VI. RIPARIAN HABITAT CONDITIONS AND WETLANDS

This chapter characterizes the riparian habitat conditions prevailing along the lower Lostine River from its confluence with the Wallowa River to the USFS boundary at Silver Cr (Ext HUC 204 area) per the OWAM, 17, pages V-3 to –14. Relevant maps and features of wetlands from the National Wetland Inventory (NWI) database are also discussed (OWAM, 17, pages V-15 to –33).

A Riparian Habitat Conditions

Table 25 shows the principal data characterizing the conditions in the 50-foot wide riparian buffers along both sides of the lower 14 miles of the Lostine River. As shown by the table, the underlying analysis was performed for 21 individual Analysis Units (AU), each ca 1 to 1-1/2 km in length. The length of each AU was chosen, where possible, such that the end points are at or near vegetation breaks on both sides of the river.

The ODFW reach numbers in the 2nd column of the table are from ODFW, 6 (see Table 2 above) and the ecoregion identification in the 4th column is from the GIS layers discussed in Ch III (see Figs. III-2 and III-3). Stream size is from ODF maps (White, 33) and CHT designations from Fig. IV-2.

Forested Riparian Buffers: The principal focus of this section is the characterization of forest cover in terms of tree type and size, tree spacing (tree count per 1000 ft of 2-sided buffer length), stream shade, and recruitment potential of large woody debris (LWD), see columns 7-12 of Table 25.

ODF GIS layers (White, 33), used to characterize vegetation cover type and fraction (crown closure) over large areas pertinent to the ROS and runoff analyses of Ch V-A, are based on satellite imagery with ca 30 m resolution, which is not adequate to describe forest characteristics in the 50-foot wide riparian buffers. Also, the ODF description key for the various forest classes gives no information on tree height, and the origin of the associated tree-diameter data was unknown to ODF personnel.

A high-resolution GIS vegetation layer covering approximately 200 m width and extending the complete length of the Lostine River, based on aerial photography at 5000-ft altitude, was obtained from Kasper, 31 and used for part of this analysis. Fig. VI-1 shows the first 2+ km of the 22.5 km river length in the Ext 204 part of the WS (AU #1 extends from 0-0.9 km, and AU #2 from 0.9-1.85 km). A few of the codes for various classes of vegetation in the illustrated 50-ft buffers on either side of the "active channel" (unforested region) are shown adjacent to the buffer strips, and are partially defined in the figure. Table 26 gives more codes and associated definitions from Kasper, 31 describing the lower Lostine WS. The average vegetation heights ("height classes"), 3rd column in Table 26, were obtained from separate consideration by the ODEQ, including field measurements at four sites along the Lostine River (Kasper, 31). The "density class" in the 4th column of Table 26 is the average fraction of surface area covered by vegetation for a given class. The veg-class labels used in the following discussion and tables indicate the average fraction cover (%).

Intermediate results required to complete the data columns of Table 25 are given by Tables 27 and 28. The values listed in columns 5 and 6 of Table 27 are obtained directly from the ODEQ GIS layer (extension of Fig. VI-1) by "clipping" the ODEQ vegetation layer with the 50-ft wide riparian buffer boundaries adjacent to the stream active region (as in Fig. VI-1), ordering entries in the resulting dbf table according to AU number and vegetation code number, and summing the incremental areas for associated buffer polygons to obtain the fraction area for each vegetation class occurring in each AU.

Table 25: Riparian Habitat Condition

Analysis Unit (AU)	ODFW Reach	Length (ft)	Ecoregion	Stream Size	CHT	Dominant Tree Type	Est Tree Count > 20" Av DBH (50 ft. x 2-side x 1000 ft)[1]	Shade (%)		Riparian Recruitment Potential[2]	Overall Riparian Benchmark[3]
								ODFW	DEQ		
1	1	2953	BlMtBsn-153	L	C4	Lrg HW	67	38	17	Unkown	U:U
2	"	3117	"	"	C4/F3	"	171	"	15	"	D:U
3	"	4265	"	"	F3	"	50	"	16	"	U:U
4	"	2887	"	"	"	"	138	"	44	"	B:B
5	"	3379	"	"	"	"	160	"	22	"	D:U
6	"	3445	"	"	F/C3	"	180	"	23	"	"
7	"	2289	"	"	"	"	97	"	16	"	B-U
8	"	3609	"	"	"	"	84	"	15	"	"
9	1, 2	3117	"	"	"	Sm HW	242	38-40	17	"	D:U
10	2	2953	"	"	C/F/B3	Lrg HW	161	40	39	"	D:B
11	"	3773	"	"	"	"	77	"	22	"	B:U
12	"	3281	"	"	"	"	118	"	38	"	B:B
13	"	3117	"	"	"	"	164	"	56	"	D:D
14	"	2461	"	"	C/D3,4	"	151	"	55	"	"
15	"	3445	"	"	"	"	173	"	49	"	D:B
16	"	3281	"	"	"	Lrg HW/Con	156	"	46	"	"
17	"	5414	Wal-7Dev-104	"	"	"	94	"	39	"	B:B
18	"	4757	"	"	"	"	75	"	21	"	B:U
19	"	3773	"	"	"	" + Lrg/Sm	155	"	24	"	D:U
20	"	3117	"	"	"	Lrg Con	33	"	34	"	U:U
21	3	4822	"	"	B2/A2	"	110	56	70	"	B:D

1. Estimated Tree Count = 1/10 Σ (1000/<sp>)^2(% BA); <sp> = tree spacing (ft), BA = buffer area
2. Level IV Ecosystem descriptions are inadequate to assess tree size/density potential
3. ODFW Tree Count Benchmarks: <76 (Undesirable), > 152 (Desirable); ODFW Shade Benchmarks: < 40 (U), > 50 (D)

Table 26: ODEQ Lostine Vegetation Codes

Description	Polygon Code	Height Class (m)	Density Class
Water	301	0.0	0%
Pasture/Cultivated Ag	302	0.9	90%
Tree Farm	303	4.6	65%
Barren - Rock	304	0.0	0%
Barren - Bank	305	0.0	0%
Barren - Clearcut	308	0.0	0%
Barren - Soil	309	0.0	0%
Steep/rocky/non-vegetated natural	310	0.0	0%
Road	400	0.0	0%
Forest Road	401	0.0	0%
Railroad	402	0.0	0%
Large Mixed Conifer-Hardwood	500	25.0	65%
Small Mixed Conifer-Hardwood	501	9.4	65%
Large Mixed Conifer-Hardwood	550	25.0	25%
Small Mixed Conifer-Hardwood	551	9.4	25%
Large Mixed Conifer-Hardwood	555	25.0	10%
Large Hardwood	600	21.3	65%
Small Hardwood	601	7.6	65%
Large Hardwood	650	21.3	25%
Small Hardwood	651	7.6	25%
Large Hardwood	655	21.3	10%
Large Conifer	700	28.6	65%
Small Conifer	701	9.8	65%
Large Conifer	750	28.6	25%
Small Conifer	751	9.8	25%
Large Conifer	755	28.6	10%
Upland Shrubs	800	1.5	65%
Upland Shrubs	850	1.5	25%
Wetland Shrubs	801	3.0	65%
Wetland Shrubs	851	3.0	25%
Grass - upland	900	0.9	90%
Active River Channel	3011	0.0	0%
Developed - House-sized Structures	3248	6.1	100%
Developed - Industrial Sized Structures	3249	9.1	100%
Dam or Weir	3252	0.0	0%
Canal	3255	0.0	0%
Dike	3256	0.0	0%
Hatchery	3300	0.0	0%

Table 27: Forest Characteristics of 2-side 50-ft Buffer on Lower Lostine River

AU	ODFW Rch	Start (Km/RM)	Extent (Km)	Veg Class	% Buffer 2-side	Av Ht (ft)	Av DBH (in)	Density (/ 1000-ft)
1	**1**	0.00	0.90	L-hw-65-600 S-hw-65-601	28 1	91.7 87.9	29.7 20.9	46.5 79.4
2	"	0.9/.56	0.95	L-hw-65-600 S-hw-65-601	50 10	91.7 87.9	29.7 20.9	46.5 79.4
3	"	1.85/1.15	1.30	L-hw-65-600	23	91.7	29.7	46.5
4	"	3.15/1.96	0.88	L-hw-65-600	64	"	"	"
5	"	4.025/2.5	1.03	L-hw-65-600	74	"	"	"
6	"	5.05/3.14	1.05	L-hw-65-600	83	"	"	"
7	"	6.10/3.79	0.85	L-hw-65-600 L-hw-25-650	42 8	" "	" "	" 28.8(1)
8	"	6.95/4.32	1.10	L-hw-65-600 L-hw-25-650	39 1	" "	" "	46.5 28.8(1)
9	**1, 2**	8.05/5.0	0.95	L-hw-65-600 S-hw-65-601	1 38	" 87.9	" 20.9	46.5 79.4
10	**2**	9.0/5.59	0.90	L-hw-65-600 S-hw-65-601	51 8	91.7 87.9	29.7 20.9	46.5 79.4
11	"	9.9/6.15	1.15	L-hw-65-600 S-hw-65-601	24 4	91.7 87.9	29.7 20.9	46.5 79.4
12	"	11.05/6.86	1.00	L-hw-65-600 S-hw-65-601	46 3	91.7 87.9	29.7 20.9	46.5 79.4
13	"	12.05/7.48	0.95	L-hw-65-600	76	91.7	29.7	46.5
14	"	13.0/8.07	0.75	L-hw-65-600	70	"	"	"
15	"	13.75/8.54	1.05	L-hw-65-600	80	"	"	"
16	"	14.8/9.19	1.00	L-hw-65-600 L-c/hw-65-500	9 67	" 101.7	" 28.4	" 45.2
17	"	15.8/9.81	1.65	L-hw-65-600 L-c/hw-65-500 L-c/hw-25-550 L-c-65-700	17 19 15 4	91.7 101.7 " 97.3	29.7 28.4 " 25.1	46.5 45.2 28.0(1) 39.0
18	"	17.45/10.8	1.45	L-hw-65-600 L-c/hw-65-500 S-hw-65-601	12 21 1	91.7 101.7 87.9	29.7 28.4 20.9	46.5 45.2 79.4
19	"	18.9/11.74	1.15	L-hw-65-600 L-c/hw-65-500 S-hw-65-601	14 30 10	91.7 101.7 87.9	29.7 28.4 20.9	46.5 45.2 79.4
20	"	20.05/12.45	0.95	L-c/hw-65-500 L-c-25-750	8 29	101.7 97.3	28.4 25.1	45.2 24.2(1)
21	**3**	21.0/13.0	1.50	L-c/hw-65-500 L-c-65-700 L-c-25-750	8 52 25	101.7 97.3 "	28.4 25.1 "	45.2 39.0 24.2(1)
Begin USFS		22.5/13.97	(1) Tree spacing for 25% cover fraction = $(65/25)^{(1/2)}$ x 65% values.					

Table 28: Summary of Tree Mensuration Measurements at Selected Lostine Field Sites

DEQ Class	Site No.	Approximate Location (RM)/(KM)	No. Trees	Individual Unit Averages			Averages for Each Tree Type			
				Av Ht (ft)	Av DBH (in)	Av Space (ft)	Av Ht (ft)	Av DBH (in)	Av Space (ft)	Density (/kf)
600-Lrg HW-65%	2-1.	0.7/1.1	10	89.2	26.7	7.7	91.7	29.7	21.5	46.5
	5-1.	3/4.8	10	106.3	36	31.9				
	7-1.	4.2/6.8	10	93.7	30.3	15				
	10-1.	5.9/9.5	13	82.9	28.2	16.8				
	12-1.	7.3/11.,7	12	93.7	25.6	24				
	15-1.	8.9/14.3	10	86.4	32.4	34.4				
601-SmHW-65%	9-1.	5.2/8.4	16	87.9	20.9	12.6	87.9	20.9	12.6	79.4
550-LrgConHW-25%	17-2.	10.3/16.6	14	104.9	30	21.4	101.7	28.4	22.1	45.2
500-LrgConHW-65%	21-3.	13.2/21.2	9	96.7	25.8	23.3				
700-LrgCon-65%	17-1.	10.617.1	8	106.7	34.5	28.5	97.3	25.1	25.7	39.0
750-LrgCon-25	21-2.	13.5/21.7	6	91.3	19.2	19				
700-LrgCon-65%	21-1.	13.9/22.4	5	89.5	17.2	29.1				

Tree Diameter and Height: Because of the lack of data to determine the large tree count (column 8 of Table 25) and the small number of field-sites (four) used by ODEQ for measurements to support the height-class values in Table 26, independent tree mensuration measurements summarized by Table 28 were made for this assessment. Based on the buffer vegetation map (extension of Fig. VI-1) and coordination with cooperating landowners, 12 field-site locations along the Lostine River were selected to evaluate tree properties for the various relevant forest classifications. As shown by Table 28, the number of field sites in each forest class were chosen to approximately reflect the extent of that class along the lower Lostine River, e.g., 6 of the 12 sites (65 of 123 trees) were in the Large Hardwood (Lrg HW) class, present throughout AUs 1-19. Columns 5-7 of Table 28 contain the average tree heights, diameters, and spacings (to 1st and 2nd nearest neighbors) for the subject sites, and columns 8-11 show the resultant weighted averages of the site data (weighted by number of trees at each site) for the relevant forest classes. The "Density" given by column 11 of the table is defined as (1000/average spacing), i.e., the average number of trees per 1000 feet of transect for a particular forest class.

Averaged forest characteristics of the 50-ft buffers in the 21 AUs from Table 28 are used for data entries in columns 7-9 of Table 27, and the corresponding large-tree count in column 8 of Table 25.

Variations in AverageTree Heights: The following table shows a comparison of average tree height values exerpted from Tables 26 and 28:

Table 29: Variation in Average Tree Heights

DEQ Class	ODEQ (ft)	This Study (ft)
Large HW	70	92
Small HW	25	88
Large Conifer/HW	82	102
Large Conifer	94	97

The table shows significant differences in results of ODEQ and of this study for average heights of three of the four forest classes. These differences correlate with hardwood content, for which other sources of mensuration data have not been found.

A partial explanation for the differences, especially for the Small HW class, is that the focus for this study was the determination of recruitment potential for large woody debris (LWD). Therefore, trees with less than 15" DBH were not counted in the field measurements for Table 28.

The four field sites used by the ODEQ for Lostine data (Kasper, 31) are almost certainly inadequate to obtain representative forest characteristics for the lower watershed (more extensive mensuration data for conifer forests in the upper WS are available from the USFS, Sarvis, 38). Likewise, the 12 field sites used in this study, each of which varied from a few hundred to a thousand or more yards in length, may not provide adequate representation of all riparian forest features over the 14-mile length.

An appropriate methodology to more fully characterize the stream buffers is set out in the ODFW guide for stream surveys, Foster, 39. This protocol calls for detailed vegetation surveys over 5 m x 30 m blocks on each side of the stream, to be repeated at every vegetation break along the stream (or at a maximum separation of 1 km between survey blocks). This would call for 22, or more, such surveys over the Ext 204 area of interest. Unfortunately, this riparian survey protocol was not part of the ODFW 1991 survey of the Lostine River (ODFW, 6).

Shade and Forest Cover: Column 9 of Table 25 gives the reach-averaged values of shade from the 1991 ODFW Lostine stream survey (ODFW, 6), and column 10 gives values for each AU based on

ODEQ model calculations (Kasper, 31). Methods to determine the ODFW and ODEQ results, and apparent discrepancies between them, are discussed below. These factors may be of special interest because riparian shade, and the associated ODEQ modeling effort, is an important part of the TMDL discussions for waters of Wallowa County and elsewhere.

The ODFW "percent shade" measured at a particular location is simply 100 x (180 - open-sky angle)/180, where the open-sky angle is the overhead angle truncated by obscurations of the sky to the left and right (the usual obscurations are trees or other vegetation, but could also be terrestrial, due to mountains, cliffs, etc.). This simple measure of shade is not intended to provide a quantitative means to determine incident energy from the sun for stream-temperature analysis, but rather provides a general measure of the quality of streamside vegetation in relation to stream shading. Although the ODFW measurements of ODFW, 6 were taken at some 263 locations along the lower Lostine River, reconstruction of shade parameters other than the overall reach averages cited in Table 25 is difficult because river locations of the units are uncertain due to off-channel and parallel channel measurements.

Figure VI-2 and column 10 of Table 25 give values of average shade for each AU determined from Kasper, 31 by averaging the shade values, calculated at 50-meter streamwise intervals by ODEQ, over each of the AU stream segments, then averaging the relevant AU values shown in Fig. VI-2 to obtain the reach averages shown by the dashed horizontal lines. The corresponding ODFW reach-averaged shade values cited above are also shown in the figure (long/two-short dashed horizontal lines).

The determination of shade by ODEQ is based on a sun-tracking model calculation that evaluates the fraction obscuration of the sun's energy due to riparian vegetation, terrestrial effects, etc. (Boyd, 40). The vegetative obscuration is determined from the geometric properties such as those indicated by Fig. VI-1, including river orientation and adjacent vegetative cover-fraction and height. The specified height- and density-class values, such as those given by Table 26, are used to determine the screening of the sun as it traverses across the sky [the ODEQ vegetative cover is not limited by the 50-ft buffer widths considered here, but is represented over a 2-sided transverse distance of ca 200 m (ca 650 ft)].

Fig. VI-2 shows large differences between the ODFW and ODEQ measures of shade. The ODFW values are nearly constant for reaches 1 (38%) and 2 (40%), increasing to 56% in reach 3 (a factor of 1.47 increase), whereas the ODEQ reach averages vary from 20% to 70% (a factor of 3.5 increase).

Fig. VI-3 illustrates another feature of the ODEQ model used to evaluate shade, namely average forest cover for each AU. The forest cover-fraction values plotted in Fig. VI-3 are determined from columns 5 and 6 of Table 27 by multiplying the density fraction in the appropriate forest-class label of column 5 times the corresponding fraction of 2-sided buffer in the AU from column 6, and summing over the forest-classes in each AU (e.g., for AU 1, fraction forest cover = 0.65 x 0.28 + 0.65 x 0.01 = 0.182 + 0.0065 = 0.19 or 19 %). Fig. VI-3 also shows the reach-averaged values of cover (solid horizontal lines), as well as the various reach-averaged values of shade from Fig. VI-2. For reference in the following discussion, these values are listed in Table 30.

Table 30: Lostine Average Shade and Cover by ODFW Reach

ODFW Reach	ODFW Shade (%)	ODEQ Shade (%)	ODEQ Cover (%)	ODFW Shade / ODEQ Cover	ODEQ Shade / ODEQ Cover
1	38	20	33	1.15	0.61
2	40	36	35	1.14	1.03
3	56	70	45	1.24	1.56

Although the absolute values of shade and forest cover cannot be compared directly, it is useful to examine the variation of each with streamwise (reach) location, see the reach-averaged values indicated by the horizontal lines in Figs. VI-2, -3, and listed in the columns of Table 30.

It is evident that the reach averages of ODFW "open sky" shade and the ODEQ cover fraction vary little between reaches 1 and 2, increasing somewhat for reach 3. The 5th column of Table 30 shows the ratio between these two quantities is 1.2 (+/- 5%) for all reaches.

It is perhaps not surprising, although certainly not self-evident, that the average ODFW measure of shade should be directly proportional to the average cover fraction. However, the last column of Table 30 shows a large variation in the corresponding ratio of ODEQ average shade to average cover, i.e., the variation between reaches from 0.61 to 1.56 is a factor of 2.56 (compared to a factor of 1.24 / 1.14 = 1.09 for the ODFW ratio in the 5th column).

Several possible factors may underlie the large variation in reach-averaged shade determined from ODEQ model results (20%-70%, see Figs. VI-2, 3 and 3rd column, Table 30) as compared to the much smaller variation in corresponding forest cover (33%-45, see cited figures and 4th column, Table 30). One possibility is the discrepancy in tree heights shown by Table 29. If the ODEQ values were incorrect, the larger height values determined from this study would tend to give higher shade in reaches 1 and 2, where hardwoods dominate in the riparian buffers (see Table 27). This explanation seems inadequate to explain the large cited variations because the discrepancies in heights in Table 29 are only 25%-30%, except for small hardwoods, which occupy a rather small fraction of the riparian buffers (Table 27).

A more likely explanation follows from close inspection of Fig. VI-1 and its extension, the upriver GIS coverage from Kasper, 31. The "Active River Channel," (ARC) shown by the figure (see discussion of the "Near Stream Disturbance Zone," in the ODEQ model description, Boyd, 40, page 165) is the unforested area along the river in the GIS coverage, which increases the exposure of the stream to direct sunlight in proportion to the ARC width and directional aspect. The widths of the ARC over the 8.5 km of Reach 1 (Table 2) are typically in the range 50-250 ft, much wider than the "bankfull widths" in the ODFW Lostine stream survey (ODFW, 6). These large ARC widths, combined with the general north-south orientation of the river (typical upstream directions, N 180° S +/- 10°-45 °), result in increased exposure of the river to sunlight, especially during the mid-day hours, i.e., decreased effectiveness of shading by riparian buffer vegetation, which lies primarily some distance to the east and west of the stream. Similar analysis of the ca 2.5 km-long Reach 3 (Table 2) shows much smaller ARC widths, typically in the range 25-60 ft. Furthermore, throughout ODFW Reach 1 and much of Reach 2 the river traverses a low-gradient, wide-valley landform, whereas Reach 3 extends into the higher-gradient, deeply-incised Lostine Canyon where increased terrestrial shading becomes a factor.

The above factors, along with the increase in average tree height from Reach 1 to Reach 3 (see Tables 27 and 29), may underlie the decreased ODEQ-model shade in Reach 1 relative to Reach 3, even though the average cover density shown by Fig. VI-3 (ODEQ model) does not vary a great deal.

Although it is beyond the scope of this study to consider the issue of riparian shade further, buffer forest cover and related factors governing shade effectiveness should be evaluated in more depth for streams where riparian restoration for improved shade is considered to be a high priority.

Recruitment Potential, Riparian Benchmarks, and Riparian Confidence Evaluation: The OWAM procedure for evaluation of riparian recruitment potential is based on the comparison of current riparian conditions with "potential streamwise vegetation" given by the ecoregion descriptions (OWAM, 17, Appendix A or OGC, 23). The relevant ecoregions for the lower Lostine Ext HUC 204 are Blue Mountain Basins, 11k, and Wallowa/Seven Devils Mountains, 11e (Figs. III-2 and –3). The

corresponding descriptions of potential streamwise vegetation (OWAM, 17, pages A-164 and A-184) state the potential near-stream (to 25'-75') vegetation for both ecoregions to be small, dense hardwoods (cottonwood, alder) and shrubs (willows). For 11e, stated potential vegetation in the extended riparian region (to 100') includes medium, dense conifers.

