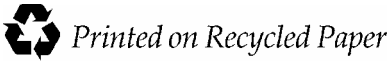
Wind River Watershed Temperature
Total Maximum Daily Load

Detailed Implementation Plan

May 2004
Publication Number 04-10-037



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Prepared by:

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Washington State Department of Ecology
Water Quality Program

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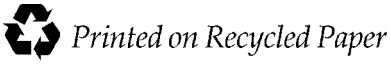

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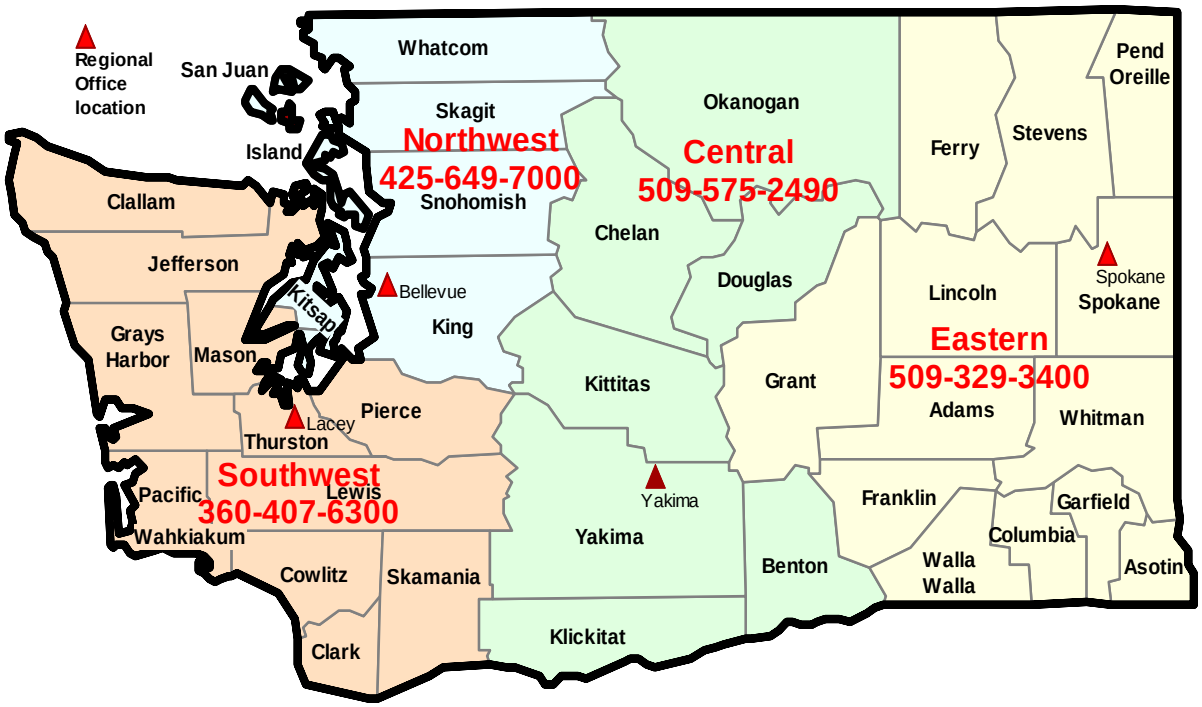

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Introduction

The federal Clean Water Act requires the U.S. Environmental Protection Agency or delegated states to develop water cleanup plans (TMDLs) for rivers, lakes, and streams that fail to meet water quality standards. The Wind River and several of its tributaries are among more than 700 water bodies in Washington State that violate water quality standards.

The Wind River Watershed covers 582 km^2 and supports a fifth-order stream system that discharges to the Columbia River near the town of Carson, Washington, in Skamania County (Figure 1). The 303(d) listings for temperature in streams in the Wind River Basin include Bear Creek, Eightmile Creek, and Trout Creek. Temperatures in the lower portion of Trout Creek have frequently been measured near or above the lethal limit for steelhead of about 24 degrees Celsius. Land uses in this watershed are mainly forest product harvest with some minimal residential use in the lower end of the watershed.

A water cleanup plan to improve temperature violations of the water quality standards in the Wind River Watershed was adopted by the Washington Department of Ecology and U.S. Environmental Protection Agency in August 2002. This water cleanup plan, called a "total maximum daily load" (TMDL), (Wind River Watershed Temperature Total Maximum Daily Load, Submittal Report, June 2002) sets forth the objectives and load allocations for water quality standards in the Wind River Watershed.

As part of an agreement on the implementation of section 303(d) of the federal Clean Water Act, Washington State must prepare a detailed implementation plan which includes a monitoring plan and measures of success.

This document is the Detailed Implementation Plan (DIP) for the Wind River Watershed. The Submittal Report and the earlier Wind River Technical Report, 2002, are available through the Washington State Department of Ecology web site at http://www.ecy.wa.gov/programs/wq/tmdl/index.html. The Wind River Submittal Report is referred to throughout this DIP as the plan. This DIP is based on the technical assessment, and decisions contained in the plan.

It is recognized that the basic requirement of this TMDL is the production of shade by tall trees in the riparian areas of the watershed. A reasonable time to expect sufficient shade to develop is in the order of 50 years or more. Therefore, the schedules and tracking schedules shown in Appendix A were developed to cover that time frame.

Within the portion of the watershed (88%) under Forest Service jurisdiction, restoration objectives and interim benchmarks will be followed as noted in the Gifford Pinchot National Forest (GPNF) Wind River Watershed Water Quality Restoration Plan (FSWQRP).

The basic implementation concept for achieving temperature reductions in the Wind River Watershed is that existing programs and requirements, if fully implemented, should result in meeting the plan targets. This document provides the detail of how monitoring of water quality and implementation activities will be used to track progress as well as indicate when adaptive

management procedures need to be employed. Adaptive management methods will be used to quickly identify whether additional effort or focus from existing programs is needed. If adaptive management methods demonstrate that existing programs are not adequate, new programs and actions will be developed.

The entire available loading capacity has been assigned to nonpoint sources. There are no point source contributors to the temperature pollution violation of water quality standards.

This DIP covers the following waters:

Waterbody	New Waterbody ID Number	Old Waterbody ID Number	1998 List	1996 List	Impaired But Unlisted	Township Range Section	New Added Segment
Bear Creek	EY5OKO	WA-29-1010	X	X		T3N R8E Sec o5	
Eightmile Creek	NC52VG	WA-29-1028	X	X		T4N R 7.5 E Sec 12	
Trout Creek		WA-29-1030		X	X		
Wind River		WA-29-1010			X		
Wind River		WA-29-1020			X		
Panther Creek		WA-29-1026			X		
Cedar Creek	TY64ZW				X	T4N R75E Sec 25	X
Compass Creek	WU14IB				X	T4N R6E Sec 11	X
Crater Creek					X	T4N R6E Sec 11	X
E Fork Trout Creek	WX40oF				X	T4N R6E Sec 11	X
Falls Creek	RN59PJ				X	T5N R7E Sec 21	X
Layout Creek	AT20BK				X	T4N R6E Sec 14	X
Little Wind River	WF20AB				X	T3N R8E Sec 22	X
Martha Creek	TO44CS				X	T4NR7E Sec 27	X
Ninemile Creek	MY17TF				X	T5N R7E Sec 28	X
Planting Creek					X	T4N R7E Sec 19	X
South Fork Falls Creek					X	T5N R7E Sec 24	X

