TOLT RIVER WATERSHED ANALYSIS

RIPARIAN FUNCTION ASSESSMENT MODULE

The following report summarizes the results of the riparian function assessment module conducted for the Tolt River watershed. All products, including forms and maps, have been reviewed by the Tolt Watershed Analysis participants and their comments have been incorporated.

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4/9/93

Date

Prepared for Weyerhaeuser Company

In accordance with
Standard Methodology for Conducting Watershed Analysis
Chapter 222-22 WAC, Version 1.10
Washington Forest Practices Act Board Manual

Tolt Watershed Analysis
Riparian Function Summary

Methods

Riparian areas in the Tolt watershed were examined using aerial photographs and field reconnaissance data to assess their current condition as sources of large organic debris (LOD) and shade. 1991 (1:12,000) photographs were available for USFS land in the headwaters, and 1990 photos were available for the remainder of the basin. 1992 (1:63,400) photos were used to update the information where necessary. Shade (% canopy closure) was measured with a densiometer during fish module surveys in January-March 1993 or during earlier temperature studies (Doughty and Caldwell 1992, Weyerhaeuser Co. unpublished data 1992). Historical stream temperature data were available from studies by Stober et al. (1983), Seattle Water Dept. (1988), Tulalip Tribes (unpublished, 1991, 1992), and Weyerhaeuser Co. (unpublished, 1992). Target shade values were based on elevation data taken from USGS 1:24,000 topographic maps (see Watershed Analysis manual for details). A map wheel was used to estimate lengths of streams reported in the following summaries.

Deviations from the manual

The riparian module procedures refer only to streams. Lakes and wetlands were included in both LOD and shade assessments for three reasons: (1) many of these are fish-bearing waters and so they are classified as types 1-3, (2) they are numerous, and (3) riparian leave strips are required by law.

There are ten lakes counting the regulating basin and the reservoir. There are over 30 wetlands that are classified as type 1-3 and numerous other type A and B wetlands. The same methods used for streams were used to estimate shade and LOD conditions along lakes and wetlands, although they may not apply.

Modifications

There were no modifications to the riparian descriptions or hazard calls on the maps. Modifications, specifically the size of riparian trees appropriate to form stable LOD in the adjacent channel, were identified in synthesis. An additional map (dd-5) not required by the manual was created to portray the five types of LOD recruitment situations identified during synthesis. These situations were defined using information from the riparian and channel modules. Basically, all fish-bearing stream segments were placed into one of four groups based on a combination of their LOD recruitment potential and the relative amounts of in-channel LOD (Figure 1). Riparian conditions were arrayed from bottom to top, highest (young hardwood) to lowest (old conifer) hazard, and arbitrarily divided into two groups. Channel conditions were (roughly) rated according to whether they met or missed the Bilby and Ward (1989) LOD targets. The 2x2 matrix is intended to help focus efforts on maintenance or restoration of riparian function for LOD recruitment. RF1 describes a situation where the riparian zone contains sufficient numbers of large trees to supply the stream with LOD. RF2 occurs where the riparian zone is again in good condition, but the adjacent stream presently lacks LOD. RF3 occurs where the channel has plenty of wood, but the riparian zone doesn't, and at some point a gap in wood recruitment will develop. RF4 is the worst situation where neither the riparian zone nor the channel have any LOD, and it would potentially be a long time before these elements have recovered. A fifth situation (RF0) was identified for certain non fish-bearing segments where LOD was judged to be vitally important for protecting downstream fish habitat. In these channels, wood functions to store sediment and dissipate flow energies that might otherwise impact fish habitat downstream.

Slight modification of the riparian shade hazard map was necessary to display the three temperature situations identified.

Results

LOD Recruitment

The type, age, and density of trees in riparian areas along both sides of all Type 1-4 waters in the Tolt basin are shown on map dd-1. The relative hazards these represent with regard to LOD recruitment are shown on map dd-2. Map dd-5 displays the location of each of the five LOD recruitment situations identified in the Tolt. Generally, situation RF1 was encountered infrequently. All of the mainstem and a large part of both forks are rated as RF4, principally because of the need for very large trees to become stable LOD in the large channels. A summary of situations RF1-RF4 for each indicator area is found in the appendix to this report.

Where no in-channel LOD information was available, for example in N. Fork Creek, then data from the riparian condition map (dd-1) was used to identify whether the segment(s) fit into category 1&2 or 3&4. Prescriptions can then be written for these using the LOD hazard x Fish habitat LOD vulnerability overlays, or the channel can be visited and assessed prior to harvest.

Shade and Stream Temperatures

Overall, current canopy closure along much of the mainstem Tolt and both forks is below target levels (map dd-3). This indicates that stream temperatures may exceed maximum water temperature standards in these areas (map dd-4). 1992 temperature data (Figures 2-6) revealed that this occurred for only one of the three instances where shade fell below target levels (see Table 1 below). At the station 1/4 mile below the reservoir, existing shade values were estimated to be on target, however, temperatures in this area exceeded water quality standards. This is likely due to the overwhelming influence of the reservoir on outflow temperatures for at least this distance downstream.

Table 1. Comparison of existing shade levels (measured or estimated from air photos) to targets for reaches of the Tolt River where maximum daily water temperatures were recorded in 1992. Observed stream temperatures relative to upstream shade levels are reflected in the last column.

1992 Site Location	Target Shade (%)	Measured* or Est.** shade	Stream Class	WQ standards Exceeded?
Upper N. Fork (seg. 18)	10	46*	A	No
Middle N. Fork (seg. 10)	40	48*	A	No
Lower N. Fork (seg. 4)	70	36*	A	No
S. F. above res. (seg. 103)	50	25**	A	No
S. F. below res (seg. 102)	60	65**	AA	Yes
Lower S. F. (seg 93)	80	47*	AA	Yes

Many of the tributaries in the basin were relatively well shaded except for Stossel Creek and other mainstem tributaries. Beaver ponds accounted for most of the areas rated as high hazard in Stossel Cr. Titicaed Cr. in the N. Fork and Phelps Cr. in the S. Fork were entirely lacking in shade.