It is difficult to correlate the above potential vegetation descriptions with the results of mensuration measurements, Tables 27 and 28, which show the prevalence of large hardwoods in the lower valley (average height of ca 90' and DBH of 20-30," with maximum DBH in the range 45"-55"), transitioning to hardwood/conifer, then conifer, in the upper part of Ext HUC 205 (average heights ca 90-100' and DBHs ca 20-30"). These mensuration data indicate good potential for recruitment of LWD into the Lostine River, but as shown by column 11 of Table 25, the recruitment potential relative to ecoregion "potential streamwise vegetation" must be regarded as unknown.

Column 12 of Table 25 lists the overall riparian "benchmarks" for tree count and shade, per ODFW, 6 and footnote 3 of Table 25.

Table 31 gives the confidence-level evaluation for this riparian section VI-A.

Table 31: Riparian Conditions Confidence Evluation

Resources Used:

X ODFW	X ODEQ Riparian Vegetation Maps
X NRCS	X WSCD
X ODF Maps	X Ecoregion Data
X Field verification of tree size/ spacing	

Confidence in assessment:

- ☐ **Low:** Unsure of procedures and/or used minimal resources.
- ☐ **Low to moderate:** Understood and followed most of the procedures, but minimal =resources available and/or used.
- ☐ **Moderate:** Understood and followed procedures, and used adequate number of resources but had moderate understanding of outcome.
- X **Moderate to high:** Understood and followed procedures, used adequate number of resources, and had high understanding of outcome.
- ☐ **High:** Understood and followed procedures, used numerous resources, and had high understanding of outcome.
- ☐ **If none of the above** categories fit, describe your own confidence level and rationale:

Recommendations for further assessment or analysis:

Determination of riparian buffer vegetation using post-1993 ODFW stream-survey protocols (5m x 30m transects on each side of stream at frequent stream-wise locations).

B Wetlands

As indicated at the beginning of this chapter, this wetland assessment is based on analysis of the National Wetland Inventory (NWI) maps of the Ext 204 area. The assessment is restricted to the NWI wetlands mapped as areas and does not consider the network of those mapped as lines, even though they are quite extensive over a portion of the Lostine WS. The subject NWI wetland areas cover ca 626 acres, approximately 4.4% of the total Ext 204 area. The historic extent of wetlands in the Lostine WS is unknown, but was likely substantially larger than is the case today. Probable effects on runoff and late-season low flows are indicated at the end of this section.

Fig. VI-4a shows the mapped NWI area-wetlands in the northern, downstream, part of the HUC – 204 (USGS Evans Quad, clipped by the HUC boundary). The Evans Quad map was acquired from Reid, 41 as a GIS coverage of the area wetlands only.

Because the USFWS has not yet converted the NWI map for the Lostine Quad to electronic form, it was acquired from Blok, 42 as a mylar transparency from which a clean copy could be made, then scanned to provide a bit map suitable for converting to an Arc View coverage. The result is shown by Fig. VI-4b.

Table 32 lists the index numbers for the individual wetland areas, the Cowardin Code describing the cumulative wetlands of each type, and the associated cumulative areas for both the portions of the Evans and Lostine quads contained within the Ext 204 boundary. The definitions of the relevant parts of the Cowardin Code, from the Blok, 42 map, are shown as Table 32a.

Table 32 shows ca 232 acres of wetlands in the Evans Quad and 394 in the Lostine Quad, for the total of ca 626 acres. Approximately 362 acres, 58% of the total , are forested wetlands in the floodplain (PFOA, -B, -C). Figures VI-4a and –4b show that a large fraction of the existing wetlands are within a few hundred feet of the Lostine River (the line representing the river is from the ODEQ coverage, Kasper, 31— note that the scale of Fig. VI-4b is 2x smaller than that of Fig. VI-4a).

As noted in Chs II, IV, and IX, diking and channelization contribute directly to instream habitat degradation. These factors, along with agricultural drainage systems, presumably underlie significant reductions of existing wetland areas compared to historic values. The discussion of land-use impacts on hydrology in OWAM, 17, Appendix IV-D, page 3, notes that agricultural practices frequently result in the elimination of wetlands with associated increases in runoff rates during the early season, causing decreased streamflow during the late season.

Significant increase in wetland area above the existing NWI-indicated value of ca 4% might significantly improve the degree of water retention, and reduce the adverse impact of late-season water use on river flow levels (see also the related discussion of possible use of excess irrigation in the early season to reduce late-season depletion of river flow, Ch V-C).

Table 32: Lostine Wetlands per National Wetlands Inventory (NWI)

Index Range	Attribute/ Cowardin Code	Wetland Area (acres)	Total Wetland Area (acres)	Source
Evans Quad				USFWS NWI
1	PEMA	2.37		"
2-11	PEMC	30.76		"
12-22	PFOA	147.95		"
23-24	PSSA	1.08		"
25-26	PUBFh	0.72		"
27-28	PUBHh	0.78		"
29-57	R3USA	47.32		"
58-60	R3USC	1.50	232.48	"
Lostine Quad				
1	PABF	0.32		"
2-25	PEMA	96.59		"
26-27	PEMB	1.25		"
28-32	PEMC	6.66		"
33-55	PFOA	207.01		"
56	PFOB	0.41		"
57-58	PFOC	7.03		"
59-62	PSSA	8.90		"
63-65	PSSC	9.26		"
66-74	PUBFh	2.60		"
75-77	PUBFx	0.85		"
78-85	PUBHh	9.53		"
86-87	PUBHx	1.79		"
88	PUSC	0.42		"
89-93	R3USA	10.32		"
94-102	R3USC	2.65	394.20	"
Total Watershed	------	------	626.68	"

Table 32a: NWI Attributes/Cowardin Code

System/SubSys	R3 — (R) Riverine / (3) Upper Perennial					
Class	UB—unconsolidated bottom			US—unconsolidated shore		
Water Regime	A—temporarily flooded			C—seasonally flooded		
System	P--Palustrine					
Class	AB-aquatic bed	EM-emergent	FO-forested	SS-scrub-shrub	UB-uncon btm	US-uncon shore
Water Regime	A-temp flood	B-saturated	C-season flood	F-semi-permanent flood		H-permanent flood
Sp. Modifier	h-diked/impounded			x-excavated		

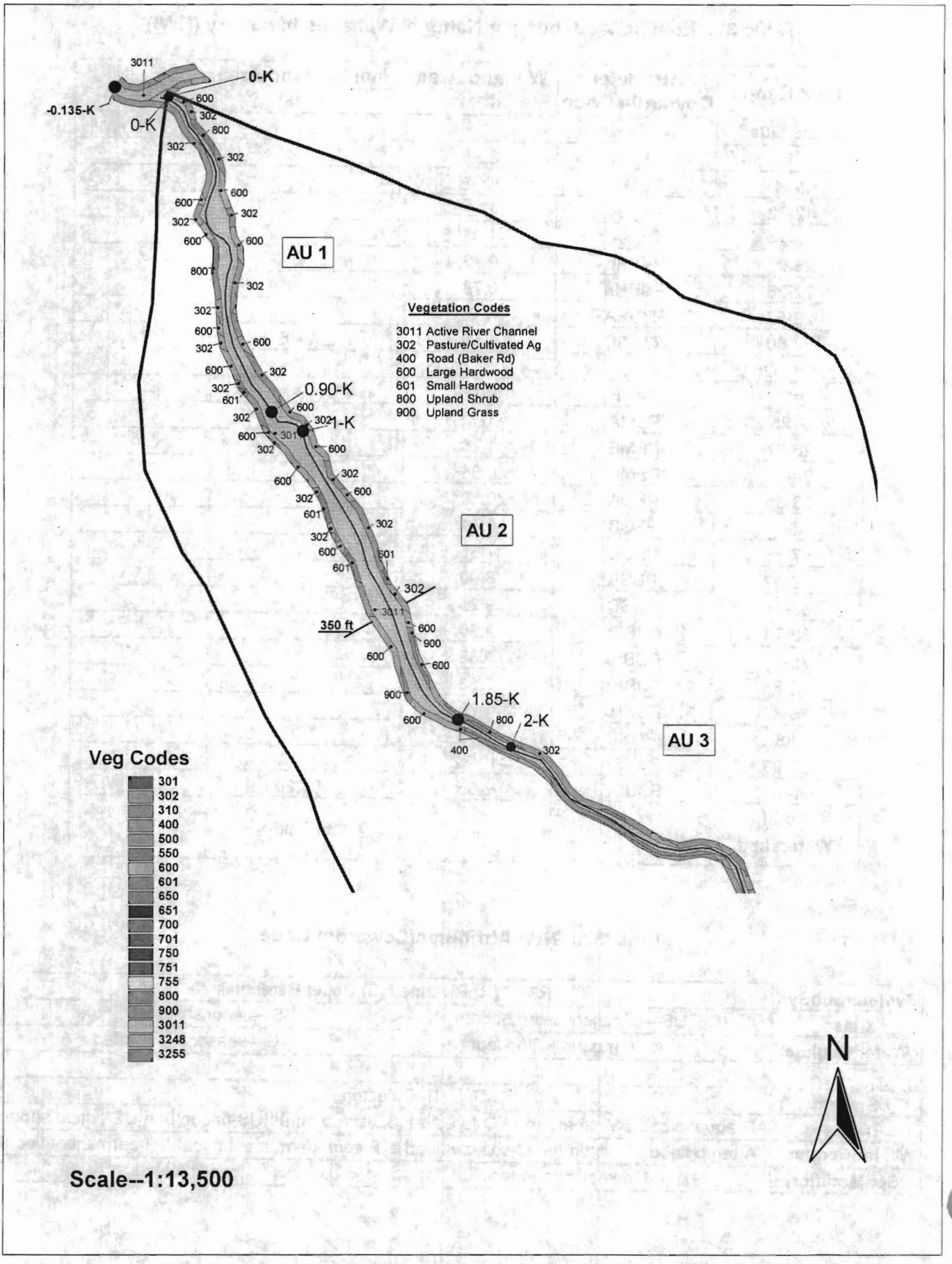
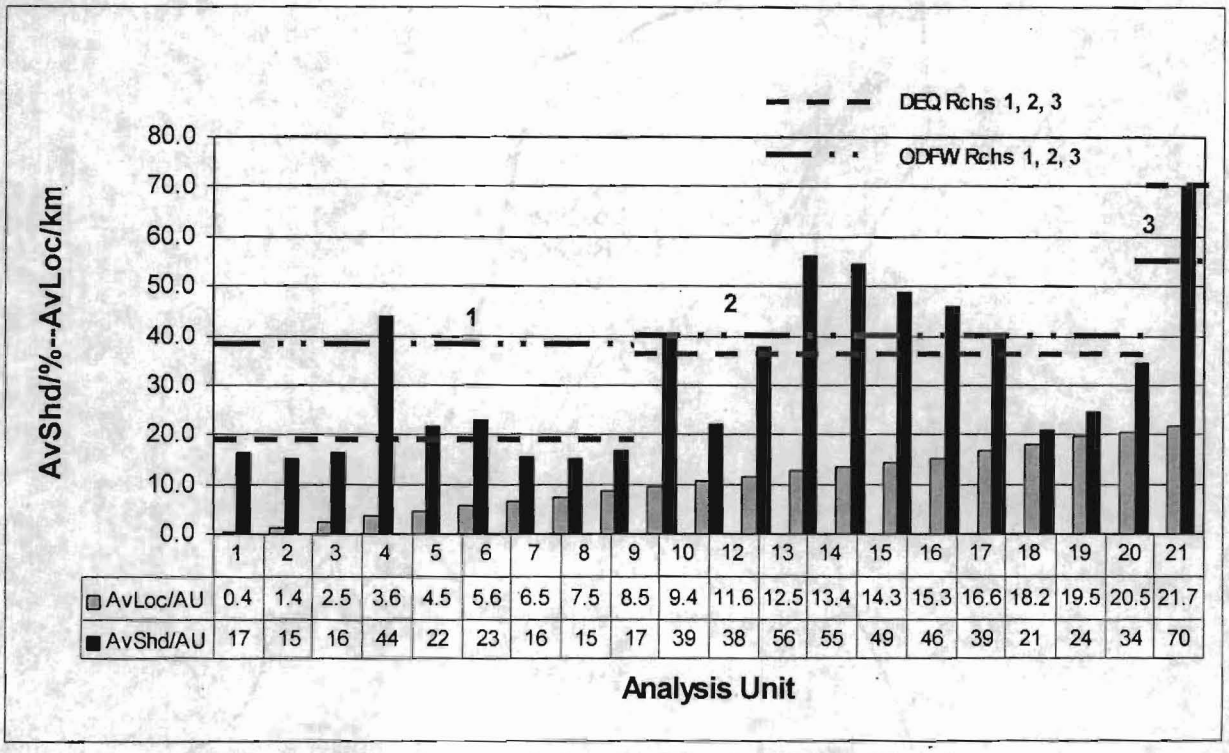
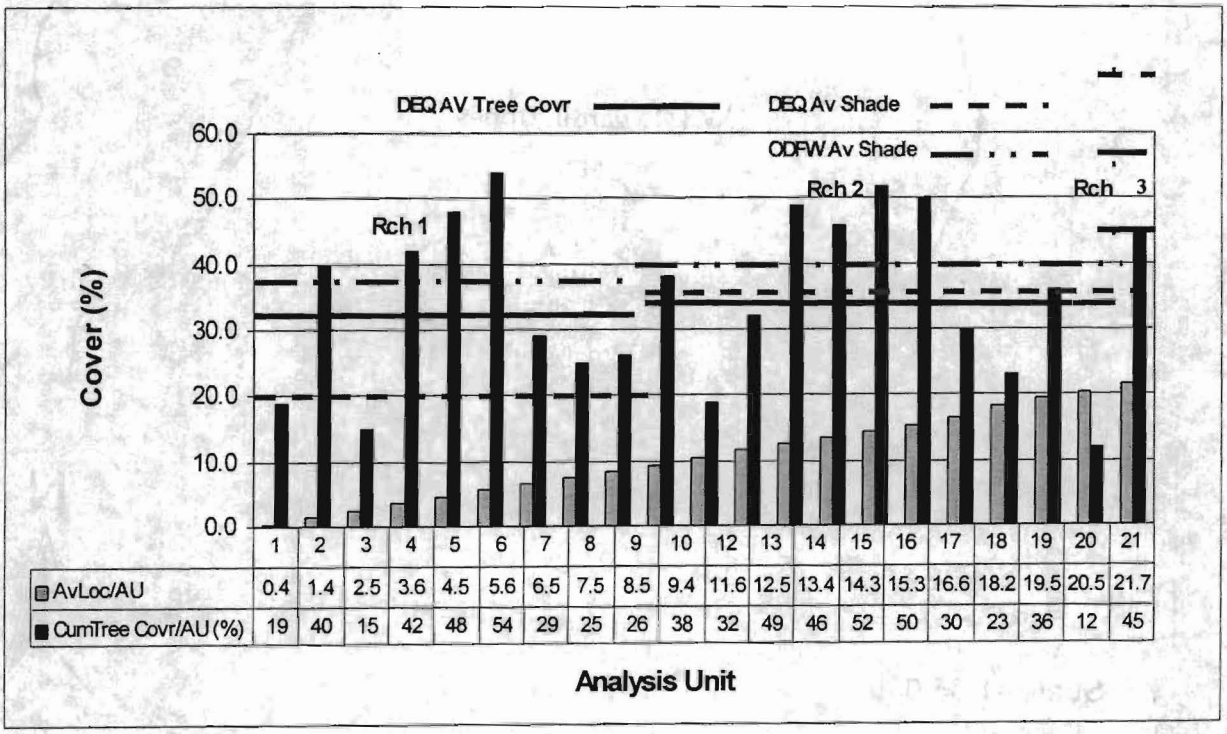


Figure VI-1: Lostine Vegetation in 50-foot Riparian Buffer; ODEQ Coverage



	1	2	3	4	5	6	7	8	9	10	12	13	14	15	16	17	18	19	20	21
AvLoc/AU	0.4	1.4	2.5	3.6	4.5	5.6	6.5	7.5	8.5	9.4	11.6	12.5	13.4	14.3	15.3	16.6	18.2	19.5	20.5	21.7
AvShd/AU	17	15	16	44	22	23	16	15	17	39	38	56	55	49	46	39	21	24	34	70

Figure VI-2: Lostine Average Shade—ODEQ Model



	1	2	3	4	5	6	7	8	9	10	12	13	14	15	16	17	18	19	20	21
AvLoc/AU	0.4	1.4	2.5	3.6	4.5	5.6	6.5	7.5	8.5	9.4	11.6	12.5	13.4	14.3	15.3	16.6	18.2	19.5	20.5	21.7
CumTree Covr/AU (%)	19	40	15	42	48	54	29	25	26	38	32	49	46	52	50	30	23	36	12	45

Figure VI-3: Lostine Tree Cover—50 ft Riparian Buffer—ODEQ Coverage

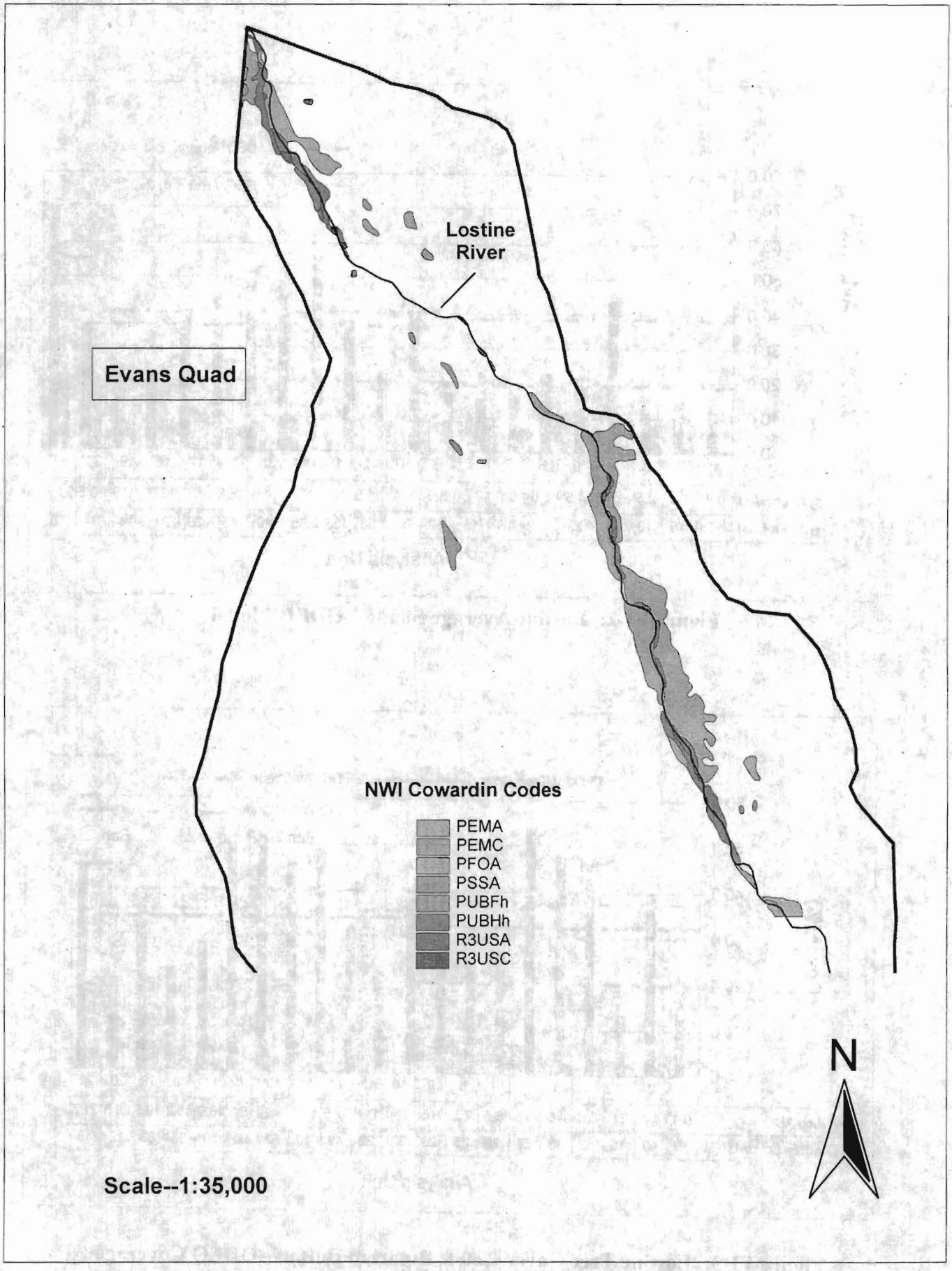


Figure VI-4a : Lostine Wetlands; NWI Evans Quad

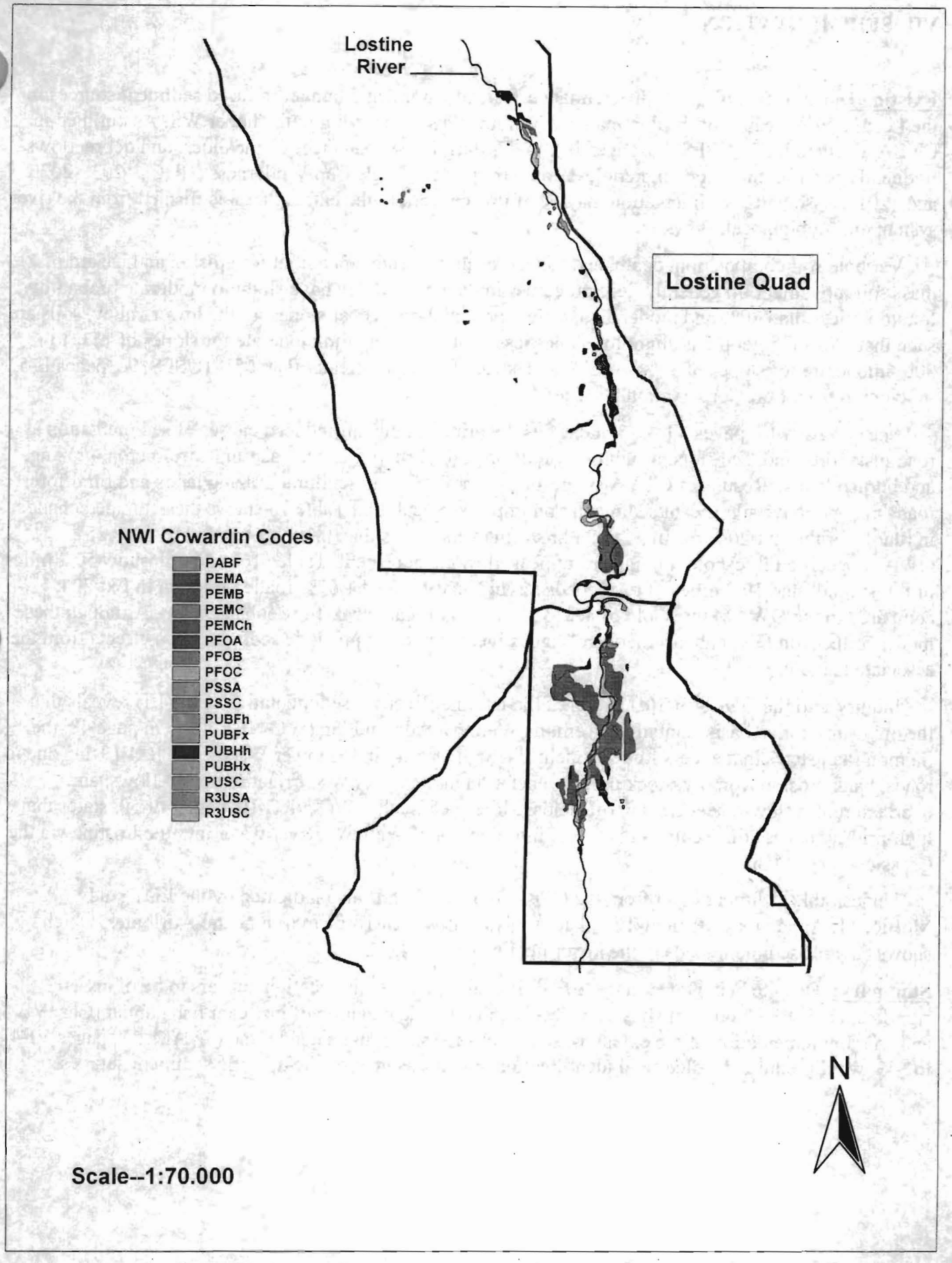


Figure VI-4b: Lostine Wetlands; NWI Lostine Quad

VII. SEDIMENTATION

Existing Data: It is difficult to differentiate effects of natural and human-induced sediment sources in the Lostine WS because of the dominance of natural causes occurring in the upper WS. As outlined in Ch IIA and detailed in USFS, 9c, pages II-4 to –7, flash flood, avalanches, landslides, and debris flows frequently occur in the steep, higher elevation terrain in the Eagle Cap Wilderness (HUCs –203, -202, and –201). Associated sedimentation may be of less concern to the extent that it is flushed from the river system during high peak flows.

