Section 3
Asotin Creek Implementation Area

3.1 Overview of the Asotin Creek Implementation Area

Asotin Creek originates in the Blue Mountains and is a tributary to the Snake River, draining an area of 208,000 acres (Northwest Power Planning Council 2001). The mainstem drains 119,000 acres and flows into the Snake River at the city of Asotin, Washington. Major tributaries to the mainstem include Charley Creek, North Fork of Asotin Creek, South Fork of Asotin Creek, and Lick Creek. The other main drainage is George Creek, which drains 89,000 acres and its major tributaries include Pintler Creek, Nims Gulch, Ayers Gulch, Kelly Creek, Rockpile Creek, and Coombs Canyon.

As described further in Section 7, the geology of the Asotin Creek subbasin consists of basaltic rocks overlain by fine-grained loess soils. Folding of the underlying bedrock has resulted in a plateau tilted slightly to the north and east. The uplift caused streams to cut down and form very steep, and generally narrow, v-shaped canyons in the upper portion of the subasin. Asotin Creek historically had a less severe gradient, a meandering flow pattern with point bars that formed pools and riffles, and well developed floodplain connections. The point bars provided habitat for an entire aquatic community of plants and animals. The stream channel had long, deep pools and a well-developed thalweg. Today, much of Asotin Creek and its tributaries have been straightened, diked, or relocated. Flood events in conjunction with these channel modifications have resulted in a braided channel lacking instream structure, pools, and woody riparian vegetation (NRCS 2001).

Pasture and rangeland, cropland, and forestland are the predominant land uses within the Asotin Creek subbasin. Historically, livestock grazing in the Asotin Creek watershed began in the early 1800s. By the early 1900s, cattle, sheep, and wild horses grazed the watershed. Pasture and rangelands occupy approximately 43 percent of the Asotin Creek subbasin, while approximately 26 percent is comprised of cropland consisting of winter wheat and spring barley with summerfallow every two to three years. Forestland covers the remaining 30 percent of the Asotin Creek subbasin primarily in the north central portion of the subbasin. The majority of forestland is in the Umatilla National Forest and is managed by the USFS for multiple uses including timber management, livestock grazing, outdoor recreation, mining, and water management. The state of Washington and non-industrial private forestland owners manage the remaining forestland.

According to the Draft Asotin Creek Subbasin Summary (NPPC 2001), historic and current land use practices have altered the hydrologic cycle of Asotin Creek. Farming, timber harvesting, and urbanization have changed the water cycle, reducing water infiltration and accelerating runoff.

3.2 Surface Water Resources

The Asotin Implementation Area is located in Asotin and Garfield Counties. The major stream reaches located within this area include Asotin Creek, Tenmile Creek, and Couse Creek.

Asotin creek is a third order tributary to the Snake River with its headwaters originating in the Blue Mountains, continuing east into the Snake River at Asotin, Washington. Asotin Creek has two major drainages, the mainstem and George Creek. Major tributaries to the mainstem include Charley Creek, North Fork of Asotin Creek, South Fork of Asotin Creek, and Lick Creek. The major tributaries to George Creek include Pintler Creek, Nims Gulch, Ayers Gulch, Kelly Creek, Rockpile Creek, and Coombs Canyon (Stovall, 2001).

Tenmile and Couse Creeks both drain into the Snake River south of Asotin. Little is known or documented in these two drainages.

This section provides an analysis of available gauging station data, a description of the available instream flow studies for the Asotin Implementation Area, a discussion of instream flow legal requirements, and identification of instream flow needs.

Discussion and quantification of other hydrologic parameters influencing surface water resources, such as precipitation, evapotranspiration, and snow pack is presented in Section 2 under watershed characteristics and in Section 8 with the description of the water balance developed for WRIA 35. Groundwater issues are discussed in detail in Section 7. Throughout these sections, it is important to remember that this assessment is limited to the review of available, existing information and is directed at identifying any additional data that may be needed to facilitate development of the watershed plan for WRIA 35.

3.2.1 Gauging Data and Stream Flows

Measurement of stream flows with gauging stations has been occurring in the Asotin Implementation Area since 1904 when a gauging station was installed on the Asotin Creek near Asotin, Washington to measure peak stream flow. The data most useful to watershed planning efforts has been compiled by the United States Geological Survey (USGS). Historically, USGS has operated gauging stations recording stream flows on a daily basis or peakflows over various time periods in this area.

The Washington Department of Fish and Wildlife (WDFW) has also collected spot data in a variety of locations on area streams to establish baseline data for fisheries research. These spot and peak-annual measurements can be useful for flood management and specific research or management activities. However, continuous records providing a complete record of seasonal flow variations are most useful for watershed planning purposes such as water budgeting, allocation and instream flow analyses.

In support of the watershed planning efforts in the Middle Snake River Basin, the Washington Department of Ecology (Ecology) and the Asotin County Public Utility District proposed to install additional gauging locations in WRIA 35. These monitoring stations are either telemetry or manual stage height stations. Telemetry stations record the stage height every fifteen minutes and data is then imported into Ecology's stream flow database, providing a continuous record of stream flow. Manual stage height stations record the river stage height 6 to 8 times a year, which can then be converted to instantaneous stream flow using a rating table or flow curve.

Ecology also operates water quality monitoring stations that are either long-term or basin stations. Long-term stations are monitored every water year (October 1 till September 30), whereas basin stations are monitored for one water year and sometimes returning every five years. Grab samples are taken usually once or twice a month and stream flow, when recorded, is either estimated or measured. Ecology water quality monitoring stations do not provide a continuous record of stream flow.

General Stream Gauging Locations

Historically, the USGS has eight (8) gauging stations in the Asotin Implementation Area over various time periods (see Table 3-1). Four (4) stations are located on Asotin Creek, USGS gauges 13334450, 13334500, 13334700, and 13335050, and have recorded stream flows on a daily basis. Of these, only gauge 13334450 is still in operation. 2 gauging stations, USGS gauges 13334400 (Mill Creek) and 13334900 (Pintler Creek), recorded only annual peak flows and none of these remain in operation today. The remaining 2 gauging stations, USGS gauges 13334360 and 13334420, are located at the mouths of Couse Creek and Tenmile Creek, respectively. However, no data is available at either location. The locations of these gages are shown on Exhibit 3-1 and listed in Table 3.2-1.

Ecology has proposed 4 additional stream flow gauging locations in the Asotin Implementation Area; of which, 3 manual stage height stations have been installed at Tenmile Creek (35J050), Couse Creek (35H050) and Asotin Creek below George Creek in 2003 and 2004. The remaining station at Asotin Creek located 1.3 miles above George Creek has been installed in 2004 but is currently not functional and will likely remain so until funding is available from Ecology (Joe Lemire, personal communication, 2004). Ecology stations 35H050 and 35J050 are manual stage height stations; however, conversion tables have not yet been developed for these sites (Jim Peterson, personal communication, 2003). Therefore, data from these Ecology stream flow gauging locations are not included in this stream flow analysis.

Ecology also operates a water quality monitoring station, 35D070, in Asotin Creek. Ecology 35D070 is a basin station with limited flow data (monthly grab samples were taken during four non-consecutive water years). Given its location in the immediate vicinity of the USGS 13335050 gauge, its limited period of record, and the correspondence of its data with that of USGS gauge 13335050, data from this Ecology site is not included in this stream flow analysis.

The locations of the Ecology gages are shown on Exhibit 3-1 and listed in Tables 3.2-1 and 3.2-2.

INSERT EXHIBIT 3-1 (Map showing all USGS and Ecology gauges/monitoring stations)

Table 3.2-1
USGS Gauging Stations[1]

Site Number	Site Name	River Mile	Period of Record	Data Type	Count
13334450	ASOTIN CREEK BELOW CONFLUENCE NEAR ASOTIN, WASH.		2001 – Current	Real-time Peak stream flow Daily stream flow	- 2 638[2]
13334500	ASOTIN CREEK NEAR ASOTIN, WASH.	8.0	1904 – 1959 1928 – 1959	Peak stream flow Daily stream flow	32 11,383
13334700	ASOTIN CREEK BELOW KEARNEY GULCH NEAR ASOTIN, WASH.	5.3	1960 – 1996 1959 – 1982; 1989 – 1996	Peak stream flow Daily stream flow	30 10,914
13335050	ASOTIN CREEK AT ASOTIN, WASH.		1990 – 2002 1988 – 1989; 1991 – 2002 1968 – 1989	Peak stream flow Daily stream flow Water Quality Samples	13 4,576 70
13334400	MILL CREEK AT ANATONE, WASH.		1971 – 1977	Peak stream flow	7
13334900	PINTLER CREEK NEAR ANATONE, WASH.		1971 – 1977	Peak stream flow	7
13334360	COUSE CREEK AT MOUTH NEAR ASOTIN, WASH.		No data available	-	-
13334420	TENMILE CREEK AT MOUTH NEAR ASOTIN, WASH.		No data available	-	-

[1] Source: USGS, 2003. [2] Count as of 12/5/2003.

Table 3.2-2
Washington Department of Ecology Monitoring Stations

Station Code	Station Type	Site Name	River Mile	Period of Record	Data Type	Count
35H050[1]	Stream flow	COUSE CREEK AT MOUTH		2003	Manual Stage Height	5
35J050[1]	Stream flow	TENMILE CREEK AT MOUTH		2003	Manual Stage Height	5
	Stream flow	ASOTIN CREEK, 1.3 MILES ABOVE GEORGE CK.		2004 Installed, but not functional[2]	Telemetry	-
	Stream flow	ASOTIN CK BELOW GEORGE CK.		2004	Manual Stage Height	3
35D070[1]	Water Quality	ASOTIN CREEK AT ASOTIN, WASH.	0.4	1976 – 1977; 1996 – 1997; 1992 – 1993; and 1991 – 2002	Water Quality – Basin	48

[1] Source: Ecology, 2003.
[2] Source: Joe Lemire, personal communication, 2003.

WDFW and other parties have also collected additional spot stream flow data in the Asotin Implementation Area. The Washington State Conservation Commission report, "Salmonid Habitat Limiting Factors Water Resource Inventory Areas 33 (Lower) & 35 (Middle) Snake Watersheds & Lower Six Miles of the Palouse River" has limited stream flow information from WDFW, U.S. Forest Service, and Asotin County Conservation District for some locations in the Asotin Implementation Area. WDFW also began collecting spot data at various locations on George Creek, Pintler Creek, Tenmile Creek, and Couse Creek since April 2000. Table 3.2-3 lists the locations where additional data have been recorded.

Although the data collected from the Ecology and WDFW sites are limited at this time, the period of record will continue to expand for these sites. These will be useful in monitoring and evaluating flow enhancement activities under an adaptive management approach.

Table 3.2-3
WDFW Spot Data Locations[1]

Site ID	Location	Count
	SOUTH FORK ASOTIN[2]	3
GC-4	GEORGE CREEK, ABOVE TRENT GRADE CULVERT	3
GC-6	GEORGE CREEK, 1.5 Mi. BELOW TRENT GRADE CULVERT	1
GC-7	GEORGE CREEK, BELOW HEFFELFINGER CREEK	1
GC-8	GEORGE CREEK, ABOVE STRINGTOWN GULCH	1
GC-9	GEORGE CREEK, BELOW ROCKPILE GULCH	2
GC-10	GEORGE CREEK, ABOVE BRIDGE AT MOUTH OF PINTLER CREEK	1
GC-11	GEORGE CREEK, 0.4 Mi. ABOVE MOUTH	1
GC-12	GEORGE CREEK, AT MOUTH	1
PC-4	PINTLER CREEK, UPPER END OF PUBLIC PROPERTY LINE	1
PC-5	PINTLER CREEK, ABOVE KELLY GULCH	1
PC-7	PINTLER CREEK, 0.5 Mi. ABOVE GEORGE CREEK	1
TC-13	TENMILE CREEK, FIRST BRIDGE	1
C-2	COUSE CREEK, 0.2 Mi. ABOVE MOUTH	3

[1] Source: Mendel, 2001, with the exception of data from South Fork Asotin.
[2] Source: Mendel, 1981.

Summary of Existing Data

Within the Asotin Implementation Area, the most useful gauging data for analyzing stream flows is available from USGS for Asotin Creek.

Table 3.2-4 summarizes:

- USGS gages with daily stream flow data and peakflow data
- Potential value and limitations of these data for characterizing stream flows
- Volume of stream flow passing this gage in an average year.

Table 3.2-4
USGS Gauging Data: Asotin Implementation Area[1]

Gauge/ Type	Site Name and Potential Planning Value	Period of Record	Volume[2] (afy)
ASOTIN CREEK			
USGS 13334450 (Daily)	ASOTIN CR BELOW CONFLUENCE NEAR ASOTIN, WASH. Indicates stream flow contribution from the North and South Forks of Asotin Creek and Lick Creek. Only currently operating gauging station on Asotin Creek.	2001 – Current	37,037
USGS 13334500 (Daily)	ASOTIN CR NEAR ASOTIN, WASH. Located at RM 8.0, just upstream of Headgate Dam. Indicates stream flow in Asotin Creek from all tributaries except George Creek. Combined with 13334700	1928 – 1959	49,591
USGS 13334700 (Daily)	ASOTIN CR BELOW KEARNEY GULCH NEAR ASOTIN, WASH. Located at RM 5.3, just upstream of the mouth of George Creek. Indicates stream flow in Asotin Creek from all tributaries except George Creek.	1959 – 1982; 1989 – 1996	53,438
USGS 13335050 (Daily)	ASOTIN CR AT ASOTIN, WASH. Located near the mouth of Asotin Creek. Indicates net stream flow entering the Snake River at Asotin.	1988 – 1989; 1991 – 2002	74,287
MILL CREEK			
USGS 13334400 (Peakflow)	MILL CREEK AT ANATONE, WASH. Indicates historical instantaneous peak flow measurements on Mill Creek.	1971 – 1977	-
PINTLER CREEK			
USGS 13334900 (Peakflow)	PINTLER CREEKNEAR ANATONE, WASH. Indicates historical instantaneous peak flow measurements on Pintler Creek.	1971 – 1977	-

[1] Source: USGS, 2003.
[2] Total volume of stream flow passing the gage in an average flow year in acre-feet/yr.

The complete daily stream flow records for the USGS gauges are summarized in Exhibits 3-2 through 3-5. The average monthly stream flows observed for those gauges over the period of record, and calculated 10% and 90% exceedance flows are summarized in Exhibits 3-6 through 3-9.

The exceedance flows were calculated from the average monthly flows for the full period of record. The 10% exceedance flow represents the flow that would be exceeded an average of only 10% of the time, and the 90% exceedance flow would be exceeded an average of 90% of the time. Although there are different standards depending on the application or analysis, the 10% exceedance flow could be considered to represent average high flows and the 90% exceedance flow to be low average flows.