Three categories of situations related to shade hazards were identified during the analysis. The first is a general situation that occurs wherever the estimated shade levels are below targets (resource sensitivity RF5 in causal mechanism reports). These areas are depicted as high hazards on the shade hazard map (dd-4). The remaining situations are subsets of RF5, and are also shown on map dd-4. RF6 occurs where channels are abnormally wide for their position in the watershed, a situation that exacerbates potential temperature problems by diminishing the effectiveness of riparian vegetation as a provider of shade, regardless of the current condition of the riparian zone. This occurs mainly in the braided reaches of the N. fork and in the reservoir itself. RF7 occurs where the stream is naturally wide enough to limit the effectiveness of riparian shading as a stream cooling agent. In the mainstem Tolt, RF7 occurs downstream of segment 6 in the N. fork, and below segment 95 in the S. fork. Outside the main channel, RF7 occurs in natural lakes, wetlands, and beaver ponds.

Confidence Evaluation

LOD Recruitment
Confidence is very high that current riparian conditions are portrayed accurately. This is based on:

(1) The quality and recent coverage of aerial photographs
(2) Current detailed forest inventory information for 2/3 of the basin.
(3) Experience of the person performing the assessment: Arnold Saasen has 35 years of forest photo interpretation experience and 23 years of field experience in the Tolt basin.

Confidence that the segments were accurately assigned to one of the five LOD situations is reasonably good based on the accuracy of the riparian condition assessment. Confidence could be improved, especially in the tributaries, by a more thorough LOD survey.

Shade and Stream Temperature
Confidence in shade estimates from aerial photographs is high based on comparisons with field data (Table 2). With the exception of shade measurements taken above 1992 thermograph stations, most shade data were gathered unsystematically and confidence in estimates could be improved with more frequent samples. However, close correlation between detailed measurements and estimates obtained from photographs suggests hazard calls would not be altered substantially. Confidence in accuracy of stream temperature data from thermographs is high based on known equipment capabilities (accurate within 1-2°C). Confidence that areas identified as having low shade are actually failing to meet water quality standards, especially in the N. Fork, could be improved with more temperature monitoring data. Discrepancies between "predicted" (based on canopy closure) and measured maximum temperatures in some areas suggest that the TFW temperature screen may not be performing as expected, or that there are anomalous situations in the basin that outweigh the cooling effects of canopy closure alone (e.g., topographic shading in the N.F. canyon, relatively large groundwater influence, etc.). Confidence that the relationship between stream temperatures and shade levels applies to beaver ponds and wetlands could also be improved through research and monitoring.

Table 2. Comparison of measured with estimated canopy closure values from selected segments of the Tolt River Watershed. Asterisks indicate the areas where detailed measurements were made. Elsewhere the measured values represent spot checks that may not accurately represent the canopy closure for the entire area the photo estimates were based on. Note that only the Stossel Creek (segments 23 and 24) measurements, if used instead of photo estimates, would alter the hazard ratings. No such changes were made due to the limited extent of measurements.

Segment Number	Canopy Closure (%) Measured	Estimated from photos	Target Value (%)
1	11	5-50	70
3	20	5-50	70
4*	36	30	70
5	24	30	60
10*	51	50	40
12*	42	50	40
12*	26	0-40	40
17*	7	10	30
23	62	80	70
24	51	80	60
43	61	80-100	40
93*	47	40	80
96	51	40-60	70

Literature Cited

Bilby, R.E. and J.W. Ward. 1989. Changes in characteristics and function of woody debris with increasing size of streams in western Washington. Trans. Am. Fish. Soc. 118:368-378.

Doughty, K and J.E. Caldwell. 1992. TFW basin planning for stream temperatures with an application to the Tolt River, Washington. Report prepared for Weyerhaeuser Environmental Forestry Group, Tacoma. 39 pp.

Seattle Water Department. 1988. North Fork Tolt River, municipal and industrial water supply project. Final report, vol 3; Appendix.

Stober, Q.J., C.R. Steward and F. Winchell. 1983. Tolt River fisheries and instream flow analysis. Final report. 352 pp.