Variable soil composition, depth, and aspect result in variable potential for erosion and hazard of mass soil movement. In general, these processes in the upper valley have slight to moderate probability for slopes less than 30% and moderate to severe potential on steeper slopes. In the lower valley, soils are such that erosion potential is slight for slopes less than 15%, slight to moderate for slopes of 15% to 30%, moderate for slopes of 30% to 65%, and severe for slopes greater than 65% (USFS, 9c, pages II-5, -6, citation from Soil Conservation Service).

The OWAM, 17, pages VI-4, -5, identifies the principal human-induced causes of sedimentation as road instability, induced slope instability, rural/forest road runoff, as well as runoff from crop, grazing, and burned lands. Results of Ch VA suggest that runoff from agricultural/grazing lands and rural/forest roads may not have significant sedimentation impacts. Recall that Table 15 shows the estimated change in runoff for the Ext 204 area in a 2yr 24 hr storm event is less than 0.10," compared to the 0.25" OWAM-specified threshold for significant peak-flow enhancement. Tables 16a and 16b show 50.2 miles of forest roads and 19.2 miles of rural roads, giving an estimated 1.67% roaded fraction in Ext 204, compared to the OWAM threshold of 4% to 5% for significant peak-flow enhancement. Although these modest effects on flow enhancement are suggestive, they do not preclude sedimentation effects from the associated land uses.

Inquiry into the ODEQ 303(d) listing of the Lostine River for sedimentation (Ch VIII) reveals that the only substantive basis is citations from the Wallowa Salmon Plan (WC-NPT, 10). On page 48, the Salmon Plan states that excess fine sediment is a high priority in the lower WS (below RM 10-11) due to roads, bank erosion from livestock use, devegetation in the upper WS, irrigation return flows, and overland return flows/sheet erosion off fields. More specifically, WC-NPT, 10, pages 49-50, states that high-priority excess fine sediment is due to introduction of Wallowa River water into the Lostine via the Cross-country Ditch.

Undesirable sediment input from the Cross-country Ditch is also indicated by the EDT study, MoBio, 11, Appendix C, Patient-Template Analysis, Lostine River Environmental Attributes, which shows adverse sediment loads in the lower Lostine (RM 0-4, 5).

Summary: Despite being cited in the 303(d) listing criteria, sedimentation appears to be of lesser significance than reduction of river-flow levels and other degradation of instream fish habitat (Chs VB and IX). Implementation of the extensive sediment assessment indicated by the OWAM, 17, pages VI-4 to –43, would require detailed field identification and assessment of site-specific sediment sources.

VIII. WATER QUALITY

This chapter generally follows the assessment procedures set out by the OWAM, 17, pages VIII-3 to –21 and its Appendix VIII-B, and incorporates the extensive Lostine River water-quality data from Menton, 3. Topics covered include beneficial uses and the 303(d) listing for water quality (WQ), exceedence of WQ criteria, Lostine WQ data, and summaries of WQ impairment and confidence evaluation.

Beneficial Uses and 303(d) Listing: Table 33 lists a few of the principal beneficial uses of the Lostine River and summarizes associated 303(d) listing factors. Table 34 shows an expanded list of beneficial uses for the Grande Ronde WS, and Table 35 shows the complete 303(d) Listing Decision Matrix for the Lostine River, downloaded from the ODEQ website, at http://waterquality.deq.state.or.us/wq.

The listing factor, flow modification in the Lostine, is addressed in depth in Ch V, habitat modification in Chs IV and IX, and sedimentation in Chs VII and IX.

Table 33: Beneficial Uses and Water Quality Issues

Beneficial Uses[1]	Check
Domestic water supply	X
Irrigation & Livestock Water	X
Resident fish and aquatic Life	X
Salmonid fish spawning	X
Salmonid fish rearing	X
Anadramous fish passage	X
Other	See OAR Beneficial Uses[1]

303(d) Stream Segment: Yes[2]

Water Quality Parameters	303) (d) List[2]	Details from 303(d) List[2]
Temperature[3]	No—See FN (3)	GR/WC Salmon Recovery Plan
Dissolved oxygen	No	----
pH	No	----
Nutrients[3]	No—See FN (3)	NPS assessed moderate
Bacteria[3]	No—See FN (3)	----
Toxics	No	----
Turbidity/suspended sediment	Yes	Excess sed. re Chinook listing
Habitat modification	Yes	Refer to Fish and Fish Habitat Ch IX
Flow modification	Yes	Refer to Hydrology and Water Use Ch V

Footnotes:

1. See Table 34 (OAR Beneficial Uses)
2. See Table 35 (Oregon Section 303(d) List Decision Matrix; Lostine River)
3. See Table 36 and related materials for Lostine R. water temperature, nutrients, and bacteria.

Table 34: OAR 340-41-722; Table 13: Beneficial Uses—Grande Ronde Basin

TABLE 13

GRANDE RONDE BASIN
(340-41-722)

Beneficial Uses	Main Stem Snake River (RM 176 to 260)	Main Stem Grande Ronde River (RM 39 to 165)	All Other Basin Waters
Public Domestic Water Supply[1]	X	X	X
Private Domestic Water Supply[1]	X	X	X
Industrial Water Supply	X	X	X
Irrigation	X	X	X
Livestock Watering	X	X	X
Anadromous Fish Passage	X	X	X
Salmonid Fish Rearing	X	X	X
Salmonid Fish Spawning	X	X	X
Resident Fish & Aquatic Life	X	X	X
Wildlife & Hunting	X	X	X
Fishing	X	X	X
Boating	X	X	X
Water Contact Recreation	X	X	X
Aesthetic Quality	X	X	X
Commercial Navigation & Transportation	X		

[1] With adequate pretreatment (filtration and disinfection) and natural quality to meet drinking water standards.

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Table 35: Oregon 303(d) List Decision Matrix for the Lostine River

Final 1998 Oregon Section 303(d) List Decision Matrix

Basin *Grande Ronde* Sub *Wallowa*

Name & Description	Waterbody Segment	Parameter	Criteria	Season	Basis for Consideration of Listing	Supporting Data or Information	Rationale for Not Listing	Listing Status
Lostine River								
Mouth to Westside Ditch	31E-LOST0	Flow Modification			Wallowa County Salmon Recovery Plan (1993); IWR (ODFW); USGS and WRD; NPS Assessment - segment 299: severe, observation (DEQ, 1988)	Snake R Chinook runs are 10-15% of historic numbers and are listed under ESA. Redds have declined (114 1964; 14/1991); irrigation withdrawals have been identified as high priority as some portions are dry at times (Wallowa Co Salmon Recovery Plan, 93).		303(d) List
		Habitat Modification			Wallowa County Salmon Recovery Plan (1993); NPS Assessment - segment 299: moderate, observation (DEQ, 1988)	Snake R Chinook runs are 10-15% of historic numbers and are listed under ESA. Redds have declined (114 in 1964; 14/91); lack of woody material for stream structure and habitat has been identified as high priority (Wallowa Co Salmon Recovery Plan, 1993).		303(d) List
		Nutrients			NPS Assessment - segment 299: moderate, observation (DEQ, 1988)		No supporting data or information	Need Data
		Sedimentation			Wallowa County Salmon Recovery Plan (1993); NPS Assessment - segment 299: moderate, observation (DEQ, 1988)	Snake R Chinook runs are 10-15% of historic numbers and are listed under ESA. Redds have declined (114 in 1964; 14/91); excess fine sediment has been identified as high priority (Wallowa County Salmon Recovery Plan, 1993).		303(d) List
		Temperature			GR Action Plan (1994); Wallowa County Salmon Recovery Plan (1993)		No supporting data or information	Need Data

Exceedence of WQ Criteria: Table 36 summarizes results of extensive Lostine WQ measurements from Menton, 3. The first column of the table lists the monitoring sites used, and the remaining columns list the WQ parameters and associated WQ data. Footnotes 1-4 of the table describe the specifics of the data entries; e.g., FN 3 gives the definition of the three entries in each cell for which WQ information is available, and the evaluation criteria from OWAM, 17, page VIII-9. Ditch locations are 50-150 yds from the river proper.

Annual percent exceedences above state evaluation-criteria levels shown by Table 36 are quite variable, 0-45% for temperature, 0-67% for nitrogen and phosphorous, 0% for E. coli, and 0-33% for fecal coliform. Measurements of other WQ parameters have not been made.

Table 36: Percent Exceedance of Water Quality Evaluation Criteria

Monitoring Site	Temp.[1], [3]	Dissolved Oxygen	pH	Nutrients[2], [3]		Bacteria[2], [3]		Turbidity	Toxics
				Nitrogen	Phosph.	E. coli	Fecal Coliform[4]		
Polebridge (USFS)	2000-2001 71-105 0%	No Data	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Upper Lostine #144	1995-2002 52-105 0-19 %	"	"	1996-97 5-6 0%	1996-97 5-6 0%	1997 5 0%	1996-97 5-6 0 %	"	"
Mid-Lostine (Caudle Ln)	1995-2002 0-105 0-44%	"	"	No Data	No Data	No Data	No Data	"	"
Cross-country Ditch (tail)	No Data	"	"	1994-98 5-6 40-67%	1994-98 5-6 40-67%	1997-98 4-6 0%	1994-98 3-6 0-33%	"	"
Lostine R/ Clearwater Ditch	"	"	"	1994-97 5-6 17-50%	1994-97 5-6 0-17%	1997 5 0%	1994-97 3-6 0-33%	"	"
Lower Lostine #148-Baker	1995-2002 52-105 0-45%	"	"	1996-97 5-6 0-33%	1996-97 5-6 0-33%	1997 5 0%	1996-97 5-6 0%	"	"

Footnotes:

1. This table summarizes the statistical parameters for detailed (seven-day rolling average) water temperature measurements taken at the indicated sites—see Table 37 and Figures VIII-1 to VIII-4.
2. This table also summarizes the statistical parameters for detailed data on nutrient (total nitrogen and phosphorus) and bacteria (E. coli and fecal coliform) levels taken at the indicated sites—see Figures VIII-5 to VIII-20.
3. The three values in each cell correspond to:
   - Range of years over which data were taken
   - Range of number of independent measurements each year
   - Range of annual % exceedance of OAR/DEQ evaluation criteria:
     --64°F for temperature
     --0.3mg/l for Nitrogen
     --0.05mg/lfor Phosphorus
     --406 counts/100mlfor E. coli
     --400 counts/100mlfor fecal coliform[4]
4. Oregon fecal coliform criteria stated in (3) above has been replaced by the stated E. coli criteria. The fecal coliform criteria, Butcher, 43, are used for reference purposes only.

Lostine WQ Data: Data from measurements of Lostine River WQ parameters given by Menton, 3 are shown by Table 37 and Figs. VIII-1 through –20, and are discussed in the following paragraphs.

Water Temperature: Table 37 contains a summary of the 7-day rolling average temperatures calculated from extensive daily water-temperature measurements at the various locations for the indicated years. As will be shown by the charts described below, the maximum values shown by the table represent annual maximums, whereas the median and minimum values are less useful because they represent, or are influenced by, the lower (spring and fall) temperatures as determined by the periods of measurement. Annual % exceedences of evaluation criteria are shown in the last row for each location.

Table 37: Summary of Lostine River Temperature Measurements; 7-day Rolling Averages

Polebridge-USFS		**1995**	**1996**	**1997**	**2000**	**2001**	**2002**
	Monitoring Period	6/25-9/3	6/25-10/7	None	None	None	None
	Number of Values	71	105	"	"	"	"
	Maximum Temp	61.13	60.97	"	"	"	"
	Minimum Temp	49.48	43.7	"	"	"	"
	Median Temp	55.58	56.54	"	"	"	"
	% Values > 64 deg	0	0	"	"	"	"
Upper GS		**1995**	**1996**	**1997**	**2000**	**2001**	**2002**
	Monitoring Period	8/7-9/30	8/15-10/5	7/4-9/9	6/23-10/5	6/23-10/5	7/1-9/28
	Number of Values	55	52	68	105	105	90
	Maximum Temp	60.15	60.61	69.74	63.79	66.64	62.98
	Minimum Temp	51.19	50.44	49.56	47.82	51.93	50.82
	Median Temp	58.26	56.64	58.89	56.85	60.31	59.25
	% Values > 64 deg	0.00	0.00	16.2	0.00	19.1	0.00
Caudle Ln		**1995**	**1996**	**1997**	**2000**	**2001**	**2002**
	Monitoring Period	8/7-9/30	8/15-10/5	None	6/23-10/5	6/23-10/5	7/1-9/28
	Number of Values	55	52	"	105	105	90
	Maximum Temp	62.61	66.41	"	65.36	70.99	65.96
	Minimum Temp	52.27	56.34	"	48.46	54.43	51.7
	Median Temp	60.33	63.29	"	58.58	63.16	60.79
	% Values > 64 deg	0	44.2	"	21.9	41.9	8.9
Baker Rd		**1995**	**1996**	**1997**	**2000**	**2001**	**2002**
	Monitoring Period	8/7-9/30	8/15-10/5	7/4-8/5	6/23-10/5	6/23-10/5	7/1-7/12
	Number of Values	55	52	52	105	105	69
	Maximum Temp	63.44	64.59	68.33	68.19	69.71	66.45
	Minimum Temp	54.34	54.18	51.87	50.21	54.42	52.51
	Median Temp	61.95	60.89	63.09	60.23	63.68	60.42
	% Values > 64 deg	0	3.8	36.5	27.6	44.8	13.1

Figs. VIII-1 to –4 display the detailed time records for the 7-day rolling-average of maximum daily river temperatures for locations and periods corresponding to those of Table 37. The order of the figures corresponds to sequential upstream-to-downstream locations, beginning with the near-Polebridge reference location south of the southern Ext 204 boundary and extending downstream to Baker Rd. The horizontal lines in the figures show the state (OAR 340) water-quality temperature standards for the indicated fish factors (OWAM, 17, page VIII-11).

Figs. VIII-1 to –4 show that the multi-year average of the 7-day rolling average values (bold curves, labeled AV) increases from a maximum summer average of ca 60° near Polebridge to ca 67° at Baker Rd. During mid-summer, the year-to-year fluctuations from these averages are frequently 8° -10° at the

downstream locations. The annual peak 7-day average temperature is ca 70 ° at all downstream locations.

Daily records from Menton, 3 show that individual daily-maximum temperatures are frequently 3 ° - 7 ° higher than the 7-day rolling averages, sometimes reaching 75 ° at the downstream Lostine locations in midsummer.

Total Nitrogen: Figs. VIII-5 to –8 show measured total nitrogen levels for the indicated river locations and years. The horizontal line at 0.3 mg/l is the indicator criterion for WQ degradation (OWAM, 17, page VIII-9). These measured nitrogen levels are much lower than the indicator value at the Upper GS (Fig. VIII-5). At the downstream stations, the measured levels are typically lower than, or comparable to, the indicator level in the May-July timeframe, generally increasing to levels somewhat higher than the indicator value during the low-flow season, August-October (Figs. VIII-6 to –8). Fig. VIII-6 shows increased nitrogen levels in Wallowa River water (in-ditch measurements) compared to those at other stations. Large variability and/or lack of late-season data at downstream stations (Figs. VIII-7, -8) preclude clear interpretation.

Total Phosphorus: Figs. VIII-9 to –12 show measured total phosphorus levels for the indicated river locations and years, and the horizontal line corresponds to the WQ indicator of 0.05 mg/l (OWAM, 17, page VIII-9). With the exception of the Cross-country Ditch and a few other downstream points, measured phosphorus levels are less than, or comparable to, the indicator level.

E. coli: Figs. VIII-13 to –16 show measured E. coli levels for the indicated locations and years (single year, 1997, for all but the Cross-country Ditch location, which has data for 1997-98). Two indicator levels are shown on the charts, 406 counts/100ml, which corresponds to single-sample measurements (such as those on the charts) and 126 counts/100ml, which corresponds to the log-mean of at least five samples at a given location over a 30-day period. The measured E. coli levels are generally much lower than the indicator levels (note the log scales on the charts). However, the number of measurements is quite small (1-2 years of data), with a correspondingly greater degree of uncertainty than for larger data sets.

Fecal coliform: Figs. VIII-17 to –20 show the measured fecal coliform levels for the indicated locations and years. The indicator level, 400 counts/ml, is recommended by ODEQ (Butcher, 43), although fecal coliform levels are no longer regulated in Oregon waters. As with E. coli above, the subject fecal coliform levels are generally well below the indicator value.

Water Quality Impairment and Confidence Evaluation: Table38 summarizes the assessment of WQ impairment for the WQ parameters for which data exist, as derived from the WQ measurements given in this chapter and from the procedures given by the OWAM, 17, VIII-15 and –16. For example, the impairment ratings for temperature, 2nd column of Table 38, are derived from application of the rule defined in FN(2) of that table to the % exceedence values for the various stations and years given by Table 37. The corresponding rankings for nutrients and bacteria are similarly derived by calculation of % exceedences from the data tables of Figs VIII-5 to –20 via the exceedence criteria give by FN(3) of Table 36 for each of the locations and years, then applying the impairment ratings via the rule just described [FN(2) of Table 38].

Table 38: Summary of Water Quality Impairment; Lostine River

Monitoring Site (location)	Temp. [2]	Dissolved Oxygen	pH	Nutrients[2]	Bacteria[2]	Turbidity	Summary of Miles Impaired[1]
Polebridge (ca 15 mi)	Not Impaired	No Data	No Data	No Data	No Data	No Data	None
Upper Lostine (9.5 mi)	Mod Impair	"	"	Not Impaired	Not Impaired	"	Temp. Impair (9.5 mi)
Caudle Ln (5.7 mi)	Impaired	"	"	No Data	No Data	"	Temp. Impair (part of 9.5 mi)
Cross-country Ditch (5.2 mi)	No Data	"	"	Impaired	??[3]	"	Nutr. Impair, Bact. ? (5.2 mi)
Lostine R @ C-W D. (3 mi)	No Data	"	"	Impaired	??[3]	"	"
Lower Lost. @ Baker Rd (1mi)	Impaired	"	"	Mod Impair	Not Impaired	"	Temp., Nutr. Impair (1 mi)

Footnotes:

1. Procedure for "Summary of Miles Impaired" If any item in the subject row is rated as Moderately Impaired or Impaired, the Summary is rated as Impaired. Miles in columns are not additive.
2. The OWAM-recommended threshold for "Moderate Impairment" is 15%-50% exceedance of criteria (OWAM, 17, page VIII-16). The criteria used here is moderate if the maximum exceedance is <34% for any single year and the exceedance is >15% for 50% or less years.
3. E. coli levels do not exceed criteria; fecal coliform exceedance levels are moderate to high.

Table 39 summarizes the confidence evaluation for this chapter and sets out recommendations for developing an expanded database for more complete evaluation of WQ issues.

Table 39: Water Quality Assessment Confidence Evaluation

Category	Potential Issue[1]	Information Sufficient[2]	Confidence in Conclusions[3]
Temperature	Yes	Yes	High
Dissolved oxygen	Unsure	No Data	----
pH	"	"	----
Nutrients	Yes	Variable	Moderate
Bacteria	Yes	No	Low
Toxics-Organic	Unsure	No Data	----
Toxics-Metals	"	"	----
Turbidity	"	"	----
Overall Evaluation	Yes	No	Variable
Recommendations for additional water quality monitoring:			
(1) Systematic, multi-year monitoring for E. coli, DO, pH, turbidity throughout the mid-to-lower –204 river segment; May-October at Caudle/Crosscountry/Clearwater/Baker Rd stations. (2) Update and expand the database for nutrients at these stations			

Footnotes: See next page

Footnotes to Table 39:

1. From existing data cited in Chs II, V, and VIII.
2. Sufficiency judged on adequate number of data points to minimize effects of "outlier" points.
3. Based on the analyst's opinion re sufficiency of the information and confidence in completing the evaluation.

