Little River Watershed

Total Maximum Daily Load (TMDL)

& Water Quality Management Plan (WQMP)

Response to Public Comment

Prepared by:
Oregon Department of Environmental Quality
December, 2001

Introduction

This Response to Public Comments addresses comments received regarding the Draft Little River Watershed Total Maximum Daily Load (TMDL) and Water Quality Management Plan (WQMP) dated June, 2001. Written comments were received during a public comment period that extended from June 4, 2001, through August 31, 2001.

List of Comments provided on Little River Watershed TMDL

The following individuals provided comments on the TMDL during the Public Comment Period. One oral comment was received and recorded at a public meeting at the Glide Community Center in Glide, Oregon, on July 10, 2001. The Hearing Officer's report is included in this document as Attachment 1.

Code	Commenter	Date Received	Media
ODF	Oregon Dept of Forestry	June 28, 2001	E-mail
LRC	Nancy Stern, for Little River Committee	July 10, 2001	Mail
TH	Tom Hatfield	July 10, 2001	Oral
EPA	US Environmental Protection Agency	July 16, 2001	Mail
BF	Senator Bill Fisher	July 23, 2001	Written
DTO	Douglas Timber Operators	July 23, 2001	Written
KS	Kent Smith	August 1, 2001	E-mail
BLM	Bureau of Land Management	August 6, 2001	Mail
OCA	Pat Larson, for Oregon Cattlemen's Association	August 9, 2001	E-mail
FS	U.S. Forest Service	August 24, 2001	Mail
GN	Geoffrey Niles	August 28, 2001	Mail
OFIC	Oregon Forest Industries Council/Douglas Timber Operators	August 30, 2001	Mail
SJ	Seneca Jones Timber Company	August 31, 2001	Mail

Some of the comments received from different individuals or organizations overlap. This responsiveness summary document attempts to combine similar comments and provide a single response where appropriate. In addition to comments, many specific questions were raised, which we have attempted to answer. DEQ appreciates the time and effort that all commenters put into reviewing the documents. All comments have been considered by DEQ and, where appropriate, have resulted in changes to the final documents that will be submitted to the Environmental Protection Agency along with a copy of this responsiveness summary.

The range of comments DEQ reflects the interest in this TMDL and WQMP. Some of the comments are competing and represent different views of the Clean Water Act, State authority, the strength of the scientific knowledge, and the ability of designated management agencies to implement the TMDL. All in all the comments resulted in improvements to the TMDL and WQMP.

As with any analysis, there is some uncertainty. As time goes on, we will continue to understand this uncertainty and be able to address it. Everyone participating in the development of the TMDL and WQMP and providing comments helped in creating more certainty on the outcome of implementing actions to address the allocations in the TMDL. While more data collection and analysis prior to finalizing the TMDL and WQMP might shed light on some issues, it is DEQ's opinion that it would not significantly alter the conclusions and would only delay implementation of needed improvement in the watershed.

Local, state and federal agencies responsible for implementing allocations in the TMDL need to be able to adjust their programs and implementing mechanisms over time as new monitoring information becomes available, and changes in water quality standards or land management practices occur. That is why DEQ is using an adaptive management approach for this TMDL. We recognize the need for a mechanism to change the TMDL and WQMP as we learn more while at the same time moving forward with implementation measures that will improve water quality.

Response to General Comments:

Comment, TH: The notification for the public meeting was very poor and DEQ should redo the notice and have another public hearing in 60 days after notifying all agencies and groups that have worked in cooperation with DEQ in preparing the draft TMDL.

Response: Although DEQ followed the proper procedures for public notice, we recognized that we did not provide notice to every affected landowner or group. In response to requests from the Douglas Timber Operators, and in response to Mr. Hatfield's request for additional time, the deadline for comments was extended twice, from July 16, 2001, to August 17, 2001, and then to August 31, 2001. With these extensions, we believe that adequate time was provided for public comment.

Comment, TH: There is no credible scientific, empirical evidence backing the TMDL. Peer review and replication of the science are needed.

Response: TMDLs and WQMPs do not represent research reports and are not the type of material subjected to peer review prior to publication. However, the TMDLs and WQMPs undergo significant scientific review from within DEQ. The references at the end of the TMDL represent the peer-reviewed science upon which the TMDLs are based. There was significant empirical evidence cited in the Draft TMDL and accompanying appendices.

Comment, SJ: As a general matter, the Report contains a myriad of assumptions, many of which are without factual support and therefore necessarily lead to unsupportable conclusions. Some of these assumptions are discussed below and some we believe will be more fully outlined in the joint comments submitted by the Oregon Forest Industries Council and the Douglas Timber Operators.

Response: DEQ has responded to the specific assumptions identified by both Seneca-Jones and the Oregon Forest Industries Council. These responses are contained in the appropriate sections below.

Comment, SJ: The Report is really a massive literature review pieced together without any apparent interdisciplinary or independent peer review. The Report generalizes that more regulation equates to better conditions, notwithstanding empirical evidence that voluntary, cooperative and incentive-based programs achieve superior on-the-ground results (e.g., the Oregon Salmon Plan) compared to regulatory-based programs (e.g., the Washington Farm/Forest Agreement).

Response: The draft TMDL/WQMP does not generalize regarding the effects of more regulation; rather, it projects, for example, future conditions based on shade analysis. No empirical evidence has been submitted showing that voluntary programs achieve superior results compared to regulatory programs. The WQMP relies heavily on voluntary and cooperative programs to address road decommissioning, channel changes associated with riparian restoration, flow enhancement, and other activities to improve water quality.

Comment, SJ: The Report (and accompanying Water Quality Management Plan) implies that a TMDL must be accompanied with an implementation plan. This is not correct. The Clean Water Act under subsection 303(d) and implementing rules at 40 CFR, Part 130, at no time prescribe or require that an implementation plan is a requirement of a TMDL.

Response: Although an implementation plan is not required by the Clean Water Act or implementing regulations, DEQ policy requires that Water Quality Management Plans accompany all TMDLs.

DEQ has entered into a Memorandum of Understanding with the U.S. Environmental Protection Agency Region 10 regarding TMDLs. In that MOU, Oregon agrees to provide Water Quality Management Plans along with all TMDLs submitted to EPA for approval, even though EPA does not review or approve them.

DEQ has agreed to develop implementation plans because we believe that they are a critical component of the effort to improve water quality and bring waterbodies into compliance with all water quality standards.

Comment, OFIC/DTO: Load Allocations to forestry should reflect current forest practice rules, rather than be based on what is needed to achieve water quality standards.

Response: Under the Clean Water Act, EPA's regulations and DEQ's memorandum of agreement with EPA, Load Allocations for nonpoint sectors such as forestry must be established at the level needed to meet water quality standards. In the event that the load actually resulting from forest operations under current forest practice will not assure attainment of water quality standards, then ORS 517.765 requires the Board of Forestry to modify the BMPs to meet the load allocations to the maximum extent practicable.

The determination of a waterbody's Loading Capacity for various types of pollutants must be determined as part of the TMDL process. That determination is based on a scientific assessment of the assimilative capacity of the waterbody for the pollutants for which the TMDL is being developed. Once the Loading Capacity has been determined, Wasteload Allocations and Load Allocations are set so that the Loading Capacity is not exceeded. The sum of the Wasteload Allocations and Load Allocations (and Margin of Safety) cannot be more than the Loading Capacity, or Total Maximum Daily Load. If forest practices are the source of pollution exceeding water quality standards, then the Load Allocation process determines the reduction necessary to meet water quality standards.

DEQ does not specify management practices for private forest lands; that is the role of the Oregon Department of Forestry. DEQ's role, however, is to allocate loads that will result in pollutant reduction. How those pollutant reductions are achieved on private forest lands is the domain of the Department of Forestry.

There is currently a Memorandum of Understanding between the Department of Forestry and DEQ regarding the study of the effectiveness of the current Forest Practice Rules in meeting water quality standards.

Comment, GN: I have studied many aspects of local water quality issues and watershed health.

Whereas only some of the inventoried rivers, streams, and tributaries within the Little River watershed are on the state's 303(d) list due to sediment and/or pH problems, every single one is on the 303(d) list due to temperature problems!

While certain other factors contribute to these problems, by far and away the single most damaging factor has been, and is, the practice of clearcutting,--most specifically, the clearcutting of forests in the upriver and headwater areas.

These clearcuts create, through the loss of canopy cover, elevated headwater stream temperatures. Generally, very little riparian reserve has been left-sometimes none-depending on factors such as when it was cut, by whom, degree of concern for compliance with the law, etc.)! When headwaters flow at an already-elevated temperature, the river's temperature is impacted all the way downstream to its terminus (in this case, the Pacific ocean.) These same clearcuts are also the primary reason for the pH and sediment problems. All of this has been documented in the Forest Service's "Little River Watershed Analysis".

Therefore, the single more important aspect, and emphasis, of any future management plan is the immediate cessation of all clearcutting activities within the watershed. This should be the highest priority in any plan you (DEQ) submit to the E.P.A.

Response: DEQ's role is to determine the Load and Wasteload Allocations needed to reduce pollutants to levels that do not violate water quality standards. After that determination, the Department of Forestry has the responsibility to assure that its requirements are adequate to satisfy water quality standards. Please see the response to the previous comment for additional information.

Comment, OCA: There were several comments made regarding a definition of science, fundamental science, goal of science, and testable laws and theories.

Response: The science used to develop this TMDL is well-established and supported in the scientific literature. With any analysis, there is some uncertainty; however, monitoring and evaluation of the proposed implementation actions and their effects on water quality will offer greater understanding of those uncertainties. The TMDL and implementation actions are meant to be adaptable to new information as it is developed.

Regarding testable laws, and theories, this TMDL attempts to use existing data and apply existing research results to determine a loading capacity, waste load allocations, and load allocations. A TMDL is applied science, not a theory to be tested or validated.

Comment, ODF: The Oregon Department of Forestry commented that the draft did not include the most recent language regarding the Forest Practices Act as agreed to by the Department of Forestry and the Department of Environmental Quality.

Response: The most recent language agreed to by the Department of Environmental Quality and the Department of Forestry regarding the Forest Practices Act has been inserted in the final version of the TMDL.

Comment, OCA: DEQ is ignoring what the Clean Water Act tells the state to do: TMDLs described in CWA are aimed at 303(d) listed streams that cannot attain the standards due to the additional stressor of a "point source" which when combined with nonpoint *source plus natural background sources causes the stream segment to exceed applicable water quality criteria. DEQ is stretching the TMDL allocations to include nonpoint source streams that do not have point source discharges. All streams in the basin are not on the 303(d) list and further, all streams cannot be assessed equally.*

Response: DEQ does not agree with this comment regarding the meaning of the Clean Water Act. We believe the Clean Water Act clearly intends to encompass waters polluted only by nonpoint sources.

Response to Comments on Temperature TMDL:

Several general comments were received, which will be addressed first, followed by responses organized by the Draft Little River TMDL Table of Contents.

General Comments

Comment, OFIC/DTO: The draft Temperature TMDL is not an appropriate thermal TMDL because the Clean Water Act requires thermal TMDLs to "assure protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife," 33 USC Section 1313 (d)(1)(D), rather than to "be established at a level necessary to implement the applicable water quality standards", the criteria for other TMDLs contained in 33 USC Section 1313(d)(1)(c).

Response: DEQ's temperature standard does, in fact, "assure protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife." DEQ's temperature standard was designed to protect those species with the most sensitivity to high temperatures. In particular, salmonid fishes, including chinook salmon and bull trout, and amphibians, including tailed frogs, were identified as the species most sensitive to temperature. This is discussed in the DEQ report of the 1992-1994 Water Quality Standards Review, when the current temperature standard was adopted. See Section 2-2.

Cold-water fish is the beneficial use which is protected by Oregon's stream temperature standard. The standard protects both rearing and spawning activities of salmonids, thus protecting their ability to propagate. Restoring cold-water habitat will enhance indigenous populations and impair invading species.

In this case, the temperature TMDL will be established at a level necessary to implement the state's temperature standard, and it will also "assure protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife."

Geographic Coverage of TMDL

Comment, OCA: The geographic scope of the temperature TMDL and WQMP is unclear. Section 2 (p.2) states that "the TMDLs apply to perennial streams within the watershed." Minimally, this implies that the Board of Forestry's Water Protection Rules addressing intermittent streams are not part of this TDL or WQMP.

However, the calculated Loading Allocation of 88 BTUs;/ft2 is based on Little River, Cavitt and Jim Creeks only. No data are provided for any of the smaller perennial tributaries and their potential contributions to cooling were ignored in Heat Source modeling. Should it be presumed that only the modeled reaches are subject to the temperature TMDL and SQMP, or perhaps only the reaches listed as impaired for temperature as shown in Figure 13 ((Appendix C, p. 173)? No data or analysis are provided for smaller tributaries.

Response: The comment is correct that the draft is unclear regarding the geographic scope of the TMDL. The final draft has been revised to make it clear that the TMDL and

WQMP apply to the entire Little River Watershed, including all lands draining to the Little River upstream of its confluence with the North Umpqua River. Intermittent streams are included in this TMDL and WQMP.

The Load Allocation of 88 BTUs per square foot applies only to the modeled portions of Little River, Cavitt Creek and Jim Creek. For all others, target shade values are identified in Table 6. Although the calculations of existing shade in the table were based only on the federally-owned portions of the watershed, the targets represent a reasonable starting point which can be refined later if necessary. This refinement process is described in the Adaptive Management discussion in Section 8.2 of the TMDL, and also in Chapter 1 of the Water Quality Management Plan.

Applicable Water Quality Standards

Comment, EPA: p. 7-8, Stream Temperature Criteria: As has been discussed in other OR Temperature TMDLs, the narrative portion of the Oregon temperature criteria "no measurable surface water temperature increase from anthropogenic activities ., . . " is critical to demonstrating attainment of the water quality in these TMDLs. As such, this part of the temperature criteria should be discussed in this chapter. The discussion on implementation measures application under these conditions is useful but does not substitute for the criterion itself. Reference to this narrative portion of the criteria should also be made in the attainment section (4.11).

Response: The recommended changes have been incorporated into the final version of the TMDL.

Comment, SJ: The 64 degree temperature standard appears to be arbitrary without regard for regional or site-specific watershed conditions. Proper baseline standards need to be set, utilizing conditions that reference the actual landscape, not the theoretical.

Response: The temperature standard is not simply 64 degrees. The 64 degree criterion was developed based on the needs of sensitive cold-water species (1992-1994 Water Quality Standards Review, Temperature, 2-1 – 2-16). The temperature standard also indicates that if the appropriate criterion is not reached following implementation of a TMDL, including all feasible steps to reduce temperature, then the standard of no anthropogenic increase is satisfied. This takes into account regional and site-specific watershed conditions.

Comment, BLM: On page 8 (Table 4) please add the time period to both standards: June 1 to September 14 for rearing and September 15 to May 31, for spawning, etc.

Response: The time period for the rearing criterion is June 1 through September 30. The time period for the spawning criterion is from spawning through fry emergence, October 1 through May 31, or water-body specific as identified by ODFW biologists. This information has been added to Table 4.

Comment BLM: There was no data available to determine whether the temperature standard is met for salmonid spawning, egg incubation, and fry emergence, i.e. the 55 degree standard.

Response: No data had been collected at the time of this TMDL to determine the period of spawning. Efforts are underway to obtain this data, and monitoring of temperature response to TMDL implementation activities will also provide additional temperature data. Spawning data is more difficult to obtain due to increased flows and limited safe access to streams for placement, auditing, and retrieval of monitoring devices. However, the draft TMDL proposes to address all anthropogenic causes of temperature loading to the Little River, so implementation will benefit all stages of the salmonid life cycle. No anthropogenic increase (i.e., system potential vegetation) will also help during other periods.

Factors Affecting Stream Temperature

Comment, BLM: Page 10 discussed solar radiation and the importance of riparian vegetation. It is stated that past management activity removed significant portions of this vegetation and that restoring vegetation is the most significant action needed to reduce stream temperatures. It would be beneficial to briefly describe those past management activities (timber harvest, roads, development, grazing, etc) that affected riparian vegetation. Also, we feel it is important to add a discussion of the importance of sustainable groundwater flows to the water table during summer months to either the Channel Form, Flows, or Channel Complexity section. Most stream channels in the watershed have been adversely down cut allowing groundwater to drain from the water table at a much faster rate: therefore, it is not available later in the summer.

Response: We agree that the disconnection of the river from its floodplain reduces groundwater available to the system late in the summer. We have added that statement to the final version of the TMDL.

Comment, OFIC/DTO: ***Pollutant Source Assessment.*** *Section 1.2 of the document states that a Source Assessment is required for the TMDL; however, no specific Source Assessment could be located in the text. The Temperature TMDL summary (Table 20 identified the two Existing Sources---anthropogenic sources of thermal gain from riparian vegetation and anthropogenic sources of thermal gain from channel modifications—but lacks an assessment. Section 4.3 discusses four factors affecting stream temperatures—solar radiation, channel form, flows, and channel complexity/large wood—but lacks specific references to the Little River watershed. The discussion of Existing Sources of Water Pollution in the draft WQMP (p. 96) adds additional confusion by listing disconnected floodplains to three factors mentioned in the TMDL--solar radiation, channel form, and flows.*

Where is the Source Assessment? Which four factors are the Existing Sources: those identified in Section 4.3 or those listed under Temperature on p. 96. Why are only two Existing Sources listed in Table 2?

