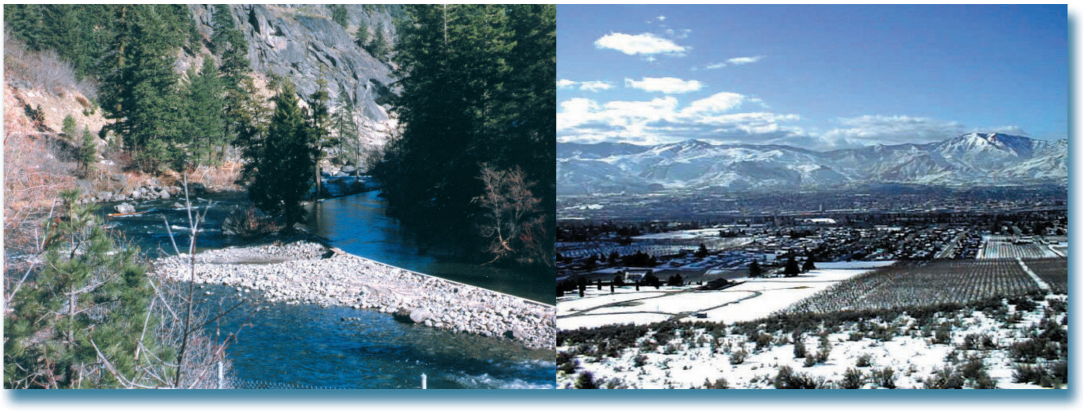
CHELAN COUNTY WATERSHED PROGRAM ■ WRIA 45

Wenatchee River Basin
WATERSHED ASSESSMENT



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Wenatchee River Basin Watershed Assessment

Prepared for:

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ACRONYM LIST

ADD	Average day demand
AFY	Acre feet per year
CCD	United States Census Bureau Census County Division
cfs	Cubic feet per second
CIR	Crop Irrigation Requirements
DOH	Washington Department of Health
DWAIN	Drinking Water Automated Information Network
Ecology	Washington Department of Ecology
EES	Economic and Engineering Services
ENSO	El Nino Southern Oscillation
ERU	Equivalent Residential Unit
FRD	Fruit Reporting District
GIS	Geographic Information System
gpd	Gallons per day
gpm	Gallons per minute
GWIS	Geographic Water Information System
IPCC	Intergovernmental Panel on Climate Change
IRPP	Instream Resources Protection Program
JISAO	Joint Institute for the Study of the Atmosphere and Oceans
MDD	Maximum day demand
MGD	Millions of gallons per day
NAS	National Academy of Sciences
NASS	National Agricultural Statistics Service
NCDC	National Climatic Data Center
NESDIS	National Environmental Satellite Data and Information Service
NLCD	National Land Cover Data Set
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
OFM	Office of Financial Management
PDO	Pacific Decadal Oscillation
PNW	Pacific Northwest
POW	Point of Withdrawal
PWS	Public Water Systems
PUD	Public Utility District
RCW	Revised Code of Washington
RM	River Mile
SADIE	System for Automated DWAIN Information Extraction
SDWA	Safe Drinking Water Act
STORET	Storage and Retrieval System for Water and Biological Monitoring Data
USBR	United States Bureau of Reclamation

ACRONYM LIST, CONTINUED

USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WDFW	Washington State Department of Fish and Wildlife
WFI	Water Facilities Inventory
WMA	Watershed Management Act
WRATS	Water Rights Application Tracking System
WRCC	Western Regional Climate Center
WRIA	Water Resource Inventory Area
WSDA	Washington State Department of Agriculture
WSU	Washington State University

1.0 Introduction

This assessment was prepared for the Wenatchee Watershed Planning Unit (WRIA 45). The purpose of this technical assessment is to characterize the water resources of WRIA 45 to provide a scientific basis for developing a watershed plan. This assessment was prepared with the data available at the time of printing. Assessment work will continue in the Wenatchee Watershed and any new data will be submitted to the planning unit as necessary.

This section presents an introduction to the Wenatchee River Basin Watershed Phase 2 Technical Assessment. Chapters 2-7 describe the physical setting, land use and land cover, summarize existing hydrologic data, characterize precipitation, streamflow, and groundwater interaction with surface water, present water rights and water use and describe existing regulatory instream flows.

1.1 Regulatory Framework

The 1998 Legislature passed Engrossed Substitute House Bill 2514 (The Watershed Management Act) to provide a framework for citizens, governments and other interest groups to collaboratively solve water related issues on a watershed-wide basis. Three phases of planning are identified in the law. Those phases are:

- Phase 1: Organizing Phase
- Phase 2: Assessment Phase
- Phase 3: Planning Phase

The Watershed Management Act identifies four elements that can be addressed as part of a Watershed Plan. Those elements are water quantity, water quality, habitat and setting of instream flows. The water quantity element is mandatory if grant funding is received. The other topics may be addressed but are optional under the law. The Watershed Management Act also specifies the type of information that must be collected for each topic to satisfy the requirements of the law.

This Watershed Technical Assessment is prepared to satisfy the requirements of the second, or assessment, phase of watershed planning and specifically the Water Quantity element.

1.2 Wenatchee River Basin Watershed Description

Water Resource Inventory Area (WRIA) 45, the Wenatchee River Basin Watershed, encompasses approximately 1,371 square miles, with 230 miles of major streams and rivers, not including those portions of WRIA 45 that drain directly into the Columbia River (Chelan County Conservation District, 1994). WRIA 45 originates in the Cascade Mountain Range with major tributaries draining from the Alpine Lakes and Glacier Peak wilderness areas. The Entiat Mountains to the northeast and the Wenatchee Mountains to the southwest flank the basin. The main surface feature of the Wenatchee River watershed is the Wenatchee River. The Little Wenatchee and White Rivers flow into Lake Wenatchee, the source of the Wenatchee River. Proceeding downstream from the lake outlet at River Mile (RM) 54.2, Nason Creek joins at RM 53.6 (just downstream of the mouth of Lake

Wenatchee) and the Chiwawa River joins about 5 miles downstream near Plain. The river descends rapidly through Tumwater Canyon, dropping into a lower gradient section in the region of Leavenworth, where Icicle Creek joins the mainstem (RM 25.6). Other major tributaries include Chiwaukum (RM 35.6), Chumstick (RM 23.5), Peshastin (RM 17.9), and Mission (RM 10.4) creeks. The river then flows southeasterly through the Wenatchee Valley and discharges into the Columbia River at Wenatchee. Map 1 provides an overview of WRIA 45. For the purposes of this Assessment, the watershed was divided into subbasins, which are shown on Map 1. Although an effort was made to use the boundaries of subbasins defined for other studies and planning efforts, the subbasins shown on Map 1 may not fit exactly with other subbasin definitions as the boundaries were prepared for the purposes of this study.

1.3 Purpose And Scope

The purpose of this Phase 2 Technical Assessment is to characterize water resources within WRIA 45 to provide a scientific basis for developing a watershed plan. This assessment was prepared for the WRIA 45 Planning Unit (formed under ESHB 2415; Chapter 90.82 RCW) and the lead agency, Chelan County, as directed by the County's Natural Resource Program. The WRIA 45 Planning Unit is made up of a diverse group of stakeholders representing a wide range of interests throughout the watershed. These interests include local governments, tribes, state and federal agencies, irrigation, agriculture, forestry, community groups, conservation groups, economic development, recreation, and individual citizens. The Water Quantity/Instream Flow Technical Subcommittee of the Watershed Planning Unit was the primary reviewer of technical work performed for this Assessment.

The Scope of Work for this Phase 2 Technical Assessment includes eight technical tasks. Those tasks are:

1. Estimate Surface and Groundwater Present
2. Estimate Water Use
3. Estimate Amount of Water Allocated
4. Assess Streamflow by Seasons
5. Summarize Administrative Status of Each Stream
6. Assess Surface Water – Groundwater Interaction
7. Assess Seasonal and Cyclical Effects of Precipitation
8. Assess Effects of Land Use Changes on Water Quantity

Those tasks are addressed in the following sections. In addition to those technical tasks, data gaps and recommendations for potential future studies are presented.

2.0 Land Use and Land Base

2.1 Land Use

The County GIS and tax parcel database was obtained and analyzed to determine zoning and land use for parcels throughout the Watershed. The primary zoned land classifications in the Wenatchee River Watershed are forestry, residential and agriculture. Eighty six percent of the watershed is classified as forest or wilderness use. Table 1 presents a breakdown of the area of different zoning classifications for the watershed. Map 2 provides an illustration of the distribution of zoning classifications throughout the watershed. The total area shown in Table 2-1 is 1,331 square miles, slightly less than the area within WRIA 45. The difference is the area at the downstream end of the Wenatchee River that does not drain to the Wenatchee River. That area has been excluded from analyses for this assessment as it does not receive water or contribute water to the Wenatchee River. Table 2-2 provides a summary of land use also from the County parcel database. Map 3 provides a representation of the agricultural land uses found in that analysis. Only the agricultural uses are shown on Map 3 as there were too many categories to show and the area within agricultural use is used in Section 6 – Water Rights and Water Use. Appendix A provides a more detailed breakdown of Zoning Classifications and land use by each individual subbasin shown in Maps 1-3.

Table 2-1
Area of Zoning in Wenatchee Watershed

Land Use Classification	Totals	% of Watershed
Commercial Agricultural	8,195	1.0%
Forest	732,209	86.0%
Public	1,226	0.1%
Rural Residential /Resource 2.5	4,411	0.5%
Rural Residential /Resource 5	19,227	2.3%
Rural Residential /Resource 10	14,619	1.7%
Rural Residential /Resource 20	59,576	7.0%
Total Rural Residential /Resource	97,833	11.5%
Rural Village	1,860	0.2%
Rural Commercial	236	0.0%
Rural Industrial	376	0.0%
Rural Recreational and Resource	853	0.1%
Rural Waterfront	1,484	0.2%
Urban Residential 1	8	0.0%
Urban Residential 3	2	0.0%
Total Urban Residential	10	0.0%
Peshastin Village Commercial	2	0.0%
General Commercial	5	0.0%
Industrial	4	0.0%
Commercial Mineral	241	0.0%
City Urban Growth Area	2,669	0.3%
Open Water	4,325	0.5%
Totals	**851,527**	**100.0%**

Source: Chelan County Planning Parcel Database

Table 2-2
Land Use Area in Wenatchee River Watershed

Land Use Designation	Area (acres)	Land Use Designation	Area (acres)
Agric In Open Space RCW 84.34	9,300.1	Other Cultural & Recreational	3.0
Agriculture Related Activities	87.2	Other Resource Production	4,812.7
Agriculture-Not In Open Space	6,562.7	Other Retail Trade	10.1
Aircraft Transportation	20.5	Other Trans, Comm, & Utilities	2.9
All Other Residential	1,556.9	Other Undeveloped Land	259.2
Amusements	4.8	Parks	435.5
Automobile Parking	2.6	Personal Services	6.2
Business Services	9.5	Petroleum Refining/Related Ind	9.6
Communication	19.9	Primary Metal Industries	7.9
Contract Const Services	39.3	Professional Services	15.9
Cultural Activities	0.0	Public Assembly	356.7
Desig. Forest Land RCW 84.33	64,606.6	Railroad/Transit Trans	118.9
Educational Services	98.4	Recreational Activities	428.2
Fabricated Metal Products	1.4	Repair Services	10.6
Finance, Ins/Real Estate Serv.	4.2	Residential Hotels-Condominium	7.3
Food/Kindred Products	8.8	Resorts And Group Camps	382.0
Furniture And Fixtures	0.6	Retail Trade-Apparel/Access	0.2
Governmental Services	344,757.1	Retail Trade-Bld. Mat.,Farm Eqpt	18.8
Highway/Street Right-Of-Way	15.4	Retail Trade-Eating/Drinking	41.8
Hotels/Motels	119.7	Retail Trade-Food	31.1
Household 2-4 Units	13.8	Retail Trade-Furniture	666.5
Institutional Lodging	82.5	Retail Trade-Gen Merchandise	4.6
Lumber/Wood Prod Exc Furniture	148.2	Retail Trade-Trans/Accessories	3.2
Mining Activities	487.9	Rubber/Misc Plastic Products	1.1
Miscellaneous Manufacturing	2.5	Single Family Units	16,807.1
Miscellaneous Services	3,284.8	Stone, Clay & Glass Products	2.4
Mobile Home Parks/Courts	76.2	Timberland In Open Sp Rcw84.34	2,017.7
Multi-Units 5 Or More	14.5	Undeveloped Land	38,040.6
Non-Residential Condominiums	0.2	Utilities	1,060.6
Noncommercial Forest	23,590.9	Vacation And Cabin	7,344.2
Open Space RCW 84.34	544.0		

2.2 Land Cover

An analysis of the type and amount of land cover in the Wenatchee Watershed was performed using data obtained from the National Land Cover Data (NLCD) Set for 1992 (USGS, http://landcover.usgs.gov/natllandcover). The NLCD was prepared by the USGS using remote sensing techniques. GIS coverage of the NLCD was obtained and analyzed for each subbasin and the entire watershed. Table 2-3 presents a summary of the analysis for the entire watershed. A summary of land cover for each subbasin is provided in Appendix A. The primary land cover is evergreen forest (67%), followed by grasslands and herbaceous cover (11.6%), shrubland (7.9%), bare rock, mines or gravel (5.3%), deciduous forest (2.1%), transitional land use (1.8%), orchards (1.4%) followed by smaller land covers. The total agricultural area mapped by the USGS is 12,836 acres. The NLCD is being updated using 2002 data but will not be available until 2004.

Table 2-3
Land Cover in Wenatchee River Basin Watershed

Classification	Area (acres)	% of Basin Area
Water	8,448.8	1.0%
Perennial Ice, Snow	2,943.5	0.3%
Low Intensity Residential	1,759.3	0.2%
Commercial, Industrial, and/or Transportation	1,496.5	0.2%
Bare Rock, Sand or Clay	45,251.7	5.3%
Quarries, Strip Mines, or Gravel	28.0	0.0%
Transitional	15,196.3	1.8%
Decidious Forest	17,416.7	2.1%
Evergreen Forest	567,650.2	67.0%
Mixed Forest	7,907.1	0.9%
Shrubland	66,487.8	7.9%
Orchards, Vineyards, Other	11,572.9	1.4%
Grasslands, Herbaceous	98,054.2	11.6%
Pasture, Hay	933.1	0.1%
Row Crops	28.1	0.0%
Small Grains	256.8	0.0%
Fallow	8.0	0.0%
Urban, Recreational Grasses	37.5	0.0%
Woody Wetlands	1,401.6	0.2%
Emergent Herbaceous Wetlands	72.5	0.0%
Total	846,950.5	100.0%

Source: USGS 1992 National Land Cover Data Set

3.0 Climate

3.1 Climate Cycles

Climate research has identified a number of somewhat-regular cycles in temperature, precipitation, atmospheric pressure, and other climate phenomena over large areas of the globe, lasting from several months to several decades. The best known is the El Niño Southern Oscillation (ENSO), an anomalous oceanographic and atmospheric event in the equatorial Pacific Ocean that usually occurs every two to seven years. El Niño is the warm phase of this cycle and is characterized by an increase in the sea-surface temperature in the eastern equatorial Pacific Ocean. The opposite or cold phase of this cycle is called either La Niña or El Viejo. A similar phenomenon, less well known but equally as important in understanding climate variability, is the Pacific Decadal Oscillation (PDO). The PDO is a pattern of varying ocean temperature that reverses on a 20-30 year timescale, is dominant in the North Pacific, and affects regions of North America. The warm phases of both cycles tend to warm the ocean off the coasts of Washington and Oregon, which leads to drier, warmer winters than average. The cold phases of both cycles tend to have the opposite effects. Because of differences in their periodicity, the two cycles may either reinforce or offset each other. Typically, warm, dry PDO phases enhance La Niña conditions and weaken El Niño conditions, while cool, wet PDO phases enhance El Niño conditions and weaken La Niña conditions (see the Joint Institute for the Study of the Atmosphere and Oceans, School of Marine Affairs, University of Washington web page: http://tao.atmos.washington.edu/PNWimpacts/CDTheme.htm#Sec3). The period of occurrence of PDO phases are listed in Table 3-1. Table 3-2 lists the years of occurrence of ENSO phases. In Table 3-2, the ENSO phases are also differentiated by their strength. For years that are not listed in Table 3-2, neither El Niño nor La Niña occurred.

