Plan as amended by the Northwest Forest Plan. These documents set the buffer width and composition at levels far exceeding the load allocations. The increased margin of safety for the Federal lands is based upon the fact that their buffers would provide a greater contribution to all factors that are mitigating stream temperature not just shade. In addition the buffers on Federal land also includes buffers for 100% of the length of high gradient non-fish bearing streams as opposed to the 50% buffers under the FFR. If a greater margin of safety is desired on FFR lands, then more comprehensive buffers could be established for FFR lands in the Detailed Implementation Plan.

Summary Implementation Strategy

Overview

The TMDL provides the framework and targets for long term monitoring and implementation activities. However, it does not include the details for what to do or the mechanisms that will ensure that water quality improvements will occur. This section summarizes the strategy and elements that should ensure effective actions to meet the established targets as well as to maintain compliance with water quality and temperature standards.

Temperature violations occur in late summer. However, the causes for elevated temperatures in forested environments are systemic conditions. These are past and current deficiencies in riparian conditions, road management and accelerated erosion and mass wasting from management activities. These are conditions that result from a variety of management actions taken throughout the years and across the landscape.

The TMDL temperature analysis has been adopted by the Services as the analytical basis for validating the effectiveness of the riparian prescriptions in the East/West Humptulips area and for guiding monitoring efforts and subsequent adaptive management. The TMDL relies on the Water Quality Restoration Plan (WQRP) for articulating the management activities, broad environmental outcomes, monitoring requirements, and the adaptive management process. Due to the growth cycle of trees in the Humptulips area it can be expected that if trees are planted to meet riparian prescriptions it should take approximately 50 years to achieve a mature stand. Given this time line if trees are planted in 2002 temperatures should meet standard by the year 2052. If conditions are not proceeding in a positive direction, as determined by monitoring, adaptive management will be used to attempt to introduce more stringent compliance measures to meet this goal.

Implementation Plan Development

Federal Forest Lands

The Olympic National Forest will manage lands under its jurisdiction within the Upper Humptulips River according to direction set forth in pertinent management documents. The Olympic National Forest has been managed under direction provided in the Olympic National Forest Land and Resource Management Plan since its implementation in 1990.

The plan sets forth Forest-wide goals and objectives, Forest-wide standards and guidelines by program element, and a system of management areas, each with its own goals, objectives and standards and guidelines for management of the Forest. 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, also known as the Northwest Forest Plan (NWFP), amends the Olympic LRMP. The ROD adopts Alternative 9 of the Final Supplemental Environmental Impact Statement (FEIS) on Management of Habitat for Late-Successional and Old-Growth Species Within the Range of the Northern Spotted Owl as modified by the ROD and as amplified by the standards and guidelines attached to it.

The NWFP amends the Olympic LRMP by overlaying a system of land allocations with their accompanying standards and guidelines. The Olympic LRMP is still valid, but is amended to include the provisions of the NWFP. In general, where NWFP standards and guidelines differ from the Olympic LRMP for specific resource areas, the NWFP standards and guidelines apply. Standards and guidelines and land allocations in the Forest plan not directly super-ceded will remain in effect.

The purpose and need for the NWFP standards and guidelines, as stated in the ROD is "to take an ecosystem management approach to forest management, with support from scientific evidence; meet the requirements of existing laws and regulations; maintain a healthy forest ecosystem with habitat that will support populations of native species (particularly those associated with late-successional and old-growth forests), including riparian areas and waters; 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 Northwest Forest Plan describes the ecological principals for management of Late-Successional forests. Late-successional Reserve areas are designated land allocations. The primary management objective for these lands is to protect and enhance conditions of late-successional forest ecosystems so that they can effectively serve as habitat for late-successional and old-growth related species. The purpose of the standards and guidelines set for the Late-successional Reserves is to maintain late-successional forest ecosystems, maintain natural ecosystem processes, accelerate development of young plantations into stands with late-successional and old-growth forest characteristics, and reduce the risk of severe impact from large-scale disturbances.

Adaptive Management Areas are landscape units designated within the Northwest Forest Plan are to be managed to encourage development and testing of technical and social approaches to desired ecological, economic and other social objectives. The overall management objective for these areas is to learn how to manage on an ecosystem basis in terms of both technical and social challenges, and in a manner consistent with applicable laws.

The Aquatic Conservation Strategy is a major component of the Northwest Forest Plan. This strategy is designed to maintain and restore the ecological health and aquatic ecosystems at the watershed or landscape scale to protect habitat for fish and other

riparian dependent species and resources. In general, watersheds that currently have the best habitat or those with the greatest potential for recovery are priority areas for increased protection and for restoration treatments. The conservation strategy aims to maintain the natural disturbance regime. Components of the Aquatic Conservation Strategy include:

1. Riparian Reserves: Lands along streams and unstable and potentially unstable areas where special standards and guidelines direct land use. Riparian reserves are designed to maintain and restore the ecological health and aquatic ecosystems. Interim widths for Riparian Reserves are established based on ecological and geomorphic factors. Interim Riparian Reserves for federal lands are delineated as part of the watershed analysis process based on identification and evaluation of critical hillslope, riparian, and channel processes. Final Riparian Reserve boundaries are determined at the site-specific level during the appropriate National Environmental Policy Act analysis.
2. Key Watersheds: A system of refugia comprising watersheds crucial to at-risk fish species and stocks and provide high quality water. Key Watersheds are generally those identified as watersheds as having the best habitat or those with the greatest potential for recovery are priority areas for increased protection and for restoration treatments. Activities to protect and restore aquatic habitat in Key Watersheds are a higher priority than similar activities in other watersheds.
3. Watershed Analysis: Procedures for conducting analysis that evaluates geomorphic and ecological processes operating in specific watersheds. This analysis should enable watershed planning that achieves Aquatic Conservation Strategy objectives. Watershed analysis provides the basis for monitoring and restoration programs and the foundation from which the Riparian Reserves can be delineated.
4. Watershed Restoration: a comprehensive, long-term program of watershed restoration to restore watershed health and aquatic ecosystems, including habitats supporting fish and other aquatic and riparian dependent organisms.

The Olympic National Forest adheres to the agency responsibilities set forth in the 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.

Private and state-owned forested lands

In 1999, various state and federal agencies, counties, some tribes and the timber industry entered into the Forests and Fish Report (F&F) to address impacts caused by forest harvesting activities on water quality and habitat for fish and six riparian-dependent amphibians. This agreement was contingent on the state adopting improved forest practice regulations as well as funding and implementing a monitoring and adaptive management program to demonstrate the effectiveness of the new rules in protecting water quality and fisheries habitat. Landowners also agreed to share water quality information with the other parties to the agreement.

Emergency forest practice regulations were adopted by the Washington Forest Practices Board and became effective March 20, 2000. These rules are representative of the F&F agreement. Permanent rules are in the process of being adopted by the legislatively mandated deadline of June 30, 2001.

Negotiated "assurances" were provided to the timber industry under the agreement for supporting improved forest practice regulations. These assurances include 1) development of TMDLs for 303(d) listed waterbodies impacted primarily or solely by forest practices may be delayed to the year 2009, 2) EPA and Ecology would not ask the Forest Practices Board to adopt any more stringent rules except through the adaptive management program set out in F&F, and 3) the F&F adaptive management process will be used for adjusting forest practices if necessary, to meet load allocations of TMDLs produced for streams in mixed use watersheds.

Initial development of this TMDL predates F&F and the allocations are necessary to address all the sources/causes of temperature problems in the Upper Humptulips River Watershed. Therefore, Ecology has proceeded with TMDL completion. Load allocations are included in this TMDL for forestlands in the Upper Humptulips Watershed in accordance with the section of F&F entitled "TMDLs produced prior to 2009 in mixed use watersheds". Also consistent with the F&F agreement, implementation of the load allocations established in this TMDL for private and state forestlands will be accomplished via implementation of the revised forest practice regulations. The effectiveness of the Forest and Fish rules will be measured through the adaptive management process and monitoring of streams in the watershed. If shade is not moving on a path toward the TMDL load allocation by 2009, Ecology will suggest changes to the Forest Practices Board.

F&F assurances are provided for forest harvesting activities conducted under regulations adopted pursuant to F&F, **the 20 acres exempt rule is not covered**. Since the Humptulips Watershed analysis concludes that most stream segments of the lower main stem of the East and West Forks of the Humptulips River and on the lower East Fork tributaries that have experience recent harvesting with out adequate leave buffers are shade deficient, existing shade should not be further reduced in the riparian buffers. Accordingly, forest practices conducted under the 20 acre exempt rule are expected to comply with the allocations for stream shade established in this TMDL. Therefore, DNR is encouraged to condition forest practices to prohibit any further reduction of stream shade and not to waive or modify any shade requirements for timber harvesting activities on these state and private lands. Ecology is committed in assisting DNR in identifying those site specific situations where reduction of shade has the potential for or could cause material damage to public resources.

Forest practices conducted in areas subject to the state Shoreline Management Act are subject to both the Shoreline Management Act and to the state Forest Practices Act. Under the Shoreline Management Act, timber cutting, alone, does not require a shoreline permit. However, road building, grading for landings or for major fire trails, and other kinds of activities commonly associated with forest practices may require a shoreline

permit. To determine whether or not a shoreline permit will be required for a particular activity, the operator should contact the local planning department. Exemption from the requirement to obtain a permit does not equal exemption from the requirement to comply with the law. Whether a permit is required or not, all forest practices must comply with the Shoreline Management Act and with the local Shoreline Master Program.

