8. WATER QUALITY DATA

8.1 Background Issues

The Watershed Management Act (Washington State, 1998) indicates that an assessment of water quality is an optional component of the watershed planning process (Economic and Engineering Services, 1999). For the Methow watershed, Okanogan County and the Methow Basin Planning Unit have decided that water quality considerations are an important consideration, and thus a water quality component has been incorporated into the assessment. This decision is based on the opinion that water quality exerts a direct and significant influence on the current and future availability of water in the Methow watershed. This influence consists of both i) water currently of poor quality potentially constraining the availability of water for various target uses, and ii) water consumption potentially causing water quality to diminish and thus constraining the availability of water for various other non-consumptive target uses .

8.2 Objective and Level of Detail

The Watershed Management Act (Washington State, 1998) specifically indicates that the water quality component be:

- An examination based on existing studies conducted by federal, state, and local agencies of the degree to which legally established water quality standards are being met in the management area; and
- An examination based on existing studies conducted by federal, state, and local agencies of the causes of water quality violations in the management area, including an examination of information regarding pollutants, point and nonpoint sources of pollution, and pollution-carrying capacity of water bodies in the management area.

The assessment is also to include items such as consideration of total maximum daily loads, and recommendations for monitoring (Economic and Engineering Services, 1999).

The Watershed Management Act (Washington State, 1998) does not specify techniques of data collection, level of detail, or methods of analysis. Thus, the planning unit has considerable latitude to determine what constitutes an adequate technical assessment for purposes of developing the watershed plan (Economic and Engineering Services, 1999). It has been determined by Okanogan County and the Methow Basin Planning Unit that, for the purposes of this report, the current level of assessment is to be a compilation and review of existing data and associated interpretative reports. Therefore, data gaps need to be identified, and recommendations need to be made on appropriate action plans to address interpretive shortfalls.

No additional collection of field data, statistical analyses of existing data, or modeling of water quality were necessary within the current scope of this assessment.

8.3 Findings from Existing Data and Reports for Water Quality

8.3.1 Overview

Water quality data have been collected and analyzed by numerous agencies. These agencies include the Washington Department of Ecology, United States Environmental Protection Agency, United States Geological Survey, United States Forest Service, and local agencies. The agencies typically follow standardized collection, analytical, and QA/QC protocols, and their data is deemed to be relatively reliable. Table 8-1 and Figure 8-1 summarize current surface water quality sampling stations (based on the Storet database).

In general, water quality in the Methow watershed appears to be of a high quality. The Methow River from its mouth upstream to the Chewuch River (at river mile 50.1) is classified as Class A (as defined by Washington State, 1997). Class A waters have the general characteristic of exceeding the requirements for all or substantially all uses. The Methow River from the Chewuch River upstream to its headwaters is classified as Class AA. Class AA waters have the general characteristic of markedly and uniformly exceeding the requirements for all or substantially all uses (Washington State, 1997). Both the Chewuch and the Twisp Rivers (tributaries to the Methow River) are classified as Class AA. Differences between Class A and Class AA water quality standards are noted in Table 8-2 (Washington State, 1997).

8.3.2 Water Quality Variables of Potential Concern

Not-with-standing that water quality is generally very good, there are water quality variables of particular concern, typically:

- Temperature;
- Dissolved oxygen;
- Suspended sediments and turbidity;
- Nutrients;
- Pesticides and herbicides;
- Fecal indicator bacteria (e.g. coliforms) and chemicals (e.g. potassium); and
- Metals.

Water temperature and dissolved oxygen have the potential to be influenced by many factors. Within the scope of this assessment, the most notable influencing factor would be the withdrawal of water. Diminished flow during warm and dry periods would result in their being less water to buffer heat load, less dilution of heated inflows, and slower moving low flows subject to extended warming.

In the Draft Methow River Basin Plan (Methow Valley Water Pilot Planning Project Planning Committee, 1994) the committee summarizes the anthropogenic factors that can affect water quality in the Methow watershed as being:

- Waste water discharge at Twisp;
- Waste water discharge at Winthrop (occasional);
- Logging;
- Grazing;
- Land clearing; and
- Road building.