Table 3-1
PDO Phase from 1900-Present

PDO Phase	Time Period
Warm, Dry	1925-1945, 1977-1995
Cool, Wet	1900-1924, 1946-1976, 1995-Present

Table 3-2
ENSO Phase from 1900-Present

Strong La Niña	La Niña	El Niño	Strong El Niño
1906	1908	1902	1905
1910	1909	1904	1911
1916	1921	1913	1914
1917	1924	1918	1923
1938	1945	1919	1940
1950	1947	1925	1941
1955	1956	1932	1965
1973	1964	1946	1972
1975	1970	1953	1977
1988	1971	1957	1982
1998	1974	1963	1987
	1981	1969	1993
	1996	1991	1994
	2000	1992	1997
		2002	

Note: Years not listed were neither El Niño or La Niña Years

The time histories of PDO and ENSO can be correlated with time histories of other meteorological parameters, like streamflow or snow depth, to gauge the impact that these year-to-year variations over the Pacific Ocean have on the region's water supply. Even though the variations in temperature and precipitation are approximately equal for PDO as for ENSO, the persistent nature of the PDO means that it has stronger impacts on some climate characteristics than does ENSO. For that reason, and because its timescale (20-30 years) is a bit closer to the climate-change timescale (50-100 years), the PDO is an important phenomenon to consider when managing water resources (Scott et al, 2000).

3.2 Pacific Northwest Climate Change

Temperature variability is significant, particularly in the Pacific Northwest (PNW), in determining whether precipitation falls as rain or snow. Temperature variability is dependent on the chemical composition of the atmosphere. One cause of temperature change is the "greenhouse effect", a natural process in which certain atmospheric gases (water vapor, carbon dioxide and methane being the most significant) allow some of the sun's radiant energy to be absorbed by the atmosphere. This leads to a natural warming of the Earth's atmosphere. Throughout history the natural warming due to the greenhouse effect has kept the planet warm enough to sustain life. What is unusual, however, is the rate at which carbon dioxide and other greenhouse gases are now increasing. In the last 150 years, the production of carbon dioxide has increased by 32% due to burning of fossil fuels.

Methane has increased by 151%, primarily through agricultural practices (Mote et al, 2001).

The 2001 report from the Intergovernmental Panel on Climate Change (IPCC), an international scientific body addressing climate change, states that the planet is indeed warming and that it is not due to natural causes. The IPCC states, "An increasing body of observations gives a collective picture of a warming world and other changes in the climate system." The evidence collected included the following (Mote et al, 2001):

- Global average surface temperature has very likely increased by 0.4 – 0.8º C
- Snow cover has decreased by approximately 10% since the late 1960's
- Glaciers and sea ice extent have decreased
- Spring, as marked by blooming or leafing-out dates of various plants, is coming earlier in much of North America

During the past 100 years, the PNW has become warmer and wetter. The average temperature has increased 0.8º C (1.5º F) (Mote et al, 2001). The warmest year in most of the PNW (especially east of the Cascades) was 1934, but the warmest decade was the 1990's, warmer than any other decade by 0.5º C (0.9º F) (Mote et al, 2001). Changes in precipitation have occurred as well, with most climatological stations showing an average annual increase of 2.9 inches over the last 100 years (Mote et al, 1999). The increase has been greater than 30% per century at approximately a dozen stations, mostly in eastern Washington, eastern Oregon, and western and northern Idaho. The changes in regional precipitation are unevenly distributed over the year (Mote et al, 2001).

Climate simulation models project temperatures in the PNW to warm 1.7 - 3.5º C with an average of 2.8º C from the 20th Century to 2050. Projected precipitation changes vary from -5% to +20% in most months between November and May, with an average of about +10%, therefore the wet season is projected to get even wetter (Mote et al, 2001). The average projected precipitation change during the dry season (i.e., June-October) is near zero. Historic and projected temperature and precipitation changes are summarized in Table 3-3.

Table 3-3
Climate Variability – Historic and Future (modeled)

	Historic Change 1900-2000	Projected Change in 2050 Range	Average
Temperature	+ 0.8º C (1.5 ºF)	1.7 – 3.5º C	2.8º C
Precipitation	+ 2.9 inches	-5 – + 20 %	+ 10 %

Climate change could significantly impact the availability of water resources in the region, particularly during summer months. The PNW relies on snowpack to transfer water from the wet season to the dry season. Modest increases in temperature dramatically affect snowpack depth and areas of accumulation as more precipitation falls as rain rather than snow during critical winter months.

Various studies have been performed at the University of Washington to understand the impacts of climate change on river basins in the Pacific Northwest. One of the studied basins is the Columbia River Basin, within which the Wenatchee River Basin is located. Water availability and streamflow in the Columbia River Basin are highly influenced by snowmelt, as most of the watershed is located at high elevations where temperatures are below freezing for most of the winter. The warming temperatures due to climate change could cause more of the precipitation to fall as rain in the winter, leaving less water stored as snowpack to supply summer streamflow. Higher spring and summer temperatures melt the snow earlier, increase the length of the growing season, and increase summer evapotranspiration, which also results in less spring, summer and fall streamflow. Projections reveal that by 2020-2030 the spring melt could occur 1-2 months earlier than it does now, with fall streamflow returning to normal levels 1-2 months later (Hamlet, no date). The maximum flows in late spring and early summer months could decrease by 17% below average historic levels in 2020, and by as much as 27% by 2050. In late summer and fall months, modeled flows decrease by an average of 25% in 2020 and 2050 (Hamlet, no date).

3.3 Precipitation Analysis

The Cascade Mountains and the prevailing westerly winds are the dominant climatic factors influencing the Wenatchee watershed. Moist air from the Pacific Ocean uplifts and cools as it moves east over the mountains. The Cascade Mountain area is characterized by heavy precipitation, with nearly 150 inches of annual precipitation and over 25 feet of snow accumulation at the crest. Winter daily temperatures average 25º F to 40º F, with summer temperatures averaging 60º F to 80º F. As air masses move east toward the Columbia Basin, moisture progressively decreases, resulting in arid conditions within the lowermost region of the watershed. In contrast to the mountainous areas, the City of Wenatchee receives 8.5 inches or less of precipitation with maximum summer temperatures reaching 95ºF to 100º F. Violent summer thunderstorms occur periodically, and can result in flash flood conditions on local watersheds.

3.3.1 Existing Precipitation Data

Several data sources were used to obtain precipitation data for WRIA 45, including the Western Regional Climate Center (WRCC) and the Natural Resources Conservation Service SNOWTEL (NRCS). Each of these data sources is discussed in more detail below.

Western Regional Climate Center

The National Oceanic and Atmospheric Administration's National Weather Service (NOAA/NWS) administers the Western Regional Climate Center. The National Climatic Data Center (NCDC) of the National Environmental Satellite, Data, and Information Service (NESDIS) provides oversight. The WRCC supports a three-tiered national climate services support program - the partners include the National Climatic Data Center, the Regional Climate Centers, and the State Climate Offices. Databases of the station data inventory listings for NOAA/NWS are posted to the WRCC web site at the following URL: http://www.wrcc.sage.dri.edu/index.html. The National Climate Data Center's Climate Data NCDC hourly precipitation are

available on CD-ROM at the University of Washington library network or can be purchased via their web page: http://www.ncdc.noaa.gov/.

There are three active climate stations in WRIA 45. One is located in Leavenworth, another in Plain, and the third is in the City of Wenatchee. There is one active climate station just outside of WRIA 45, located at the Wenatchee airport. Three inactive climate stations were also located in WRIA 45. Those stations were located at Stevens Pass, Lake Wenatchee, and at an Experimental Station in Wenatchee. Descriptions of the active and inactive stations are listed in Table 3-4. Map 4 shows the locations of the active and inactive stations.

Table 3-4
Available NWS Climate Records in/near WRIA 45

Agency	Station No.	Name/Location	Period of Record	Average Annual Precipitation (inches)
NWS	458089	Stevens Pass	1950-1994	84.5
NWS	454446	Lake Wenatchee	1948-1985	39.3
NWS	456534	Plain	1948-Present	37.0
NWS	454572	Leavenworth 3 S	1948-1973, 1979-Present	25.3
NWS	450929	Wenatchee EXP STN	1950-1951, 1971-1997	10.3
NWS	459074	Wenatchee	1931-Present	8.9
NWS	459082	Wenatchee FAA AP	1959-Present	8.4

Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) provides data and performs research on climate and other environmental issues. They operate the National Water and Climate Center, which provides a variety of climate and water information. One program they run is SNOWTEL, a snowpack telemetry program providing snow and other climate data for the western United States. A site list with links to data is available from their website at:

http://www.wcc.nrcs.usda.gov/water/snow/sntllist.html .

There are four active SNOWTEL sites in or near WRIA 45. The stations in WRIA 45 are located at Stevens Pass, Blewett Pass, and Upper Wheeler. The Fish Lake station is located just outside the western boundary in Kittitas County. Descriptions of those stations are provided in Table 3-5. Map 4 shows the location of the SNOWTEL stations.

Table 3-5
Available SNOWTEL Records in/near WRIA 45

Agency	Station No.	Name/Location	Period of Record	Average Annual Precipitation (inches)
NRCS	21b01s	Stevens Pass	1980-Present	84.5
NRCS	21b04s	Fish Lake (Kittitas County)	1981-Present	64.9
NRCS	20b20s	Blewett Pass	1981-Present	35.5
NRCS	20b07s	Upper Wheeler	1981-Present	27.3

3.3.2 Spatial Distribution of Precipitation

The majority of precipitation from Pacific Ocean storms falls on the western slope and along the crest of the Cascade Mountains. The rain shadow caused by the Cascade Mountains creates a strong gradient in precipitation from west to east in the Wenatchee Watershed. Stevens Pass is the furthest west station in WRIA 45. It has the highest annual average precipitation of all of the stations examined (84.5 inches). Wenatchee, the furthest east station in WRIA 45, has 1/10th the annual average precipitation of Stevens Pass (8.9 inches). Figure 3.1 provides a time series of annual precipitation volumes recorded at climate stations listed in Table 3-4.

The geographic distribution of precipitation is a significant controlling factor in the variation of surface water runoff and groundwater recharge across the WRIA. The potential for runoff and recharge increases with increasing precipitation. Factors such as land cover, soil properties and surficial geology control how the available precipitation is distributed between runoff and recharge. In either case, the annual quantity and seasonal timing of recharge are key influences on groundwater and surface water availability. A map showing the estimated average annual precipitation throughout WRIA 45 was created with data obtained from Oregon State University's Spatial Climate Analysis Service and is plotted in Map 4.

3.3.3 Analysis of Precipitation Data

Precipitation data were analyzed to find seasonal, annual, and long-term climate trends. The seasonal analysis was conducted by water year to be consistent with surface water data analyses. Annual data were compiled by calendar year to be consistent with the format of data presented by NWS and NRCS. Long-term trends were also examined using data compiled into calendar years.

Seasonal Data Analysis

On a seasonal time scale, WRIA 45 experiences a "wet season" between the months of October and March, and a “dry season” during the intervening months. Figures 3.2 through 3.12 show monthly average precipitation at the NWS stations listed in Table 3-4, as well as monthly snow water equivalent for the SNOWTEL stations listed in Table 3-5. Figure 3.13 summarizes the seasonal variability of precipitation. For each month, precipitation is expressed as a percentage of the annual total. The figure shows similar seasonal trends among the five gages shown, with more than 70 percent of the total precipitation falling between the months of October and March.

Figures 3.14 through 3.22 illustrate the variability of precipitation by graphing low, median and high values of monthly precipitation values for each precipitation station. The low value of precipitation is defined as the precipitation values that occur once every 10 years (exceeded 90 percent of the time). The median values are those that are exceeded 50 percent of the time while the high values are those that are exceeded only 10 percent of the time. The graphs show the wide range of precipitation that can occur between dry, normal and wet months and seasons. For example, the amount of precipitation at Stevens Pass for a dry July is about 0.24 inches, while for a wet July the amount is about 2.4 inches, or a factor of 10 times greater. The amount of precipitation directly affects the amount of runoff or groundwater recharge that occurs in that month or following months.

3.3.4 Annual Data Analysis and Variations Due To Climate Cycles

Figures 3-23 through 3-32 provide a time series of annual precipitation at NWS and NRCS stations for the period of 1948 to the present. The time period of 1948 – present was selected as most gages started collecting data in 1948. The Wenatchee gage started the earliest, in 1931. Data are not available in each year for every station but they are plotted on a consistent time scale to facilitate comparison of the records. On those same plots the trends in precipitation are plotted (expressed as the 5-year moving average) and the PDO phases are highlighted. The annual precipitation can vary substantially, over 100%, from year to year at each station depending on climatic conditions. The highest volumes of precipitation experience generally occur during the cool, wet phase of the PDO and during El Niño years. The lowest volumes of precipitation generally occur during the warm, dry phase of the PDO and during La Niña years. Figure 3.33 provides a more detailed comparison of precipitation to the PDO phases. In Figure 3.33, the annual precipitation in Wenatchee is compared to the PDO Index, a numerical value for the PDO. The PDO index is compiled by the Joint Institute for the Study of the Atmosphere and the Ocean and can be found at: ftp://ftp.atmos.washington.edu/mantua/pnw_impacts/INDICES/PDO.latest.

The 5-year moving average of precipitation in Wenatchee follows the wet and dry phases of the PDO in most years. The most evident period where Wenatchee precipitation does not follow the PDO index is in 1982 and 1983. This is likely due to one of the most severe El Niño’s on record, where precipitation in Idaho, Oregon, and Washington was 25% greater than normal (CIG website, 2003). Precipitation in Wenatchee during that event was 67% higher than normal. Effects of other strong El Niño events are evident in 1940 and 1972. A strong La Niña in 1975 caused an almost 50% drop in Wenatchee precipitation. Effects of strong La Niñas can also be seen in 1938 and 1988.