In addition to the Forest and Fish agreement state forestlands administered by the Department of Natural Resources are covered by a Habitat Conservation Plan (HCP). This HCP is designed to address long-term habitat needs of fish and wildlife, while allowing "DNR to continue a sustainable timber sales program that produces hundreds of millions of dollars per year for public schools, universities, local services, and other public purposes." The HCP set minimum buffer widths for type 1-4 streams in Western Washington at 100 feet or 1 site potential tree height which ever is greater. Type five streams will be protected "when necessary for water quality, fisheries habitat, stream banks, wildlife, and other important elements of the aquatic system".

Non-Forested Lands

The Gray's Harbor Conservation District (GHCD) has implemented several activities in the past to mitigate the effects of land use on the water temperature in the Humptulips River. The CD has funded 130 miles of riparian fencing to exclude live stock from the riparian area in order to preserve riparian vegetation and to reduce fecal contamination. They have also funded riparian revegetation efforts on the main stem and tributaries of the Humptulips River. In 2001 the Humptulips River was added to the Conservation Restoration and Enhancement Program (CREP). In the future GHCD hopes to continue and expand these programs, dependent on funding, to provide resources and financial support to local landowners to improve riparian management and thereby reduce temperature and improving habitat.

Implementation Activities

Federal Forest Lands

The Upper Humptulips River area is not designated as Key Watershed according to the NWFP. Based on direction in the ROD, activities aimed at protecting and restoring aquatic habitat within non-Key Watersheds are considered a lower priority than similar activities within watersheds designated as Key Watersheds. Therefore, implementation of restoration activities within the Upper Humptulips River will be prioritized based on this direction.

Within the Upper Humptulips River, the Olympic National Forest will mange its lands under its jurisdiction based on the standards and guidelines set for the different land allocations. The Forest will manage wilderness and undeveloped recreation non-motorized management areas based management direction by the Olympic LRMP, as amended by the NWFP. The Forest will manage Late-successional Reserves, Riparian

Reserves and Adaptive Management Areas, based on standards and guidelines designated in the Northwest Forest Plan. Late-successional Reserves comprise approximately 98 percent of the lands administered by the Forest Service within the Upper Humptulips. Adaptive Management Areas comprise the remaining 2 percent. Riparian Reserves overlap all management areas and land allocations and cover nearly 60 percent of these lands under Forest Service jurisdiction. These Riparian Reserves additionally provide protection for unclassified streams in the upper watershed.

The Olympic National Forest identified restoration opportunities for lands it administers during the East Fork and West Fork Humptulips Watershed Analysis process. The section of the watershed analysis document entitled "Key Restoration Opportunities" summarizes several restoration opportunities identified by analysis team members. In general, the types of restoration opportunities identified include: stand density control; snag development; forage seeding, planting, and fertilizing; reduction of road density; riparian silviculture; in-channel large woody debris placement; investigate development of log jams and off-channel habitat; road treatments (stabilization, drainage, upgrade, and decommissioning, reduction of sediment production and delivery to the aquatic system). Restoration opportunities for federal lands are also identified within some of the assessment modules in the watershed analysis document. The Vegetation Assessment Module outlines restoration actions that would enhance vegetative processes and structures that have been compromised in comparison with historic levels due to forest management practices. The Riparian Module outlines several types of restoration actions that could be taken to improve riparian conditions. In addition, this module ranks subbasins based on low large woody debris recruitment potential and below-target shade, information that is useful in prioritizing restoration activities.

The Olympic National Forest has conducted a Forest-wide analysis to determine the environmental risks and access needs of its road system. This preliminary information is useful in determining what roads pose the greatest potential risk to aquatic resources and what roads are good candidates for different types of road treatments. The analysis also provides information that is useful in prioritizing road-related work at a Forest-wide scale. The Forest plans to incorporate this information in updating Forest Access and Travel Management plans.

The Olympic National Forest has completed several restoration activities on its ownership within the East Fork and West Fork Humptulips watersheds in recent years. The types of activities implemented include road decommissioning, road stabilization and riparian plantings. In addition, the Forest plans to implement various types of treatments on roads within these watersheds that received damage from flood events that occurred in 1997 and 1999. Specific information on completed and planned restoration actions will be included in the Detailed Implementation Schedule.

Private and State-owned Forested lands

Forested lands not covered under the "20-acre rule" are required to abide by The Forest Practices Rules and the Forest and Fish agreement. The 20-acre exempt rule allows certain small landowners to harvest based on the permanent RMZ rules in effect on

January 1, 1999, while adding 15% to the width of the buffer and to the leave tree count. The Forest & Fish agreement defers implementation of the prescriptions detailed in this TMDL report until 2009. The effectiveness of the Forest and Fish rules will be measured through the adaptive management process and monitoring of streams in the watershed. If shade is not moving on a path toward the TMDL load allocation by 2009, Ecology will suggest changes to the Forest Practices Board. The Forests and Fish Report and the forest practices rules are designed to protect a multitude of natural resources on a statewide basis. Ecology did participate in developing the Forests and Fish Report and the subsequent forest practices rules, and does believe, that on a statewide basis, the rules will put us on a trajectory toward meeting the water quality standards. However, Ecology has stated that we need to test both the assumptions that underlie the Forests and Fish Report and the effectiveness of the rules as they are implemented before we can be certain that this is the case. This is why the adaptive management component of the rules is so important.

For those forested watersheds in which forest practices are done in compliance with the rules, the preparation of TMDLs is a lower priority until 2009. This will give us time to test the assumptions underlying the Forests and Fish Report, to assess the effectiveness of the rules and of the adaptive management process, and to determine some initial water quality trends. This lower priority for preparation of TMDLs was not offered based on any specific prescription. Rather, Ecology believes we will obtain two benefits from the new forest practices rules. First, we will achieve early implementation of many of the same BMPs we believe would be the result of doing TMDLs in forested watersheds. Second, Ecology believes that the forest practices rules, in their entirety, along with a robust and timely adaptive management program (which means that the rules will NOT be static over time), could meet water quality standards in the long term.

State Forest Practices Program: The Forests & Fish Report

The Forests and Fish Report (FFR) is a science-based plan for fish habitat and water quality protection on non-federal forestland in the state of Washington. Federal and state regulatory agencies, Tribes, county government and private landowners negotiated the major elements of the FFR starting in 1997 and ending in the early winter of 1999. The agencies, tribes, landowners, and other key stakeholders developed a plan for forest practices that would meet the following goals:

1. To provide compliance with the Endangered Species Act for aquatic and riparian-dependent species on non-federal forestlands.
2. To restore and maintain riparian habitat on non-federal forestlands to support a harvestable supply of fish.
3. To meet the requirements of the Clean Water Act for water quality on non-federal forest-lands.
4. To keep the timber industry economically viable in the State of Washington.

The *Forests & Fish Report* (FFR) is a consensus recommendation for changes in forest practices statutes, regulations, and management systems to attain the stated goals. The FFR recommends increased resource protection through programmatic and prescriptive standards and guidelines. A primary focus of these new standards and guidelines is to manage riparian vegetation and sediment input to maintain or enhance stream habitats and water quality. The recommendations, which are now incorporated as permanent rules under the Forest Practices Act (76.09), are intended to improve management in several key resource areas, which are listed below. An outline of these factors is presented below. Additional elaboration on each topic may be found in Appendix C.

- **Fish and Stream Classification**
- **Westside Riparian Strategies**
    - ***Fish-Habitat Streams.*** West of the Cascade crest (Westside), fish-habitat streams will be protected with buffers that extend up to a site-potential tree height from the outer edge of the stream or channel migration zone.
    - ***Non-Fish-Habitat Streams.*** Perennial non-fish-habitat streams will receive a 50-foot-wide no-harvest buffer on each side for at least 50 percent of their length

- **Unstable Slopes**
- **Forest Roads**
- **Pesticide Application**
- **Wetland Protection**
- **Other Provisions**
    - **Adaptive Management to Address**

        - The effectiveness of the forest practices prescriptions in meeting resource objectives.
        - The validity of the resource objectives for achieving the overall goals.
        - Basic scientific uncertainties in the ecological interactions among managed forests, in-stream functions, and fish habitat.
        - Support harvestable levels of salmonids;
        - Support the long-term viability of other covered species; or
        - Meet or exceed water quality standards (protection of designated uses, narrative and numeric criteria, and antidegradation)."

    - **Resource Objectives**
    - **Monitoring**

        - **Compliance monitoring**
        - **Effectiveness monitoring and research**

- **Validation monitoring and research**

FFR-based rules Address Heat Energy

The FFR-based rules incorporate the Shade Rule without the distance restrictions imposed by the old rules to substantially increase protection of shade along streams and related habitat conditions on private forestland. The shade management measures include:

- **Shade Rule**
- **Bull Trout Overlay**
- **Riparian Management Zones (RMZs)**
- **Sensitive Site RMZs**.

Protection of Habitat Variables Important to Aquatic Habitat Functions

- ***Prescriptive Rules: Vegetative (Riparian) Management Across the Landscape***.
- ***Prescriptive Rules: Sediment Management Across the Landscape.***
- ***Prescriptive Rules: Hydrology***.