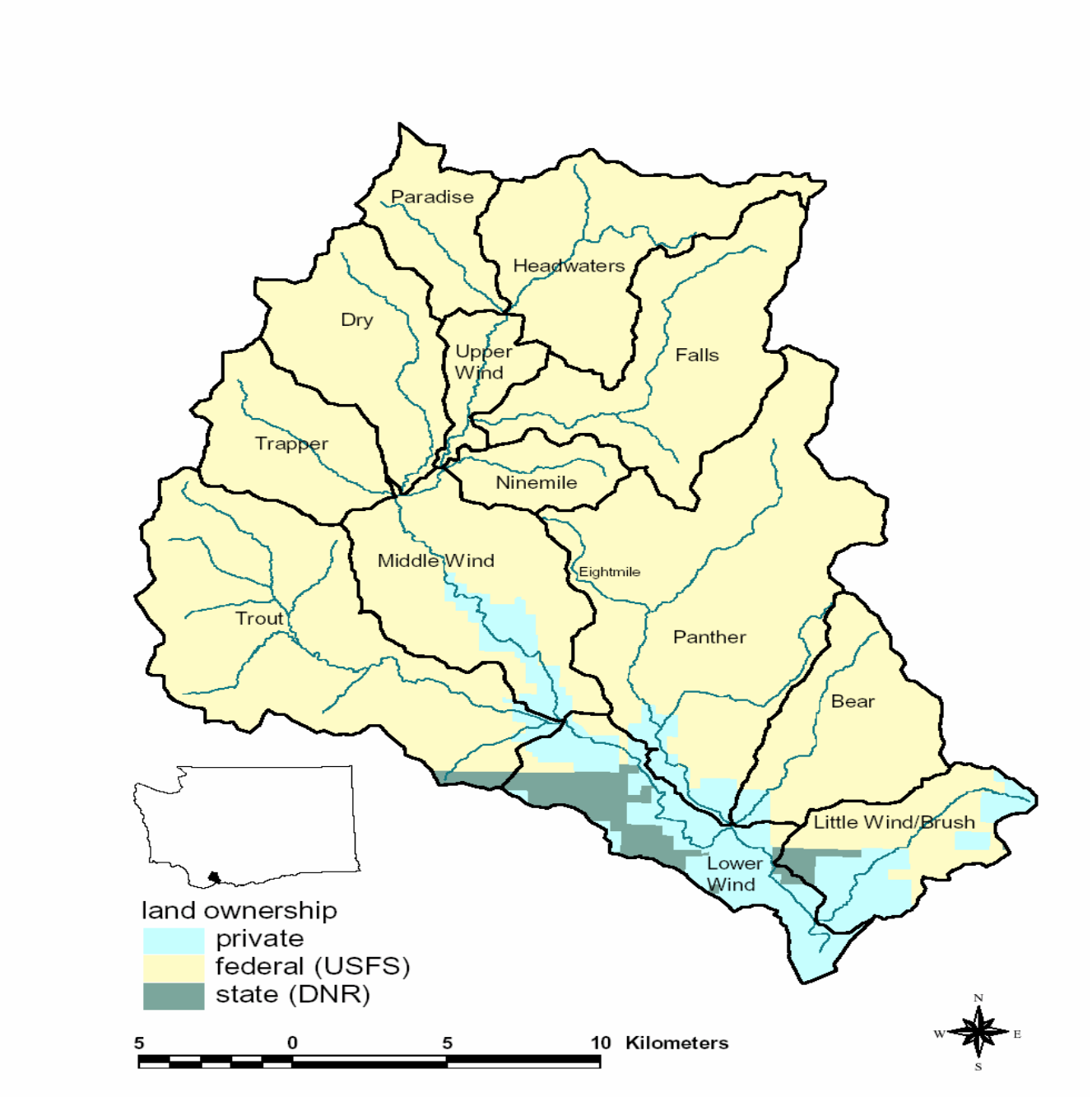

Figure 1. Wind River Land Ownership

The Approach

For the past ten years, the Wind River has been listed on the 303(d) list for temperature violations of the water quality standards. During this time, intensive water quality monitoring at 33 stations in the watershed have led to the development of the plan.

The plan uses effective shade as a surrogate measure of heat flux to fulfill the requirements of the federal Clean Water Act Section 303(d) for a Total Maximum Daily Load for temperature. Effective shade is defined as the fraction of incoming solar shortwave radiation above the vegetation and topography that is blocked from reaching the surface of the stream.

In addition to the load allocations for effective shade, other management activities are recommended for compliance with water quality standards for water temperature, including measures to reduce channel width to depth ratios.

In general, the load allocations for effective shade in the Wind River Watershed are as follows:

- For perennial streams on USFS land, the load allocation for effective shade is the maximum potential effective shade that would occur from mature riparian vegetation. Load allocations for effective shade can be found in the plan and in Appendix B of this document. For other areas on USFS land, the effective shade that would be produced from mature riparian vegetation is greater than approximately 70 percent.
- For perennial streams on non-USFS land, the load allocation for effective shade from riparian vegetation and topography is 70 percent, or shade produced by mature riparian vegetation, whichever is less.

The four stream temperature restoration objectives include the following:

1) Restore shade to limit solar radiation to streams.
2) Restore channel integrity so that low flow channel form avoids increases to stream solar radiation.
3) Limit road related runoff so that channel form can be maintained.
4) Maintain low flow so that temperature is not affected.

The five-year interim benchmarks towards attaining the four restoration objectives are as follows:

1) Enhance shade development in over 150 acres.
2) Restore 15 miles of stream channel.
3) Decommission five miles of road.
4) Determine the affects of the municipal water supply withdrawal on the temperatures of Bear Creek.
5) Establish any Forest Service water right changes as a result of the Wind River Nursery closure.

All cooperators will participate in an annual review conducted each January. The success of the GPNF in meeting the requirements of the FSWQRP will be assessed and future priorities for projects on both private and state-owned lands will be determined.

For privately owned forest land, the riparian vegetation prescriptions in the Department of Natural Resources Forests and Fish Report (April 29, 1999) are recommended for all perennial streams. Load allocations are included in the plan for forest lands in the Wind River Basin in accordance with the section of Forests and Fish entitled "TMDLs produced prior to 2009 in mixed use watersheds." Also consistent with the Forests and Fish agreement, implementation of the load allocations established in the plan for private and state forestlands will be accomplished through implementation of the revised forest practice regulations. The effectiveness of the Forests and Fish rules will be measured through the adaptive management process and monitoring of streams in the watershed. If riparian shade is not progressing toward the load allocation by 2009, Ecology will suggest changes to the Forest Practices Board.

Pollution Sources

Riparian vegetation, stream morphology, hydrology, climate, and geographic location influence stream temperature. While climate and geographic location are outside of human control, riparian condition, channel morphology, and hydrology are affected by land use in the vicinity. Specifically, the elevated summertime stream temperatures attributed to anthropogenic sources in the Wind River Basin result from the following:

- Riparian vegetation disturbance reduces stream surface shading through decreased riparian vegetation height, width, and/or density, thus increasing the amount of solar radiation reaching the stream surface. Several causes of reduced shade include past riparian timber harvest, development for residential housing or recreation, and agricultural uses for orchards and nurseries (Tracy et al, 2001).
- Channel widening (increased width to depth ratios) increases the stream surface area exposed to energy processes, namely solar radiation. Several causes of channel widening include past riparian harvest, splash dams, road building, and harvest related landslides (Tracy et al, 2001). A significant widening of the natural channel for a portion of Trout Creek was caused by the construction of Hemlock Dam. The shallow reservoir created by Hemlock Dam is approximately 180 meters wide and 430 meters long with little shading at the margins. Widening of the near-stream disturbance zone (NSDZ) throughout the Wind River Watershed also decreases the effectiveness of potential shading from near-stream vegetation.
- Reduced summertime base flows may result from instream withdrawals and hydraulically connected groundwater withdrawals. Reducing the amount of water in a stream can increase stream temperature (Brown, 1972). Within the Wind River Watershed, the cumulative water rights of significant magnitude to alter low flows and consequently affect stream temperatures exist in the Trout Creek, Bear Creek, middle Wind River, and lower Wind River Watersheds (Tracy et al, 2001).

It is estimated that water quality standards will be met within 50 years of the establishment of the trees that will produce the shade that is the primary tool to reduce water temperature.

Organizational Responsibilities

The following is a description of the key agencies, which are cooperating on the implementation of the plan, along with other groups that have influence, regulatory authority, involvement, or other controls that will be incorporated into a coordinated effort to implement the water cleanup plan.

1. Skamania County

Current and anticipated federal Endangered Species Act (ESA) and Clean Water Act stormwater requirements are placing more demands on state and local governments for staffing and resources. Stormwater management represents a significant funding challenge for local and state governments as well as a potential outstanding liability due to third party actions.

Skamania County has received a grant from Ecology to carry out the watershed planning authorized by RCW 90.82. This law established the watershed planning process including water quantity, quality, habitat, and in-stream flow issues. Wind River will have such a plan developed in conjunction with this process by May 2005.

Skamania County is currently reviewing the problems with stormwater in the Carson area, using Ecology grant funds. A consultant's report with recommendations for action was completed in February 2002. County commissioners are reviewing the report and implementation may begin soon.

Within the watershed, the county has received an Ecology grant for the Stabler Area Water Quantity and Quality Study. This study will assess surface and groundwater interactions, sources of water quality contaminants such as leaking septic systems, and impacts of future water withdrawals on surface and ground water levels in the Stabler area. In addition, the project will establish a long term water quality and quantity monitoring program for the area. The project was completed late in 2003. As the result of the study further monitoring and study will be required to reach more definitive results. This second phase study will be started once funding is acquired.

An additional effort funded by Ecology that affects water quality at the mouth of the Wind River is the development of a Skamania County Aquatic Weed Plan. Eurasian water milfoil is known to slow water currents, reduce dissolved oxygen levels, and raise water temperatures in infested water bodies. Development and implementation of a control plan will benefit Wind River water temperatures. This project should be complete by late 2004.

2. Underwood Conservation District

The Underwood Conservation District (UCD) works closely with Ecology, the U.S. Department of Agriculture, and the Natural Resource Conservation Service (NRCS) in developing resource management plans. The UCD also provides education and technical assistance to landowners. Landowners receiving a Notice of Correction or a formal enforcement action frequently get assistance from the UCD to achieve compliance.

The UCD has received funding from Bonneville Power Administration to provide services to the Wind River Watershed Council (WRWC). The WRWC meets monthly to consider and prioritize stream restoration projects. All of these projects have a direct impact on water temperature conditions in the Wind River Watershed. The UCD also maintains a network of water temperature recording devices in the Wind River Watershed in conjunction with the Forest Service and US Geological Service (USGS). These recording devices have provided the data used in the Wind River Technical Report and are expected to be maintained in the future.