Response: Appendix A to the TMDL contains a quantitative assessment of the existing sources. These factors are discussed in the text in Sections 4.3, Factors Affecting Stream Temperatures, and 4.4, Current Conditions.

Comment, OFIC/DTO: Please evaluate water diversions as an Existing Source and consider adding flow reduction in the loading capacity discussion, particularly if it can provide some relief for the dependency on riparian shade to manage temperatures.

Comment, OFIC/DTO: It is uncertain whether the proposed loading allocations will ensure attainment of Oregon's 64° F. water temperature standard. Indications are that even System Potential shade would not result in temperature standard attainment for many reaches. Water withdrawal is identified as a potential source of elevated water temperatures, although no consistent quantitative analysis is provided that demonstrates the significance of this problem. The load allocation does not address water withdrawal or its effect on flow.

Response: Stream flows were discussed in the section on Factors Affecting Stream Temperature. However, the pollutant identified for this TMDL is excess heat energy, and shade was identified as the most appropriate surrogate for establishing targets. DEQ does not have the authority to change existing law regarding water rights; however, the Water Quality Management Plan discusses voluntary efforts at flow enhancement. This was considered as a component of the Margin of Safety.

Comment, OCA: A comment was received regarding the longitudinal heating of streams and other contributors to increased water temperatures

Response: We believe the assessment and modeling efforts in this proposed TMDL account for the contributing factors mentioned in the comment: reduced effect of groundwater with increasing stream volume, downstream wider channel relation to effective shade, and air temperature; although measured data, observation and modeling show the least effect due to air temperature.

Comment, OCA: Background sources include loading to the water body that come from sources outside the defined segment, such as loading from upstream and estimated atmospheric deposition of a pollutant. Historical discharges that might be a source of toxicant may be considered as background sources.

A better discussion of this initial statement should be included. Describe how DEQ justifies taking such liberties as inclusion of "all streams" without clearly documenting the combined and separate influences of natural background, nonpoint sources, and point source additions.

Response: Background sources are taken into consideration in the modeling. Heat Source uses an upstream "boundary condition" that incorporates background sources. The amount of heat energy conveyed from upstream is measured with continuous temperature thermistors at the site of the upstream boundary of the modeling. For future condition simulation, background heat loading is the heat load with system potential vegetation.

Current Conditions

Comment, BLM: Page 11 shows a map of current temperature conditions. The map is dated 1995. You may want to add some explanation about why you don't show more current information You should also add a discussion as to whether this was a normal or *an unusual year. In fact, our monitoring data suggests that 1995 was a fairly cool year for stream temperature.*

Response: The map on page 11 has been replaced with a table showing the 303(d) listings for temperature.

Flows

Comment, OFIC/DTO: ***Flows.*** *Please explain the discrepancy in issued water rights in the Little River watershed. Table 5 (p 13) indicates that 11.90 cfs have been issued, but the discussion of Flow Volume on p. 124 (Appendix A) indicates that 28 cfs have been issued (9.5 cfs for the Little River mainstem and 18.5 cfs for the tributaries). Also, it would be helpful to know what instream water rights have been issued for fish because they provide assurance for minimum flows.*

Response: Table 5 shows only consumptive water rights and does not include instream water rights. Figure 4 shows all water rights, including instream water rights, by month.

As is noted in the draft, the priority dates for the instream water rights are 1974 and 1991, whereas many of the consumptive uses have earlier priority dates. Therefore, the instream water rights are not met during the summer and the instream rights do not provide assurance for minimum flows. According to the Douglas County Watermaster, the instream water rights would not likely be met even if there were no other water rights in the watershed.

Riparian Shade

Comment, OFIC/DTO: ***Riparian Shade.*** *The second paragraph (p. 14) incorrectly indicates that restoration of riparian shade would result in "an increase in summer flows." On the contrary, riparian shade restoration probably would not increase flows, but would decrease flows by increasing evapotranspiration (e.g., Adams and Ringer 1994). Discussions of theoretical relationships between riparian shade and channel complexity, streambank stability, toxicity buffering, and wildlife habitat are inappropriate for this section. Only discussions that are pertinent to the proposed Loading Capacity and Loading Allocation should be addressed in this section.*

Response: The effect of streamside vegetation on summer low flows is not clearly understood, but several riparian restoration projects in the Umpqua basin have resulted in increases in summer surface flow, including flow restoration in channels which had previously gone dry. Evapotranspiration is reduced when vegetation is not actively growing, as is the case with much streamside vegetation during the summer in Little River. Further, there is evidence that riparian vegetation restoration can re-establish pathways between surface and groundwater, opening up a potential source of colder water and additional flows. See Poole, et al.

DEQ believes that the additional environmental benefits to water quality from riparian vegetation in addition to shade are pertinent to the discussion in this section.

Loading Capacity

Comment, EPA: ***p. 15, last paragraph Section 4.7:*** *Since the LC must be established at a level which will lead to the attainment of the applicable criteria, I suggest this paragraph highlight how that is accomplished by the LC established. One suggestion: "Since the system potential temperature exceeds 64 °F., the loading capacity has been established at an average of 88 BTUs per square foot of stream surface per day, a level which will provide for no measurable surface water temperature increase from anthropogenic activities. That limit can be achieved by ...."*

Response: The recommended changes have been incorporated into the final TMDL.

Comment, EPA: ***p. 15, first full paragraph:*** *I recommend also providing the percent of streams predicted to exceed 64 °F. in the system potential simulation, especially since this is the simulation utilized for determining the loading capacity.*

Response: The recommended changes have been incorporated into the final TMDL.

Comment, OFIC/DTO: Loading Capacity. According to EPA, loading capacity is "the greatest amount of loading that a water can receive without violating water quality standards." It provides a reference for calculating the amount of pollutant reduction needed to bring water into compliance with standards. ODEQ calculated the loading capacity to be 88 BTUs/ft2 for the modeled reach of little River, Cavitt and Jim Creeks. Surprisingly, the temperature loading allocation addresses only stream shade, substituted as a surrogate for heat load. No loading capacities or allocations are provided for channel form, flows, and channel complexity/large wood. Widened and simplified channels and reduced summertime base flows through water diversions, which are potential sources of elevated stream temperature, are not addressed in the prescribed loading capacities. According to Appendix A (p. 124), diversions for irrigation and domestic use may account for up to 28 cfs, but measured September flow at the Little River's mouth was only about 23 cfs. The effect of flow reduction on temperature may be significant. Section 4.11 states that "any streamflow enhances that are achieved will further reduce the rate of warming."

Response: The Clean Water Act requires a TMDL to identify pollution sources and to set a load allocation for that pollutant(s). This has been done and excessive solar energy was identified as the pollutant (a natural energy source available to the stream in unnatural amounts due to human caused disturbances). This TMDL further translates reductions of solar energy into equivalent units of increased shade. It is recognized that several of the strategies mentioned in this comment can also reduce stream temperatures and their beneficial contributions should be maximized wherever possible. The interaction of these multiple additional process is still poorly understood, and substituting any increase in, say, channel complexity, as a substitute for X amount of riparian shade is beyond our analytical methods. Only continual monitoring of stream temperatures as the watershed responds to restoration efforts will tell us where we have under- and over-estimated benefits to stream temperature and thereby suggest modification in our restoration approach.

Loading Allocation

*Comment, EPA: **Section 4.8:** The term "Loading Allocation" should be changed to "Load Allocation" throughout the section.*

Response: The recommended changes have been incorporated into the final TMDL.

Comment, EPA: A load allocation must be allocated to specific sources or entities responsible for implementation. As such, each DMA with responsibility for this allocation should be specifically identified. This may be done by inserting the DMAs in a parentheses after "for all nonpoint sources".

Response: The recommended changes have been incorporated into the final TMDL.

Shade Targets

*Comment, EPA: **p. 16-17:** It would be easier to read if the effective shade levels at the bottom of p. 16 and top of p. 17 were put into a table.*

Response: The recommended changes have been incorporated into the final TMDL.

Comment, OFIC/DTO: Shade Targets. In section 4.9, no data are provided for predicted Effective shade over small streams, nor the time expected for full system potential recovery. Loss of riparian shade is temporary. Shade recovery along small streams should be rapid because shade-providing shrubs and understory vegetation regrows within a few years after timber harvest (ODF 1994, Beat 1993). For channels generally less than 15 feet wide, shade recovery from vegetation regrowth occurs within 7 to 15 years assuming no riparian buffer retention (Summers 1983). Andrus and Froehlich (1988) showed that angular canopy densities approach the values for old-growth stands (80-90 percent) within 10 years for small forested tributaries in the Oregon Coast Range.

Response: We do not dispute that smaller tributaries shade over faster than larger streams. The modeling on Little River opted to simulate reasonable worst case conditions – summer solar load, warmest time of the day and widest streams in the watershed. The expectation is that all other areas in the watershed should reach system potential faster than along the mainstem.

Comment, BLM: Pages 15-18 discuss shade as a surrogate measure for temperature. There are several different discussions of the shade target. Page 15 (second from last paragraph) lists the TMDL surrogate target for Little River as 93.7 % effective shade. Page 16 and 18 describe shade allocations as 90%, 95%, or 98% based on stream width. Page 18 shows the shade table developed for federal lands and states that these target shade calculations are the initial targets. Please clarify which of these is the target.

Response: For the Little River mainstem, the overall target is 93.7% effective shade. That, however, is an average. Breaking down the sections of Little River by their wetted widths allows a more precise determination of shade percentage. The target for segments of Little River is the percent effective shade for that segment's wetted width. Together, these will average 93.7 % effective shade.

Heat Source modeling was not done for most of the streams in the watershed. For those, the targets are those as identified in the federal Water Quality Restoration Plan, Appendix C to this TMDL.

Buffer Width

Comment, SJ: Direct benefits of wider buffer widths are unsubstantiated. Rather than focus on larger buffer widths which have diminishing returns the farther you go from the stream's edge, more emphasis should be placed on providing maximum shade in those areas closest to the stream. Scientific studies advocate the benefits of this approach.

Comment, BLM: Page 18 contains a discussion of stream buffer widths. It would be helpful to the general public to further explain the buffer (is the 200' from each side of the stream or is it the total width). It would also be beneficial to describe what the literature and other TMDLs say about effective shade buffers.

Comment, BLM: Page 19: the first paragraph should include an explanation of why "no minimum buffer width is specified."

Comment, KS: The 200 foot buffer width seems excessive and there doesn't appear to be information to explain the model. If one tree width is at 75% shade density, it seems to follow that two tree widths would be at 94%. Generally the effective average density of a buffer strip is affected by open gaps. Average buffer density may be better improved by filling gaps than adding width. Also, it should be noted that trees in open, unexposed areas tend to be denser than individual trees growing in a cluster. Consequently, narrow buffers may be more effective on a per unit width basis than wider buffers. However, in the case of timber harvest, the remaining buffer trees have the same characteristics as trees in a clump and the above comments do not apply in the short term.
It should be noted that the buffer width requirements is important because it directly affects the amount of land available for other uses. It appears from other discussion that a buffer with an effective density of 75% is sufficient to meet the 88 BTU requirement. Topographic shading at 100% density will supplement the vegetative shading.

Comment, KS: The text indicates that a certain width is needed to achieve "full shade." More discussion would be helpful since buffer width is a key issue related to the TMNDL compliance. Specifically, what assumptions are reasoning were used?

Response: The TMDL does not specify required buffer widths but rather focuses on shade needed to intercept solar radiation reaching the stream surface. The section showing the modeled impacts of various buffer widths has been removed from the final TMDL to reduce confusion regarding the TMDL's requirements. The various management agencies have the responsibility to determine what, if any, buffer width is necessary to produce the requisite amount of shade.

Comment, OFIC/DTO: During the Alsea Watershed Study in Oregon, small buffers approximately 50'-100' wide were used to protect Deer Creek during harvesting (Brown

1972). Very small increases in stream water temperature occurred in Deer Creek while the completely clearcut Needle Branch, without buffers, experienced major temperature increases an order of magnitude greater than Deer Creek (Ice in press). [Incidentally, elevated water temperatures found in the headwater reaches did not continue to increase throughout the unit. Instead, water temperatures at the main gaging station while increased, were less than those observed in the upper reaches.

Response: These effects described from the Alsea River are quite conceivable and are not in conflict with the modeling results seen from Little River. Shading on small-sized streams is more effective than on larger streams, if all other factors are held constant. Other systems, with different stream aspects, groundwater interaction and weather conditions, will likely show different responses than those seen in the Alsea. In fact, some parts of Little River had different responses to shade than other sections within the same watershed. This is why, until more watersheds have been studied, it is important to calibrate the Heat Source model with specific field and instream measurements collected in the specific watershed and under the same weather conditions where modeling simulations are needed.

Water Quality Attainment

Comment, EPA: ***Section 4.11, p. 20:*** *A statement should be added which notes that these allocations will lead to the attainment of the "no measurable surface water temperature increase from anthropogenic sources" clause of the temperature criteria and thus attains the criteria.*

Response: The recommended changes have been incorporated into the final TMDL.

Wasteload Allocations

Comment, EPA: ***Section 4.12, first paragraph:*** *Since the site potential temperature is utilized in the calculation, I suggest that this paragraph also utilize that temperature as a reference, and not 17.8° C. The word "even" from the last sentence.*

Response: The recommended changes have been incorporated into the final version of the TMDL.

Comment, EPA: ***p. 21, second paragraph:*** *The first sentence should be modified as follows: "EPA has indicated that, if a facility discharges the pollutant addressed by a TMDL, a wasteload allocation is required for that discharge, regardless of quantity."*

Response: The recommended changes have been incorporated into the final version of the TMDL.

Comment, EPA: ***p. 21-22, expression of WLA:*** *The wasteload allocation should be expressed in terms of either BTUs, kilocalories per day, or maximum effluent temperature so that it can be readily inserted into the NPDES permit. It appears that the column labeled Loading Capacity at the top of page 22 and in Table 7 would be more accurately identified as the WLA. You may wish to keep the last two columns, one for allowable kilocalories per day and the other for the maximum effluent temperature.*

Response: The recommended changes have been incorporated into the final version of the TMDL.

Implicit Margin of Safety

Comment, EPA: ***Margin of Safety:*** *Very well written, especially the section regarding groundwater inputs.*

Response: No response necessary.

Comment, OFIC/DTO: Multiple levels of margins of safety are incorporated into the proposed temperature TMDL, including many assumptions inherent in the DEQ temperature standard itself and the Oregon Board of Forestry Water Protection Rules. These compounding margins of safety result in a temperature TMDL and water quality management plan that are more restrictive than scientific studies support.

Comment, OFIC/DTO: Regulation of water temperature in the Pacific Northwest appears to be triple dipping on margins of safety. Margins of safety are incorporated into: (1) the EPA's water temperatures standard itself; (2) the proposed WQMP for temperature management on private forest lands (i.e., the Board of Forestry's Water Protection Rules); and (3) this draft temperature TMDL, which acknowledges numerous instances where margins of safety are built into the results. The major concern is that the implicit margins of safety will generate a conservative temperature TMDL and WQMP that would be more protective and restrictive than scientific studies would suggest or recommend.

Response. The temperature standard employed in the TMDL was adopted by the Oregon Environmental Quality Commission after development by an advisory committee. The EPA does not establish the standard, although that agency did approve the standard employed in this TMDL.

The only "margin of safety" in the state temperature standard is for the protection of landowners. One of the objectives of the temperature standard set out by the Technical Committee was as follows:

> To address natural temperature variability, the standard should contain a **margin of safety** to provide for the difference between average and critical years (e.g., extremely hot dry years). A stream in compliance will not exceed the standard more than once every other year, on average. 1992-94 Water Quality Standards Review, Section 3.12.1.

The actual standard adopted by the Commission contains a provision exempting violations of the temperature standard during exceptionally warm years: OAR 340-041-0285, Section (2)(b)(B).

Thus the margin of safety in the temperature standard itself is not to protect the beneficial use but to protect landowners during periods of weather extremes.

The Water Protection Rules adopted by the Board of Forestry in effect at this time are being studied to determine whether, in fact, they go far enough to protect stream temperature. There has been no showing that a margin of safety for water quality was incorporated into the Rules.

As required, the TMDL does contain a margin of safety. That margin of safety is accounted for in conservative assumptions used in developing the TMDL.

Most of the other aspects of the temperature margin of safety relate to possible actions by landowners in the future. Since these activities are not required by the Forest Practices Act or any other enforceable law or rule and would depend on voluntary action by landowners (decommissioning roads, riparian restoration-induced channel structure improvements, increases in storage of groundwater, reduction of human-induced sediment, future flow enhancements). Whether these activities occur, how frequently they occur, and how effective they will be are factors that cannot be predicted. No amount of additional study would provide the kind of data that would allow quantification of these factors.