Exhibit 3-2
Asotin Creek below the Confluence with Asotin Creek North and South Forks
Complete Record of Average Monthly Values (CFS): USGS Gage 13334450
(1/2001 to Current)

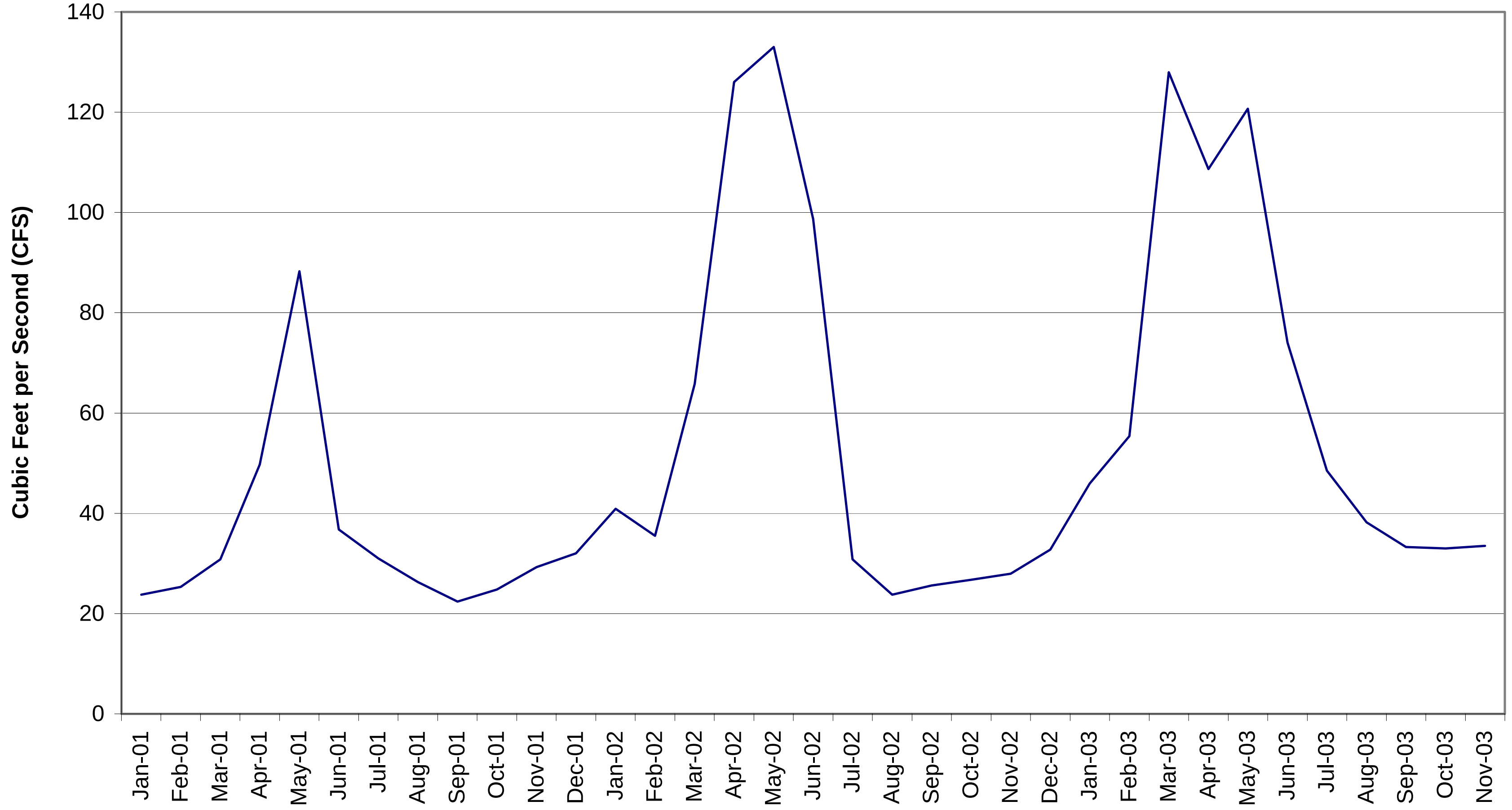


Exhibit 3-3
Asotin Creek just upstream of Headgate Dam
Complete Record of Average Monthly Values (CFS): USGS Gage 13334500
(10/1928 to 11/1959)

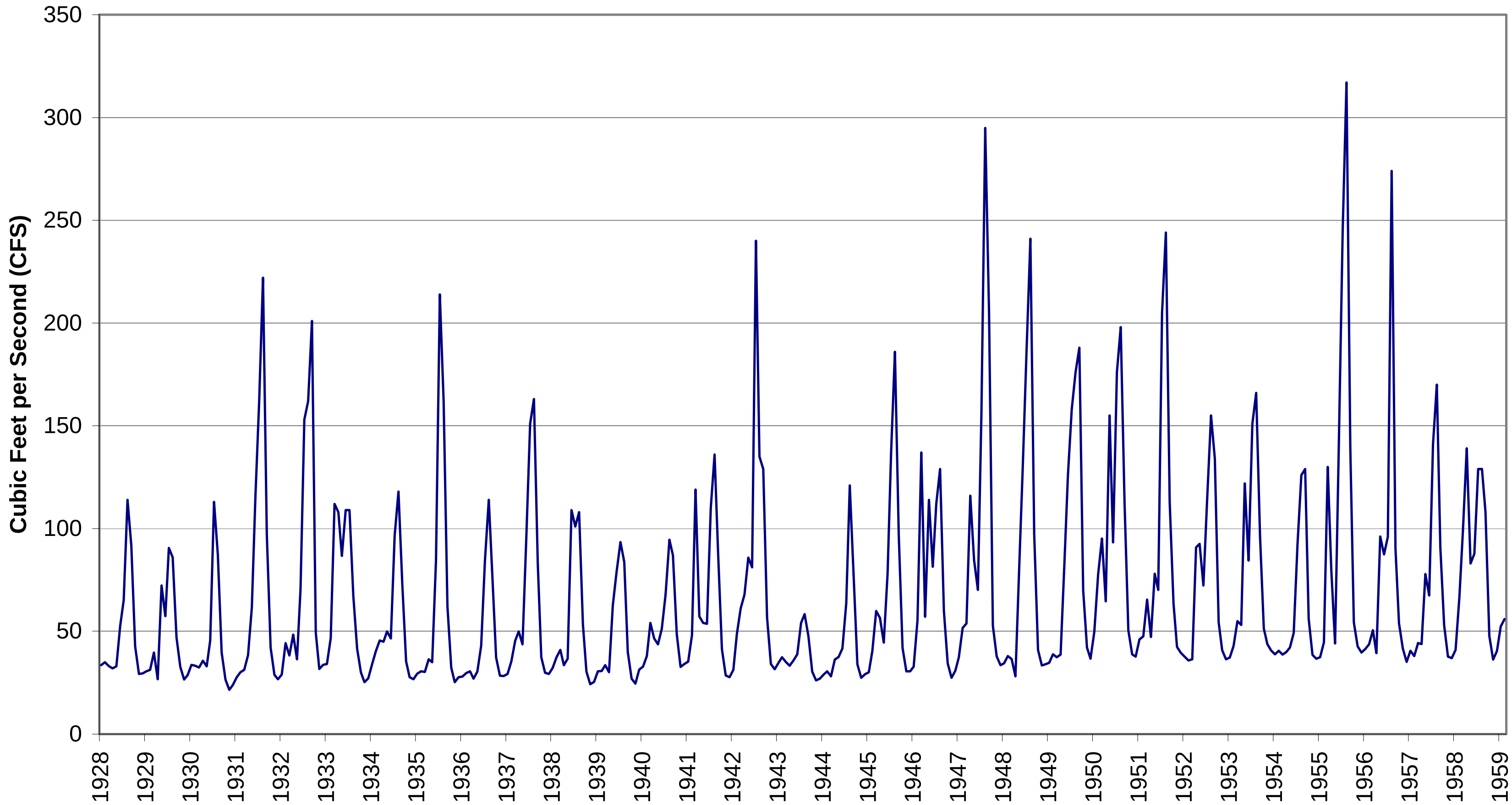


Exhibit 3-4
Asotin Creek below Kearney Gulch near Asotin, WA
Complete Record of Average Monthly Values (CFS): USGS Gage 13334700
(10/1959 to 10/1982; 10/1989 to 6/1996)

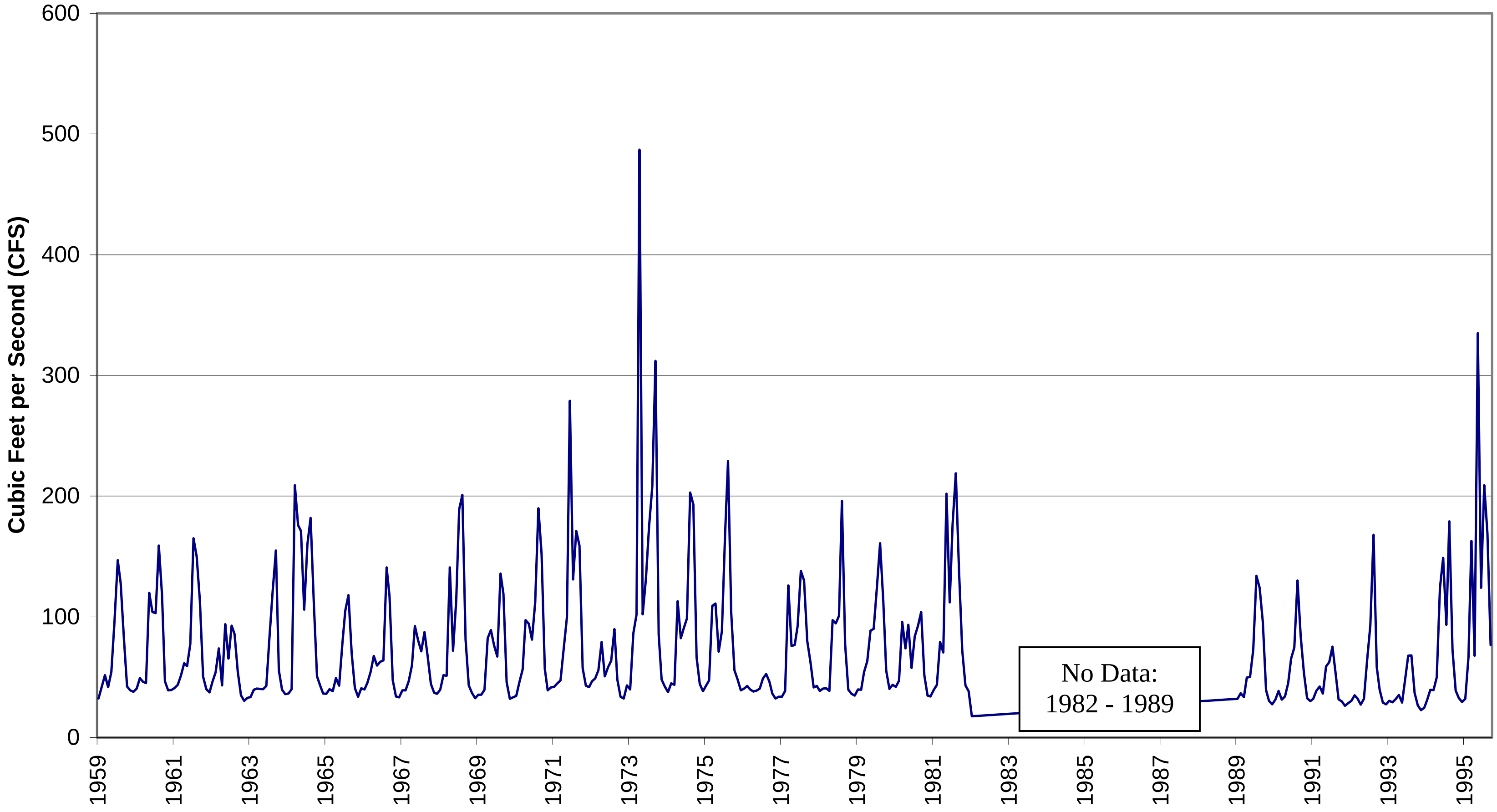


Exhibit 3-5
Asotion Creek at Asotin, WA
Complete Record of Average Monthly Values (CFS): USGS Gage 13335050
(10/1988 to 9/1989; 4/1991 to 9/2002)

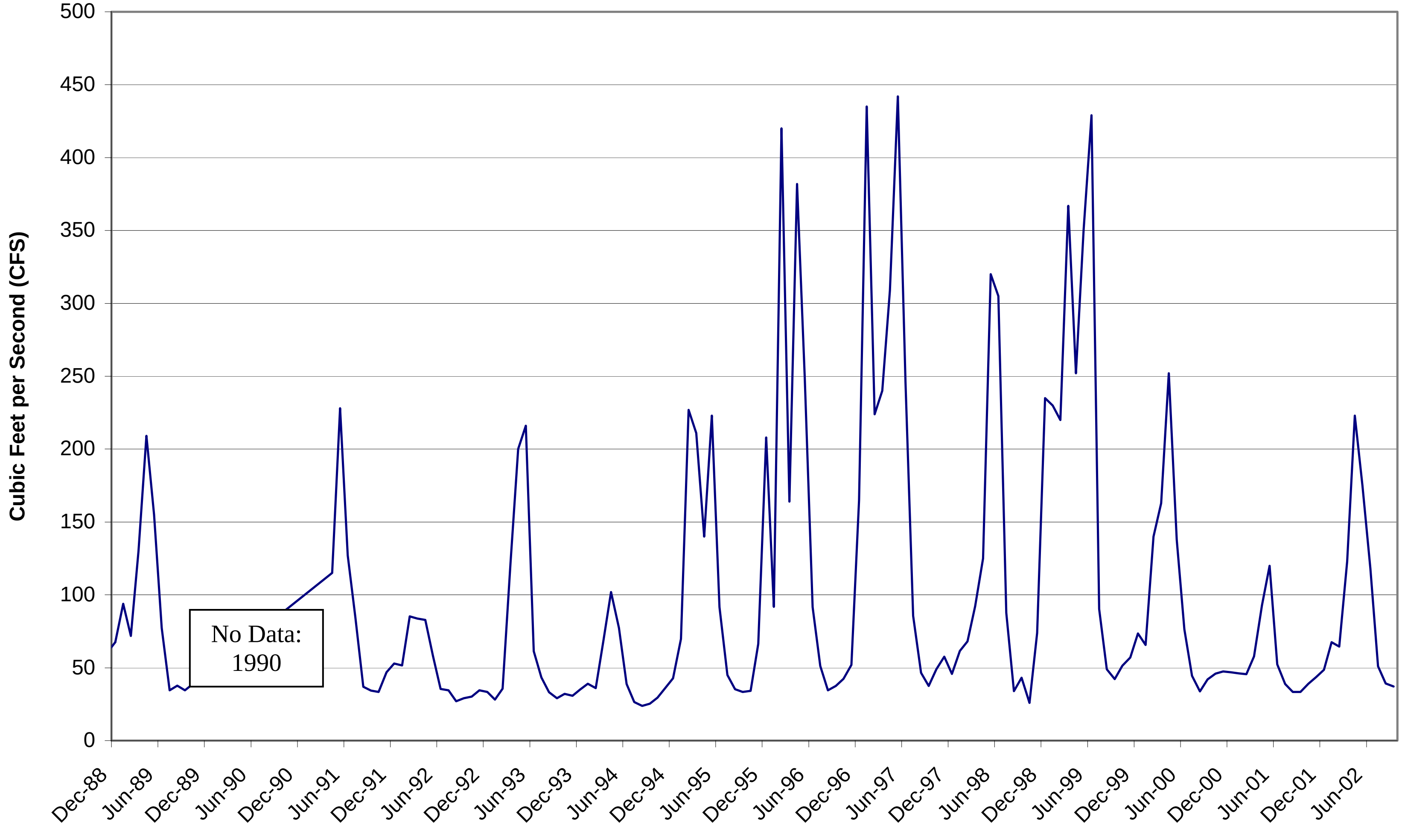


Exhibit 3-6
Asotin Creek below the Confluence with Asotin Creek North and South Forks
Average Monthly, 90% Exceedance, and 10% Exceedance Flows
Mean Annual Volume = 37,037 ac-ft, USGS Gage 13334450
(1/2001 to current)

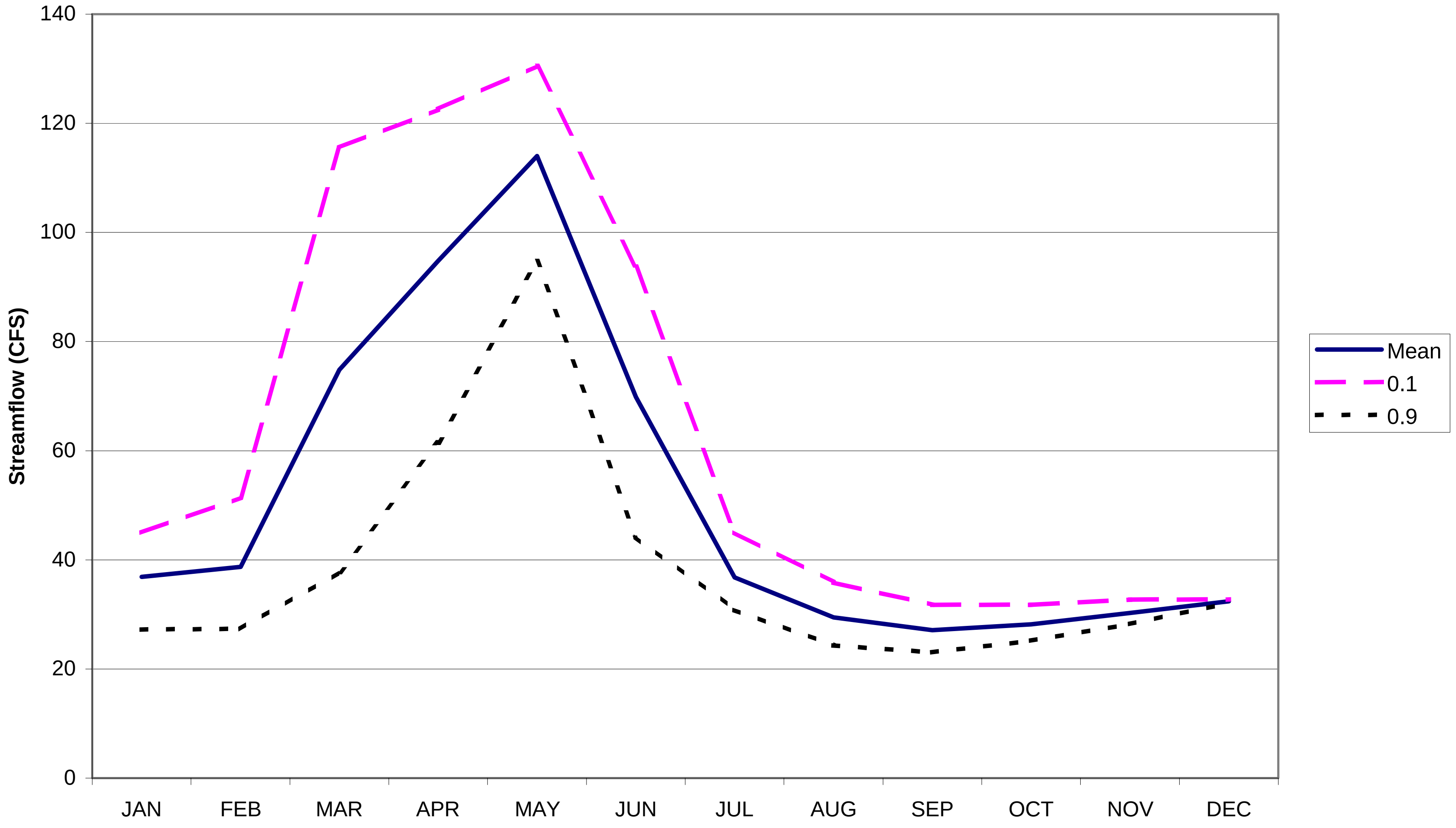


Exhibit 3-7
Asotin Creek just upstream of Headgate Dam
Average Monthly, 90% Exceedance, and 10% Exceedance Flows
Mean Annual Volume = 49,591 ac-ft, USGS Gage 13334500
(10/1928 to 11/1959)