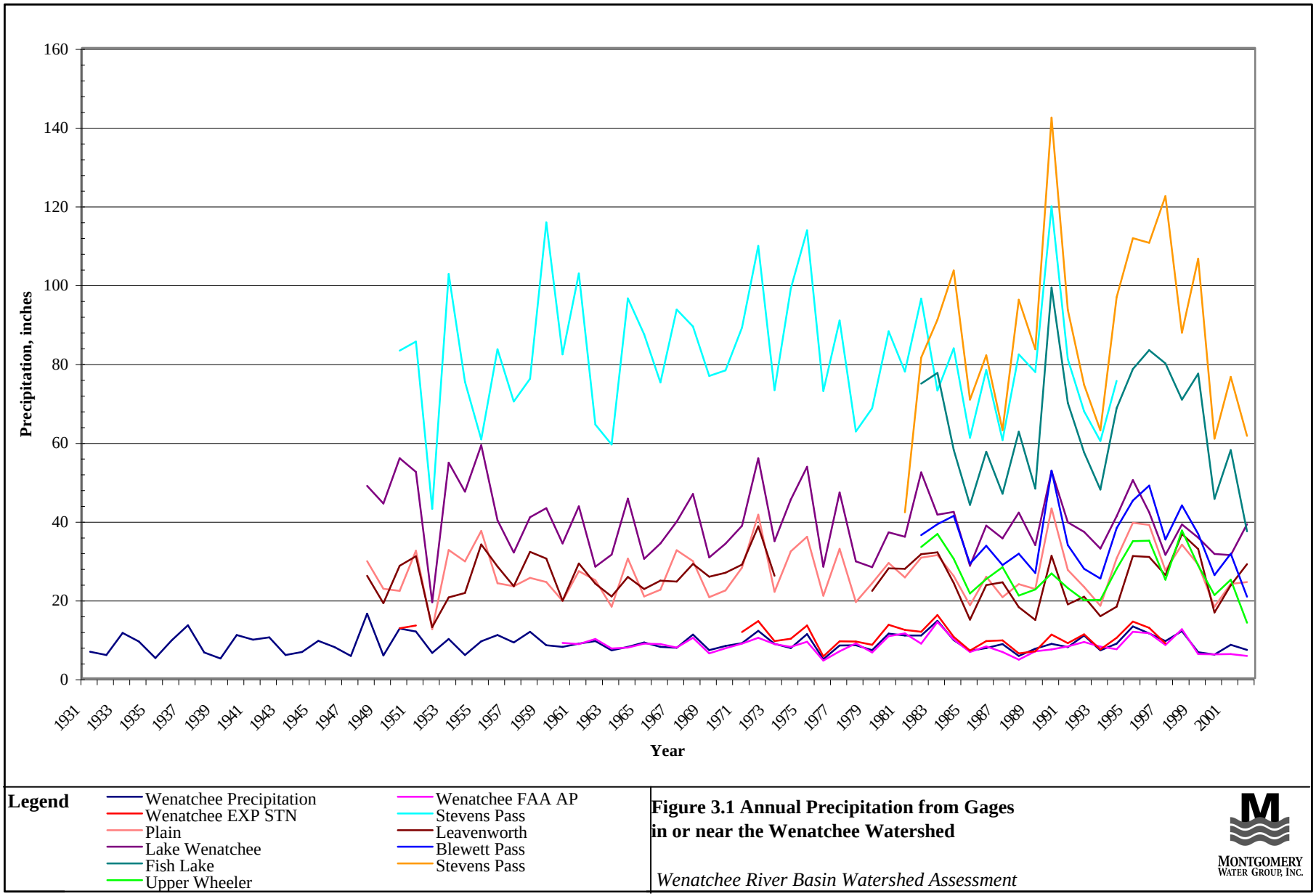
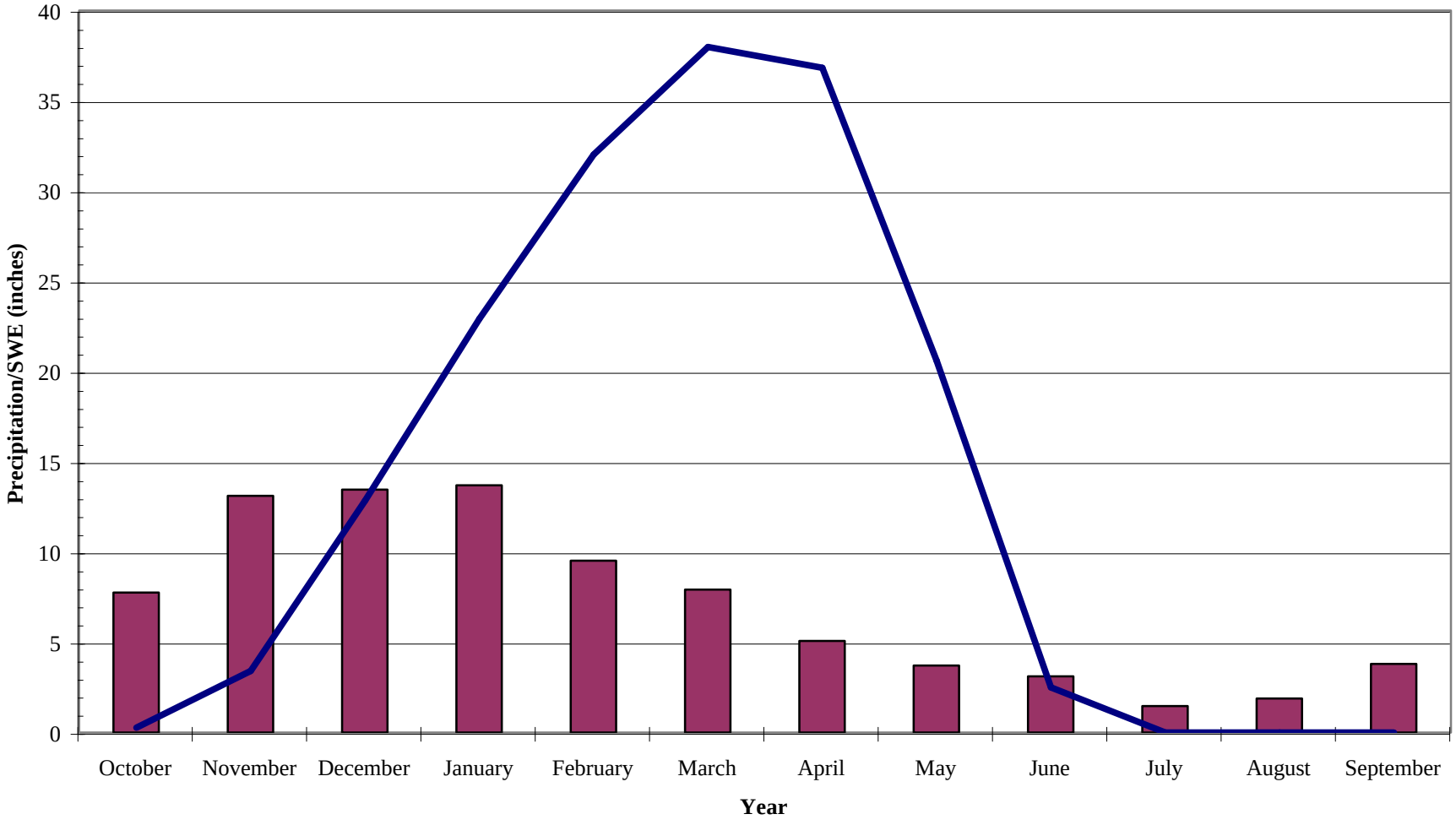


Figure 3.1 Annual Precipitation from Gages in or near the Wenatchee Watershed

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



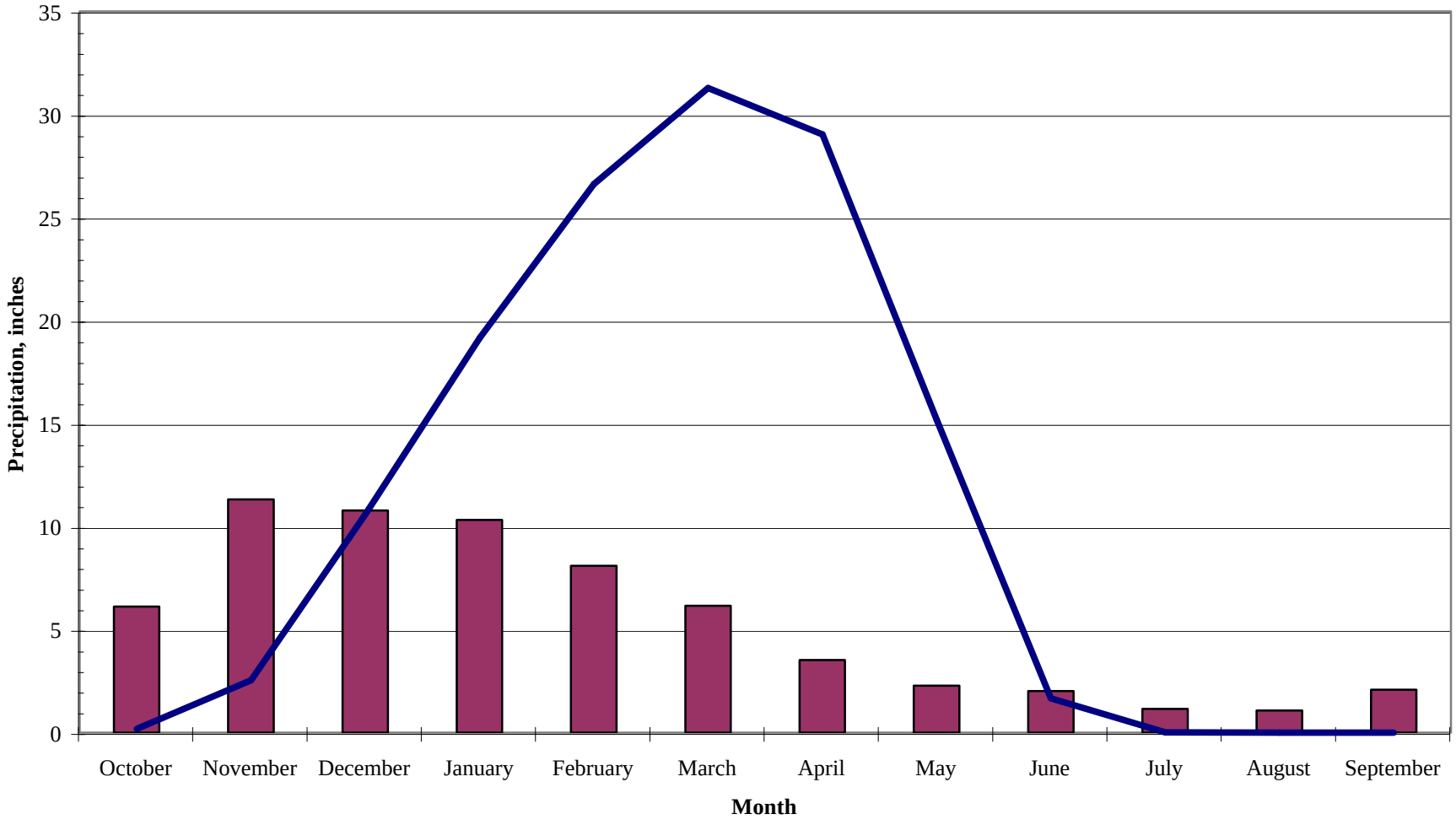
Legend
NRCS Snowtel Gage 21b01s
Period of Record 1980-Present
WRCC Station Number 458089
Period of Record 1950-1994
Mean Annual Precipitation = 84.5 in.

Mean Monthly Precipitation
Mean Monthly Snow Water Equivalent

Figure 3.2 Monthly Average Precipitation
Monthly Average Snow Water Equivalent
Stevens Pass, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

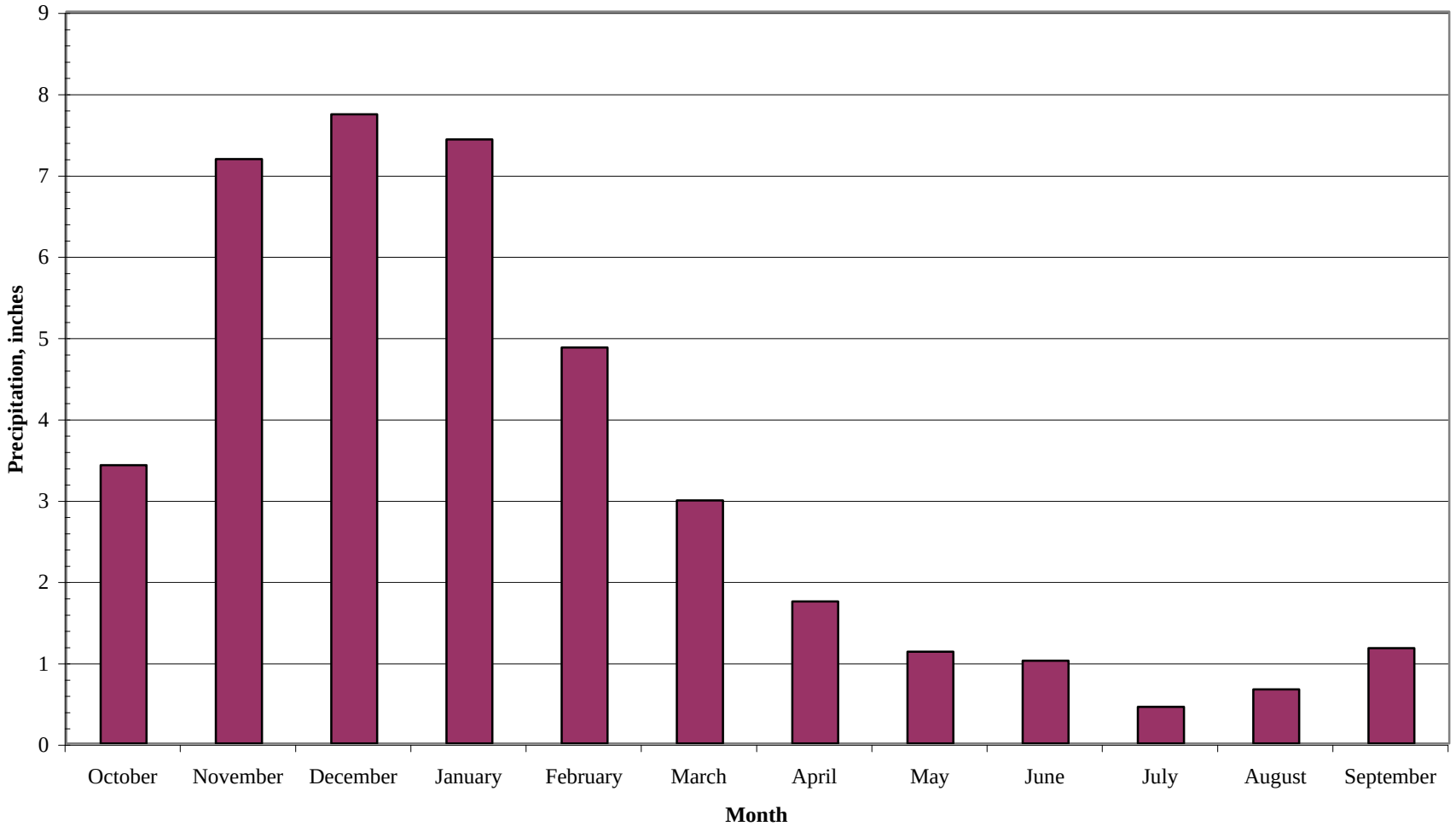
NRCS Snowtel Gage 21b04s
Mean Annual Precipitation = 64.9 in.
Period of Record 1981-Present

Mean Monthly Precipitation
Mean Monthly Snow Water Equivalent

Figure 3.3 Mean Monthly Precipitation
Mean Monthly Snow Water Equivalent
Fish Lake (Kittitas County), WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

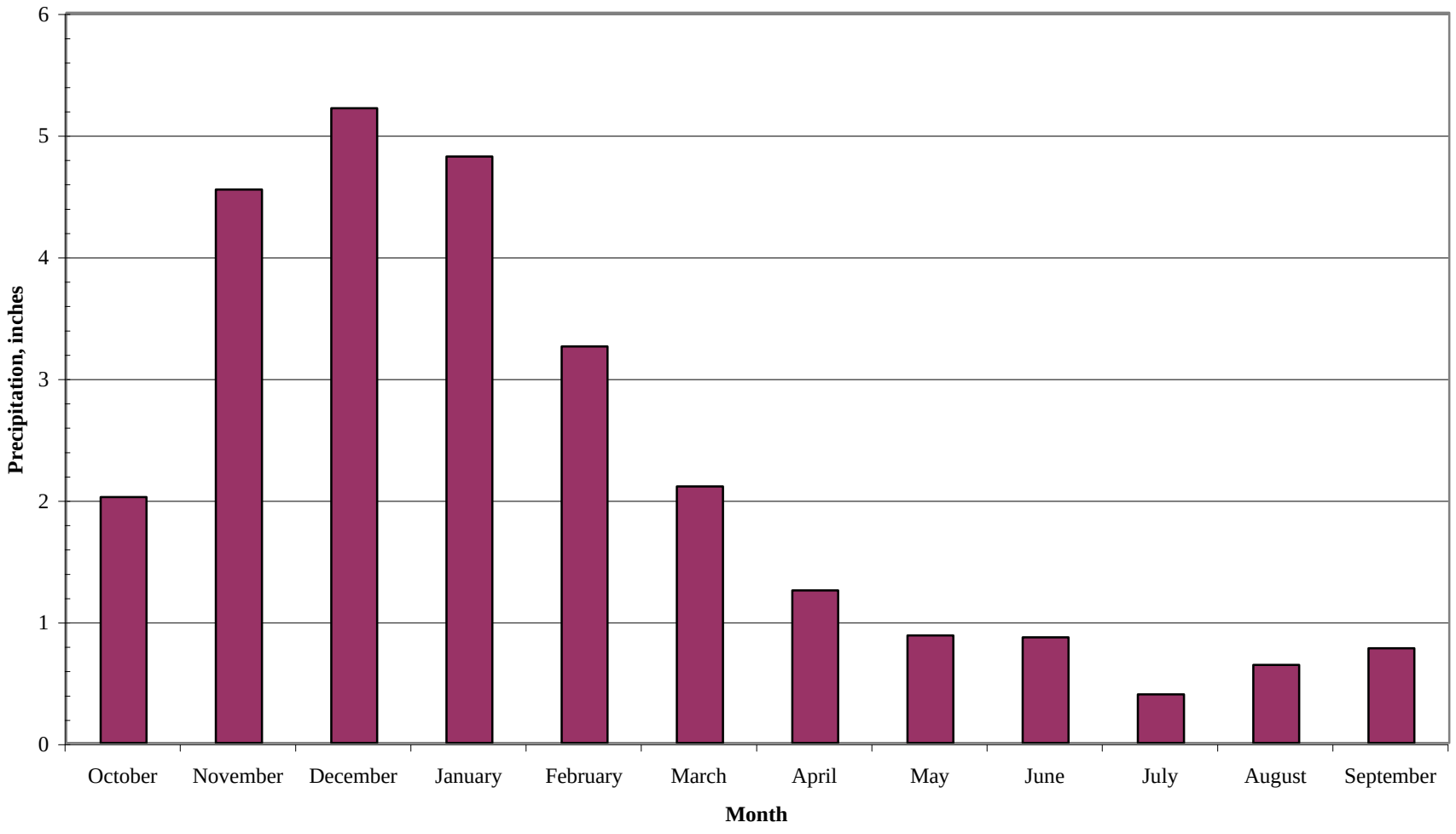
WRCC Station Number 454446
Mean Annual Precipitation = 39.3 in.
Period of Record 1948-1985

Mean Monthly Precipitation

Figure 3.4 Mean Monthly Precipitation
Lake Wenatchee, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY
WATER GROUP, INC.