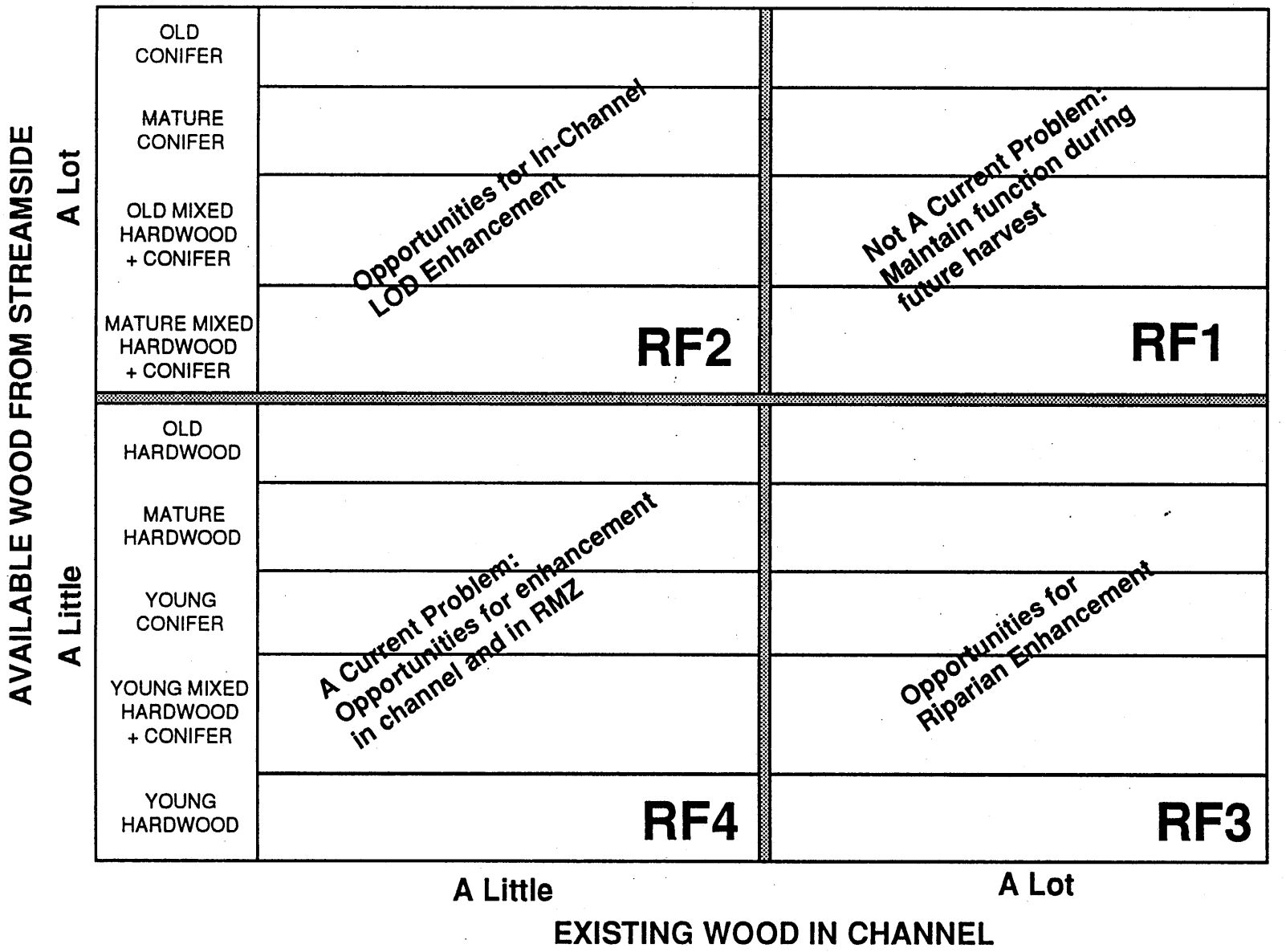


Figure 1. Riparian situation description chart.

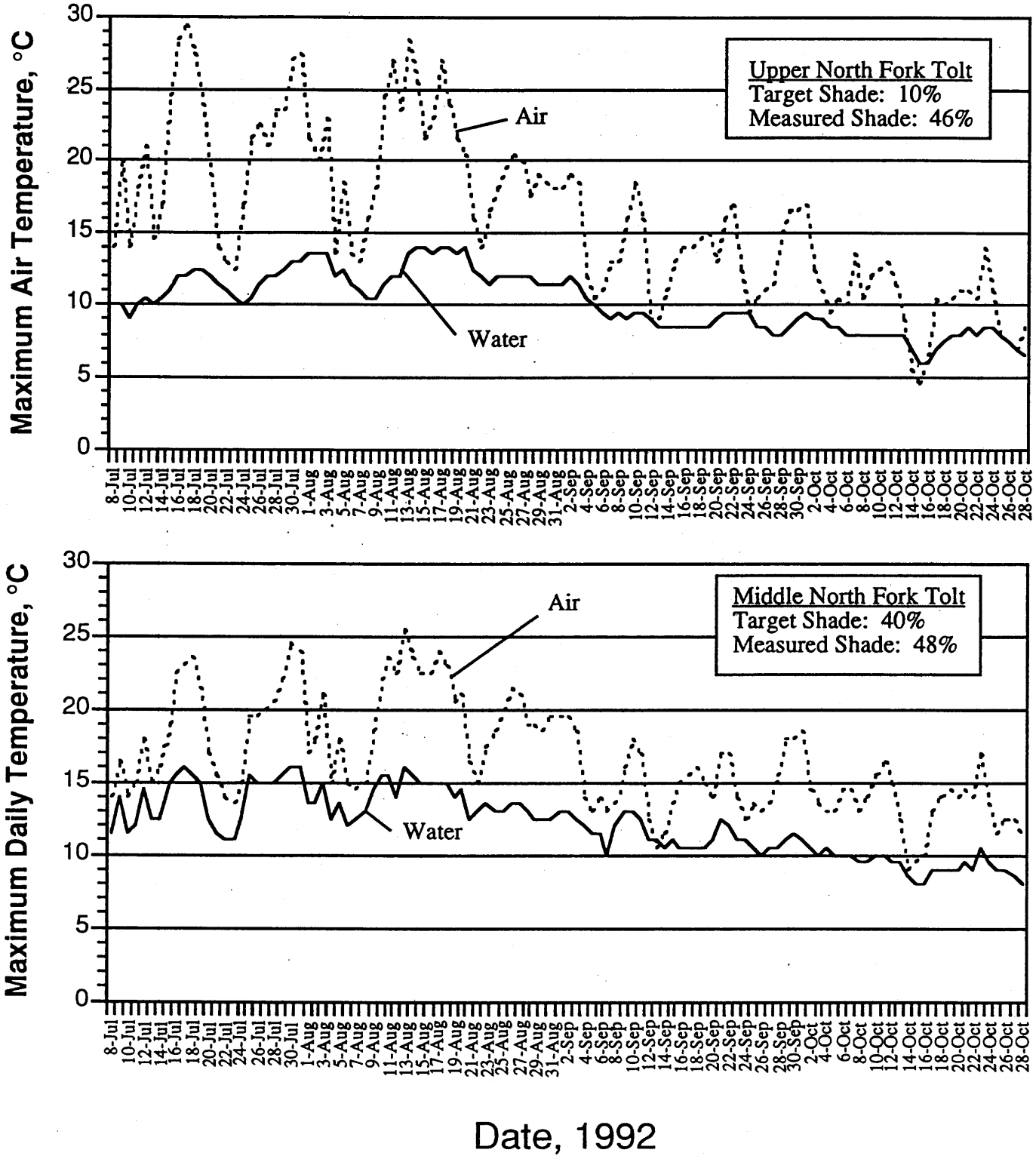


Figure 2. Maximum daily air and water temperatures recorded in the upper (segment 18) and middle (segment 10) N. Fork Tolt River.