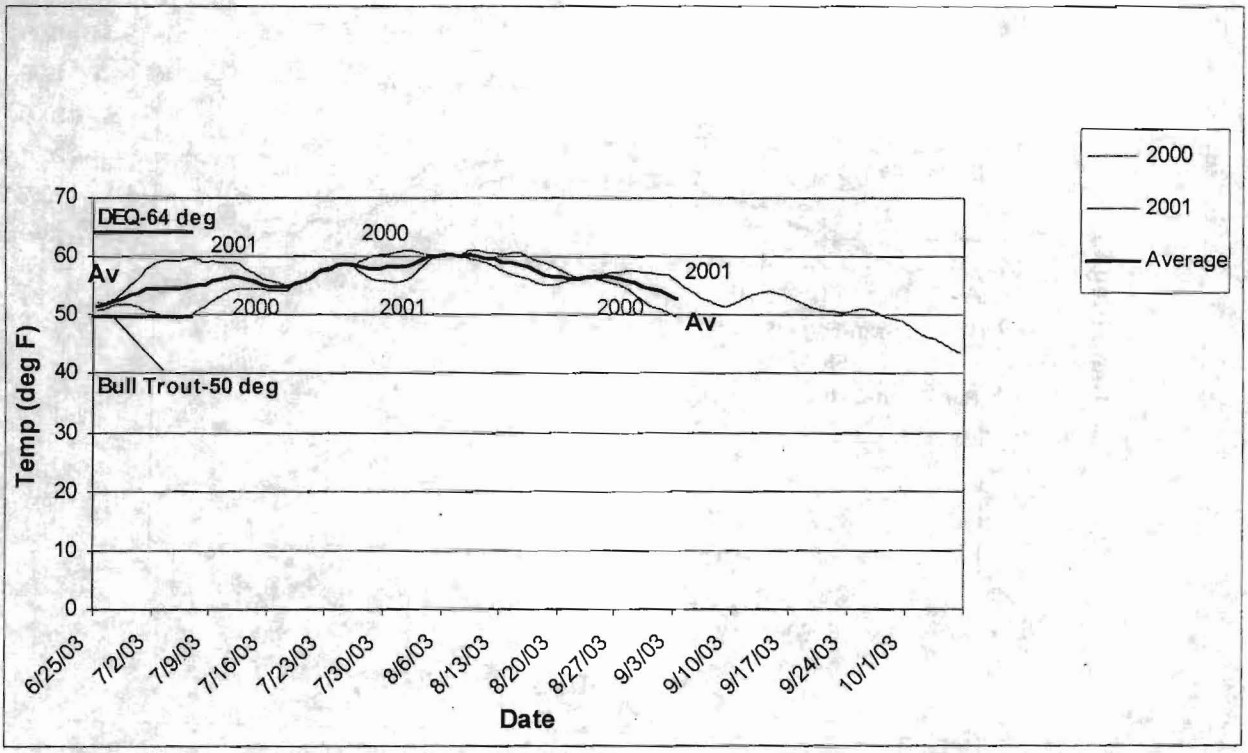


Figure VIII-1: Maximum 7-day Rolling Average Temperature; Reference Near Polebridge

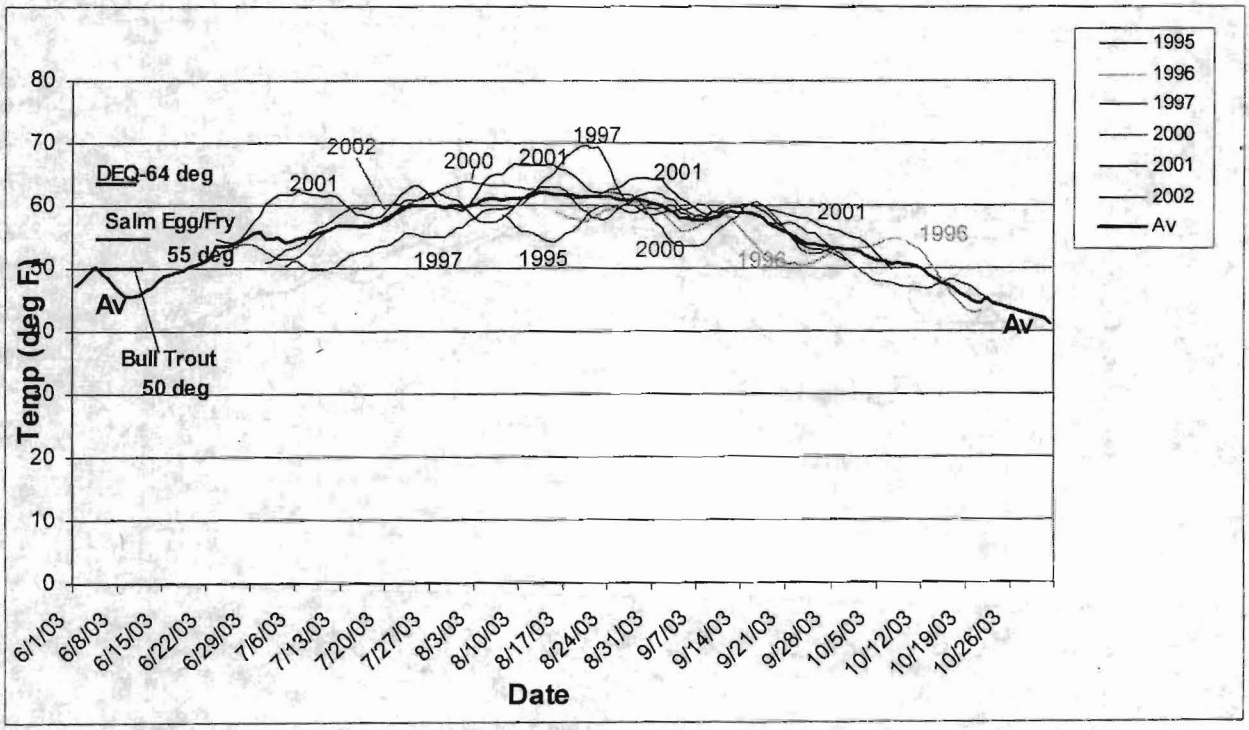


Figure VIII-2: Maximum 7-day Rolling Average Temperature; Upper GS

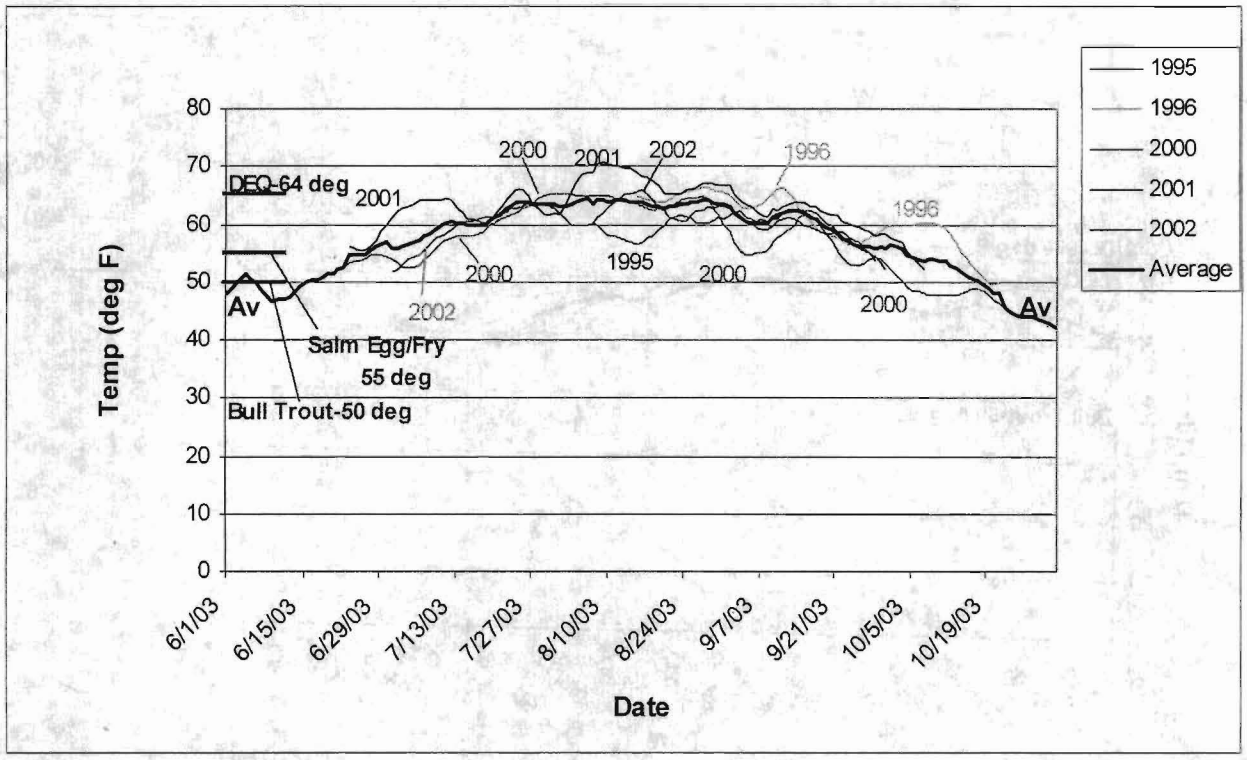


Figure VIII-3: Maximum 7-day Rolling Average Temperature; Caudle Ln

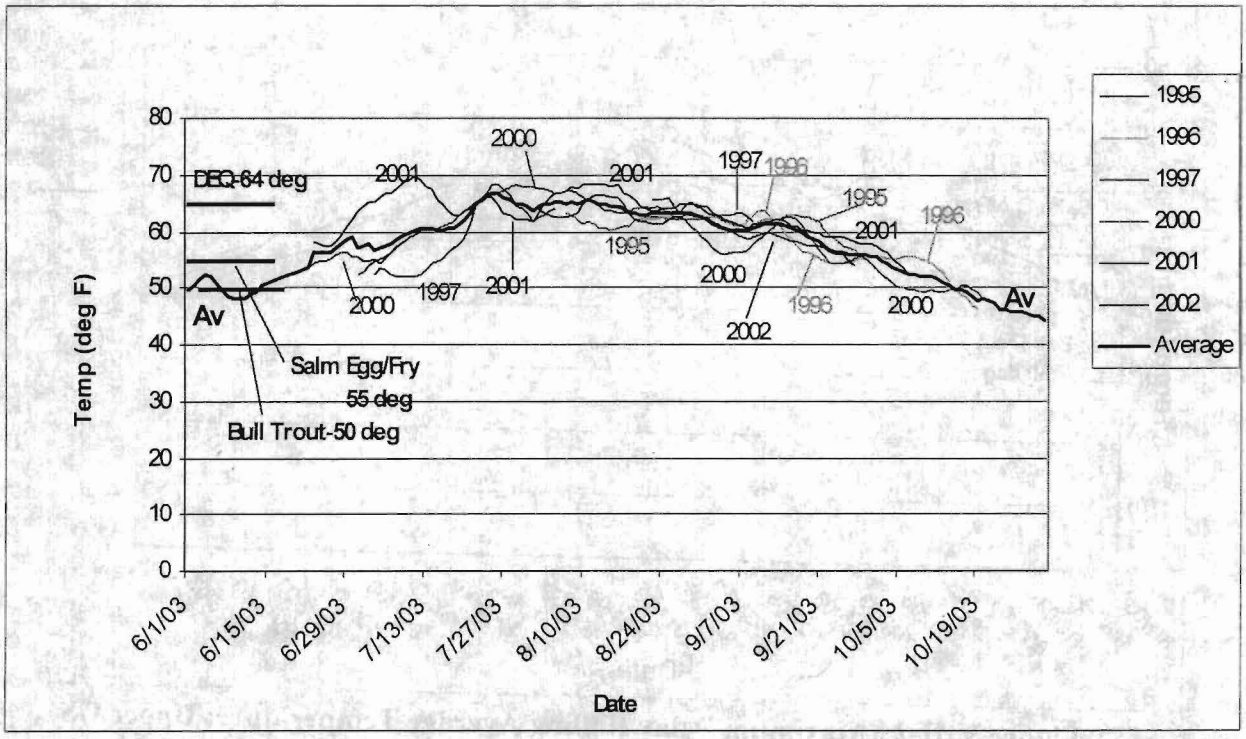
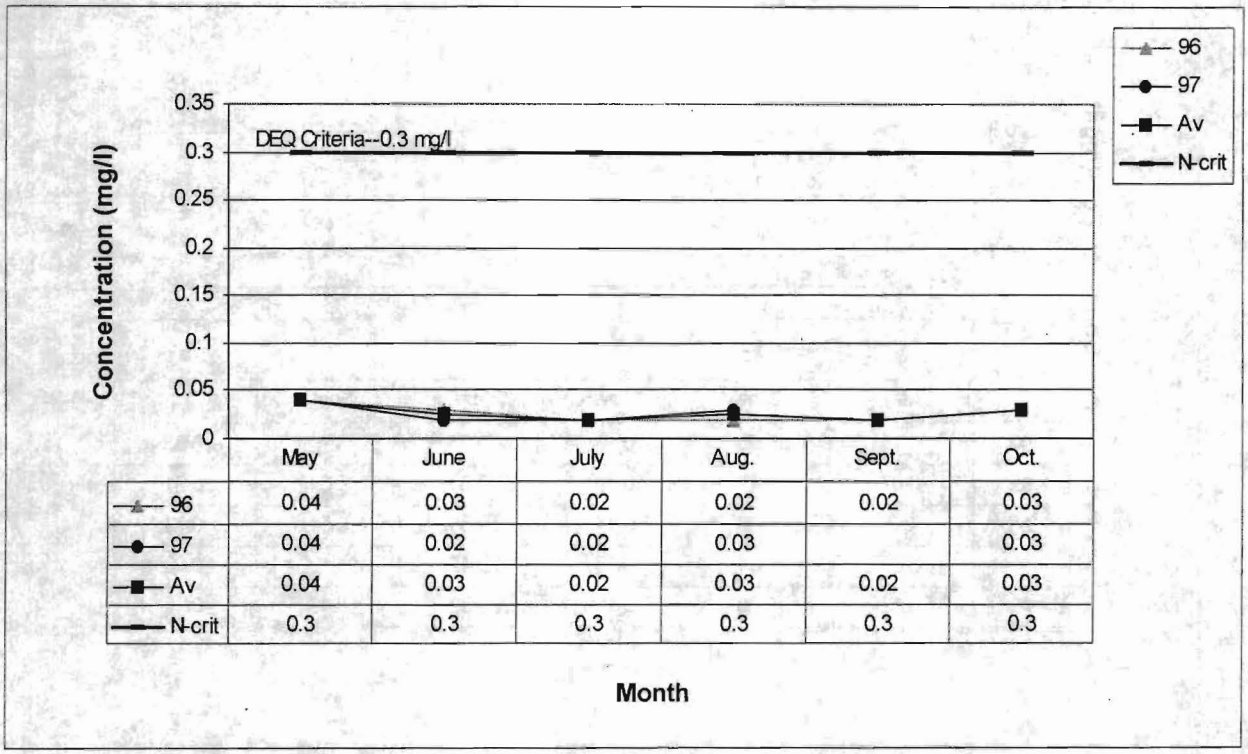
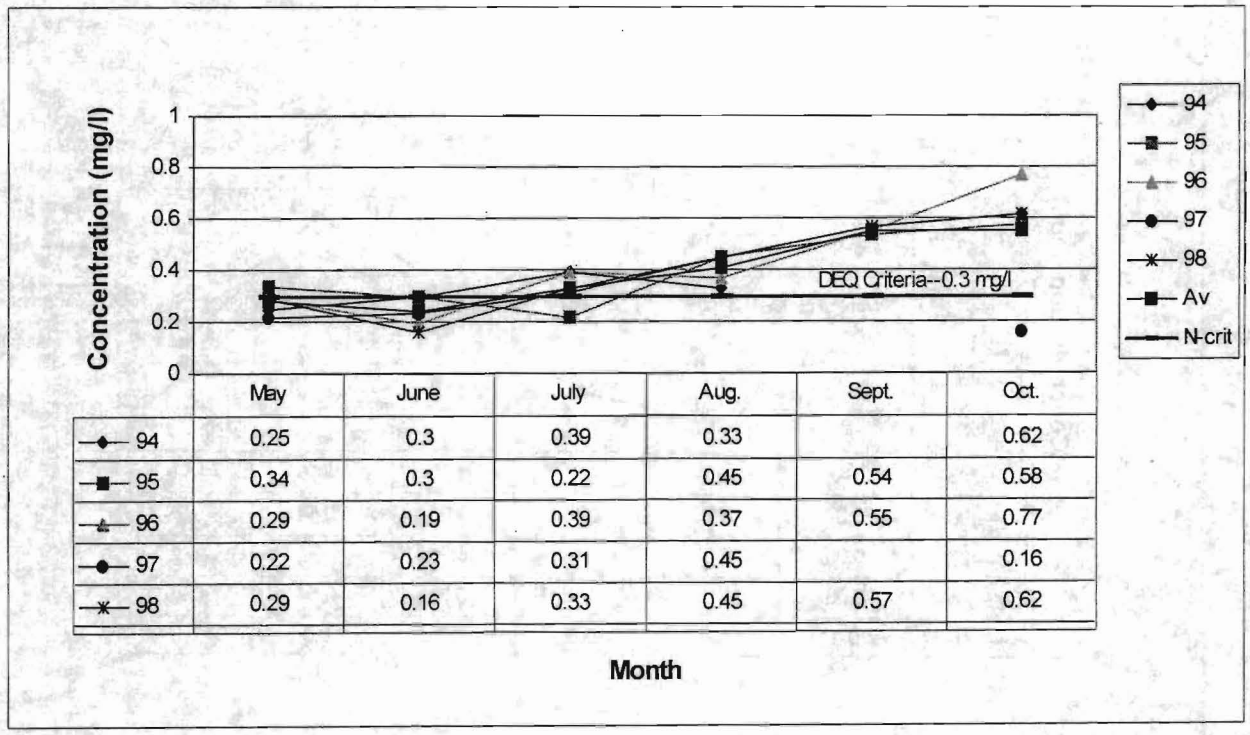


Figure VIII-4: Maximum 7-day Rolling Average Temperature; Baker Rd



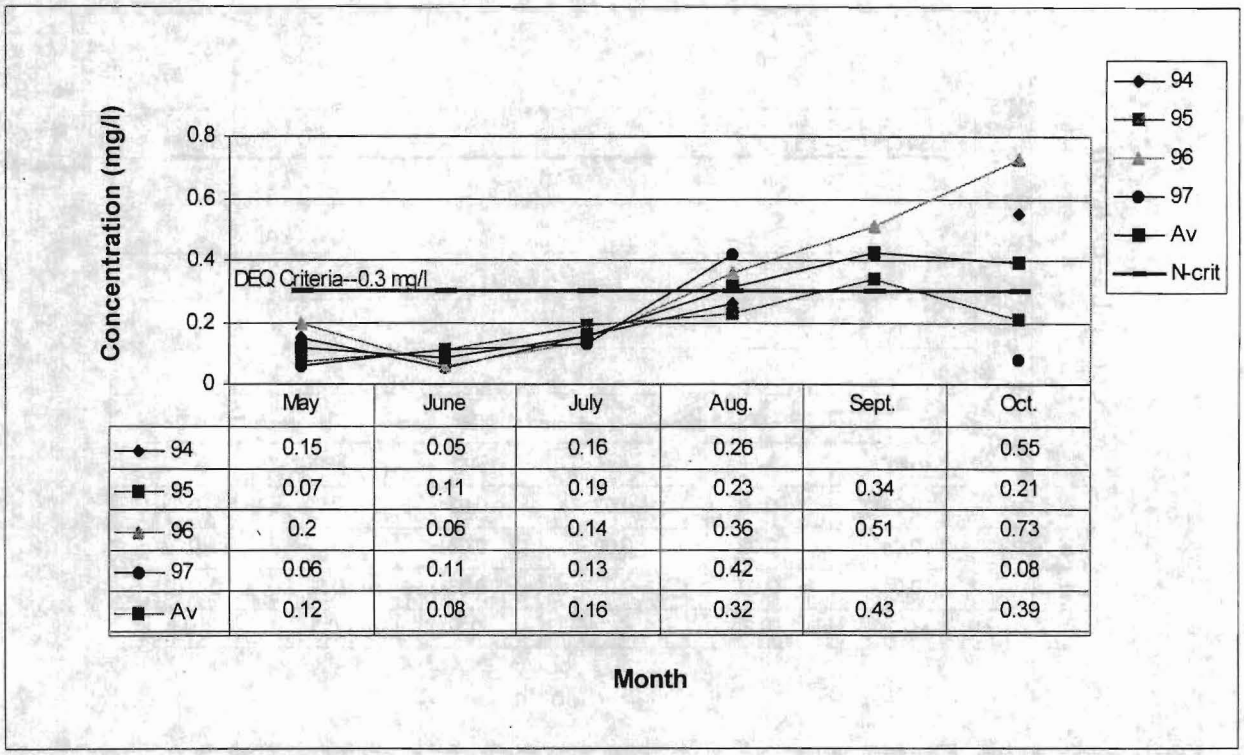
	May	June	July	Aug.	Sept.	Oct.
96	0.04	0.03	0.02	0.02	0.02	0.03
97	0.04	0.02	0.02	0.03		0.03
Av	0.04	0.03	0.02	0.03	0.02	0.03
N-crit	0.3	0.3	0.3	0.3	0.3	0.3