Legend

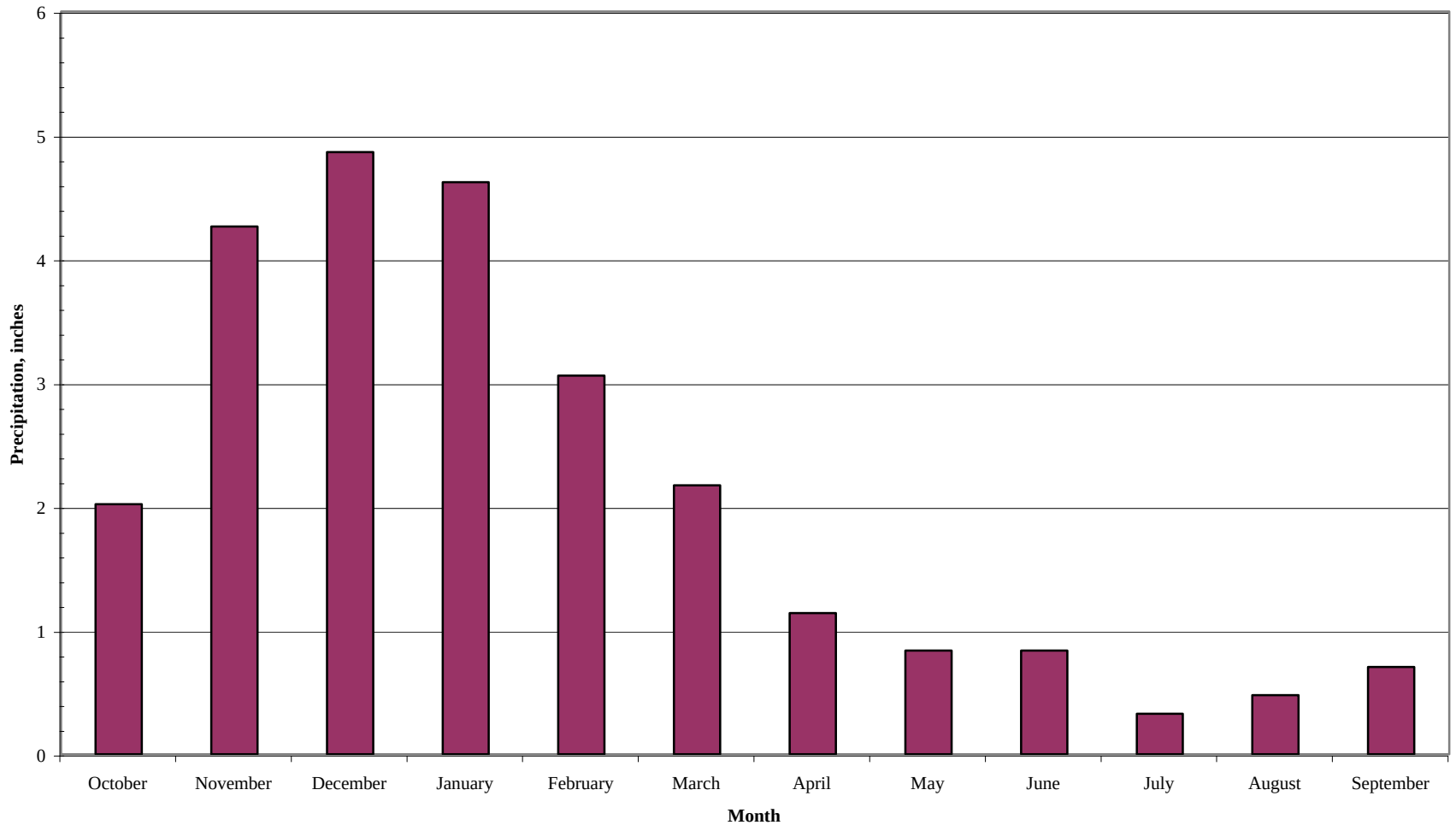
WRCC Station Number 456534
Mean Annual Precipitation = 37.0 in.
Period of Record 1948-Present

Mean Monthly Precipitation

Figure 3.5 Mean Monthly Precipitation
Plain, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

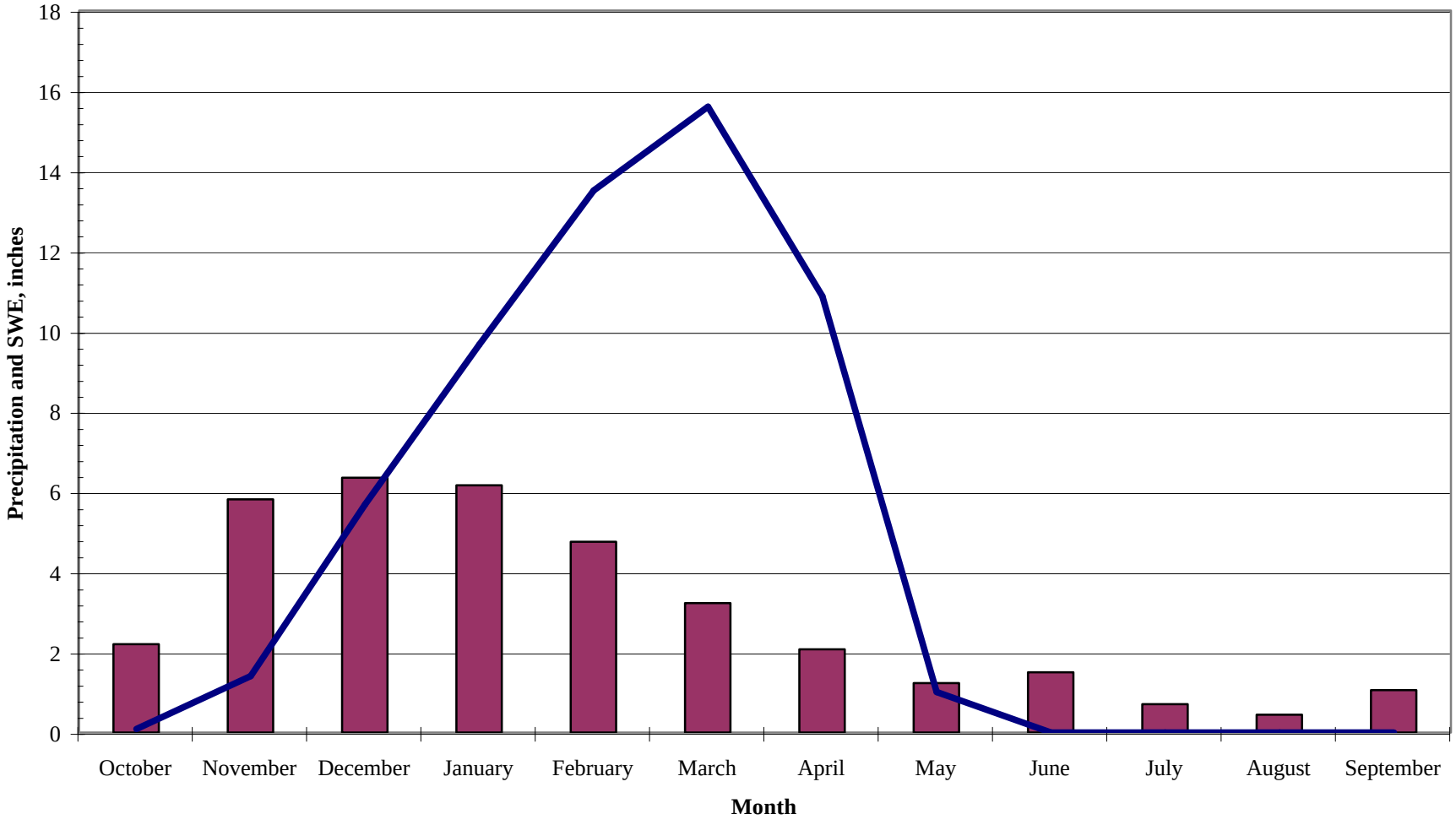
WRCC Station Number 454572
Mean Annual Precipitation = 25.3 in.
Period of Record 1948-1973, 1979-Present

Mean Monthly Precipitation

Figure 3.6 Mean Monthly Precipitation
Leavenworth, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

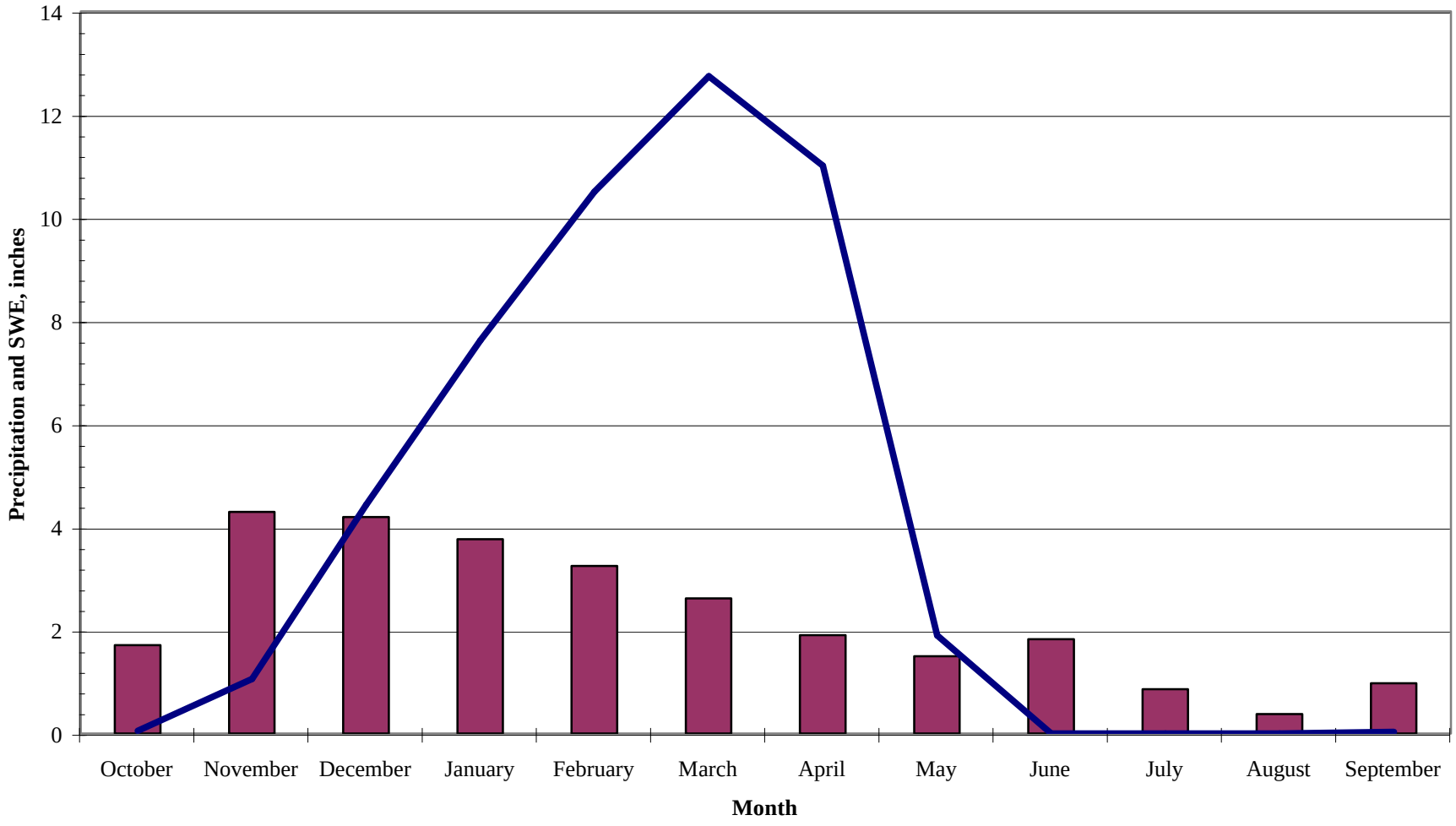
NRCS Snowtel Gage 20b20s
Mean Annual Precipitation = 35.5 in.
Period of Record 1981-Present

Mean Monthly Precipitation
Mean Monthly Snow Water Equivalent

Figure 3.7 Mean Monthly Precipitation
Mean Monthly Snow Water Equivalent
Blewett Pass, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

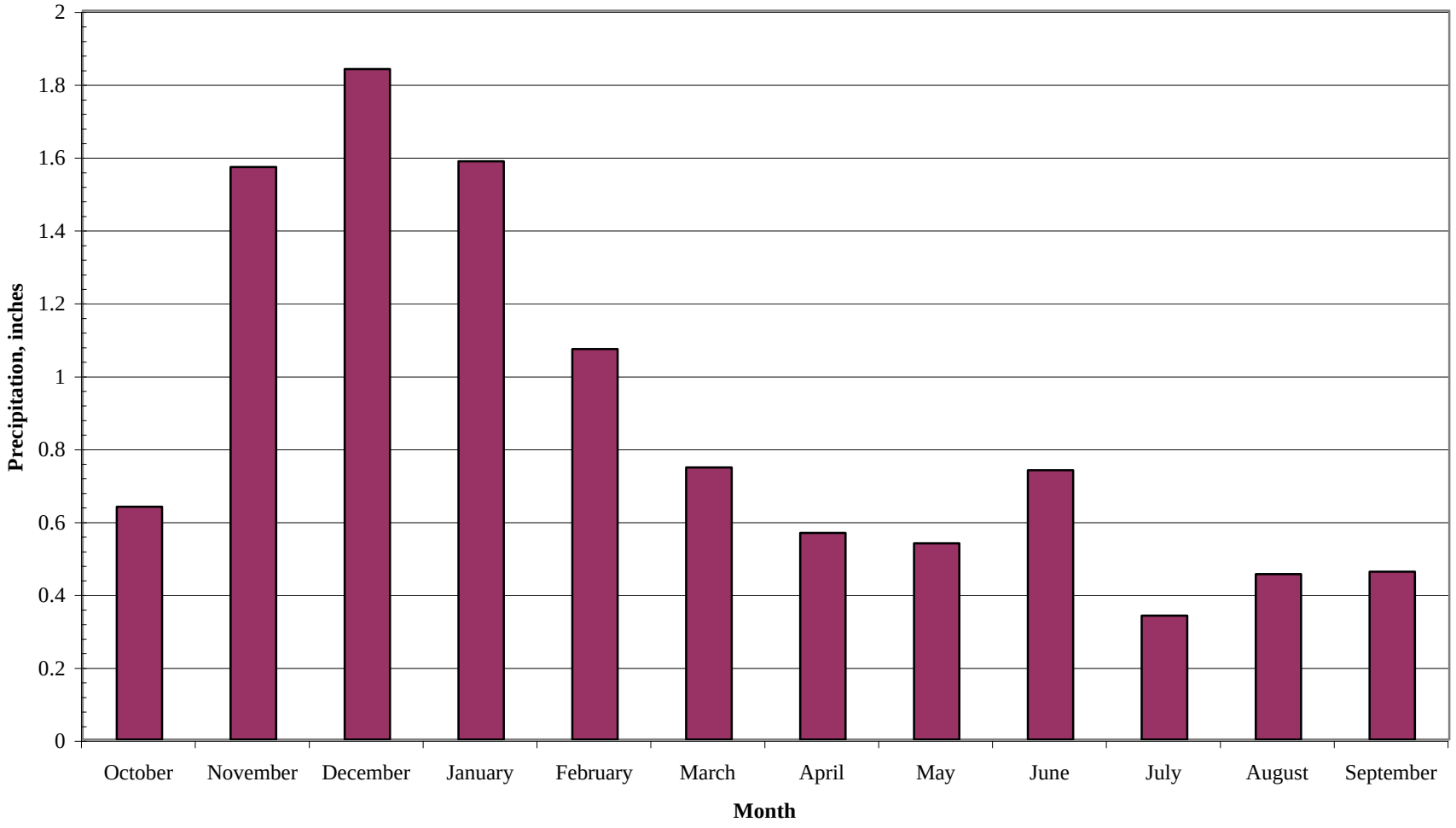
NRCS Snowtel Gage 20b07s
Mean Annual Precipitation = 27.3 in.
Period of Record 1981-Present