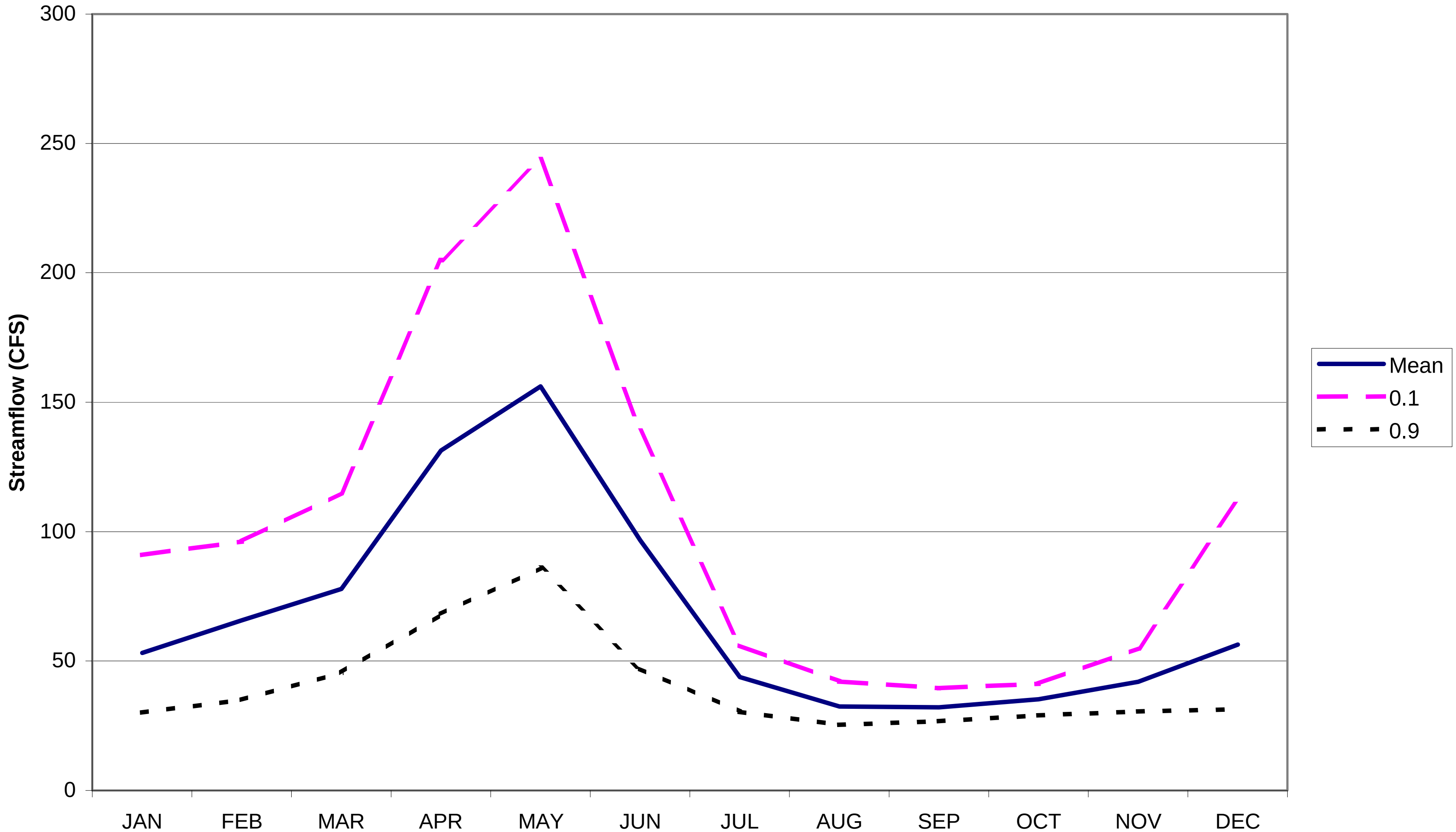


Exhibit 3-8
Asotin Creek below Kearney Gulch near Asotin, WA
Average Monthly, 90% Exceedance, and 10% Exceedance Flows
Mean Annual Volume = 53,438 ac-ft, USGS Gage 13334700
(10/1959 to 10/1982; 10/1989 to 6/1996)

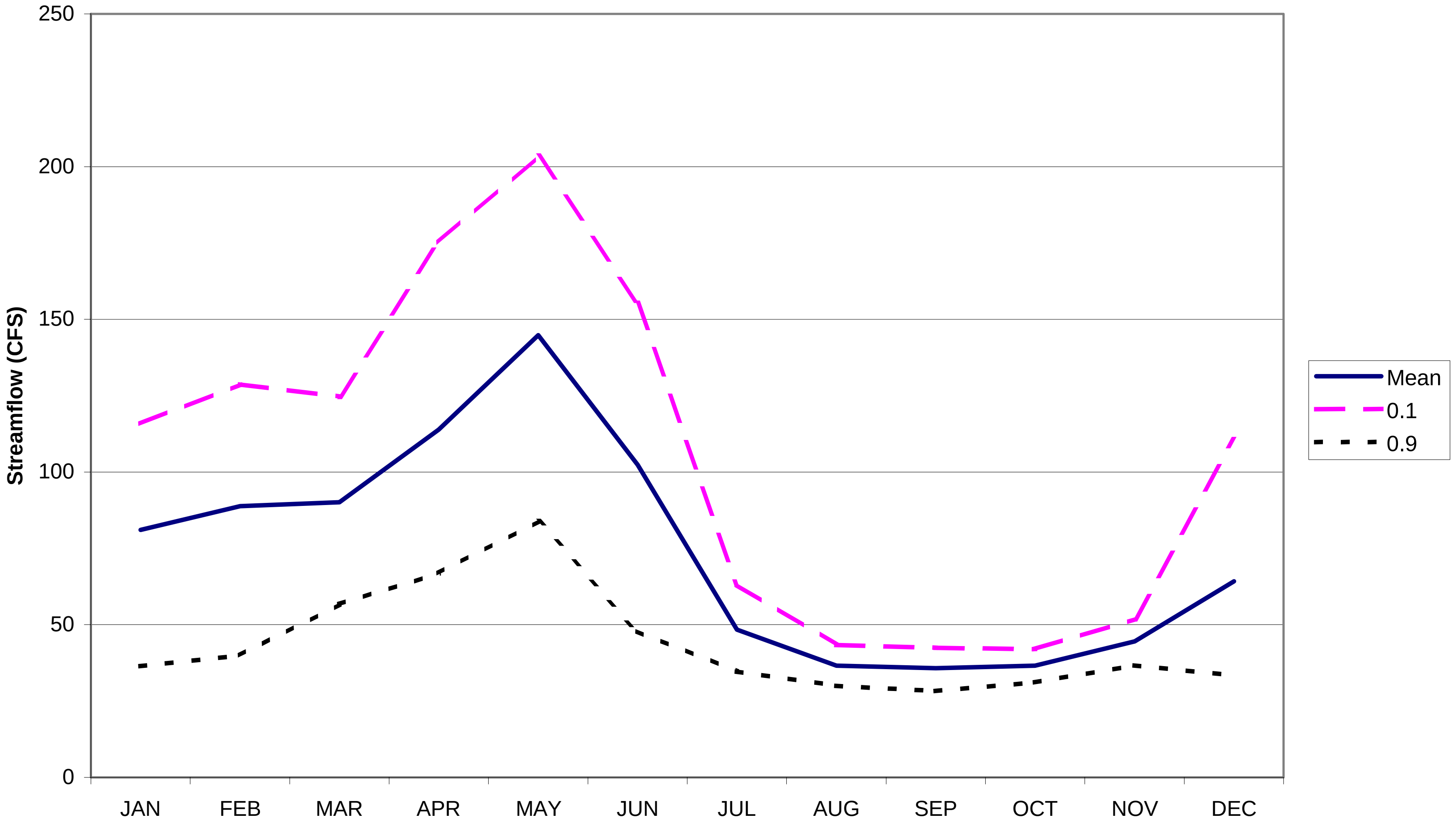
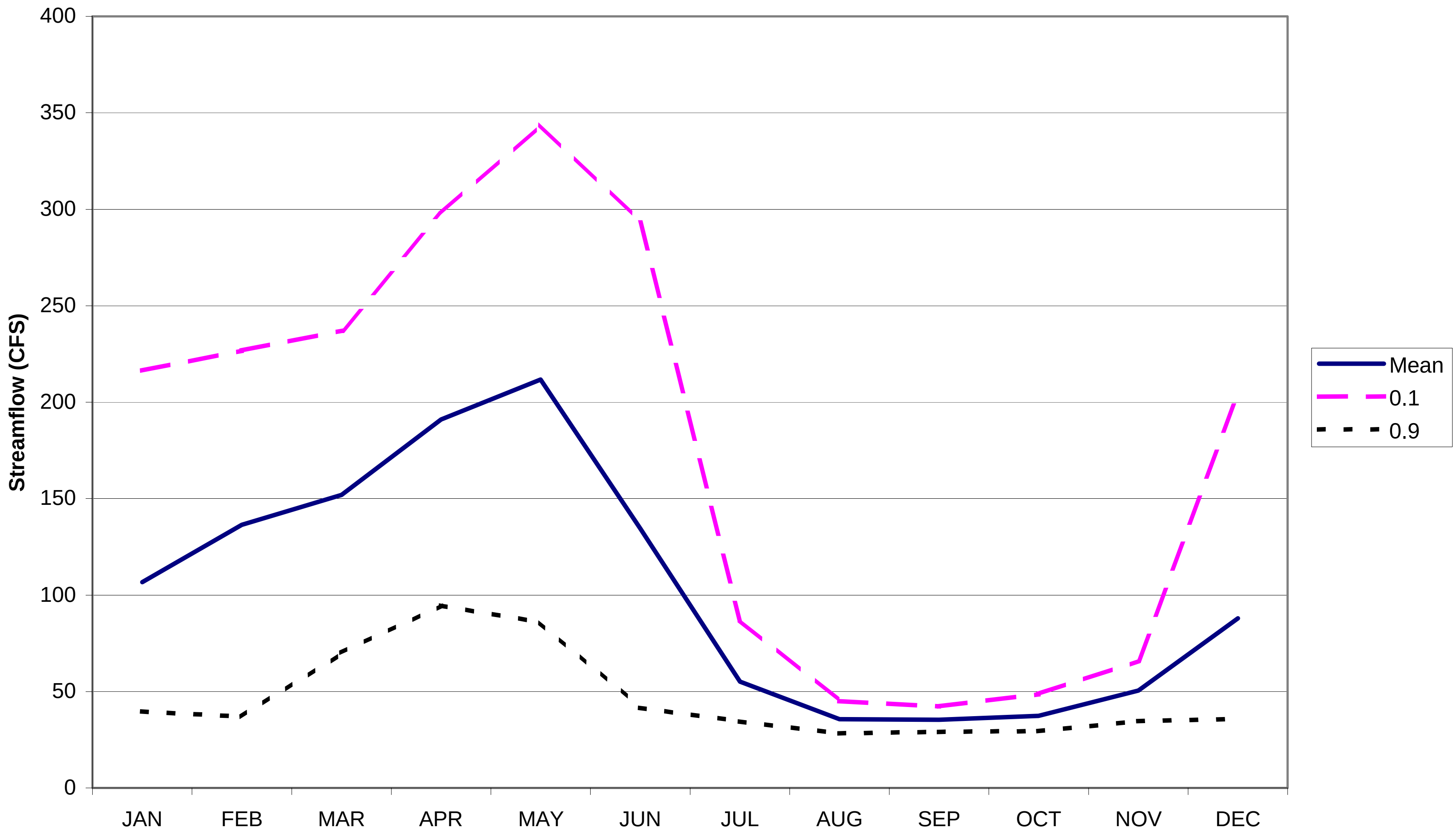


Exhibit 3-9
Asotin Creek at Asotin, WA
Average Monthly, 90% Exceedance, and 10% Exceedance Flows
Mean Annual Volume = 74,287 ac-ft, USGS Gage 13335050
(10/1988 to 9/1989; 4/1991 to 9/2002)



The following summarizes the available data, and seasonal and long-term trends suggested by the data, for each of the streams in this Implementation Area:

Asotin Creek:

The USGS gauges along Asotin Creek suggest that the general stream flow pattern of Asotin Creek coincides with winter precipitation and spring snowmelt. The long-term trend for base flows over the period of record is generally stable and consistent. Peak flows, occurring mostly in the winter and spring, vary from year to year, but are generally consistent. High variability in winter peak stream flow is due to year-to-year variations in the volume and stability of the snowpack, coupled with the lack of storage and flow regulation.

Asotin Creek from North and South Forks Confluence to Charley Creek Confluence

- USGS Gauge 13334450 data is only available for recent years. The records indicate a mean annual flow of about 50 cfs, a normal low flow of 25-30 cfs in late summer, and a normal high flow of 70-120 cfs between March and June. Average late summer flows are about 33 percent of the average spring flows. The total annual stream flow volume in this reach is about 37,000 acre-feet per year. The long-term trend cannot be determined.

Asotin Creek from Charley Creek Confluence to George Creek Confluence

- USGS Gauge 13334500 (Exhibits 3-3 and 3-7) and USGS Gauge 13334700 (Exhibit 3-4 and 3-8) suggest that peak flows along this reach are variable and dynamic. The records indicate a mean annual flow of about 70 cfs, a normal low flow of 30-45 cfs in late summer, and a normal high of 75-155 cfs between March and June. Average late summer flows are about 30-34 percent of the average spring flows. The total annual stream flow passing USGS Gauge 13334500 upstream of Headgate Dam is about 50,000 acre-feet per year. At the confluence with Kearney Gulch (USGS Gauge 13334700), the total annual volume is 53,000 acre-feet per year. Long-term trends for these gages appear generally stable.

- Ecology installed a telemetry gauge at Asotin Creek about 1.3 miles above the confluence of George Creek in 2004; however the gauge is not functional and is not expected to be functional until funding is made available from Ecology.

Asotin Creek from George Creek Confluence to Snake River

- USGS Gauge 13335050 (Exhibits 3-5 and 3-9) suggests that peak flows along this reach are variable and dynamic. The records indicate a mean annual flow of about 100 cfs, a normal low flow of 35-50 cfs in late summer, and a normal high of 130-210 cfs between March and June. Average late summer flows are about 23 percent of the average spring flows. The total annual stream flow volume is about 74,000 acre-feet per year for this stream reach.

- Ecology installed a manual stage height gauge at Asotin Creek just below the mouth of George Creek at the Robert Hepton Ranch. To date, only 3 readings have been made at this location.

Lick Creek from Headwaters to Asotin Creek North Fork

- No gauging information is available for this stream reach.

North Fork from Headwaters to Asotin Creek

No gauging information is available for this stream reach. Available data is limited and was obtained from Washington State Conservation Commission, "Salmonid Habitat Limiting Factors Water Resource Inventory Areas 33 (Lower) & 35 (Middle) Snake Watersheds & Lower Six Miles of the Palouse River" report (Kuttel, 2002):

- "Summer flows on North Fork Asotin Creek generally average about 20cfs. Flows on North Fork Asotin Creek averaged 16 cfs in August 1992. South Fork of N.F. Asotin Creek, Middle Branch, and Cougar Creek contribute up to 7 cfs of each to summer flows in North Fork Asotin Creek."

South Fork from Headwaters to Asotin Creek

- No gauging information is available for this stream reach. WDFW recorded average daily stream flows of 7.8 cfs and 25.3 cfs on June 2 and 9, 1981; and 2.9 cfs on August 18, 1981. The flow of 25.3 cfs occurred after heavy rain showers and the low discharge in August may not reflect the lowest level for the summer or fall (Mendel, 1981).

Charley Creek from Headwaters to Asotin Creek

- No gauging information is available for this stream reach.

George Creek and tributaries

- No gauging information is available for George Creek and its tributaries. Available data is limited and was obtained from WDFW reports.