The latter four factors are specifically noted to potentially increase sediment loading. The committee cites EMCON Northwest (1993) and others as concluding that the relatively high water table and highly permeable soils leading to considerable potential for contamination from sewer effluent.

Inactive and abandoned mines, waste rock dumps, and tailings can also be the source of contaminated water and have the potential to impact nearby streams (Raforth et. al., 2000). In his study of a sulfidic mine waste impoundment in north-central Washington, Lambeth (1992) found that acidic pore water exiting tailings impoundments resulted in the dissolution of mine waste-derived heavy metals into an underlying unconsolidated aquifer. Dissolution of mine-waste derived heavy metals was found to occur as a consequence of oxidation of sulfide minerals in the unsaturated zone of the mine waste. Infiltrating precipitation can carry the oxidation products into underlying aquifer(s). However in this case, oxidation and coprecipitation of dissolved metals was found to possibly be an effective mechanism for attenuating metals concentrations within 560 meters downgradient of the impoundment. Eventually these less reactive oxidized products can reach surface waters in the basin where dilution effects will minimize their contribution to total surface water metals levels.

The effects of mining on metals presence in groundwater and surface water are discussed further in Section 8.3.7.

8.3.3 Reported Temperature and Dissolved Oxygen Conditions

Water temperatures in the lower reaches fluctuate between 0 and 23.5 C. Water temperatures generally remain at or near 0 C between November through February. Thermal regimes in the upper reaches of the mainstem and in tributaries differ widely with orientation, elevation, and input from rainfall, snowmelt, and aquifers. Oxygen content is normally at or above saturation levels (Mullan et. al., 1992).

The mainstem upper Methow River, at the inflow to the Winthrop National Fish Hatchery (RM 50.4), is listed on the State of Washington 303(d) (Ecology, 1998) list for exceedances of state water quality temperature criterion. The 303 (d) list is created under the federal Clean Water Act, which requires states to maintain a list of stream segments that do not meet water quality standards. All reaches in the basin that have been 303(d) listed are shown in Figure 8-2. These include listings for both exceedance of temperature criterion and for instream flow. For the mainstem upper Methow River, the 303(d) listing was based on “WDFW data showing numerous excursions beyond State water quality criterion” (Washington State Conservation Commission, 2000).

Mullan et. al. (1992) used instantaneous water temperatures and regressions to develop a model (Bartholow, 1989) to predict heat budgets in the Methow River drainage. While this model was intended only for predicting conditions between July 1988 and July 1989, some of their findings provide great insight into factors affecting temperature within the watershed. Streams were categorized as (1) west/north orientation, (2) east/south orientation, and (3) the north/south mainstem Methow River.

Streams within the first category generally flowed east or north from perpetual snowfields or glaciers along the crest of the deeply incised ridge dividing the Chelan River drainage from the Methow River drainage or the Cascade Mountains at the head of the valley. Sunlight tends to strike streams tangentially for brief periods because of topographic shade from valley walls. Dense old-growth forests in most headwaters minimize isolation (Mullan et. al., 1992).

Streams in the second category drain the west slopes of the mountains that divide the Methow and Okanogan river drainages. The topography is less elevated, incised, and forested, and there is less precipitation. Solar exposure and heating is generally higher because of perpendicular insolation (Mullan et. al., 1992).

The third category, the lower mainstem Methow River, courses through a steep-sided canyon that broadens upstream. The wide channel and sparse riparian vegetation expose the Methow River to direct insolation for much of the day during the summer. Ground water is the primary contributor to flow in the middle river during the low-flow period (Appendix C) (Mullan et. al., 1992).

The findings for tributaries are provided below:

i) Chewuch River
Temperature data in this reach has not indicated a thermal barrier, but higher temperature may cause migration delays of hours with cooler temperatures recovered during the night. Temperature data was collected by the Pacific Watershed Institute and provided to the USFS for 1996 and 1997 (J. Smith, PWI, pers. comm., 2000) (as noted in Washington State Conservation Commission, 2000).

ii) Twisp River
The Twisp River was listed on the 1998 Washington State 303(d) list for inadequate instream flow and for temperature exceedances, based on 2 excursions beyond the criterion near the mouth. Temperatures of 17.2°C/69.9°F on August 29, 1989 and 17.9°C/64.2°F on August 30, 1989 were recorded (Washington State Conservation Commission, 2000).