Mean Monthly Precipitation
Mean Monthly Snow Water Equivalent

Figure 3.8 Mean Monthly Precipitation
Mean Monthly Snow Water Equivalent
Upper Wheeler, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

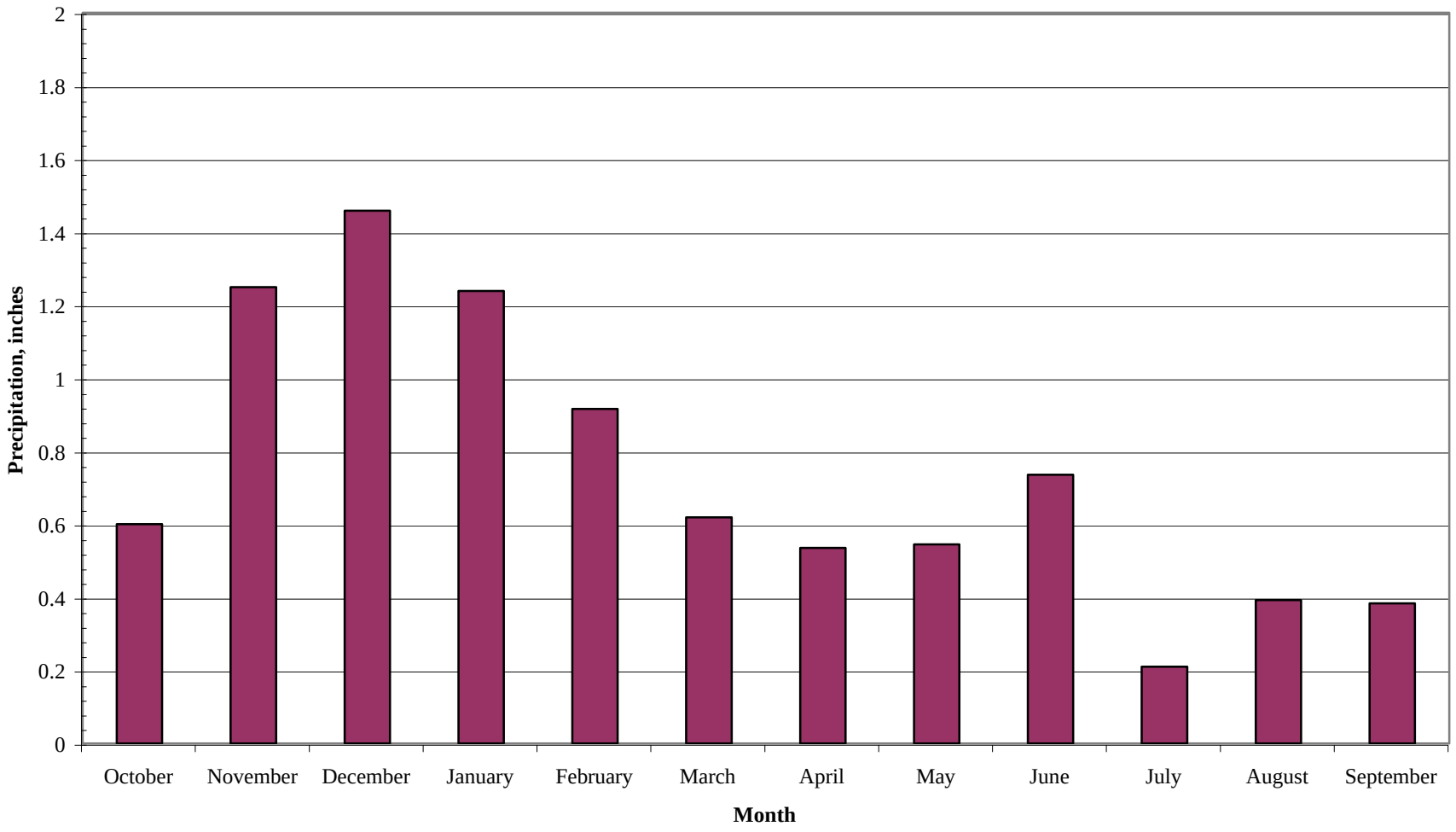
WRCC Station Number 459029
Mean Annual Precipitation = 10.3 in.
Period of Record 1950-1951, 1971-1997

Mean Monthly Precipitation

Figure 3.9 Mean Monthly Precipitation
Wenatchee EXP STN, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

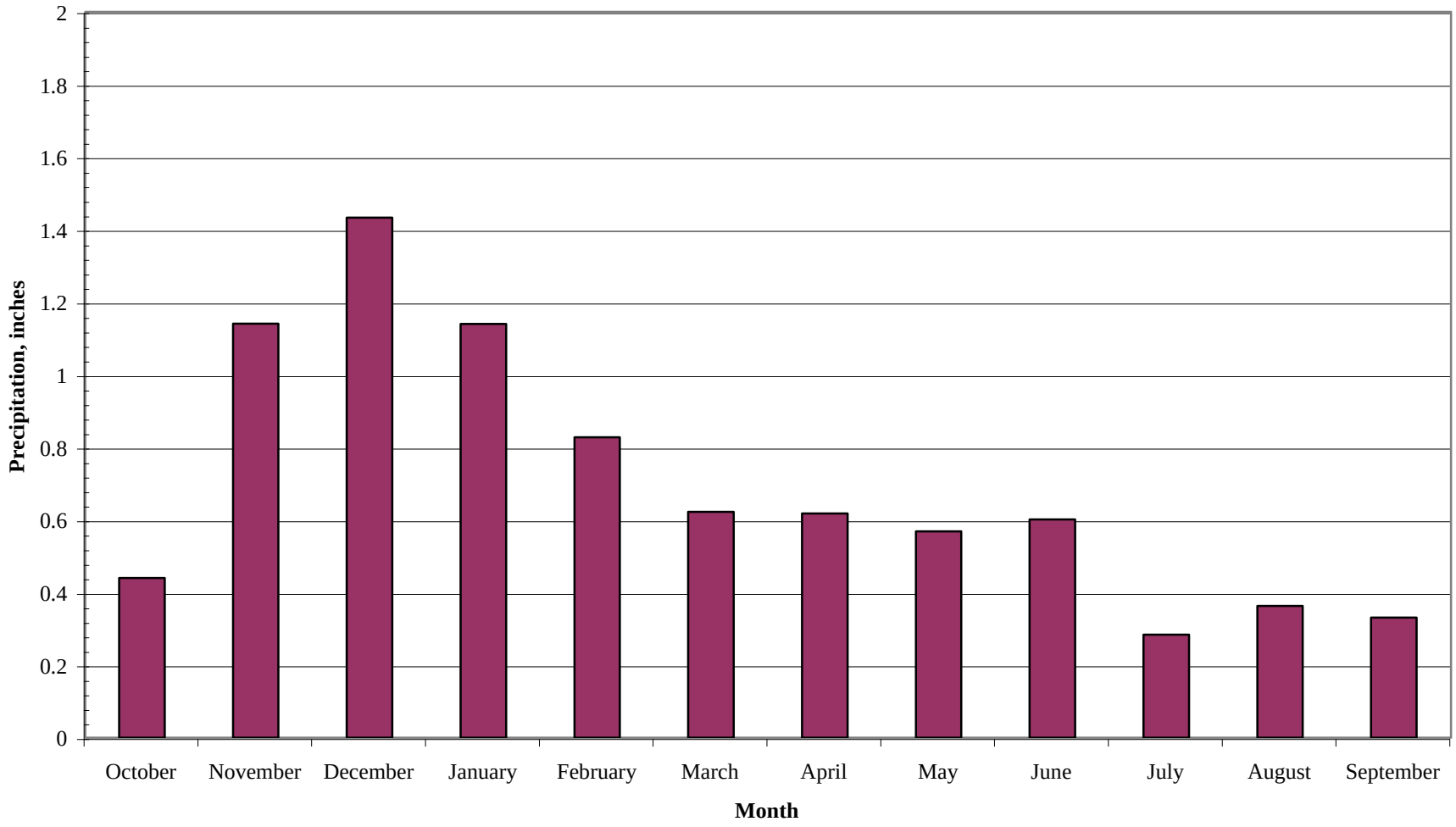
WRCC Station Number 459074
Mean Annual Precipitation = 8.9 in.
Period of Record 1931-Present

Mean Monthly Precipitation

Figure 3.10 Mean Monthly Precipitation
Wenatchee, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY
WATER GROUP, INC.



Legend

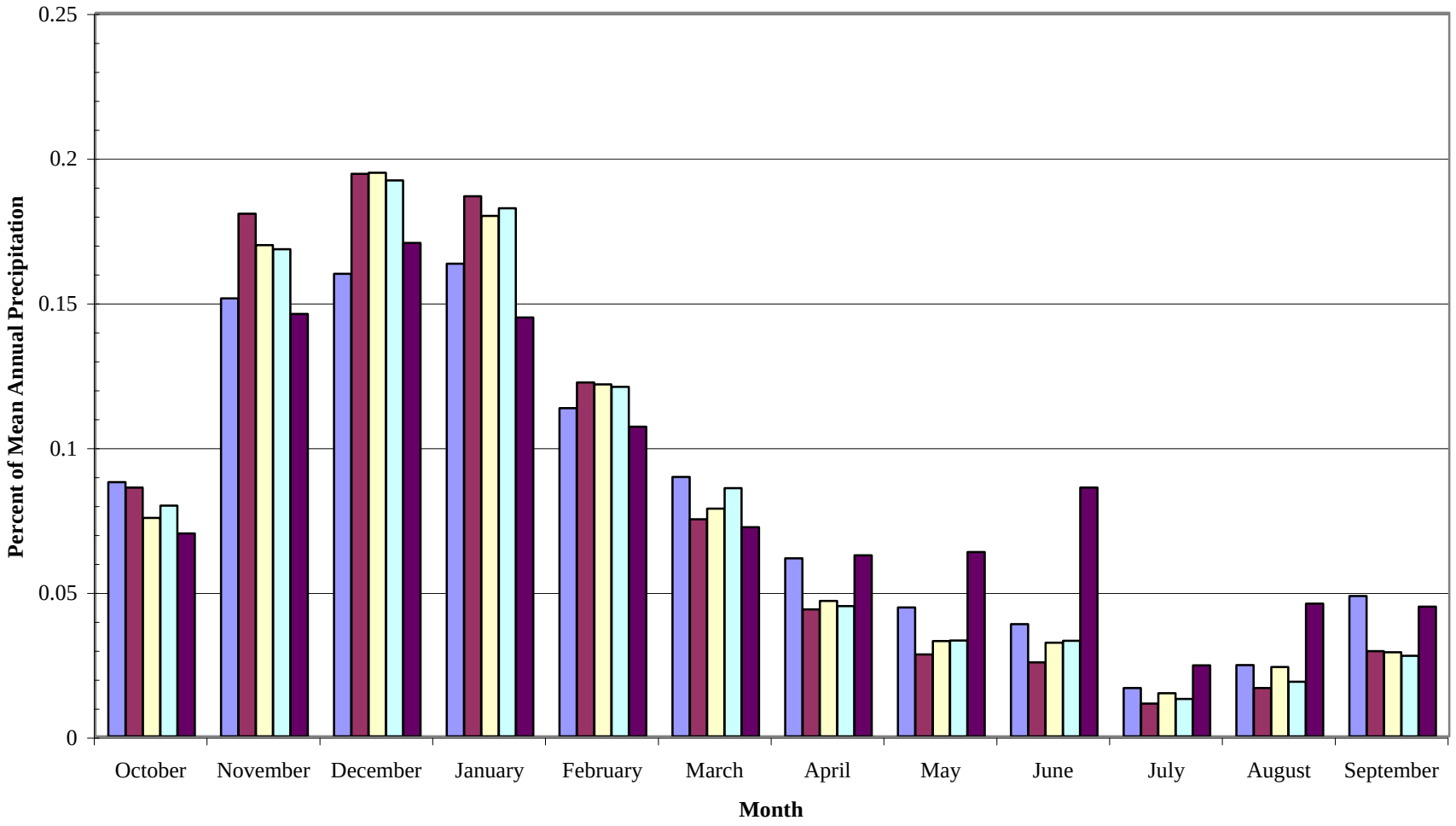
WRCC Station Number 459082
Mean Annual Precipitation = 8.4 in.
Period of Record 1959-Present

Mean Monthly Precipitation

Figure 3.11 Mean Monthly Precipitation
Wenatchee FAA AP, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



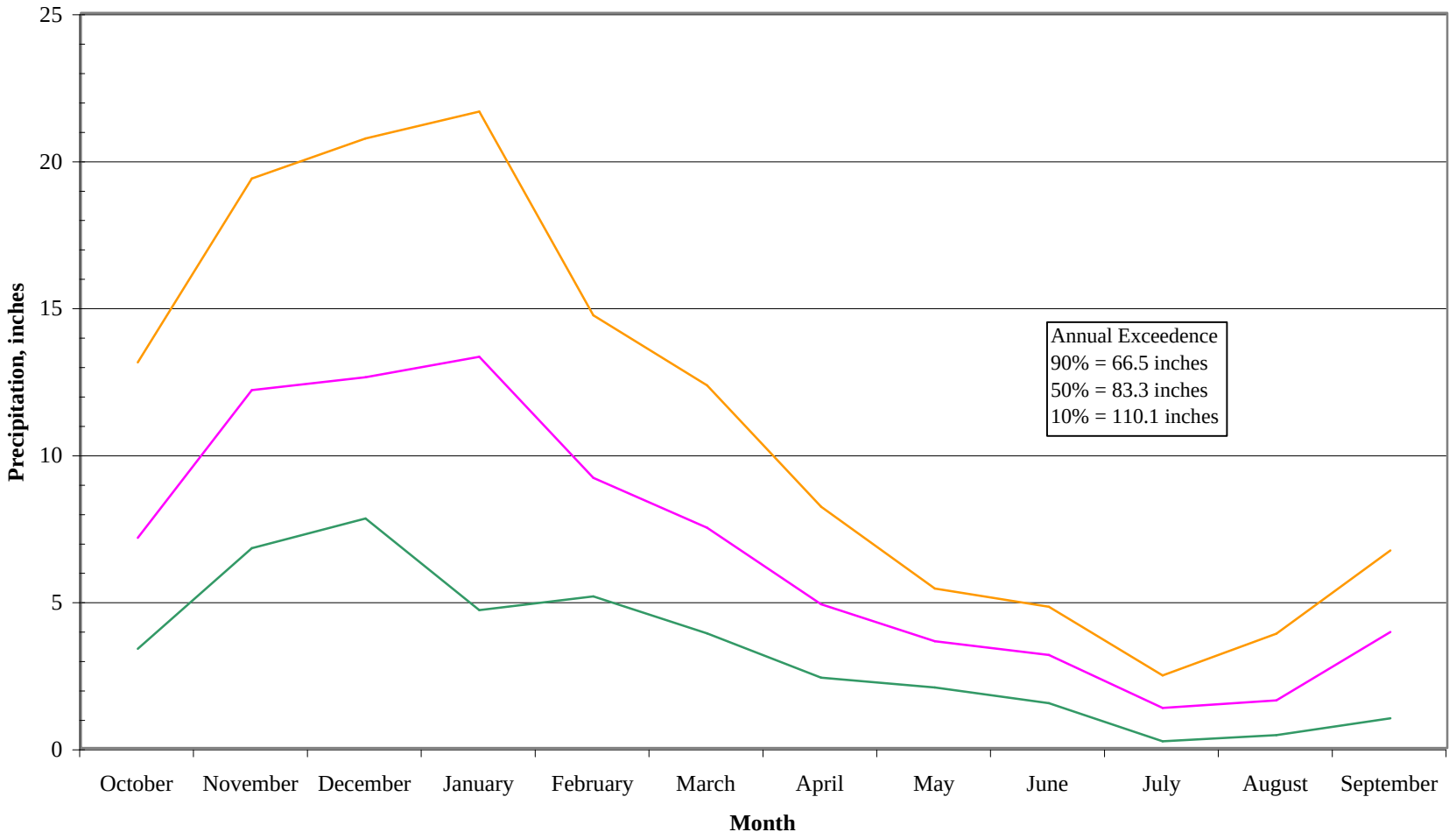
Legend

- Stevens Pass
- Lake Wenatchee
- Plain
- Leavenworth
- Wenatchee

Figure 3.12 Seasonal Variability of Precipitation at Selected WRCC Precipitation Gages