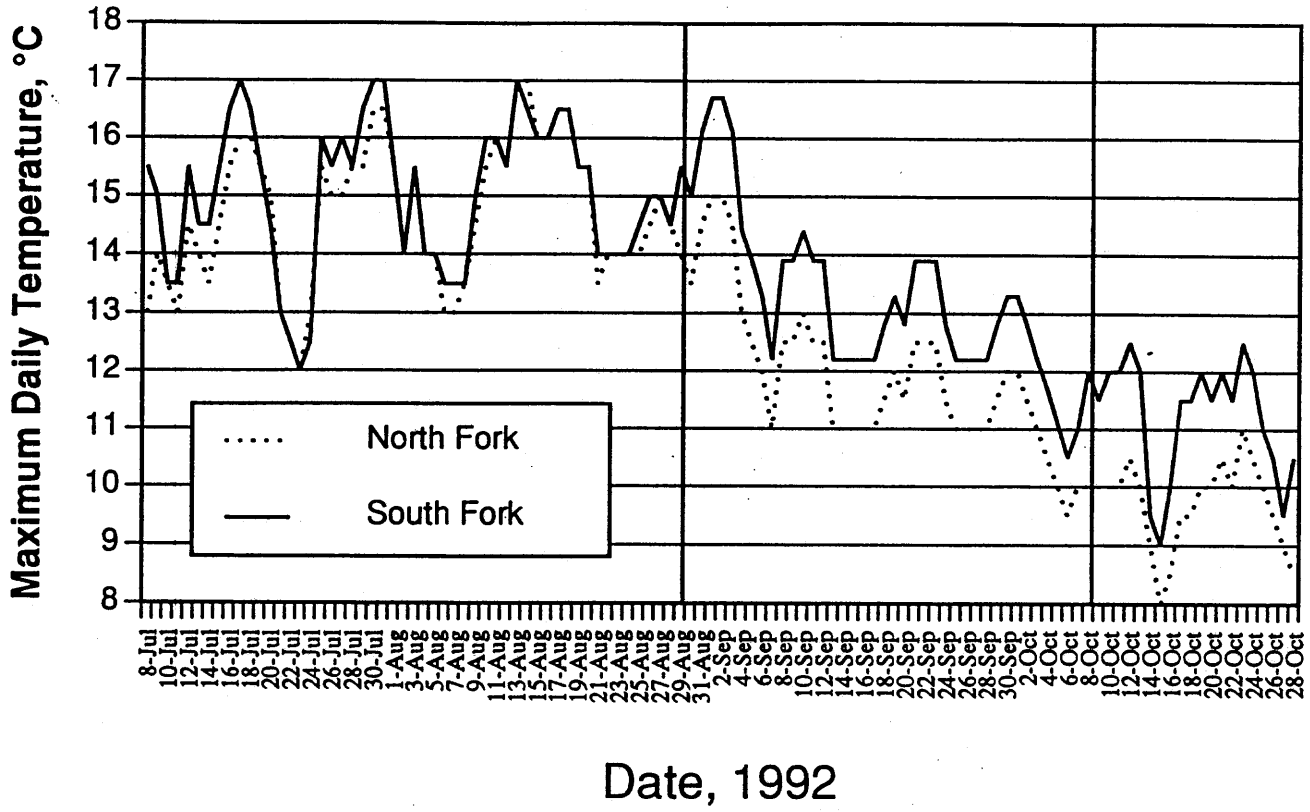
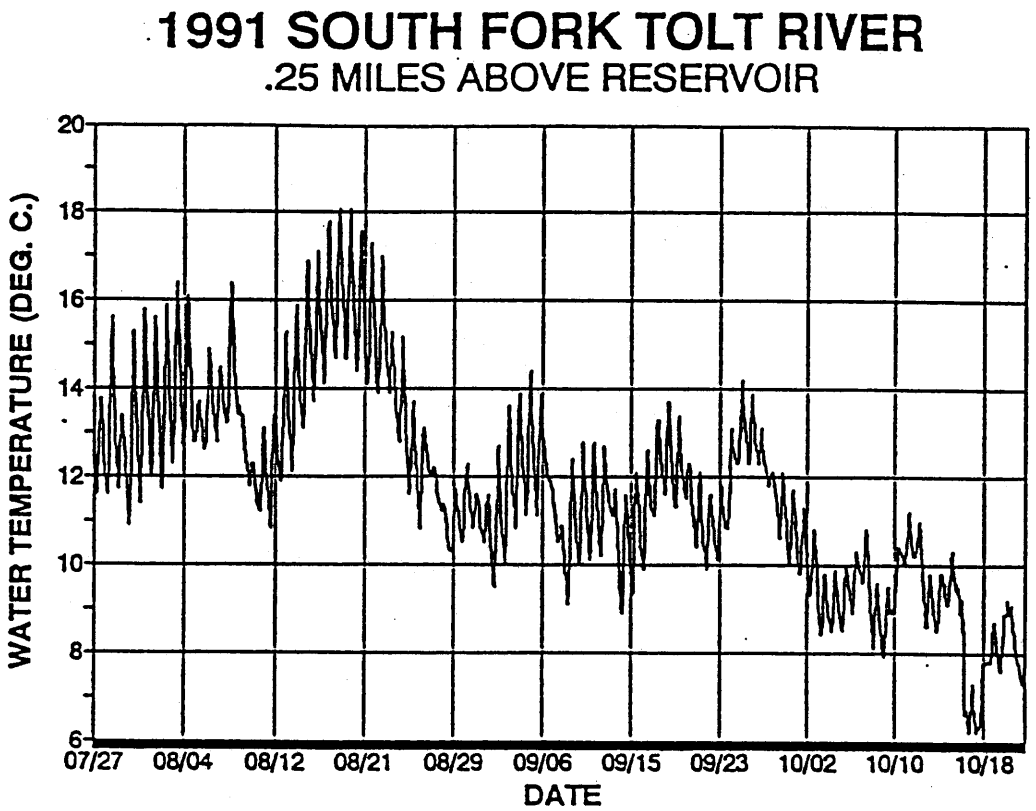


Figure 3. Maximum daily water temperatures recorded in the lower North Fork (segment 4) and South Fork (segment 93) Tolt River.