- A gross estimation of stream flow may be obtained from the difference in mean gauge readings between USGS Gauge 13335050 and USGS Gauge 13334700 based on the assumptions that downstream of Kearney Gulch, George Creek is the major contributor to Asotin Creek and that there are no diversions. This estimate would include base flows and return flows/losses. This results in an estimated mean annual flow of about 20 cfs, with average low flow of 0-2 cfs in late summer, and average high of 40-70 cfs between February and June. WDFW recorded a flow of 45 cfs at the mouth of George Creek on April 26, 2000. The total annual volume contributed by George Creek is roughly estimated at 15,000 acre-feet per year. Additional data would be required to determine the long-term trend.

- Pintler Creek is the main tributary to George Creek. USGS Gauge 13334900 recorded peak stream flows ranging between 0.5 cfs and 26 cfs in the winter and early spring months between 1971 and 1976 on Pintler Creek, and 8.6 cfs on May 15, 1975. WDFW recorded flows between 1.6 cfs and near 0 cfs in April and July of 2000. There is insufficient data to determine seasonal or long-term trends.

Tenmile Creek:

Tenmile Creek from Snake River to Mill Creek Confluence

- Limited data is available for this reach. In June and August 2003, Ecology 35J050 also recorded stage height data at the mouth of Tenmile Creek in 2003. At this time, a conversion table is unavailable and instantaneous stream flows cannot be obtained. WDFW recorded a flow of 10.6 cfs in April of 2000 near the mouth of Tenmile Creek.

Tenmile Creek Headwaters to Confluence with Mill Creek

- No gaging information is available for this stream reach.

Mill Creek Headwaters to Tenmile Creek

- Little gaging information is available for this stream reach. USGS Gauge 13334400 recorded peak stream flows ranging between 24 cfs and 88 cfs in the winter and early spring months between 1971 and 1976, and one record of 50 cfs in June 1977. There is insufficient data to determine seasonal or long-term trends.

Couse Creek:

Couse Creek Headwaters to Snake River

- Limited data is available for this reach. Ecology recently began operating a manual stage height stream flow monitoring station (35H050) at the mouth of Couse Creek in 2003. At this time, a conversion table is unavailable and instantaneous stream flows cannot be obtained.

- WDFW also collected spot data in this reach in 2000 and 2001. A portion of Couse Creek was found to be dry in July 2000, from about 1.5 miles above the mouth to 0.5 miles above the bridge at Montgomery Gulch (Kuttel, 2002). Stream flows recorded in 2002 at 0.2 miles above the mouth ranged from 0.93 cfs to 3.63 cfs between April and October 2000 (Mendel et al. 2001). In 2001, stream flows ranged from 0.75 cfs to 2.39 cfs between April and July 2001, and was recorded at 0.95 cfs on November 9, 2001 at RM 0.1 (Kuttel, 2002).

(NOTE: From conversation with Glen Mendel, a draft report will be completed in January 2005 that may have additional stream flow information pertinent to this Implementation Area.)

Adequacy of Existing Data

The following summarizes the usefulness of the available data for quantifying the stream flow entering or originating within the Implementation Area:

Asotin Creek:

Asotin Creek from North and South Forks Confluence to Charley Creek Confluence

- The stream flow entering this reach can be estimated using USGS Gauge 13334450. However, individual stream flow contributions from the North Fork, South Fork, or Lick Creek cannot be determined.

Asotin Creek from Charley Creek Confluence to George Creek Confluence

- The stream flow entering this reach can be estimated using USGS Gauges 13334500 just upstream of Headgate Dam and USGS 13334700 below Kearney Gulch. Contributions from Kearney Gulch and other smaller tributaries are not known. Note that these gauges do not include the contribution of George Creek. Once the Ecology telemetry data is functional at this location, continuous stream flow data will be collected near the mouth of George Creek.

Asotin Creek from George Creek Confluence to Snake River

- Stream flows entering this reach can be estimated using USGS Gauges 13335050. Contributions from George Creek may be grossly estimated using USGS Gauge 13335050 and USGS Gauge 13334700. However, this is only limited to 1991 to 1996. An Ecology manual stage height station has been installed at this reach. Instantaneous stream flow records will be available as more data is collected.

Lick Creek from Headwaters to Asotin Creek North Fork

- No gauging information is available for this stream reach.

North Fork from Headwaters to Asotin Creek

- No gauging information is available for this stream reach.

South Fork from Headwaters to Asotin Creek

- No gauging information is available for this stream reach.

Charley Creek from Headwaters to Asotin Creek

- No gauging information is available for this stream reach.

George Creek and tributaries

- Little gaging information is available for George Creek and its tributaries. There is a USGS gauge on Pintler Creek (USGS Gauge 13334900) with limited peakflow data. WDFW also collected spot data at several locations along George Creek and Pintler Creek in 2000.

Tenmile Creek:

Tenmile Creek from Snake River to Mill Creek Confluence

- No gauging data is available for this stream reach. Ecology recently began operating a manual stage height stream flow monitoring station (35J050) at the mouth of Tenmile

Creek in 2003. Instantaneous stream flow records will be available as more data is collected.

Tenmile Creek Headwaters to Confluence with Mill Creek

- No gaging information is available for this stream reach.

Mill Creek Headwaters to Tenmile Creek

- Little gaging information is available for this stream reach. There is a USGS gauge on Mill Creek (USGS Gauge 13334400) with limited peakflow data.

Couse Creek:

Couse Creek Headwaters to Snake River

- No gaging information is available for this stream reach. Ecology recently began operating a manual stage height stream flow monitoring station (35H050) at the mouth of Couse Creek in 2003. Instantaneous stream flow records will be available as more data is collected.

3.2.2 Instream Flow Requirements

A listing of specific flow requirements is presented in this subsection. The general discussion on instream flows and instream flow studies are presented in Section 9. Asotin Creek subbasin currently has no instream flow requirements, however, there are surface water source limitations (SWSL) on Asotin Creek. A description of the SWSLs are shown in Table 3.2-5.

Table 3.2-5
Surface Water Source Limitations in the Asotin Creek Subbasin

Stream Name	Type	Location	Documentation Basis
Asotin Creek	Low Flow	Township 10N, Range 45E Section 19	Letter from Fisheries, Dec. 11, 1956; June 26, 1969; 10 cfs @ T10N, R. 45 E, Sect. 19
Asotin Creek	Low Flow	Township 10N, Range 46E, Section 16	70 cfs @ T10N , R. 46E, Sec. 16, Apr. 1 to June 30; 15 cfs @ T10N, R. 46E, Sec. 16, July 1 to Mar 31

An instream flow incremental method (IFIM) instream flow study was conducted in 1992 and 1993 by the Department of Ecology and a report is pending at this time.

3.3 Water Demand Projections

This section includes the demand projections for the Asotin Creek subbasin. A general discussion of water use is included in Section 2. In general, there are four major categories of water users identified in the Asotin Creek subbasin. These are: (i) major public water systems (City of Asotin); (ii) small public water systems (Anatone); (iii) individual household wells; and (iv) agricultural water users. Because the communities in this subbasin are relatively small and pasture and rangeland, cropland, and forestland are the predominant land uses within the Asotin Creek subbasin, the most significant water use is associated with agricultural use (including stock watering and pastures).

A summary of principal water demands for municipal and rural residential needs, along with agricultural demands are outlined in the subsections below.

3.3.1 Municipal and Rural Residential Demand

Planning for future water supply needs requires projection of long-term demand to quantify probable water resource requirements. For watershed planning, quantifying current and projected diversions for domestic, commercial, and industrial uses is essential to determine the distribution of instream and out-of-stream water resources and demands. For municipalities, such forecasts guide the sizing and identification of long-range supply facilities.

Planning for future water supply needs requires projection of long-term demand for all purposes, including domestic, commercial, industrial, and agricultural uses. In this section, demand is projected for the residential customers in Asotin Creek subbasin. The method described here is the same method used for all other subbasins in WRIA 35. In general, commercial and industrial uses that occur in urban areas are included in the municipal (residential) demand projections developed below.

The planning unit's initial efforts to obtain demand projections focused on gathering existing forecasts from local water suppliers. However, the planning unit found only one projection within the entire WRIA 35 performed by the Asotin Public Utility District; the largest supplier for all customers within the Clarkson urban area. The demand forecast for the Clarkston urban area represents total system demand. In general, the planning unit anticipates very minor increases in population and/or economic activity—and some suppliers anticipate decreases in one or the other.

The planning unit calculated future demand by sub-basin using population forecasts, land area, and per capita demand, as described below. The population forecasts described in Section 2.4 is used as the basis for the demand projections. For convenience the population projections for Asotin Creek subbasin is repeated below in Table 3.3-1.

Table 3.3-1 Population Projection for Asotin Sub-basin			
	City of Asotin	**Rural Asotin Co.**	**Rural Garfield Co.**
1990	981	-	-
1995	1,072	-	-
2000	1,095	576	815
2005	1,137	507	819
2010	1,195	572	819
2015	1,256	541	819
2020	1,320	497	819
2025	1,388	352	819

In order to convert population forecasts to projections of water demand, an average per capita demand was used for each sub-basin. The per capita demand was calculated using a modified Department of Health formula published in the "Water System Design Manual" (2001), Publication 331-123, as follows:

$$\text{Average per capita demand} = [(8{,}000/R)+200]/2.5,$$

where R is the average rainfall. The formula was modified so that the resulting units were in gallons per capita, instead of gallons per residential connection. The modification required an assumption that an average of 2.5 persons lives in a household (residential connection). The results of the average rainfall calculations are found in Table 3.3-2 as well as the calculated average per capita demand.

Table 3.3-2 Average Rainfall and Per Capita Residential Demand					
	Asotin County	**Town of Asotin**	**Columbia County**	**Garfield County**	**Whitman County**
Average Rainfall (inches/year)(1)	14.4	13.3	25.3	16.3	18.1
Average per Capita Demand (gallons) (1)	300.9	320.6	206.7	276.3	257.3

(1) Rounded to the nearest tenth.

County rainfall data was obtained from the website worldclimate.com.[1] The average rainfall per year for the Town of Asotin was used (versus rainfall for other incorporated areas) because the data was readily available in the WRIA 32 Level 1 Assessment. The estimated per capita demands are relatively high, compared to other estimates of typical average per capita residential demands in other regions of the state. However, because of the type of uses such as irrigation of

[1] Worldclimate.com gathers climate data from dozens of reputable sources, including the National Climactic Data Center of the National Oceanic and Atmospheric Administration.

larger residential lots and the drier climate in WRIA 35, the per capita demand numbers are considered reasonable.

Using sub-basin populations forecasts shown in Table 3.3-1 and per capita demand shown in Table 3.3-2 the planning unit projected average day demand for residential connections through 2025. The results of this calculation for Asotin Creek subbasin are provided in Table 3.3-3 (in gallons per day) and in Table 3.3-4 in acre feet per year.

Table 3.3-3
Average Day Demand Projection for Asotin Creek Subbasin

Year	City of Asotin	Rural Asotin Co.	Rural Garflield Co.
1990	314,510	-	-
1995	343,685	-	-
2000	351,059	125,409	19,980
2005	364,656	110,358	20,094
2010	383,257	124,552	20,094
2015	402,807	117,930	20,094
2020	423,354	108,372	20,094
2025	444,949	76,609	20,094

Units in Gallons per day

Table 3.3-4
Average Annual Volume Projection for Asotin Creek Sub-basin (acre feet per year)

	City of Asotin	Rural Asotin Co.	Rural Garfield Co.
1990	353	-	-
1995	385	-	-
2000	394	141	22
2005	409	124	23
2010	430	140	23
2015	452	132	23
2020	475	121	23
2025	499	86	23

Units in acre feet per year

In order to determine the portion of the projected demand associated with surface water versus ground water, a comprehensive survey of water users is needed. This was not done for the Level 1 assessment. However, based on a comparison of the water rights for non-irrigation purposes (see Section 3.4), ground water use is higher on annual basis than surface water use in this subbasin. This is because the Town of Asotin uses a ground water source and most individual household users use wells for water supply. Based strictly on the water rights ratios, it is estimated that ground water use is three times the amount of surface water use (or 75 percent of total use) for municipal and rural residential (non-irrigation) use in the Asotin Creek subbasin. Complicating this estimation is the fact that several water rights have multiple purposes of use, and it was outside the scope of this effort to determine the actual use of these water rights.

3.3.2 Agricultural Demand

Prior to 1993 — and effectively until 2002 — agricultural irrigators have not been required to measure, record, and report their annual water use. As a result, there is little data documenting the actual volume of surface or ground waters diverted for agricultural irrigation on a watershed scale.

In 1993, the Washington State Legislature revised the State Water Code (Chapter 90.03 RCW) to require measuring for all surface water diversions. In 1999, five environmental groups jointly sued Ecology for not complying with this 1993 water measuring law. In March 2000, a summary judgment was filed to settle the controversy without a trial. In December 2000, Thurston County Superior Court issued a final ruling, ordering Ecology to submit a Compliance Plan describing how Ecology will bring its water compliance program into line with the state water measuring law by December 31, 2002.

As a result, Ecology has created a new rule clarifying the *Requirements for Measuring and Reporting Water Use*, Chapter 173-173 WAC. The state legislature has allocated $3.4 million in grants to assist water users in purchasing water measuring devices, and Ecology's Water Resources Program is administering these funds. The Compliance Plan developed by Ecology for administering the new rule calls for the water users comprising the top 80 percent of total water use in 16 fish critical watersheds (of which WRIA 35 is one) to conform measuring and reporting practices to the new rule. In the spring of 2002, informal letters were sent to water right-holders identified as using 80 percent of the water in WRIA 35, notifying the users that they would receive a regulatory compliance order. The timeline for issuance of the orders was as follows:

- March 31, 2002: Issue measurement orders to holders of claims, permits, and certificates who are already required to measure so they conform to the revised rule.
- June 30, 2002: Issue measurement orders to 25 percent of the largest holders of claims, permits, and certificates.
- September 30, 2002: Issue orders to an additional 50 percent of the largest holders of claims, permits, and certificates.
- December 31, 2002: Issue orders to the remaining largest holders of claims, permits, and certificates.

Water meters are currently being installed by many irrigators to monitor water diversions in WRIA 35. In time, this new rule will likely result in improved data regarding agricultural and other water uses.

Estimation Methods

For the purposes of this Level 1 Assessment, the most cost-effective way to estimate current water diversions for agricultural irrigation is to:

- collect all available data pertaining to irrigation in the Subbasin;
- estimate the acreage of the primary crops grown in the Subbasin;
- estimate the amount (depth) of irrigation water applied to each of these crops on an annual basis;
- calculate the total water use for each Subbasin from estimates of crop acreage and annual irrigation depth.

This computation is summarized in a table for each Subbasin. The acreage values used in this table were compiled from several different sources. They should be considered general in nature for three reasons:

- First, sound agronomic practices suggest that crops should be rotated on a given land parcel from year-to-year. The scheduling of such rotation varies for different crops.
- Second, data specific to WRIA 35 and its Subbasins are difficult to come by, as most agricultural data have been compiled using Counties as jurisdictional boundaries. Since these boundaries do not follow watershed boundaries, data specific to each Subbasin are not readily available.
- Third, regional and global market forces impact the viability of growing various crops in this region.

Irrigation values in this table were also compiled from several different sources and should be considered general in nature. Actual water use for a given crop on any given farm can vary from these values for a multitude of reasons, including the following:

- First, irrigation water demand is affected by the microclimate and hydrology of the land parcel. For example, a low-lying parcel situated on a river floodplain and shielded from prevailing winds can require substantially less irrigation than an exposed parcel on a windy bluff. Similarly, irrigated lands in higher rainfall areas can require less irrigation than more arid lands.
- Second, irrigation water demand can be subject to timing of water application, both seasonally and daily. Irrigating during periods when air temperature is lower results in less of the water evaporating prior to being stored in the soil. Timing of irrigation can also be a factor on a short-term basis, simply in terms of irrigators turning water on and off in accordance with crop water needs. This level of management can vary substantially from farm-to-farm.

- Third, irrigation water demand is affected by the methods used to apply the water to crops. Depending on the crop being grown and site-specific constraints, newer irrigation technologies such as center pivots with low-pressure sprinklers on drop tubes and drip irrigation are being used to substantially reduce evaporation losses and increase water use efficiency.

- Fourth, irrigation water demand is affected by adherence to water right law. Many landowners and farmers irrigate lands to avoid decreasing the value of their property by relinquishing their water right due to non-use.

- Fifth, total water demand can be affected by other uses of water such as frost protection and overhead cooling of fruit trees. Although there are not many orchards in WRIA 35, many, but not all, orchardists use overhead sprinkler systems to apply water to the canopy of fruit trees (mostly apples) to cool the fruit and prevent heat damage. The use and details of this practice vary from farm-to-farm.

Despite the uncertainties mentioned above, these estimates remain useful in the context of watershed planning.

Agricultural Usage in Asotin Creek Subbasin

Agricultural water usage is limited in the Asotin Subbasin. The 1997 Census of Agriculture documented 329 acres of irrigated land in the Subbasin[2]. However, the large majority of this land, 289 acres, is pasture used for livestock grazing[3]. There is potential for additional stock watering from exempt wells in the Subbasin, but the extent and impact of this water use is unknown. Stock watering use can be estimated by using information from Ag Stats and standard livestock water usage, but was not conducted as part of this Level 1 assessment. This review may be conducted if necessary under the Level 2 assessment.