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

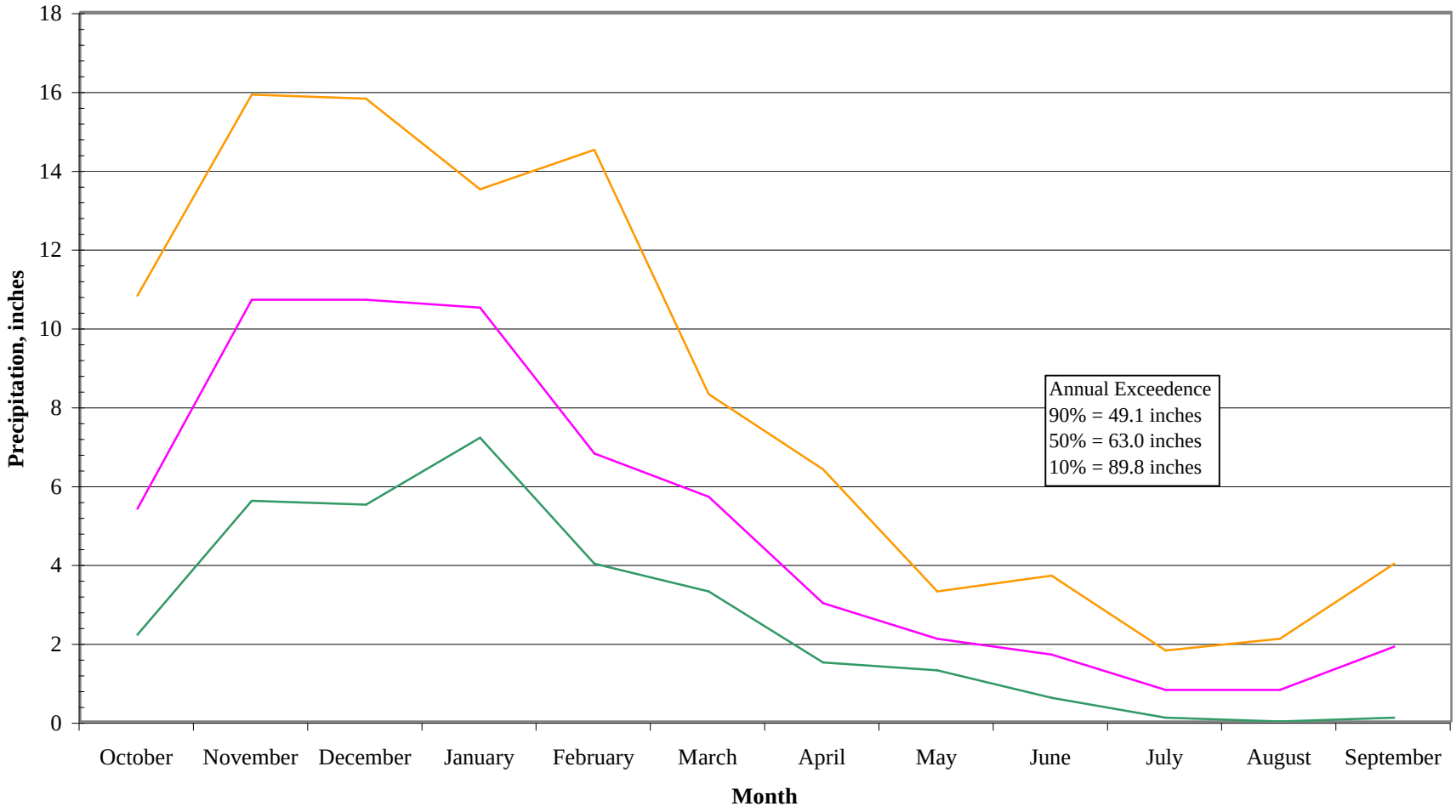
NRCS Snowtel Gage 21b01s
Period of Record 1980-Present
WRCC Station Number 458089
Period of Record 1950-1994
Mean Annual Precipitation = 84.5 in.

90% Exceedence
50% Exceedence
10% Exceedence

Figure 3.13 Monthly Precipitation Exceedence Probability Stevens Pass, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

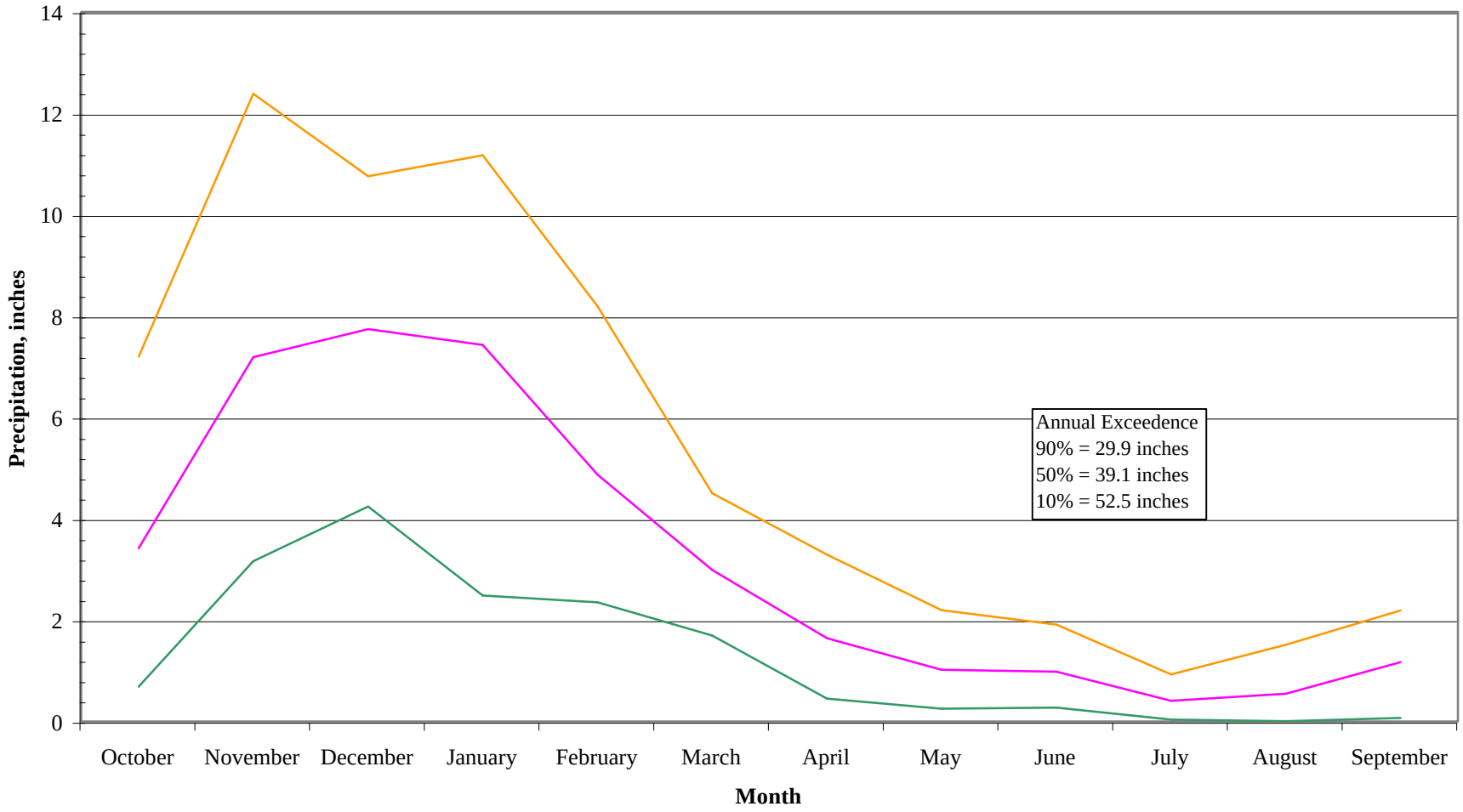
NRCS Snowtel Gage 21b04s
Mean Annual Precipitation = 64.9 in.
Period of Record 1981-Present

90% Exceedence
50% Exceedence
10% Exceedence

Figure 3.14 Monthly Precipitation Exceedence Probability
Fish Lake (Kittitas County), WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

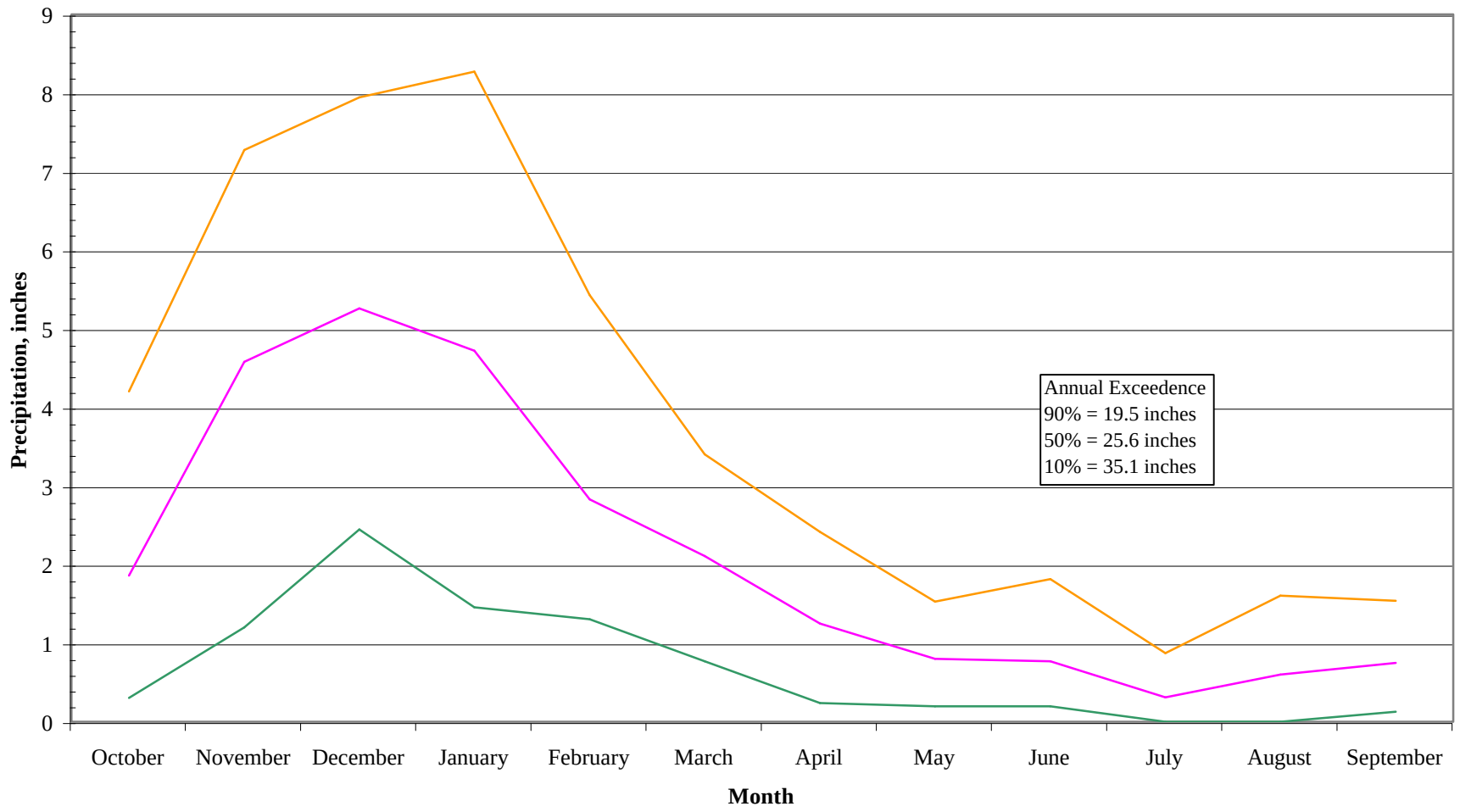
WRCC Station Number 454446
Mean Annual Precipitation = 39.3 in.
Period of Record 1948-1985

90% Exceedence
50% Exceedence
10% Exceedence

Figure 3.15 Monthly Precipitation Exceedence Probability
Lake Wenatchee, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

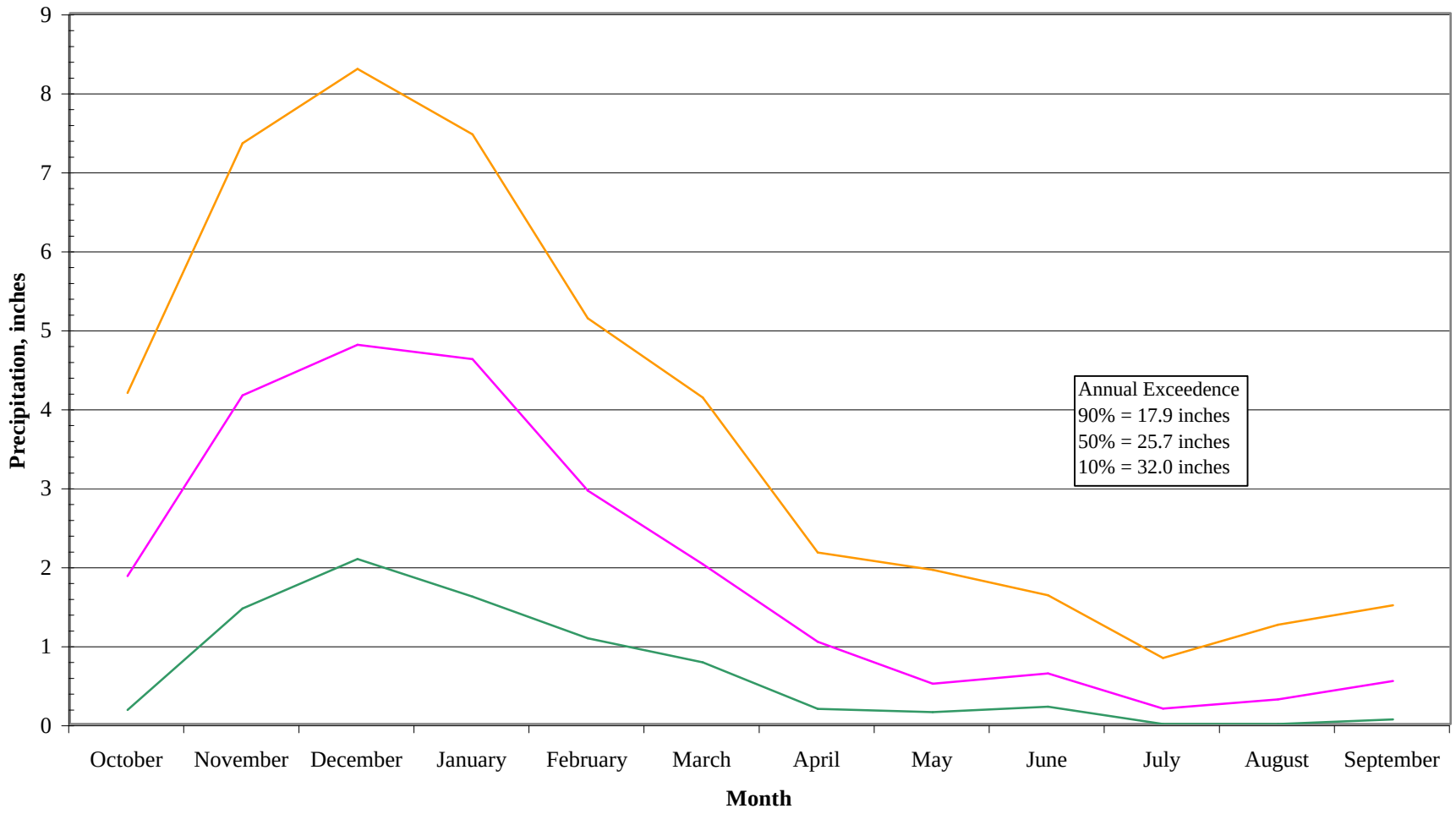
WRCC Station Number 456534
Mean Annual Precipitation = 37.0 in.
Period of Record 1948-Present