Overall, the FFR-based rules require biologically sound and economically practical regulations that will improve and protect riparian habitat on non-federal forestlands in the Washington. Ecology believes that implementation of the rules will protect water quality and will provide a set of BMPs that will establish a trajectory toward meeting water quality standards where they are not currently being met.

Private Non-Forested Lands

Private non-forest lands are asked to conform to the prescriptions detailed in this report, on a voluntary basis. Several avenues are available to implement these plans. The Humptulips has recently been included in the Conservation Restoration and Enhancement Program (CREP). The CREP program a joint, state-federal land conservation program targeted to address agriculture-related environmental effects. This voluntary program uses financial incentives to encourage farmers and ranchers to enroll in contracts of 10 to 15 years in duration to remove lands from agricultural production. The Gray's Harbor Conservation district has already implemented practices that will aid in meeting prescriptions such as riparian fencing to exclude live stock from the riparian area and riparian re-vegetation efforts. The timing for implementation of BMPs is dependent upon funding.

Monitoring Strategy

Federal Forest Lands

Direction within the Olympic LRMP as amended by the NWFP provides the framework for monitoring implementation of restoration actions on lands administered by the Olympic National Forest. This direction emphasizes coordination and cooperation between various federal, state and local agencies, American Indian tribes and other interest groups. The Forest recognizes that it may take several years following implementation of restoration actions aimed at improvements to the aquatic system to meet the objectives of the action. In some cases, responses to improvements in aquatic ecosystems can be expected in 10 to 20 years. In other cases, it may take decades or possibly more than a century to see the effects of restoration on the aquatic system.

Development of the monitoring strategy for the Upper Humptulips on federal lands will reflect this recognition that it may take several years before responses by the natural system are observable or measurable. The Forest monitoring strategy will include evaluation of short and long-term effectiveness of restoration treatments. Water temperature monitoring will be included as part the strategy and will be designed to collect stream temperature information at strategic locations within the stream network in order to determine compliance with Washington State Water Quality Standards. Forest temperature monitoring efforts will be coordinated with Washington State Department of Ecology and other interested groups. The monitoring strategy will be further described within the Detailed Implementation Schedule.

Private and State-owned Forested Lands; Non-Forested Lands

There are EPA (1991) guidance calls for a monitoring plan for TMDLs where implementation will be phased in over time. The monitoring is conducted to provide assurance that the control measures achieve the expected load reductions. Monitoring can be conducted in three ways. First, the actual water temperature can be measured to test for downward trends. Second, the level of factors influencing temperature (e.g. shade) can be measured. Third, implementation can be monitored to assess the progress on implementation. There are a number of monitoring activities planned that touch on all three types of monitoring:

- In accordance with the Forest and Fish agreement a statewide monitoring plan is being developed by Ecology to assess the effectiveness of the Forest Practice Rules.

- Ecology is developing a statewide effectiveness-monitoring plan to assess the effectiveness of TMDLs.

- The cyclical scoping and assessment process allocates 5 ambient monitoring stations to be placed in the Gray's Harbor Water Quality Management Area.

- The Conservation Reserve Enhancement Program will monitor the amount of land taken out of agriculture for riparian restoration.
- Department of Ecology is coordinating with the USDA Forest Service in the development of a monitoring plan for the Upper Humptulips.
- The Conservation Districts will monitor the amount of riparian corridor restored.

These monitoring activities individually provide valuable information. To effectively evaluate the short and long-term effectiveness of riparian restoration these programs will have to be coordinated and augmented. This will be addressed in the Detailed Implementation Plan.

Adaptive Management

"Adaptive management" is often defined as the reliance on scientific methods to test the results of actions taken so that the management and related policy can be changed promptly and appropriately. Above all it requires clear focus on elements with the greatest uncertainties or risks.

Some TMDL analytical techniques are widely used and applied in evaluating source loading and determining impacts on waterbodies. However, for certain pollutants, such as heat and sediment, the methods used are newer or still in development. The selection of analysis techniques is based on scientific rationale coupled with interpretation of observed data. Without the benefit now of long term experience and testing of the methods used to derive TMDLs, the potential for the estimates to require refinement is quite high. This uncertainty underscores the need for adaptive management. The selection of the margin of safety has clarified the implications for monitoring and implementation planning in refining the estimate if necessary.

A TMDL and margin of safety that is reasonable and results in an overall allocation represents the best estimate of how standards can be achieved.

The TMDL process accommodates the ability to track and ultimately refine assumptions within the implementation component. This TMDL plan allows for future changes in loading capacities and surrogate measures (allocations) in the event that scientifically valid reasons support alterations. It is important to recognize the continual study and progression of understanding of water quality parameters addressed in this TMDL (e.g. stream temperature, sediment, riparian condition). The East/West Humptulips WA addresses future monitoring plans. In the event that data show that changes are warranted in the WA, these changes will be made.

Ecology performs a cyclical watershed scoping for the whole state where each region in the state is divided into five scoping periods. Each year one of these scoping areas is

evaluated and activities are prioritized based on severity of the needs. The Humptulips area will be evaluated again in the year 2006 and then in 2011 and every five-year period after. The effectiveness of management activities will be monitored and adaptive actions will be instituted as needed.

Potential Funding Sources

Federal Forest Lands

The Olympic National Forest has funded restoration activities implemented on lands it administers within the Upper Humptulips in recent years. The types of restoration activities include road decommissioning, road stabilization and riparian plantings. The types of funds used to complete this work include Emergency Repair for Federally-Owned Roads, Supplemental Emergency Flood, 10 Percent, and Appropriated funds.

The Forest plans expenditure of additional ERFO funds to repair damage to roads that received damage from flood events that occurred in 1997 and 1999. Appropriated funds provide a potential source for future projects.

Private and State-owned Forested Lands; Non-Forested Lands

Ecology will provide funds and technical assistance to perform monitoring work necessary to implement the TMDL. The Centennial Clean Water Fund, Section 319 grants under the federal Clean Water Act, and State Revolving Fund (SRF) grants are available to fund activities by jurisdictions to help implementation of the TMDL. Non government organizations can apply to be funded by a 319 grant to provide additional assistance. Ecology will work with the stakeholders to prepare appropriate scopes of work, to implement this TMDL, and to assist with applying for grant opportunities as they arise. The Environmental Quality Incentives Program (EQIP) is a federal cost share program available to all farms.

Reasonable Assurances

Federal Forest Lands

Operational assurance that WQRP will be faithfully carried out falls within several avenues including the Olympic National Forest Land and Resource Management Plan, The Northwest Forest Plan and the Ecology/USFS MOA. These are the regulatory tool for Clean Water Act compliance of forest management activity in Washington State. The Northwest Forest Plan is a federal directive designed to protect the range of the Northern Spotted owl. The Aquatic Conservation Strategy is a major component of the Northwest Forest Plan. This strategy is designed to maintain and restore the ecological health and aquatic ecosystems at the watershed or landscape scale to protect habitat for fish and other riparian dependent species and resources. The Olympic National Forest adheres to the agency responsibilities set forth in the Memorandum of Agreement between the USDA Forest Service, Region 6 and the Washington State Department of Ecology for meeting federal and State water quality regulations. These programs provide reasonable assurance for federal lands that is backed by Federal mandate.

Private and State-owned Forested Lands

For state and privately held forestlands the Forest Practice Rules/Forest and Fish Agreement hold precedence. The Forest and Fish Agreement Provides assurances to land owners that prescriptions detailed under a TMDL will not be implemented until 2009, and then only if the prescriptions detailed in the Forest Practice Rules are not effective in mitigating the caused of a 303(d) listing. Forest and Fish calls for monitoring and adaptive management to modify prescriptions to meet water quality standards. If after 2009 it is found that the forest and fish prescriptions and adaptations do not bring the waterbody into compliance with standard the prescriptions in the TMDL will be implemented.

Non-Forested Lands

For non-forested mixed-use land several entities share an interest in seeing improvements in water quality, soil conservation, and habitat restoration. The Gray's Harbor Conservation District, in cooperation with local ranchers has conducted efforts in riparian management such as riparian fencing, riparian replanting, and fecal coliform water testing. The Humptulips River was added in 2001 to the Conservation Restoration and Enhancement Program (CREP). The CREP program is a voluntary cost share program that encourages landowners to take lands out of production in exchange for financial support. This programs aims to increase bank stability and to restore and enhance habitat. The Local Watershed Planning Program instituted under ESHB 2514 and the Salmon Recovery Program, ESHB 2496, also have limited involvement in the Humptulips watershed. The local watershed-planning program under the direction of the Department of Ecology is tasked with establishing a procedure for controlling stream

flow and has the option to deal with water quality issues. Increasing flow during critical periods has the potential of decreasing temperature. The Humptulips River is one of the waterbodies administered by the Chehalis Watershed Planning group. They are currently studying the possibilities for flow restoration in the basin.

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Appendix A: Public Involvement and Response

Public Involvement and Response

Upper Humptulips River Temperature TMDL

Introduction

The public comment period for this document was for 30 days commencing 30 April 2001 and ending 30 June 2001. The draft document is available on-line via Washington Department of Ecology's web page (http://www.ecy.wa.gov/programs/wq/wqhome.html) and hard copies will be available by contacting Ecology at:

Department of Ecology
Publications
P.O. Box 47600
Olympia, WA 98504-7600
Telephone: (360) 407-7472

The draft will be replaced by the final submittal report when completed.

Public meetings were held on May 16, 2001 in Hoquiam at 1:00 p.m., for principle stakeholders, and Humptulips for the general public at 7:00 p.m. The comments received and the response to comments are included in the final document.