Primary crops on the remaining 40 acres of irrigated cropland in the Asotin Subbasin include grass hay, alfalfa hay and one orchard. The majority of the water used is derived from Asotin Creek; one irrigator in the Subbasin is known to utilize a well in addition to surface water[4]. Diversions generally take place from early May through August[5]. Diversions are not metered, so it is difficult to determine the amount of water being diverted for agricultural use.

Table 3.3-5 provides estimates of agricultural water usage in the Asotin Subbasin. These estimates are based on the number of acres devoted to each crop type, the estimated evapotranspiration rate for each crop type, and the estimated amount of water applied to these crops from May through August.

---

[2] Personal communication with Cheryl Sonnen, Asotin County Conservation District, February 2004
[3] Personal communication with Mark Heitstuman, WSU Extension Agent, February 2004
[4] Personal communication with Mark Heitstuman, WSU Extension Agent, February 2004
[5] Personal communication with Mark Heitstuman, WSU Extension Agent, February 2004

Table 3.3-5 Water Use by Crop in the Asotin Subbasin*			
Irrigated Crop	**Acreage (Asotin Subbasin)**	**Estimated Total Water Use per Acre** (afy)**	**Estimated Total Annual Irrigation (afy)**
Pasture	289	2.0	578
Hay (Grass)	10	2.0	20
Hay (Alfalfa)	20	2.5	50
Orchard	10	2.8	28
TOTALS	329	n/a	676

** Data provided by WSU Cooperative Extension and Asotin County Conservation District*
***Estimates from AgriMet ET data from the Legrow, Washington weather station, May – August, 2003.*

The irrigated acreages associated with the water rights in the subbasin are summarized in Table 3.3-6 below. Possessing a water right does not mean that it is currently beneficially used nor that it was included in the Census data taken in 1997.

Table 3.3-6 Irrigation Water Right Summary in the Asotin Subbasin			
Purpose	**Acreage**	**Instantaneous Flow (cfs)**	**Annual Volume (afy)**
Surface – Primary	101	1.53	385
Surface - Supplemental	39	0.98	172
Ground – Primary	126	1.91	529
Ground - Supplemental	7	0.16	35
Primary Totals	227	3.44	914

** Data compiled from DOE WRATS database, no warranties to accuracy are implied.*

Irrigation systems consist of hand and wheel lines, and one raised pipe system in the orchard[6]. These are relatively simplistic irrigation systems, with an estimated 65% field application efficiency[7]. Future upgrades of irrigation practices to increase efficiency, changes in irrigation timing, or use of storage to collect water for use during the dry summer months could potentially impact Stream Flows in the Subbasin.

In recent years, there has been some interest in development of vineyards in the Subbasin, which would likely be located a considerable distance from surface water sources and thus require irrigation from wells[8]. If this development is pursued, the extent of irrigated agriculture in the

[6] Personal communication with Cheryl Sonnen, Asotin County Conservation District, February 2004 and Mark Heitstuman, WSU Extension Agent, February 2004
[7] Washington State University, 1985, Washington State Irrigation Guide
[8] Personal communication with Mark Heitstuman, WSU Extension Agent, February 2004

Asotin Subbasin would increase in the future. Barring the development of vineyards, agricultural activity and associated water use is anticipated to remain constant. Due to the uncertainty regarding development of vineyards in the Subbasin, and in an effort to include conservative estimates in this Level 1 Assessment, it is anticipated that agricultural water use in the Middle Snake Subbasin will remain constant.

3.4 Water Rights and Claims

Section 2.9 includes a general discussion of the water rights and claims status for the WRIA 35 watershed as a whole. This section includes a subbasin-specific summary of the types of use and the estimated quantities of water rights for the Asotin Creek subbasin.

In order to derive the subbasin-specific water rights, individual water rights were mapped based on their location per the township-range-section description in the WRATS database (refer to Section 2.9). The same analysis as conducted to prepare Tables 2.8-1 and 2.8-3 was used, except that only those water rights within the Asotin Creek subbasin were included. Tables 3.4-1 and 3.4-2 include summaries of the types of use and associated quantities for surface and ground water permitted and certificated water rights, respectively. Water rights with irrigation being one of the purposes of use accounts for over 60 percent of the total annual water rights allocated. Almost 60 percent of the water rights in terms of annual volume limits are associated with surface water sources.

Table 3.4-1
Summary of Surface Water Rights[1] for Asotin Creek Subbasin

Purpose of Use	Number of Records	Annual Quantity, Qa (afy)	Instantaneous Quantity, Qi (cfs)
IR	19	633.90	3.15
ST WL	9	33.50	0.80
IR ST	2	40.00	0.12
ST	2	2.31	0.03
DS	1	1.00	0.01
DS IR	1	2.30	0.02
DS IR ST	1	5.00	0.02
DS ST	1	3.00	0.02
DS ST WL	1	3.50	0.08
FS IR	1	73.00	0.50
FS RE	1	10.00	0.10

NOTES:

1 The detailed summary by Purpose of Use only includes data pertaining only to water right permits and certificates, as listed in the Department of Ecology Water Rights Application Tracking System (WRATS) database (February 4, 2004). Quantities of water associated with claims and water right applications are not included in this table. There are no annual or instantaneous quantities associated with water right applications, because they are not appropriated rights.

- ***DG***--*Domestic General (use of water for all domestic uses not specifically defined in the water right record or not defined by the other specific domestic use categories.*
- ***DM***--*Domestic Multiple (more than one dwelling none of which are under municipal control)*
- ***DS***--*Domestic Single (one dwelling with lawn and garden, up to one-half acre)*
- ***FS***--*Fish Propagation*
- ***HW***--*Highway (maintenance and construction)*
- ***IR***--*Irrigation*
- ***RE***—*Recreational*
- ***RW***--*Railway (use of water to serve railway equipment and facilities)*
- ***ST***--*Stock Watering*
- ***WL***--*Wildlife Propagation*

Table 3.4-2
Summary of Ground Water Rights[1] for Asotin Creek Subbasin

Purpose of Use	Number of Records	Annual Quantity, Qa (afy)	Instantaneous Quantity, Qi (gpm)
DS	5	9.34	43
DS IR	4	87.95	125
DG HW	1	120	75
DM	1	20.8	13
DM FS IR	1	119	225
DM IR	1	16.39	70
DS IR ST	1	5	10
IR	1	222	200

NOTES:

(1) The detailed summary by Purpose of Use only includes data pertaining only to water right permits and certificates, as listed in the Department of Ecology Water Rights Application Tracking System (WRATS) database (February 4, 2004). Quantities of water associated with claims and water right applications are not included in this table. There is no feasible means of evaluating the validity, or documenting the amount of, water associated with claims. There are no annual or instantaneous quantities associated with water right applications, because they are not appropriated rights.

- ***DG***--*Domestic General (use of water for all domestic uses not specifically defined in the water right record or not defined by the other specific domestic use categories.*
- ***DM***--*Domestic Multiple (more than one dwelling none of which are under municipal control)*
- ***DS***--*Domestic Single (one dwelling with lawn and garden, up to one-half acre)*
- ***FS***--*Fish Propagation*
- ***HW***--*Highway (maintenance and construction)*
- ***IR***--*Irrigation*
- ***ST***--*Stock Watering*

3.5 Surface Water Quality

In much of Eastern Washington, the volume of water available for instream and out-of-stream uses is a primary factor of consideration when evaluating watershed health. Insufficient flow volumes can have significant direct impacts upon water quality, including parameters such as water temperature and dissolved oxygen. However, even when sufficient flow volumes are available the beneficial use of both ground and surface water can be limited by water quality. Various degrees of water quality impairment can restrict the beneficial uses of surface and ground water for the purposes of recreational, drinking, industrial, and agricultural uses, as well as for fish habitat.

This section includes a discussion of water quality parameters, surface water quality regulation, and surface water quality in the Asotin Implementation Area. Ground water quality and associated regulations are discussed in Section 7. Note that all of the exhibits associated with the surface water quality discussion (Section 3.5) are included at the end of this Section.

3.5.1 Water Quality Parameters

Dissolved Oxygen

Dissolved oxygen (DO) is oxygen that is dissolved in water through diffusion from the surrounding air, aeration of water that has tumbled over falls and rapids, and as a waste product of photosynthesis. DO varies by stream segment and vertically within the waterbody. DO levels also vary diurnally, with the lowest values normally occurring early in the morning as vegetative respiration has gone on throughout the night without replacement of oxygen through photosynthesis. DO is important in maintaining healthy aquatic ecosystems. Adequate DO is essential to maintaining healthy salmonid stocks. Low DO directly impacts the health and productivity of aquatic species and indirectly impacts aquatic species by increasing the availability and toxicity of substances. DO is affected by a number of interacting factors including instream flow rates/volume, water temperature, time of year, presence/absence of aquatic plants and microorganisms, dissolved/suspended solids, nutrient concentrations, and riparian vegetation.

pH

As a measure of acidity, pH represents the effective concentration of hydrogen ions in water. The pH scale ranges from 0 (strongly acidic) to 14 (strongly basic). In pure water, the concentration of positive hydrogen ions is in equilibrium with the concentration of negative hydroxide ions, and the pH measures exactly 7. The state pH standard for aquatic life in fresh water is between 6.5 and 8.5. Excessive pH values (greater than 9.5 or less than 4.5) are unsuitable for most aquatic organisms including salmonids, but some impacts to aquatic organisms can also occur within this range as well.

A variety of beneficial uses are affected by pH, including support of aquatic life and suitability of use for drinking water. Changes in pH can affect aquatic life directly through damage to cellular membranes and metabolism disruption. Aquatic life can also be affected by pH through alteration of water chemistry (e.g. low pH levels can accelerate the release of metals from rocks or sediments in the stream). The concentration of dissolved carbon dioxide in the water (related to vegetation activity) and local geology can all impact the pH of a waterbody.

Temperature

Water temperature influences many biological and chemical processes in a waterbody. All aquatic species have preferred temperature ranges, which makes temperature a critical parameter in assessing the health of an aquatic ecosystem. It controls the rate of metabolic and reproductive activities, and determines which species can survive. Further, excessive water temperatures can form thermal barriers that can delay migration or prevent use of particular stream reaches by fish and other aquatic organisms. It can speed up or slow down chemical reactions affecting water quality. Variations in temperature affect the amount of DO in water, since oxygen becomes more soluble in water at colder temperatures. Higher temperatures also lead to depletion of DO. Water temperature is impacted by a variety of factors including but not limited to natural climate (e.g. elevated summer air temperatures), high solar radiation inputs (e.g. due to lack of riparian shade and woody debris), high soil temperatures that heat overland runoff, and high-temperature point discharges such as that from wastewater treatment plants. Instream flow rates play a significant role in controlling water temperature on a watershed scale. Streams with larger volume are less susceptible to warming in summer months. Because of the relationships between water temperature and other water quality parameters, increasing instream flows often has significant impacts with respect to water temperature and overall water quality.

Total Suspended Solids / Turbidity

Values reported for turbidity and total suspended solids (TSS) are closely correlated. Although these two parameters are measured differently, they are both a measure of the amount of solids suspended in water. TSS levels indicate of the amount of suspended solid material in a given volume of water, whereas turbidity is measured by the amount of light penetrating a sample. TSS and turbidity can both be caused by a combination of organic and inorganic material, and is often related to the amount of eroded soil in the waterbody. The source of this material can be from bank erosion and/or from upland practices such as tillage practices. Many water quality pollutants, especially contaminants such as those found in many pesticides and heavy metals, can attach to sediments and are transported into surface water bodies during erosion events. Therefore, sediment and organic fines can be a significant transport vector for chemical pollutants into surface waterbodies. In addition, suspended sediment can have adverse impacts on aquatic life, including aquatic plants, invertebrates, and fish by blocking light penetration (leading to a reduced photosynthetic capacity), reducing visibility, covering spawning beds, etc. Common causes of TSS/turbidity impairments include high flow rates that carry an increased sediment load and contribute to erosion, upland practices such as construction or logging that can increase erosion, unstable stream banks, urban runoff, wastewater effluent, and seasonal algae populations. There is no water quality standard for total suspended solids in Washington State; however, the U. S. Fish and Wildlife Service (1995) suggests the upper limit of continuous exposure for the optimum health of salmonids is 80 mg/l.

Fecal Coliform Bacteria / Pathogens

Fecal coliform bacteria have historically been used as an indicator of public health concerns related to water-borne pathogens. Fecal coliform bacteria (e.g. *Escherichia coli*) originate in the intestinal tracts of warm-blooded animals, and reach water through fecal discharge. Identification of fecal coliform bacteria in a water body can suggest the presence of harmful organisms, which cause cholera, hepatitis A, shigellosis, typhoid fever, bacillary and amoebic dysentery or parasitic protozoans like *Giardia lambli*a, and *Cryptosporidium parvu*m. Note, the presence or absence of fecal *indicator* bacteria within a water body does not automatically indicate the presence of disease causing agents. However, it indicates the degree to which a water body is polluted with fecal material. Common sources of fecal coliform bacteria and other pathogens include wastewater treatment plant discharges, failed septic systems, and improperly managed livestock. These are "human caused" sources of fecal coliform bacteria. There are other natural sources of fecal coliform, such as from wildlife waste.

Nutrients

Nutrients include a number of different chemical species of nitrogen and phosphorus that are cycled through an ecosystem in various forms. Generally, nitrogen is measured analytically in terms of nitrate plus nitrite, ammonia, and ammonia plus organic nitrogen. Phosphorus is measured analytically in terms of soluble reactive phosphorus (SRP) and total phosphorus (TP). SRP is also sometimes termed orthophosphate. The concentration at which TP becomes harmful varies for fish, humans, or the water body in general. U.S. Fish and Wildlife Services (1995) recommends an optimum phosophorous concentration between 0.01 mg/L to 3.0 mg/L for trout.

Nutrients in the water column can affect both human health and the vitality of aquatic ecosystems. Nutrient enrichment can lead to the occurrence of harmful algal blooms, thus contributing to a reduction in dissolved oxygen. This is primarily a concern for lakes, ponds, and other still waterbodies. This causes habitat degradation for many aquatic organisms. As with any set of parameters having pronounced effects on aquatic habitat conditions, nutrient enrichment can potentially alter the composition and species diversity of aquatic populations.

Human health can also be affected by nutrients in water bodies used as a source of drinking water. At levels above 10.0 mg/L, nitrite (a reduced form of nitrate) can be hazardous to infants under the age of 3 months.

Toxics

Toxics include a wide variety of materials that can be directly detrimental to aquatic life and human health. These include heavy metals such as cadmium, mercury, and lead as well as pesticides and industrial chemicals. Heavy metals can enter waterbodies from both natural and anthropogenic sources, while pesticides and industrial chemicals are purely of anthropogenic origin. Many of these substances are particularly problematic as they accumulate in tissue over time. Sources of toxics in a waterbody can include local geology, urban runoff, agricultural runoff, and industrial discharges.

3.5.2 Surface Water Quality Regulations

Surface water quality is regulated under the federal Clean Water Act (CWA; USC Title 33, Chapter 26-I, Section 1251). The CWA is intended to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters". The U.S. Environmental Protection Agency (EPA) administers the CWA, although the EPA has the authority to delegate its responsibilities under the CWA to individual state agencies. In Washington, EPA has delegated CWA administrative authority to the Washington Department of Ecology (Ecology). Ecology regulates water quality under the Water Pollution Control Act (Revised Code of Washington (RCW) Chapter 90.48), and the Surface Water Quality Standards for the State of Washington (Washington Administrative Code (WAC) Chapter 173-201A). The general process for regulating water quality includes establishing standards, monitoring for compliance with those standards, and developing compliance strategies for those areas in which the standards are not met.

In accordance with Section 303(d) of the Clean Water Act, States are required to submit a list of its impaired and threatened waterbodies to the EPA every two years. These water bodies are commonly known as the 303(d) list. The 1998 303(d) list is the currently approved list of impaired waters. States were not required to submit a 303(d) list in 2000; and the recently prepared preliminary draft of the 2002/2004 303(d) list is available for public review, but has not been approved by the EPA at this time.

Once water bodies are listed on the 303(d) list, the State must then establish a priority ranking of the listed waterbodies and identify the waters targeted for Total Maximum Daily Load (TMDL) development. A TMDL establishes limits on pollutants that can be received by a waterbody and still meet water quality standards. In Washington, watersheds are divided into Water Quality Management Areas (WQMA), and TMDLs for each WQMA is developed on a five-year rotating schedule to systematically assess water quality conditions. The steps to be accomplished during the five-year period include: 1) Identifying and prioritizing known and suspected water quality issues within the WQMA; 2) Develop Quality Assurance Project Plans for TMDLS, data collection and analysis; 3) Develop a WQMA Plan of Action, TMDLs, and implementation strategies; and 4) Implement TMDLs.