3. USDA Natural Resource Conservation Service

The USDA Natural Resource Conservation Service (NRCS) provides the guidance and general standards and specifications used in developing farm plans. Best management practices (BMPs) developed in Field Technical Guides are included in farm plans to protect water quality. Examples of BMPs are tree planting in the riparian area to shade the stream. The NRCS administers cost-share money that is frequently used by farmers for farm improvements. The NRCS will help Ecology and UCD evaluate the effectiveness of the BMPs as they are implemented in the Wind River Watershed. This work will occur during the same time frame as the UCD work.

4. Gifford Pinchot National Forest

The Gifford Pinchot National Forest (GPNF) completed a Wind River Watershed Water Quality Restoration Plan (WQRP) in October 2001. This plan spelled out four stream temperature restoration objectives. As actions to meet these objectives are carried out, there will be coordination with Ecology to assess the success and/or need for further actions.

The GPNF will continue to follow the mandates concerning riparian reserves as outlined in the Northwest Forest Plan. It is also cooperatively conducting a water quality monitoring program and provides data to the UCD and other area partners.

5. Washington State Department of Natural Resources

The Department of Natural Resources (DNR) is responsible for implementing the Forest and Fish Report (FFR) as described on pages 13 through 15 of the Technical Report (available at http://www.ecy.wa.gov/programs/wq/tmdl/index.html). Briefly, the DNR and Ecology are committed to working together to identify those site-specific situations where reduction of shade has the potential for or could cause material damage to public resources. We work with the private timber land owner to develop BMPs for maintaining roads and other silvicultural practices. If by 2009 BMPs effective for implementing this plan are not in place, Ecology will notify the State Forest Practice Board for further action. Resource Maps (RMAPS) for each landowner are developed and reviewed on an annual basis to determine effectiveness.

6. Lower Columbia Fish Recovery Board

Established in 1998 by state law, the Lower Columbia Fish Recovery Board (LCFRB) encompasses five counties in southwest Washington: Clark, Cowlitz, Lewis, Skamania, and Wahkiakum. The 15-member board is comprised of representatives from the Washington State Legislature, city and county governments, the Cowlitz Tribe, private property owners, hydro-project operators, the environmental community, and concerned citizens. Its goal is to forge a broadly based regional partnership to return fish populations to healthy levels.

State law directs the board to:

- Participate in the development of a regional fish recovery plan, particularly habitat recovery measures. In doing so the board is to coordinate with local governments, the state, and the National Marine Fisheries Service.

- Assess the factors for decline of salmon and steelhead on a "stream-by-stream" basis.

- Implement the local government responsibilities for habitat restoration and preservation, including prioritizing and approving projects and programs, and receiving and disbursing funds.

7. Washington State Department of Ecology

Ecology has been delegated authority by EPA to implement many aspects of the federal Clean Water Act. This includes the Total Maximum Daily Load program. Ecology maintains a watershed coordinator in the Vancouver Field Office with responsibility to work with all the partners to implement the plan. In January of each year, the Ecology watershed coordinator will receive annual reports from all partners and conduct a meeting of the partners to discuss accomplishments and set direction for the next year's activities. This will include a review of the schedules laid out in Appendix A and consideration of effectiveness monitoring and enforcement actions.

Ecology works closely with the UCD and NRCS identifying and prioritizing referrals in the Wind River Watershed for resource management planning.

Management Roles, Activities, and Schedules

Agency	Abbreviation	Activity	Sources	Schedule	Performance Measures
Department of Ecology	Ecology	**Education** Report on Wind River TMDL implementation. **Financial Assistance** Provide funding through 319 funds, Centennial Grants, and State Revolving Loan Funds. **Effectiveness Monitoring** Provide assurance that control measures put in place during implementation achieve the expected load reductions. **Enforcement** Enforce state Water Pollution Control Act (RCW 90.48).	Timber management practices on forest lands.	Annually Every five years starting in 2007.	Interim targets as identified in Appendix A are met. Water quality standards met in watershed
Skamania County	County	**Education** Implement proposed forest conversion ordinance after approval by DNR and Ecology. Developing watershed plan with funding from Ecology. Developing storm water program for Carson area. Pursuing funding from Ecology and LCFRB for controlling road related landslides into Wind River.	Road runoff and landslide sediment impacts in lower part of Wind River.	As funding is available. This plan will be complete in 2005. County Commissioners developing plan for adoption in 2004. Projects are developed and funding is requested on an annual basis from BPA. This is one of the principle products of the Wind River Watershed Council.	Maintaining adequate width to depth ratios in Wind River.

Agency	Abbreviation	Activity	Sources	Schedule	Performance Measures
Underwood Conservation District	UCD	**Education** Provide technical assistance to farmers in the form of farm plans. Maintain water quality monitoring program.	Road runoff and landslide sediment impacts in lower part of Wind River.	Annual reports to Ecology by Underwood Conservation District on status of farm plans.	Number and location of farm plans implemented. Temperature reports submitted annually to Ecology.
Natural Resource Conservation Service	NRCS	**Education** Provides technical guidance for UCD. Provides technical and financial assistance to farmers.	Road runoff and landslide sediment impacts in lower part of Wind River. Annual cycle.	Local working group every fall, chaired by NRCS, determines priorities for projects in watershed. Fund priority projects.	Annual report detailing number of farm plans developed and implemented.
Gifford Pinchot National Forest	GPNF	Maintain water quality monitoring program. Implement Wind River Watershed Analysis and Restoration Plan.	Timber management practices on forest lands.	Annual Reports to Ecology.	Interim targets as identified in Appendix A.
Department of Natural Resources	DNR	Implement Forest and Fish Act requirements with private forest landowners. Develop RMAPS.	Timber management practices on forest lands.	Annual reports to Ecology.	Interim targets as identified in Appendix A
Lower Columbia Fish Recovery Board	LCFRB	During development of the various fish recovery strategies provide data on stream restoration needs.	Timber management practices on forest lands.	Recovery srrategies in place by May 2005.	Stream restoration projects developed, funded, and implemented.
Geological Survey	USGS	Maintain water quality monitoring program.	Timber management practices on forest lands.	Annual Reports to Ecology.	Biological reports on fish survival factors including water quality issues.

Performance Measures and Targets

It is recognized that the basic requirement of this TMDL is the production of shade by tall trees in the riparian areas of the watershed. A reasonable time to expect sufficient shade to develop is in the order of 50 years or more. Therefore, the schedules and tracking schedules shown in Appendix A were developed to cover that time frame.

For Forest Service lands in the Wind River Watershed, this DIP relies on the implementation of the USFS Water Quality Restoration Plan (WQRP). The Memorandum of Agreement (MOA) between Ecology and USFS requires annual reporting by USFS to Ecology for WQRPs. Given this, both agencies can evaluate work conducted by the USFS under the Wind River DIP as part of the annual reporting requirements of the MOA. If the MOA terminates, Ecology's Vancouver lead will facilitate annual meetings with organizations indicated here-in to review the status of progress.

Appendix B provides the detail for performance targets and schedules. During the first five years of this DIP, the basic work will be done to develop the baseline for the data required to establish if targets are being met.

For privately owned land, the effective shade that would be produced by the riparian vegetation prescriptions in the Forest and Fish Report (FFR) is the load allocation for shade from vegetation. The effective shade that would result from the buffers that are prescribed in the Forest and Fish Report are expected to result in actual effective shade of greater than 70 percent, except where site potential shade is less than 70 percent. Load allocations are included in this TMDL for forest lands in the Wind River Basin in accordance with the section of Forest and Fish entitled "TMDLs produced prior to 2009 in mixed-use watersheds". Also consistent with the Forest and Fish 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 Forests 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.

For USFS land, the effective shade that would be produced by the specified riparian reserves in the Northwest Forest Plan is the load allocation for shade from vegetation. In addition to the load allocations for effective shade, the following management activities are recommended for compliance with the water quality standards for water temperature:

- Reduction of sediment loading to the Wind River and its tributaries is recommended according to the Water Quality Restoration Plan (Tracy et al, 2001).

- Removal of Hemlock Dam in the Trout Creek watershed is recommended to reduce stream widths and increase effective shade.

- Channel restoration projects are recommended according to the Water Quality Restoration Plan (Tracy et al, 2001) to also reduce stream width-depth ratios and reduce the width of the near-stream disturbance zone.
- Reduction of consumptive water use withdrawals are recommended according to the Water Quality Restoration Plan (Tracy et al, 2001).
- Decommissioning of forest roads is recommended according to the Water Quality Restoration Plan (Tracy et al, 2001) to reduce runoff and sediment loading from roads and improve channel conditions.
- Special studies of Bear Creek are recommended according to the Water Quality Restoration Plan (Tracy et al) to determine the relationship between water withdrawal by the city of Carson and water temperature in Bear Creek. Special studies should also be conducted to characterize the channel geometry, and determine the flow and temperature of distributed inflows along the reach downstream from the USFS temperature station.

Monitoring Plan

Department of Ecology Effectiveness Monitoring

The purpose of effectiveness monitoring is to provide assurance that control measures put in place during TMDL implementation achieve the expected load reductions. Ecology is responsible for determining, through effectiveness monitoring, the status of water bodies subsequent to the development and implementation of each TMDL. The timing of this monitoring will be dependent upon the pollution parameters addressed in the TMDL, the period after which positive results should be identifiable, and the availability of resources. Effectiveness monitoring priorities will be selected by each regional office and verified through the annual scoping process to begin approximately five years subsequent to the approval of this TMDL.