The Department of Ecology placed display ads announcing the comment period in the Aberdeen Daily World on May 6th, 2001. A poster was placed at the Humptulips Grocery on May 2nd. Ecology also direct mailed notice to over 250 people. A major stakeholder meeting/hearing was held at the Hoquiam City Hall May 16th. Ten people attended the stakeholder meeting, representing Grays's Harbor County, DNR, Gray's Harbor conservation district, Rayonier Timber, USFS and Department of Ecology. A public meeting/hearing was also held at the Humptulips Community center Forty-five people (other than Department of Ecology staff) signed in at the meeting.

The following Persons/Organizations provided written comments:

- Robert Meier for Rayonier Timber Company
- Ann Goos for Washington Forest Protection Association
- Brian Erickson for Columbia-Pacific Resource Conservation and Economic Development District
- Mary E. Weed for League of Women Voters Grays Harbor
- Stanley W. Hallett
- Paul Milbourn
- Kurt Loris
- Jim and Joan Stoken

Comments covered a wide range of subjects including past logging, salmon restoration, and government regulations. This response to comments will address those comments having to do with the Draft Water Cleanup Plan.

On the basis of comments received, we have made a number of changes to the draft as we finalized the Water Cleanup Plan. Those changes are noted in the responses below. We will submit the final Water Cleanup Plan for temperature in the Upper Humptulips River to the U.S. Environmental Protection Agency for approval.

The Water Cleanup Plan is a framework for the community-based work needed for water quality improvement. Under the federal Clean Water Act, the Department of Ecology must develop a detailed plan for water quality improvement (called a Detailed Implementation Plan) within one year of EPA's approval of the Water Cleanup Plan. The Detailed Implementation Plan (DIP) will describe specific activities and funding sources for achieving and monitoring water quality standards in the Upper Humptulips River.

There are families who have lived on and cared for the Humptulips River for many years. In a time when people everywhere are feeling the weight of government and other restrictions, the families of the Humptulips River are in a difficult situation. These restrictions have resulted in long-term physical, economic, and social effects on the families living on or near the Humptulips River.

Ecology is aware that this water quality improvement process is yet another burden. We are also aware that the solution to water quality improvement lies with the people of the area.

Although Ecology is required to develop a Detailed Implementation Plan that assures that high temperatures on the upper Humptulips return to acceptable levels, there is flexibility in how those levels are achieved. We are committed to working with the people of the Humptulips area and other responsible agencies and groups to develop the Detailed Implementation Plan. In most of these areas work has already been done - fencing, riparian plantings etc. That work will become the basis of the DIP. We will form an advisory group to help develop the plan. The advisory group will also help to identify and conduct activities to keep other residents of the area informed. We will form the advisory committee and begin work on the Detailed Implementation Plan later this fall.

In the responses below, related comments have been grouped and paraphrased. You may request a transcript of verbal comments and copies of written comments by contacting Chris Peredney, Dept. of Ecology, P.O. Box 47600, Olympia WA 98504-7600, email chpe461@ecy.wa.gov, (360) 407-7241. Comments are divided into those received during the public meetings and those received via e-mail/mail during the comment period. Those presented verbally are not attributed to a particular source but rather to the meeting in which they were presented. The submitter is named in those presented by mail. These comments are not meant to be verbatim, the author has condensed and summarized the comments to reduce the length of the document.

Water Cleanup Plans

Ecology seeks comments on a plan to improve water quality in the Humptulips River Watershed

Issue

The Washington Department of Ecology (Ecology) and partners have completed a draft of the Water Cleanup Plan that identifies strategies for reducing water temperatures and to protect and restore critical habitat in the Humptulips River. The cleanup plan was developed with input from private timberland managers, the Quinault Tribe and state and federal agencies in order to meet federal total maximum daily load (TMDL) requirements.

You are invited to learn about the Plan at a public meeting May 16, 2001. You may comment on the Plan from April 23, 2001 until May 25, 2001. Once the public comment period has ended and Ecology determines how to incorporate the input it receives, the agency will submit the plan to the U.S. Environmental Protection Agency (EPA) for approval. Upon approval by EPA, Ecology will work with landowners, tribes, and agencies on how to best implement the plan.

Background

The Humptulips River Watershed has been actively "managed" by humans for over 100 years. Land use in the Upper Humptulips is predominantly silviculture, including commercial forest owned by Rayonier. Some valley bottomland in the extreme lower watershed consists of small farms.

The headwaters of the Humptulips River originate in the steep Olympic Mountains in the Olympic National Forest. The streams then flow into gradually broadening glaciated river valleys. Salmon, steelhead, and cutthroat trout are present in the Upper Humptulips watershed. Significant fish-bearing streams within the watershed include the East Fork Humptulips and West Forks Humptulips mainstems and key tributaries (Goforth Creek, Flatbottom Creek, Donkey Creek, Chester Creek).

A partnership made up of private timberland managers, the Quinault Tribe and state and federal agencies evaluated the condition of the East Fork and West Fork Humptulips River Watersheds. Water quality sampling indicates that temperatures in the river system

exceed state water-quality standards. Although high water temperatures are the primary concern, sediment in the river and loss of spawning and rearing habitat are also of concern.

Ecology sets water quality standards to protect the beneficial uses, such as swimming, fishing and fish and wildlife habitat, associated with surface waters of the state (lakes, rivers, wetlands, etc). Increased temperatures can reduce the quality of habitat for salmon, steelhead and trout. Typical causes of increased temperatures include roads, riparian vegetation removal and channel widening, as well as timber harvest in sensitive areas outside the riparian zone.

Federal law requires cleanup of polluted waters

Federal law requires states to identify sources of pollution in waters that fall short of water quality standards, and to determine how much pollution needs to be reduced for the water body to remain healthy. Using the source and allocation information, Ecology and local interests develop strategies for achieving the necessary reduction or elimination of pollution. The result is a water cleanup plan or Total Maximum Daily Load (TMDL).

Water Cleanup plan process

Principle partners for the current Water Cleanup Plan process are Ecology, EPA, U.S. Forest Service, and Rayonier Inc. The Watershed Analysis of the East Fork and West Fork Humptulips conducted in 1999 provided the technical basis for this process. Partners used existing temperature data to evaluate the effects of human activities on water temperatures and the effectiveness of possible management strategies.

The Water Cleanup Plan identifies:

- The temperature problems and causes in the watershed.
- Temperature levels required to assure healthy water quality in the creeks and the river.
- The amount of added shade needed to achieve temperature standards.
- Actions for reducing temperature and restoring habitat (Summary Implementation Strategy)
- A monitoring plan to assess effectiveness.

What comes next

After the TMDL is finalized and submitted to EPA for their approval, we will use the cleanup plan to work with landowners and agencies to develop a detailed implementation plan to meet TMDL goals. Current and on-going water quality restoration projects will be incorporated into the detailed plan. Ecology will continue to work with landowners to identify best management practices.

How you can participate

Come to the public meeting May 16, 2001, 7 – 9 PM
Humptulips Community Center, 32 McAfee Rd.

You may also review the draft Plan and the proposed actions for improving water quality and providing comments at the following locations….
OR on the Internet at: www.ecy.wa.gov/biblio/0110022.html

Or call Ann Butler to receive a copy – 360-407-6480

Please send written comments by June 1 to: Chris Peredney
Department of Ecology
Water Quality Program
PO Box 47600
Olympia, WA 98504-7600
or email cper461@ecy.wa.gov

For more information, call Ann Butler at 360-407-6480. For this information in alternative formats of other special accommodations, please call at 360-407-6480 or (360) 407-6066 (TDD).

Meeting Notice May 16 public meeting planned on Humptulips River water cleanup plan

The Washington Department of Ecology (Ecology) will host a public meeting to discuss Humptulips River water cleanup planning from 7 – 9 p.m. Wednesday, May 16 at Humptulips Community Center, 32 McAfee Road.

The public comment period on the plan is May 1 – June 1.

Ecology studies have found that temperatures in the river system exceed state water-quality standards above the U.S. Highway 101 bridge. Increased water temperatures can reduce the quality of habitat for salmon, trout and steelhead. Typical causes of high water temperatures include human practices that remove shade from the watershed, including road building, removal of streamside vegetation, channel widening, and timber harvesting practices.

Besides temperature, the watershed also has sediment problems and declining fish spawning habitat.

Partners in the water cleanup planning effort include Ecology, the U.S. Environmental Protection Agency, the U.S. Forest Service, Rayonier Inc., the Quinault tribe and the Grays Harbor Conservation District.

Copies of the East/West Humptulips River Watershed Temperature Total Maximum Daily Load (Water Cleanup Plan) are available to view at the Hoquiam Timberland Library, 420 7th Street or can be found on-line at Ecology's Web site at http://www.ecy.wa.gov/biblio/0110022.html

To receive a copy of the Water Cleanup Plan and/or if you have questions call Ecology's Ann Butler at 360-407-6480. Written comments should be directed to Chris Peredney, Department of Ecology, by e-mail to cper461@ecy.wa.gov or through the mail at P.O. Box 47600, Olympia, Wash., 98504-7600.