Ecology's 303(d) listing policy has been updated since 1998. The 2002/2004 303(d) list includes new categories in addition to the 303(d) list to provide a more comprehensive picture of the State's water quality. The categories are based on those recommended by EPA's 2002 Integrated Water Quality Monitoring and Assessment Guidance. With the exception of reservation land, all waters in the State have been classified into the five categories below:

- Category 1 – Stream segments that meet the tested standards
- Category 2 – When there is insufficient data for listing as impaired, but segments are waters of concern
- Category 3 – When there is no data or no usable data for assessing water quality standard
- Category 4 – Impaired streams that do not require a TMDL either because:
  - 4a – Stream segment has a TMDL

4b – Stream segment has a pollution control plan
4c – Stream segment is impaired due to a non-pollutant, such as aquatic habitat degradation

- Category 5: 303(d) list of impaired waters for which a TMDL will be required

3.5.3 Surface Water Quality Criteria and 303(d) List

The State of Washington recently adopted revised surface water quality standards on June 25, 2003. However, the changes must be reviewed and adopted by EPA and other federal agencies before they go into effect. Key changes applicable to the study area include a focus on pollution prevention, targeting (1) temperature requirements, (2) new criteria for ammonia, and (3) classifying fresh waters by actual use rather than by class. While these revisions do not change the general process to achieve water quality standards, the mechanics of that process and the goals for specific water bodies will change.

Under the revised water quality standards for Washington, surface waters of the state are assigned to be protected for certain designated uses and the water quality criteria associated with them, as described in WAC 173-201A-200. Use designation for waters of the state is described in WAC 173-201A-600. The designated uses and water quality standard assigned to waterbodies in the Asotin Implementation Area are described in Table 3.5-1.

The 1998 and 2002 303(d) listed streams and impaired waters within the Asotin Implementation Area are summarized in Table 3.5-2 and are illustrated in Exhibits 3.5-1 and 3.5-2, respectively. Elevated stream temperature identified by the monitoring is thought to be due to lack of riparian vegetation (Kuttel 2002). At this time, temperature is the only parameter included in the 303(d) lists; however this is primarily because temperature is the most commonly monitored parameter collected by Ecology as well as other entities who submit data to Ecology. Future monitoring of other parameters may result in other parameters being listed or other streams being listed. All data is checked for accuracy and compliance with established QA/QC procedures prior to establishing the listings.

3.5.4 Existing Surface Water Quality Monitoring

Ecology has been conducting a long-term Ambient Water Quality Monitoring Program, which is used in support of the Ecology 303(d) listing program under the federal and state CWA. The water quality monitoring stations operated by Ecology are either long-term or basin stations. Long-term stations are monitored every water year (October 1 through September 30 the following year), whereas basin stations are monitored for one water year and sometimes returning every five years. Grab samples are usually taken once or twice a month.

Water quality parameters typically measured through this program include: dissolved oxygen, pH, temperature, total suspended solids, turbidity, fecal coliform bacteria, soluble reactive phosphorus, total phosphorus, ammonia, nitrate plus nitrite, and total nitrogen. Numeric water quality standards associated with each of these parameters are presented in detail in WAC 173-201A.

Water quality monitoring stations in the Asotin Implementation area have been present since 1955. The majority of water quality data in the Implementation Area is available from federal and state agencies such as the EPA STORET database, Ecology, USGS, and U.S. Forest Service (USFS). Station locations and years of record can be found in Table 3.5-3 and Exhibit 3.5-3.

In addition, the Pomeroy Ranger District of the Umatilla National Forest, USFS, has been monitoring water quality within the area as part of the requirements under the National Forest Management Act (USFS 1998, 1999, 2000 and 2001), shown in Exhibit 3.5-4 and 3.5-5; and WDFW has collected limited water quality data in Asotin Creek and its tributaries (Exhibits 3.5-5 and 3.5-6) and in Tenmile Creek and Couse Creek (Exhibit 3.5-7) in order to assess fisheries and their habitats (Bumgarner 2001, 2002a and 2002b; and Mendel 2001 and 2004). The Asotin County Conservation District (ACCD) and Washington State University (WSU) have also cooperatively completed two water quality assessments on Asotin Creek in the last decade. These include the "Asotin Creek water quality monitoring: 1990 to 1993, a report to the Asotin Conservation District" (Moore 1993 as documented by Stovall 2001), and the "Asotin Creek watershed water quality monitoring final report" (ACCD 2000 as documented in Stovall 2001). Exhibit 3.5-8 shows the ACCD/WSU water quality monitoring stations.

Table 3.5-1
Designated Uses and Water Quality Standards: Asotin Implementation Area

Waterbody	Designated Uses	Water Quality Standards[5]	
Asotin Creek and tributaries			
All waters including tributaries of the following that are <u>not in or [illegible]e the Umatilla National Forest</u>: ▪ N. Fork Asotin Creek and all tributaries above Lick Creek ▪ Charley Creek: Above the junction of Charley Creek and unnamed tributary at longitude –117.3216 and latitude 46.2851	▪ Char ▪ Primary Contact Recreation ▪ Domestic, Industrial, Agricultural and Stock water supply ▪ Wildlife habitat, harvesting, commerce/ navigation, boating and aesthetics	**Temperature**, 7-day average of daily max.	12°C (53.6°F)
		Dissolved Oxygen, 1-day min.	9.5 mg/L
		Turbidity[1] Background Turbidity ≤ 50 NTU: Background Turbidity > 50 NTU:	< 5 NTU over background < 10% increase
		Total Dissolved Gas[2]	< 110% saturation
		pH[3]	6.5 – 8.5, variation of < 0.2
		Fecal coliform[4]	< 100 colonies/100mL
All waters including tributaries of the following that are <u>in the Umatilla National Forest</u>: ▪ N. Fork Asotin Creek and all tributaries above Lick Creek ▪ Charley Creek: Above the junction of Charley Creek and unnamed tributary at longitude –117.3216 and latitude 46.2851	▪ Char ▪ Extraordinary Primary Contact Recreation ▪ Domestic, Industrial, Agricultural and Stock water supply ▪ Wildlife habitat, harvesting, commerce/ navigation, boating and aesthetics	**Temperature**, 7-day average of daily max.	12°C (53.6°)
		Dissolved Oxygen, 1-day min.	9.5 mg/L
		Turbidity[1] Background Turbidity ≤ 50 NTU: Background Turbidity > 50 NTU:	< 5 NTU over background < 10% increase
		Total Dissolved Gas[2]	< 110% saturation
		pH[3]	6.5 – 8.5, variation of < 0.2
		Fecal coliform[4]	< 50 colonies/100mL
▪ Asotin Creek and all tributaries below Lick Creek ▪ Charley Creek below the junction of Charley Creek and unnamed tributary at longitude –117.3216 and latitude 46.2851	▪ Salmon and trout spawning, non-core rearing, and migration ▪ Primary Contact Recreation ▪ Domestic, Industrial, Agricultural and Stock water supply ▪ Wildlife habitat, harvesting, commerce/ navigation, boating and aesthetics	**Temperature**, 7-day average of daily max.	17.5°C (63.5°F)
		Dissolved Oxygen, 1-day min.	8.0 mg/L
		Turbidity[1] Background Turbidity ≤ 50 NTU: Background Turbidity > 50 NTU:	< 5 NTU over background < 10% increase
		Total Dissolved Gas[2]	< 110% saturation
		pH[3]	6.5 – 8.5, variation of < 0.5
		Fecal coliform[4]	< 100 colonies/100mL

Source: WAC 173-201A.

Table 3.5-1 continued
Designated Uses and Water Quality Standards: Asotin Implementation Area

Waterbody	Designated Uses	Water Quality Standards[5]	
Tenmile Creek			
Tenmile Creek and all tributaries	▪ Salmon and trout spawning, non-core rearing, and migration ▪ Primary Contact Recreation ▪ Domestic, Industrial, Agricultural and Stock water supply ▪ Wildlife habitat, harvesting, commerce/ navigation, boating and aesthetics	**Temperature**, 7-day average of daily max.	17.5°C (63.5°F)
		Dissolved Oxygen, 1-day min.	8.0 mg/L
		Turbidity[1] Background Turbidity ≤ 50 NTU: Background Turbidity > 50 NTU:	< 5 NTU over background < 10% increase
		Total Dissolved Gas[2]	< 110% saturation
		pH[3]	6.5 – 8.5, variation of < 0.5
		Fecal coliform[4]	< 100 colonies/100mL
Couse Creek			
Couse Creek and all tributaries	▪ Salmon and trout spawning, non-core rearing, and migration ▪ Primary Contact Recreation ▪ Domestic, Industrial, Agricultural and Stock water supply ▪ Wildlife habitat, harvesting, commerce/ navigation, boating and aesthetics	**Temperature**, 7-day average of daily max.	17.5°C (63.5°F)
		Dissolved Oxygen, 1-day min.	8.0 mg/L
		Turbidity[1] Background Turbidity ≤ 50 NTU: Background Turbidity > 50 NTU:	< 5 NTU over background < 10% increase
		Total Dissolved Gas[2]	< 110% saturation
		pH[3]	6.5 – 8.5, variation of < 0.5
		Fecal coliform[4]	< 100 colonies/100mL

Source: WAC 173-201A.

Notes:

[1] Turbidity is measured in Nephelometric Turbidity Units (NTU). Ecology may allow modification of the turbidity criteria to allow a temporary area of mixing during and immediately after necessary in-water construction activities.

[2] Total dissolved gas criteria does not apply when the stream flow exceeds the 7-day, 10-year frequency flood.

[3] pH variation is for human caused variations within the given range.

[4] Not more than 10% of all samples obtained for calculating the geometric mean value may exceed the fecal coliform organism levels shown in the table.

[5] Toxic, radioactive, or deleterious material concentrations, and aesthetic values are not shown in this table. Toxic, radioactive, or deleterious material concentrations shall be below the potential to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health as determined by Ecology; and aesthetic values must not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste.

Table 3.5-2
303(d) Listed and Impaired Stream Segments: Asotin Implementation Area[1]

Segment Description [Stream ID; Listing ID(	Parameter(s) Exceeding Standards	1998 List (#)	2002 List[2]		Comments
			4	5	
N. Fork Asotin Creek near headwaters [NP96OC; 13986]	Temperature			X	based on WDFW unpublished data
N. Fork Asotin Creek [NP96OC; 13985]	Temperature			X	based on WDFW unpublished data
N. Fork Asotin Creek near confluence with Asotin Creek [NP96OC; 21201, 22425]	Fish Habitat		X		based on Kuttel 2002, factors limiting salmon uses: streambank condition, substrate embeddedness, pools
	Temperature			X	based on Umatilla National Forest unpublished data
S. Fork Asotin Creek near headwaters [SS80KO; 22426]	Temperature			X	based on Umatilla National Forest unpublished data
S. Fork Asotin Creek near confluence with Asotin Creek [SS80KO; 21202, 13858]	Fish Habitat		X		based on Kuttel 2002, factors limiting salmon uses: pools
	Temperature			X	based on WDFW unpublished data
Asotin Creek upstream of Charley Creek [KP78KL; 13863]	Temperature			X	based on WDFW unpublished data
Asotin Creek near confluence with Charley Creek [KP78KL; 13860]	Temperature			X	based on WDFW unpublished data
Asotin Creek [KP78KL; 13854]	Temperature			X	based on WDFW unpublished data
Asotin Creek near confluence with George Creek [KP78KL; 21200, 13852]	Fish Habitat		X		based on Kuttel 2002, factors limiting salmon uses: riparian, pools
	Temperature			X	based on WDFW unpublished data
Asotin Creek near mouth [KP78KL; 16795, 13851]	Fecal Coliform Temperature	X (202)		X X	based on Ecology monitoring data
Lick Creek [OV73QV; 22430]	Temperature			X	based on Umatilla National Forest unpublished data
Lick Creek near confluence with Asotin Creek [OV73QV; 16643]	Instream Flow		X		based on Kuttel 2002, factors limiting salmon uses: inadequate stream flow
Charley Creek near headwaters [RX42NZ; 22427]	Temperature			X	based on Umatilla National Forest unpublished data

[1] Source: Ecology 2004b.
[2] The 2002/2004 Categories 4 and 5 are shown in the table.

Table 3.5-2 continued
303(d) Listed and Impaired Stream Segments: Asotin Implementation Area[1]

Segment Description [Stream ID; Listing ID(s)]	Parameter(s) Exceeding Standards	1998 List (#)	2002 List[2]		Comments
			4	5	
Charley Creek near confluence with Asotin Creek [RX42NZ; 21203, 13862]	Fish Habitat		X		based on Kuttel 2002, factors limiting salmon uses: riparian, streambank condition, floodplain connectivity, pools
	Temperature			X	based on WDFW unpublished data
George Creek [TC82JH; 22429]	Temperature			X	based on Umatilla National Forest unpublished data
George Creek [TC82JH; 21207]	Fish Habitat		X		based on Kuttel 2002, factors limiting salmon uses: pools
George Creek near Trent Grade Gulch [TC82JH; 20352]	Temperature			X	based on WDFW unpublished data
George Creek near confluence with Asotin Creek [TC82JH; 29321, 21208, 16646]	Temperature			X	based on WDFW unpublished data
	Fish Habitat Instream Flow		X X		based on Kuttel 2002, factors limiting salmon uses: riparian, streambank condition, width:depth ratio, off-channel habitat, large woody debris, pools, inadequate stream flow
Pintler Creek near Nims Gulch [ZS85EI; 20354]	Temperature			X	based on WDFW unpublished data
Pintler Creek near confluence with George Creek [ZS85EI; 16647, 21217]	Instream Flow, Fish Habitat		X		based on Kuttel 2002, factors limiting salmon uses: inadequate instream flows, substrate embeddedness
Tenmile Creek upstream of Mill Creek confluence [IK96EU; 21220, 16642]	Fish Habitat, Instream Flow		X		based on Kuttel 2002, factors limiting salmon uses: streambank condition, substrate embeddedness, inadequate instream flows
Tenmile Creek approximately 1.5 mi below Mill Creek mouth [IK96EU; 20356]	Temperature			X	based on WDFW unpublished data
Tenmile Creek [IK96EU; 18836]	Temperature			X	based on WDFW unpublished data

[1] *Source: Ecology 2004b.*
[2] *The 2002/2004 Categories 4 and 5 are shown in the table.*

Table 3.5-2 continued
303(d) Listed and Impaired Stream Segments: Asotin Implementation Area[1]

Segment Description [Stream ID; Listing ID(s)]	Parameter(s) Exceeding Standards	1998 List (#)	2002 List[2]		Comments
			4	5	
Tenmile Creek near confluence with Snake River [IK96EU; 20355, 18835, 21221, 16641]	Temperature			X	based on WDFW unpublished data
	Fish Habitat, Instream Flow		X		based on Kuttel 2002, factors limiting salmon uses: riparian, streambank condition, width:depth ratio, off-channel habitat,substrate embeddedness, large woody debris, pools, inadequate instream flows
Mill Creek near headwaters [AA13WD; 29317]	Temperature			X	based on WDFW unpublished data collected at Mill Cr. Rd. culvert
Couse Creek [SV96TE; 29320]	Temperature			X	based on WDFW unpublished data
Couse Creek near confluence with Snake River [SV96TE; 29318, 21204, 16645]	Temperature			X	based on WDFW unpublished data
	Temperature			X	based on WDFW unpublished data
	Fish Habitat Instream Flow		X X		based on Kuttel 2002, factors limiting salmon uses: streambank condition, substrate embeddedness, large woody debris, pools, inadequate instream flows

[1] *Source: Ecology 2004b.*
[2] *The 2002/2004 Categories 4 and 5 are shown in the table.*

Table 3.5-3
Water Quality Monitoring Stations: Asotin Implementation Area[1]

Agency & Station Number	Description	Years of Record for Water Quality Data
Ecology 35D070	Asotin Creek near mouth	1977; 1993; 1997; 2002
USGS 13335050	Asotin Creek at Asotin, Washington	1968; 1976; 1977; 1989
EPA 10EPAINT 153665	Asotin Creek at mouth	1975 (2 days)
EPA 1119MOTH 01208N44E221	George Creek	1974-1975
USFS 14020001 (Umatilla National Forest)	Charley Creek, below Tamarack Creek	1955; 1973-1982; 1994-1996; 1998
USFS 14020002 (Umatilla National Forest)	North Fork Asotin Creek	1973 (1 day)
USFS 14020003 (Umatilla National Forest)	Middle Branch North Fork Asotin Creek	1973 (1 day)
USFS 14020004 (Umatilla National Forest)	South Fork, North Fork Asotin Creek	1973 (1day); 1977 (3 days)
USFS 14020007 (Umatilla National Forest)	Tributary to South Fork of North Fork Asotin Creek	1973 (1 day)

[1] Sources: Ecology 2004a; USGS 2004; EPA STORET database 2004. Does not include other monitoring locations by Umatilla National Forest, WDFW, ACCD and WSU.