Note: The South Fork of the Tolt R. has missing water temperature data between Aug 29 and Oct. 8. The missing data was filled in via a correlation with data from the N. Fork companion station just above the confluence of the N. and S. forks. The correlation was figured using data from both stations during time periods bracketing the missing data period. The regression equation used was:

SFork max water temp. = Nfork max water * 1.11
R2 = .89

	Target Shade	Measured Shade
Lower South Fork class AA stream	80%	47%
Lower North Fork class A stream	70%	36%



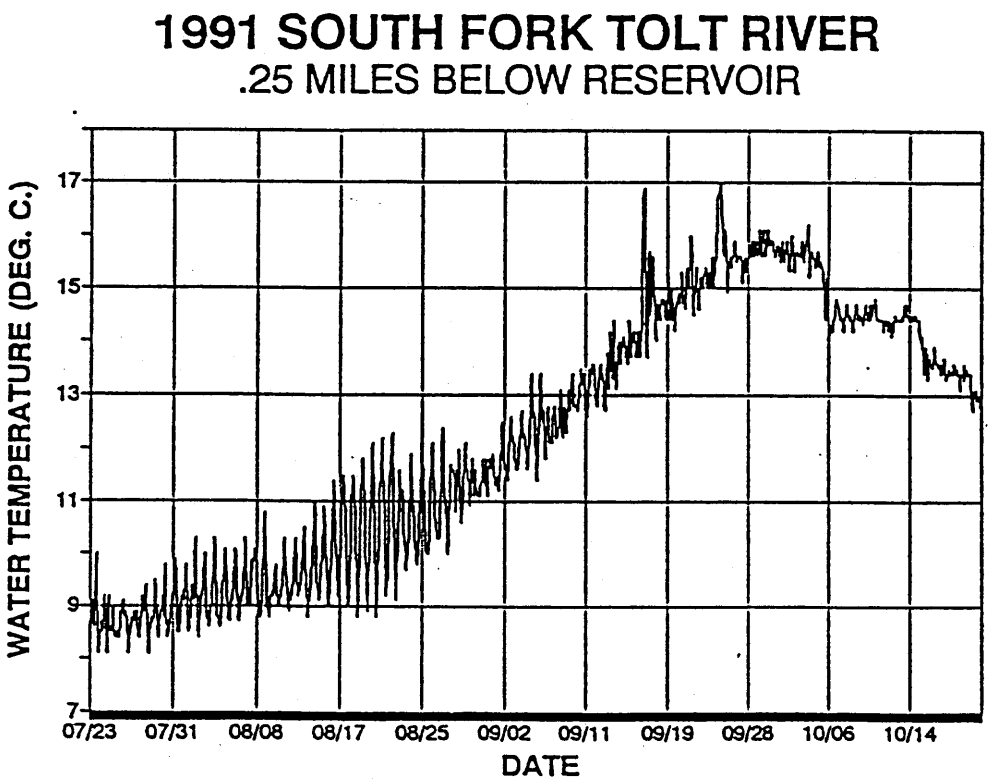


Figure 4. 1991 max. daily water temperature data. From Tulalip Tribes (unpublished).