Comments and Responses from the Public Meetings

Humptulips TMDL meeting – May 16, 2001
Hoquiam City Hall 1:30 PM
10 attendees

- **We need to work together more often.**
- **Contact us before you do the technical study, we have up-to-date information to contribute.**
- **As a primary stakeholder, we wanted a preview of TMDL by stakeholders before general public review. Work with us.**
- **There needed to be a broader review and involvement, keeping us up-to-date and including us, we can turn things around quickly.**
- **Skipping a step doesn't speed up the process.**

  The TMDL has been under development for several years. Efforts were made to involve major stakeholders in the TMDL process. The Forest Service was an active partner in the process from the watershed analysis (WA) through the completion of the TMDL. Rayonier was instrumental in the preparation of the WA. Several efforts were made to involve major stakeholders in the completion of the TMDL. Complete meeting notes leading to the completion of the TMDL were submitted to Rayonier. This TMDL was on a "fast track" and is not typical of the pace of other TMDLs, past and future. On future TMDLs all efforts will be made to involve all stakeholder from an early stage. We look forward to working with all of the stakeholders on the formulation of a detailed implementation plan.

- **Will small farmers be asked to do something?**
- **What about non-forested lands, farms and mixed landuse folks?**
- **People are scared that someone from other programs at Ecology will come into our communities with still other regulations after we deal with these.**
- **Residents have already given up so much for other Ecology rules – shoreline rules, Forest and fish, now this TMDL.**
- **Farmers concern – Reduced land base because of ESA can create problems with managing livestock waste.**
- **Concerned that farmers may reach compromise with one law at ECY/EPA and not meet another law, we shouldn't be required to do something for one law and then something incompatible for another law.**

If measures that occur in the upper watershed are not sufficient to deal with the temperature exceedances voluntary compliance with riparian conditions developed as part of Farm plans will deal with conditions in the lower watershed. The Governor's Statewide Salmon Recovery Strategy calls for the development of agricultural conservation standards for protection of resources. This process is designed to meet restoration goals required under the Endangered Species Act (ESA) and hopefully to

meet Clean Water Act (CWA) standards as well. The document that details these procedures is the Field Office Technical Guides (FOTGs) developed by the Natural Resource Conservation Service (NRCS). Currently Several state and federal agencies, as well as tribes, environmental groups and representatives from the agricultural community are meeting to revise these standards as part of the Agriculture, Fish, and Water Process (AFW). The result of this process would be to develop farm plans that deal with issues such as riparian shade, bank stability, and water quality. The desired outcome is to have farm plans that would provide assurances under the CWA and ESA. It is anticipated that through the development of farm plans riparian conditions can be improved resulting in better water quality.

The new procedure in the completion of TMDLs is a single entry into a watershed. TMDLs will cover all parameters in a single effort and present the results and recommendations in a single community involvement effort; this will help to minimize multiple messages. Efforts are being made to involve other programs at the Department of Ecology through the watershed planning groups. This is so that we can coordinate our activities and speak with one voice. We can not however foresee the future, new regulations and the changing needs of the people of the state of Washington, require a constantly evolving process to ensure the highest environmental quality for all citizens. This process may require the refinement of existing rules and the creation of new rules, but all efforts will be made to involve the community in the decision and rule making process.

- **What about forested lands under 20 acres? Forest and fish**

The 20-acre exempt rule states that owners of forest parcels of 20 contiguous acres or less are exempt from the riparian buffer requirements of the forest practices requirements of the Forest and Fish Report. This allows certain small land owners to harvest based on the permanent Riparian Management Zone (RMZ) rules in effect on January 1, 1999, while adding 15% to the width of the buffer and to the leave tree count. However, "20-acre" exemption does not provide the Clean Water Act (CWA) assurances that are provided by complying with Forest and Fish. Small landowners can comply with Forest and Fish and receive CWA assurances or they can implement the allocations detailed in the TMDL to comply with the CWA.

- **The Humptulips TMDL report doesn't give enough weight to forest and fish, the technical merit of forest and fish, and needs to be re-worded.**
- **Forest and fish is the way to go.**

The revised submittal document includes a more comprehensive treatment of the Forest and Fish agreement prepared in cooperation with Ann Goos of WFPA. The Forest and Fish agreement was constructed to be a statewide plan for the management of forested lands. The agreement acknowledges the need for adaptive management if the prescriptions laid out are determined to be insufficient to meet the intent of the document,

to protect terrestrial and aquatic resources within forest lands. Evidence from completed TMDLs and other site-specific information will be used, in cooperation with DNR, to identify sites where additional steps may be necessary to address the potential for water quality standard violation.

Humptulips TMDL meeting – May 16, 2001
Humptulips Community Center 7 PM
45 attendees

Comments, Questions and Responses:

- **How often do we measure Temp?**
- **Where do we measure? How do we do the measurements (depth temp taken)?**
- **There are differences in temp at depth – you should measure more evenly.**
- **How did you choose sites – 101 bridge – to sample for temp? It's much cooler upstream, you selected the wrong site.**
- **How many exceedences?**
- **How many years have you studied this?**
- **Consistent trends in Temp over the years of monitoring?**

There are standard Department of Ecology protocols for the collection of environmental data. The temperature is taken by lowering a calibrated thermistor probe into mid-channel of the sampling location to about .03 meters below the water surface. This method is derived from the standard method developed by the American Public Health Association (1998). The samples are obtained in an area of good flow and mixing. In a river of this size stratification, different water temperatures at different depths should not be present in areas of good mixing. The sample location, highway 101 bridge, was chosen because it provides access to mid-channel without requiring access to private lands. The ambient monitoring program has conducted temperature measurements at the 101-bridge from 1985 to 1996 in this time span 6 exceedances were detected. Sampling was conducted only once a mouth and may have missed many more exceedances. The Watershed Analysis conducted by the Olympic National Forest and Rayonier Timber detected 10 other sites that exceeded criteria on multiple occasions. These exceedances would have been grounds for listing the Humptulips River on the State List of Impaired Waters (303(d) list) if a TMDL was not in progress.

- **What about natural warming of climate?**
- **How do you know that this weather pattern is not natural?**
- **How do we know over the ages that these perfect water temps you propose have ever been met? Maybe over time the temp changes are natural. How can your numbers be valid?**
- **Sampling has only been done for 10 years. How do we know going back is to these water quality standards? What empirical data do you have?**

- **How do we know what the temp has been – historically?**
- **Is this really a problem – we don't believe there is a problem in the Humptulips. We need to see the data that show high temp.**
- **How do you know this standard 60 – 64 F is the correct one?**

State water quality standards are set based upon the best scientific judgment. The TMDL technical study considered the effects of climatological change and if the water quality standards can be met or if "natural" conditions exceed standards. If natural conditions exceed the standard temperature then human activities are only allowed to increase the temperature by 0.3° C.

We do not have data that precedes the settlement of the area by Europeans. In the last 150 year there has been widespread and intensive forestry practiced in the watershed that has effected the stream temperature and stream channel form. Although the conditions may not have changed greatly in the last 50 years this is no indication that the present condition approximates historical natural conditions. Given the past management of the watershed it can be reasonably assumed that there have been changes from natural conditions. The purpose of this TMDL is to restore conditions to a state that allows for a properly functioning ecosystem and to meet State water quality criteria.

- **Where are the major stakeholders? Rayonier and USFS should be addressing temp problems, not us. Their practices are the source of the problem.**
- **If exempt for forest and fish shouldn't have to be under regulatory mandate?**
- **Are standards the same for large and small landowners?**
- **Start the study at the forks of E & W Humptulips and go upstream. Most problems are upstream and not here with small landowners.**
- **Suggest a community-supported program to work with USFS to deal with problem. Maybe we won't need to ask small landowners to change practices.**

The major stakeholders (Rayonier Timber, DNR, Gray's Harbor County, Gray's Harbor CD, USFS, Ecology, et al.) attended a separate meeting in Hoquiam at 13:00 on May 16th 2001. Some did not choose to attend the "public" meeting in Humptulips.

The USFS Olympic National Forest is acting under the Olympic Forest plan as amended by the Northwest Forest Plan. This plan calls for buffer widths that exceed the load allocations suggested in the TMDL, resulting in a large margin of safety. In addition the USFS is involved in an intensive road management program to reduce sediment and control width-depth ratios. The USFS is doing more than is recommended in the TMDL to control temperature. Managers of Rayonier Timber, State of Washington Timber lands, and Gray's Harbor County timber land are acting under the Forest and Fish Agreement and plan to abide by the shade and buffer width guidelines in the Forest Practices manual. Under this agreement they will receive CWA assurances for following practices believed to be sufficient to bring the waters into compliance with the CWA.

The major stakeholders are addressing the temperature problems on their land, which may bring the Humptulips River at the 101-Bridge into compliance. Through

cooperation between the major stakeholders, local citizen landowners, Grays Harbor Conservation District and the Department of Ecology we can address what, if any, actions may be advised on lands managed by each of the involved parties. This procedure should occur during the Detailed Implementation Planning phase. The purpose of the TMDL is to provide guideline to meet water quality standards, not to force people off their land. The Detailed Implementation Plan process will allow people to make decisions about their own land and how to ensure environmental quality while maintaining local quality of life for this and future generations.

- **ESA/CWA what requirements of law? That's what we have to deal with, let's not deal with fish if they aren't present or threatened.**
- **Stop looking for other problems (*parameters*) that may or may not exist – deal with temp.**
- **Were salmon present in these waters?**
- **How many fish and are they & are they threatened?**
- **Haven't seen fish dying or suffering here in the Humptulips**.