90% Exceedence
50% Exceedence
10% Exceedence

Figure 3.16 Monthly Precipitation Exceedence Probability Plain, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

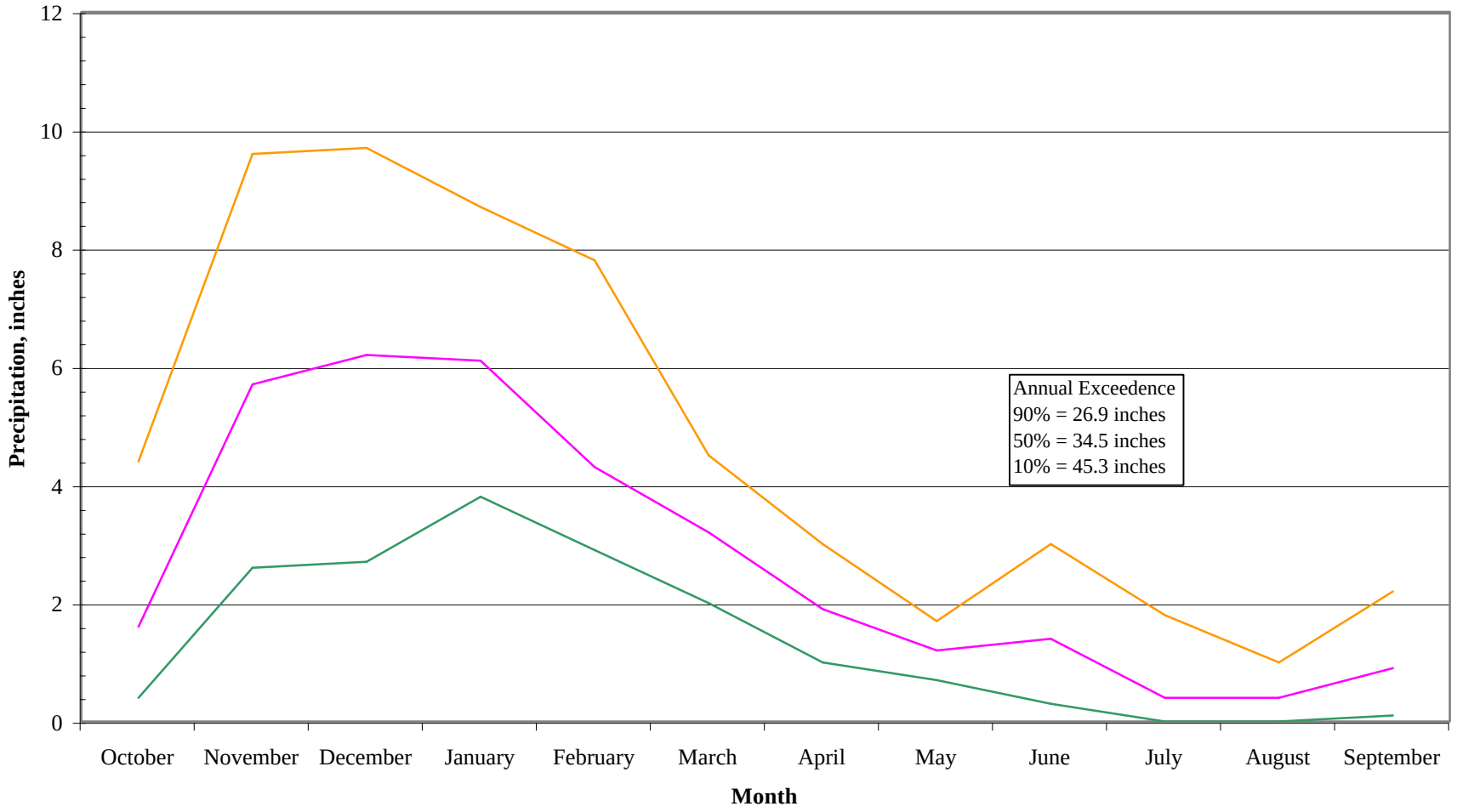
WRCC Station Number 454572
Mean Annual Precipitation = 25.3 in.
Period of Record 1948-1973, 1979-Present

90% Exceedence
50% Exceedence
10% Exceedence

Figure 3.17 Monthly Precipitation Exceedence Probability Leavenworth, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

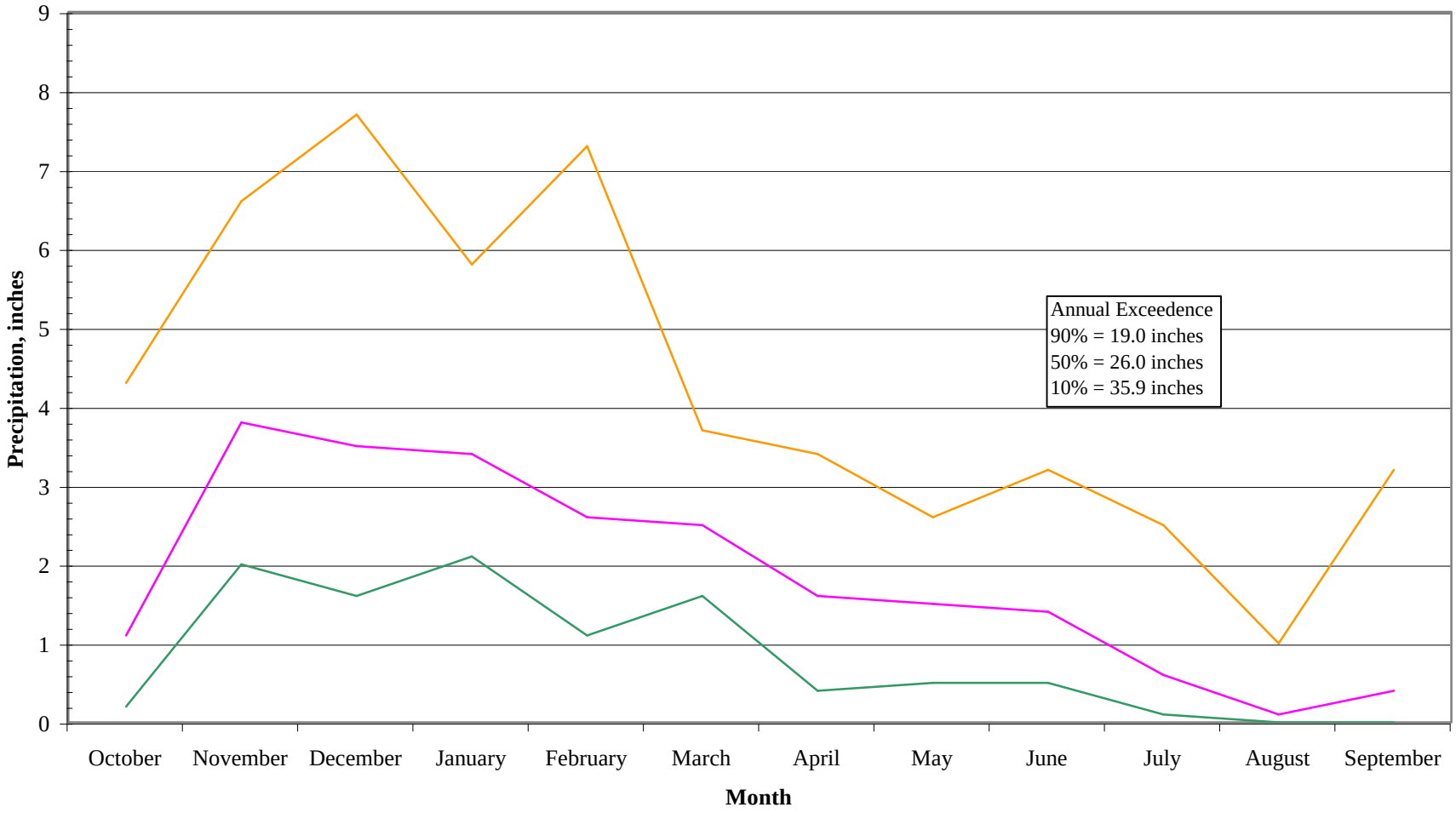
NRCS Snowtel Gage 20b20s
Mean Annual Precipitation = 35.5 in.
Period of Record 1981-Present

90% Exceedence
50% Exceedence
10% Exceedence

Figure 3.18 Monthly Precipitation Exceedence Probability
Blewett Pass, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

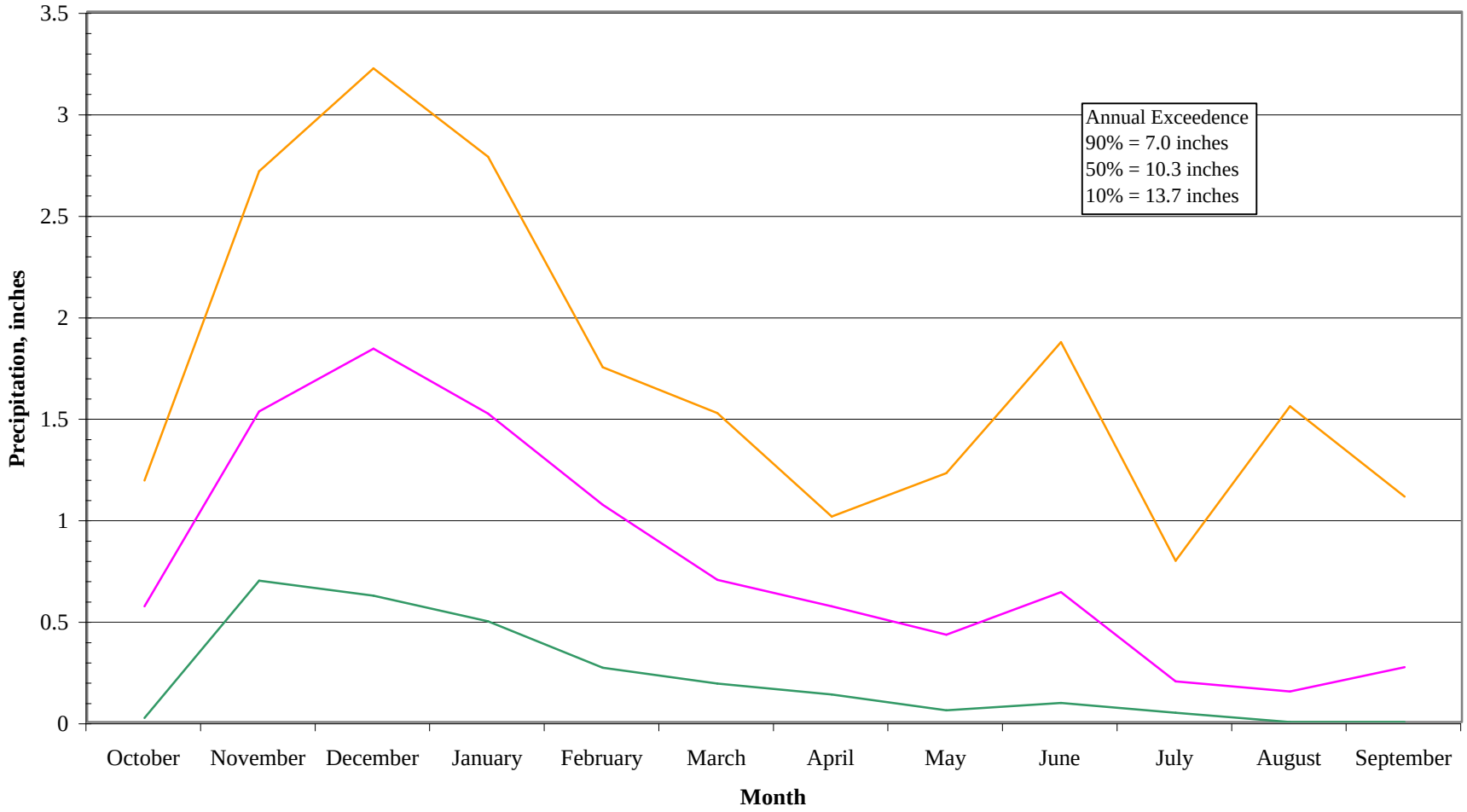
NRCS Snowtel Gage 20b07s
Mean Annual Precipitation = 27.3 in.
Period of Record 1981-Present

90% Exceedence
50% Exceedence
10% Exceedence

Figure 3.19 Monthly Precipitation Exceedence Probability
Upper Wheeler, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

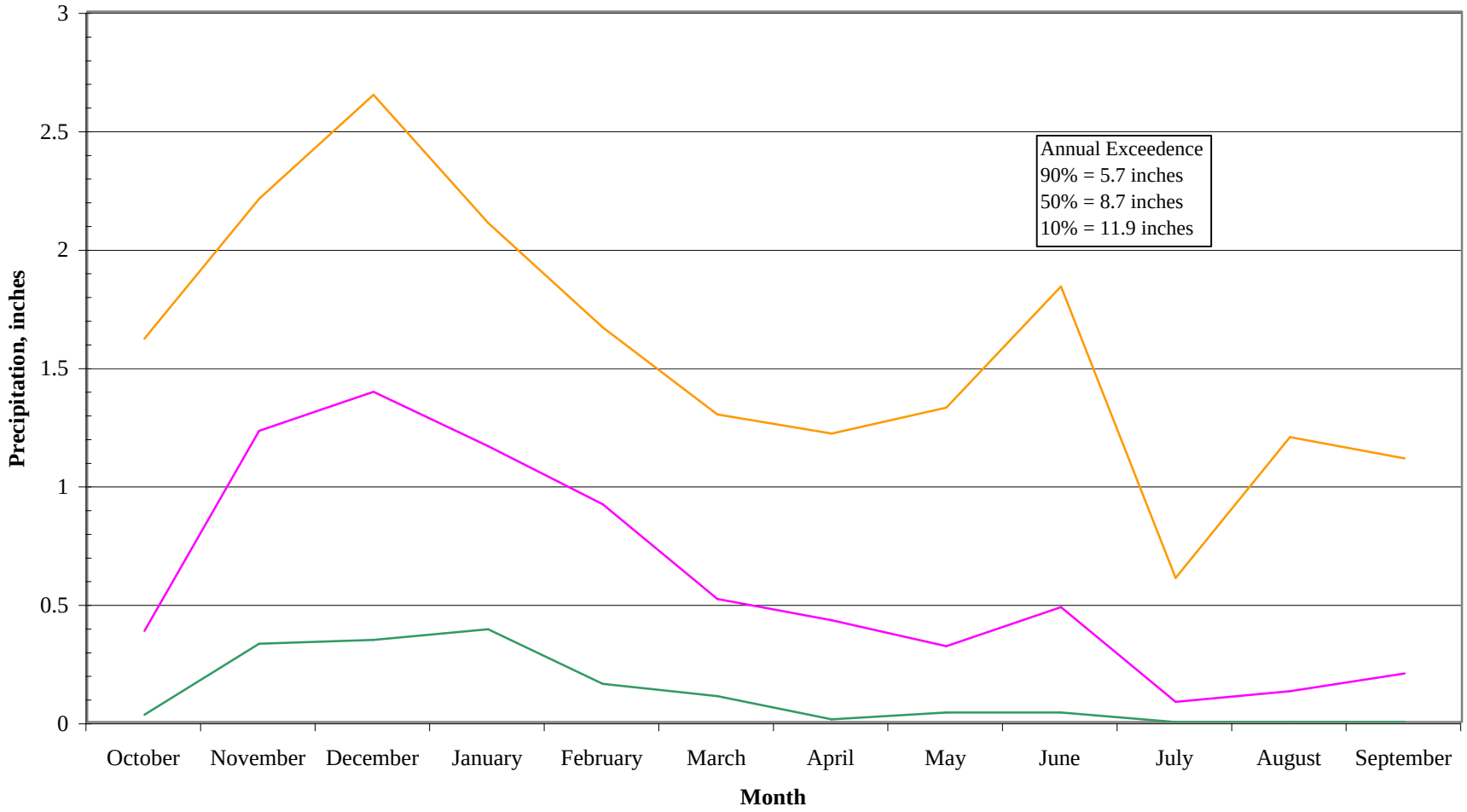
WRCC Station Number 459029
Mean Annual Precipitation = 10.3 in.
Period of Record 1950-1951, 1971-1997