iii) Goat Creek

Water temperatures greater than 59°F (15°C) based on a 7-day average were considered to be functioning at an unacceptable level for rearing and migration (USFWS 1998). Water temperatures in the lower and middle Goat Creek exceeded 60°F on 15 days during the summer of 1997, reaching a high temperature of 64°F (RM 1.3). The highest water temperature recorded by surveyors in 1992 was 65°F on August 13 (RM 4.0). High water temperatures in lower and middle Goat Creek could be attributed to the aspect of the drainage (south facing), the lack of seeps and springs in the confined channel, and the removal of vegetative cover in Goat Creek and in its lower tributaries (USFS 2000a). Low flows can also contributed to higher instream temperatures. Stream temperatures in upper Goat Creek (RM 9.0) were very cold, reaching a high temperature of 54°F in 1997. Upper Goat Creek is unharvested and well-shaded, with numerous seeps and springs. Populations of bull trout were found only in upper Goat Creek where stream temperatures remain cooler (USFS 2000a) (as noted in Washington State Conservation Commission, 2000).

iv) Wolf Creek

Although stream temperatures in excess of 60°F were recorded at the mouth of Wolf Creek during the summer of 1999 (unpublished data, H. Bartlett, WDFW), high water temperatures were not believed to be the factor limiting salmonid production in Wolf Creek (TAG). During the period of record, on all occasions when water temperatures were recorded in excess of 60°F at the mouth of Wolf Creek, during the evening and early morning hours water temperatures dropped back below the 60°F threshold. It was the TAG's professional opinion that 7-day average water temperatures provided a more revealing indication of water temperature relative to its potential to affect salmonid behavior and health. In the case of the stream reach at the mouth of Wolf Creek, because the riparian canopy was intact at this location and the Wolf Creek Reclamation District ditch ran only for about 3 weeks in August 1999 at reduced withdrawal rates, the TAG believed water temperature exceedances at the mouth during August of 1999 were a function of natural fluctuations given the existing natural environmental conditions (as noted in Washington State Conservation Commission, 2000).

v) Lost River

Water temperatures in Lost River were very cold for a stream its size and elevation, due partly to 5 miles of subsurface flow in the summer time. The highest water temperature recorded in Lost River during the summer of 1994 was 54°F, on August 26 (USFS 2000c) (as note in Washington State Conservation Commission, 2000).

vi) Early Winters Creek

During July, August, and September of 1989, water temperatures were collected in Early Winters Creek by WDFW (Mullan et al. 1992). In the lower 1.5 mile reach, the peak weekly mean water temperatures from RM 0.0 – 1.5 was recorded at 56.4°F. Federal standards and guidelines identify temperatures exceeding 59°F (>15°C) as presenting potential thermal barriers to migrating salmonids and negatively impacting rearing salmonids (USFWS 1998). Water temperatures in excess of 59°F at the mouth could impede bull trout migrating and spawning and salmon and steelhead rearing (USFS 1998c). At the time of the development of the Limiting Factors report, water temperature monitoring was being conducted in the lower 1.5 miles of Early Winters Creek to more thoroughly investigate whether high water temperatures were occurring, but that were not captured during the short monitoring window in 1989 (as noted in Washington State Conservation Commission, 2000).

vii) Libby Creek.
Water temperatures were monitored at the mouth of Libby Creek (elevation 1,500') and at the confluence of the South and the North Forks (elevation 2,500') during 1998. Water temperatures exceeded the Pacfish standard (maximum daily temperatures greater than 60°F; USFS and BLM 1995) for salmonid spawning on 15 days during the summer of 1998 at the mouth and on 3 days at the upper elevation monitoring site. The maximum water temperature recorded at the mouth was 63°F on July 27, 1998. Water temperatures exceeded the 7 day average maximum temperature of > 59°F at the mouth on 26 days during the summer. Given the elevation of Libby Creek at the mouth and the relative smallness of Libby Creek with its higher gradient, higher elevation and better stream shading, the USFS stated that even with these exceedances of Standards, water temperatures are not considered excessive (USFS 1999; USFS 2000b) (as noted in Washington State Conservation Commission, 2000).