The commenter indicated that no data exist for the small streams in the watershed, and that the cooling effects of tributary inflow were not accounted for in the model. In fact, temperature data does exist for portions of most streams in the watershed, based on studies by the Umpqua National Forest from 1994 – 99. (See Appendix C, figure 14 temperature summary.) Additionally, measured temperatures at the mouths of tributaries were employed in the model. As was stated in the comment, many of these smaller streams do have good shade, producing lower stream temperatures. Any tributary contributing 5% or more of the flow of Little River was measured and its temperature at the mouth employed by the model. The margin of safety is that potential changes in temperature at the mouth and their effect on the mainstem have not been modeled, but any additional temperature reductions will aid standard achievement.

It is also important to note that the modeling shows that with improvements in vegetation in the modeled reaches, the criterion of 64 ° F. will not be attained, and additional cooling from the margin of safety factors may or may not be sufficient to bring stream temperatures down to 64 degrees. In other words, the factors which were modeled do not show criteria attainment; criteria attainment will be possible only if some of the factors in the margin of safety actually do occur.

Finally, the TMDL and WQMP are based on adaptive management, which will allow changes in the allocations if monitoring shows that temperature improvements are not as expected (either more or less effective).

Comment, KS: Page 169 indicates that there are 156 miles of perennial streams. Assuming a net discharge of 25 cfs, this leads to an average groundwater input of .16 cfs per stream mile. This could be noted as part of the margin of safety discussion since groundwater was not fully used in the model.

The summer time flow bullet could be expanded to include hyporheic flow. With restored riparian vegetation., stream channels are expected to regain woody structure with corresponding increase in channel diversity. The addition of gravel and pools will improve hyporheic action and In-channel water storage with a net cooling effect.

Response: We agree that these factors provide an additional margin of safety and have made appropriate changes in the final version.

Comment, OFIC/DTO: We appreciate the extent to which ODEQ has identified sources of uncertainty and factors for which data is lacking. However, the lack of certain watershed information leads us to question the validity of the model results and the credibility of the TMDL. Most disconcerting is the lack of information pertaining to the cooling effects of groundwater discharge, tributary inflow, flow enhancements, and increases in shade overhang. Also, we are concerned that no temperature data exist for approximately 90 percent of the stream miles in the watershed (i.e., the small streams). The potential significance of the groundwater factor was demonstrated by the inability to calibrate the Heat Source model for the Little River reach between Emile and Wolf Creeks without assuming significant groundwater inflow (p. 23).

Response: The Heat Source model can incorporate changes in groundwater discharge, tributary inflow, flow enhancements and increases in shade overhang when such data is available, and in fact the model has been calibrated with current conditions for tributary inflow, flow, and shade overhang. The inability to calibrate Heat Source without assuming groundwater in a certain reach strengthens rather than decreases the validity of the model. Without the addition of the groundwater, the model did not adequately describe observed temperatures. The assumption of additional groundwater was later verified through field measurements, proving the validity of the model.

The TMDL does contain some temperature data on small streams in public ownership. DEQ welcomes the contribution of additional quality-assured data regarding temperatures of small streams in private ownership, and will incorporate those into its analyses when the TMDL is revisited.

Seasonal Variation and Critical Conditions

Comment, EPA: ***p. 24, last paragraph:*** *I suggest this paragraph be modified to note that only "summer conditions were assessed" by the TMDL due to lack of data during other times of the year instead of saying that only the "64° F. criterion was addressed". In addition, I recommend adding a sentence to the end of the paragraph which explains that the same implementation efforts which will be put in place to address summer conditions will also reduce solar loading during other times of the year.*

Response: The recommended changes have been incorporated into the final version of the TMDL.

Comment, OCA: The Season Variations (page 21) should measure the winter variations and determine how the natural temperature cycles are affected in the winter. If the riparian vegetation is key to summer temperatures then work should be conducted on the winter temperature cycles in order to determine if riparian vegetation is also a vital component under winter conditions.

Response: Winter stream temperatures in Oregon have not been documented as impaired or affecting any of the beneficial uses; however, riparian vegetation that persists through the winter would have a similar buffering effect on stream temperature in the winter as it does in the summer to the extent it provides shade. Deciduous trees do not provide the same cover in the winter.

Heat Source Model: Appendix A

Comment, OFIC/DTO: ***Extent of Modeling.*** *The extent of water quality modeling (Map 1) indicates that no temperature data are available for most small streams and tributaries. Without data for small streams, it may be inappropriate to include small streams in this temperature TMDL.*

Response: Temperature data sets were sought from streams that increase the total flow volume more than 5% (calculated at that confluence point). This is because streams contributing less that that 5% or the flow usually have only small and localized influence on the temperature of the mainstem. Smaller streams may not affect mainstem temperatures, but may provide high habitat potential to fish as refuge or nursery areas. Temperature control in smaller streams may be even more beneficial to fish populations than temperature control in the mainstem. Further, shading is easier to provide on smaller streams.

The federal agencies have compiled both temperature data and vegetation information on their lands within the basin (63 % of the basin is in federal ownership), including many tributaries to Little River. This information can be found in Appendix C to the TMDL. While this does not cover every small stream in the watershed, it gives an indication of general conditions. Also, any waterbody that drains to a 303(d) stream must not contribute heat load above system potential. That is, we are considering stream network thermodynamics and the fact that tributaries affect temperatures of streams they flow into.

Comment, OFIC/DTO: ***Temperature Sets.*** *Please explain why the temperature data from 9/15/95 was most suitable for Heat Source simulation.*

Response: The data picked to calibrate the model are, ideally, measured between July 15th and August 15th during a period of steady flow volumes. This is the time of maximum solar loading during the year. Steady flows mean that the system is not being perturbed by sudden changes in irrigation demands or summer rainstorms. For the Little River model, the field data was collected in 1995, before the Heat Source model had even been developed – hence the data set was not as optimal as newer data sets. September 15th was chosen because it was the day of recorded data closest to the late July/early August window. The future condition simulations were run for the solar loading appropriate for the September conditions, and these were compared to a run where July solar loading was substituted. Result between the two runs were very close, within a few percent of each other. Although using the September data set was admittedly sub-optimal, the net effect was shown to be negligible.

Comment, OFIC/DTO: ***Flow volume.*** *Figure 2 indicates that total flow after water diversions was about 23 cfs. This was less than the potential amount of flow diverted (i.e., 28 cfs), or only about 45 percent of total flow. The inflow volume for Black Creek should be labeled in the figure.*

Response: The inflow volume has been added to the label. The commenter's calculation of the percentage of total flow would be correct only if all potential diversions were exercised at the same time. Typically no more than 50 percent of potential diversions are exercised at any one time according to the Watermaster for Douglas County. Total flow is therefore no more than 37 cfs, and total flow after water diversions is at least 62 % of total flow.

Comment, OFIC/DTO: ***Channel substrate.*** *It is surprising that channel substrate was not measured in the field. Why not measure this parameter directly if it is important enough to include in the model?*

Response: Substrate composition was not measured with the same resolution as shade parameters, but the numbers used in the model were derived from field observations. The dominant substrates for Little River and Cavitt Creek were identified by the North Umpqua Ranger District and this generalized data was supplemented by observations taken during flow volume measurements. This resolution was adequate because the energy pathway this parameter is used to model (streambed heat conduction), although measurable, is a relatively minor energy component overall.

Comment, OFIC/DTO: ***Shade Width.*** *We agree that a shade width of 300 feet is beyond the width needed to provide full shading.*

Response: No response necessary.

Comment, OFIC/DTO: ***Shade overhang.*** *Shade overhang can make a substantial contribution to solar blocking. Differential accounting of shade overhang is one of the primary reasons that empirical shade measurements exceed model projections of shade from forested riparian areas. By ignoring the expected increase in shade overhang over time, a significant stream cooling may be ignored.*

Response: We agree that using current shade overhang for future condition simulations (in places where overall shade quality and quantity are expected to increase) will likely act to underestimate future shading. This was done intentionally, so that the margin of safety in the current analysis is on the conservative side.

Comment, OFIC/DTO: ***Model Calibration.*** *The text states that the Heat Source model could not be calibrated without adding a factor for groundwater input for a reach of the Little River. Significant amounts of groundwater discharges probably also occur in other reaches. Without groundwater input to the model, the Little River's channels were assumed to be less complex, wider, and deeper than they actually are.*

Response: Groundwater can easily be added at the modeling stage; the problem is actually measuring groundwater interaction in the field. Additional groundwater was not added to the model until it became clear that this was the only way to make simulated temperatures agree with recorded temperatures at this one site in the middle of the modeled reach. After this was done, the Umpqua National Forest Service hydrologist was consulted. He agreed that the geology immediately upstream of the "problem" site was the best candidate in the basin for providing subsurface flows to the mainstem. Subsequent field measurements the next summer also validated the appearance of subsurface flows of the same general magnitude (approximately 1 cfs – 12% of the flow at that point) and temperature (just under 61 ° F) of those used in the model.

Comment, OFIC/DTO: ***Effective Shading in the Riparian Zone.*** *It would be helpful to provide the reader with an understanding of how Heat Source calculates the "Energy Blocked."*

Response: The total solar flux falling on each segment is calculated and corrected for any local topographic shading. The amount of energy that then passes through the vegetative shade belt in each segment is also calculated. The difference between these two values is the amount of solar flux blocked by streamside vegetation.

Comment, OFIC/DTO: ***Stream Temperature.*** *In figure 20, it seems strange that the Current temperature does not increase at the confluence with Cavitt Creek, but the two projected stream temperatures do. Was the temperature influence of Cavitt Creek only accounted for in the predicted future temperatures? Figure 23b indicates that Cavitt Creek would have a warming effect on the Little River under Current conditions.*

Response: The Cavitt Creek temperature data used for the calibration run were instream measurements taken from a temperature logger placed near the mouth. Both future condition temperatures for Cavitt Creek were expected temperatures based on Heat Source modeling output that used expected future conditions in the Cavitt Creek sub-watershed as input data.

Comment, OFIC/DTO: It is interesting that the Heat Source assumptions did not account for cooling by tributary inflows. Many of the smaller tributaries probably have high Effective Shade and relatively cool temperatures.

Response: Future condition simulations did not "cool" all tributaries down to some possible future temperature – additional cooling that may come from future tributary conditions was considered a "margin of safety" to the analysis.

The present state of smaller tributary shade conditions on streams in federal lands is found in Table 6 of the TMDL, and indicates that while many streams in the upper portion of the watershed have less than 10 % shade loss, compared to their system potential, others have up to 27 % shade loss. If the smaller tributaries have high effective shade and cool temperatures, they will likely not cool down as much in the future, and the current temperature may represent a reasonable future condition as well.

Comment, OFIC/DTO: Maps 3 and 4 on p. 139 and 140 are confusing. Should the five categories in the Map 3 legend be labeled Effective Shade, not Current Shade? Should the Map 3 title read effective shade, not Riparian Shade? What data on the Map 3 is "Observed"? Our understanding is that Effective Shade conditions are derived. What data on Map 4 are observed?

Response: We agree that the maps contain confusing labels, and have relabeled them in the final version.

Comment, OFIC/DTO: ***The Cumulative Effects of Tributary Cooling****. Although the section heading suggests one, a cumulative effects analysis appears to be lacking.*

There appears to be only one temperature effect analyzed—the effect of inflow from Jim Creek to Cavitt Creek.

Response: It is true that the cumulative effects analysis of temperature changes due to upstream conditions are not universal throughout the watershed. This was not possible due to the model construction and the dataset available. The probable future effect of Cavitt Creek on Little River and the effect of Jim Creek on Cavitt Creek were modeled.

Comment, OFIC/DTO: Figure 24 indicates that inflow from a cool water tributary like Jim Creek can help a warmer receiving water like Cavitt Creek attain a target temperature standard that could not be attained by system potential shade alone.

Response: This is true. Increased shade, cooler temperatures from tributaries and increased groundwater/surface water interaction can all decrease temperatures in a stream.

Comment, OFIC/DTO: This discussion is incomplete. Is there a cumulative effect of tributary cooling? Does the analysis imply that tributaries need to be maintained at system potential shade? If tributary cooling was accounted for, would water in the Little River system meet the temperature standard under current Effective Shade conditions?

Response: It is not possible to quantify the margin of safety in the Little River TMDL between what the model calculates and how the watershed actually responds to solar loads. It is conceivable that some combination of conditions might occur that would bring the Little River to the currently modeled system potential condition without some subwatershed being at system potential. It is also possible that the calculated system potential temperatures are not as cold as the Little River could achieve with increased groundwater interaction. This is why the model output must suggest management actions for today, but that future compliance will only be achieved when future stream monitoring shows stream temperatures below the numeric criterion.

Comment, OFIC/DTO: As a reach-based stream temperature model, Heat Source presents significant limitations for basin-wide extrapolation of temperature predictions and the formulation of temperature TMDLs for whole watersheds. It simply does not take into account the range of conditions and linkages among stream segments of an entire network.

Response: The comment about the limitation of the model is not true. Heat Source is capable of modeling stream networks. It does, however, require significant intensive data. If sufficient data and modeling resources were available, models for the significant tributaries could be developed, and the temperature output of each is then used as an input to the model for the mainstem.

Comment, OFIC/DTO: Water temperatures in the mainstem of the Little River are controlled by, and in equilibrium with, their local conditions. Mainstem water temperatures essentially are independent of conditions on the smaller forested tributaries upstream (Brown 1983). Heating or cooling of small forested tributaries will have little or no effect on the mainstem Little River.

Response: Water temperature does seek an equilibrium, but watersheds are a dynamic environment. Solar load increases and decreases during the day and energy can go in and out of the water column by at least five different pathways. That is why an equilibrium condition is calculated for each model segment for each minute of the day. The resulting energy flow between segments as well as tributary inflows are all taken into account to calculate stream temperatures. Some inputs affect temperature a considerable distance downstream, some affect only local conditions. It is agreed, everything else held equal, that very small flow inputs have less effect on the mainstem than large ones.

Comment, OCA: What should the overnight low be in order to establish a lower starting point for the water temperature increases at dawn? At what time does equilibrium temperatures become established? Was equilibrium considered in the modeling effort? What does the monitoring data show? How did the Heat Source model address the equilibrium points and when does equilibrium take place in the basin? Statistical testing of data already in the DEQ database should be conducted using the mathematical laws of probability.

Response: See the answer to the previous question. Additionally, during calibration, the model is balanced to mirror the temperatures recorded instream at six mainstem sites and six tributary sites (for the Little River simulation). At present, we are using the best science and the best tools available.

Comment, OFIC/DTO: Increases in stream solar exposure that may result from allowable limited tree removal in riparian areas under the Oregon Forest Practice Rules probably would be insignificant in terms of increases in stream temperature. Any such increases recover to normal equilibrium temperatures in unaffected areas downstream (Zwieniecki and Newton 1999).

Response: The findings of Zwieniecki and Newton do not hold true in all cases, especially for larger streams which dissipate heat much more slowly.

The Forest Practice Act rules are currently being reviewed to determine their effectiveness in meeting water quality standards. Until the review is complete and any necessary changes to the rules are adopted, current FPA rules apply.

Comment, SJ: First, and foremost, DEQ should incorporate changes recommended by OFIC/CH2M Hill's review of the existing heat source model. This would help address shortcomings in the Report and provide better results for the Little River TMDL, as well as all future TMDLs. Ignoring constructive, professional reviews such as this raises questions concerning the overall and long-term direction of the TMDL process.

Comment, OCA: The model fails to account for thermal heating of all objects according to Physics that: If A = B and B = C then A = C. This equation addresses the natural law of thermal equilibrium and DEQ should not use Heat Source as a model of the thermal environment until this is corrected in the model .

Response: The Heat Source model was peer-reviewed nationally by leading academicians and scientists. The following experts submitted comments that were taken into consideration in refining the Heat Source model:

- Dr. Graham B. Wallis, Dartmouth
- Bruce Cleland, Senior Environmental Scientist, EPA Region X
- William C. Krueger, Department Head Rangeland Resources, OSU
- Dr. Robert L. Beschta, Professor of forest Hydrology, OSU
- Jack Douglas Smith, Ph.D., Omicron Associates

The comments and DEQ responses can be found on the Internet at:
http://www.deq.state.or.us/wq/HeatSource/HeatSource.htm

We believe the Heat Source model has been adequately reviewed and documented. It represents, in the words of Bruce Cleland,

> . . . one of the more comprehensive accounting methods that has been developed to assess water temperature changes in streams. Heat Source incorporates methodologies developed and tested over the past 30 years. I believe that Heat Source is a major advance in the field of water temperature modeling. Simulations are focused on hourly temperature changes using current knowledge of energy sources which deliver heat to stream systems. Many other models predict only daily average and maximum water temperature values. The output form Heat Source provides hourly heat budget and temperature information. This enables a much easier cross-checking of model results with standard equations and easier comparison to actual thermograph data.

We continue to work on and refine inputs to the Heat Source model. As new information becomes available, the methodology will be refined.

Comment, SJ: Tributary stream cooling influence was given little consideration. Previous documentation, such as OFIC' temperature study conducted in the 1990's, has proven that tributary influence on main stem streams can have effects on stream temperature and salmonid refuge.

Response: There is no question that tributary cooling influence can be profound. We focused on Jim, Cavitt and Little River because that is where we had data. Other streams in the watershed should react in a similar way to those that were modeled.