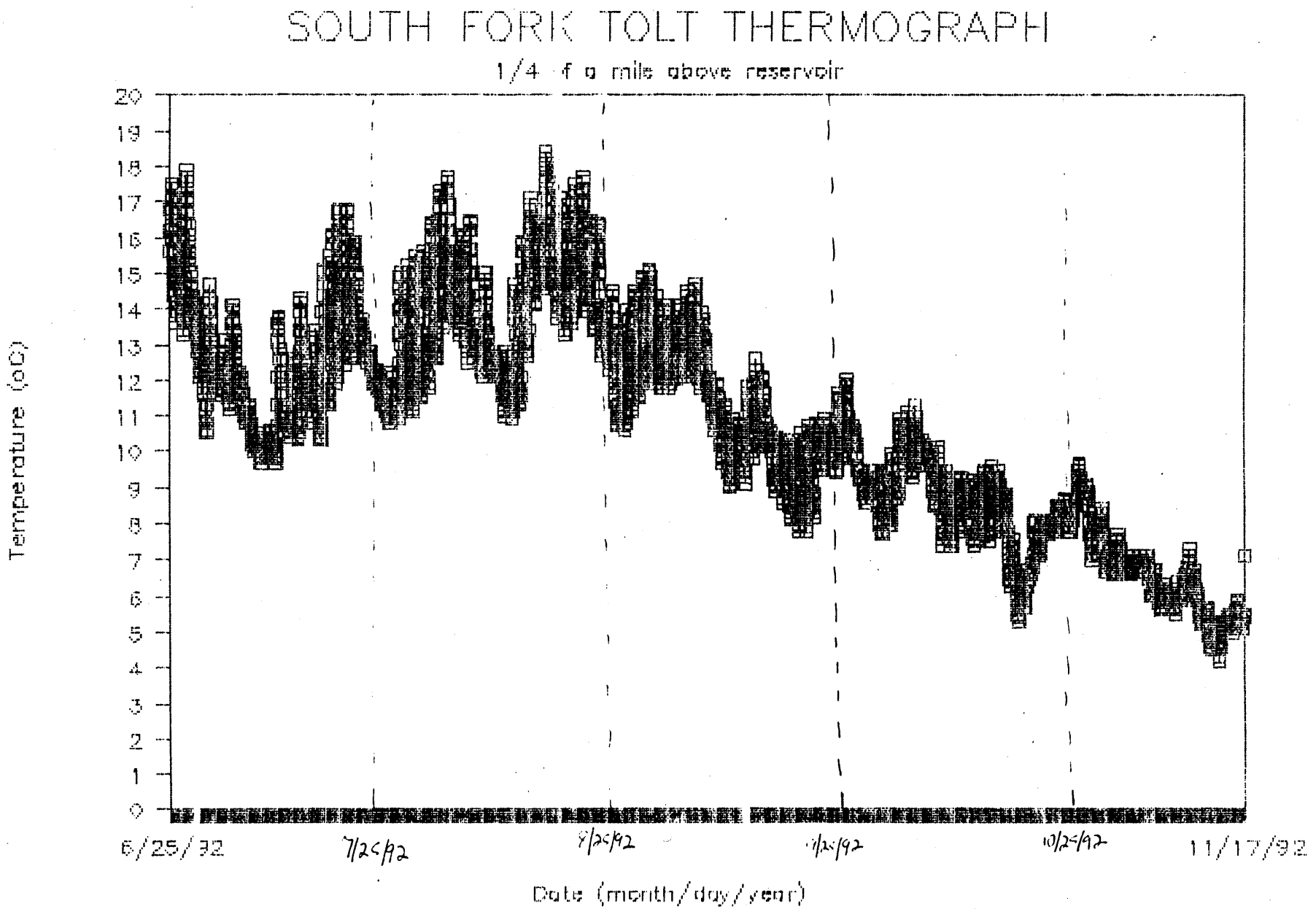


Figure 5. 1992 maximum daily water temperatures from above the S.F. Tolt reservoir. From Tulalip Tribes (unpublished data).

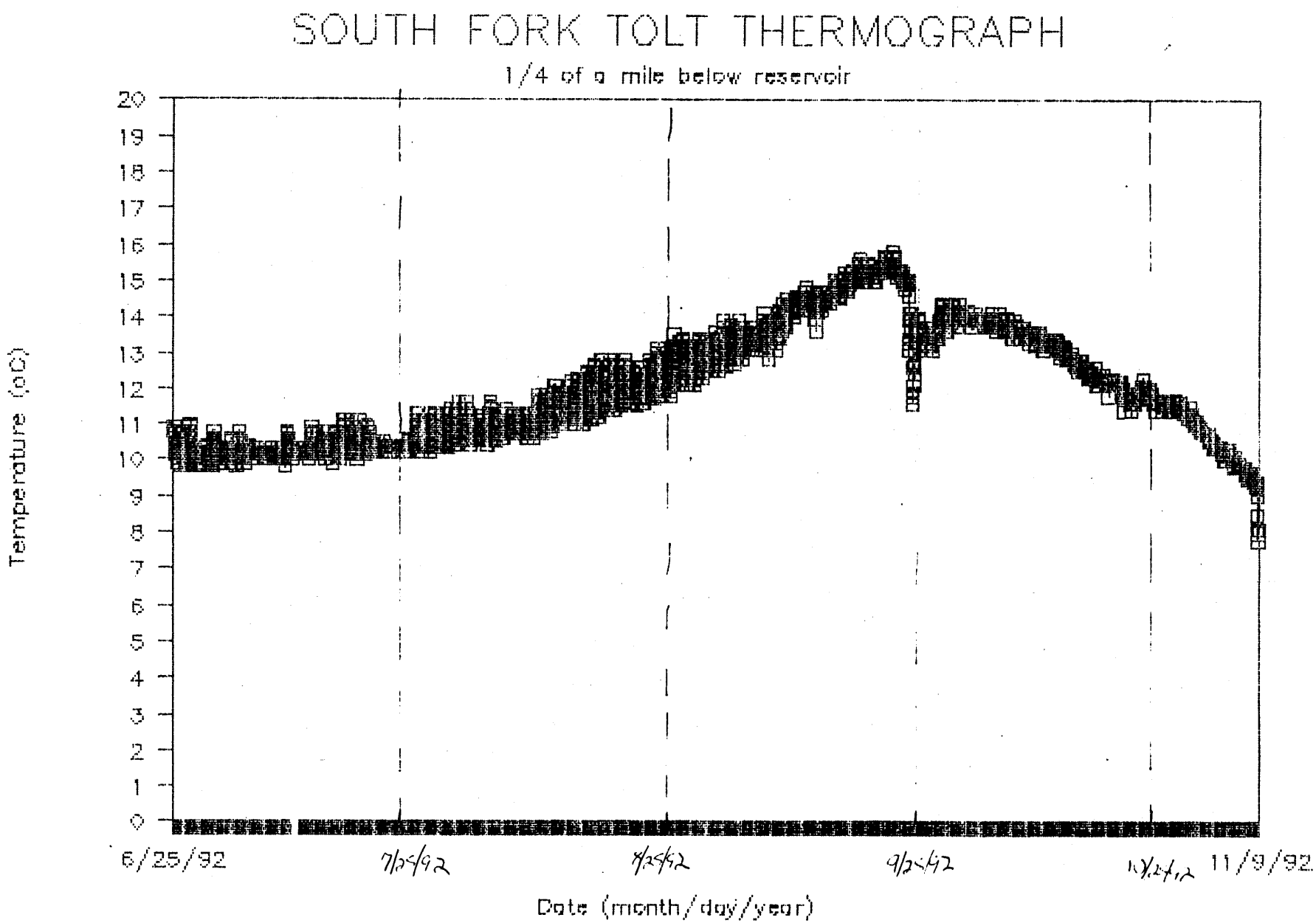


Figure 6. 1992 maximum daily water temperatures from below the S.F. Tolt reservoir. From Tulalip Tribes (unpublished data).

RECOMMENDED MANUAL ADDITIONS OR CHANGES

1. There should be a minimum stocking category for LOD such as everything under 20% crown closure. Some high-elevation areas are solid rock and have few or no trees. Just 1 or 2 mature conifer per acre could make this a moderate hazard area instead of high hazard.

2. There should be some reference in the manual on what to do with lakes and wetlands. If they are to be ignored, the manual should say so not just ignore them.

3. Need a copy of the DOE stream classes for types AA, A and B waters. This should include the defintion of each type.

4. Clarify what is meant by "unit" for percent shade. Figure dd-4 and instructions in the manual indicate a unit is everything between target shade level changes. This may be adequate for steep streams but not for low gradient streams which often have miles between shade level changes. There should be a line code to show unit boundaries on the map and a minimum segment length like for LOD.

5. Define "vegetation" which creates shade. The manual indicates trees, but the lab instructor said anything that creates shade.

6. The hazard rating map is of questionable value. Synthesis brings together the current channel condition and future needs. Synthesis actually defines the type and extent of riparian hazard. Managers have to know what is there now to prescribe for current and future needs. The description of current conditions gives all the information necessary to make these decisions.