Figure VIII-5: Measured Total Nitrogen; Upper GS



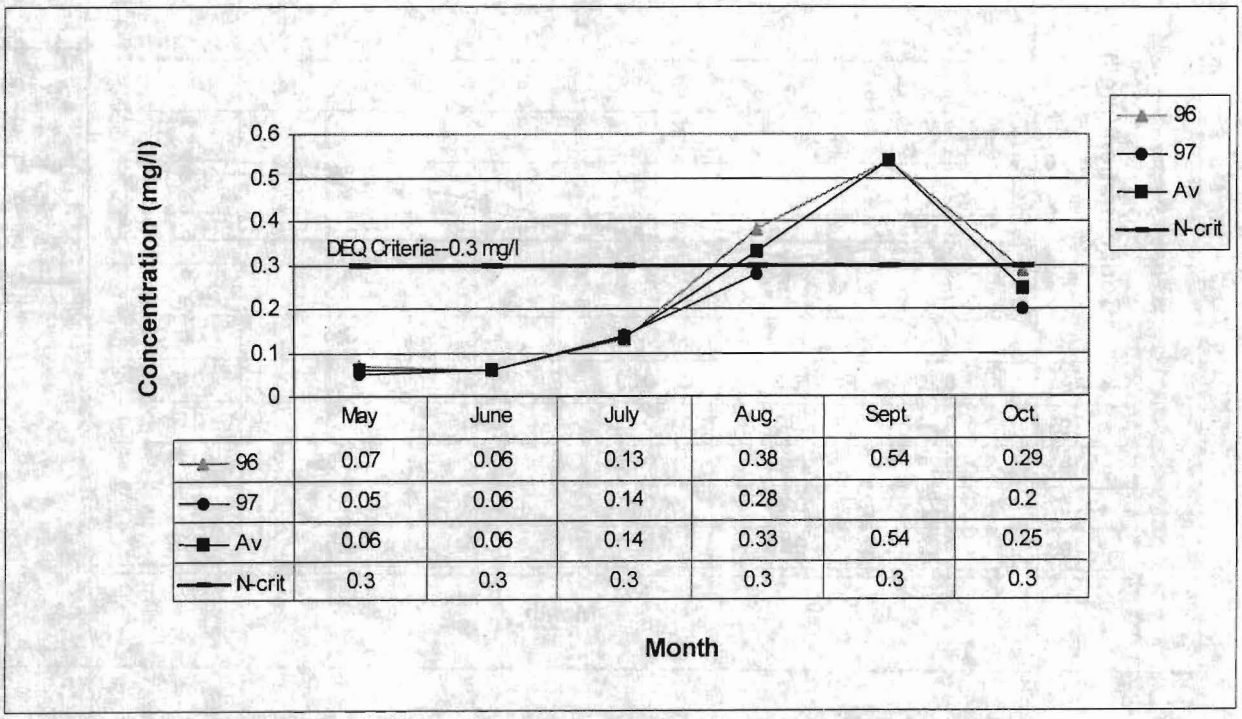
	May	June	July	Aug.	Sept.	Oct.
94	0.25	0.3	0.39	0.33		0.62
95	0.34	0.3	0.22	0.45	0.54	0.58
96	0.29	0.19	0.39	0.37	0.55	0.77
97	0.22	0.23	0.31	0.45		0.16
98	0.29	0.16	0.33	0.45	0.57	0.62

Figure VIII-6: Measured Total Nitrogen; At Cross-country Ditch



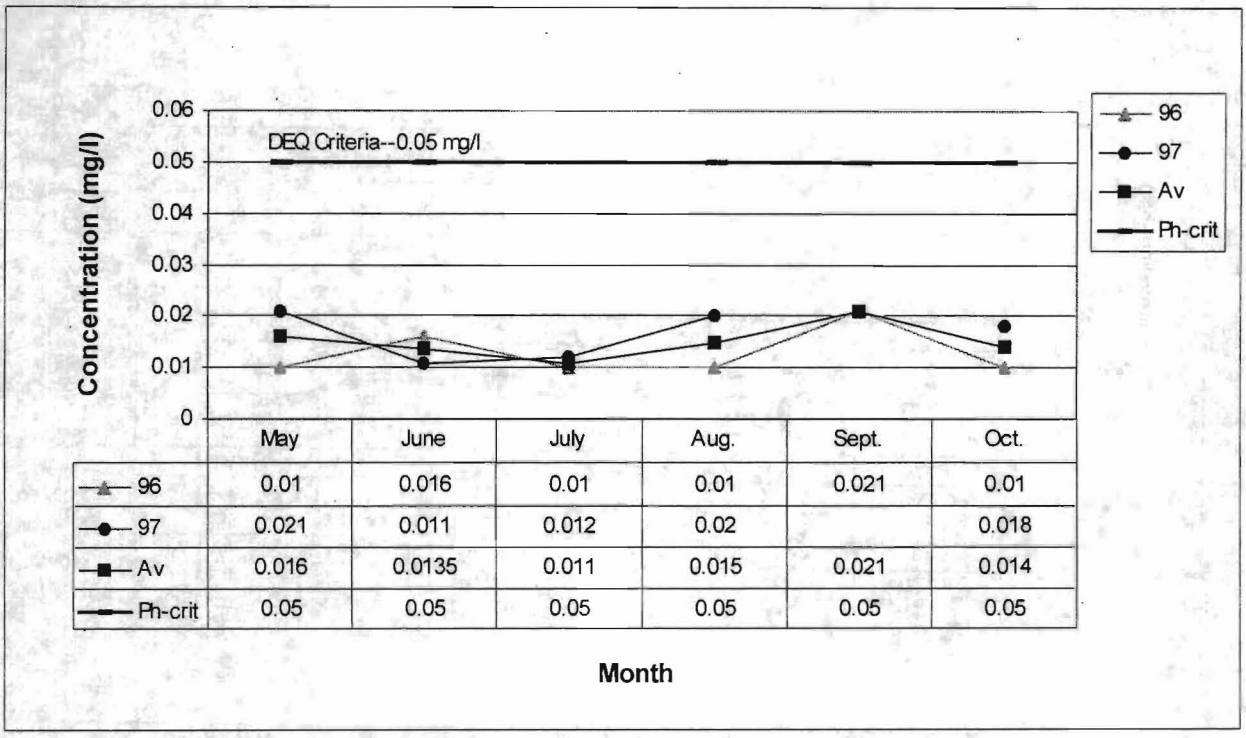
	May	June	July	Aug.	Sept.	Oct.
94	0.15	0.05	0.16	0.26		0.55
95	0.07	0.11	0.19	0.23	0.34	0.21
96	0.2	0.06	0.14	0.36	0.51	0.73
97	0.06	0.11	0.13	0.42		0.08
Av	0.12	0.08	0.16	0.32	0.43	0.39

Figure VIII-7: Measured Total Nitrogen; At Clearwater Ditch



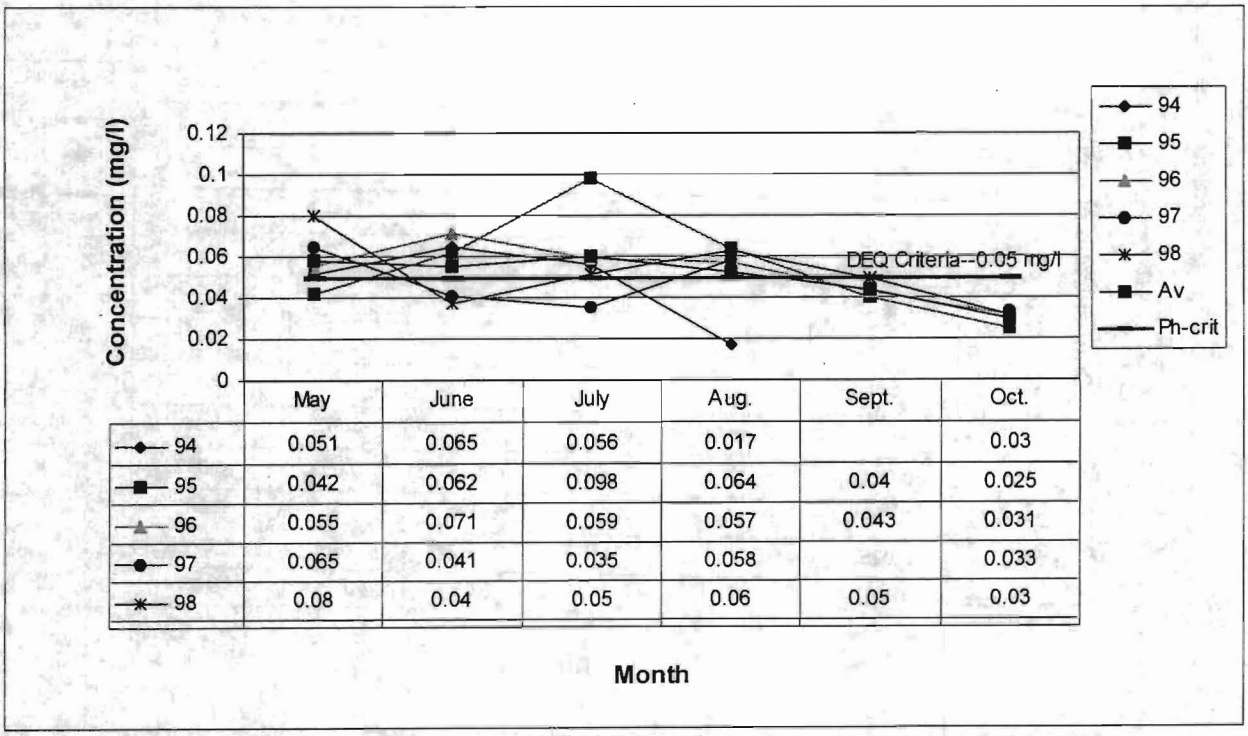
	May	June	July	Aug.	Sept.	Oct.
96	0.07	0.06	0.13	0.38	0.54	0.29
97	0.05	0.06	0.14	0.28		0.2
Av	0.06	0.06	0.14	0.33	0.54	0.25
N-crit	0.3	0.3	0.3	0.3	0.3	0.3

Figure VIII-8: Measured Total Nitrogen; Baker Rd



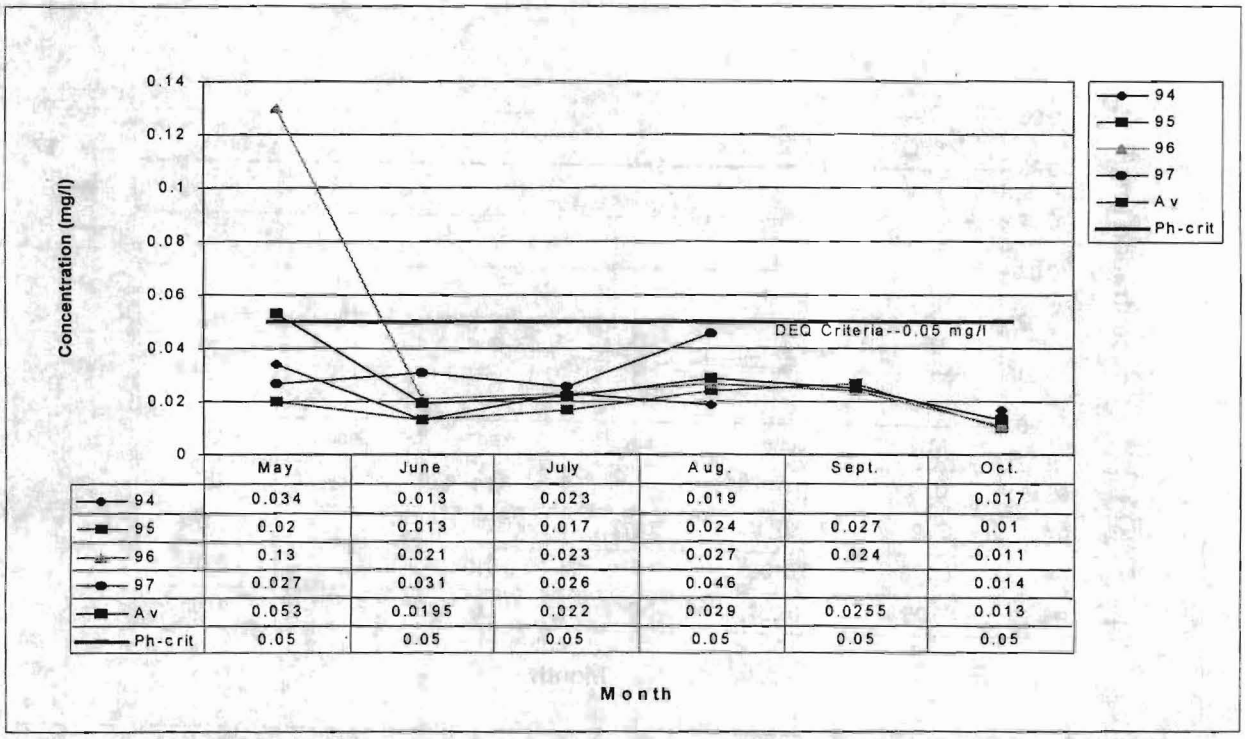
	May	June	July	Aug.	Sept.	Oct.
96	0.01	0.016	0.01	0.01	0.021	0.01
97	0.021	0.011	0.012	0.02		0.018
Av	0.016	0.0135	0.011	0.015	0.021	0.014
Ph-crit	0.05	0.05	0.05	0.05	0.05	0.05

Figure VIII-9: Measured Total Phosphorus; Upper GS



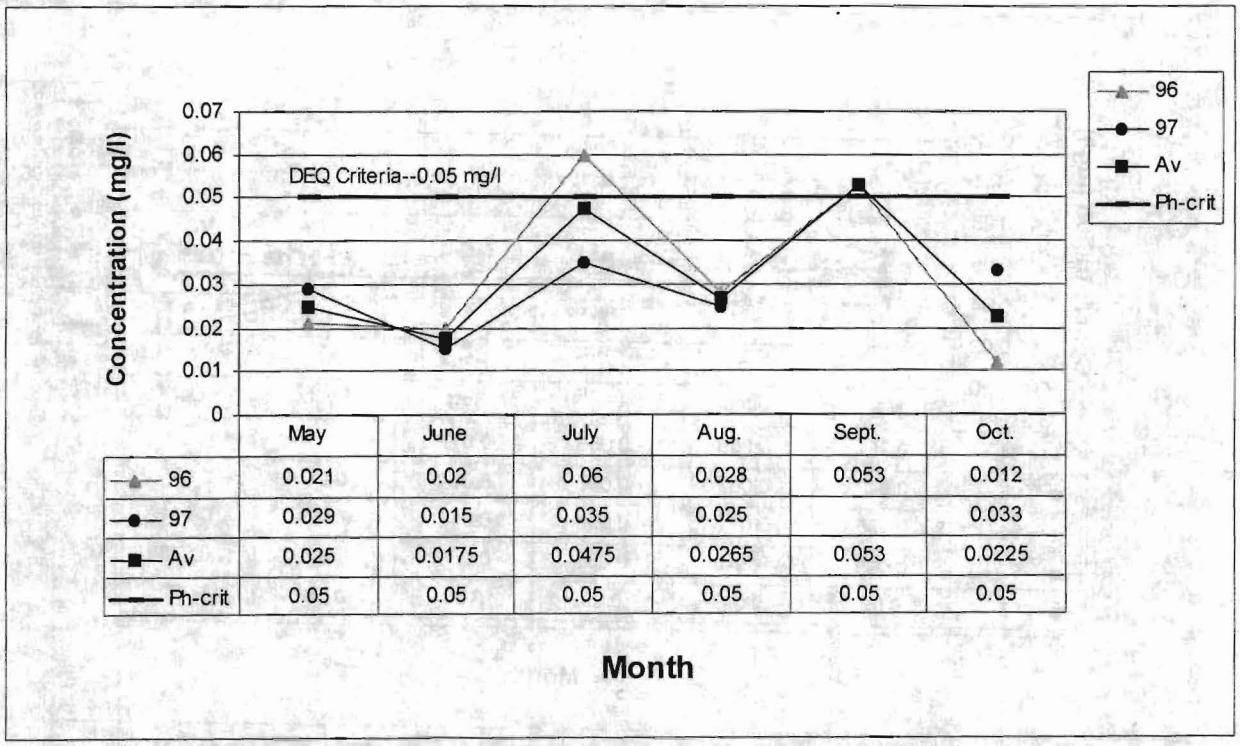
	May	June	July	Aug.	Sept.	Oct.
94	0.051	0.065	0.056	0.017		0.03
95	0.042	0.062	0.098	0.064	0.04	0.025
96	0.055	0.071	0.059	0.057	0.043	0.031
97	0.065	0.041	0.035	0.058		0.033
98	0.08	0.04	0.05	0.06	0.05	0.03

Figure VIII-10: Measured Total Phosphorus; At Cross-country Ditch



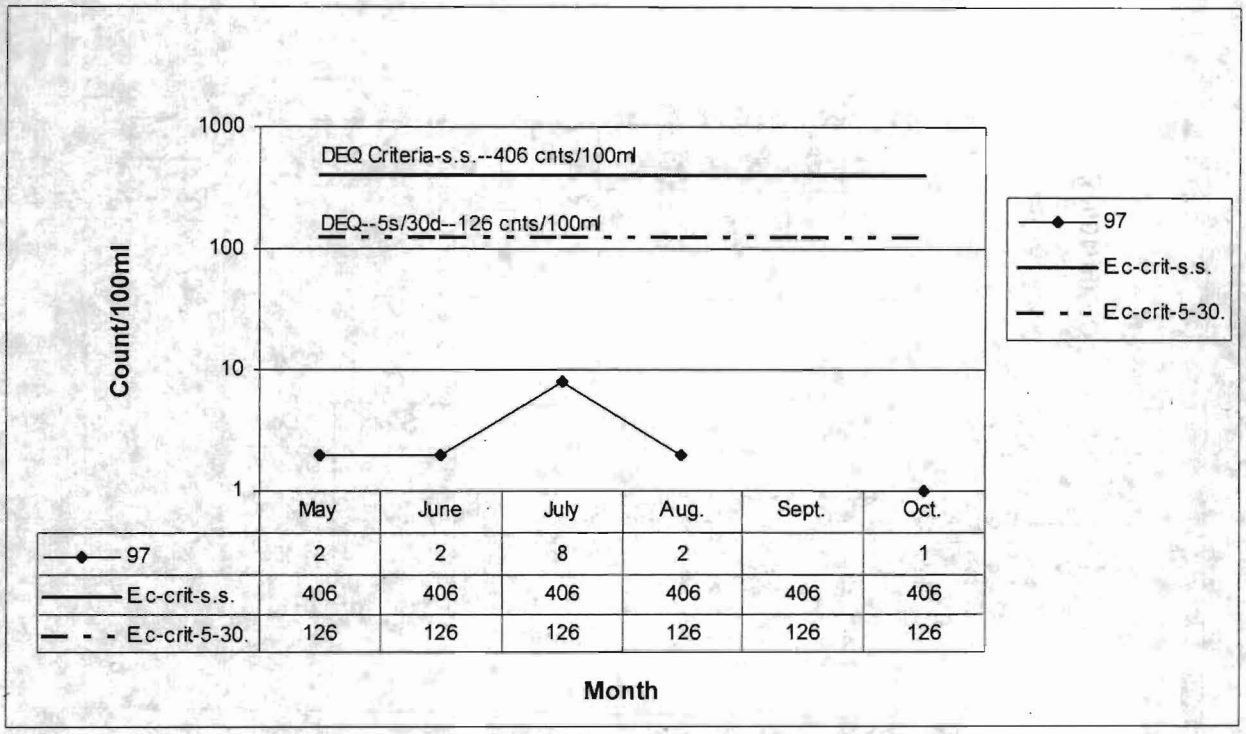
	May	June	July	Aug.	Sept.	Oct.
94	0.034	0.013	0.023	0.019		0.017
95	0.02	0.013	0.017	0.024	0.027	0.01
96	0.13	0.021	0.023	0.027	0.024	0.011
97	0.027	0.031	0.026	0.046		0.014
Av	0.053	0.0195	0.022	0.029	0.0255	0.013
Ph-crit	0.05	0.05	0.05	0.05	0.05	0.05

Figure VIII-11: Measured Total Phosphorus at Clearwater Ditch



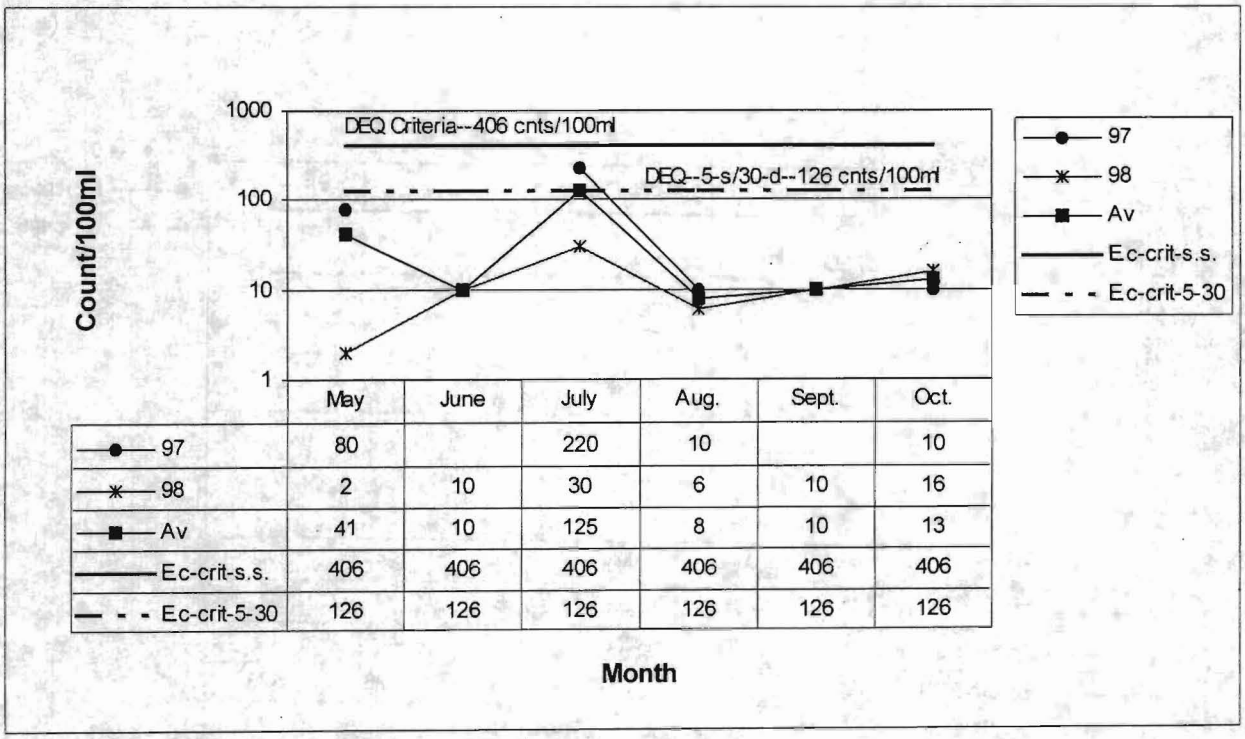
	May	June	July	Aug.	Sept.	Oct.
96	0.021	0.02	0.06	0.028	0.053	0.012
97	0.029	0.015	0.035	0.025		0.033
Av	0.025	0.0175	0.0475	0.0265	0.053	0.0225
Ph-crit	0.05	0.05	0.05	0.05	0.05	0.05