Comment, OCA: Stream heating above a natural temperature could be considered a violation of the state standard, but there is nothing provided in the TMDL that demonstrates that a natural heating cycle has even been established at DEQ. Where is this information?

Comment, OFIC/DTO: We are greatly concerned that the theoretical temperature model predicts that half of the stream reaches will fail to achieve the 64-degree standard at a time when forest cover exceeds that which existed at the time of European settlement of this area. Either the temperature standard is not based on nature (and therefore inappropriate) or the model is not credible.

Response: This either-or statement does not reflect the only two conclusions possible. No one can say with certainty what temperatures in pre-settlement Little River were like. The best evidence, based on the biological needs of cold-water aquatic life, including salmon, resulted in the standard chosen. The model is credible, but within limitations that were expressed in the modeling summary. To reiterate those limitations, the Heat Source model considered temperature decreases that can be brought about by increased shade. Additional temperature decreases that may be possible through modifications in groundwater interaction, increases in base flow or cooling of tributary streams were not able to be modeled without considerable extrapolation from currently measurable conditions. Future monitoring will show how close our predictions come to actual future conditions.

Comment, SJ: Ignoring the influence of groundwater due to time constraints puts the credibility of the entire temperature program into question. Studies show that the average groundwater temperature in the Umpqua Basin is approximately 52 degrees F. Thus, as summer flows decrease, the percent impact of groundwater increases. This influence may even be localized within any given stream reach; yet serves as a valuable source of habitat for salmonid refuge during summer low flows.

Response: Groundwater interaction is very difficult to measure over an entire watershed. Although the question of how much groundwater interaction affected Little River temperatures was not ignored, it is true that the resulting model input data was greatly simplified from what probably exists. One advantage to modeling a single day is that the seasonal changes mentioned in the comment (due to the seasonal changes in relative percentage of base flow due to groundwater input) do not come into play. The utility of these groundwater-dominated sites as refuge areas is unquestioned.

Whether groundwater influence provides a valuable source of habitat for salmon during summer low flows depends on a number of factors, such as whether there is enough water in the stream for fish to survive, and whether residual deep pools provide adequate cover or simply serve as feeding areas for predators.

What has been established is that the mouths of tributaries in the Umpqua basin often provide significant cold-water habitat at the confluence with the mainstem, even when tributary surface flows are reduced or absent. Smith, 2000.

Comment, OCA: Brown, Bestcha and Wetherred, are all modeling attempts, none of which experimentally collected data that verified the influence of shade on stream temperature. The investigators assumed that the water temperatures were too high for the sites and failed to determine what was natural heating versus what was influenced by the historical activities. Reliance on these publications alone has caused an error to be included in the TMDL as the authors of the reported literature did not first determine if the water was thermally polluted. Water "must" heat during a day and empirical data indicates that all streams in Oregon do heat. It must first be determined if the streams are heating an expected amount based on the specific heat and density of the water. Heating above or below the expected rates will indicate reaches that are too warm or too cool. Boyd's Heat Source model fails to approach the problem properly. Heat Source assumes all stream reaches are thermally polluted. DEQ assumes all streams are thermally polluted simply based on the life cycle of the fish. Water temperature is not governed by fish, but instead is governed by the Thermodynamic Laws. Fish and other beneficial uses should be examined after the natural water temperatures are established.

Response: We disagree with this comment. Our approach of dealing with temperature is logical and based on biology as well as physics. No one has temperature datasets from 200 years ago. However, we do know what kinds of native fish were present and their approximate numbers. These fish require certain temperature regimes to propagate plentifully, and these optimal temperatures have been determined in the laboratory or by direct observations of native populations in the field. Since the effect of temperature upon salmonid populations is well understood, determining detrimental temperatures, and basing a standard on those temperatures can (and has) been logically and defensibly done. Using Heat Source, admittedly with some conservative assumptions, we can get an idea of how much shade might be required to reach these temperatures that we infer must have been present.

Continual monitoring during our restoration process is essential. That way our model predictions can be “proofed” all along the way. Our goal is to restore the thermal balance of this watershed with the greatest possible efficacy. If anything in our approach is faulty, it will soon be discovered through field monitoring and our approach can be adjusted. Please see the Adaptive Management discussions in Section 8.2 of the TMDL and Chapter 1 of the Water Quality Management Plan.

Comment, OFIC/DTO: If the shade assumptions in Heat Source were realistic, we would expect measurements of water temperature, recorded in the field in Eastern Oregon, to be much higher than the maximums found in the Little River basin. Oregon Cattlemen's Association has an extensive data collection of East side streams in sagebrush without 76% shade and 140 foot trees. These streams are not warmer than the Little Creek basin streams. In fact, when comparisons were made between the East side streams and streams in the Umpqua basin we discovered that days with similar climate conditions had similar maximum water temperatures. Statistically we cannot find a difference between the Eastern stream and the West side stream when periods of testing were compared.

Comment, OCA: If the shade theory is correct, it should work in a similar manner and provide similar results every place in the state. What is wrong here? Isn't there an error in the calculations someplace? How do you justify shade at various percentages and various widths that are not consistent? The Little River region has more precipitation and produces much more vegetation than the Grande Ronde Basin and it is unclear why those streams aren't already cooler than the Grande Ronde as well as other streams in Eastern Oregon. We have examined Eastern Oregon data sets and find many streams with no shade reaching similar maximum temperatures as the Little River basin.

Response: It is not clear from the comment which streams in eastern Oregon are being referenced. Their condition compared to their native system potential is unknown. They may or may not be in pristine condition.

It is readily acknowledged that other factors besides riparian shade affect stream temperature. Topographic shading, stream aspect, channel cross-section geometry, groundwater interaction, snow melt, and average wind speed are just a few of the additional factors that can influence stream temperature. The eastern Oregon streams mentioned may very well have some of these other factors at work; these factors can certainly affect stream temperatures on the west side of the Cascades. However, even if we agree that these additional factors can and do enter into the overall equations of stream temperature control, one cannot minimize the additional cooling effect that an additional 15% of shade would provide (difference between the current and system potential distance-weighted average effective shade values for Little River).

Comment, OCA: By including a blocking component in the Heat Source model, there is an assumption that blocking solar input at the stream surface will cool the stream and the model predicts what these temperatures will be. Heat Source may have an error in some of the calculations. For many streams in Eastern Oregon there is little or no shade on many miles of streams, but the water temperatures do not exceed those that are found in the Little River Basin. If the Heat Source / shade theory being proposed is correct, then it should work the same everywhere. Field work has been unable to verity its usefulness due to the misapplication of solar radiation influence on water heating.

Response: Another way of stating this comment is that the stream temperature in Little River is no better than some eastern Oregon streams that have little or no shade on many miles of stream. Using these kind of eastern Oregon conditions to “set the bar” on stream potential conditions for the dense conifer forests of western Oregon makes no sense from a fisheries, climatic or ecological point of view. We do not believe it is appropriate to compare streams that are in different ecoregions that have different climatic conditions. Every stream has its own fingerprint in terms of channel morphology, riparian vegetation and flow.

Comment, OCA: Since there are "many factors" affecting stream temperature (page 9) and some are beyond human control such as aspect, climate and weather, how has Heat Source addressed these factors? The IMST (state science team) recently released a report discussing the shade influence and did not conclude that focusing on shade alone could adequately address stream heating in the streams. This topic should be addressed again in the Little River TMDL and provide a better analysis of the potential to create shade at the levels indicated and examine the theory for inconsistencies with what is known about the natural heating laws. We suggest limiting references to other modeling efforts and make appeals to authority through studies that examine water using "water science" rather than "fish science". Study of fish physiology cannot explain the physical characteristics of water. Instead, a study about water characteristics would indicate that some information needs to be included that discusses how fish adapt to different habitat characteristics.

Response: Heat Source takes stream aspect, and weather condition into account for its energy balance calculations. It does not take climate into account because it calculates processes for a one day time span. While taking these factors into account for their contribution to energy loads, Heat Source modeling does not suggest any management to these processes, they are beyond our control. Restoration efforts in the Little River will focus on factors that can be changed by human action and shade is one of them.

Comment, OCA: All shade values targeted in Table 6 exceed 80%. Recovery is suggested to take place in 75 years. If the shade theory were correct, it might be assumed that all creeks in Oregon with 67% shade would cool at the same rate when provided 90% shade. This suggests that other TMDLs in the state, such as the Grande Ronde on the East side, with 7 day maximum temperatures around 75¼F, and 10% current shade should have different water temperatures than the Little River basin which has reaches at 67% shade. However this is not the case. The Grande Ronde TMDL identifies sections of stream that currently only produce 10% shade, have 7 day maximum water temperatures similar to the Little River, but the TMDL target is for a 50%

canopy of black cottonwood while the Little River is to achieve a 90% canopy. Two streams, nearly equal in the 7 day maximum rolling average, but with very different shading components and DEQs approach is to increase shade on both. If 67% shade hasn't kept the Little River below 64¼F, then why will it work on the Grande Ronde River?

Response: This comment correctly points out that riparian vegetation species are not the same everywhere in the state. That is why system potential conditions are modeled for each watershed. Those system potential conditions are based on the probable maximum shade that could be produced by local riparian species composition, local rainfall, and local soils. Applying system potential conditions from eastern Oregon to western Oregon, or vice-versa, is not appropriate. Additional shade is suggested as a management strategy only if current conditions are below those expected at the local system potential, regardless of which side of the mountain the watershed is on.

Comment, OCA: Why are these two TMDLs different? The current shade available on the Little River is more than enough for the Grande Ronde Basin to meet its targets to provide shade and cool streams below the state standards. If 67% shade on the Little River doesn't prevent stream temperatures from climbing above the standard, how will 67% shade in other areas of Oregon be expected to do so? Why does the Little River need more shade than the Grande Ronde Basin?

Response: The TMDL targets are different because the system potential conditions are different. More shade is appropriate on the Little River because western Oregon forest zones grow large and dense stands of trees, which typically provide high levels of shade. Shade also depends on stream width. The wider the stream the less riparian vegetation will provide shade.

Comment, OCA: Page 20: Is there an error here? "Average flat plane solar radiation loads above the riparian canopy in mid-September are on the order of 366 BTU / ft2 /day???????? In referencing Figure 15 on page 134 the available radiation to the Little River system is in the range of 1200 and 1600 BTUs/sq ft/day. How were these estimates derived OR where is the data collected used in the calculation?

Rewrite this and correct it or put in discussion about the derivation of the numbers. Solar radiation is sometimes reported in Langley/day where solar radiation is measured. It is unclear what is being stated or how the figures were developed. 88 BTUs /sq f /day is approximately 1 BUT /sq ft /min over a 12 hour period. Is this what is intended? How many BTUs are being allowed and during which hours are they being applied? Too little discussion is presented to understand what is being modeled and how a determination was made to use the number 88. Also, radiation takes place throughout the day and night. Has that been factored into this?

Response: The commenter is correct that there is an error in this section. Rather than 366 BTUs per square foot per day for flat plane solar radiation above the canopy in mid-September, the correct figure should be an average of 1400s BTUs per square foot per day. An average of 366 BTUs per square foot per day is the amount of heat energy currently reaching the stream surface. The TMDL has been changed to reflect this.

All BTU numbers are calculated from Heat Source-tabulated Langleys and refer to the daily total for all 24 hours, Although it is true that solar flux does not enter the system between sunset and sunrise, other energy pathways move energy through the system throughout the night. These net energy gains/losses are tabulated and accounted for.

The commenter's calculation of 1 BTU per square foot per minute is not accurate. Converting 88 BTUs per square foot per day to BTUs per square foot per minute results in 0.061 BTUs per square foot per minute based on 24 hours, or 0.12 BTUs per square foot per minute based on 12 hours.

Comment, KS: This figure, labeled current conditions, gives the impression that much of Little River meets the temperature standard. However, the table in Figure 14, page 174 indicates that none of Little River meets the standard. Apparently, figure 2 applies to conditions at 4 pm on a day in mid-September in 1995. This leads the reader to the conclusion that the modeling was done for conditions significantly cooler than the seasonal maximum conditions. Some additional explanation would be helpful to avoid confusion.

Response: The table on page 174 refers to the segments of the Little River officially listed on the 1996/1998 EPA's 303(d) list. Instream monitoring data showed that temperatures were above the basin numeric criterion (a seven-day running average of daily highs that was above 64 ° F). These data were collected at specific sites, and the determination of where each water quality limited segments ended was open to some interpretation. Usually, the water quality limited designation remained in place until another temperature logger site produced data that showed no additional water quality limitation or until the headwaters was reached.

Figure 2 on page 11 is based on Heat Source modeling, which produces much higher resolution of the temperature profile in Little River. Using the model to "fill in the blanks" between field measurement sites shows that some areas of Little River do maintain better instream temperatures than others. Also, the model displays instantaneous temperatures expected at 4:00 pm rather then the 7-day running mean used on page 174. The information in these two graphics/tables is indeed different and direct comparison was not intended.

Comment, OFIC/DTO: No temperature data exist for the small tributary streams in the watershed, which comprise most of the stream miles. Consequently, their potential contributions to cooling were ignored in Heat Source modeling. The temperature effects of Effective Shade management along the small tributaries on listed reaches are unknown. Therefore, caution should be used in prescribing TMDLs for small streams, particularly because a proportionately large riparian area could be regulated without data to support load allocations.

Response: For the purposes of temperature modeling, data was collected from larger tributary streams (defined as contributing more than 5% of the flow at that confluence point). Streams smaller than this (in terms of flow volume) have usually been shown to make only small and localized contributions to temperature in the mainstem. That is not to say that these smaller tributaries might not have a high fisheries value based on the habitat they provide which is independent of their temperature control value.

Comment, OFIC/DTO: In reality, the equilibrium temperature is not a constant, but varies with changes in environmental conditions over time and space. For example, as the temperature of the air above the stream rises over time, the water temperature also *will rise. Also, there is a spatial limit to the influence of upstream reaches on the water temperature of downstream reaches because water temperature adjust to the specific conditions in each particular reach, as well as constantly changing solar radiation and air temperature, Downstream water temperature is essentially independent of upstream conditions as long as the stream has had sufficient time to equilibrate (Sullivan and Adams 1990; Zwieniecki and Newton 1999).*

Response: We agree that watershed conditions are never in equilibrium, in the classical sense. The watershed system is dynamically reacting to changing conditions over the entire day. We also agree that there is a limit as to how far downstream a disturbance can influence temperature before more local disturbances predominate. We would, however, make the point that multiple disturbances, that are closely spaced, warm up streams much faster than if they were in their native state. Looking at the temperature profile simulated in system potential conditions proves this. Each watershed has a “thermal reserve” that once used up, is gone. Holding on to this thermal reserve for as long as possible is the goal of our restoration efforts. We have few options to cool down streams once they get warm, we must instead “hold on to coldness” as long as possible.

The conclusions of Zwieniecki and Newton have been challenged due to concerns over study design and data interpretation. Poole, 2001. The conclusions were far broader than what was actually studied. See further discussion in “Spatial and Temporal Patterns of Stream Temperature, Poole at al, 2001.

Comment, OCA: Beschta (1997) showed that shade from vegetation is important for small streams in forested watersheds Beschta noted that over ninety percent of fish-bearing streams in a watershed have summertime wetted stream widths average 10 feet or less. Widths for non-fish-bearing streams are even less. The abundance of streams with narrow channels need to be acknowledge in Effective Shade allocations for listed streams.

Response: This comment speaks to the importance of smaller streams in providing good aquatic habitat. We would only add that fish populations do not live in smaller streams in isolation from the mainstem rivers. The mainstem river must also allow a certain amount of adult and juvenile passage, rearing habitat and even spawning function (depending on the species) to maintain healthy populations.

Comment, OFIC/DTO: The Oregon Department of Forestry has been monitoring changes in stream temperature associated with various riparian management treatments under the current forest practice rules (Dent and Walsh 1997). Using some analytical procedures, they found that there may be a statistical difference between stream water temperatures entering and leaving harvest units with streamside management zones. The uncertainty about whether any increase actually has occurred is due to the very small changes observed and the natural tendency for stream temperatures to increase as they move downstream.   Similarly, Zwieniecki and Newton (1999) report that small temperature increases through operational harvest zones with streamside management zones (SMZs) are followed by a rapid return to the equilibrium conditions of the stream temperature profile. This is consistent with other observations that if streamside management zones are used to maintain shade, any temperature increases are modest, and downstream delivery of heated waters would be prevented.

Response: This is why Heat Source was developed. Instead of looking for changes over just a few hundred yards, it attempts to "connect the dots" over many miles. It can do this because it is calibrated to real instream field measurements collected along the length of the modeled reach. Once the model is balanced to reflect real-time monitoring data, the relative temperature increase (or decrease) rates experienced in different areas starts to come into focus. These observations can then be used to better manage activities in the watershed and guide restoration efforts.

Comment, OFIC/DTO: Zwieniecki and Newton (1999) found that for 14 Westside Oregon streams studies, mean percent shade above and below cutting units averaged 82.6 percent, and decreased within units by only 4.4 to 78.2 percent. Temperature increases associated with increased solar exposure were minor and temperatures recovered to normal undisturbed levels within 500 feet below the cutting units.