viii) Eightmile Creek
Harsh winter conditions can result in icing conditions during some years in this subwatershed. At the confluences of Eightmile Creek, Twentymile Creek and some of the larger side channels such as the one near No Snake Creek, ground water recharge occurs. Alterations to channel reaches may reduce the potential for the maintenance of thermal refuges during icing conditions (as noted in Washington State Conservation Commission, 2000).

ix) Twentymile Creek
Harsh winter conditions can result in icing conditions during some years in this subwatershed. At the confluences of Eightmile Creek, Twentymile Creek and some of the larger side channels such as the one near No Snake Creek, ground water recharge occurs. Alterations to channel reaches may reduce the potential for the maintenance of thermal refuges during icing conditions (as noted in Washington State Conservation Commission, 2000).

8.3.4 Reported Suspended Sediment and Turbidity Conditions

The waters of the Methow watershed are usually very clear. However, the sediment load now delivered to the Methow River from human activity is about 10% above natural background levels (USFS 1989, 1990) (as noted in Mullan et. al., 1992).

Alder Creek has been shown to exceed the state turbidity standard, and had TSS levels that afford low protection to aquatic communities (Raforth et. al., 2000). Currently, TSS exceedances on Alder Creek may qualify it for the next 303(d) listing (personal communication, Ecology, March 2002).

The Limiting Factors report (Washington State Conservation Commission, 2000) noted that in the Boulder Creek watershed, the Boulder Creek Road is a main factor contributing to high sediment levels and channel scour in Boulder Creek. This is exacerbated by its channelized alluvial fan and low LWD levels from the North Fork Boulder Creek confluence downstream. Boulder Creek drainage's highly erosive soils make it especially susceptible to erosion (Washington State Conservation Commission, 2000).

8.3.5 Reported Nutrient Conditions

The extent to which discharge from the Winthrop and the Twisp Sewage Treatment Plants or agricultural activities may be negatively impacting water quality and affecting fish productivity is generally unknown (TAG) (Washington State Conservation Commission, 2000). However, moderate amounts of phosphorus and nitrogen from sewage treatment plants, fish hatcheries, urbanization, and agriculture, have not noticeably affected dissolved oxygen levels in the Methow River (Mullan et. al., 1992). Parameters such as phosphorus and nitrogen not only affect dissolved oxygen levels, but can more immediately impact water bodies by the growth of filamentous algae on the bottom substrate of the stream.

Livestock grazing and golf course and residential development along the Bear Creek stream corridor are thought to have the potential to negatively impact water quality. Furthermore, the return flow from the Fulton Irrigation Ditch has the potential to negatively impact water quality in Bear Creek (TAG) (Washington State Conservation Commission, 2000).

8.3.6 Reported Fecal Coliform Conditions

The extent to which discharge from the Winthrop and the Twisp Sewage Treatment Plants may be negatively impacting water quality is unknown (TAG) (as noted in Washington State Conservation Commission, 2000).

Livestock grazing and golf course and residential development along the Bear Creek stream corridor have the potential to negatively impact water quality (TAG) (as noted in Washington State Conservation Commission, 2000).

The Limiting Factors report (Washington State Conservation Commission, 2000) noted that for at least Beaver Creek (and presumably other areas within the Methow watershed) an analysis of the impact of livestock grazing on water quality is needed on both public and private lands. Presence of fecal coliform bacteria in surface waters can be derived from grazing lands located uphill from or next to a stream (Personal Communications, Dept. of Ecology, March, 2002).

8.3.7 Reported Metal Conditions

A study by Raforth et. al. (2000) assessed the influence of old mining activities on water quality in Washington State. Prior to this study, there apparently was almost no data available to evaluate the potential extent of the problem. While the study only looked at the one mine site (Alder) that was within the Methow watershed, other mine sites may be experiencing similar influences on water quality. The abandoned Alder Mine is located approximately 3 miles south of Twisp on the western slope of McClure Mountain. The abandoned Red Shirt Mine is also located in the basin.

Exceedances of state metals standards for protection of aquatic life were noted in Alder Creek. Zinc and cadmium exceeded standards in Alder Creek (Raforth et. al., 2000). Similarly, zinc and cadmium concentrations in Alder Creek sediments substantially exceeded sediment quality guidelines (Raforth et. al., 2000). There were also elevated concentrations of copper and selenium in the stream water and sediments of Alder Creek (Peplow and Edmonds 1999) (as noted in Washington State Conservation Commission, 2000).