The stations with the most information in Asotin Creek include Ecology 35D070 and USGS 13335050, both located near the mouth of Asotin Creek. Ecology 35D070 is a basin station with monthly grab samples taken over four non-consecutive water years. USGS 13335050 has collected occasional water quality data for four years between 1968 and 1989 with monthly samples for parts of three years, and more frequent samples for part of one. Both of these stations are currently in operation. EPA 10EPAINT153665 also collected water quality data near the mouth of Asotin Creek for one day in 1975. However, given its location in the immediate vicinity of the Ecology and USGS gauges and its limited period of record, data from this EPA site is not included in this analysis. Further upstream, USFS (Umatilla National Forest) has four stations with limited data located on the North Fork of Asotin Creek.

Water quality information for George Creek from EPA 1119MOTH01208N44E221 is very limited because only breakdown products of organochlorine pestides (eg. DDT, p,p'-DDE, for example) was monitored. Most water quality information is available for Charley Creek from USFS 14020001.

3.5.5 Areas of Impacted Water Quality

The following is a discussion of the specific water quality parameters that impact each of the streams in this Implementation Area. It should be noted that a majority of the identified water quality impairments are associated with elevated temperature. This is because temperature is the most commonly monitored parameter. Thus, the likelihood of detecting levels exceeding water quality standards is greater. Other parameters commonly monitored include suspended solids, turbidity, and pH, but they are not monitored to the extent that temperature is monitored. Similar exceedances of standards may be observed for the other parameters if and when they are monitored, as is the case in other streams where they are measured as described below. In reviewing the information provided below, it should be kept in mind that restoration actions should focus not solely on temperature issues, but in actions that can address temperature as well as the other parameters.

Asotin Creek and Tributaries

Elevated stream temperature is the most commonly measured water quality concern in many reaches of Asotin Creeks and its tributaries. High temperatures relative to "fish" targets have been attributed to reduction in stream shading due to lack of riparian vegetation, especially in the summer months (Stovall 2001). Generally, the stream temperatures appear to increase from upstream to downstream.

The standard for fecal coliform bacteria has also been exceeded near the mouth of Asotin Creek as seen from data collected by Ecology station 35D070; however, this has not occurred at other locations along Asotin Creek.

High total suspended solids concentration is another cause of concern in the lower reaches of Asotin Creek. Data from ACCD and WSU described in Stovall (2001) show that this was exceeded near the mouth of Asotin Creek. The primary natural process affecting the concentrations of total suspended solids is soil erosion caused by precipitation, in the form of spring snowmelt or rainfall; therefore, higher total suspended solids concentrations generally occurred in March and in November and December (Stovall 2001).

Limited to no information is available on the other water quality parameters for most reaches of the Asotin Creek and its tributaries.

- **North Fork Asotin Creek and tributaries:** There was no water quality data available on fecal coliform concentration, pH, dissolved oxygen concentration, turbidity, suspended solids, or nutrients for this stream reach.

  Temperature: Water temperature in the North Fork Asotin Creek has been monitored by the Umatilla National Forest and by the WDFW (refer to Exhibit 3.5-5). The annual summer maximum temperatures recorded by Umatilla National Forest between 1994 and 2001 (Table 3.5-4) show 7-day mean of daily maximum values of 62ºF to 70ºF (16.6ºC to 21.1ºC), which exceed the designated use temperature standard of 12°C (53.6°F) for char spawning and rearing.

  Although slightly lower temperatures were recorded by WDFW, the 2001 temperature monitoring data (Exhibit 3.5-9) also indicates that in the summer months the daily maximum temperatures recorded were above 53.6°F. The highest maximum daily temperatures recorded by WDFW on North Fork Asotin Creek at the Forest Service Boundary were 63.7°F (17.6°C), in August 2000 and July 2001, and 65.8°F (18.8°C) in July 2002 (Bumgarner 2002a, 2002b). These have resulted in the placement of various reaches of the North Fork Asotin Creek on the 2002 303(d) list for temperature (see Table 3.5-2).

Table 3.5-4
Annual Summer Maximum Temperatures: North Fork Asotin Creek[1]
Umatilla National Forest Data

Station	7-day moving average of the daily maximum Temperature (°F)							
	1994	1995	1996	1997	1998	1999	2000	2001
NF Asotin @ Lick Creek	66	62	66	63	68	-	-	-
NF Asotin @ Forest Service Boundary	-	-	-	No data	69	65	70	67

[1] Source: USFS 1998 and USFS 2002. 1994 – 1996 data is based on the 1998 Monitoring Report and 1997 – 2001 data is based on the 2001 Monitoring Report.

- **South Fork Asotin Creek and tributaries:** There was no water quality data available on fecal coliform concentration, pH, dissolved oxygen concentration, turbidity, or nutrients for this stream reach.

  Temperature: Water temperature in the South Fork Asotin Creek has been monitored by the Umatilla National Forest and by the WDFW (refer to Exhibit 3.5-5). The annual summer maximum temperatures recorded by Umatilla National Forest between 1994 and 2001 on the South Fork of Asotin Creek near the Forest Service Boundary (Table 3.5-5) show 7-day mean of daily maximum values of 56ºF to 67ºF (ºC to ºC), which exceed the designated use temperature standard of 12°C (53.6°F) for char spawning and rearing.

Table 3.5-5
Annual Summer Maximum Temperatures: South Fork Asotin Creek[1]

Station	7-day moving average of the daily maximum Temperature (°F)							
	1994	1995	1996	1997	1998	1999	2000	2001
SF Asotin @ Forest Service Boundary	63	57	56	No Data	60	67	60	61

[1] Source: USFS 1998 and USFS 2002. 1994 – 1996 data is based on the 1998 Monitoring Report and 1997 – 2001 data is based on the 2001 Monitoring Report.

Slightly higher temperatures were recorded by WDFW near the mouth of South Fork Asotin Creek (Exhibit 3.5-10). The highest maximum daily temperatures recorded by WDFW at that location were 73.1°F (22.8°C) in August 2000, 73.4°F (23°C) in July 2001, and 72.2°F (22.3°C) in July 2002 (Bumgarner 2002a, 2002b). These have resulted in the placement of various reaches of the South Fork Asotin Creek on the 2002 303(d) list for temperature (see Table 3.5-2).

Suspended Solids: ACCD and WSU recorded the peak instantaneous total suspended solids (average of two readings) between 1998 and 1999 in the South Fork of Asotin Creek (see Exhibit 3.5-11) at approximately 50mg/L.

- **Asotin Creek from North and South Forks Confluence to Charley Creek Confluence:** There was no water quality data available on fecal coliform concentration, pH, dissolved oxygen concentration, turbidity, or nutrients for this stream reach.

  Temperature: WDFW recorded water temperatures at the confluence of the North and South Forks of Asotin Creek (refer to Exhibit 3.5-5). Exhibit 3.5-12 shows the mean, minimum and maximum water temperatures recorded in Asotin Creek at the North and South Forks confluence. The highest maximum daily temperatures recorded by WDFW at that location were 70.7°F (21.5°C) and 69.8°F (21°C) in July 2001 and 2002, respectively (Bumgarner 2002a, 2002b). Unpublished data submitted to Ecology by WDFW for this station also shows a 7-day mean of daily maximum values of 20.6ºC (69.1ºF) for the week ending July 14, 2001 (Ecology 2004b). This exceeds the designated use temperature standard of 17.5°C (63.5°F) for salmon and trout spawning, non-core rearing and migration and resulted in the placement of this reach of Asotin Creek on the 2002 303(d) list for temperature (see Table 3.5-2).

  Suspended Solids: ACCD and WSU recorded the peak instantaneous total suspended solids (average of two readings) between 1998 and 1999 downstream of the North and South Forks confluence on Asotin Creek (see Exhibit 3.5-11) at less than 10 mg/L (Stovall, 2001).

- **Asotin Creek from Charley Creek Confluence to George Creek Confluence:** There was no water quality data available on fecal coliform concentration, pH, dissolved oxygen concentration, turbidity, or nutrients for this stream reach.

  Temperature: Water temperature in this reach recorded by WDFW (refer to Exhibit 3.5-5) and by ACCD (refer to Exhibit 3.5-8) indicate that the designated use temperature standard of 17.5°C (63.5°F) for salmon and trout spawning, non-core rearing and migration was often exceeded in the summer months, resulting in the placement of this reach of Asotin Creek on the 2002 303(d) list for temperature (see Table 3.5-2). Exhibit 3.5-13 and 3.5-14 show the mean, minimum and maximum water temperatures recorded in Asotin Creek at Headgate Park and above George Creek confluence. The highest maximum daily temperatures recorded by WDFW at Headgate Park were 75.3°F (24°C) in July 2000 and 2001, and 74.6°F (23.7°C) in July 2002 (Bumgarner 2002a, 2002b). Upstream of George Creek, the highest maximum daily temperatures recorded by WDFW in Asotin Creek were 76.2°F (24.6°C) in July and August 2000, 77.5°F (25.3°C) in July 2001, and 76.5°F (24.7°C) in July 2002 (Bumgarner 2002a, 2002b). ACCD monitoring data, as discussed in Stovall (2001), indicates that in July and August 2000, the maximum average mean daily temperature was about 62.5ºF (16.9ºC) at Koch's culvert, 66ºF (18.9ºC) at Headgate Park, and 68ºF (20ºC) above George Creek. Water temperatures in Asotin Creek appear to increase as one proceeds downstream.

  Suspended Solids: ACCD and WSU recorded total suspended solids between 1997 and 1999 at various locations along this reach of Asotin Creek between Charley Creek and George Creek confluences (see Exhibit 3.5-11). The peak instantaneous total suspended solids (average of two readings) recorded at the various locations ranged from approximately 10mg/L to 50mg/L in March 1999.

- **Asotin Creek from George Creek Confluence to the Snake River:** Table 3.5-6 summarizes the current water quality conditions in the reach of Asotin Creek between George Creek and the Snake River.

  Temperature: Water temperature near the mouth of Asotin Creek was recorded by Ecology, USGS, WDFW and ACCD. The data recorded by Ecology and USGS water quality stations 35D070 and 13335050 indicate that the mean temperatures in the summer months for the period of record ranged between 15.9ºC and 23.9ºC (60.6ºF and 75ºF) near the mouth of Asotin Creek. Exhibit 3.5-15 shows the mean temperatures by month for the period of record.

  The mean, minimum and maximum water temperatures recorded by WDFW in Asotin Creek near the mouth at Asotin City Park is shown in Exhibit 3.5-16. The highest maximum daily temperatures recorded by WDFW at that location were 78.5°F (25.8°C) in July 2001, and 77.6°F (25.3°C) in July 2002 (Bumgarner 2002a, 2002b). Unpublished data submitted to Ecology by WDFW for this station also shows a 7-day mean of daily maximum values of 24.5ºC (76.1ºF) for the week ending July 13, 2001 (Ecology 2004b). This exceeds the designated use temperature standard of 17.5°C (63.5°F) for salmon and trout spawning, non-core rearing and migration and resulted in the placement of this reach on the 2002 303(d) list for temperature (see Table 3.5-2).

  Fecal Coliform Bacteria: Fecal coliform concentrations recorded by Ecology 35D070 near the mouth of Asotin Creek indicates that out of the 36 samples taken, 9 samples exceeded state criteria, thus listing the Asotin Creek segment near the mouth on the 1998 and 2002 303(d) lists (see Table 3.5-2). Exhibit 3.5-17 shows the fecal coliform concentrations recorded by Ecology 35D070 for the period of record. The mean fecal coliform concentrations per month exceed the state criteria 3 months of the year and are close to exceeding the criteria for 4 other months, indicating that there is room for improvement.

  pH: pH concentrations were recorded by Ecology, USGS, and EPA near the mouth of Asotin Creek. Of the three stations, Ecology (35D070) has the longest record. During the period of record, the pH concentration exceeded the pH standard of 8.5 four times; however, the Asotin Creek segment near the mouth is not listed on the 303(d) list for pH. Exhibit 3.5-18 shows the pH concentrations recorded by Ecology 35D070 for the period of record.

  Dissolved Oxygen: Dissolved oxygen concentration was recorded by USGS and Ecology. Of these, Ecology (35D070) has the longest record. During the period of record, all dissolved oxygen measurements were above the minimum 8.0 mg/L standard for dissolved oxygen. Exhibit 3.5-19 shows the dissolved oxygen concentrations recorded by Ecology 35D070 for the period of record.

Turbidity: Turbidity recorded by Ecology 35D070 for the 1977, 1993, 1997 and 2002 water years. Exhibit 3.5-20 shows the turbidity concentrations recorded for the period of record. In the 2002 water year, the turbidity recorded ranged from 1 NTU in November to 65 NTU in March. The highest turbidity concentration at this location was 270 mg/L recorded on May 4, 1993.

Suspended Solids: Ecology 35D070 recorded total suspended solids concentrations once a month over three water years. Exhibit 3.5-21 shows the total suspended solids concentrations recorded by Ecology. 2 of the 36 records exceeded the USFWS recommended standard of 80mg/L. ACCD and WSU also recorded total suspended solids between 1998 and 1999 at two locations along this reach of Asotin Creek between George Creek confluence and the Snake River (see Exhibit 3.5-11). The peak instantaneous total suspended solids (average of two readings) recorded was about 65mg/L at the George Creek confluence, and about 125mg/L near the mouth of Asotin Creek, which exceeds the USFWS recommended standard of 80mg/L (Stovall, 2001).

Nutrients: Based on the Asotin Creek Subbasin Summary (Stovall 2001), nutrient loadings in Asotin Creek from nitrates, nitrites, ammonia, chlorides, and phosphates were reported to be at low levels and not a significant impact to overall water quality. Ecology 35D070 recorded ammonia and total phosphorous in the 1977, 1993, 1997 and 2002 water years. Exhibits 3.5-22 and 3.5-23 show the ammonia and total phosphorous concentrations recorded by Ecology for the period of record. In the 2002 water year, ammonia concentrations ranged from 0.01 mg/L to 0.015 mg/L, with a mean concentration of 0.011 mg/L. The total phosphorous concentration recorded during the same period ranged from 0.068 mg/L to 0.097 mg/L, with a mean concentration of 0.095 mg/L.

- **Lick Creek and tributaries:**

  There was no water quality data available on fecal coliform concentration, pH, dissolved oxygen concentration, turbidity, suspended solids, or nutrients for this stream reach.

  Temperature: Data obtained from the report by Kuttel (2002) indicates that the 7-day mean of daily maximum values on Lick Creek from 1992 to 2000 was 60°F (15.5°C). In addition, unpublished data from the Umatilla National Forest indicate a maximum 7-day mean of maximum daily temperatures of 16.7°C (62.1°F) was collected in 2001 near the Forest Service boundary (Ecology 2004b). These exceed the designated use temperature standard of 12°C (53.6°F) for the char spawning and rearing and resulted in the placement of Lick Creek on the 2002 303(d) list for temperature (see Table 3.5-2).

- **Charley Creek and tributaries:** There was no water quality data available on fecal coliform concentration or nutrients for this stream reach. Turbidity was monitored by USFS 14020001 from 1973 to 1998; however data was recorded in Jackson Candle Units (JTU). Table 3.5-7 summarizes the current water quality conditions in Charley Creek.

Insert Table 3.5-7

Temperature: Water temperature in Charley Creek was recorded by WDFW and Umatilla National Forest. The mean, minimum and maximum water temperatures recorded by WDFW in Charley Creek near the Forest Service Boundary and near the mouth are shown in Exhibits 35-24 and 3.5-25. The highest maximum daily temperatures recorded by WDFW were 64.1°F (17.8°C), 63.5°F (17.5°C), and 64.4°F (18°C) in July 2000, 2001 and 2002 near the Forest Service Boundary; and 72.5°F (22.5°C) in July 2000, and 72.2°F (22.3°C) in July 2001 and 2002 near the mouth of Charley Creek (Bumgarner 2002a, 2002b). Unpublished data submitted to Ecology by the Umatilla National Forest also show 7-day mean of daily maximum values ranging from 14.4ºC to 15ºC (57.9ºF to 59ºF) and maximum daily values of 15ºC to 17.2ºC (59ºF to 63ºF) from data collected in 2002 at station 'Charley Cr – along 4206 Rd' (Ecology 2004b). This exceeds the designated use temperature standard of 12°C (53.6°F) for char spawning and rearing and resulted in the placement of this reach on the 2002 303(d) list for temperature (see Table 3.5-2). Historical data recorded by USFS 14020001 indicates that the maximum temperatures recorded in the summer months from 1973 to 1977 ranged between 36ºF and 70ºF (2.2ºC and 21.1ºC) in Charley Creek, which is also generally consistent with the more current data. Exhibit 3.5-26 shows the mean maximum temperatures by month for the period of record for USFS 14020001.

pH: USFS 14020001 recorded pH concentrations from June to October, 1973 (Exhibit 3.5-27). The pH levels recorded ranged from pH 7.4 to 8.5, which meets the pH standard of between 6.5 and 8.5.

Dissolved Oxygen: There is insufficient data available on dissolved oxygen concentration. USFS 14020001 recorded dissolved oxygen concentrations of 10 mg/L on June 8, 1974, 8 mg/L on September 10, 1973 and 9 mg/L on April 8, 1974. All three records meet the designated use minimum dissolved oxygen standard of 8 mg/L for salmon and trout spawning, non-core rearing, and migration.