Response: While some studies have shown thermal recovery downstream of clearcuts, this is not universally true. For example, there is one reach in the upper Little River (between Hemlock and Clover Creeks) where stream temperatures were simulated to climb almost 10 ° F. in a very short distance, and then remained high for over a mile. The head of this reach was bounded by an old clearcut where harvest had occurred right down to the streambank. This is a case where because of very low base flow, absence of goundwater/tributary cooling and a solar-favorable stream aspect, the energy available overwhelmed the local thermal capacity of the system and excessive temperatures persisted for a distance downstream.

Finally, the conclusions of Zwienieck and Newton (2000) have been challenged based on flaws in study design and overly broad conclusions given the small sample size of the study. See Poole, 2001 for further discussion.

Even if harvest-related increases in temperature are moderated downstream, they still impact the habitat in the area of the harvest. Salmon do need cold water in the tributaries as well as the mainstem rivers, and any stretch with increased temperatures reduces the habitat available for them.

Comment, OFIC/DTO: Sugden and others (1998) demonstrated that selective harvest in riparian buffers resulted in minimal effect on shade in pine and fir forests of Montana and Idaho. Harvest within buffer zones 50' or 100' wide for a distance of 600' on both sides of 10 streams decreased average canopy density by only 5 percent, from 67 to 62 percent, even though mean stand density decreased from 165 to 117 trees per acre.

Response: It is very probable that harvest methods can be (and have been) developed so that their effect on streamside shade production is reduced. Careful management of streamside habitats, to enhance their role in stream temperature control, is the main goal of this TMDL and WQMP, and is consistent with the riparian forest management goals of the Forest Practices Act.

Comment, OCA: Although DEQ has long maintained that the surrogate 'shade' will change water temperatures, the theory violates the fundamental physical laws governing how heating and cooling takes place on earth. Stream temperatures cannot be cooled or prevented from heating via riparian shade when the Physical Laws are applied. We suggest a review of the literature available which experimentally investigates the *application of the Thermodynamic Laws. Measured water temperature should be compared to other components in the watershed in order to determine if the rates of heating are similar among the components based on the specific heat capacity of each.*

Response: Heat Source uses very basic laws of physics to calculate how much solar energy falls on a stream and how that energy is expressed as heat. The premise that solar energy can be intercepted by vegetation is also well accepted. Our conclusion that taking energy out of a system (via plant interception) will result in lower potential energy to that system is an inescapable consequence of the Law of Conservation of Energy. Our review of the science involved only increases our confidence in the underlying assumptions that Heat Source uses.

Comment, OCA: Lumping the expected Effective Shade into groups based on wetted widths is unclear. Rewrite this and include references from literature which concluded a link between wetted widths and shade trees separate from other factors. Wetted widths aren't usually associated with riparian shade. Other riparian vegetation less than tree heights might be associated with a wetted width but what is presented is unclear and is possibly unsound.

Response: Lumping the expected Effective Shade into groups based on wetted widths was done to recognize that the same vegetation will produce varying amounts of shade on streams of varying widths. Smaller streams can be shaded more easily than wider streams. Thus for the Little River, the wider the stream, the less effective is the shading from riparian vegetation.

The wetted widths used were those determined for each segment in the Heat Source model. This will be clarified in the final document.

Comment, BLM: The table on page 19 was taken from the BLM/USFS Water Quality Restoration Plan (WQRP). The calculations were based on federal land only. If you continue to use this table, you should clearly make note of this and also add a caveat that the information shown would be different if the analysis had been done for all lands.

Response: We agree and have made the appropriate changes in the final document.

Comment, KS: Page 15 3rd paragraph Even at system potential, portions of the wide streams will likely to receive more than 88 BTU/ft^{-2}day^{-1}.
Suggested change: In contrast, at system potential vegetation, only 88 BTUs, on the average, will reach each square foot of stream surface each day.

Response: We agree and have made the appropriate changes in the final document.

Comment, KS: Page 15 Loading Capacity and Shade Targets. The interested reader may want to know what kind of buffer is needed to meet the TMDL. Page 15 indicates that the 88 BTU loading is equivalent to 93.7% effective shade but it is unclear how that relates to shade density which is more readily determined by the typical reader. On page 128, the shade density used for the model is 75%, which suggests that topographic shading (@ 100 % density) makes up the difference. This should be made clear so the reader will have a good idea of what shade density is required to meet the TMDL. [Some of the answer may be on page 128 but it is covered by the Figure 10 chart.]

Response: The language regarding buffers has been changed, and additional language has been added to clarify the shade wall concept.

Comment, KS: Page 6: Target identification: Loading Capacity: Is the goal to reach the "system potential" or the "Current management potential?" In addition, averaging over the entire length could result in the cool headwaters bringing the average down at the expense of the critical lower reaches.

Suggested change:
No more than 88 BTU /ft^2/day solar loading as an average measured over any one mile of the perennial stream length, or attainment of maximum effective shade reasonably possible at a given site under current management requirements.

Response: The goal is to reach system potential. Loading Capacity was determined using system potential. Current management potential was modeled only for comparison purposes. The language in the final TMDL has been changed to reflect an average value for the Loading Capacity, but based on system potential rather than current management potential.

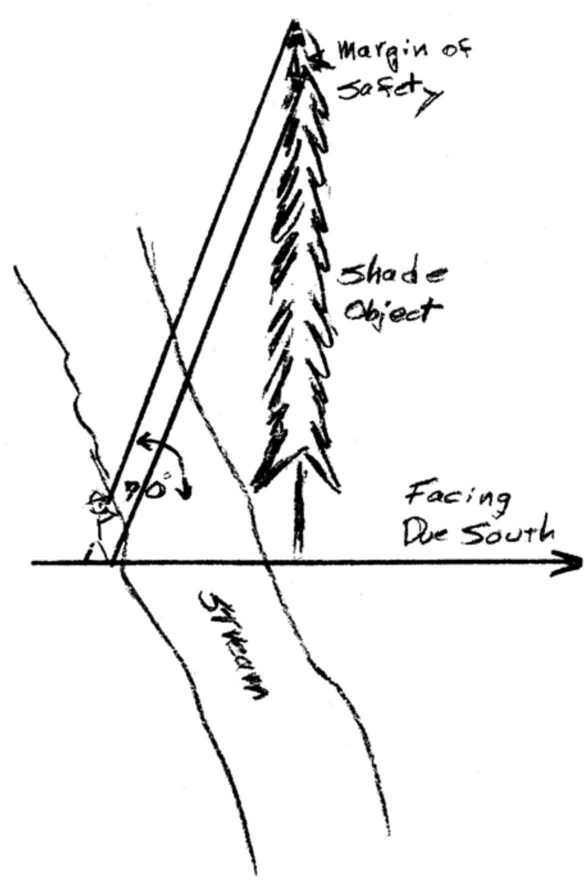
Comment, KS: Page 15 Shade Targets. Since the TMDL is based on stream shade, it is reasonable for a reader to want to know how to identify specifically the vegetation that is essential to fully shade the stream. The following is some suggested text to address this subject:

Since the shade across a stream depends on tree height and the position of the sun, knowing the exact range of the sun's movement will determine the tree height necessary to fully shade the stream.

Procedure for the Determination of Essential Shade-Wall

During the summer the sun moves in an arc starting in the morning in the NE and rising across the sky to a maximum at the due South direction at noon and then descending and setting in the evening in the NW. This arc gets higher as the summer progresses reaching a maximum noon altitude angle at the summer solstice on June 22. This is the most restrictive time for stream shading.

	Solar
Direction	Altitude
East	36°
SE	65°
South	70°
SW	65°
West	36°



The table shows the maximum altitude angle of the solar path for a latitude of 43.25°for different aspects. This latitude is consistent with the Little River planning area. The table can be used to define the effective shade wall that is necessary to fully shade a stream during any time of the year. For example, in the sketch the observer *is looking due south across the stream and sees the top of the vegetation on the opposite bank at a 70° angle. In this case, the shadow of the tree will extend from the base of the tree to or beyond the observer at any time of the year when the sun is at the noon position.. If the observer turned to either the SE or the SW, the effective shade angle would be 65°, which determines the shadow length for mid morning and mid afternoon.. This procedure can be used to determine the maximum solar path and the corresponding shade wall needed to fully shade a stream for any time of the day. Vegetation that extends above this imaginary line will not provide shade to the stream at any time.*

It is worth noting that the shade wall extends to the north and south directions since the sun rises in the NE and sets in the NW during the summer months.

Note also that the height of the observer adds a "margin of safety" since the shade wall height could be reduced by the height of the observer if s/he is standing upright at the edge of the stream.

The density of the shade wall is also important. To meet the TMDL requirement of 88 BTU $ft^{-2}day^{-1}$ requires that the shade wall block at least 75% of the direct sunlight.

Even though not all the trees along a stream are essential for shading the stream, it is a good general practice to maintain a well-stocked buffer on both sides of the stream. The tree roots in a buffer zone can help prevent stream banks from eroding during high water and reduce soil erosion from water flowing down off of the side slopes. The buffer zone provides good habitat to terrestrial and aquatic life that is beneficial to the area. Tree-line buffer areas may pass flood flows more effectively than brush-lined streams resulting in lower flood levels and less flood damage. Buffers are also a source of woody material for streams, providing essential structure needed to maintain high water tables and diverse aquatic habitat. A full sized buffer can also affect the microclimate of the riparian area by reducing wind speeds and soil temperatures causing additional reduction in stream temperature.

It may take a long time to develop an effective shade wall. Trees are generally better than brush since they will eventually reach higher and block more sunlight. Properly managed, shade buffers should become denser and taller each year until they reach the fully mature site potential condition.

Response: The suggested language has been added to the TMDL to provide more guidance to landowners regarding meeting the Load Allocation for temperature.

Comment, KS: The comments regarding stream aspect may be misleading and result in poor management decisions. Examination of the solar path will show that an east-west stream may be exposed to the sun two times per day, albeit at a lower radiation level, if the topographical horizon is less than 36 degrees above the horizontal. If there are tall shading the stream

Response: There is always a danger in expressing general principles. Any process affecting stream temperature at a specific site is acting in concert with multiple other processes that can work to magnify or negate its effect. DEQ did not mean to imply that N-S streams have no bearing on temperature control, only that riparian shading is more effective along E-W reaches, mile-for-mile and everything else being equal, than along

N-S reaches. DEQ did not mean to imply that N-S streams cannot provide temperatures that support robust fish activities. DEQ agrees that shading on north-south streams is important.

Comment, KS: The above calculation [on page 142 of the draft] suggests that the amount of measurable cooling by the tributaries is quite small. However, this fact should not devalue the importance of the tributaries. The real importance of the tributaries may be to provide cold-water refuge in a relatively small zone at the confluence. Any small improvement in the tributary temperature could have a very significant effect in the quality and quantity of habitat in this zone. These refuge zones may be critical to the survival of the cold-water species during the warm summer months.

Response: We agree that tributaries are critical habitat for cold-water species during the summer, and that improvement in temperature could significantly enhance salmonid habitat.

Comment, BLM: Page 23,: the first paragraph mentions "significant groundwater inflow." It would be helpful to describe this further or quantify it and reference who documented it.

Response: DEQ and OWRD documented this 2-3 cfs gain in this reach over and above contributions noted from the tributaries in this reach during an intensive survey to collect pH data in August, 2000. This will be noted in the TMDL.

Comment, KS: The bold text statement seems to imply that any change in temperature in a tributary will influence the temperature of main channel. Stream temperature is not conservative and it is possible for the effects of a temperature change at a given point to be partially or fully dissipated before reaching the main stem.
However that is not to say that additional cooling is not beneficial and generally desirable. Additional cooling at any point in the system that exceeds 64 deg will benefit the cold-water dependent organisms that are trying to survive in that area. Also, additional cooling that lowers the temperature at a tributary confluence will increase the size and the quality of the thermal refuge zone at the point of confluence. These refuge sites may be extremely critical to fish survival during the low flow-high temperature period.

Response: Currently it is true that most systems (in the summertime) increase in temperature as one goes downstream. Many streams, including Little River, are so divorced from their innate temperature control processes (like groundwater interaction and natural channel geometry) that we underestimate the potential gains to be had. Heat Source only looks at temperature control through shade interaction and misses these potential temperature reducers too. We do not mean to imply that temperature reduction in small tributaries is only important for how it affects mainstem temperature.

Comment, KS: Page 141 ***Tributary Cooling****. The text indicates that Jim Creek can cool Cavitt Creek to the 64°F standard however, the information presented does not appear to support that statement. Page 174 indicates that the drainage areas for Jim Creek and Cavitt Creek are 2,757 and 32,157 acres respectively. Based on drainage area, one would expect the flows in Cavitt Creek to be about 10 times greater than Jim Creek. Figure 21 on page 141 indicates that under current conditions Cavitt Ck above*

Jim Creek is about 77 °F. Figure 3 on page 124 indicates that Cavitt Creek is flowing about 6 cfs at the mouth.

The general mixing formula found on page 21 is commonly used to determine effect of tributaries. Assuming a very conservative case of equal flows for Jim Ck and Cavitt Creek, the following inputs were use:

> *Jim Creek Flow = 3 cfs*
> *Cavitt Creek above Jim Ck Flow = 3 cfs*
> *Cavitt above Jim temperature   77 °F*
> *Cavitt Ck below Jim temperature   64°F*

Applying the formula yields 51°F for temperature of Jim Creek. Based on this information it appears unlikely that Jim Creek is cold enough to reduce Cavitt Ck to 64 degrees.
Assuming Cavitt above Jim is reduced to 72°F; Jim Creek would have to be at 56 °F with equal flows to cool Cavitt to standard.

Apparently, the data shows a sharp drop in temperature below Jim Creek however, tributary contribution is probably not the complete explanation.

Response: Calculation of summertime base flow based only on watershed area is confounded by local differences in the timing of groundwater releases relative to surface flow and water withdrawals by humans. That is why these flow volumes were measured directly.

The correct figures for doing a mass-balance calculation for the system potential condition are:

Flow/Temp of Cavitt Cr just upstream of Jim Creek 3.99 cfs/ 70.2 °F.
Flow /Temp of Jim Creek at Mouth 1.98 cfs/62.1 °F

This results in a flow of 5.97 cfs and a temp of 67.5 °F in Cavitt Creek just below the confluence with Jim Creek. The statement that Jim Creek cools Cavitt Creek to below the standard is in error – It should read that the Jim Creek influence cools Cavitt Creek about halfway to the numeric criterion. This has been corrected in the final version.

Comment, OCA: No one has been able to replicate the Heat Source model theory that shade will cool the water. It is not realistic when compared to on-site data collections. The natural heating that has been identified in watersheds using empirical data indicates that the limitation of 200 BTUs in the Little River watershed by providing a shade block over the stream to prevent direct solar radiation is flawed. Other streams in the Umpqua River Basin that have limited direct solar radiation exceed the state temperature standard and the exceedances have been accounted for through statistical analysis of the data collections. There is no reasonable assurance that the Little River watershed will benefit from the DEQ prescription indicated by the Heat Source model. There is less than a 50-50 chance that the shade theory will work. Until DEQ can demonstrate where it might work, and when it might work the assurances are at best "wishful thinking".

Response: Shade does not cool water, it simply prevents it from getting warm (although shade can provide a microclimate that can result in cooling water). The Heat Source model substantiates this. Present conditions of vegetative cover are associated with an environment where most streams are simply too warm to support the fish populations that have historically used them. Data collection from around the state, the Little River watershed included, show time and time again that the warmest stream temperatures occur at stream locations with the least riparian shade (everything else being equal). Ultimately, stream temperatures may be more or less sensitive to riparian shade than the model predicts. Only vegetative regrowth and continual monitoring will prove this on watershed scales.

Comment, OCA: Does the shade theory hold up during winter? The Heat Source prediction suggests that during the winter months, streams with conifers providing shade will demonstrate a pattern of frozen water where there are trees and open water where the shade is missing. Is this how Heat Source works during the winter? Is water colder with conifer shading in January compared to stream reaches without shade? If the theory is correct it must work the same regardless of time or place. It cannot just be a "summertime" model if it is correct.

Response: The presence of shade does not provide active cooling such as a refrigerator would. It simply blocks the ambient solar energy. Less energy is available in the winter, so air and stream temperatures are lower than in the summer. Shaded reaches might be cooler than they are today, but low stream temperatures have not been identified as a limitation to native fish species in Oregon.

Comment, OCA: The model run was conducted for September. The temperature assessment has been made for a single day during a single year. The standard is calculated on a 7 day moving average and the TMDL should at least make an assessment using a similar formula rather than a single point in time on a convenient day.

Response: The model output is different than the data statistic that the numeric criterion is based upon. The model does not attempt to predict what the rolling 7-day mean of daily highs value might be in the future. It does calculate how many BTUs will be blocked from the stream compared to today if the estimated system potential conditions are met.