Figure VIII-12: Measured Total Phosphorus; Baker Rd



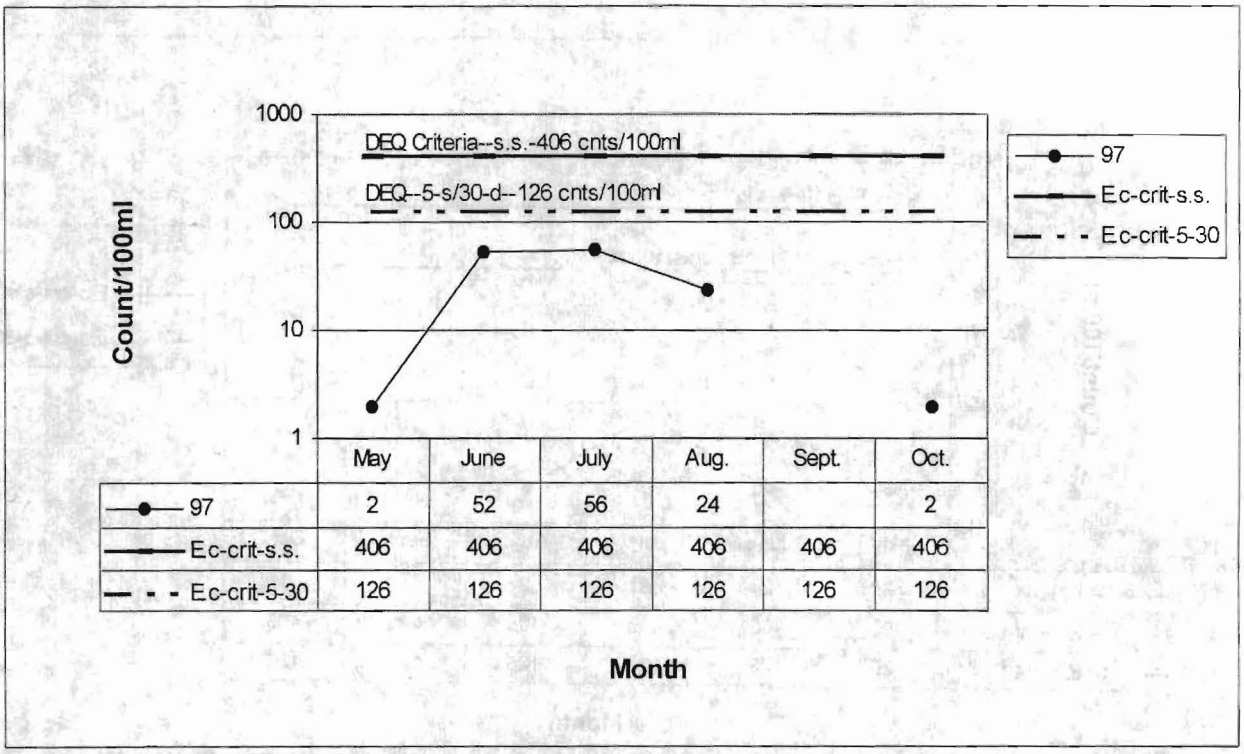
	May	June	July	Aug.	Sept.	Oct.
97	2	2	8	2		1
Ec-crit-s.s.	406	406	406	406	406	406
Ec-crit-5-30.	126	126	126	126	126	126

Figure VIII-13: Measured E. coli; Upper GS



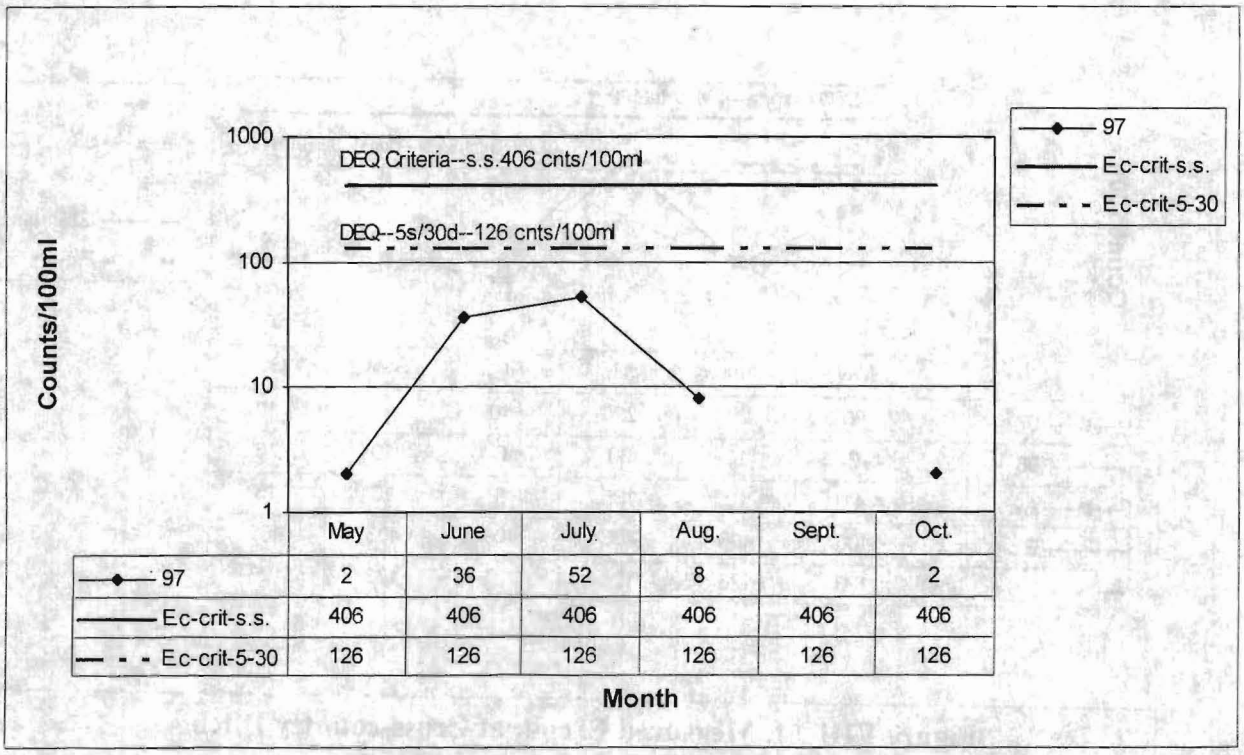
	May	June	July	Aug.	Sept.	Oct.
97	80		220	10		10
98	2	10	30	6	10	16
Av	41	10	125	8	10	13
Ec-crit-s.s.	406	406	406	406	406	406
Ec-crit-5-30	126	126	126	126	126	126

Figure VIII-14: Measured E. coli; at Cross-country Ditch



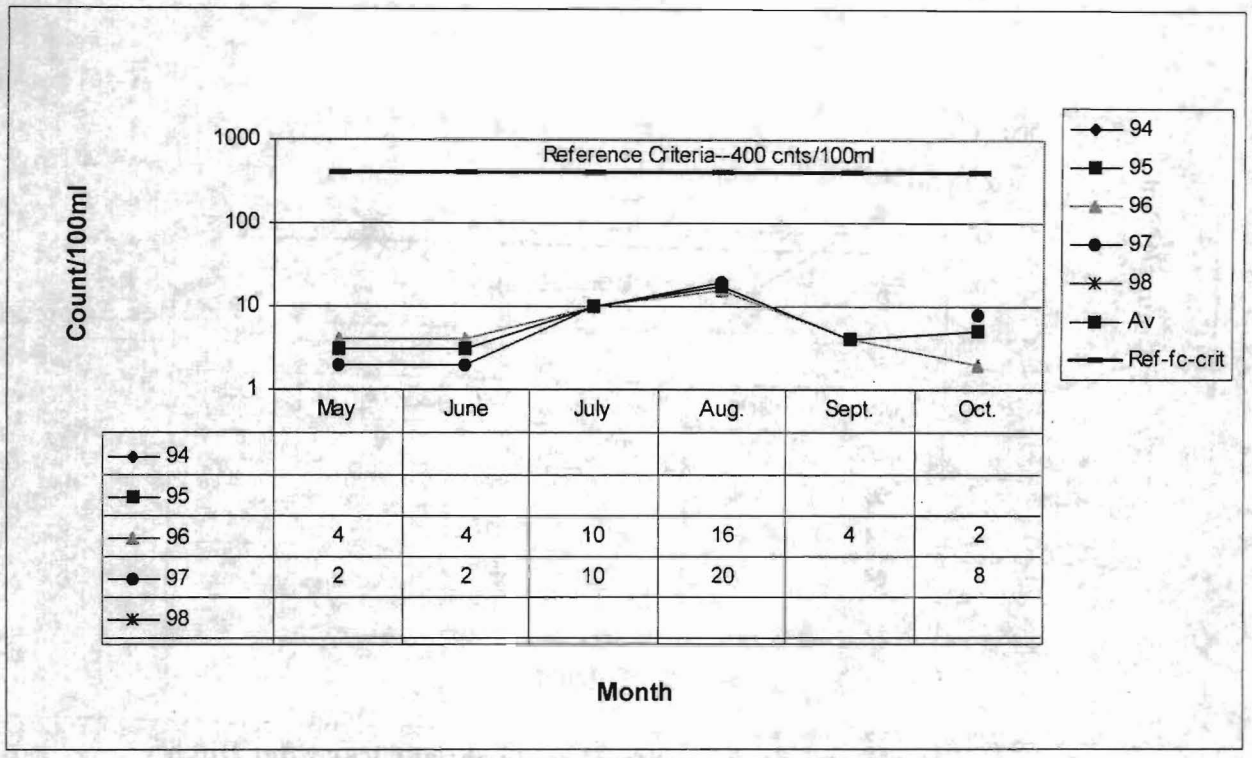
	May	June	July	Aug.	Sept.	Oct.
97	2	52	56	24		2
Ec-crit-s.s.	406	406	406	406	406	406
Ec-crit-5-30	126	126	126	126	126	126

Figure VIII-15: Measured E. coli; at Clearwater Ditch



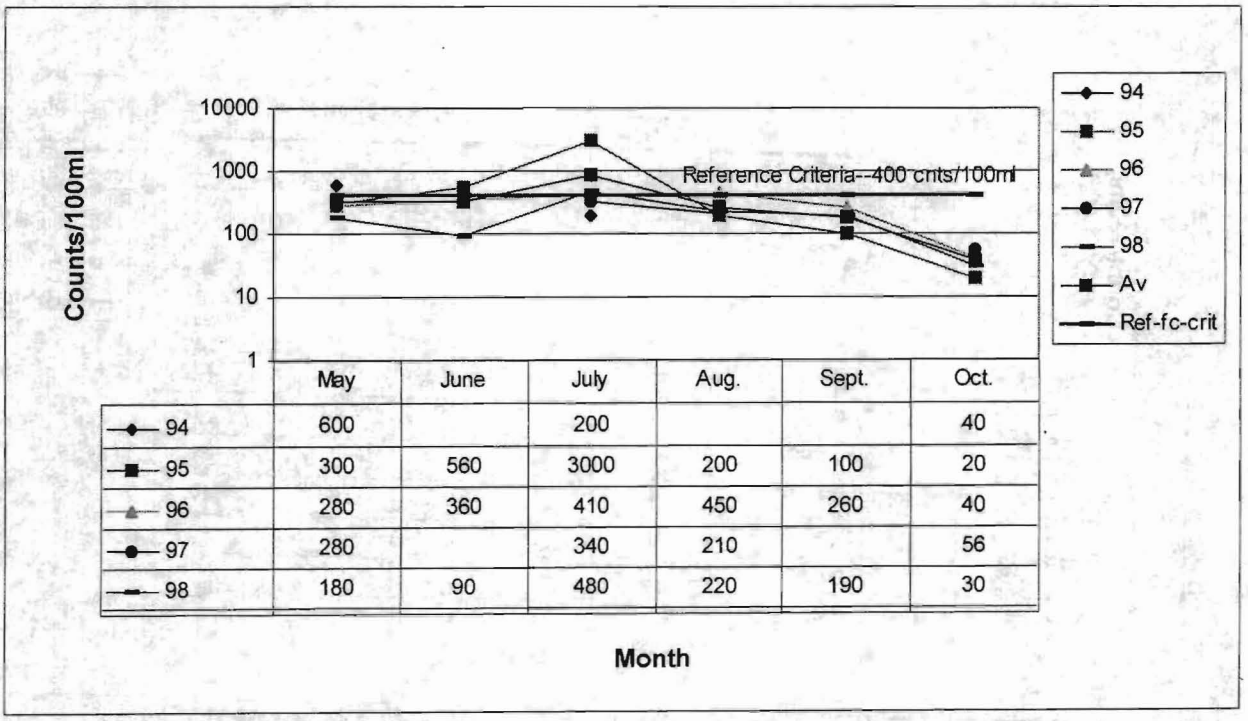
	May	June	July	Aug.	Sept.	Oct.
97	2	36	52	8		2
Ec-crit-s.s.	406	406	406	406	406	406
Ec-crit-5-30	126	126	126	126	126	126

Figure VIII-16: Measured E. coli; Baker Rd



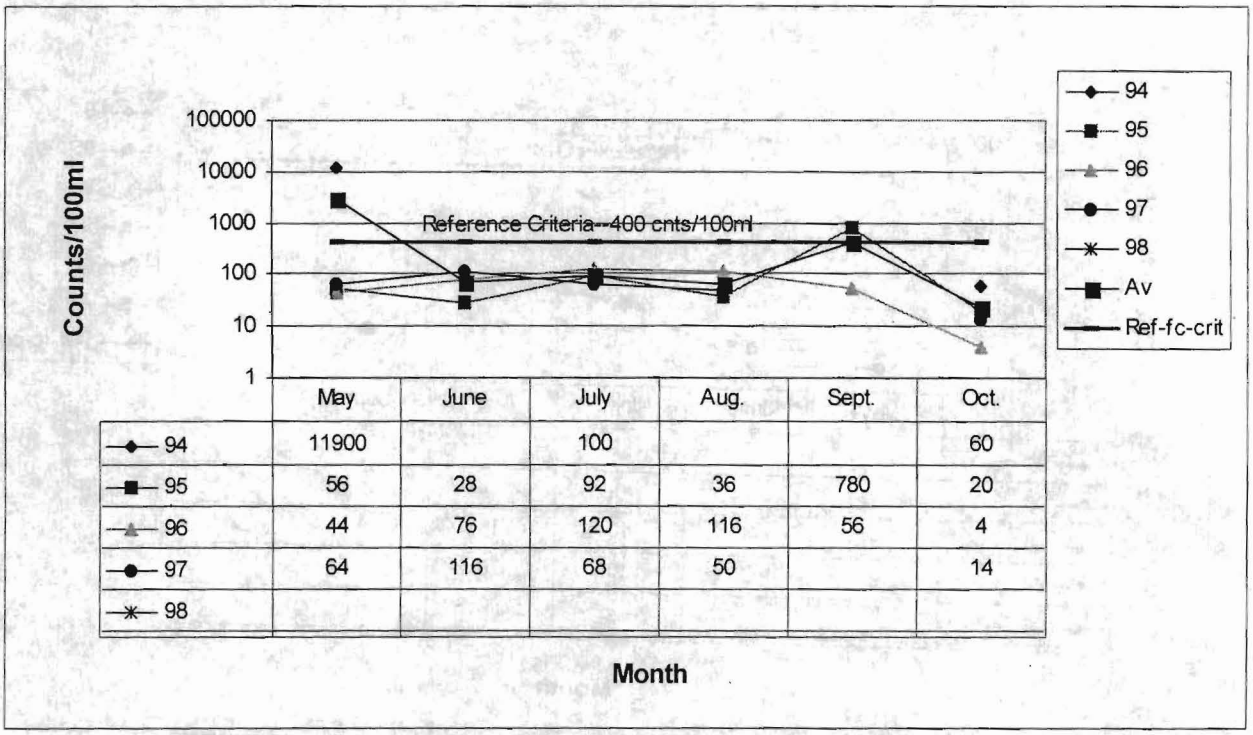
	May	June	July	Aug.	Sept.	Oct.
94						
95						
96	4	4	10	16	4	2
97	2	2	10	20		8
98						

Figure VIII-17: Measured fecal coliform; Upper GS



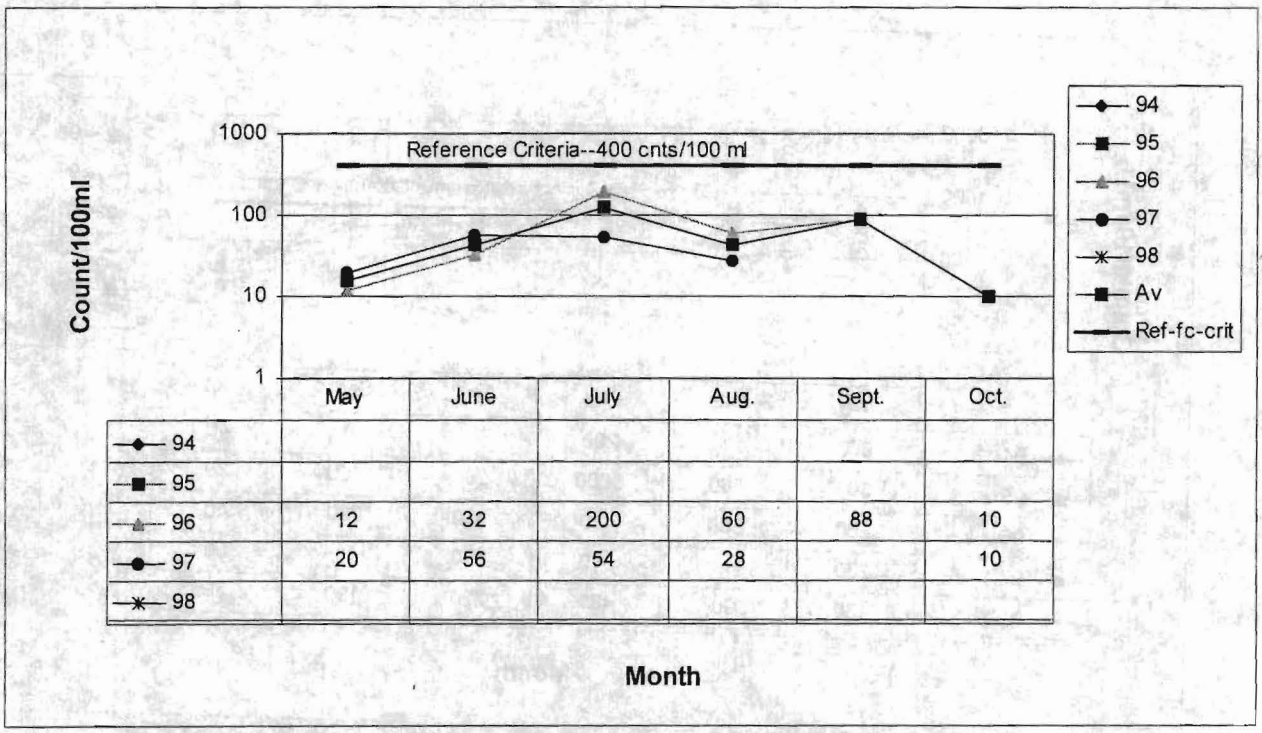
	May	June	July	Aug.	Sept.	Oct.
94	600		200			40
95	300	560	3000	200	100	20
96	280	360	410	450	260	40
97	280		340	210		56
98	180	90	480	220	190	30

Figure VIII-18: Measured fecal coliform; at Cross-country Ditch



	May	June	July	Aug.	Sept.	Oct.
94	11900		100			60
95	56	28	92	36	780	20
96	44	76	120	116	56	4
97	64	116	68	50		14
98						

Figure VIII-19: Measured fecal coliform; at Clearwater Ditch



	May	June	July	Aug.	Sept.	Oct.
94						
95						
96	12	32	200	60	88	10
97	20	56	54	28		10
98						

Figure VIII-20: Measured fecal coliform; Baker Rd

IX. FISH AND FISH HABITAT CONDITIONS

Organization of this chapter follows that set out in the OWAM, 17, pages IX-3 to –17, and its Appendices IX-A, -B, and –C. Sources of extensive data specific to the Lostine include ODFW personnel (Knox and Smith, 44) as well as Refs. 4, 6, 7, 8, 16, and 22.

Overview: Table 40 gives a summary outline of the results of the fish and fish habitat assessment. Part 40-a lists the fish species of concern and their status; 40-b indicates the single species, Coho Salmon, known to have vanished from the WS; 40-c gives the current and past stocking history; 40-d indicates life stages for the various fish species; 40-e describes locations of spawning and rearing habitat; 40-f lists locations of known migration barriers (all are "natural" barriers induced by low flow rates); and 40-g indicates fish combinations and inter-relationships. Data are from Knox and Smith, 44 except as noted in the following discussions of specific topics of concern.

Table 40: Fisheries Information Summary

a—Species of concern in the WS

Species	ESA Status	ODFW Status, Population Trends	Source
Spring Chinook	Threatened	Stable	ODFW redd counts, **See Fig. IX-1**
Summer Steelhead	"	"	ODFW
Bull Trout	"	Unknown	"
Rainbow Trout	--	Stable	"
N. Pike Minnow	--	Unknown	"
CS/BL/Mt. Suckers(2)	--	"	"
Sculpin	--	"	"
Redside Shiners	--	"	"
Peamouth	--	"	"
LN/SP Dace(3)	--	"	"
Chislemouth	--	"	"
Mt. Whitefish	--	"	"

(1) Index area, three-mile reach downstream from Six-mile Bridge
(2) Course-Scale and Bridge Lip Suckers
(3) Longnose and Speckled Dace

b—Species vanished from WS

Species	Source
Coho	ODFW

c—Stocked species (past and present)

Species	Stocking Notes	Native or Exotic?	Source
Brook Trout	1940s-1950s	Exotic	ODFW
Rainbow Trout	1945-1991	Non-endemic	"
Cutthroat Trout	1948-1990	Exotic	"
Golden Trout	1950s	"	"
Spring Chinook	1998-2003	Endemic stock	"

Table 40: Fisheries Information Summary (con't)

d—Life history patterns

See Fig. IX-2, life stages chart

e—Locations for holding, spawning, and rearing

Location	Species/Purpose	Source
RM 10.5-26 (Upper Gauging Station to E-W Forks)	Bull Trout spawning, rearing	ODFW
See Figs. IX-3, -4, -5, spawning and juvenile habitat areas for Spring Chinook and Steelhead Trout.		

f—Known migration barriers

Location (subwatershed, trib., site)	BarrierType: C-culvert, N-natural, D-dam	Source
Lostine R: Rch 1: Site 1: RM 1.2[1]	N—Low Flow	R2, 4, p 4-31[1]
	-Salmon—40 cfs	
	-Steelhead—16 cfs	
	-Res. Trout—5 cfs	
Lostine R: Rch 2: Site 1: RM 5.5[1]	N—Low Flow	R2, 4, p 4-32[1]
	-Salmon—28 cfs	
	-Steelhead—14 cfs	
	-Res. Trout—4.6 cfs	
See Figs. IX-6, -7, -8, minimum flows for fish passage.		

g—Combinations of fish in WS

Combination	Yes/No
Brook trout/Bull trout (competition, inbreeding)	Yes[2]
Rainbow/Cutthroat trout (" " " ")	No
Hatchery/wild stock interaction	Yes[3]

(1) Reaches and site locations per Lostine Instream Flow Study, ibid.