For metals, comparison of upstream, middle, and downstream sample results are only available for low-flow conditions. Zinc, copper, lead, and cadmium concentrations are substantially elevated in the downstream sample, but even more so at the middle location. Thus, there is an increase from the upstream location to the middle location, but lower concentrations in the downstream sample (Raforth et. al., 2000). These changes are consistent with the general chemistry results. The middle sample is located directly downhill from the Alder Mine North Adit and the water quality results correspond to the mineralogy of the ore produced from the mine. Dilution would account for the decreased concentrations between the middle sample and furthest downstream sample (Raforth et. al., 2000).

Water quality impacts were seasonal, with maximum degradation commonly occurring during high-flow. Nearly all metals concentrations are uniformly lower during low-flow conditions, illustrating seasonality in water quality in this district. Zinc, copper, and cadmium, three of the metals with the highest concentration during high-flow, show the greatest decrease during low-flow conditions (Raforth et. al., 2000).

At the downstream Alder Creek location during high-flow, state water quality standards were exceeded for zinc and cadmium. For a hardness level of 298 mg/L, the zinc concentration of 484 µg/L exceeded the acute criterion of 289 µg/L and the cadmium concentration of 9.5 mg/L exceeded the chronic criterion of 2.3 µg/L. During low-flow, cadmium levels were at or slightly below the chronic standard in both middle and downstream Alder Creek (Raforth et. al., 2000)

These metals are thought to have reduced species richness and abundance in the community structure of benthic macroinvertebrates in Alder Creek. Furthermore, cadmium and zinc were discovered to have concentrated in the gills and livers of rainbow trout. The extent of the problem appears to reach the confluence of Alder Creek and the Methow River. Metals exceeding water quality criteria at the confluence of

Alder Creek and the Methow River pose a risk to threatened species of juvenile salmonids which use the lower portion of Alder Creek as rearing habitat (Peplow 1999) (as note in Washington State Conservation Commission, 2000).

Among the general chemistry parameters, sulfate, and total dissolved solids appeared to be the most useful indicators of water quality and sediment quality impacts from mining. A ratio of sulfate to total dissolved solids above 20% was found to adequately identify exceedances of water quality and sediment quality standards or guidelines (Raforth et. al., 2000).

pH is not necessarily the primary manifestation for ARD. Mine drainage from the North Adit contained high concentrations of metals at a low pH value typical of what is considered as classic ARD conditions. Most of these metals are present at elevated levels in the middle and downstream Alder Creek samples, although the pH is nearly neutral. This shows that some metals – zinc and cadmium, for example – once released by ARD can remain mobile under nearly neutral pH conditions and have an adverse impact on receiving water. As a result, collection of pH data alone would not diagnose ARD impacts on the receiving water (Raforth et. al., 2000).

8.3.8 Other variables

Historically, settlers often protected apple trees from codling moths with arsenate of lead. It is suspected that arsenate of lead was used for up to 50 years in the orchards that fringe the lower reaches of the Methow River. However, there have been no known fish kills that can be traced to pesticides in the Methow River, despite their widespread use (Mullan et. al., 1992).

8.4 Constraints and use of existing database

The existing Storet database contains a great deal of information. However, scope and budget constraints did not allow for the database to be imported and modified into a format that would allow for immediate use during this study.

The next step in the use of existing data would be to import and modify the Storet database into a useable form. At that time, it would be possible to evaluate whether or not specific samples at specific sites have exceeded water quality criteria. While data are generally not adequate to statistically assess the cause of any exceedances, the exceedances can be noted. Subsequently, hypotheses on possible causes can be developed, and a monitoring program could be developed to address such hypotheses.

For example, existing data allow for some monitoring of temperature and dissolved oxygen; especially if water quality monitoring sites are correlated to water withdrawal and water return sites. Most of both the existing monitoring sites and water-use sites are on mainstem reaches and in the lower watersheds. Thus, existing data may allow for a qualitative ("sense") assessment of the level of influence that water withdrawal has on temperature and dissolved oxygen. However, data on temperature and dissolved oxygen generally do not appear to be adequate for conducting a quantitative ("statistical") assessment beyond merely determining means, medians, and deviations.