Comment, OCA: DEQ Temperature Theory

DEQ has elected to establish a nonpoint TMDL using the following steps in their reasoning:

1. *Ignore the numerical 64¼F temperature standard.*
2. *Switch to an estimated energy input from sun beams.*
3. *Talk about the difficulties of using a sun beam number to set the TMDL.*
4. *Ignore the limitations of the model and begin talking about vegetation as a screen to prevent sun beams from striking the water.*
5. *Change the subject and substitute vegetation with a new idea called shade.*
6. *State that it's hard to put a number on shade.*
7. *Change the subject again and talk about site potential in the basin.*
8. *Create a new number to describe how many trees might grow tall enough to make a shade screen.*

9. Find a way to transform a shade screen into a number so DEQ can use the Boyd Heat Source model (which was developed in 1996) to estimate the amount of shade needed to block all those sunbeams.
10. The TMDL decides:
a. Land will have to be occupied by a specific amount of vegetation.
b. Trees must be located on enough stream banks to create a wall of very tall trees.
c. The trees must cast shadows and block sun beams.
d. The TMDL shade must prevent the River and tributaries from heating during July and August above the 64¼F standard.
e. The River must be cooled up to 15 F degrees during the July, August and the first part of September.

Response: We disagree that these listed steps characterize our TMDL process. Our description of the process would better be described as:

1. Identify streams that have excessive temperatures.
2. For an identified stream, calculate the amount of solar energy available to the system.
3. Measure the amount of solar energy entering the system today by using equivalent parameters (which describe shade) that are easier to measure in the field.
4. Identify the sources of data used, the quality assurance steps taken during that data collection and discuss the limitations of the model using a sensitivity analysis method.
5. Calibrate the model so that predictions replicate the specific instream temperature data collected in the system.
6. Identify realistic system potential conditions for watershed riparian vegetation and channel characteristics.
7. Enter the system potential data into the model to predict the difference from today's observed conditions and the expected future conditions.
8. Use this modeling data as a guide in setting TMDL allocations for temperature.

These steps are consistent with TMDL requirements and Oregon's temperature standard.

Comment, OCA: DEQ has made an "assessment" and an assumption, that the streams are directly influenced by various land practices that decreased shade. The assumption that direct solar radiation is the cause of the high temperatures in the streams and is demonstrated in the TMDL and model leads us to conclude:
1. This is a determination that sunshine is a pollutant.

Comment, OCA: DEQ is telling us that sunshine is a pollutant, but science and scientists have never described sunshine, earth's energy source, as a pollutant. Agriculture is being told that they must now tame nature and prevent sunshine from polluting the streams using shade and riparian vegetation as a surrogate standard. What is the listing distance from a stream that makes each tree a viable part of the shade screen? What density, in trees per acre will be effective?

Response: Sunshine (heat energy) is not a pollutant unless it leads to excessive temperatures based on human-caused changes to the landscape. The total amount of energy falling on the Little River watershed is the same as it has always been. However, human caused disturbance has increased the amount of solar energy which can enter the stream. The energy now available is beyond that which can be assimilated by the system, and that does, essentially, pollute. The distance and density of vegetation that can be grown is dependant on local conditions. This is factored into the assumptions in the model.

Comment, OCA: If it's the sun causing the heating, then maybe DEQ and EPA should think about what this implies. How much light is present with 76% shade and 140 foot (height) trees? Might this be too dark for other kinds of life? Is it possible that achievement of shade levels throughout the basin between 50-70% might harm another plant or aquatic species? There are no assurances that the beneficial use "fish" will in fact be helped and not harmed by the increased shade and overhang as suggested in the TMDL plan. If shade will solve all the problems then why is shade not being used at the point source sites as remedy for the permits?

Response: Areas with natural vegetative conditions exist in Oregon. Our indicator fish species and associated aquatic life flourish in these systems. Our monitoring over time will mark the progress of stream temperature improvement as well as animal/plant populations. If shade toxicity is ever described as a limiting factor, our management options will be reassessed at that time. Also, it is important to point out that the vegetion assumptions are not artificial. They are based on local conditions and appropriate vegetation based on those conditions.

Comment, OCA: What elements have been used to justify site potentials that can support vegetative components suggested in the model output...Appendix B? Where are the natural conditions that must be used to make land management prescriptions to ensure the plan can be implemented with success? How many areas have natural background conditions that cannot be changed according to the model predictions?

Response: In all cases, it was attempted to use conservative assumptions for system potential simulations. Said another way, all model runs used data which estimate the watershed's temperature response to future conditions. Incorporated into this is a margin of safety to ensure the standard is met. Real life conditions that do not fit the data used for future condition modeling are expected. Only continued monitoring will validate exactly how far the watershed will respond to different management strategies implemented after the TMDL is completed.

Comment, OCA: What other management options has DEQ considered that could cool the river water? Adaptive management and Best Management Practices should not be limited to a single activity to solve all the pollution contribution problems.

Response: DEQ is not prescribing any approach. The ultimate goal is to reduce stream temperatures to levels that support the beneficial use – in this case native fish populations--and meet the temperature standard. Effective shade is used as a convenient surrogate for measuring direct solar flux in BTUs/SqFt/Day. Increasing shade is not the only method of reducing stream temperature. As has been stated before, decreasing stream temperature through increased groundwater interaction and better channel geometry's are also desirable methods.

Comment, OCA: Aristotle (384-322 BC) proposed one of the earliest heat theories. It simply stated that: Heat is what produces the sensation of hotness. The Greeks used the theory and over time stated it as: Heat flows into our bodies creating a sense of hotness and flows out of our bodies and we sense coldness. Rudolph Clausius (1850-1868) developed the modern day theory of heat which describes heat as one kind of energy which can be exchanged for another any time without a net loss on the total energy of the universe. Clausius' work established the Laws of Thermodynamics. Heat and temperature are not the same thing. Heat is a flow of energy and temperature is a macroscopic property of the object. When two different materials are brought into thermal contact with each other, they reach thermal equilibrium, but do not experience the same changes in temperature because of their different specific heats and masses.

Heat Source apparently is using the Aristolean theory of heat rather than the modern day theory. Clausius' work does not support the idea that shade will be effective in lowering stream temperatures.

Response: The first part of the comment supposes that our understanding of Thermodynamics does not mesh with that of Clausius. The commenter suggests we apparently misunderstand that " … the modern day theory of heat which describes heat as one kind of energy which can be exchanged for another any time without a net loss on the total energy of the universe." It is our opinion that we are applying the Laws of Thermodynamics correctly. The First Law of Thermodynamics does state that heat is one kind of energy, and that energy can be transformed from one form to another. The Second Law of Thermodynamics goes on to state that that energy transfer is NEVER 100% efficient, that is, the ENTROPY of the system always increases in a closed system.

The second part of the comment uses heat transfer through conduction as an example. Heat Source accounts for conductive heat transfer as well as four other energy transfer mechanisms, all of which are compatible with each of the Laws of Thermodynamics. By accounting for all of these relative energy pathways, the resulting effect on stream temperature is ultimately calculated.

Comment, OCA: If the temperature TMDL assessment has errors, the nutrients (nitrates, phosphates, pH etc) are all suspect. We suggest giving serious consideration to providing a TMDL for the point source reaches after the general laws of science have been reviewed.

We disagree that our analysis has errors of a magnitude that would negate the conclusion. No analysis is perfect, that is why we seek to quantitate the probable error of that analysis. It is our responsibility to specify the quality of our observed data , outline our analysis methods and identify any simplifying assumptions we have used in the analysis. This is how all science, research and applied, operates.

pH Comments

pH Loading Capacity

Comment, EPA: Section 5.5: The appendix describes pH conditions which would be present under system potential while the discussion here focuses on the current management potential scenario. Thus, a graph on pH's expected under at the maximum potential under current management should be included in the appendix. It should be explained why current management potential was utilized instead of system potential.

pH is also listed as a pollutant impairing Cavitt and Wolf creeks. Please add language which states how this approach will also lead to the pH criteria in these two waterbodies.

Response: The current management potential temperatures were used in the pH modeling because they were available before system potential had been modeled using Heat Source. The requested graph has been included in the appendix.

Emile Creek also is listed for pH. Language has been added to the final TMDL explaining that Cavitt, Wolf, and Emile Creeks are expected to respond similarly to Little River due to their similar geology, climate, land cover and elevation. There was insufficient data to fully model Cavitt, Wolf, and Emile Creeks, and best professional judgment was exercised in the determination that these Creeks would respond similarly, but probably more quickly than the larger Little River.

*Comment, EPA: **Section 5.6:** Add the word "load" before allocations in the second paragraph.*

Response: The requested change has been made in the final version.

*Comment, EPA: **Section 5.7:** Since the permit currently contains an effluent limit for pH, it is appropriate that a wasteload allocation be developed for the Wolf Creek Conservation Center. Since the current pH limit appears to be protective of instream water quality, it is possible to utilize that limit as the pH WLA. In addition, since heat load is the surrogate utilized in this TMDL, the temperature WLA established in Section 4.12 should be referenced.*

Response: The recommended changes have been incorporated into the final TMDL.

*Comment, EPA: **p. 35, second bullet:** If the current management potential scenario was utilized in the pH evaluation instead of the site potential scenario utilized in the temperature allocations, this would also provide for an additional margin of safety.*

Response: Language has been added to the Margin of Safety discussion for pH indicating the additional margin of safety from the use of the current management potential.

Comment, LRC: The Little River Committee comments that forest practices can have a detrimental impact on pH. The comments suggest that practices such as clear cutting, road building, slash burning, fertilization, and the use of fire retardants strongly impact *pH. The comments also cite a Colliding Rivers Research study that builds a good case for concluding that elevated pH in Little River is the result of the cumulative effects of upstream logging, exacerbated by solar exposure and modified stream morphology that provides favorable substrate for algae. Concern was also expressed that the reason that nutrients are measured in low concentrations is that the nutrients are utilized soon after being released in the system.*

Response: The Department agrees that the concerns of the Little River Committee are valid. Forest practices can have a significant impact on instream temperature that can exacerbate periphyton growth that can cause pH standard violations. The temperature and pH TMDLs target restoration of riparian habitat to system potential. The restoration of riparian vegetation as required by the TMDL will result in multiple benefits for Little River, including a reduction in thermal loading and solar radiation exposure, improved channel morphology, and increased large woody debris, all of which should reduce periphyton growth and pH.

The Department also agrees that reducing nutrients in Little River would have benefits. The pH modeling and data review indicate that the pH standard will be achieved through thermal loading reductions. Nonetheless, all efforts to reduce nutrients would also help to reduce periphyton growth and pH. The increased riparian vegetation realized through implementation of the temperature/pH allocations can help to reduce nutrients by reducing upland erosion, filtering runoff, and reducing streambank erosion. Nutrient reduction management measures should also be explored in the water quality management plan and implemented where possible.

Comment, OCA: The TMDL narrative provides no indication of an understanding of pH.

Response: Appendix B includes a discussion of photosynthesis and the carbonate buffering system, and the carbon balance pH model utilized for pH modeling.

Comment, OCA: What are the pH ranges of the soils in the riparian areas? The TMDL should make a distinction between background levels and those measured that exceed the standard. What are the natural pH levels?

Response: It was beyond the scope of data collection efforts to characterize the pH of the soils and to determine background pH. Monitoring surveys were the most comprehensive as could be conducted at the time. The Federal Clean Water Act requires that TMDLs be determined with available data, with any uncertainty being factored into a margin of safety.

Little River pH observed at rivermile 26.0 is 7.9 SU, well below the 8.5 SU pH standard. It is highly unlikely that additional monitoring and analysis to estimate background pH would have resulted in different allocations. The pH model used to determine the TMDL used the rivermile 26.0 pH as the baseline condition, and was calibrated to observed pH at downstream locations where standard violations occurred. The TMDL allocation model scenario used system potential stream temperatures as inputs, and the output predicted that the reduced temperature would result in the pH standard being achieved.

Comment, OCA: Are the nutrient concentrations found in Little River similar to those in the Tualatin River? What part of the concentrations are due to natural and other activities?

Response: Nutrient concentrations are much lower in Little River than in the Tualatin River. Much lower nutrient concentrations can support periphyton growth in Little River than the phytoplankton growth in the Tualatin River.

No effort was made to estimate the background nutrient concentrations in Little River. The pH TMDL modeling predicted that the pH standard would be achieved through instream temperature reductions. Nutrients were not allocated in this first iteration of the TMDL.

Sediment Comments

Several general comments were received, which will be addressed first, followed by responses organized by the Little River Draft TMDL Table of Comments.

General Comments

Comment, EPA: As noted above, EPA wishes to acknowledge the thorough nature of this analysis and the depth to which you have investigated the numerous sources of sediment. In addition, Section 6.7 was very well written and clearly presented the logic and assumptions utilized in developing the LC. The link between the narrative water quality criteria and the established loading capacity was also clearly presented.

Response: No response necessary.

Comment, BLM: Where is the riffle crest area in a stream?

Response: Typically a riffle crest is the tail-out of a pool or glide containing substrates and flow velocities conducive to salmonid spawning relating to the beneficial use needing support.

Comment, OCA: The comments in the Table 13 on Page 36 under Comment column across from WQS Attainment Analysis do not make sense.

Response: The sediment analysis identified the management-related sediment as compared to reference condition. Land managers feel that 70 % of this load is controllable. Reducing the management-related sediment this much will result in attaining the range of the target values for background level contribution, thereby attaining the standard.

Comment, OCA: How far must an activity be to avoid displacing sediment into a stream and how much is released into a stream due to and activity.

Response: Various degrees of land-altering disturbances and slope, coupled with intensity and duration of precipitation, distance from entry into stream and buffer width and vegetation type in those buffers are just a few of the variables that are involved with answering this question. Buffer widths vary depending on designated land management agency or group. All buffer widths should be wide enough to reduce the amount of sediment delivered to the stream sufficiently to mimic background levels. These guidelines are developed in the Northwest Forest Plan, Forest Practice Act and Umpqua SB1010 Water Quality Basin Plan.

Applicable Water Quality Standards

Comment, OFIC/DTO, SJ, OCA: Does a violation of the sediment standard exist?

Response: Resident fish and aquatic life, salmonid fish spawning and rearing are the beneficial uses affected by sediment, and protected by the sediment standard. The sediment standard that applies to the Little River Watershed, as well as waters in all basins, is:

> The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry shall not be allowed. OAR 340-41-0285(2)(j)

In order to be listed on the 303(d) list, the following documentation of a sediment standard violation is required:

> **WATER QUALITY LIMITED CRITERIA:** Documented that sedimentation is a significant limitation to fish or other aquatic life as indicated by the following information:
>
> > Beneficial uses are impaired. This documentation can consist of data on aquatic community status that shows aquatic communities (primarily macroinvertebrates) which are 60% or less of the expected reference community for both multimetric scores and multivariate model scores are considered impaired. Streams with either multimetric scores or multivariate scores between 61% and 75% of expected reference communities are considered as streams of concern. Streams greater than 75% of expected reference communities using either multimetric or multivariate models are considered unimpaired.
> >
> > -or-
> >
> > Where monitoring methods determined a Biotic Condition Index, Index of Biotic Integrity, or similar metric rating of poor or a significant departure from reference conditions utilizing a suggested EPA biomonitoring protocol or other technique acceptable to DEQ.
> >
> > -or-
> >
> > Fishery data on escapement, redd counts, population survey, etc. that show fish species have declined due to water quality conditions; and
> >
> > Documentation through a watershed analysis or other published report which summarizes the data and utilizes standard protocols, criteria and benchmarks (e.g. those currently used and accepted by Oregon Fish and Wildlife or Federal agencies (PACFISH)). Measurements of cobble embeddedness or percent fines are considered under sedimentation. Documentation should indicate that there are conditions that are deleterious to fish or other aquatic life.

Information contained in the 1995 Little River Watershed Analysis and Appendix (USFS/BLM) indicated such impairments to salmonids and macroinvertebrates, warranting the listing and therefore requiring the development of a Total Maximum Daily Load for sediment for the Little River Watershed.

The Watershed Analysis Aquatic Section reviewed smolt trap information and how sediment impacts the coho, chinook and steelhead rearing success by the early emergence of sac -fry (larval fish) due to excessive fines in the rearing gravels. The various stream surveys noted in the appendix likewise indicate an excessive amount of fine sediments reducing habitat conditions.

The WA noted that eight sites were sampled for aquatic insects in 1994. No previous data was available using similar protocol. Of the eight sites sampled most rated fair or fair to poor. Fine sediments were noted as partial reasons for reduced taxa richness.

Based on data submitted, DEQ believes the listing is justified.

Numeric Targets and Instream Numeric Targets

Comment: Several commentaries questioned the appropriateness of the numeric targets and in stream indicators used in the TMDL since they paralleled figures used in the Redwood Creek TMDL in Northern California.

Response: The information used to place Little River and Cavitt Creek on the 303(d) list was related to salmonid production and macroinvertebrate populations. Instream target values are appropriate to determine beneficial use attainment.

PERCENT FINES
The beneficial use impacted in both Little River and Redwood Creek TMDLs is the support of the salmonid fishes namely coho, chinook and steelhead. Life histories for these fishes are similar and need similar rearing habitat and water quality needs.

As noted by EPA in the Redwood Creek TMDL, Tappel and Bjorn (1983) predicted that 14% fines<0.85 mm in combination with about 30% fines <9.5mm would provide an average of 50% survival to emergence for steelhead and an average of 70% survival to emergence for Chinook salmon. These were considered acceptable rates of survival to emergence for EPA who recognized that there would be spatial and temporal variability around the target level for instream indicators.