(2) Potential, actual not well known per ODFW.

(3) Low-level interaction for Wallowa R. hatchery Steelhead entering the Lostine R. system per ODFW.

Spring Chinook Population Trends: Fig. IX-1 shows the variation of ODFW redd counts for Spring Chinook in the Lostine "Index Area," reach extending approximately three miles downstream from the Six-mile Bridge (ca RM 13 to 10), during the period, 1950-2002. Discounting the short-term year-to-year fluctuations, averaged redd counts exhibited a strong decline from 35-40 per mile during the mid-1960s to mid-1970s to 2-5 per mile in the mid-1990s, with subsequent increase to 20-25 per mile (Knox and Smith, 44).

Fish Life Stages and Streamwise Distributions: Figure IX-2 shows calendar-year life stages for relevant fish species on the Lostine. These data are taken from R2, 4, Fig. 1-2, for the Grande Ronde subbasin, with appropriate modifications for the Lostine WS (Knox and Smith, 44).

Associated ODFW fish distributions for the Lostine WS (Bowers, 22) show spawning and rearing use by both Spring Chinook and Steelhead throughout the lower Lostine from the mouth to the falls near

the confluence of the E and W forks (RM 0-26). The lower Lostine (RM 0-10) is used for migration by Bull Trout, and the upstream portion (RM 10-26) for spawning and rearing.

The combined life-stage and stream-distribution data are of particular significance as regards the needs for fish spawning, rearing, and/or migration throughout the lower Lostine (Fig. IX-2 and Bowers, 22).

Spawning and Rearing Habitat: Figs. IX-3 to –5 from R2, 4 show the effects of river flow rates on essential instream habitat area for spawning and rearing of Chinook and Steelhead. Procedures used by R2 Resource Consultants to develop these data were discussed in Ch II above. In brief, river characteristics were evaluated at 44 cross-stream traverses distributed over the lower 14 miles of river (Ext 204 priv area) for low, medium, and high flow conditions. Use of these data in a physical habitat simulation model provides important insight into habitat variations as shown by Figs. IX-3 to –5 (R2, 4, pages 3-6 to –12 and 4-1 to –41).

The cited figures display the variation of instream habitat area with flow rate for the indicated fish uses and (R2) stream reaches (comparison of Tables 2 and 3 show that the ODFW and R2 definitions of Reach 1 are the same, that the ODFW Reach 2 corresponds to the R2 Reaches 2 and 3, and that the R2 Reach 4 includes the ODFW Reach 3 plus ca 1.5 RM in National Forest lands above Silver Cr.).

Fig. IX-3 shows that Chinook and Steelhead spawning habitat areas in reach R2-1 are nearly zero at low flow rates (ca 10 cfs and lower), increasing strongly with flow rate to 70-80 cfs with diminishing increases for higher flow rates. Corresponding juvenile rearing habitat areas increase from low values, at 10-cfs and lower flow rates, to maximum values at 50-60 cfs flow rates, decreasing slowly at still higher flow rates.

Fig. IX-4 shows that the Chinook and Steelhead spawning areas in reach R2-2 are negligible for the range of flow rates considered, and that associated juvenile rearing habitat areas increase significantly with flow rate up to 20-40 cfs, decreasing slowly for higher flow rates.

Fig IX-5 shows the Chinook and Steelhead spawning habitat areas in reach R2-3 increase strongly from negligible values at ca 10 cfs to high values at 80-100 cfs, increasing more slowly at higher flow rates. The corresponding juvenile rearing habitat increases strongly with flow rate to ca 40 cfs, slowly increasing and/or decreasing thereafter.

Fish Passage: The cited R2 flow study also addressed minimum flow rates required for fish passage at the 44 traverse sites. The criteria used for fish passage were the following required water depths over a three-foot transverse span: 4.8" (0.4') for resident trout, 7.2" (0.6') for Steelhead, and 9.6" (0.8') for Chinook (R2, 4, page 3-12).

Fig. IX-6 summarizes the minimum required flows for the critical reaches R2-1 and –2. Figs IX-7 and –8 show the more detailed results for the various survey sites. Fig. IX-7 shows minimum flows of 35-40 cfs are required for salmon and ca 15 cfs for Steelhead at several sites in reach R2-1. Fig. IX-8 shows a lower, but comparable, flow requirement at one site in reach R2-2, with lower requirements at the other sites.

Summary of Fish and Flow Issues: Per the discussion above, Figs. IX-3 to –8 show that principal spawning and/or juvenile rearing habitat, as well as requirements for salmon passage, in the lower Lostine require, or strongly benefit from, flow rates of 40 cfs and higher. Fig. IX-2 shows Chinook spawning and migration are important during the low-flow period, Aug-Sept. Unfortunately, as shown by Fig. V-6, average flow rates at the Caudle Ln and Baker Rd GS generally fall below these values in Sept, and are marginal from Aug-Oct. Fig. V-7 shows that the corresponding minimum, monthly-averaged flow rates in Aug-Sept are substantially less than those for fish needs at both the Caudle and Baker GS.

Lostine Habitat Conditions: Tables 41 and 42 contain summaries of Lostine habitat conditions, derived primarily from data acquired in ODFW and USFS stream surveys (ODFW, 6 and 16 and USFS, 7 and 8), respectively covering the lower (Ext 204 priv) and upper (National Forest and Eagle Cap Wilderness) stream reaches.

As indicted by the headings, Table 41 addresses overall stream characteristics (adjacent land uses, stream gradient, CHT, and active stream width), as well as detailed pool characteristics. Footnote (4) of the table references ODFW habitat benchmarks for rating pool features (fraction stream area, frequency of occurrence in channel widths, depth, and complexity), see Foster, 39. Data are generally less complete for upstream reaches.

Table 42 contains similar data for riffle and woody habitat conditions. Riffle features and associated ODFW benchmarks include width-to-depth ratio and fractions of various bed materials (gravel, silt, sand, organics); woody habitat features and benchmarks include density of LWD pieces (>15 cm dia x 3 m long), associated wood volume, and density of "key" pieces (> 60 cm dia x 10 m long), again see Foster, 39.

Recall that forest characteristics in adjacent 50-ft riparian buffers are described in Ch VI-A (see Tables 25, 27, and 28).

Table 41: Lostine Pool Habitat Condition Summary

Site	Length Sampled (PricnII-m/RM)	Land use (Luse1)	Gradient (%)	CHT	Active Width (m)	Pool Area		Pool Frequency		Residual Pool Depth		Complex Pools		Overall Pool Rating
(1), (4)						Pctpool (%)	Bench-mark	CW/pool	Bench-mark	Resid Pd (m)	Bench-mark	Compool / km	Bench-mark	
-204-ODFW Rch #1	9,191/5.7	Ag/Lg	1.1	C/F4,3	20.5	5.8	U	23.2	U	0.57	U	0.2	U	U
-204-ODFW Rch #2	12,996/8.1	"	"	C/F/B3,4	19.1	16.7	B	15.5	B	0.54	U	0.8	U	B/U
-204-ODFW Rch #3	16,18/1.0	ST/SG	3.1	B/A2	20.0	0.6	U	85.6	U	0.51	U	0	U	U
Total ODFW-204	23,805/14.8	----	1.2	----	19.7	10.5	B-	23.2	U	0.54	U	0.5	U	U
(2), (4)														
-203-USFS Rch#4	7,724/4.8	Rec	4	unk	15.6	8	U	26.5	U	1.34	B	Unk[3]	Unk	Unk[3]
-202-USFS Rch#5	4,506/2.8	"	2	unk	16.9	10	B-	13.2	B	0.88	"	"	"	"
-202-USFS Rch#6	6,437/4.0	"	3	unk	16.2	15	B	8.2	D-	0.79	"	"	"	"
-201-USFS Rch#7	9,656/6.0	ECW	7	unk	10.6	10	B-	21.0	U	0.94	"	"	"	"
Total USFS-203-201	28,323/17.6	----	4.5	----	14.2	10.6	B-	18.4	B	0.93	"	"	"	"

Footnotes:

(1) All data for –204 Rch #1-3 are from ODFW, Aquatic Inventory Project, Physical Habitat Survey, Lostine Stream Report, surveyed 1991, revised 2002; Refs. 6 and 16.

(2) All data for USFS Rch #4-7 (USFS designation, Rch #1, 2, 3, 4) from USFS "Stream Survey Report/Lostine River" (1992), see also USFS "Lostine River Watershed Analysis" (1997); Refs. 8 and 7.

(3) Per USFS Ref. 7, page 39, depth, number, complexity of pools and pool habitat indicate these reaches of the Lostine River are functioning at their natural potential.

(4) Benchmark designations D, B, U correspond, respectively, to desirable, between, and undesirable categories. The criteria for determining these categories are from Table 4 ODFW Aquatic Inventory and Analysis Project: Habitat Benchmarks; Ref. 39.

Table 42: Lostine Riffle and Woody Habitat Condition Summary

Site	Width/Depth Ratio[1]		Gravel[1] (%area)		Silt-sand-organics[1] (%area)		Overall Riffle Rating	LWD Pieces /100m[2]		Volume LWD /100m[2]		Key Pieces /100m[2]		Overall LWD Rating
	WDratio	Bench-mark	Pctgravel	Bench-mark	Pctsndor	Bench-mark		LWDpiece1	Bench-mark	LWDvol1	Bench-mark	KeyLWD1	Bench-mark	
-204-ODFW Rch #1	49.5	U	42	D	0	D	B	0.8	U	1.3	U	0.1	U	U
-204-ODFW Rch #2	40.2	U	21.5	B	0.65	D	B	1.3	U	0.9	U	0	U	"
-204-ODFW Rch #3	28.6	B/U	0	U	0	D	B	2.2	U	1.1	U	0	U	"
Total ODFW-204 [1], [3]	45.0	U	32.1	B^+	0.27	D	B	1.2	U	1.1	U	0.04	U	"
-203-USFS Rch#4	16.1-17.7	B	9.1	U	0	D	B	1.3	U	Unk	U?	Unk	U?	U/B
-202-USFS Rch#5	26.7	B	41.7	D	25	U	B	0.5	U	"	"	"	"	"
-202-USFS Rch#6	24.5	B	37.5	D	12.5	B	B^+	0.8	U	"	"	"	"	"
-201-USFS Rch#7	16.8	B	36.4	D	27.3	U	B	0.1	U	"	"	"	"	"
Total USFS-203-201	20.3-20.8	B	30.6	B	15.3	B	B	0.7	U	"	"	"	"	"

Footnotes:

1. ODFW, data for riffles only; USFS, restricted to riffles as data permits; multi-element averages by area weighting (Refs. 6, 16, 7, and 8).
2. Multi-reach averages by length weighting.
3. For USFS reaches, the % area for sand/organic and gravel (S/G) substrates are not available. Estimated fractions (%s) of S/G substrates are determined by counting the number of ½ mile segments (N_x) in each reach for which S/G is given by the USFS Stream Survey report, Ref. 7, as the dominant and/or subdominant substrate, then calculating: $Fraction_{S/G} = [N_{dom\text{-}S/G} + ½ N_{Sub\text{-}dom\text{-}S/G}]/N_{reach}$.

Fish Assessment Confidence Evaluation: Table 43 lists the resources used for this chapter, confidence level of results, and recommendations for future work.

Table 43: Fish Assessment Confidence Evaluation

Resources Used:

X ODFW personnel	X Fish barrier analysis/data
X Stream surveys	X USFS
X Stream maps	
X Study reports	

Confidence in assessment:

- ☐ **Low:** Unsure of procedures and/or used minimal resources.
- ☐ **Low to moderate:** Understood and followed most of the procedures, but minimal resources available and/or used.
- ☐ **Moderate:** Understood and followed procedures, and used adequate number of resources but had moderate understanding of outcome.
- X **Moderate to high:** Understood and followed procedures, used adequate number of resources, and had high understanding of outcome.
- ☐ **High:** Understood and followed procedures, used numerous resources, and had high understanding of outcome.
- ☐ **If none of the above** categories fit, describe your own confidence level and rationale:

Recommendations for further assessment or analysis:

Continued in-stream surveys to monitor fish populations and fish-passage barriers.