The Federal Clean Water Act requires that a TMDL be performed if a waterbody is shown to be out of compliance with state water quality criteria. This TMDL is designed to deal with temperature. There is a separate TMDL affecting the Humptulips for bacteria, *The Gray's Harbor Fecal Coliform TMDL*. When in the process of conducting a scientific study to provide evidence and data for a TMDL, exceedances of other criteria are detected it is required that these exceedances be reported. These additional exceedances may require a separate TMDL study. It is our current policy to conduct and present all of these studies as a comprehensive report. But, if exceedances are detected in the future after the completion of a TMDL report, further studies may be required. Currently there are no listed fish species in the Humptulips. A progressive approach will help prevent species from becoming listed. The allocations developed under a TMDL are at this time voluntary, but if a species becomes listed they will not be. If the species in the Humptulips become listed then Federal regulations will take effect and enforcement will be conducted under the Endangered Species Act. Negative effects of high temperature on fish are not necessary immediately apparent and are not part of the standard. The effects of increased temperature may be subtler than noticeable fish kills, such as decreased size and decreased reproduction.

- There are different requirements for different stream types/fish present or not, etc. Would USFS be the model for riparian buffer?

The Olympic National forest is operating under the Olympic National Forest Plan as amended by the Northwest Forest Plan. This plan calls for buffers that provide shade in exceedance of the load allocations in the TMDL. Private forest lands will be managed under the Forest and Fish agreement which has different buffers than the USFS but in

most cases are expected to meet allocations detailed in the TMDL. The case where Forest and Fish may not meet allocations is in high gradient non-fish bearing streams.

- Are large stakeholders getting paid for restoration work they do after making money on recent logging that has been done here?

Large stakeholders are not eligible for funding such as Conservation Reserve Enhancement Program (CREP), Centennial Clean Water Fund (CCWF), or Stewardship Incentive Program (SIP) for riparian restoration. Local governments and Conservation districts are eligible to receive various funds for riparian restoration and easement leases. This money can then be distributed to local landowners to improve the conditions on their land.

- Sun will impact summer river temperatures no matter how much buffer or how tall it is.

One way that the sun impacts river temperature is by directly striking the stream and heating it. It is true that on some large streams no amount of buffer will completely shade the stream. The purpose of setting allocations for riparian buffer is to attempt to limit the amount of solar radiation effecting stream temperature. By setting reasonable allocations and implementing them we can ensure that stream temperature meets criteria or, at least, that cool refugia exist along the banks.

- Trees grow so slowly, how can you reevaluate progress in water quality in only 9 years – this won't give you an accurate assessment.

The monitoring strategy for Forest and Fish lands is being developed. The approach is to begin monitoring now. Reference watersheds that have management strategies approximating Forest and Fish prescription will be evaluated for effectiveness in meeting criteria. Additionally, in the future, lands that are moving towards Forest and Fish prescriptions will be evaluated to determine if they are on a path to meet criteria.

Comments received via mail/e-mail during comment period

Comments received from Washington Forest Protection Association (Ann Goos)

- Please provide a more detailed description of state and private land management planning including the Forest and Fish agreement, DNRs HCP, and the forest practices rule. The level of detail should match the treatment given to USFS management.

The section on the Forest and Fish agreement in the submittal report has been bolstered with the help of Ann Goos of Washington Forest Protection Association. This section now has a more comprehensive and detail treatment of the protection that non-federal forestland will receive. The HCP performed for all DNR lands is now noted and explained in the text and Appendix C.

- Please explain Ecology's role in developing the Forest and Fish Report (FFR) and the forest practices.

The Forests and Fish Report (FFR) and the forest practices rules are designed to protect a multitude of natural resources on a statewide basis. Ecology did participate in developing the Forests and Fish Report and the subsequent forest practices rules, and does believe, that on a statewide basis, the rules will put us on a trajectory toward meeting the water quality standards. However, Ecology has stated that we need to test both the assumptions that underlie the Forests and Fish Report and the effectiveness of the rules as they are implemented before we can be certain that this is the case. This is why the adaptive management component of the rules is so important.

For those forested watersheds in which forest practices are performed in compliance with the rules, the preparation of TMDLs is a lower priority until 2009. This will give us time to test the assumptions underlying the Forests and Fish Report, to assess the effectiveness of the rules and of the adaptive management process, and to determine some initial water quality trends. This lower priority for preparation of TMDLs was not offered based on any specific prescription. Rather, Ecology believes we will obtain two benefits from the new Forest Practices Rules. First, we will achieve early implementation of many of the same BMPs we believe would be the result of doing TMDLs in forested watersheds. Second, Ecology believes that the forest practices rules, in their entirety, along with a robust and timely adaptive management program (which means that the rules will NOT be static over time), could meet water quality standards in the long term.

- "The proposed TMDLs should describe the effectiveness of the FFR-based forest practices shade rule. Several studies represent that most of the potential shade comes from the riparian area within 75' (23 m) of the channel…"

The allocations in the TMDL do not specify a buffer width. They are shade allocations and are not directly linked to a buffer width. While buffer width is a factor, density, age, and species composition play a large role in determining the shade that is provided. How the allocations will be met is part of the Detailed Implementation Plan. The studies presented as evidence for the sufficiency of 75' buffers were not performed on the Olympic peninsula. One of the papers cited, Lynch et al (1985) concludes that " The Width of these buffer strips {protective buffer strips along perennial and intermittent streams} may vary from site to site, but generally, these strips should be at least 30 m (98 feet) wide on each side of the stream channel. Generally, no logging should occur in this

streamside management zone." This is much more restrictive than FFR practices that allow various management zones with in 30 meters of the stream. The allocations in the TMDL also allow innovative management by not setting prescriptive buffers but rather by setting shade target that can be satisfied by several different management schemes.

- There is an objection to the fact that the Margin of Safety (MOS) is smaller on the FFR lands than on Federal lands.

A more thorough explanation of the reason for differing MOSs is presented in the margin of safety section of the text. The main reason for a larger margin of safety is the factors affecting temperature, other than shade, that result from riparian buffers.

Comments received from Rayonier Timber (Robert Meier)

- "The Washington Department of Ecology played an integral Role in development of the Forest & Fish Rules", "Forest and Fish Rules will meet water Standards"

(See response to WFPA's question on the same subjects (*above*))

- "The Margin of Safety Discussion should be modified"

A more thorough explanation of the reason for differing MOSs is presented in the text. The main reason for a larger margin of safety is the factors affecting temperature, other than shade, that result from riparian buffers.

- "A simple analysis and visualization demonstrates the cumulative protections and adequacy of Forest and Fish"

Rayonier states that based upon analysis of 6 harvest units permitted under Forest and Fish in the Humptulips drainages that it is easy to see why Forest and Fish will be sufficient to meet water quality standards. They go on to equilibrate buffer widths to shade and deduce that a 300' buffer that is 50% harvested is equal to a 150' no cut buffer. They go on to assume that based upon this evidence that Forest and Fish will insure that waters will meet standards.

The TMDL does not make any buffer width prescriptions; it is based solely on shade. The amount of shade that is obtained from a buffer is based not only on width but also on density, stand age and composition. This study was not brought to our attention prior to the comment period and the data has not been provided to allow us to make any appraisal of the aforementioned study. It can not be determine if any conclusions about the effectiveness of Forest and Fish prescriptions can be made with out data from the study. There is no argument that the prescriptions in Forest and Fish are much more protective than prior rules, but only through time and study can it be determined where and under

what conditions the allocations will be sufficient to meet criteria.

- "The TMDL indicated that 303(d) listing of streams in forestland are not needed"

Rayonier states that " The conclusion of the TMDL is that no other restrictions or requirements are likely needed to meet water quality standards support(s) the proposition that DOE no longer needs to make 303(d) listings for streams in forest areas protected by Forest & Fish."

This was not the conclusion of the TMDL. Rather, it was concluded that monitoring would be needed and adaptive management may be required to bring the waterbodies into compliance. During the Watershed Analysis, which was part of the technical study for the TMDL, continuous temperature data loggers were placed in streams on Federal and Private forestland. These loggers recorded temperatures that exceeded water quality standards at 10 sites on private and federal forestlands on multiple occasions during the study. These waterbodies would have been listed on the 303(d) list if they were not detected as part of a TMDL technical study. Federal mandate requires that when an exceedance of water quality is detected it be noted. These additional exceedances will be reported to USEPA for accounting. The Clean Water Act specifies that a TMDL is required to deal with listed waterbodies. Prior to 1998 the "other controls in place" exclusion for listing was accepted allowing waters to avoid being listed or desisted if controls other than TMDLs were in place. This no longer the case and waterbodies will be listed even if controls other than TMDLs are in place. Therefore 303(d) listing will continue to be made and maintained on Forest & Fish lands.

- The TMDL did not provide any evidence that new water quality standards are needed or appropriate.

It is not the purpose or intent of this TMDL to establish the need or propriety of water quality standards. The revision of standards is handled through a separate process with public comment (Triennial Review), Rayonier is encourage to participate in this process.

- WFPA comments should be given considerable weight in the review of this TMDL

The comments from WFPA were noted, commented on and changes were made to the TMDL. Ann Goos (WFPA Director of Environmental affairs) has prepared a comprehensive statement on the Forest and Fish Agreement that will be included in the TMDL.

- "Implementation strategy should be a separate document and is not subject to review by EPA"

Rayonier states that the Summary Implementation Strategy (SIS) should not be included in the TMDL submittal because it will subject the Forest and Fish allocations to EPA scrutiny.