Oregon ODFW has established Habitat Benchmarks (desired conditions) to promote successful propagation of Oregon salmonids using various stream conditions. Included in these benchmarks are the desirable and undesirable levels of silt-sand-organics in riffles. The values are noted for volcanic and sedimentary parent material. Undesirable levels for volcanic and sedimentary are greater then 15 and greater than 20 respectively. Desirable values are less than 8 for volcanic and less than 10 for sedimentary parent material. The mean of these values is 13.25 somewhat similar to the value noted by Tappel and Bjorn. DEQ recognizes, as did EPA in the Redwood Creek TMDL, that these target values for instream indicators will have some spatial and temporal variability. When additional monitoring data is available for Little River, these target values can be reassessed and amended if necessary.

Comment, OCA: What does Little River need for good fish habitat? How many fish are currently being lost to sediment levels?

Response: ODFW has established a variety of desirable and undesirable benchmarks for streams in forested lands.

The sediment TMDL was developed as a requirement of the federal Clean Water Act resulting from an impairment to the beneficial use, (salmonid rearing and macroinvertebrate populations). Upon improvements (i.e., reductions in sediment loading as well as pH and temperature) populations should attain system potential in the watershed.

Comment, OCA: What is the frequency and protocol used in the surveys completed for determining the amount of fines in Little River?

Response: The stream surveys conducted and used in the Little River Watershed Analysis were variations of the Hankin and Reeves (1988) survey methodology, and standard protocols were used. Channel substrate is analyzed for every unit of habitat (pool, riffle, glide etc.), and therefore the number of habitats in a reach determines the frequency. For example, in one survey of 5,373 meters of Little River mainstem, 48 riffles were identified, so in this reach a riffle substrate composition was recorded about every 112 meters.

Hillslope Targets

Comment, OFIC/DTO: Some of the hillslope target values in Table 15 should be amended to reflect FPA guidelines

Response: The table will be amended to reflect FPA guidelines while maintaining the guidelines proposed by the federal agencies.

Problem Statement

Comment, OFIC/DTO, SJ, OCA: The macroinvertebrate data reported and methodologies used are not supportive of the conclusion that these populations are impaired.

Response: The macroinvertebrate summary information displayed in the TMDL and taken from the 1995 Watershed Analysis does not display the metric analyses conducted on each site sampled. A biotic index assessment protocol developed by Aquatic Biology Associates was used to analyze the macroinvertebrate data and is similar to the Index of Biotic Integrity. The evaluation of the various metric scores indicated that several sampling stations were below the expected macroinvertebrate community to a degree of being significantly impaired. Some of those stations have been sampled since 1994 and, as noted in the monitoring portion of the TMDL and Federal Water Quality Restoration Plan (Appendix C to the TMDL), these stations will be sampled periodically to determine trends. There appears to be no over-all current trend indicating there are still environmental stressors impacting the expected macroinvertebrate communities. High temperatures and pH could also be contributing to these lower scores. Reaching system potential temperatures and pH will improve water quality to the extent each reach is capable. Evaluation of macroinvertebrate data can be modified if warranted in the future iterations of the TMDL when revisited.

Comment, OFIC/DTO: There are concerns about the use of macroinvertebrate indices and their ability to distinguish impacts due to sedimentation based on several assessment indices. The commenter noted the work of Relyea and others at Idaho State University. These indices noted by OFIC included species richness, %EPT, EPT/D ratio and Simpson's methodologies.

Response: Relyea notes that these bioassessment methodologies may lack sufficient resolution, and the development of the Fine Sediment Biotic Index (FSBI), an index that identifies species present, absent, tolerant and intolerant to sediment in substrates. The index does have the resolution to discriminate between various percentages of fine sediment. Further refinement of this protocol may distinguish species composition at 10% increments of substrate sediments.

Comment, SJ: Did we consider the1980 Mt. St. Helen's events and its subsequent recovery?

Response: This is outside of the scope of the Little River TMDL. However, a Washington State Conservation Commission web-site report indicates that ". . . most streams are naturally recovering from the disturbance. The North Fork Toutle (most directly impacted by the debris torrent) is one exception where recovery has lagged behind. … A number of habitat constraints still limit production within the subbasin including: limited floodplain, off channel, and pool habitat, high width-to-depth ratios and poor riparian conditions that contribute to elevated stream temperatures, lack of instream cover and LWD, and unstable substrate conditions. Hydrologic immaturity and high road densities within the subbasin contribute to increased peak flows and additional channel instability. High road densities and numerous stream adjacent roads also contribute excessive amounts of fine sediment to stream channels."
http://www.conserver.org/salmon/reports/wria26sum.shtml

Comment, TH: DEQ should not be doing a lot of sediment work when it is all natural and should not punish people because of mother natures impacts.

Response: The TMDL determined the management related sediment inputs. Non-management related sediment contributions are considered background. The NWFP, FPA and Umpqua Basin SB1010 Area Water Quality Management Plan all have guidance to minimize sediment delivery to stream channels and are the foundation for land management.

Sediment Sources (Source Loading)

Comment, OFIC/DTO: There were several comments regarding the sources of sediment noted in the TMDL The following items in the source assessment are outlined and DEQ responses follow the comments.

Response: EPA requires that a TMDL is required to have certain essential components noted on page two in the TMDL that include:

Geographic Description
Source Assessment

Loading Capacity
Loading Allocations
Margin of Safety
Seasonal Variation and Critical Conditions
Reasonable Assurance of Implementation
Public Involvement

Surface Erosion

Comment, OFIC/DTO: The amount of sediment eroded from timber harvest was not quantified in the sediment budget and therefore the section should be deleted.

Response: As noted in the draft TMDL, the buffers and guidelines in the NWFP, FPA and Agriculture Water Quality Management Area Plan for the Umpqua Basin are current management strategies for reducing sediment delivery to streams. Surface erosion from forestry was not included in the sediment budget calculations, but since it could be a potential source, discussion in the TMDL is appropriate.

Mass Wasting

Comment, OFIC/DTO: "The landslide inventory attributes identified in the 1995 federal Little River Watershed Analysis and North Fork of the Umpqua River Stillwater Sciences sediment budget . . . were never intended to be used within the sediment budgeting procedures employed in the Little River TMDL." Other commenters had concern about the methodology and values used to compute the target allocations and subsequent sediment reductions needed by managed lands to attain those targets and suggested using approaches in the 1999 ODF Report, Storm Impacts and Landslides of 1996: Final Report.

Response: The TMDL recognized the shortcomings of an aerial photo-based landslide inventory for the Little River watershed. This is why a field-based inventory was done as part of the TMDL analysis. After an evaluation of the field-based inventory, it was determined that due to the amount of area inventoried and variability in the data, it would be inappropriate to extrapolate these rates to a watershed scale. The inventory of a larger area of the watershed may have arrived at the same uncertainty and would have been cost prohibitive.

Furthermore, we agree that some of the problems associated with determining management/natural landslide ratios recognized under this section of the comments are inescapable. Any management/natural landslide classification has the uncertainty associated with quantifying the indirect and cumulative effects of management on sedimentation and stream flows. In other words, it is impossible with a field based inventory to separate "natural" erosion processes from the management-related effects of altered stream flow and sediment regimes. Also, there is an equally uncertain relationship between the timing of management activities, storm events and intensity, and cause and effect relationships between the two.

The TMDL sediment budgeting process was designed as an assessment of input sources. This assessment of inputs to the sediment budget identifies landslides as a primary sediment source. The field-based inventory conducted in Tuttle (reference watershed) and Engles (managed watershed) Creeks validated the following cause and effect relationships between management-related landslides also recognized in the 1999 ODF report:

- The majority of landslides entering channels occurred on steep slopes adjacent to stream channels.
- Geomorphic processes have a large influence on landslide processes. In the Little River geomorphic setting, the majority of landslide sediment volumes that were delivered to streams were found to occur in the inner gorge of streams in Landslide-Earthflow Complex terrain.
- Most landslides are not road-related, but road-related landslides deliver larger volumes of sediment.
- “Highly impacted” stream channels correlate with road-related landslides.

The 1999 ODF Report discusses limitations of that study, at page 3:

> "The combination of variation in storm characteristics (Precipitation intensity and duration) and variation across the landscape to susceptibility of landsliding resulted in a range of hillslope and channel responses even within the February and November storm study areas. This variability can limit the ability to separate management-related effects or from natural variability. The focus of this study was on two individual storm events and therefore the results cannot be extrapolated to predict long term conditions. Doing so could either under-predict or over-predict landslide rates on forestland."

The report goes on to say that "Efforts were made to only include landslides that occurred during the February and November storms. Observed landslides that were significantly re-vegetated, had consolidated deposits, or which were known to have occurred in earlier years were not included in this database." This methodology would limit the extrapolation of information over time as noted in the study design.

The report goes on to discuss landslide density and erosion volumes as they relate to four groups of forest stand age (0-9, 10-30,31-100 and 100+ years). When comparing the four study areas and age classes, no statistically sound relationships for both density and volume of sediment delivery were found. The report does say that,

> ". . . on a case study basis, the Scottsburg study area clearly has a much greater landslide density in younger age classes. In addition, in three out of four study areas there is a greater landslide density and landslide erosion volume in recently clearcut stands (0-9-year age class) as compared to the mature forest stands. Therefore, for the most landslide prone landscapes, these results indicate there is a 75 percent chance that recently clearcut areas will have greater landslide erosion or density as compared to mature forest stands after a very large storm. For the 10 to 30 year old forests, three out of four study areas had lower landslide densities than found in mature forest, and two of four study

> areas has reduced erosion volume. For the 31 to 100 year old forests, three out of four study areas had both lower landslides and erosion volume as compared to mature forests. Therefore, for the most erosion prone landscapes, these results also indicate that 10 to 30 year old forests have a 75 percent chance of having lower landslide density than mature forests. In a similar light, 31 to 100 year old forests have a 75 percent chance of having both lower landslide density and erosion (sediment delivery to channels) as compared with mature forests."

This reduction in rates suggests some hydrologic recovery in these intermediate age stands.

Near the beginning of the report other landslide studies are discussed. On page five the report notes "The 1997 study by Swanson et al. utilized an aerial photo inventory to determine landslide frequency in clearcut areas, and a ground survey of 1300 acres to find landslides in older forests. The study was conducted in the Mapleton ranger district of the Siuslaw National Forest and overlapped one of the study sites used for the ODF study. Swanson found that erosion rates were higher in clearcuts than unmanaged stands. The clearcut erosion rates ranged from 1.2 to 1.3 times higher than unmanaged stands for most landtypes. For the most landslide prone landtype, clearcut erosion rates were 4.0 times higher than in unmanaged stands. Since not all landslides can be detected on aerial photos even in clearcuts, and the study compares an air-based clearcut sample to a ground-based in forest sample, these erosion rate ratios may be artificially low. A 1978 study by Ketcheson and Foelich field investigated small watersheds (100 acres or less) in the Mapleton area that were unaffected by forest roads. The watersheds were generally inspected by walking on one side of the drainage carefully inspecting each headwall. They found 104 landslides in a 1,076 acre study area. Landslide data were collected on failures as old as 15 years with unspecified dating techniques. This study found that the erosion rate in clearcuts was approximately 3.7 times higher than that of undisturbed forests." The managed to unmanaged erosion rates are higher than the 3.1 (649 tons/sq mi. /210 tons/sq.mi.) managed to unmanaged sediment ratio used in the TMDL.

The EPA regulations indicate that load allocations are "best estimates of the loading which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading" [40 CFR 130.2(g)]. DEQ has reviewed and assisted in gathering additional data to try to refine the values noted in the sediment budget and load allocations. As noted earlier, DEQ realizes there are some uncertainties with the sediment TMDL. As additional data and methodologies are available we will revisit the sediment TMDL to adjust targets and amend the TMDL accordingly. The periodic review of information including monitoring data will help determine the effectiveness of management measures put in place to address sedimentation issues in Little River.

Peak Flows and Bank Erosion

Comment, BLM: The federal lands occupy a larger percentage of the watershed and the statement regarding most of the potential high peak flows and low hydrologic recovery areas being on federal lands is misleading.

Response: Language has been added to the TMDL to clarify the percentage of the watershed ownership and hydrologic recovery.

Comment, OFIC/DTO: The comment noted that the discussion in the TMDL on page 45 inferred that timber harvest has increased the frequency of flooding.

Response: The paragraph noted is intended to show the correlation of harvest rates in the watershed and some of the largest storm events witnessed during current times. Canopy cover in some of these areas had not fully recovered and sediment delivery to channels increased as noted in table 19 on page 48 of the draft.

Comment, OCA: OCA commented that the GIS depiction of rain on snow peak flows does not describe the composition of the 40 year old stands.

Response: Figure 16 page 50 of the draft TMDL does not include the stand age data (<40 years). This information is combined on Figure 17(page 51) with the areas noted in red as having both high peak flow and low hydrologic recovery (Stands < 40 years of age). Sites with a canopy closure of less than 70% have not attained hydrologic recovery.

Comment, OFIC/DTO: Given the absence of any evidence that peak flows and bank erosion from timber harvest have increased in the Little River watershed, this purported mechanism should be deleted from the TMDL list of sediment sources.

Response: In order to differentiate stream bank erosion potential, a screening approach was adapted from the Augusta Creek Study on the Willamette National Forest (Cissel et al, 1998). The method was adjusted for the North Umpqua River Subbasin. This approach was used to identify the sub-watershed areas with higher rain-on-snow susceptibility and lower hydrologic condition because of canopy removal. Also, this product was overlaid with the geomorphic landtype mapping for Little River to identify upslope areas where these conditions are present and potentially contributing to streams in landslide-earthflow terrain with inner-gorge features. These areas have the higher potential to influence stream bank erosion of the inner-gorge as observed in the Tuttle Creek survey (1999) on the Umpqua National Forest. This screening approach distinguishes between general stream banks and those in the inner-gorge landtype. As in the Augusta Creek Study, the purpose was to identify higher risk areas on the Federal lands. Cissel et al concluded that “The rain-on-snow potential map does show, however, two extensive areas of highest risk.” (Cissel, 1998)

It is reasonable to conclude that the same processes produce sediment in the Little River watershed.

Roads

Comment: OFIC/DTO "…it hardly makes sense for the TMDL to identify roads as a material source of sediment…(since) elimination of such a source would be immeasurably small in the channel of Little River, and would have virtually no impact on beneficial uses."

Response: Surface erosion from roads, including "contributing ditch lengths," is a sediment source, albeit small compared to landslides. However, in addition to being a direct sediment source, "contributing ditch lengths" cause indirect and cumulative effects on both stream flows and sedimentation:

- Contributing ditch lengths represent a 30% extension to the stream network in Little River (LRWA, H-29) and affect the magnitude and timing of peak flows (Jones, J. A., 2000).
- As much as 37% of the road network on private lands in the Western Cascades are connected to streams (ODF, 1998. Forest Road Sediment and Drainage Monitoring Project report for Private and State lands in Western Oregon).
- Sediment blockage reduces culvert capacity and, as a result, may indirectly contribute to the ineffectiveness of road drainage structures to disconnect road ditches and streams (ODF, 1998, p. 12).
- Accelerated streambank erosion, a cumulative effect of road ditch connections to streams, mobilizes sediments adjacent to stream channels, particularly in the inner gorge stream segments of Landslide-Earthflow Complex terrain in Little River (Draft TMDL, Appendix C, p. 189).
- Valley inner gorges are among the most landslide prone geomorphic landtypes and most sensitive to forest management (Wolfe, M. D. and J. W. Williams, 1986. Rates of Landsliding as Impacted by Timber Management Activities in Northwestern California).

Sediment contributions from roads are a part of the sediment contribution from management activities and are included in the sediment budget.

Ditches

Comment, OFIC/DTO: The TMDL presents no data or analysis to support the hypothesis that roads have increased peak flow in the Little River watershed and should be deleted from the list of sediment sources.

Response: There are two separate opinions on whether roads influence peak flow response. Researchers from the U. S. Forest Service Pacific Northwest Research Station and the Department of Geosciences at Oregon State University have drawn conclusions that link roads in varying degrees to peak flow increases. However, researcher with the National Council for Air and Stream Improvement stated that their analysis did not support the same conclusion. The following statements are from recent research papers relevant to Little River watershed in the Western Cascades of Oregon:

> "The addition of roads to clear-cutting in small basins produced a quite different hydrologic response than clear-cutting alone, leading to significant increases in all sizes of peak discharges in all seasons, and especially prolonged increases in peak discharges of winter events. These results support the hypothesis that roads interact positively with clear-cutting to modify water flow paths and speed the delivery of water to channels during storm events, producing much greater changes in peak discharges than either clear-cutting or roads alone."… "Roads alone appear to advance the time of peak discharges and increase them slightly." (Cite from Jones and Grant: Peak Flow Responses to Clear-Cutting, Roads. Water Resources Research, vol.32, no.4; p970; 1996)
>
> "While this work does not prove that roads cause increases in peak flows, it supports the hypothesis that road segments linked to the channel network increases flow routing efficiency and hence provides a plausible mechanism for observed increases in peak flows." (Cite from Wemple, Jones, and Grant: Channel Network Extension by Logging Roads in Two Basins, Western Cascades, Oregon. Water Resources Bulletin, American Water Resources Association; vol.32, no. 6; p1206; 1996).
>
> "In basins with roads in this study, the subsurface flow interception effect produced moderate (13-36%) increases of peak discharge events with >1 year return periods, and increases persisted for decades. However, road effects on subsurface flow interception appeared to vary according to road design and placement relative to soil depth and hillslope position." (Cite from Jones: Hydrologic Processes and Peak Discharge Response. Water Resources Research; vol. 36, no. 9, p 2638; 2000).
>
> "Thomas and Megahan did not refute that the road network may contribute to increase peak discharges; instead, a variety of field and modeling efforts have supported Jones and Grant's hypothesis that roads can affect flow peaks." (Cite from Jones and Grant: Comment on "Peak Flow Responses to Clear-cutting and Roads in Small and Large Basins, Western Cascades, Oregon: A Second Opinion" by R. B. Thomas and W. F. Megahan; Water Resources Research; vol. 37, no. 1, p177; 2001.