DETERMINATION METHOD FOR RIPARIAN SHADE

Riparian shade was determined from percent canopy closure. Percent canopy closure was determined using Table dd-9 in the manual and aerial photography. A densiometer sampling was minimal since there is no hardwood foliage this time of year. A sample based on vegetation crown location was taken and readings checked out closely with estimated shade percents.

Stream shade segments were the same as target shade segments in most cases. Target shade segments were broken further when actual shade percent changed from above to below required target shade.

Form dd-1. Activities Contributing to LOD Recruitment Impacts

Streams

Riparian Unit	Impact Rating	Contributing Activity
1, 2, 5	H	In the lower 3 miles of the main stem the river width varies from 200' to 900'. The riparian is all hardwood. Nothing holds in the wide channel. The only wood appears to be desbris dams which threaten public works.
13, 23, 25, 33 & 34	H	Main stem channel from mile 3 to forks. Width 100-200'. Mostly mature or young hardwood which will not hold long enough to do any good. The only LOD consisted of a very few pieces over 20" in diameter
6	H	River changed channels leaving young hardwoods along the bank of a Type 3 creek.
149, 166	M	Sparse old growth. Logging and natural causes. Some younger understory but old growth will be the primary source of LOD for many years.
51, 52, 60, 76 185	M	Dense mature hardwoods. Will probably never be better than moderate impact.
143	M	Rocky open valley. Will never have sufficient LOD due to lack of soil. This condition is common in high elevation Type 4 waters.
262	M	Natural old growth forest but only a few old growth in the riparian strip. Stream widening in the past has taken out most older trees leaving young trees near the stream and old growth furthest away. Tree size forms a V along the channel
numerous units	M & H	Logging is the primary cause of riparian impact. Segments are to numerous to list individually but all young stands are due to harvest.

Form dd-1. Activities Contributing to LOD Recruitment Impacts

Lake:

Riparian Unit	Impact Rating	Contributing Activity
7	H	Power line across 1/2 the unit. Rest was logged about 15 yrs ago.
30	H	This is a lake surrounded by a Type 4 wetland. There are no trees in the wetland so there will never be riparian timber around the lake
101	H	Mostly Tolt reservoir dam and spillway.
90, 106	H	Roads in riparian zone along reservoir.
168	H	Seattle water regulating basin. Road all the way around the lake so will never have riparian timber
145	M	Very sparse and rocky around the lake. Will never have sufficient LOD
240, 258	M	Sparse old growth due to natural conditions
11, 202	H	Logging

Form dd-2. Activities Contributing to Riparian Shade Impact

Streams

Riparian Segment	Impact Rating	Contributing Activity
1	H	Wide meandering streambed eliminates vegetation along channel on all of main Toll
6	H	Logging and debris flow
5	H	old river channel. Sufficient vegetation has not come back to provide shading. upper end taken out by debris flow
24, 86, 88, 62, 103, 118, 129, 132	H	River wide enough that shade is only along the banks.
29	H	River channel wide enough that shade is only along the banks. The lower half of this segment is in a deep canyon. The canyon walls have a significant shading affect so actual hazard is not as high as data indicates.
40	H	Debris from flood killed all the trees and buried most of the brush.
50, 51	H	Steep slopes and wide channel.
59, 60, 61, 63	H	Wide stream bed so no shade during low water.
68	H	Wide streambed and rocky stream banks. Debris flow has wiped out all vegetation on lower ⅓ of the segment.

Form dd-2. Activities Contributing to Riparian Shade Impact

Streams

Riparian Segment	Impact Rating	Contributing Activity
55	H	West half of this segment is the delta at the head of the reservoir and is a wide gravel bar. The east half is open but not as wide.
134	H	wide channel in unlogged upper end of North Fork.

Form dd-2. Activities Contributing to Riparian Shade Impact

Lakes & Wetlands

Riparian Segment	Impact Rating	Contributing Activity
7	H	Lake. No vegetation around open water.
9, 11, 38	H	Lake Vegetation only along shoreline,
12	H	Lake. in middle of Type 4 wetland.
13, 17, 33, 35	H	Wetland. Vegetation only along the shoreline.
21, 23, 27	H	wetland. Mostly brushy with some open water
49	H	Tall reservoir. Mostly open water. Shade along shore only when reservoir is full.
70	H	Lake. Ground too rocky for vegetation to grow.
87	H	Regulating basin. Road around the edge.

RIPARIAN SUMMARY

Indicator Area: **S.F. Below Reservoir**
(Segs. 93-102, 126, 127, 142)

Summary data:

Tree type	Tree Age	meas'd map units		Amount of In-Channel LOD	Riparian Situation Category
Deciduous	Young	4.3	(21%)	Off-target	RF4
	Mature	4.9	(24%)	Off-target	RF4
Mixed	Young	3.8	(19%)	Off-target	RF4
	Mature	3.6	(18%)	Off-target	RF2 -
Conifer	Young	0.4	(2%)	Off-target	RF4
	Mature	0.6	(3%)	Off-target	RF2 -
	Old	2.7	(13%)	Off-target	RF2 -
		20.3	100%		

LOD Situation Summary

Category RF2 —34% of this area has plenty in the riparian sone but lacks wood in channel.

Category RF4 —66% of this area lacks sufficient recruitable wood, and channel is also lacking.

Indicator Area: **Lynch Creek**
[Segs. 112-117 (Mainstem); 118-121, 123 (Crazy Creek); 125 (Unnamed Trib.)]

Summary data:

Tree type	Tree Age	meas'd map units		Amount of In-Channel LOD	Situation Category
Deciduous	Young	2.6	(16%)	On-target	RF3
	Mature	1.4	(8%)	On-target	RF3
Mixed	Young	–	–	–	–
	Mature	6.3	(39%)	On-target	RF1
Conifer	Young	0.9	(6%)	On-target	RF3
	Mature	5.1	(31%)	On-target	RF1
		16.3	100%		

LOD Situation Summary

Category RF1 –70% of system recruiting okay; maintain during future harvest.

Category RF3 –30% has enough in channel but recruitment impaired.