The SIS is required to be an element of the submittal report by a Memorandum of Agreement between Department of Ecology and USEPA Region 10. The SIS is part of the review process; EPA looks for the presence of specific elements. But, the SIS it self is not approved or denied and the TMDL is not approved or denied based on the SIS. The commentator acknowledges the EPA had an active role in the development of the Forest and Fish rules. EPA has already had chance to comment on Forest and Fish prescriptions and EPA will not be assessing the "adequacy" of the Forest Practices rules.

Columbia-Pacific Resource Conservation and Economic Development District (Brian Erickson, Project Coordinator)

- Some of the waterbodies covered by this TMDL may not have salmonid use.

The water quality standards are not based solely on salmonid usage. They are set to protect all beneficial uses (see page seven of the TMDL and WAC 173-201A-030(2)). If they are found to be in exceedance of standard they are listed on the 303(d) list and require that a TMDL be performed.

- On large streams the maximum shade possible may not shade the entire stream

It is true that on wide streams it may be impossible under natural conditions to have canopy cover over the entire stream. The TMDL takes into account the width of the stream and acknowledges partial shading. The purpose of the TMDL is to set loads that minimize solar radiation impacting the stream given natural conditions. This is anticipated to bring the stream into compliance with regulations.

- "If temperature measurements are taken in mainstem and large tributaries, is the(re) data reflecting what is happing to temperature related issues elsewhere?"

The temperature monitoring stations established during the Watershed Analysis and by the Department of Ecology Ambient Monitoring Program were in different stream types from small streams to the mainstem Humptulips on Private and Federal lands. These stations were established to give a good overall picture of water temperatures in the watershed.

- The problems seem to be related to forestry in the upper watershed and not to residents in the lower watershed.

See responses to this question in the stakeholders meeting section

Comments from Private citizens

Stanley W. Hallett

Mr. Hallett Suggest several possible causes of high temperature in the watershed including over cutting, farming, gravel mining, flooding and world warming. He made several suggestions for remedies such as increased buffer zones where needed for shade and bank stability, mandatory replanting for future forest products and planting of rapidly growing species.

Many of these ideas will be used to control the temperature in the watershed. These ideas will be considered in the detailed implementation plan (DIP) and Mr. Hallett is encouraged to participate in the development of the DIP.

Paul Milbourn

Mr. Milbourn addresses three main issues. First that a 50 foot buffer would provide 70% shade of the river and that to achieve more would result in undue hardship. Second, that the desire of ecology is to use temperature as a pretense to convert the watershed into a later successional reserve. Last, that the science behind the TMDL is flawed.

There is no evidence that a 50' buffer would provide 70% in this watershed. The shade that can be provided by a buffer is dependent on several factors such as buffer width, species composition, stand age, stem density, and ecoregion. Site specific data needs to be used to determine necessary buffer widths. The forest and Fish agreement specifies buffer widths for forested land. The formulation of the detailed implementation plan will hope to determine what, if any, changes are recommended for non-forest lands. (*See comments in public meeting responses*)

There is no intent to even suggest that the private lands in the watershed be converted into a late successional reserve (LSR). LSR's are not associated with TMDLs. The USFS will be instituting LSRs on federal lands but it is not necessary or imaginable that these would be required on private lands.

Mr. Milbourn cites several studies by Dr. Robert Beschta and his TEMP-84 model. It appears that Mr. Milbourn believes that this is the model used for this study. We have come a long way in temperature modeling since the initial work of Dr. Beschta. We used a basic heat budget (See page 18 of the Humptulips submittal report) to derive the loads. Inputs in to this heat budget were developed in part by the use of the HeatSource model which has been verified with actual field data (Oregon DEQ's Grande Ronde TMDL. http://waterquality.deq.state.or.us/wq/TMDLs/TMDLs.htm). This method is not a "novel approach" and has been reviewed and accepted by both private timber companies and by Federal resource agencies.

Jim and Joan Stoken, Paul Milbourn, Kurt Loris

Several parties have responded in writing and verbally that there is not a problem in the Humptulips and that the TMDL is a ploy to deprive residents of their property rights.

The intent of this TMDL is to address a scientifically documented exceedance of water quality standards. The prescriptions in the TMDL are targets believed to be sufficient to meet standards. Compliance with these prescriptions is voluntary on private land. We do not intend to deprive anyone of there property rights. We additionally recognize that the residents of the Humptulips area wish to be good stewards of their land and that local citizens have completed many conservation activities. We do not want to impose hardship on the local citizens, rather we want to work with local citizens to determine what activities have been completed and where we can work together to ensure that there is water quality for this and future generations. Private landowners are encouraged to use the temperature targets in the TMDL as information to assist in improving shade.

Appendix B: East /West Humptulips Watershed Analysis

Bound Separately

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Appendix C: Description of Forest and Fish Agreement

By Ann Goos: Washington Forest Protection Association

State Forest Practices Program: The Forests & Fish Report

The Forests and Fish Report (FFR) is a science-based plan for fish habitat and water quality protection on non-federal forestland in the state of Washington. Federal and state regulatory agencies, Tribes, county government and private landowners negotiated the major elements of the FFR starting in 1997 and ending in the early winter of 1999. The agencies, tribes, landowners, and other key stakeholders developed a plan for forest practices that would meet the following goals:

5. To provide compliance with the Endangered Species Act for aquatic and riparian-dependent species on non-federal forestlands.
6. To restore and maintain riparian habitat on non-federal forestlands to support a harvestable supply of fish.
7. To meet the requirements of the Clean Water Act for water quality on non-federal forest-lands.
8. To keep the timber industry economically viable in the State of Washington.

The *Forests & Fish Report* (FFR) is a consensus recommendation for changes in forest practices statutes, regulations, and management systems to attain the stated goals. The FFR recommends increased resource protection through programmatic and prescriptive standards and guidelines. A primary focus of these new standards and guidelines is to manage riparian vegetation and sediment input to maintain or enhance stream habitats and water quality. The recommendations, which are now incorporated as permanent rules under the Forest Practices Act (76.09), are intended to improve management in several key resource areas, which are summarized below:

Fish and Stream Classification

The FFR-based rules will broaden the list of fish covered by the rules and change the classification of streams to expand the area where protection is applied. Under the FFR-based rules, all fish will receive the same protection. The old forest practices rules limited protection to salmon and resident game fish. Also, the new rules will place all streams that provide fish habitat in the same category as streams where fish are currently present. This change will provide equal protection for habitat that may become occupied as fish populations recover. In addition, riparian protection will be extended to the channel migration zones associated with fish habitat streams. These migration areas include off-channel habitat, wetlands, and floodplains that are likely to become part of the stream in the future as natural processes work the stream across the valley bottom.

Westside Riparian Strategies

Fish-Habitat Streams. West of the Cascade crest (Westside), fish-habitat streams will be protected with buffers that extend up to a site-potential tree height from the outer edge of the stream or channel migration zone. This distance is 90 to 200 feet, depending on the productivity of the land near the stream. Timber

management within the buffers is progressively more restrictive in the zones closer to the stream. The riparian strategy consists of three zones. The "core zone" is the 50-foot no-harvest area closest to the stream. The "inner zone" is the area between 50 feet and 80 to 150 feet from the stream. Management in the inner zone is regulated to ensure that desired future riparian conditions grow and develop. The "outer zone" is the area beyond the inner zone. It will be regulated to leave up to 20 trees per acre to protect special sites such as seeps, springs, or forested wetlands, or to provide permanent leave trees to support riparian protection.

Non-Fish-Habitat Streams. The upper reaches of streams typically are not expected to be occupied by fish, but are important because they deliver water, organic matter, and sediments downstream to fish habitat. In the FFR-based rules, these streams fall into two categories, perennial and seasonal streams. Perennial non-fish-habitat streams will receive a 50-foot-wide no-harvest buffer on each side for at least 50 percent of their length. The buffer will be placed at sensitive sites, such as perennial seeps, springs, unstable inner gorge slopes, alluvial fans, and perennial stream intersections. The buffering of special sites may increase the total percentage of buffer length along the perennial non-fish bearing streams. A 30-foot-wide equipment limitation zone on each side will border portions of perennial and all-seasonal non-fish-habitat streams that do not receive 50-foot-wide no-harvest buffers. The equipment limitation zone is designed to protect streambank vegetation, prevent bank erosion, and substantially limit the potential for sediment delivery to the streams.

Eastside Riparian Strategies

East of the Cascade crest (Eastside), riparian strategies are influenced by unique climatic and forest conditions that are different from the Westside. The goals for habitat protection are the same as on the Westside, but the rules differ.

Fish-Habitat Streams. Buffers on fish-habitat streams will extend to at least one site-potential tree height from the edge of the stream or channel migration zone, up to 130 feet. The no-harvest core zone will be 30 feet wide. The restricted inner zone will extend to 75 or 100 feet from the core zone, depending on stream width. Where site-potential tree height is greater than the fixed inner zone width, up to 20 of the largest trees per acre would be left in an outer zone**.** Timber management in the inner zone will be controlled by maximum and minimum tree densities over a range of growing sites to address current and future riparian function and forest health.

Non-Fish-Habitat Streams. Non-fish-habitat streams will receive either a continuous, managed 50-foot buffer where partial-cut management techniques are used, or a no-harvest, discontinuous buffer where clearcut-management techniques are used. The 30-foot equipment limitation zone will apply to portions of perennial streams without a leave-tree buffer and all-seasonal non-fish-habitat streams.