In order to be thorough in accomplishing this task, monitoring personnel will follow a review sequence. The sequence will include consultations with the original TMDL modeler to determine critical parts of the implementation plan and to verify critical locations. They will also contact the regional office TMDL coordinator to learn the results of implementation monitoring and the status of the TMDL implementation plan. Both monitoring and regional staff will make an effort to identify a local partnership to assist with the actual data collection. On completion of these steps, an examination of the resulting data will be made and a water quality status determination will be announced for the water body in an advisory memorandum followed by a technical report.

Part of the effectiveness monitoring will be to ensure we are getting closer to achieving the effective shade targets. The monitoring provides useful information about the current riparian age and species composition of the watershed. However, the current information does not translate well into Geographic Information System (GIS) for incorporation into the heat budget analysis. The analysis tools that can derive the actual effective shade for comparison to the effective shade targets are presently being developed and perfected.

Federal Forest Land – (United States Forest Service)
Watershed Water Quality Restoration Plan

Direction within the Gifford Pinchot National Forest (GPNF) as amended by the NWFP provides the framework for monitoring implementation of restoration actions on lands administered by the GPNF. This direction emphasizes coordination and cooperation between various federal, state and local agencies, American Indian tribes, and other interest groups.

The GPNF 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 from restoration of the aquatic system. Monitoring conducted in the Wind River on GPNF lands will reflect this recognition that it may take several years before responses by the natural system are observable or measurable.

The GPNF monitoring approach will include evaluation of short and long-term effectiveness of riparian restoration treatments. Water temperature monitoring is included as part of the strategy and is designed to collect stream temperature information at strategic locations within the stream network in order to determine compliance with Washington State Water Quality Standards set for temperature. Forest temperature monitoring efforts will continue to be coordinated with Ecology, USGS, and the Underwood Conservation District.

Private, County, and State Owned Forest Land

The FFR riparian effective shade levels can be reviewed in coordination with review of new aerial photos. This could be performed in approximately five- or ten-year intervals. The Road Maintenance and Abandonment Plans (RMAP) are reviewed on an annual basis.

To gain further knowledge and to start compliance monitoring, the USGS, GPNF, and UCD have continued to deploy temperature data loggers in most of the previous locations on private and federal lands. This collaborative temperature monitoring will be reviewed on an annual basis. The next comprehensive temperature study will be in 2008.

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 water bodies. 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.

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 that there is continual study and progression of understanding of the original plan. The GPNF Watershed Water Quality Restoration Plan and this DIP address future monitoring plans. In the event that data shows that changes are warranted, these changes will be made. This determination will be done by all the partners as part of the annual review process conducted by Ecology.

Enforcement

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

Reasonable Assurances

Federal Forest Lands

Operational assurance that the Northwest Forest Plan (NWFP) will be carried out are provided by the GPNF Land and Resource Management Plan, the NWFP, and Ecology/USFS MOA. These are some additional regulatory tools to ensure 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 GPNF 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 are backed by federal mandate.

Private, County, and State Owned Forested Lands

For state, county, and privately held forestlands, the FFR that is now contained within the Forest Practice Rules (WAC 222) holds precedence. Forest and Fish calls for monitoring and adaptive

management to modify the watershed analysis prescriptions to meet state water quality standards (if needed).

In addition to complying with FFRs, Washington State trust lands managed by the DNR must comply with provisions of their federally approved Habitat Conservation Plan (HCP). This is a multi-species conservation strategy to provide habitat for animal species of concern and other unlisted animal species. The HCP covers strategies for the protection of fish species (listed salmon, steelhead, and native trout), amphibians, arthropods, mollusks, mammals, birds, and reptiles.

Non-Forested Lands

For non-forested mixed-use lands, several entities share an interest in seeing improvements in water quality, soil conservation, and habitat restoration. The Underwood Conservation District, in cooperation with local landowners, has conducted efforts in riparian management such as riparian replanting. The local watershed planning program has been instituted under ESHB 2514 and the Salmon Recovery Program, ESHB 2496, by the Lower Columbia Fish Recovery Board. The local watershed-planning program under the direction of the Department of Ecology is tasked with establishing a procedure for controlling stream flow and improving water quality and riparian habitat. Increasing flow during critical periods has the potential of decreasing temperature.

Public Involvement

The Wind River Detailed Implementation Plan (DIP) was presented at public meetings of the Wind River Watershed Council (WRWC) and the Wind River Technical Advisory Committee (WRTAC). The WRWC was formed in 1996 to address concerns about the condition of natural resources within the Wind River Basin. Members include local landowners, business owners, citizens, tribes, advocacy groups, recreational users, and resource managers from government and private entities. The WRWC holds monthly meetings to address water issues, develop stream restoration projects, secure funding, and review proposals to improve water quality and quantity in the Wind River Watershed. Monthly notices of WRWC meetings are sent to the Pioneer, the weekly newspaper for the area.

The WRWC receives technical support through the WRTAC which formed in 1994. Due to the small population in the watershed, under 1,000, these groups are very inclusive and representative of the watershed. Over 90 percent of the watershed is in the GPNF and they are well represented in the review of these documents. Yakama tribal representatives were present at the meetings noted below and an invitation to have a special presentation for the tribe was given to them. No meeting was requested and no written comments from the tribe were received.

The draft DIP was presented to several meetings of the WRWC. These meetings occurred on November 20, 2002, and March 19, 2003. A final draft was submitted to the WRWC on June 16, 2003. Members of the WRTAC were also in attendance. Comments received at all of these meetings were incorporated in the DIP.

Funding Opportunities

Centennial/Salmon Recovery Fund/319 – These three funding sources are managed by Ecology through one combined application program. Funds are available to public entities as grants or low-interest loans. Grants require a 25 percent match. They may be used to provide education/outreach, technical assistance for specific water quality projects, or as seed money to establish various kinds of water quality related programs or program components. Grant funds may not be used for capital improvements to private property. However, riparian fencing, riparian revegetation, and alternative stock water are grant eligible.

Low-interest loans are available to public entities for all the above uses. They have also been used as "pass-through money" to provide low-interest loans to homeowners for agricultural best management practices. Loan money can be used for a wide range of improvements on private property, for instance:

Conservation Reserve Enhancement Program (CREP) – Provides incentives to restore and improve salmon and steelhead habitat on private land. This is a voluntary program to establish forested buffers along streams where streamside habitat is a significant limiting factor for salmonids. In addition to providing habitat the buffers improve water quality and increase stream stability. Land enrolled in CREP is removed from production and grazing under 10-15 year contracts. In return landowners receive annual rental, incentives, maintenance, and cost-share payments. The annual payments can equal 100 percent of the weighted average soil rental rate (incentive is 110 percent in areas designated by Growth Management Act).

Conservation Reserve Program (CRP) – A voluntary program that offers annual rental payments, incentive payments for certain activities, and cost-share assistance to establish approved cover on eligible cropland. Assistance is available in an amount equal to or not more than 50 percent of the participant's costs in establishing approved practices - contract duration between 10-15 years. The CRP is administered through the Underwood Conservation District.

Environmental Quality Incentives Program (EQIP) - This federally funded program is administered by the NRCS. This program:

- Provides technical assistance, cost share payments, and incentive payments to assist crop and livestock producers with environmental and conservation improvements on the farm.
- Provides $5.8 billon over the next 6 years (nationally).
- Allows 75 percent cost sharing but allows 90 percent if producer is a limited resource or beginning farmer or rancher.
- Distributes program funding 60 percent for livestock-related practices, 40 percent for cropland.
- Supports contracts that are 1 to 10 years in duration.
- Sets no annual payment limitation; sum not to exceed $450,000 per individual or entity.

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

- You own land as an individual or as part of a partnership, corporation, or other nongovernmental legal entity.
- You own : a.) own one parcel of more than 20 continuous acres, or b.) a parcel of less than 20 acres as part of a total ownership of multiple parcels in Washington State that together total more than 80 acres.
- You have timber next to a river, stream, lake, pond, or wetland that you plan to harvest in the near future.
- You historically have not harvested an average of more than 2 million board feet of timber each year from all of your ownerships.
- The state has access to the property by foot or vehicle.
- There are no hazardous substances.

2514 Planning Unit for Water Resource Inventory Area (WRIA) 29 – Through this planning process, citizens and agencies are evaluating and making recommendations for the water resources in the Wind River Watershed (WRIA 29). Implementation funding was provided by the last session of the Washington legislature for various purposes, including some funds for water quality related projects.

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

Wetland Reserve Program (WRP) – A voluntary program to restore and protect wetlands on private property (including farmland that has become a wetland as a result of flooding). Landowners can receive financial incentives to enhance wetlands in exchange for retiring marginal agricultural land. Landowner limits future use of the land, but retains ownership, controls access, and may lease the land for undeveloped recreational activities and possibly other compatible uses.