Not all papers have supported the hypothesis that roads influence peak flows. Measured responses have been varied that included decreased, no change, and increased peak flow. In reply to Jones and Grant, Thomas and Megahan (2001) made the following comment:

> "We do not deny that roads may increase peak flows in some situations. However, there is also evidence from both empirical watershed studies [Springer and Coltharp, 1980; King and Tennyson, 1984] and modeling studies (M. Wigmosta, personal communication, 2000) that roads can decrease flows as well." (Cite from Thomas and Megahan: Reply - Comment on "Peak Flow Responses to clear-cutting and Roads in Small and Large Basins, Western

> Cascades, Oregon: A Second Opinion" by R. B. Thomas and W. F. Megahan; Water Resources Research; vol. 37, no. 1, p182; 2001.

The type of road interacting with the local geology, topography, and climate can affect the outcome (Beschta and Reiter, 1995). However, when evaluating the potential influence of roads on runoff events, Reiter and Beschta identified the following ways roads might affect runoff:

> "…(1) increased surface runoff from compacted roadways because of reduced infiltration rates, (2) interception of subsurface water by cut slopes, and (3) more rapid routing of water to stream channels via road ditches and culverts (in essence the ditch system may operate much like an extended stream network)." (Cite from Reiter and Beschta: Cumulative Effects of Forest Practices in Oregon, Oregon Department of Forestry, chapter 7 – effects of forest practices on water, section 7.2.3, p18; 1995)

The road ditches are not physically or functionally (i.e., dimensions, flow capability, roughness, aquatic habitat, and seasonal flow response) the same as streams but roads have the potential to extended the overall stream network as cited above by Wemple, Jones, and Grant (1996) and Reiter and Beschta (1995). In modeling land use change effects on hydrology, Bowling, Lettenmaier, Wigmosta, and Perkins (1996) recognized roads as one of the potential influencing mechanisms:

> "….construction and maintenance of forest roads which channel intercepted subsurface flow and infiltration excess runoff to the stream network more quickly." (Cite from L. C. Bowling, D. P. Lettenmaier, M. S. Wigmosta, and W. A. Perkins: Predicting the Effects of Forest Roads on Streamflow Using a Distributed Hydrological Model, American Geophysical Union poster presentation; San Francisco; CA, 1996.

In summary, the development of the Little River Water Quality Restoration Plan for the Federal lands in this watershed addressed potential factors that could influence the water quality and in this situation the peak flow. Roads appear to have a potential influence on runoff efficiency, which could affect volume of flow. Although peak flow increases in Little River have not been determined, the condition of the landscape and channels in contrast with the watershed studies in the Western Cascades certainly suggest peak flow increases to be the case. Drawing from relevant studies suggests that roads with ditches draining to streams can have an influence on timing and amount of peak flow. For the Federal lands, it was decided to recognize roads as a mechanism of influence on peak flow. DEQ has similar thoughts and recognizes roads as a mechanism of influence on peak flow for other lands in the watershed.

Stream Crossings

Comment, OFIC/DTO: The TMDL and the 1995 federal Little River Watershed Analysis do not demonstrate that "diversions" have added to the sediment budget of Little River.

Response: The limitations of the Stillwater Sciences sediment budget inputs for Little River were investigated in two small-scale field inventories that were designed to inventory the storm impacts and landslides of 1996 in Tuttle and Engles Creeks (Draft TMDL, p. 59). These Little River inventories support the conclusions about the size and stream channel effects of road-related landslides that are reported in a recent, field-based landslide inventory conducted by the Oregon Department of Forestry (ODF, 1999. Oregon Department of Forestry Storm Impacts and Landslides of 1996 Final Report). In fact, a debris flow feature initiated by a road drainage diversion dominates the landslide data for Engles Creek.

Comment, OFIC/DTO: "…no analysis or presentation of data (in the 1995 federal Little River Watershed Analysis)…demonstrates that the 100-year flood design versus…the 50-year design demanded by the Oregon Forest Practices Rules would affect the sediment budget of Little River."

Response: The road/stream crossing inventory for federally managed roads in Little River was re-evaluated to determine water diversion potential and the risk and consequence of stream crossing failure (Draft TMDL, p. 53).

The Little River Watershed Analysis assessment of culvert failure potential quantifies failure potential differences for 50 and 100-year flood events at stream crossings with drainage areas greater than 100 acres (LRWA, appendix H-27). Of 189 culverts at stream crossings identified, 146 would fail with a 50 year flood flow versus 153 for a 100 year flood. This result is a reflection of the small difference between flow volumes for the two events predicted for catchments larger than 100 acres. In other words, there is little difference in drainage structure design that would accommodate flows of 50 year versus 100-year flood events.

Improperly maintained or designed crossings can fail during storm events and sediment will be delivered. This is a potential source and therefore is included in the sediment budget discussion.

Large Woody Debris and Sediment Storage

Comment, OCA: One comment had questions regarding the capability of large woody debris to store sediments and other functions it provides regarding fish values.

Response: The stream surveys conducted in Little River indicate a lack of large woody debris, essential to maintaining a diverse stream channel. The function of LWD is noted in the Independent Multidisciplinary Science Team Sept. 8, 1999 Technical Report 1999-1 "'The function of large wood varies with the size of the stream. In smaller streams, large wood can generally span the channel. There it becomes an important structural element that increases the frequency and volume of pools, traps organic material and slowly releases nutrients to the stream, provides substrate and food for aquatic invertebrates, and traps fine sediments. The smaller stream channels are also the conduits that deliver much of the large wood to the channels lower in the watershed. Large wood increases channel complexity, obstructs and diversifies currents, and creates features of salmonid habitat, such as plunge (created by water flowing over logs), lateral (along the bank), and backwater pools (Spence et al. 1996)."

Adequate amounts of LWD in smaller streams will function to store more sediment reducing sediment loads to the larger receiving stream. Storm events can mobilize LWD however, LWD of sufficient size can endure storm events and trap other smaller wood pieces reducing the amount of material transported downstream potentially causing damage.

Comment, OCA: Why does some LWD store sediment and other does not?

Response: LWD orientation (vertical vs. horizontal) can determine if a piece of wood stores sediment or may create scour. Those sites that did not store sediment were recorded in this category.

Sediment Budgets

Comment, OCA: Where is the area discussed as a "reference condition?"

Response: The area in the Little River watershed sediment TMDL noted as a reference area is the Tuttle Creek area. It was selected as being the least disturbed by land management activities.

Loading Capacity

Comment, EPA: ***p. 68, background loading:*** *The background loading should be expressed as a load allocation. Thus, the TMDL (LC) = 405 = 0 (WLA) + LA (nonpoint source loading) + LA (background loading)**.***

Response: The recommended changes have been incorporated into the final TMDL.

Comment, EPA: ***p. 68, load allocation:*** *The load allocation must be applied to individual sources or responsible management agencies. The sentence presenting the final load allocations should be modified accordingly. One suggestion: "Thus, a Load Allocation of 195 tons per square mile per year to applied to each DMA with management responsibilities in the Little River Watershed - USFS, BLM, ODF, ODA, and Douglas County.**"***

Response: The recommended changes have been incorporated into the final draft.

Comment, OFIC/DTO: The comment questioned the use of a 70% reduction in sediment from human-caused inputs.

Response: The amount of sediment in excess of background contributions is attributable to human inputs. A portion of this input may not be responsive to treatments and therefore is deemed uncontrollable. Reviews of other TMDL efforts indicated a wide range of controllability of these human-induced inputs. As noted in the draft TMDL on pages 63 and 65, a 70% reduction in management related sediments is the initial target. The 70% reduction of human induced sediment is discussed later in the draft TMDL and, with the reduction of management related sediment inputs, results in the attainment of the range of sediment within background loading predictions.

Habitat Modification Comments

Comment, EPA: last paragraph, second sentence: I suggest you also specifically state that a TMDL is not being developed. One suggestion: "Because a pollutant ... does not apply and thus, a TMDL has not been developed."

Response: The recommended changes have been incorporated into the final draft.

Comment, SJ: Habitat Modification. There appears to be no accounting for large wood inputs over time. Science has proven that increases in stream structure (logs and boulders) will influence sediment loading and storage, water temperature and salmonid habitat.

Response: We agree that large wood can play an important role in stream habitat, and the lack of large wood was in part the basis for the Habitat Modification listing on the 303(d) list.

Large wood is accounted for in the sediment TMDL. One of the hillslope targets is to place large woody debris (see Section 6.8, Restoration Actions and Milestones). The federal Water Quality Restoration Plan (Appendix C) has a detailed discussion of the role of large wood (see Habitat Modification section).

Public Participation

Comment, EPA: The second and last paragraphs should be edited, as appropriate, in the final version.

Response: The recommended changes have been incorporated into the final draft.

Water Quality Management Plan

There were several comments regarding statements in the Water Quality Restoration Plan (Appendix C to the TMDL/WQMP) developed by the federal agencies for use on their lands in the watershed. Those comments have been passed on to the federal agencies for their use and will not be addressed in this document.

Comment, EPA: At present, the Little River WQMP is a general framework, identifying DMAs and programs, and laying out a pathway for more detailed planning and tracking. As such, except for the federal water quality restoration plan section, it has only general, conceptual ties to the TMDL load allocations. We understand that this document is a first iteration of the Little River WQMP. Some parts of it were completed before the TMDL was completed (the AWQMP for example). Because the document is general and conceptual, and because the programs and agencies run on separate tracks, it is not clear what the unifying mechanism is that would consistently look at the watershed as a whole, piecing together the seven DMA implementation plans. From this WQMP, we cannot even get an idea whether or not the DMAs coordinate with each other in this watershed. Chapter 7 indicates that full implementation and monitoring plans will be submitted by the end of 2001. Where are they sent? Who reviews them and asks for modifications? It sounds as if DEQ will be trying to follow seven separately spinning wheels, based on annual reports. We believe that a coordinated approach, where data and technical information is shared among DMAs, would be more effective and efficient.

Response: DEQ will attempt to coordinate implementation among all DMAs as resources permit. The Umpqua Basin Watershed Council and its Technical Advisory Committee are two groups that are involved with coordination of watershed recovery, and include representatives of the major landowners and DMAs in the watershed. DEQ has been working actively with the Watershed Council since 1995, and participates regularly in the Technical Advisory Committee meetings. The TAC plays an important coordination role among the various agencies and interests doing work in the watershed.

An example of Watershed Council-facilitated coordination involves the detailed road risk assessment on Cavitt Creek in the Little River Watershed. The Watershed Council obtained funding and secured matching funds from private timber, the Umpqua National Forest, and the Bureau of Land Management to support the development of a protocol for road risk assessment, followed by application of the protocol to 242 miles of roads in the Cavitt Creek drainage. The partners have continued to cooperate in efforts to secure funding for implementation of the work identified as necessary by the risk assessment.

Comment, EPA: There is another factor worth mentioning. It is becoming more widely recognized that the spatial and temporal patterns in aquatic temperature conditions are important, particularly for salmonids who need well-connected, well-distributed cold water areas throughout the aquatic system. That concept is an important one to recognize and articulate because it affects decisions on which protection and recovery actions will be undertaken and where. We suggest adding a brief description of the concept in the "Condition Assessment and Problem Description" section. For more detail, see Poole and Berman, 2001 (attached) and EPA Issue Paper 3, "Spatial and Temporal Patterns of Stream Temperature," (also attached). The federal WQRP takes *the concept into account in descriptions of protective and restorative priorities, and particularly in the discussion of potential refuge basins (page 216).*

Response: A brief description of the concept has been added to the final TMDL.

Comment, EPA: With the TMDL now in hand, EPA believes that the existing 1010 plan should be revised to better align with the TMDL load allocations. Since the scope of this TMDL is smaller than the 1010 plan, will there be a revision specifically for the Little River? If not, when will the Umpqua AWQMP be revised and what will form the basis of that revision?

Response: It is probable that, due to resource constraints, the Umpqua AWQMP will not be revised to incorporate Load Allocations until all the TMDLs for the Umpqua Basin are completed, projected to be at the end of 2002.

Comment, EPA: While the sentence on page 238 states that the FPA provides a broad array of water quality benefits and contributes to meeting water quality standards for water quality parameters such as temperature, an in-depth look at data and analyses show that modifications are needed to meet specific load allocations in specific places like the Little River. We will continue to work with the processes in place to review and revise the Oregon Forest Practices Act. We recently provided comments to both ODEQ and Oregon Department of Forestry (ODF) on the adequacy of current forest practices to meet temperature water quality standards. We concluded that there are water quality impairments due to forest management activities even with FPA rules and BMPs. Consequently, we would expect that those rules and BMPs be revised and improved to better align with allocations in TMDLs intended to meet water quality standards. Otherwise, the temperature impairments will persist and water quality standards as called for by this TMDL will not be achieved and recovery of salmonid species may be compromised.

Response: DEQ agrees that it is critical to determine the adequacy of current Forest Practice rules to meet the Load Allocations of this, and other, TMDLs.

DMAs and the watershed groups are also encouraged to take credit for stewardship activities that have been undertaken which are not required by FPA and which help achieve the targets set forth in this TMDL.

*Comment, EPA: **Wastewater Treatment Plant, Chapter 6, p. 102** - While the effluent is not a significant contributor of the pollutants of concern in these TMDLs, it is a source of pollution. The first sentence in this paragraph should be changed accordingly.*

Response: The first sentence has been changed accordingly.

*Comment, EPA: **Confined Animal Facilities***
The plan does not describe confined animal facilities and whether or not they are an aspect of agricultural operations in the Umpqua Basin which should be addressed

Response: Confined animal facilities, as they are currently defined, are not a significant aspect of agricultural operations in the Umpqua Basin, although grazing is an important land use. The Department of Agriculture is working on identifying operations which meet the proposed new EPA definition of confined animal facilities. If any are identified in the Umpqua Basin, they will be addressed through the AWQMAP.

Comment, EPA: The plan rightly points out that monitoring is crucial and speaks of a monitoring strategy for this plan which would include tracking of landscape conditions and response of the chemical, physical and biological aquatic conditions. Who will develop this strategy and when?

Response: The monitoring strategy will be developed and implemented as part of DEQ's implementation activities.

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Draft Little River TMDL
Public Hearing
7-10-01
Glide Community Center

Presiding Officer: John W. Blanchard

The informational portion of the hearing was opened at approximately 6:10 PM. An explanation of the history and background regarding 303d listing issues was presented as
well as specific informational on the draft TMDL by the three listed parameters currently being addressed; temperature, pH, and sediment. After the informational presentation a question and answer session was conducted. (Questions were also responded to during the presentation.)

The formal hearing was called to order at approximately 7:30 as the presentation and Q &
A session ran longer than the original hour allocated. (Original tape on file.)

Three persons signed in to provide testimony:

Nancy Stern. Ms. Stern decided not to testify but instead submitted written comment.

Dan Newton. Mr. Newton was no longer present and did not return to testify .

Tom Hatfield. Mr. Hatfield stated that the notification for this meeting had been very poor and that he found out about it by chance. He stated the notification needed to be redone and DEQ needed to have another public hearing in 60 days.
All stakeholders in the Little River drainage need to be notified and all groups and agencies that have worked in cooperation with DEQ in the preparation of the draft
TMDL, including SWCD, Watershed Council, and others.

Mr .Hatfield also stated that he saw no" . . . credible, scientifically substantiable , empirical evidence here backing you. . ." We need peer review and replication of the science to show research has been done correctly and can be duplicated in other places.

We shouldn't be getting out of bounds and not be doing a lot of sediment work when it is natural. We shouldn't punish farmers because mother nature dumps a bunch of sediment in a stream, that's wrong. We need a reasonable, rational approach to this so that we are not breaking everybody and running them out of the area.

Mr .Hatfield also complained that the CD Rom provided to him was not compatible with his computer even though he has latest equipment. He could not get the information to prepare for this hearing.

After Mr. Hatfield's testimony, there were three more requests from the presiding officer for anyone else to come forward.

The hearing was then closed at approximately 7:45.

Submitted by John W. Blanchard
Little River Draft TMDL Presiding Hearings Officer