By using the qualitative assessments, and by noting specific exceedances of temperature and dissolved oxygen criteria, potential sources of anthropogenic impacts (such as solar-heated irrigation return waters, or diminished flows due to irrigation withdrawal, or poor riparian conditions) could be noted. These potential sources of impacts could then become the subject of specific monitoring programs. Subsequently, it may then be possible to predict the effectiveness of various management options, and to adaptively manage the sources of anthropogenic impacts

It is likely that many of these specific assessment programs would entail the expansion of existing monitoring programs, so as to supplement the existing database with enough new data to allow for quantitative assessments. This appears to be especially true for those programs that assess impacts in the lower to mid mainstem; programs for the upper mainstem or in tributaries may require more extensive or new programs.

8.5 Groundwater Quality

The Groundwater Advisory Committee (GWAC) in their 1994 Groundwater Management Program (GWMP) identified six separate activities/issues that could potentially impact the quality of groundwater in the basin. The GWAC studied moderate risk waste, solid waste handling, stormwater management, conservation, wastewater, best agricultural management practices and institutional responsibilities. The GWMP presents policies to address each these activities to ensure preservation of the quality of groundwater in the basin.

Given the large percentage of residents in the basin who utilize groundwater for their primary potable water supply (see Section 10), a groundwater contamination incident in a sub-basin would have significant impacts on the population relying on that groundwater. Similarly, a major contamination incident could significantly affect future water availability in the basin. Currently, residents in the Twisp sub-basin have been provided bottled water while an investigation of elevated arsenic levels in their wells is undertaken.

Agricultural irrigation recharge also likely affects groundwater quality in some fashion. Leakage from canals may actually flush out or dilute chemical concentrations in groundwater. Recharge from crop irrigation may also affect the quality of the underlying aquifer, however, it is unknown whether the affect is one of dilution or of chemical delivery of fertilizers, pesticides or other materials utilized in the area.

8.6 QA/QC Considerations

No formal Technical Validation Process (TVP) has been established for water quality data. Thus the review of the suitability and acceptability of existing data was based upon professional judgment. This professional judgment considered such aspects as:

- "Shelf life" of existing data that were collected some time ago;
- Adequacy of methods, as compared with currently available and standardized methods;
- Completeness of data, for planning purposes;
- Quality control and assurance measures taken at the time of original data collection; and
- Uncertainty associated with the data (Economic and Engineering Services, 1999).