Title II - The Secure Rural Schools and Community Self-Determination Act of 2000 allows 50 percent of all Title II project funds be used for road maintenance or abandonment, and for the restoration of streams and watersheds. The overarching intent of Title II is to foster local creativity and innovation with regard to the projects that participating counties and resource advisory committees (RAC) recommend. Projects are reviewed and ranked by the RAC. RAC must submit project proposals to the Secretary of Agriculture concerned no later than September

30 for fiscal year 2001 and each September 30 thereafter for each succeeding fiscal year through fiscal year 2006.

References Cited

Howard, D. 2002. Wind River Temperature TMDL Submittal Report. Washington State Department of Ecology, Vancouver, Washington

Pelletier, G. 2002. Wind River Watershed Temperature TMDL Technical Report. Washington State Department of Ecology, Lacey, Washington

Tracy, R., B. Coffin, J. Forsberg and I. Ward. 2001. Wind River Watershed, Water Quality Restoration Plan. Gifford Pinchot National Forest. U.S. Forest Service

USFS (U.S. Forest Service) 1996. Wind River Basin Watershed Analysis. Wind River Basin Watershed Analysis. Wind River Ranger District, Carson, Washington

Appendix A
Schedules and Tracking

Schedules and Tracking

In an attempt to predict and project future successes in the Wind River watershed, the following tables contain interim target elements that take a conservative estimate of implementation that is reasonably expected to occur during the life of the TMDL (2002-2052) It is based on planning and funding sources that have been identified at the time this document was completed. Much of the "goal" column has been left unfilled in several tables as future funding sources are unknown; these columns should be filled in over time as plans develop and funds are located. Additionally, note that all projections for voluntary stewardship actions are dependent on availability of appropriate funding to complete implementation at the level estimated. If in a given year all funding for any type of voluntary implementation becomes unavailable after reasonable efforts have been made to secure such funding, then that type of voluntary implementation may be considered unavailable for that year. Changes to this plan will occur after an annual review conducted by Ecology and the cooperators as identified in the earlier section on organizational responsibilities.

1. Enhance shade development on at least 150 acres.

Table A-1: Shade Development

Year	Acres of trees planted in riparian areas		Percent Achievement
	Goal	Result	
2007	150 acres		
2012	150 acres		
2017	150 acres		
2022	150 acres		
2027	150 acres		
2032	150 acres		
2037	150 acres		
2042	150 acres		
2047	150 acres		
2052	150 acres		

2. Restoration of Stream Channel.

Table A-2: Restoration of Stream Channel

Year	Miles of stream channel restored		Percent Achievement
	Goal	Result	
2007	15 miles		
2012	15 miles		
2017	15 miles		
2022	15 miles		
2027	15 miles		
2032	15 miles		
2037	15 miles		
2042	15 miles		
2047	15 miles		
2052	15 miles		

3. Road decommissioning by USFS, state and private timber owners.

Table A-3: Road Decommissioning

Year	Road decommissioning		Percent Achievement
	Goal	Result	
2007	Decommission 5 miles of forest roads		
2012	Decommission 5 miles of forest roads		
2017	Decommission 5 miles of forest roads		
2022	Decommission 5 miles of forest roads		
2027	Decommission 5 miles of forest roads		
2032	Decommission 5 miles of forest roads		
2037	Decommission 5 miles of forest roads		
2042	Decommission 5 miles of forest roads		
2047	Decommission 5 miles of forest roads		
2052	Decommission 5 miles of forest roads		

4. Road improvements to forest roads. Best management practices (BMPs) for sediment control implemented by USFS, state and private timber owners. This will implement the recommendations of the Forest and Fish Report.

Table A-4: Road Improvements

Year	Road improvements and maintenance		Percent Achievement
	Goal	Result	
2007	**BMPs in place on 10% of watershed forest roads**		
2012	**BMPs in place on 10% of watershed forest roads**		
2017	**BMPs in place on 20% of watershed forest roads**		
2022	**BMPs in place on 30% of watershed forest roads**		
2027	**BMPs in place on 40% of watershed forest roads**		
2032	**BMPs in place on 50% of watershed forest roads**		
2037	**BMPs in place on 60% of watershed forest roads**		
2042	**BMPs in place on 70% of watershed forest roads**		
2047	**BMPs in place on 1 80% of watershed forest roads**		
2052	**BMPs in place on 90% of watershed forest roads**		

5. Bank stabilization. Stabilization actions, such as installation of revetments and barbs, will be completed by NRCS, UCD, and others. Funding will be provided by Bonneville Power Administration, Ecology, and others. Individual landowners should not attempt to install bank stabilization structures without first seeking professional advice from one of the resource advisory agencies (NRCS, UCD, WSU Extension, or others); additionally, in stream work may require permits from the Washington Department of Fish and Wildlife (WDFW), Ecology, and/or others).

Table A-5: Riverbank Stabilization

Year	Riverbank stabilization completed		Percent Achievement
	Goal	Result	
2007	5 sites		
2012	5 sites		
2017	5 sites		
2022	5 sites		
2027	5 sites		
2032	5 sites		
2037	5 sites		
2042	5 sites		
2047	5 sites		
2052	5 sites		

Appendix B
Load Allocations

Load Allocations

The load allocations for effective shade for the Wind River, Trout Creek, Panther Creek, Eightmile Creek, and Bear Creek are presented in Tables B-3, B-4, B-5, and B-6. The solar flux estimated for August 1 at the load allocations for effective shade is presented in Figures 20 and 21. In general, the load allocations for effective shade in the Wind River watershed are as follows:

- For perennial streams on USFS land, the load allocation for effective shade is the maximum potential effective shade that would occur from mature riparian vegetation. Load allocations for effective shade are quantified for the evaluated reaches in Tables
- B-3, B-4, B-5, and B-6. For other areas on USFS land the effective shade that would be produced from mature riparian vegetation is generally estimated to be greater than approximately 70 percent.
- For perennial streams on non-USFS land, the load allocation for effective shade from riparian vegetation and topography is 70 percent, or shade produced by mature riparian vegetation, whichever is less.

In addition to the load allocations for effective shade, the following management activities are recommended for compliance with the water quality standards for water temperature:

- For U.S. Forest Service land, the riparian reserves in the Northwest Forest Plan are recommended for establishment of mature riparian vegetation.

- For privately owned forestland, the riparian vegetation prescriptions in the Forests and Fish Report are recommended for all perennial streams. Load allocations are included in this TMDL for forestlands in the Wind River Basin in accordance with the section of Forests and Fish entitled “TMDLs produced prior to 2009 in mixed-use watersheds.”

- Reduction of sediment loading to the Wind River and its tributaries is recommended according to the Water Quality Restoration Plan (Tracy et al, 2001).

- Removal of Hemlock Dam in the Trout Creek watershed is recommended to reduce stream widths and increase effective shade.

- Channel restoration projects are recommended according to the Water Quality Restoration Plan (Tracy et al, 2001) to reduce stream width-to-depth ratios and reduce the width of the near-stream disturbance zone.

- Reduction of consumptive water use withdrawals are recommended according to the Water Quality Restoration Plan (Tracy et al, 2001).

- Decommissioning of forest roads is recommended according to the Water Quality Restoration Plan (Tracy et al, 2001) to reduce runoff and sediment loading from roads and improve channel conditions.

- Special studies of Bear Creek are recommended according to the Water Quality Restoration Plan (Tracy et al) to determine the relationship between water withdrawal by the city of Carson and water temperature in Bear Creek. Special studies should also be conducted to characterize the channel geometry, and determine the flow and temperature of distributed inflows along the reach downstream from the USFS temperature station.

Table B -1. Effective shade and solar flux for the Wind River.