Suspended Solids: USFS 14020001 recorded total suspended solids concentrations at various times from December 1975 to December 1998. The primary natural process affecting the concentrations of total suspended solids is soil erosion caused by precipitation, in the form of spring snowmelt or rainfall (Stovall, 2001). The records from USFS 14020001 are consistent with this as can been seen in Exhibit 3.5-28, which shows the mean total suspended solids concentrations for the period of record. The highest total suspended solids concentration was 2,618.9 mg/L, recorded on February 24, 1982.

- **George Creek and tributaries:** There was no water quality data available on fecal coliform concentrations, pH concentrations, dissolved oxygen concentrations, total suspended solids concentrations, or nutrients for George Creek and Pintler Creek.

  Temperature: Water temperature was recorded in the upper reaches of George Creek at the Forest Service Boundary by Umatilla National Forest, and at other locations along George Creek by WDFW (see Exhibit 3.5-6).

Unpublished data submitted to Ecology by Umatilla National Forest from station 'George Creek at Forest Service Boundary' show a maximum 7-day mean of maximum daily temperatures of 17.2°C (63°F) in 2001 and 17.8°C (64°F) in 2002. The designated use temperature standard of 17.5°C (63.5°F) for salmon and trout spawning, non-core rearing and migration was exceeded in 2002 and resulted in the placement of this reach on the 2002 303(d) list for temperature (see Table 3.5-2).

WDFW recorded temperatures in the upper and lower reaches of George Creek in 2000, 2001 and 2002. The mean, minimum and maximum water temperatures recorded by WDFW in George Creek are shown in Exhibits 3.5-29 and 3.5-30 for 2001 and Exhibits 3.5-31 and 3.5-32 for 2002. At the Trent Grade monitoring station on upper George Creek, the 7-day mean of maximum daily temperature was 17.5°C (63.5°F) in 2000, 17.3°C (63.1°F) in 2001, and 20.9°C (69.6°F) in 2002, as submitted to Ecology by WDFW (Ecology 2004b). These exceed the designated use temperature standard of 17.5°C (63.5°F) for salmon and trout spawning, non-core rearing and migration and resulted in the placement of this reach on the 2002 303(d) list for temperature. On lower George Creek below Rockpile Gulch, the 7-day mean of maximum daily temperature was 21.7°C (71°F) in 2000, 25.5°C (77.9°F) in 2001, and 23.6°C (74.5°F) in 2002, as submitted to Ecology by WDFW (Ecology 2004b). These also exceed the designated use temperature standard and resulted in the placement of this reach on the 2002 303(d) list for temperature (see Table 3.5-2).

In Pintler Creek, WDFW recorded maximum daily temperatures between May and September in 2000 ranging from 49°F to 75°F (9.4°C to 23.9°C) in the middle reach about a mile below Nims Gulch, and 55°F to 64°F (12.8°C to 17.8°C) in the lower reach below Ayers Gulch (Mendel et. al. 2001). Data submitted to Ecology by WDFW show that the 7-day mean of maximum daily temperature at that location was 23.4°C (74.1°F) in 2000 (Ecology 2004b). This exceeds the designated use temperature standard of 17.5°C (63.5°F) for salmon and trout spawning, non-core rearing and migration and resulted in the placement of this reach on the 2002 303(d) list for temperature (see Table 3.5-2).

Tenmile Creek and Tributaries

Similar to other streams in the Implementation Area, elevated stream temperature is the most commonly measured water quality of concern in Tenmile Creek and its tributaries. Other than temperature monitoring, there was no water quality data available for fecal coliform concentrations, pH concentrations, dissolved oxygen concentrations, total suspended solids concentrations, or nutrients for Tenmile Creek or its tributaries.

- **Tenmile Creek mainstem:**

  Temperature: Water temperature recorded at various locations along Tenmile Creek by WDFW in 2000, 2001 and 2002 (see Exhibit 3.5-7) indicate that the designated use temperature standard of 17.5°C (63.5°F) for salmon and trout spawning, non-core rearing and migration was often exceeded in the summer months, resulting in the placement of various reaches of Tenmile Creek on the 2002 303(d) list for temperature (Mendel et. al. 2001, Figure 3, and Mendel et. al. 2004) (see Table 3.5-2). The mean, minimum and maximum water temperatures recorded by WDFW in Tenmile Creek are shown in Exhibits 3.5-33 and 3.5-34 for 2001 and Exhibits 3.5-35 and 3.5-36 for 2002.

In the upper reaches of Tenmile Creek, WDFW recorded maximum temperatures ranging from 51°F to 79°F (10.6°C to 26.1°C) above Mill Creek between May and September 2000 (Mendel et. al. 2001), with a 7-day mean of maximum daily temperature of 25.5°C (77.9°F) in 2000, as submitted to Ecology by WDFW (Ecology 2004b).

In the middle reaches of Tenmile Creek, WDFW recorded maximum temperatures between May and September ranging from 50°F to 67°F (10°C to 19.4°C) at RM 6.1 in 2001, and 38°F to 68°F (3.3°C to 20°C) at RM 5.4 in 2002 (Mendel et. al. 2004). The 7-day mean of maximum daily temperature was 18.7°C (65.7°F) in 2001 at RM 6.1 and 17.9°C (64.2°F) in 2002 at RM 5.4, as submitted to Ecology by WDFW (Ecology 2004b).

In the lower reaches of Tenmile Creek, WDFW recorded maximum temperatures between May and mid-July ranging from 55°F to 77°F (12.8°C to 25°C) above Beckham Gulch in 2000. Unpublished data submitted to Ecology by WDFW show a 7-day mean of maximum daily temperature of 24.2°C (75.6°F) in 2000 at the 2nd bridge (Ecology 2004b).

Near the mouth of Tenmile Creek at Snake River Road, WDFW recorded maximum temperatures between May and September ranging from 54°F to 75°F (12.2°C to 23.9°C) in 2001, and 50°F to 76°F (10°C to 24.4°C) in 2002 (Mendel et. al. 2004). The 7-day mean of maximum daily temperature was 22.8°C (73°F) in 2001 and 23.5°C (74.3°F) in 2002 at that location, as submitted to Ecology by WDFW (Ecology 2004b).

- **Mill Creek:**

  Temperature: WDFW recorded maximum water temperatures in Mill Creek ranging from 47°F to 71°F (8.3°C to 21.7°C) between mid-April and mid-July 2000 (Mendel et. al. 2001). The unpublished data submitted to Ecology by WDFW show a 7-day mean of maximum daily temperature of 20.4°C (68.7°F) at the Mill Creek Road culvert in 2000 (Ecology 2004b). This exceeds the designated use temperature standard of 17.5°C (63.5°F) for salmon and trout spawning, non-core rearing and migration and resulted in the placement of this reach on the 2002 303(d) list for temperature (see Table 3.5-2).

Couse Creek and Tributaries

Similar to Tenmile Creek and Asotin Creek, elevated stream temperature is the most commonly measured water quality concern in Couse Creek and its tributaries. Other than temperature monitoring, there was no water quality data available for fecal coliform concentrations, pH concentrations, dissolved oxygen concentrations, total suspended solids concentrations, or nutrients for Couse Creek or its tributaries.

- **Couse Creek mainstem:**

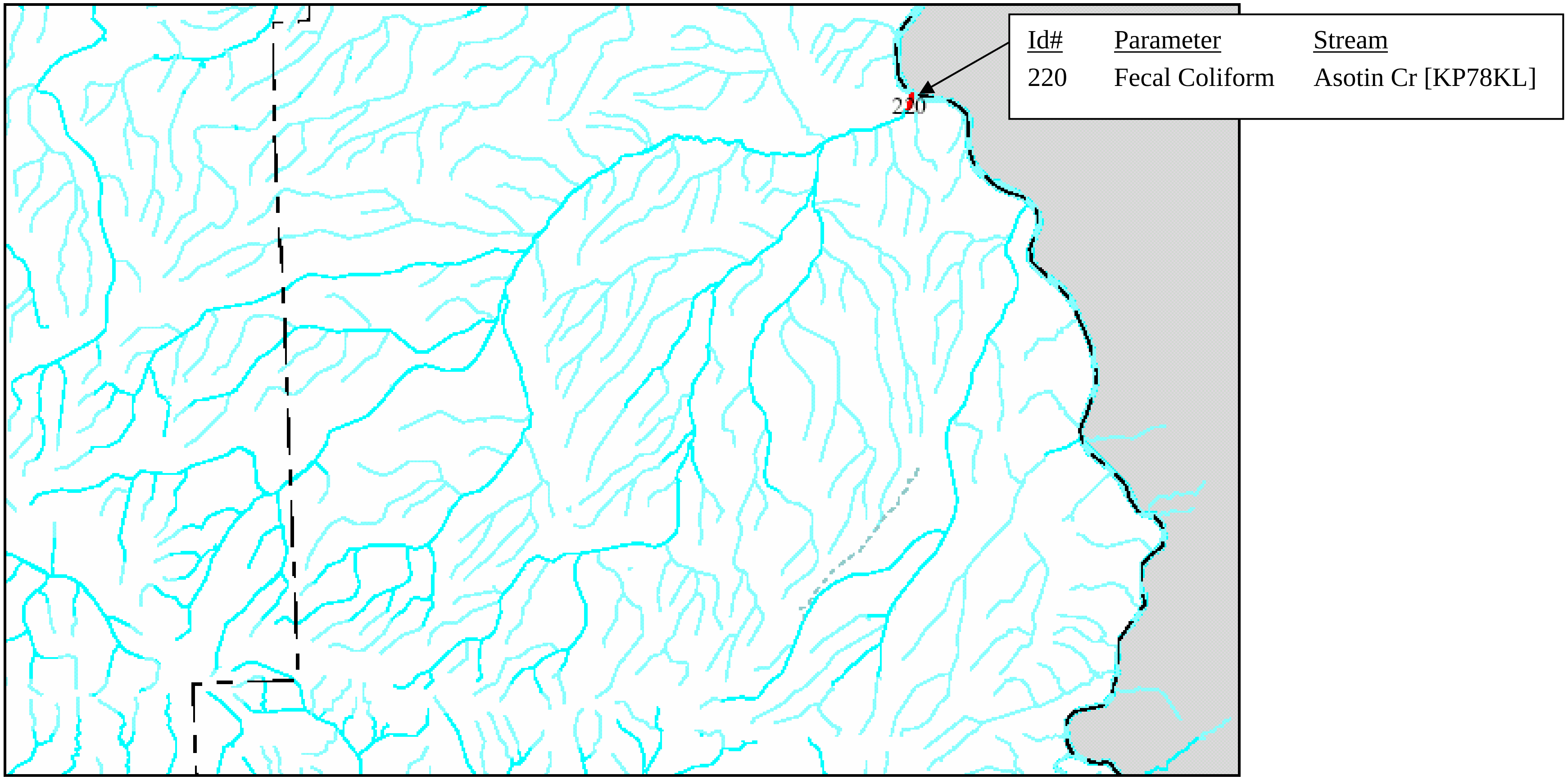
  Temperature: Water temperature recorded at various locations along Couse Creek by WDFW in 2000, 2001 and 2002 (see Exhibit 3.5-7) indicate that the designated use temperature standard of 17.5°C (63.5°F) for salmon and trout spawning, non-core rearing and migration was often exceeded in the summer months, resulting in the placement of various reaches of Couse Creek on the 2002 303(d) list for temperature (Mendel et. al. 2001, Figure 3, and Mendel et. al. 2004) (see Table 3.5-2). The mean, minimum and maximum water temperatures recorded by WDFW in Couse Creek are shown in Exhibits 3.5-37 and 3.5-38 for 2001 and Exhibit 3.5-39 for 2002.

  In the upper reaches of Couse Creek, WDFW recorded maximum temperatures ranging from 49°F to 75°F (9.4°C to 23.9°C) from May through September 2000 (Mendel et. al. 2001), and 41°F to 73°F (5°C to 22.8°C) between mid-April and mid-July 2001 (Mendel et. al. 2004) above Hoskins Gulch (RM 5.7). Unpublished data submitted to Ecology by WDFW for this location show a 7-day mean of maximum daily temperature of 21.3°C (70.3°F) in 2001 and 23.3°C (73.9°F) in 2002 (Ecology 2004b).

  Near the mouth of Couse Creek near Snake River Road, WDFW recorded maximum temperatures from May through September ranging from 54°F to 72°F (12.2°C to 22.2°C) in 2000 (Mendel et. al. 2001), 55°F to 74°F (12.8°C to 23.3°C) in 2001 and 55°F to 72°F (12.8°C to 22.2°C) in 2002 (Mendel et. al. 2004). Unpublished data submitted to Ecology by WDFW in this vicinity show a 7-day mean of maximum daily temperature of 21.6°C (70.9°F) in 2000, 21.1°C (70°F) in 2001, and 21.4°C (70.5°F) in 2002 (Ecology 2004b).

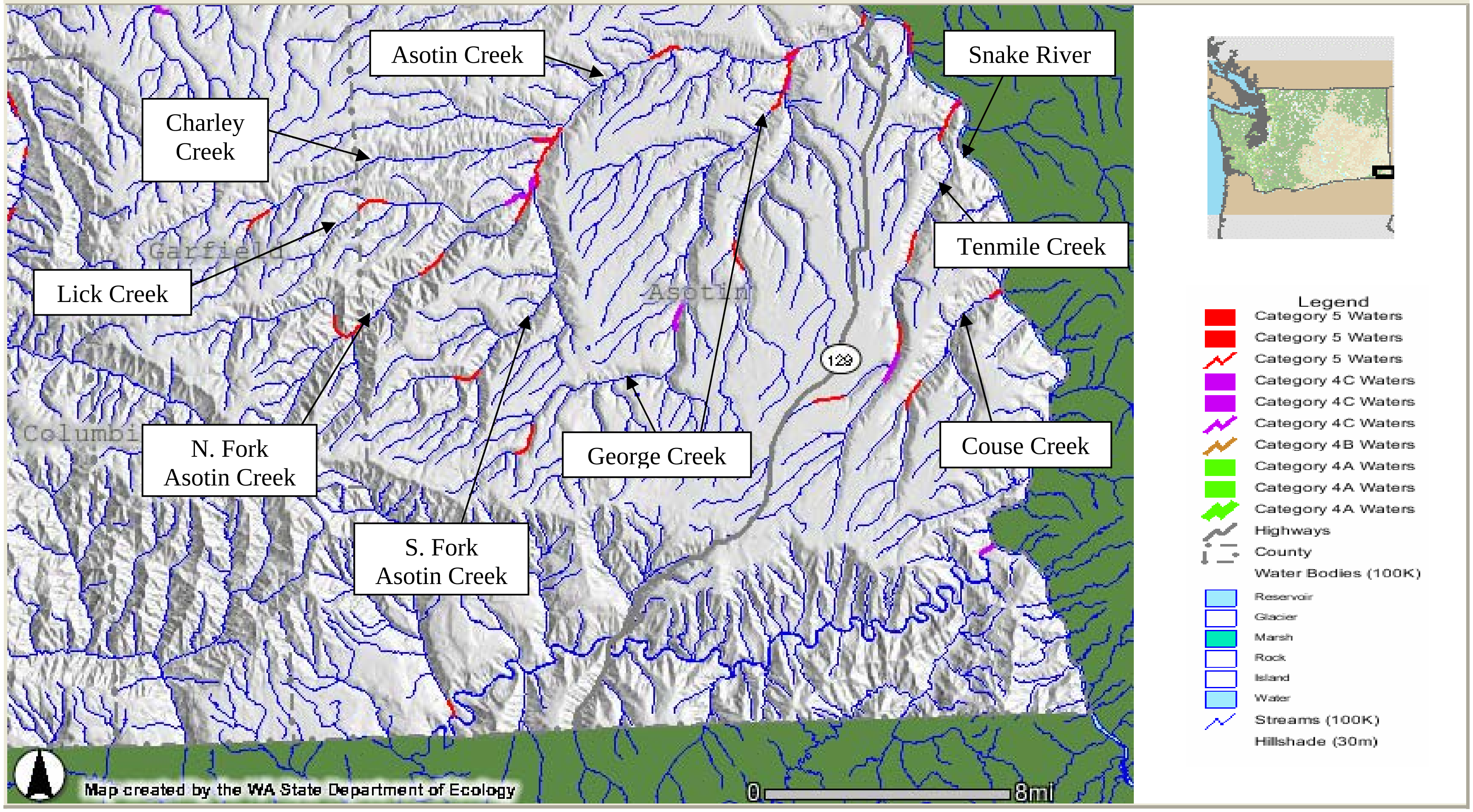
Exhibit 3.5-1

1998 303(d) Listed Stream Segments: Asotin Implementation Area



Source: Ecology, 2004. WRIA 35 - Middle Snake webpage

Exhibit 3.5-2
2002 303(d) Listed and Impaired Stream Segments: Asotin Implementation Area



Source: Water Quality Assessment of Washington webpage (Ecology 2004b).