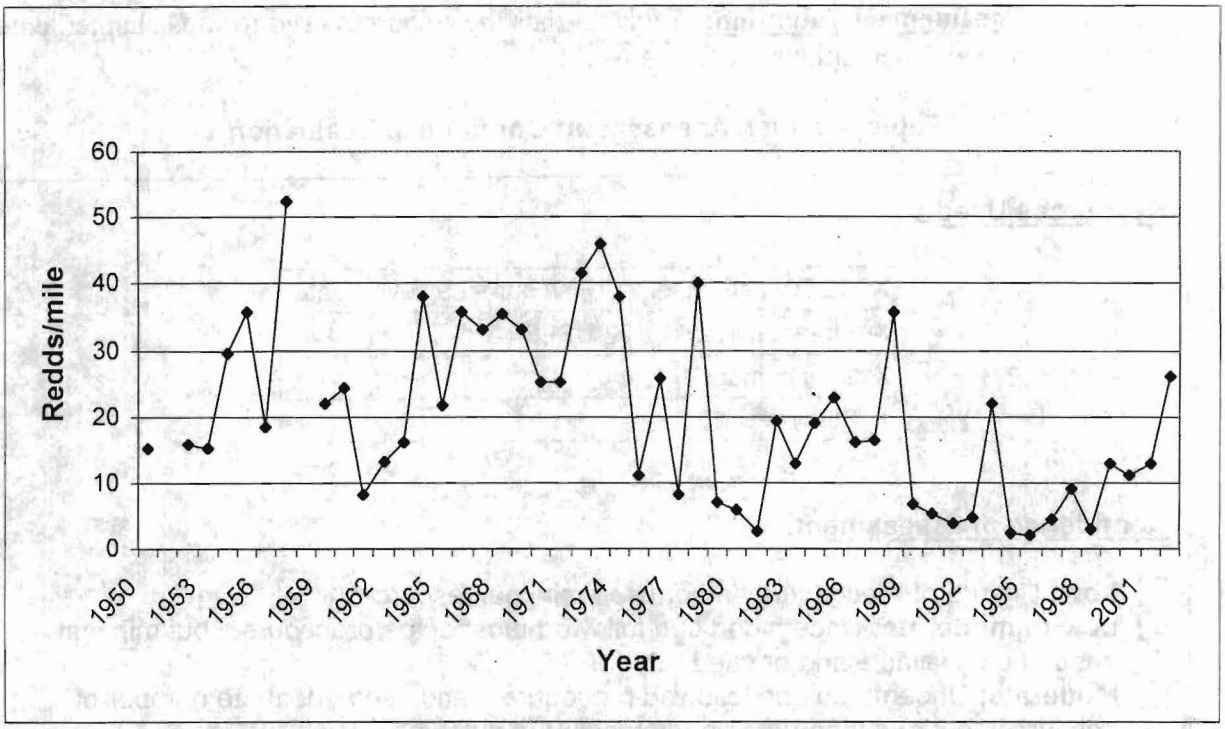


Figure IX-1: Spring Chinook Redd Count; Lostine Index Area; 1950-2002

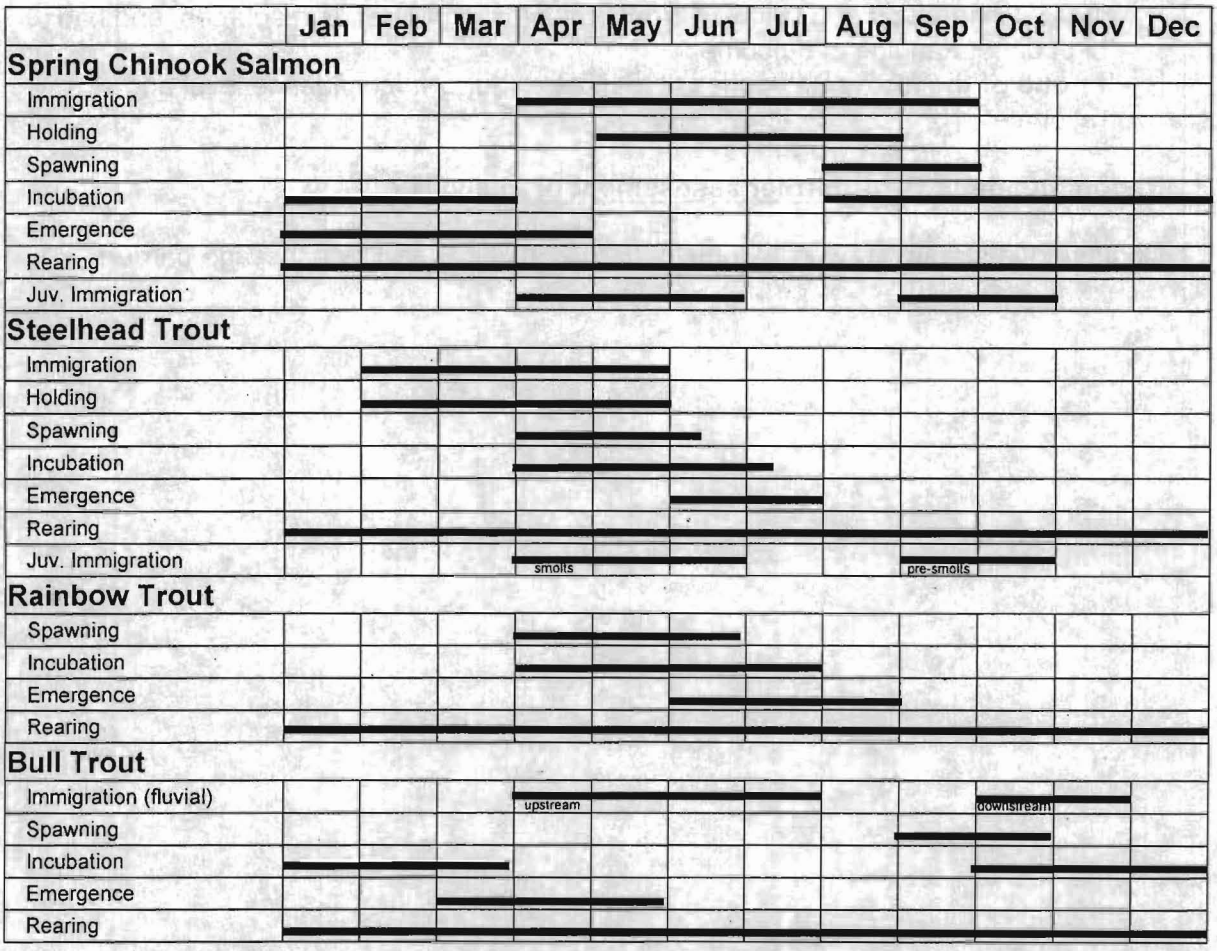


Figure IX-2 Life Stages for Anadromous and Resident Fish in the Lostine River

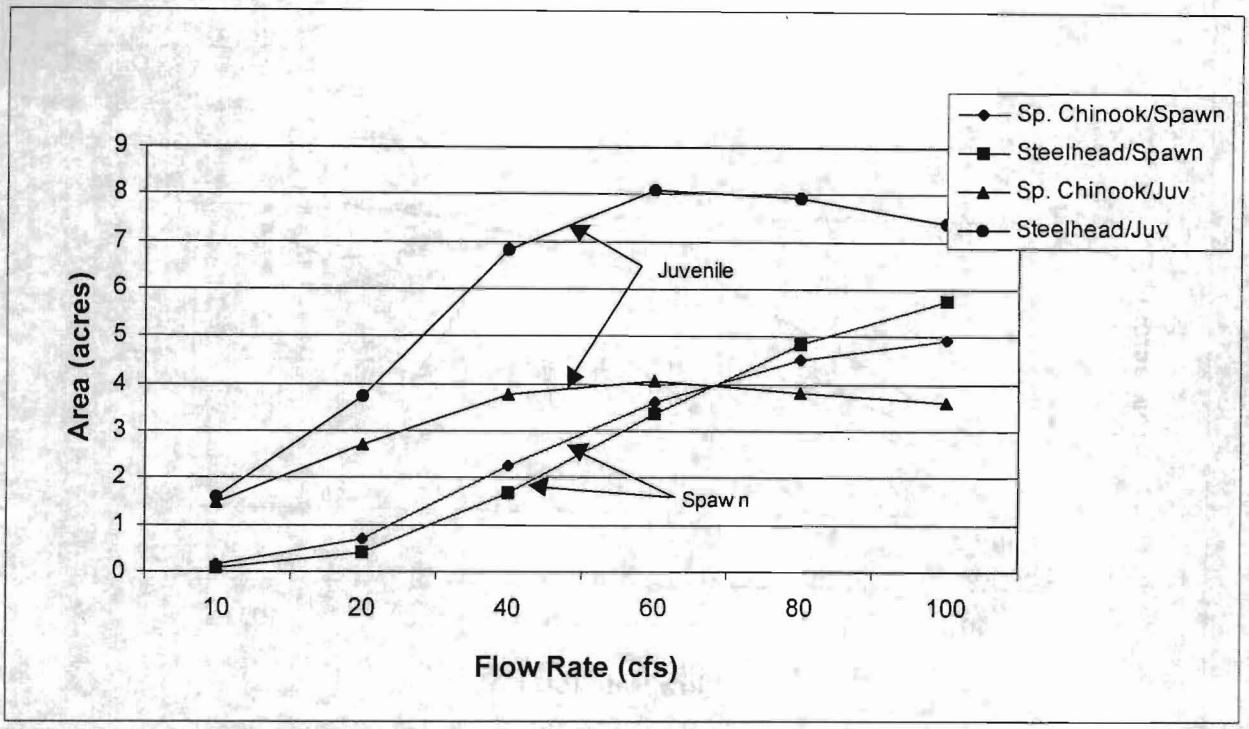


Figure IX-3: Spawning and Juvenile Habitat Areas; R2 Reach 1

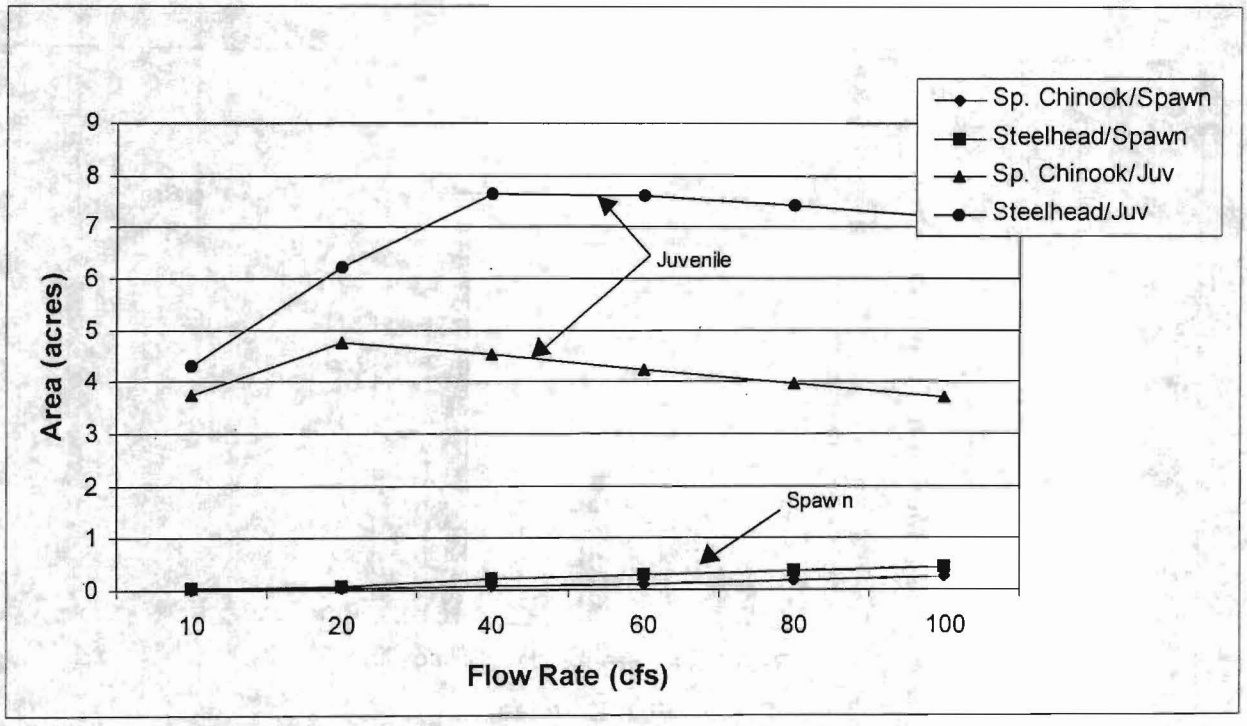


Figure IX-4: Spawning and Juvenile Habitat Areas; R2 Reach 2

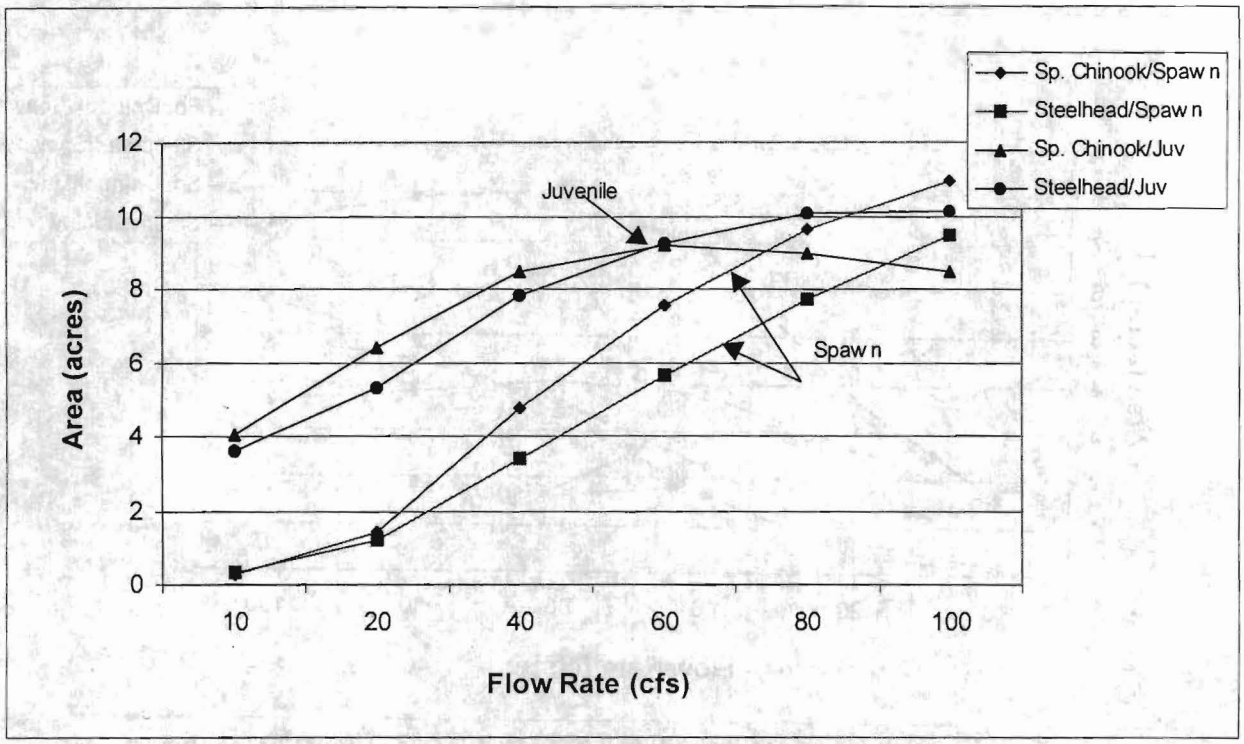


Figure IX-5: Spawning and Juvenile Habitat Areas; R2 Reach 3

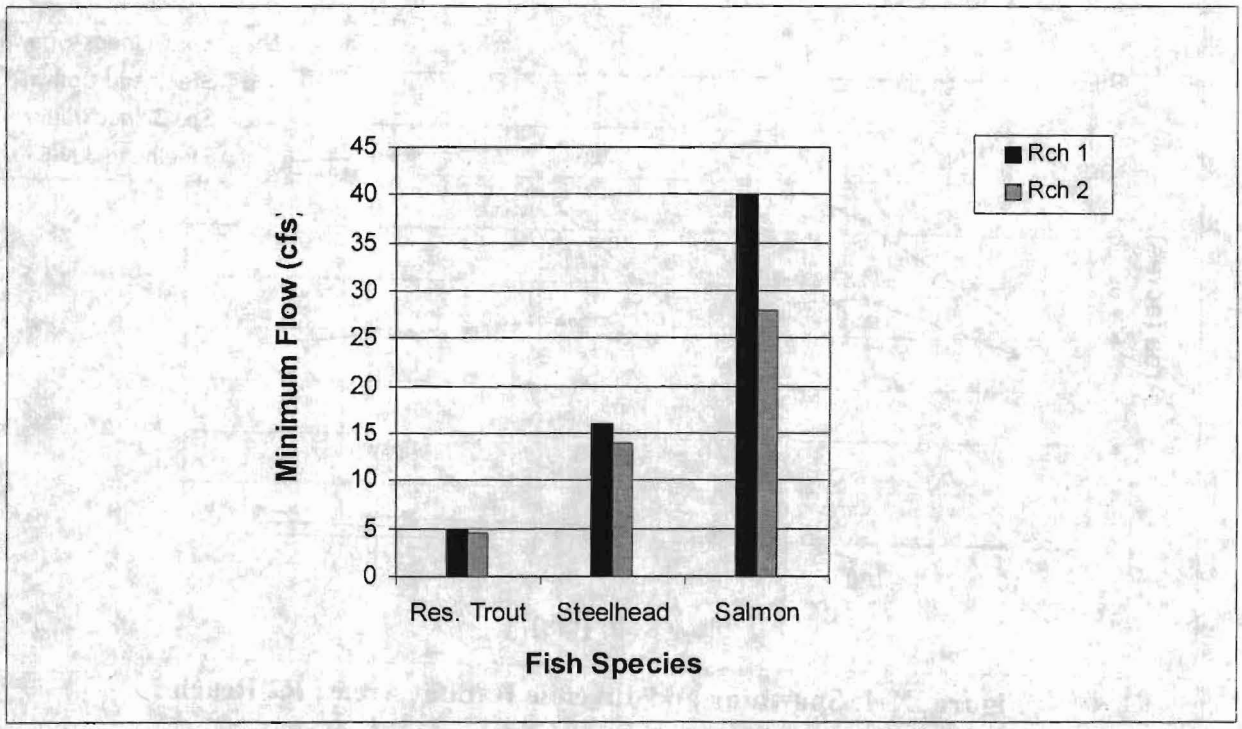


Figure IX-6: Minimum Fish Passage Flows; R2 Reaches 1 & 2

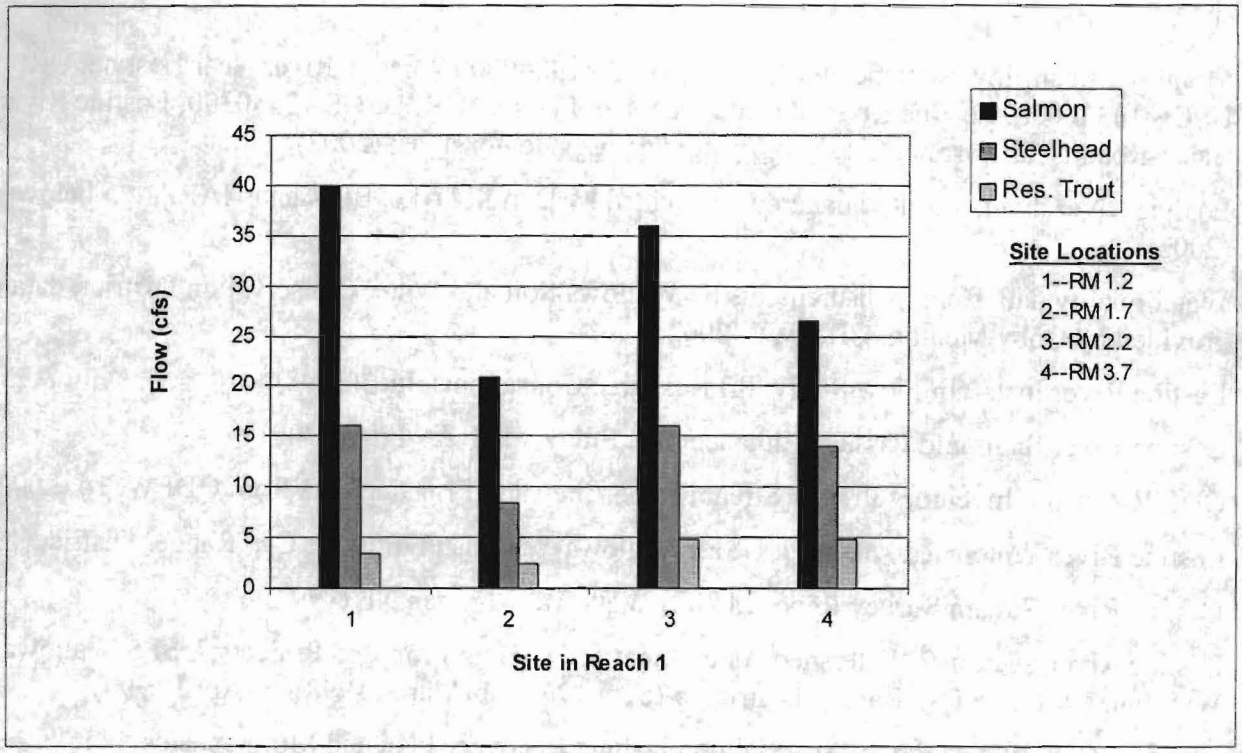


Figure IX-7: Minimum Fish Passage Flows; R2 Reach 1

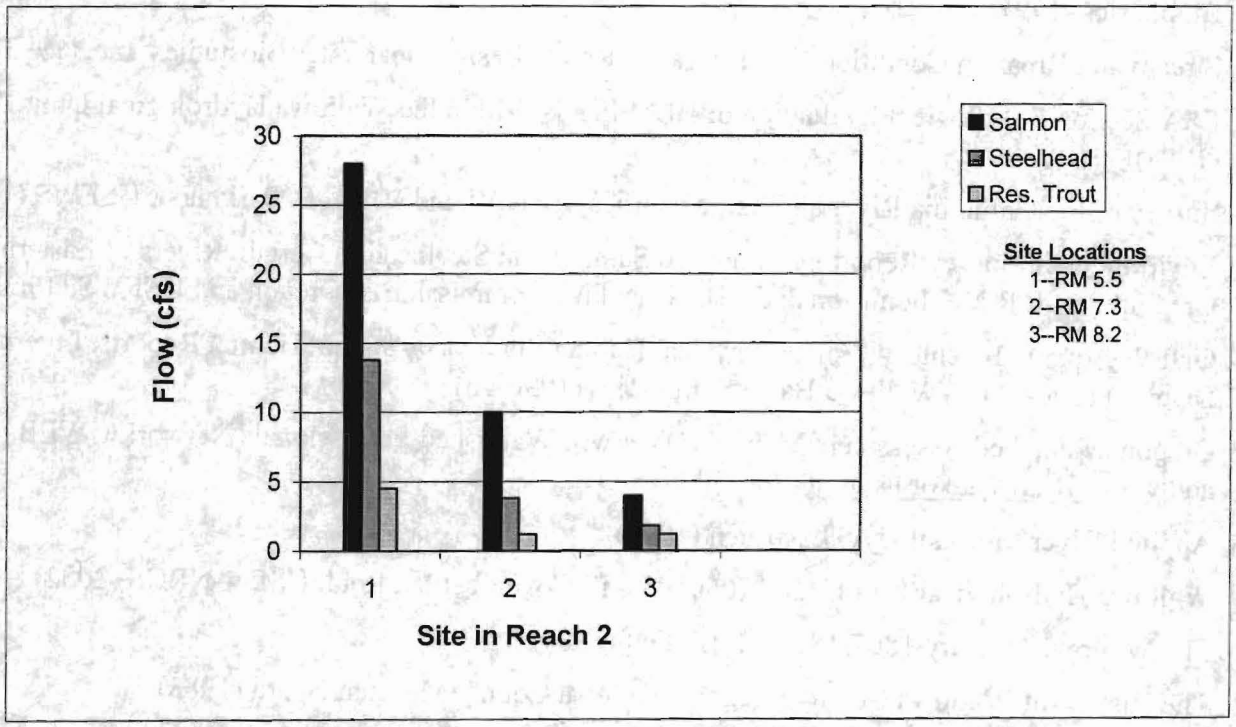


Figure IX-8: Minimum Fish Passage Flows; R2 Reach 2

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A. APPENDIX: Explanatory Notes for Lostine Watershed Hydrologic Runoff Analysis (See Tables 9 and 12-15)

Agricultural and Timber-Grazing Units on Private and State Lands

(1a) As noted by Table 9, footnote (4), the ad hoc "watershed unit" selected for hydrologic analysis on private and state lands, "Ext 204 Priv," is composed of Lostine HUC 170601050204, excluding ca 1720 acres of USFS land in the SW corner, plus ca 3336 acres of private and state lands in the NE part of –203. The state lands part of the unit consists of the 1012-acre wildlife unit for Bighorn Sheep winter range, located in HUC –203 immediately north of the USFS/Eagle Cap Wilderness boundaries.

For purposes of this hydrology analysis, this watershed unit is subdivided into two principal parts, respectively, denoted "Huc 204-non-forest" and "Ext204-tg + ODFW." The first of these, defined as the non-forest part of the GIS 204 vegetation layer obtained from the ODF (White, 33), corresponds closely to the area of agricultural uses, excluding grazing on forest lands, defined by the NRCS private land-use layer for the Lostine watershed (Smith, 25). This non-forested area also corresponds closely to the part of the Blue Mountain Basins—11k ecoregion contained within the Lostine watershed (OWAM, 17, Appendix A, page A-182).

The second part, Ext204-tg + ODFW includes part of the extension of the –204 forested region into the northern part of –203, i.e., the private timber-grazing lands and the ODFW wildlife unit. As is noted by Table 9, footnote 5, the complete Ext Huc 204-Priv area also includes ca 350 acres of lands designated for rural residential and other miscellaneous uses.

GIS Analysis: Hydrologic Data, Curve Numbers, and Runoff Depth

(1b) The agricultural land-use data and runoff analysis documented by Tables 12-15 require quantitative determination of area values corresponding to the relevant hydrological soil groups B, C, and D; to the vegetative cover type/treatment; to the degree of crown closure for forested areas; and to the associated hydrologic condition (good, fair, or poor).

Areas delineated by watershed element, soil type, and land use are determined from attribute tables of the appropriate GIS map files listing these features (see footnotes to Tables 12-15). The determination of area values by soil and vegetative-cover type (Columns 0, 1 of Tables 13-14) are determined for the various cover types and forest-cover fractions via use of the ArcView polygon tool, viewing the appropriate land-use or crown-closure layers through the overlaid soil layer, "windowed" to sequentially expose the areas of soil types B, C, and D.

The following data are determined from ODF vegetative and crown-closure GIS layers (White, 33); NRCS land-use and soil layers (Smith, 25); and Tables 2–2A, -2B, -2C (NRCS TR 55)—see OWAM, 17, Appendix IV-B, Tables B-1, -2, -3, pages 1-4 (referenced below as Tables B-1, ...); and NRCS recommendations on hydrologic and historic conditions.

(2) In the lower valley, **204 Non-forest, Cropland and Hayland/Rotation Meadow** runoff characteristics are taken to have the same runoff parameters, i.e., Table B-1 gives the following

curve-number values for soils B/C, under good (G) to poor (P) hydrologic conditions **for Small Grain/Straight Row:**

Soil B—P 76 Soil C—P 84
G 75 G 83

and for **Legumes Rotation Meadow/Straight Row:**

Soil B—P 77 Soil C—P 85
G 72 G 81

or, with small variation, use for **Cropland/Hayland** under all hydrologic conditions:

Soil B—75 Soil C—83.

(3) For **CRP and Soil B**, from Table B-2 use curve number **for Meadow—continuous grass; protected from grazing**: 58.

(4) **Pasture and Rangeland in the lower valley** (204 Non-forest) are taken to have the same curve numbers, from Table B-2 for **fair** hydrologic conditions (**F**) and for **Pasture, grassland—continuous forage for grazing**:

Soil B—69
C—79
D—84

(5) Background (historic) curve numbers for all Ag uses in the lower valley (204 Non-forest) are taken as **Herbaceous—mixture of grass, weeds, and low-growing brush in good (G) condition**, i.e., from Table B-3:

Soil B—62
C—74
D—85

(Note: These curve number correspond closely to those in Table B-2 **for Pasture, grassland, or range . . . in good** condition.)

(6) Curve numbers for the mixed forest-grasslands in **Ext204-Timber-Grazing+ODFW** (ridge-tops and steep side-slopes at higher elevation) are calculated from the % Crown Closure levels [median

90/58/17 % woods with corresponding 10/42/83 % grasslands using curve numbers for **Woods** (Table B-2) and **Herbaceous—mixture of grass, weeds, low brush** (Table B-3) under **fair (F)** hydrological conditions as:

Soil B	0.9 W + 0.10H	0.90 x 60 + 0.10 x 71 = 61.1
	0.58W + 0.42H	0.58 x 60 + 0.42 x 71 = 64.6
	0.17W + 0.83H	0.17 x 60 + 0.83 x 71 = 69.1
Soil C	0.90W + 0.10H	0.90 x 73 + 0.10 x 81 = 73.8
	0.58W + 0.42H	0.58 x 73 + 0.42 x 81 = 76.4
	0.17W + 0.83H	0.17 x 73 + 0.83 x 81 = 79.6
Soil D	0.90W + 0.10H	0.90 x 79 + 0.10 x 89 = 80
	0.58W + 0.42H	0.58 x 79 + 0.42 x 89 = 83.2
	0.17W + 0.83H	0.17 x 79 + 0.83 x 89 = 87.3

(7) The background curve numbers (historic conditions) for the **Ext204-timber-grazing + ODFW** are calculated using a similar method to that discussed under (6); in this case assume (average) historic cover fractions of **20% Woods, 40% Woods-grass combination** (50:50), **and 40% Pasture, grassland, or range**, (40:60 woods:grass overall), all in **Good** condition, i.e., from Table B-2:

Soil B	0.20 x 55 + 0.40 x 58 + 0.40 x 61 = 58.6
Soil C	0.20 x 70 + 0.40 x 72 + 0.40 x 74 = 72.4
Soil D	0.20 x 77 + 0.40 x 79 + 0.40 x 80 = 79.0

[Again note that the curve numbers above for pasture and grasslands correspond closely to those for Herbaceous mixtures from Table B-3. The appropriate choice for "background" fractions of woodlands and grasslands is not well known, even though the values above are consistent with the description of historical condition for the corresponding "Wallowas/Seven Devils Mountains" ecoregion. Evaluation of runoff curve numbers for a quite different cover combination: 40% Woods, 40% Woods-grass combination, and 20% Pasture . . .(60:40 woods:grass as compared to 40:60 woods:grass above) gives very little variation in curve runoff number and depth with this large change in forest fraction (typically 1%-2% variation in runoff numbers and 10% or less variation in runoff depth).]

(8) Average rainfall values for the 2yr24hr precipitation event were calculated separately for the (lower elevation) 204 Non-forested and the (higher elevation) Ext204 timber-grazing + ODFW

areas from the NOAA Atlas 2 precipitation contour map (Vol X—Oregon, Figure 25, page 33). Because these precipitation contours are available only in hard-copy form, the calculation process included creation of a scanned bit-map image, which was inserted into the ArcView project. Subsequently, a movable and scalable graphic of the relevant precipitation contours was copied from the image using a poly tool and, after relocating and scaling this graphic to match the appropriate watershed map, the contours were converted to a GIS polygon layer (data base) via the poly tool, which was then used to calculate the average 2yr24hr precipitation levels for the areas of interest. For reference, these average precipitation values were also determined for the Lostine HUCs –203, -202, and –201.

(9) Derived from Table B-4, OWAM Appendix IV-B.

(10) In preparation for calculating average changes in runoff depth for the complete Ext 204 area for each soil type, and the average change over total area for all soil types (Table 15), values in Columns 8a, Tables 13 and 14, are calculated from the changes in runoff depth given in the corresponding Columns 8 by weighting each runoff value by the ratio of its associated area to the total area of that soil type in Ext 204. These weighted values for the various cover types are summed to give the complete incremental changes for each soil type, calculated separately for the 204 Non-forested and Ext204 timber-grazing subareas. The resulting summed values are listed in Columns 3, 5 of Table 15 for further summation and weighting as described in footnotes (1)-(3) of Table 15.