						Load Allocations (1)	
	Distance from mouth to upstream segment boundary (Km)	Distance from mouth to downstream segment boundary (Km)	Current condition effective shade from HeatSource model using current vegetation estimates	Estimated daily average solar flux to water surface on August 1 with current vegetation (cal/cm2/day)	Site potential effective shade from HeatSource model using minimum 160-ft treeheight and 85% canopy density	Load allocation for effective shade assuming mature riparian vegetation on USFS land (160-ft treeheight and 85% canopy density), and effective shade of 70% or shade produced by mature riparian vegetation, whichever is less, on non-USFS land. For Trout Creek the proposed LA is also based on removal of Hemlock Dam.	Estimated daily average flux of short-wave solar radiation to the water surface on August 1 at the load allocation for effective shade (cal/cm2/day)
Wind River:	46.8	45.8	77%	165	89%	89%	77
Wind River:	45.8	44.8	78%	158	90%	90%	69
Wind River:	44.8	43.8	69%	222	91%	91%	65
Wind River:	43.8	42.8	69%	222	87%	87%	94
Wind River:	42.8	41.8	82%	129	91%	91%	62
Wind River:	41.8	40.8	43%	408	92%	92%	57
Wind River:	40.8	39.8	15%	609	89%	89%	82
Wind River:	39.8	38.8	28%	516	89%	89%	80
Wind River:	38.8	37.8	21%	566	93%	93%	51
Wind River:	37.8	36.8	71%	208	89%	89%	75
Wind River:	36.8	35.8	64%	441	88%	88%	89
Wind River:	35.8	34.8	90%	329	90%	90%	71
Wind River:	34.8	33.8	81%	368	82%	82%	132
Wind River:	33.8	32.8	81%	368	82%	82%	132
Wind River:	32.8	31.8	70%	415	86%	86%	102
Wind River:	31.8	30.8	36%	458	85%	85%	108
Wind River:	30.8	29.8	21%	566	86%	86%	101
Wind River:	29.8	28.8	25%	537	84%	84%	116
Wind River:	28.8	27.8	19%	580	84%	84%	114
Wind River:	27.8	26.8	10%	645	86%	70%	215
Wind River:	26.8	25.8	4%	688	85%	70%	215
Wind River:	25.8	24.8	5%	680	85%	70%	215
Wind River:	24.8	23.8	9%	652	86%	70%	215
Wind River:	23.8	22.8	30%	501	86%	70%	215
Wind River:	22.8	21.8	22%	559	88%	70%	215
Wind River:	21.8	20.8	10%	645	90%	70%	215
Wind River:	20.8	19.8	16%	602	92%	70%	215
Wind River:	19.8	18.8	32%	487	89%	70%	215
Wind River:	18.8	17.8	21%	566	85%	70%	215
Wind River:	17.8	16.8	14%	616	88%	70%	215
Wind River:	16.8	15.8	41%	423	91%	70%	215
Wind River:	15.8	14.8	28%	516	89%	70%	215
Wind River:	14.8	13.8	29%	509	85%	70%	215
Wind River:	13.8	12.8	27%	523	84%	70%	215
Wind River:	12.8	11.8	18%	587	75%	70%	215
Wind River:	11.8	10.8	4%	688	79%	70%	215
Wind River:	10.8	9.8	11%	637	78%	70%	215
Wind River:	9.8	8.8	23%	551	75%	70%	215
Wind River:	8.8	7.8	16%	602	81%	70%	215
Wind River:	7.8	6.8	36%	458	86%	70%	215
Wind River:	6.8	5.8	24%	544	84%	70%	215
Wind River:	5.8	4.8	26%	530	85%	70%	215
Wind River:	4.8	3.8	55%	322	78%	70%	215
Wind River:	3.8	2.8	25%	537	83%	70%	215
Wind River:	2.8	1.8	30%	501	81%	70%	215
Wind River:	1.8	0.8	6%	673	54%	54%	330
Wind River:	0.8	0.0	5%	680	44%	44%	400

(1) The surrogate load allocations for effective shade on privately owned land are proposed as estimated targets. Actual effective shade from Forest and Fish buffers is expected to be greater than 70%.

Table B-2. Effective shade and solar flux for Trout Creek.

						Load Allocations (1)	
	Distance from mouth to upstream segment boundary (Km)	Distance from mouth to downstream segment boundary (Km)	Current condition effective shade from HeatSource model using current vegetation estimates	Estimated daily average solar flux to water surface on August 1 with current vegetation (cal/cm2/day)	Site potential effective shade from HeatSource model using minimum 160-ft treeheight and 85% canopy density	Load allocation for effective shade assuming mature riparian vegetation on USFS land (160-ft treeheight and 85% canopy density), and effective shade of 70% or shade produced by mature riparian vegetation, whichever is less, on non-USFS land. For Trout Creek the proposed LA is also based on removal of Hemlock Dam.	Estimated daily average flux of short-wave solar radiation to the water surface on August 1 at the load allocation for effective shade (cal/cm2/day)
Trout Creek:	15.1	14.6	42%	417	92%	92%	60
Trout Creek:	14.6	14.1	31%	491	92%	92%	56
Trout Creek:	14.1	13.6	48%	372	90%	90%	72
Trout Creek:	13.6	13.1	58%	507	89%	89%	82
Trout Creek:	13.1	12.6	72%	459	87%	87%	91
Trout Creek:	12.6	12.1	29%	613	89%	89%	77
Trout Creek:	12.1	11.6	22%	558	89%	89%	79
Trout Creek:	11.6	11.1	36%	462	85%	85%	105
Trout Creek:	11.1	10.6	57%	306	88%	88%	89
Trout Creek:	10.6	10.1	38%	447	88%	88%	88
Trout Creek:	10.1	9.6	28%	515	89%	89%	77
Trout Creek:	9.6	9.1	70%	213	87%	87%	92
Trout Creek:	9.1	8.6	64%	258	88%	88%	90
Trout Creek:	8.6	8.1	42%	418	87%	87%	97
Trout Creek:	8.1	7.6	23%	549	88%	88%	87
Trout Creek:	7.6	7.1	50%	357	89%	89%	79
Trout Creek:	7.1	6.6	23%	551	88%	88%	85
Trout Creek:	6.6	6.1	6%	672	90%	90%	74
Trout Creek:	6.1	5.6	22%	561	90%	90%	69
Trout Creek:	5.6	5.1	49%	363	90%	90%	70
Trout Creek:	5.1	4.6	34%	476	79%	79%	151
Trout Creek:	4.6	4.1	32%	486	87%	87%	95
Trout Creek:	4.1	3.6	26%	531	90%	90%	72
Trout Creek:	3.6	3.1	44%	401	89%	89%	78
Trout Creek:	3.1	2.6	2%	704	42%	89%	78
Trout Creek:	2.6	2.1	27%	520	88%	70%	215
Trout Creek:	2.1	1.6	28%	518	89%	70%	215
Trout Creek:	1.6	1.1	41%	420	89%	70%	215
Trout Creek:	1.1	0.6	13%	623	90%	70%	215
Trout Creek:	0.6	0.0	38%	441	95%	70%	215

(1) The surrogate load allocations for effective shade on privately owned land are proposed as estimated targets. Actual effective shade from Forest and Fish buffers is expected to be greater than 70%.

Table B-3. Effective shade and solar flux for Panther Creek.

						Load Allocations (1)	
	Distance from mouth to upstream segment boundary (Km)	Distance from mouth to downstream segment boundary (Km)	Current condition effective shade from HeatSource model using current vegetation estimates	Estimated daily average solar flux to water surface on August 1 with current vegetation (cal/cm2/day)	Site potential effective shade from HeatSource model using minimum 160-ft treeheight and 85% canopy density	Load allocation for effective shade assuming mature riparian vegetation on USFS land (160-ft treeheight and 85% canopy density), and effective shade of 70% or shade produced by mature riparian vegetation, whichever is less, on non-USFS land. For Trout Creek the proposed LA is also based on removal of Hemlock Dam.	Estimated daily average flux of short-wave solar radiation to the water surface on August 1 at the load allocation for effective shade (cal/cm2/day)
Panther Creek:	12.4	11.9	68%	226	88%	88%	82
Panther Creek:	11.9	11.4	78%	156	88%	88%	86
Panther Creek:	11.4	10.9	20%	566	88%	88%	88
Panther Creek:	10.9	10.4	15%	601	85%	85%	110
Panther Creek:	10.4	9.9	54%	325	78%	78%	154
Panther Creek:	9.9	9.4	58%	297	75%	75%	179
Panther Creek:	9.4	8.9	35%	460	75%	75%	180
Panther Creek:	8.9	8.4	70%	212	78%	78%	154
Panther Creek:	8.4	7.9	7%	658	82%	82%	129
Panther Creek:	7.9	7.4	6%	665	87%	87%	89
Panther Creek:	7.4	6.9	31%	488	86%	86%	97
Panther Creek:	6.9	6.4	51%	347	87%	87%	95
Panther Creek:	6.4	5.9	29%	502	80%	80%	145
Panther Creek:	5.9	5.4	34%	467	87%	87%	95
Panther Creek:	5.4	4.9	24%	538	89%	89%	80
Panther Creek:	4.9	4.4	37%	446	88%	88%	83
Panther Creek:	4.4	3.9	54%	325	89%	89%	81
Panther Creek:	3.9	3.4	65%	248	88%	88%	88
Panther Creek:	3.4	2.9	51%	347	85%	70%	212
Panther Creek:	2.9	2.4	57%	304	88%	70%	212
Panther Creek:	2.4	1.9	56%	311	91%	70%	212
Panther Creek:	1.9	1.4	60%	283	88%	70%	212
Panther Creek:	1.4	0.9	61%	276	89%	70%	212
Panther Creek:	0.9	0.4	55%	318	90%	70%	212
Panther Creek:	0.4	0.0	54%	325	91%	70%	212

(1) The surrogate load allocations for effective shade on privately owned land are proposed as estimated targets. Actual effective shade from Forest and Fish buffers is expected to be greater than 70%.

Table B-4. Effective shade and solar flux for Bear Creek and Eightmile Creek.