See map dd-5 for specific locations.

Indicator Area: **S.F. Above Reservoir**
(Segs. 103-109, 128-132, 134, 135)

Summary data:

Tree type	Tree Age	meas'd map units		Amount of In-Channel LOD	Situation Category
Deciduous	Young	–			
	Mature	–			
Mixed	Young	6.7	(33%)	Off-target	RF4
	Mature	–			
Conifer	Young	8.7	(43%)	Off-target	RF4
	Mature	1.4	(7%)	?	RF1 or RF2
	Old	3.6	(18%)	?	RF1 or RF2
Total		20.4	101%		

LOD Situation Summary

75% in Category RF4.
25% in Category RF1 or RF2, channels not examined.
- 63% of segments observed via ground surveys or helicopters.
- 89% of these had low in-channel LOD amounts.

Indicator Area: **Stossel Creek**
(Segs. 23-28, 141, 144)

Summary data:

Tree type	Tree Age	meas'd map units		Amount of In-Channel LOD	Situation Category
Deciduous	Young	–			
	Mature	1.9	(14%)	On-target	RF3
Mixed	Young	3.6	(27%)	On-target	RF3
	Mature	7.2	(52%)	On- & Off-target	RF1
	Old	–			
Conifer	Young	1.0	(7%)	On-target	RF3
Total		13.7	100%		

LOD Situation Summary

52% of basin in situation RF1 – maintain
48% of basin in situation RF3 – opportunities to enhance riparian zone.

Indicator Area: **North Fork Creek** (not visited)
(Segs. 29-35 – Seg. 33 not measured)

Summary Data:

Tree type	Tree Age	meas'd map units		Amount of In-Channel LOD	Situation Category
Mixed	Mature	4.8	(38%)	?	RF1 or RF2
Conifer	Young	0.9	(7%)	?	RF3 or RF4
	Mature	7.1	(55%)	?	RF1 or RF2
Total		12.8	100%		

LOD Situation Summary

93% situation RF1 or RF2
7% situation RF3 or RF4.
On-site check needed for in-channel LOD

Indicator Area: **North Fork Canyon**
(Segs. 4-10)

Summary data:

Tree type	Tree Age	meas'd map units		Amount of In-Channel LOD	Situation Category
Mixed	Young	0.3	(3%)	Off-target	RF4
	Mature	2.1	(24%)	Off-target	RF2
Conifer	Mature	1.7	(20%)	Off-target	RF2
	Old	4.5	(52%)	Off-target	RF2
Total		8.6		↓ Conservative Call	

LOD Situation Summary

3% of reach in Category RF4.
97% in RF2, and could be RF1 in many locations given nature of channel (canyon).

Indicator Area: **Titicaca Creek** (Segs. 68-72)

LOD Situation Summary

Only segment 68 is fish-bearing and the riparian areas are young, sparse, conifer (Category RF4).
Remainder probably also young, sparse, conifer since they're Type 4 waters.

Indicator Area: **Titicaed Creek** (Segs. 82 and 83)

LOD Situation Summary

14% Mixed Young
86% Young Conifer – probably same for rest of basin since recently harvested and T4.
Category RF3 or RF4 (did not see channel to confirm LOD call).

Indicator Area: **Area Above Titicaed Cr.**

Old Growth USFS (Segs. 19 and 20)

Summary data:

Tree type	Tree Age	meas'd map units		Amount of In-Channel LOD	Situation Category
Conifer	Mature	3.4	(100%)	On-target	RF1

Category RF1 but maybe RF2 (channel not checked thoroughly)

Indicator Area: **Braided Reaches in N.F. Tolt**
(Segs. 13, 15, 17)

Summary data:				Amount of In-Channel LOD	Situation Category
Tree type	Tree Age	meas'd map units			
Hardwood	Young	2.1	(20%)	Off-target	RF4
Mixed	Young	5.6	(54%)	Off-target	RF4
	Mature	2.1	(20%)	Off-target	RF2
Conifer	Young	0.2	(2%)	Off-target	RF4
	Mature	0.3	(3%)	Off-target	RF2
Total		10.3	99%		

LOD Situation Summary

On the whole, these reaches excluding 12b are Category RF4 and 23% Category RF2 – no wood in channel, but some areas ready to recruit 12'-20" dbh material. May not be large enough.

Indicator Area: **Chutes in N.F. Between M.S. Braided Reaches**
(Segs. 14, 16, 18)

Summary data:				Amount of In-Channel LOD	Situation Category
Tree type	Tree Age	meas'd map units			
Deciduous	Young	0.5	(7%)	Off-target	RF4
Mixed	Young	4.8	(67%)	Off-target	RF4
Conifer	Young	1.9	(26%)	Off-target	RF4
Total		7.2	100%		

LOD Situation Summary

100% in Category RF4—all young.
Material in RM7 and nothing in channel.

Indicator Area: **Mainstem Tolt including selected fish-bearing tribs.**
(Segs. 1-3, 88-91; excludes Stossel Cr. and Moss Lake outflow stream)

Summary data:

Tree type	Tree Age	meas'd map units		Amount of In-Channel LOD	Situation Category
Deciduous	Young	6.1	(22%)	Off-target	RF4
	Mature	11.1	(40%)	Off-target	RF4
Mixed	Young	2.7	(10%)	Off-target	RF4
	Mature	5.0	(18%)	Off-target	RF2
Conifer	Young	2.7	(10%)	Off-target	RF4
Total		27.6	100%		

LOD Situation Summary

82% in Category RF4.
18% in Category RF2.

Indicator Area: **Mainstem** (Segs. 1-3 only; no tributaries)

Summary data:

Tree type	Tree Age	meas'd map units		Amount of In-Channel LOD	Riparian Situation Category
Deciduous	Young	5.6	(27%)	Off-target	RF4
	Mature	11.1	(54%)	Off-target	RF4
Mixed	Young	2.7	(13%)	Off-target	RF4
	Mature	1.0	(5%)	Off-target	RF2
		20.4			

LOD Situation Summary:

95% of mainstem presently lacks recruitable wood and the channel also lacks wood—situation RF4