Unstable Slopes

The FFR-based rules require considerable improvements to forest practices permitting processes with the goal of preventing forest practices from causing an increased rate of landslide-related sediment delivery. Improved topographic and geologic mapping will provide landowners and the Department of Natural Resources (DNR) with more accurate tools to predict where landslides may occur. Detailed standards will be established to field-identify the most hazardous areas. Local slope stability issues will be identified through regional efforts following adoption of new rules**.** Resource professionals representing agencies, tribes, and landowners will be trained to recognize potentially unstable slopes and a team of geologists will map hazard areas and assist resource professionals in assessing slope stability issues on the ground.

Forest Roads

The FFR-based rules require that all existing forest roads be improved and maintained to a higher standard for providing fish passage, preventing landslides, limiting delivery of sediment and surface runoff water to streams, and avoiding capture or redirection of surface or groundwater. To accomplish this, landowners will be required to bring all of their forest roads into an approved maintenance plan within 5 years and to complete improvements within 15 years. The rules specify new road construction standards to meet water quality goals. Standards, priorities, and implementation guidelines are recommended by FFR and are included in the forest practices rules and the Forest Practices Board manual.

Pesticide Application

The FFR-based rules require changes in buffering rules and best management practices for the application of forest pesticides, including herbicides, to prevent direct entry into water. There are also rules that limit unintentional damage to riparian vegetation by limiting spraying near riparian management zones.

Wetland Protection

The FFR acknowledges that timber harvest in some forested wetlands may influence the interaction between the wetland and fish-habitat waters. There are recommendations for specific scientific studies to assess the impacts of harvesting in these wetlands. In addition, the FFR recommends improved mapping of wetlands and clarification of existing rules for wetland protection.

Other Provisions

The FFR contains agreement on adaptive management and a number of additional issues covering programmatic changes to forest practice regulation, assurances from regulatory agencies, and funding that are not directly addressed in this review. These issues are essential to the consensus reached by the authors of the FFR and are critical components of the overall system of forest practices regulation.

Adaptive Management The authors of the FFR recognized that current scientific knowledge falls short of providing definitive scientific answers to all of the water quality and fish habitat resource questions. Gaining answers to some of these questions in a timely manner and having confidence that new rules will respond to new findings was a critical element for the federal and state agency agreement on the provisions of FFR. The FFR-based rules established an adaptive management program to address:

- The effectiveness of the forest practices prescriptions in meeting resource objectives.
- The validity of the resource objectives for achieving the overall goals.
- Basic scientific uncertainties in the ecological interactions among managed forests, in-stream functions, and fish habitat.

Under the FFR-based rules, forest practices will be regulated to meet specific biological goals within the context of maintaining the sustainable, economic viability of the timber industry. The biological goals were established at the outset of FFR discussions: "Forest practices, either singly or cumulatively, will not significantly impair the capacity of aquatic habitat to:

- Support harvestable levels of salmonids;
- Support the long-term viability of other covered species; or
- Meet or exceed water quality standards (protection of designated uses, narrative and numeric criteria, and antidegradation)."

Objectives. The FPB established **"**resource objectives", which are intended to meet the overall performance goals. Individual resource objectives have been defined for each key aquatic condition or process affected by forest practices, such as water temperature, large woody debris or fish passage. Performance targets are measurable criteria that define specific, attainable forest conditions or processes for each resource objective. A preliminary list of key research and related resource objectives and performance targets is displayed in Schedule L-1 of the *Forests and Fish Report* (1999) and further refined in Schedule L-2. Both documents are available from the DNR and Ecology.

Monitoring. Monitoring is a key component of the adaptive management program.

Compliance monitoring will answer the question*: Are forest practices being conducted in compliance with the prescriptions contemplated in the FFR-based rules?* The DNR will continue to conduct compliance monitoring as part of the agency's responsibility to administer forest practices rules.
Effectiveness monitoring and research will answer the question*: Will the forest practices rules produce forest conditions and processes that achieve resource objectives within the context of natural spatial and temporal variability inherent to forest ecosystems?* Effectiveness monitoring will be conducted over a sufficient time period to account for forest development toward target conditions.
Validation monitoring and research will answer the question: *Are the resource*

objectives appropriate to achieve the overall performance goals? Monitoring and research is being designed to validate or verify the assumptions underlying the resource objectives.

The effectiveness and validation monitoring and research elements of the adaptive management program are designed to meet a strict set of protocols and standards and will be subjected to peer review to strengthen the value of results.

FFR-based rules Address Heat Energy

The amount of shade needed to meet the temperature standards is defined in the old forest practices rules (i.e., in effect prior to adoption of the FFR-based emergency rules passed in January 2000 and replaced by the FFR-based permanent rules which go into effect on June 30, 2001) (WAC 222-30-040). The shade targets were developed from the Timber Fish Wildlife (TFW) Temperature Study (Sullivan et al. 1990). The targets identify the minimum amount of shade, as measured by canopy cover, needed to maintain water temperature within water quality standards. The shade requirements (i.e., minimum canopy cover) vary by region, water temperature criteria, and elevation.

The FFR-based rules incorporate the Shade Rule without the distance restrictions imposed by the old rules to substantially increase protection of shade along streams and related habitat conditions on private forestland.

Prescriptive Rules: Shade Management Across the Landscape. The FFR recommended, and the FPB approved a set of specific rules for managing shade across the landscape. The forest practices measures are focused to protect resources at locations where water temperature is a concern for water quality and fish and other aquatic resources. The shade management measures include:

- **Shade Rule**—requirements to maintain water temperature in fish-habitat streams.
- **Bull Trout Overlay**—special shade provisions for bull trout habitat in eastern Washington.
- **Riparian Management Zones (RMZs)**—three distinct riparian management zones—the core, inner, and outer zones—for fish-habitat streams that provide more shade with increasing proximity to streams.
- **Sensitive Site RMZs**—tree retention provisions for sensitive sites, priority areas, and aquatic features on perennial, non-fish-habitat waters.

Shade Rule. RMZs on both sides of fish-habitat streams will be managed to provide adequate shade to maintain compliance with temperature standards. The practical application of the Shade Rule requires that if a tree within 75 feet of a fish-habitat stream, or CMZ, is providing shade needed to meet water quality standards, the tree may not be removed (see temperature prediction method of the Forest Practices Board Manual). Under some circumstances, harvest of trees beyond 75 feet may be restricted if they are shown by the methodology to be required to meet the Shade Rule. Furthermore, shade requirements must be satisfied whether or not a stream-adjacent parallel road is present. Shade requirements in the Forest Practices Board Manual will be adjusted if the Department of Ecology changes the water temperature standards.

***Bull Trout Overlay*.** Within the bull trout overlay, all available shade to streams will be retained within 75 feet of the bankfull width or CMZ of the stream (Forest Practices Board Manual). The bull trout habitat overlay includes portions of perennial streams in eastern Washington with bull trout habitat identified by the Washington Department of Fish and Wildlife. The overlay area will be revised as better habitat information becomes available.

Riparian Management Zones (RMZs) and Sensitive Site RMZs. The same rules that require buffers to maintain LWD and litter recruitment will also provide additional shade.

Overall, the Shade Rule will be applied to fish-habitat streams across the landscape as forest practices are conducted. Discontinuous buffers apply to perennial non-fish-habitat streams. Equipment limitation zones apply to seasonally intermittent, non-fish-habitat streams.

Protection of Habitat Variables Important to Aquatic Habitat Functions

Prescriptive Rules: Vegetative (Riparian) Management Across the Landscape. The FFR-based rules allow for silvicultural options for management of large wood and litterfall, in addition to shade, that ensures these inputs where they are needed most and at locations where they can be effective. Rules will provide LWD, shade, and litterfall to streams in relation to channel type and presence of fish habitat by requiring buffers and leave-tree areas for riparian management zones and potentially unstable slopes.

Prescriptive Rules: Sediment Management Across the Landscape. The FFR-based rules specify a list of diagnostic landforms in Washington that are potentially unstable, and an administrative process for identifying, reviewing, and regulating forest practices on potentially unstable slopes, including road construction. The FFR–based rules also require an administrative process for identifying, reviewing, and regulating forest practices that may contribute to fine sediment delivery. In addition to buffers protecting streams from the effects of hillslope erosion and protecting bank stability, stricter standards for long-term road maintenance and improvement plans will ensure that erosion control methods are applied and monitored.

Prescriptive Rules: Hydrology. The FFR-based rules will reduce the undesirable effects on the surface water network by requiring road maintenance and abandonment plans, upgrading existing roads, and constructing new roads to minimize effects on water routing. Rules for perennial streams require the retention of functional riparian areas, including the retention of trees and downed wood around seeps, springs, and forested riparian areas. No-harvest buffers and equipment limitation zones in and around riparian areas, including channel migration zones, will protect the shallow subsurface flows beneath and adjacent to streams. Protection of the hydrological continuity of forested wetlands will be increased by impact avoidance and minimization, and wetland restoration and replacement.

Overall, the FFR-based rules require biologically sound and economically practical regulations that will improve and protect riparian habitat on non-federal forestlands in the Washington. Ecology believes that implementation of the rules will protect water quality and will provide a set of BMPs that will establish a trajectory toward meeting water quality standards where they are not currently being met.