						Load Allocations (1)	
	Distance from mouth to upstream segment boundary (Km)	Distance from mouth to downstream segment boundary (Km)	Current condition effective shade from HeatSource model using current vegetation estimates	Estimated daily average solar flux to water surface on August 1 with current vegetation (cal/cm2/day)	Site potential effective shade from HeatSource model using minimum 160-ft treeheight and 85% canopy density	Load allocation for effective shade assuming mature riparian vegetation on USFS land (160-ft treeheight and 85% canopy density), and effective shade of 70% or shade produced by mature riparian vegetation, whichever is less, on non-USFS land. For Trout Creek the proposed LA is also based on removal of Hemlock Dam.	Estimated daily average flux of short-wave solar radiation to the water surface on August 1 at the load allocation for effective shade (cal/cm2/day)
Bear Creek:	#REF!	9.2	56%	320	88%	88%	87
Bear Creek:	9.2	8.7	91%	65	92%	92%	58
Bear Creek:	8.7	8.2	93%	49	93%	93%	49
Bear Creek:	8.2	7.7	89%	79	89%	89%	78
Bear Creek:	7.7	7.2	85%	109	91%	91%	65
Bear Creek:	7.2	6.7	60%	291	88%	88%	88
Bear Creek:	6.7	6.2	83%	122	87%	87%	97
Bear Creek:	6.2	5.7	20%	580	87%	87%	91
Bear Creek:	5.7	5.2	19%	590	95%	95%	39
Bear Creek:	5.2	4.7	64%	265	91%	91%	66
Bear Creek:	4.7	4.2	29%	519	93%	93%	54
Bear Creek:	4.2	3.7	76%	176	92%	92%	56
Bear Creek:	3.7	3.2	82%	131	90%	90%	73
Bear Creek:	3.2	2.7	83%	122	90%	90%	76
Bear Creek:	2.7	2.2	74%	189	92%	92%	60
Bear Creek:	2.2	1.7	73%	194	91%	70%	218
Bear Creek:	1.7	1.2	73%	199	90%	70%	218
Bear Creek:	1.2	0.7	81%	142	92%	70%	218
Bear Creek:	0.7	0.0	58%	303	92%	70%	218
Eightmile Creek:	5.1	4.6	98%	12	99%	99%	8
Eightmile Creek:	4.6	4.1	78%	161	93%	93%	52
Eightmile Creek:	4.1	3.6	83%	127	93%	93%	51
Eightmile Creek:	3.6	3.1	83%	126	94%	94%	42
Eightmile Creek:	3.1	2.6	86%	103	94%	94%	42
Eightmile Creek:	2.6	2.1	93%	51	95%	95%	39
Eightmile Creek:	2.1	1.6	89%	78	94%	94%	44
Eightmile Creek:	1.6	1.1	67%	237	94%	94%	42
Eightmile Creek:	1.1	0.6	95%	39	95%	95%	39
Eightmile Creek:	0.6	0.0	95%	38	95%	95%	38

(1) The surrogate load allocations for effective shade on privately owned land are proposed as estimated targets. Actual effective shade from Forest and Fish buffers is expected to be greater than 70%.

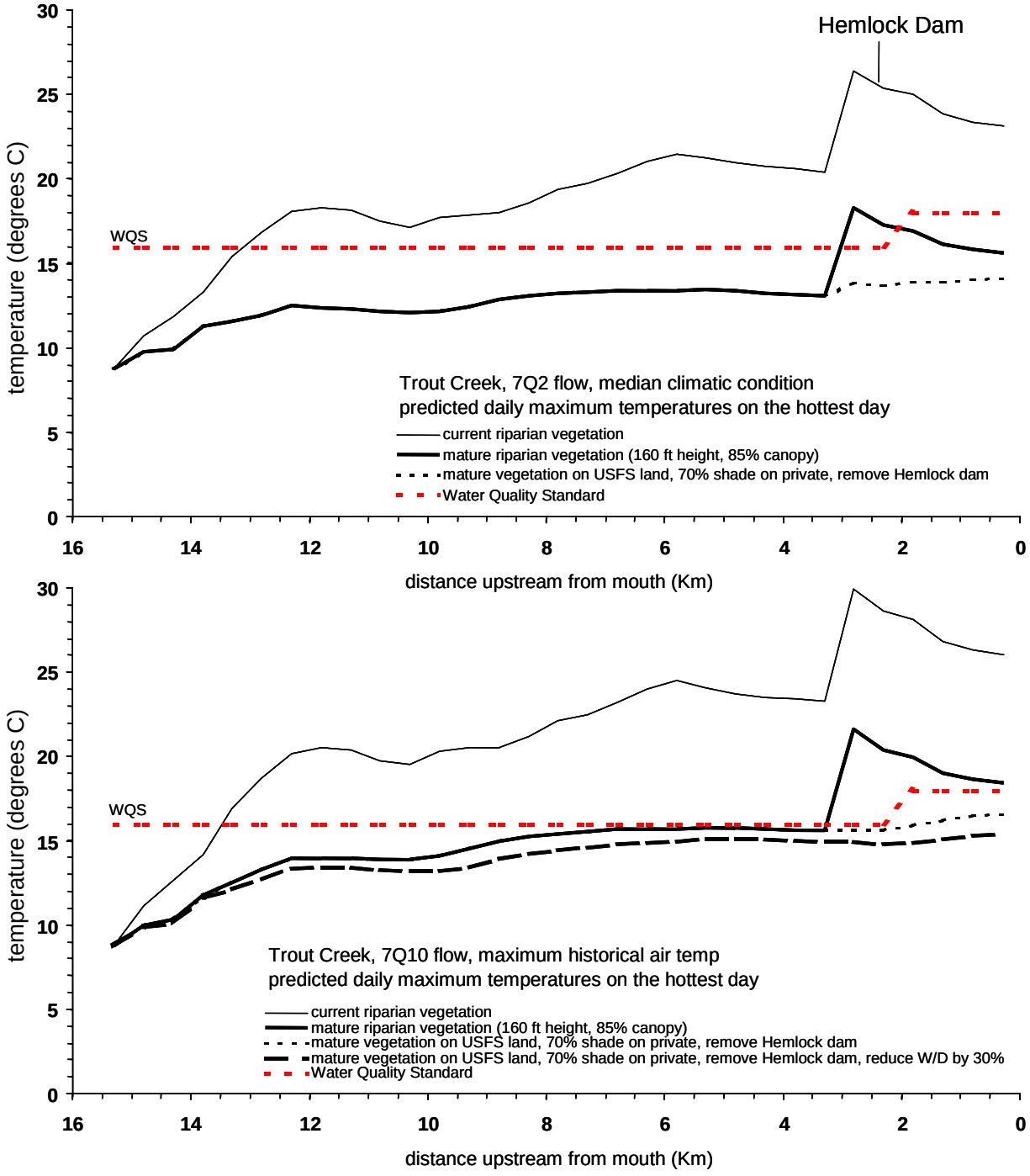

Figure 18. Predicted daily maximum temperature in Trout Creek under critical conditions for the TMDL.

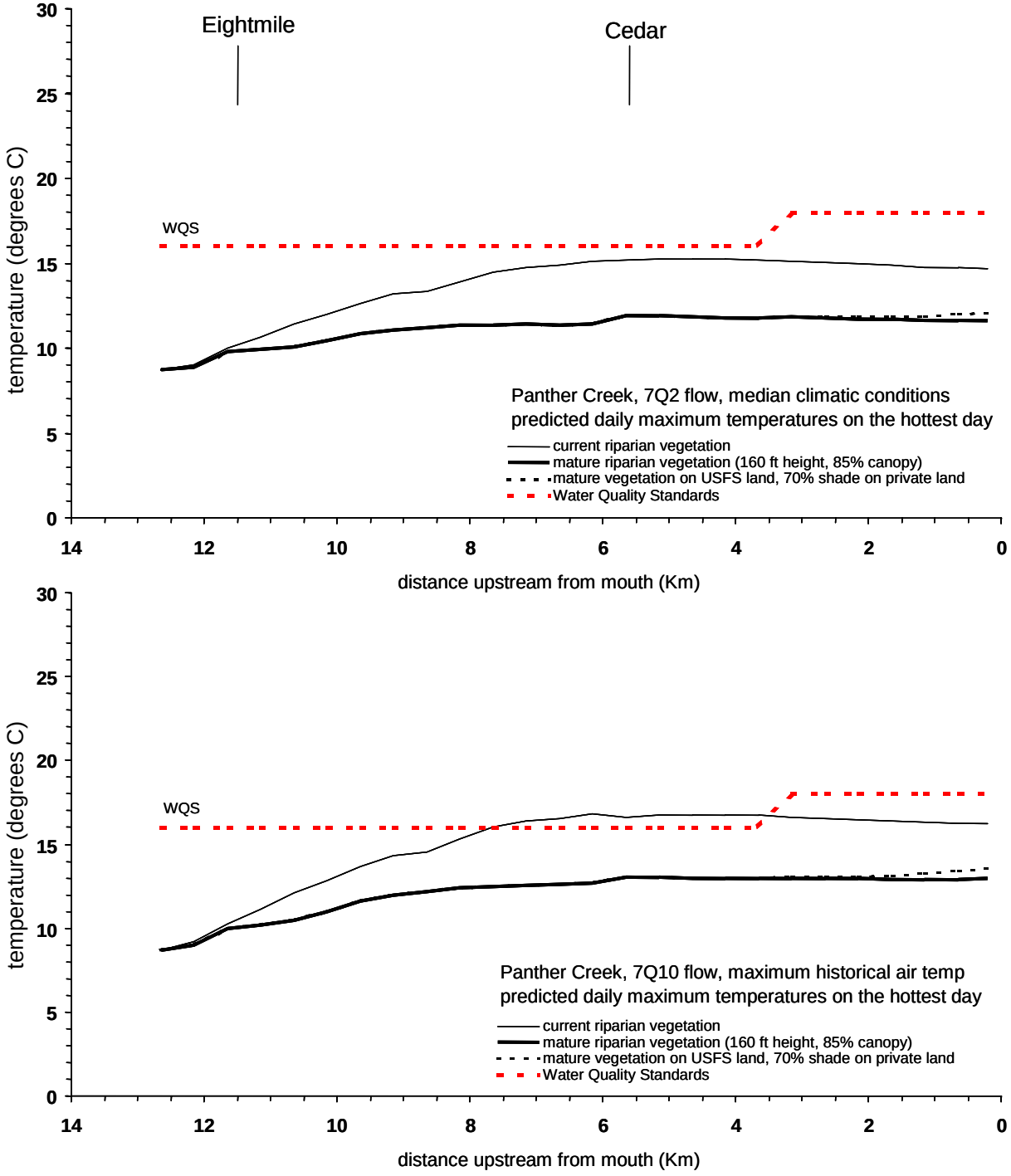

Figure 19. Predicted daily maximum temperature in Panther Creek under critical conditions for the TMDL.