TABLE 8-1

Summary of Available Water Quality Sampling Information

Map ID	Station Location	Location		Number of Samplings	
		Latitude	Longitude	Flow	Water Quality
1	Aeneas Creek At Road 358 Crossing	48.57	119.13		17
2	Andrews Creek Above Peepsight Near Mazama	48.88	120.17		1
3	Andrews Creek Near Mazama	48.82	120.14	91	99
4	Antoine Creek Below W adams Creek	47.95	119.98		1
5	Beaver Creek At Beaver Crossing	48.85	118.98		16
6	Beaver Creek At USGS Gage	48.13	120.17		18
7	Benson Creek Near Mouth	48.30	120.00		18
8	Black Canyon Creek At Forest Service Boundary	48.07	120.00		11
9	Boulder Creek At Bridge Near Mouth	48.58	120.17		30
10	Boulder Creek Below Bernhardt Creek	48.62	120.00		4
11	Cedar Creek Tributary At Sandy Bu Ccut	48.57	120.47	8	24
12	Chewack River At 30 Mile Crossing	48.82	120.02		1
13	Chewack River At Road 392 Bridge	48.57	120.18		24
14	Chewack River Above 8 Mile Creek	48.60	120.17		3
15	Chewack River At Winthrop	48.48	120.19	22	23
16	Coleman Tributary Near Mazama	48.90	120.18		1
17	Cub Creek Above Fourth Creek	48.60	120.27	1	1
18	Cub Creek At Road 3620 Culvert	48.63	120.30	1	1
19	Cub Creek Below Third Creek	48.58	120.23		17
20	Cutthroat Creek Trailhead	48.57	120.67		1
21	Early Winters Creek At Klipchk Bridge	48.60	120.50	14	39
22	Early Winters Creek Near Klipchk Crossing	48.60	120.48		103
23	Early Winters Creek Near Mouth	48.62	120.47	1	116
24	East Fork of Fawn Creek At Road 366 Culvert	48.58	120.33	11	111
25	Eightmile Creek At Road 392 Bridge	48.60	120.17		17
26	Eightmile Creek Below Billy Goat Creek	48.77	120.30		2
27	Goat Creek At Road 375 Bridge	48.58	120.37	1	50
28	Goat Creek At Vanderpool Creek Crossing	48.67	120.33	13	13
29	Gold Creek Below South Fork	48.20	120.13		16
30	Libby Creek At Road 3202 Bridge	48.25	120.17		16
31	Little Bridge Creek Near Mouth	48.38	120.28		22
32	Long Creek At Road 375 Culvert	48.63	120.35	12	12
33	Looney Creek On Sandy Butte	48.58	120.43	8	25
34	Methow River At Weeman Br Near Mazama	48.54	120.32	24	25
35	Methow R Below Gate Creek Near Mazama	48.63	120.46	43	44
36	Methow River At Twisp	48.36	120.11	79	84
37	Methow River Near Pateros	48.07	119.96	314	353
38	Methow River Near Twisp	48.35	120.11	131	140
39	Myers Creek Near Lost Lake	48.83	119.12	1	14
40	Myers Creek Tributary Near Lost Lake	48.87	119.05	1	1
41	Peepsight Creek Below Dry Lake Near Mazama	48.90	120.23		1

TABLE 8-1

Summary of Available Water Quality Sampling Information (Continued)

Map ID	Station Location	Location		Number of Samplings	
		Latitude	Longitude	Flow	Water Quality
42	Peepsight Creek Near Mazama Wa	48.88	120.17		1
43	Remmel Mountain Tributary Near Mazama	48.91	120.20		1
44	Swamp Gas Tributary Near Mazama	48.90	120.19		1
45	Twisp River At South Creek Crossing	48.43	120.53		1
46	Twisp River At War Creek Bridge	48.37	120.40		20
47	Twisp River Below Little Bridge	48.38	120.28		23
48	Twisp River Near Mouth	48.38	120.15		2
49	Upper Andrews Creek Near Mazama	48.92	120.21		1
50	West Fork of Fawn Creek At Road 366 Culvert	48.58	120.33	11	11
51	West Fork Fawn Creek Tributary At Road 366	48.58	120.33	11	11
52	Whiteface Creek At Road 375 Culvert	48.63	120.37	10	11
53	Winthrop NFH Methow River	48.47	120.19		11
54	Wolf Creek At Forest Service Boundary	48.47	120.25		2
55	Yockey Creek Near Mouth	48.30	120.00		17

TABLE 8-2

Contrasts Between Class A and Class AA Water Quality Standards
Source: Washington State, 1997

Water Quality Variable	Class A Standard	Class AA Standard
Fecal Coliforms	Geometric mean of less that 100 colonies / 100 ml. No more than 10% of all samples obtained for calculating the geometric mean value exceed 200 colonies/100ml	Geometric mean of less that 50 colonies / 100 ml. No more than 10% of all samples obtained for calculating the geometric mean value exceed 100 colonies/100ml
Dissolved Oxygen	Exceed 8.0 mg/l	Exceed 9.5 mg/l
Temperature	Not exceed 18 C. When natural conditions exceed 18 C, no increase will be allowed which will raise the receiving water temperature by greater than 0.3 C.	Not exceed 16 C. When natural conditions exceed 16 C, no increase will be allowed which will raise the receiving water temperature by greater than 0.3 C.
Incremental Temperature Increases	Increases resulting from point source activities shall not, at any time, exceed $t=28/(T_{background}+7)$. Increases from nonpoint source activities shall not exceed 2.8 C	Increases resulting from point source activities shall not, at any time, exceed $t=23/(T_{background}+5)$. Increases from nonpoint source activities shall not exceed 2.8 C
pH	Within range 6.5 to 8.5, with human-caused variation within less than 0.2.	Within range 6.5 to 8.5, with human-caused variation within less than 0.5.