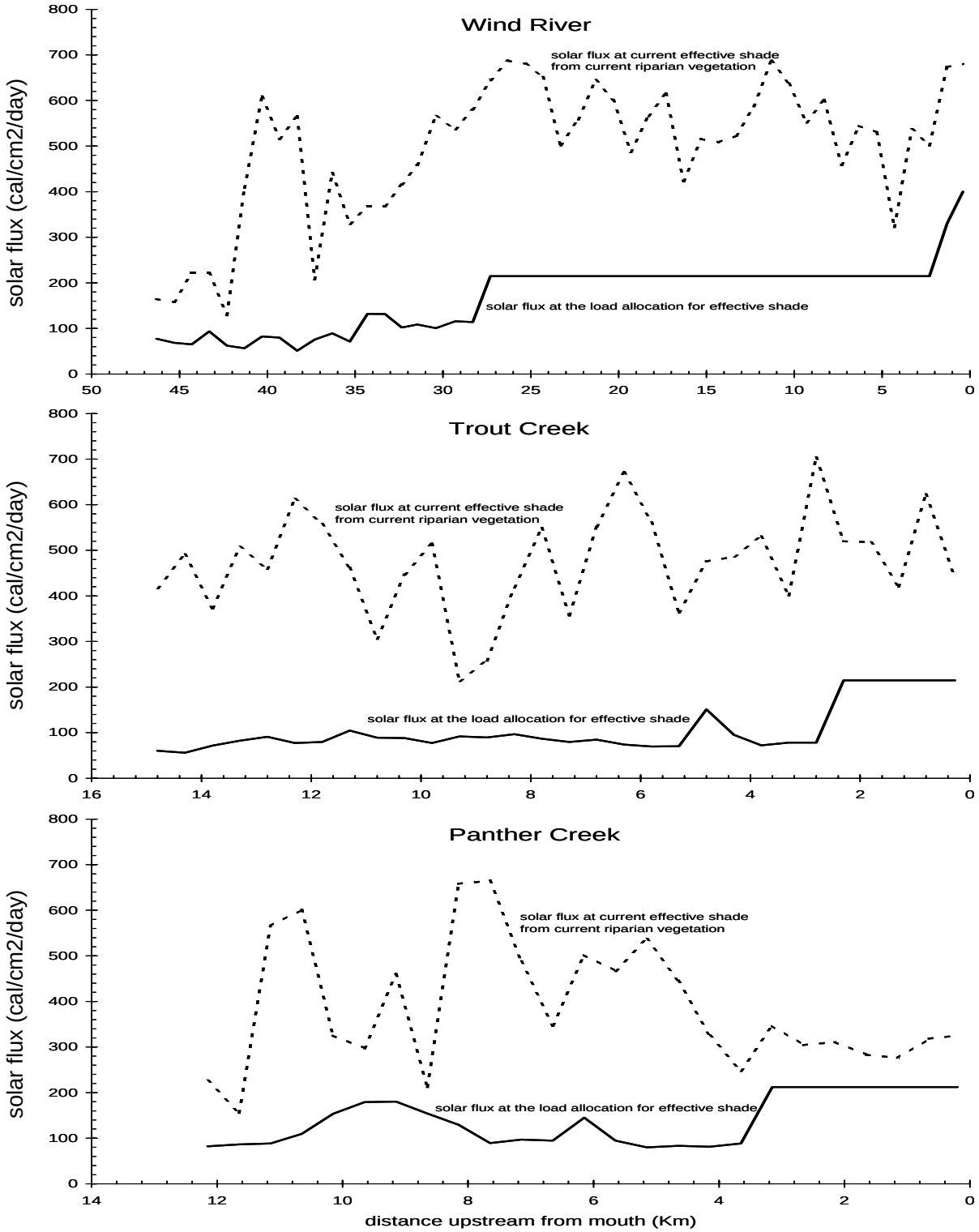

Figure 20. Loading capacity for solar flux to the water surface on August 1 at the load allocations for effective shade for the Wind River, Trout, and Panther Creek (at 7Q10 low flow conditions and maximum historical air temperatures).

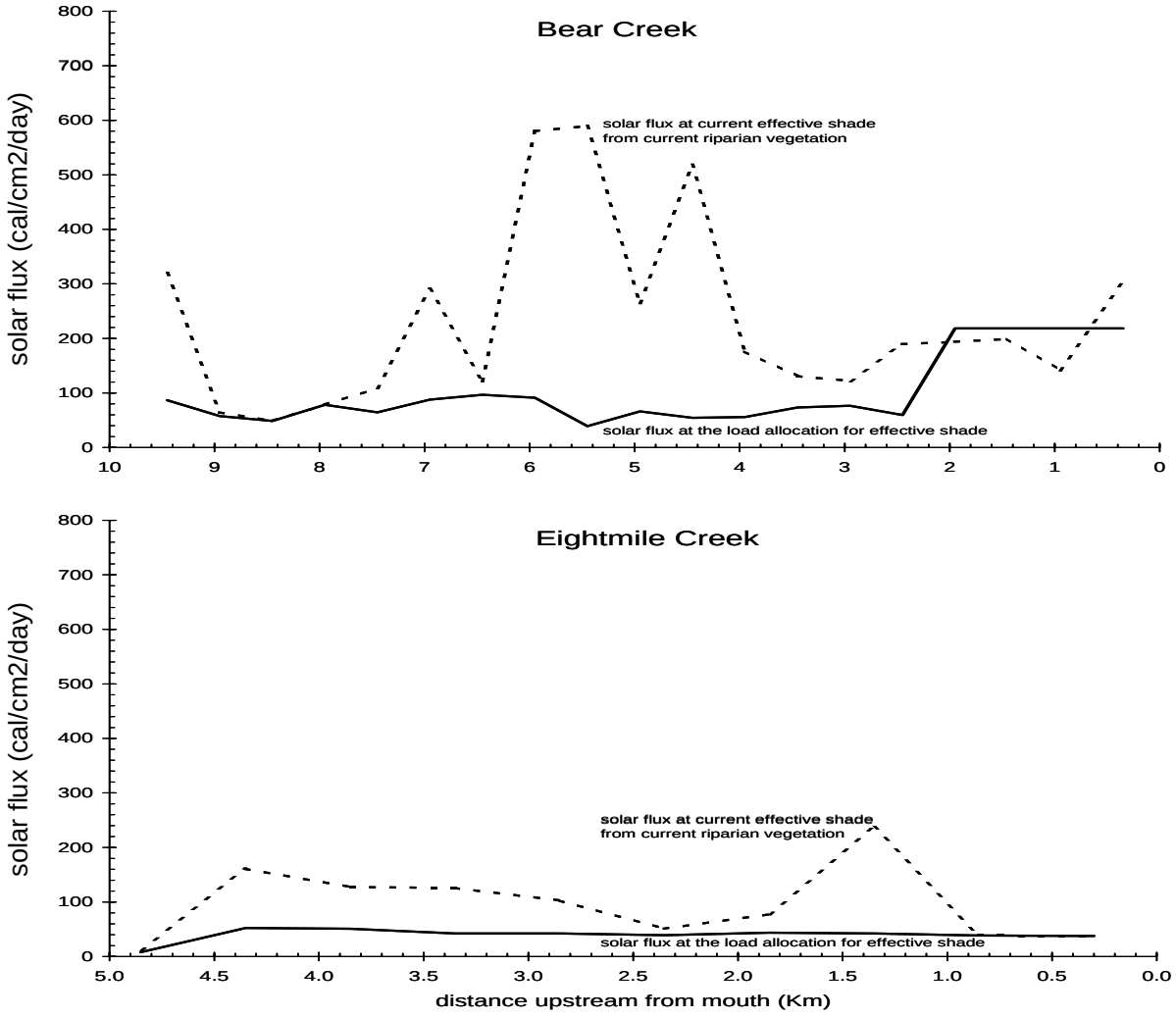

Figure 21. Loading capacity for solar flux to the water surface on August 1 at the load allocations for effective shade for Bear and Eightmile Creeks (at 7Q10 low flow conditions and maximum historical air temperatures).