90% Exceedence
50% Exceedence
10% Exceedence

Figure 3.20 Monthly Precipitation Exceedence Probability
Wenatchee EXP STN, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

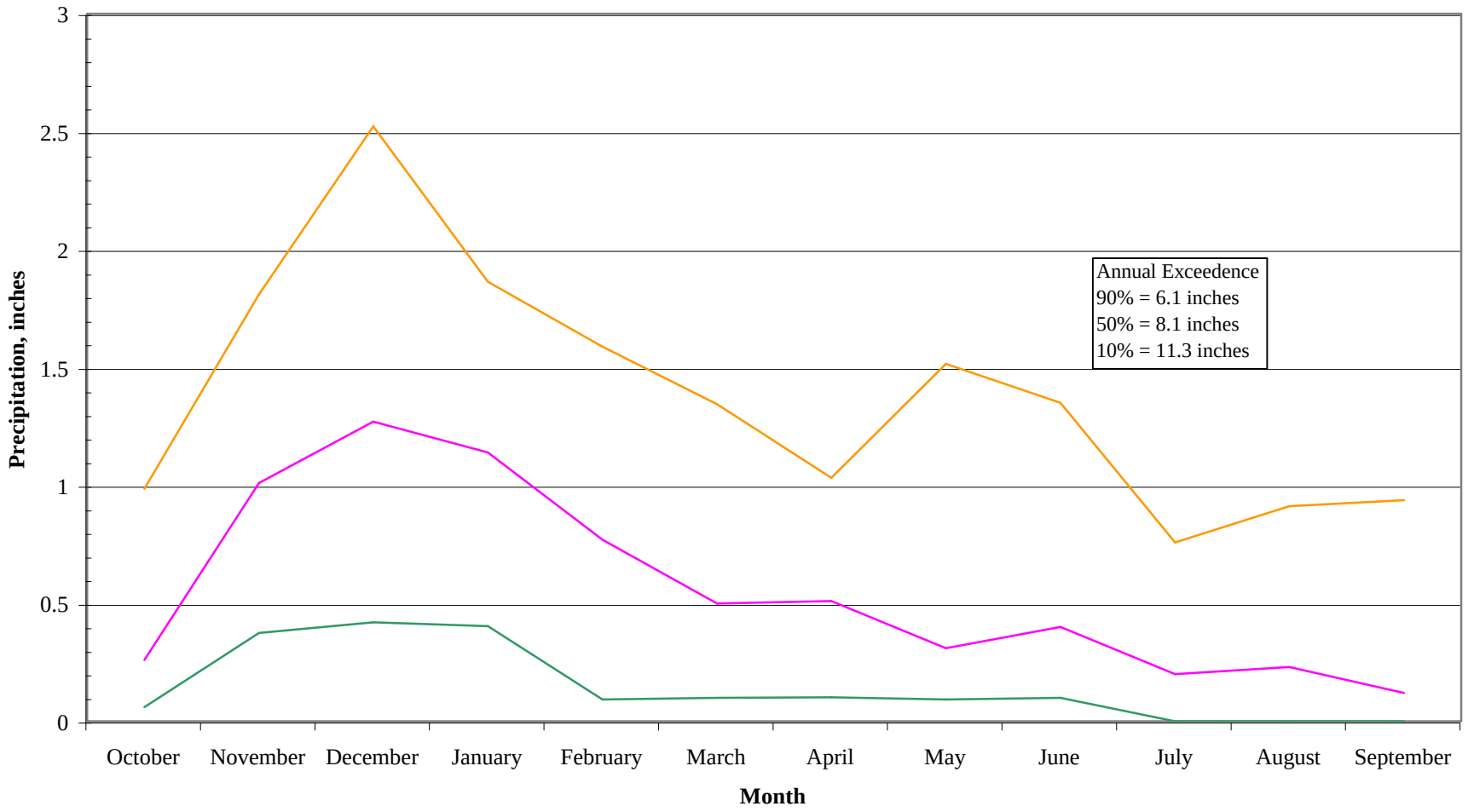
WRCC Station Number 459074
Mean Annual Precipitation = 8.9 in.
Period of Record 1931-Present

90% Exceedence
50% Exceedence
10% Exceedence

Figure 3.21 Monthly Precipitation Exceedence Probability
Wenatchee, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

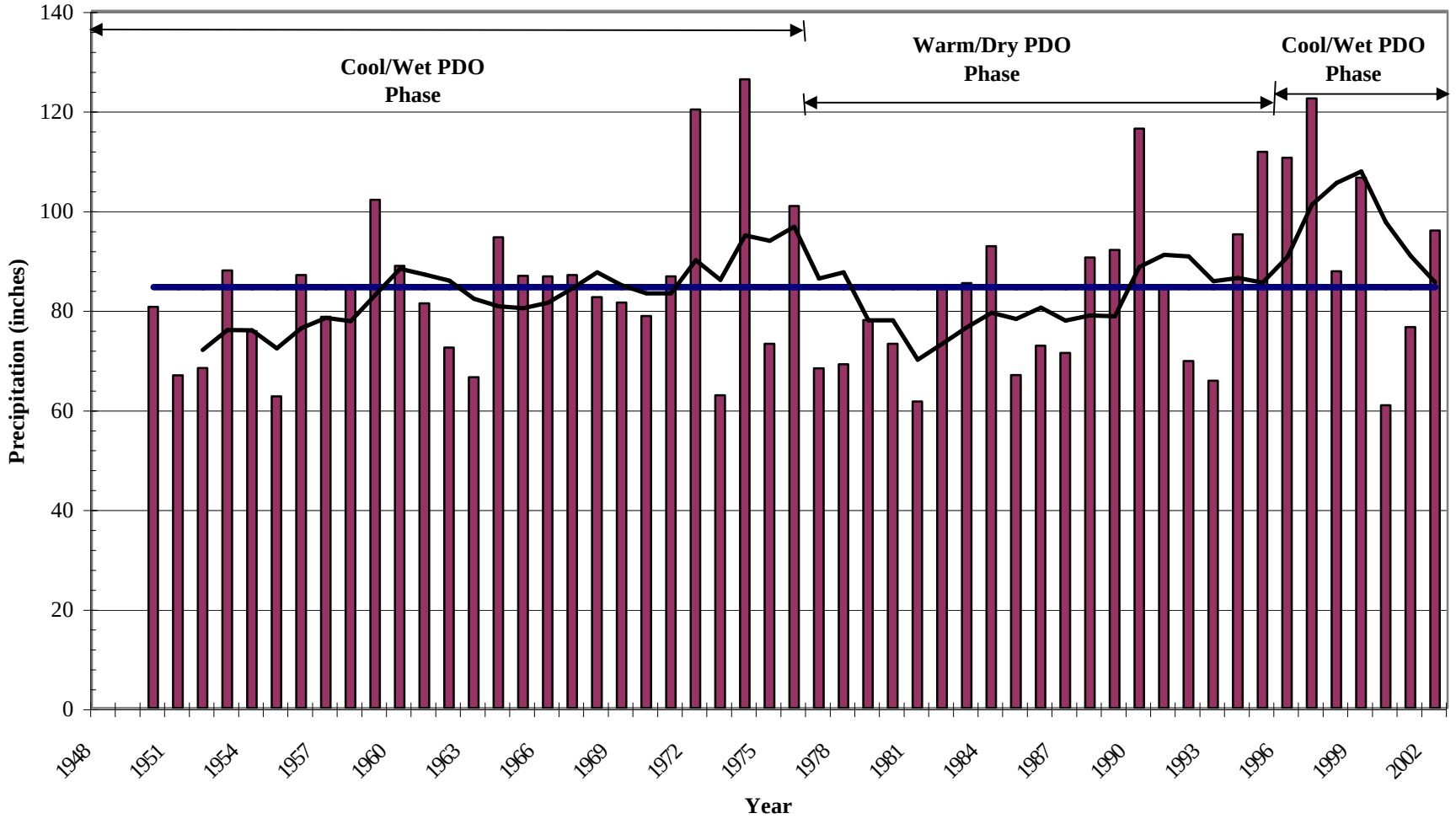
WRCC Station Number 459082
Mean Annual Precipitation = 8.4 in.
Period of Record 1959-Present

90% Exceedence
50% Exceedence
10% Exceedence

Figure 3.22 Monthly Precipitation Exceedence Probability
Wenatchee FAA AP, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

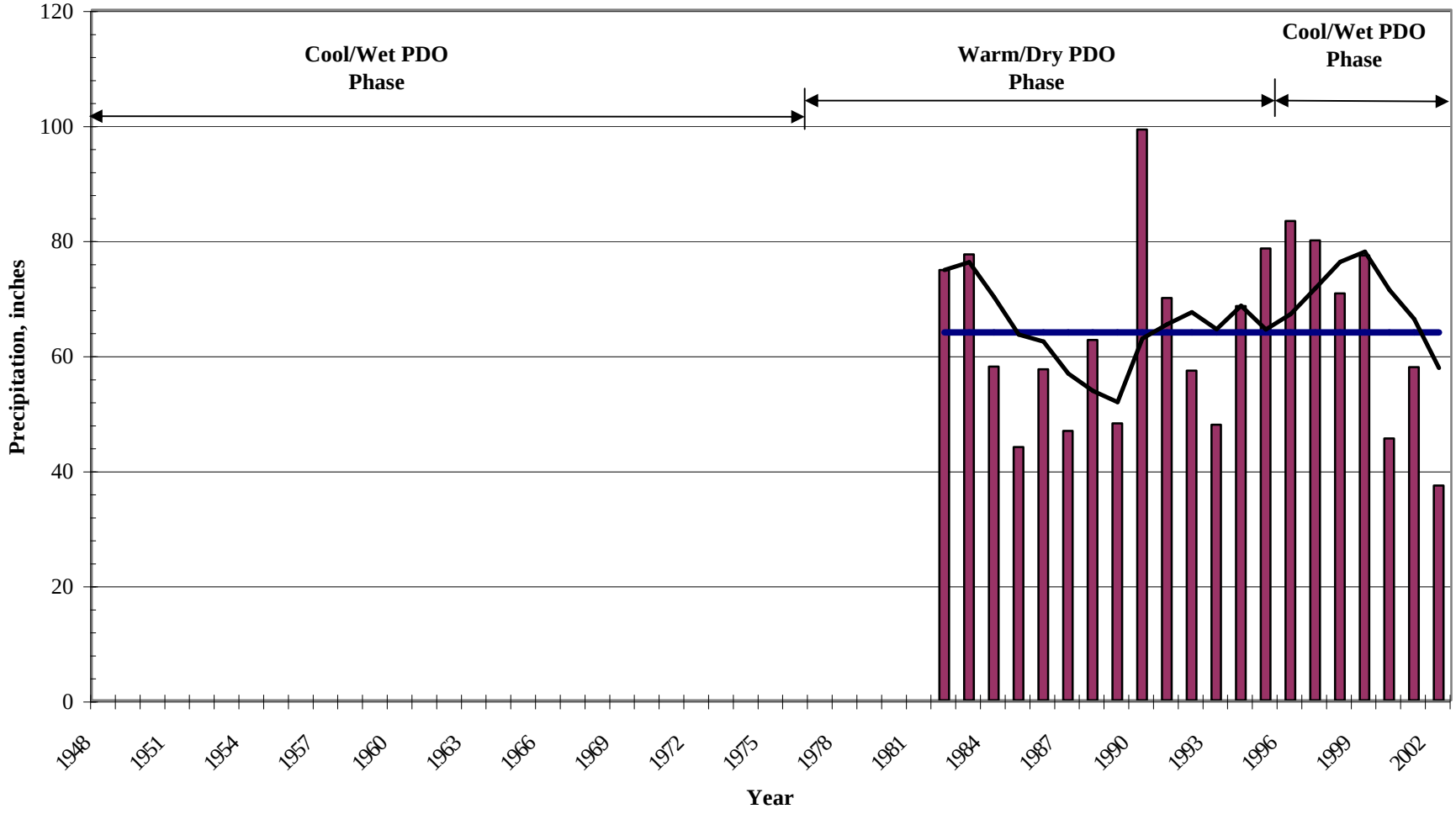
NRCS Snowtel Gage 21b01s
Period of Record 1980-Present
WRCC Station Number 458089
Period of Record 1950-1994
Mean Annual Precipitation = 84.5 in.

Annual Precipitation
Mean Annual Precipitation
5-Year Moving Average

Figure 3.23 Precipitation Record
Stevens Pass, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

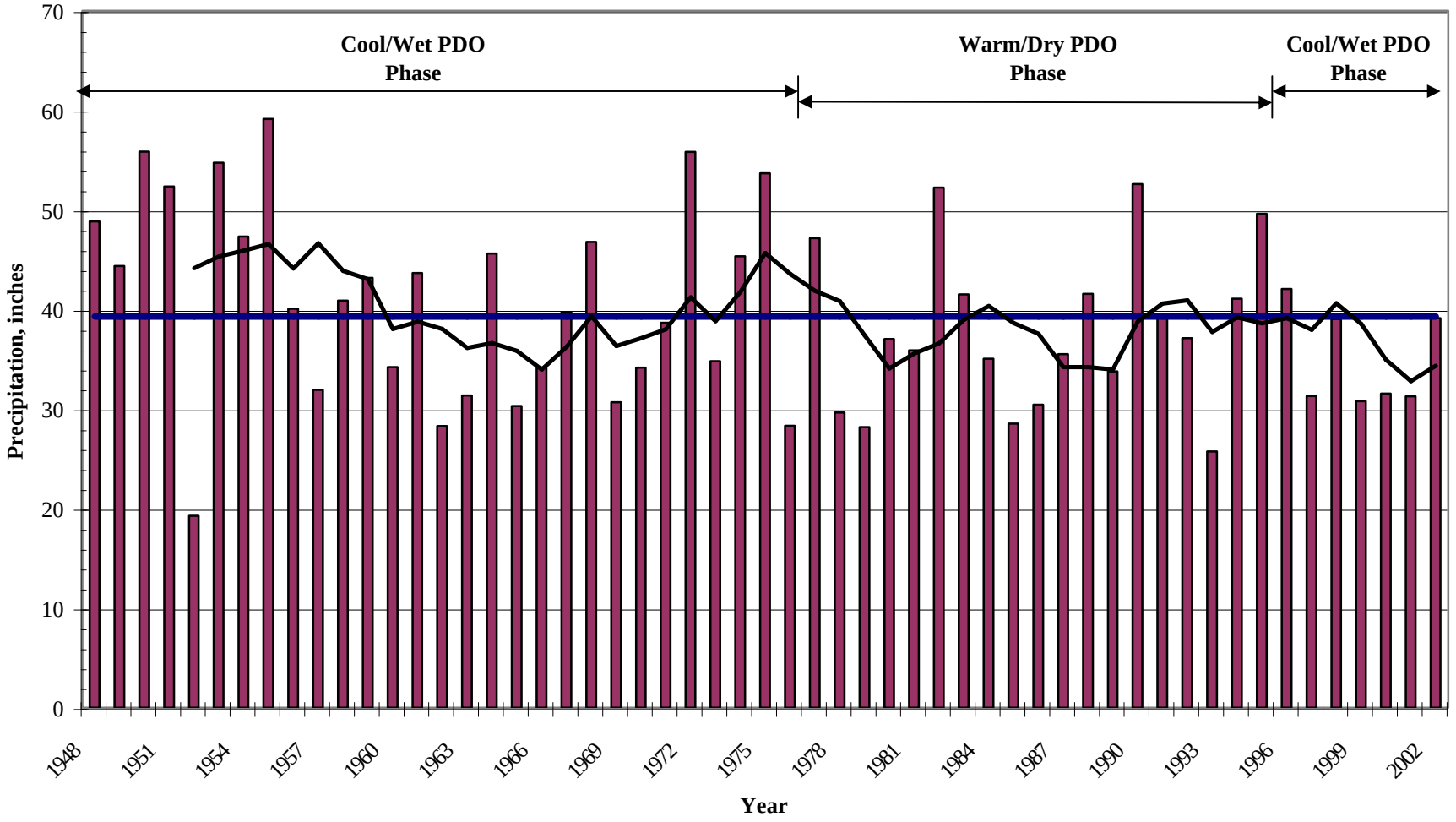
NRCS Snowtel Gage 21b04s
Mean Annual Precipitation = 64.9 in.
Period of Record 1981-Present

Annual Precipitation
Mean Annual Precipitation
5-Year Moving Average

Figure 3.24 Precipitation Record
Fish Lake (Kittitas County), WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

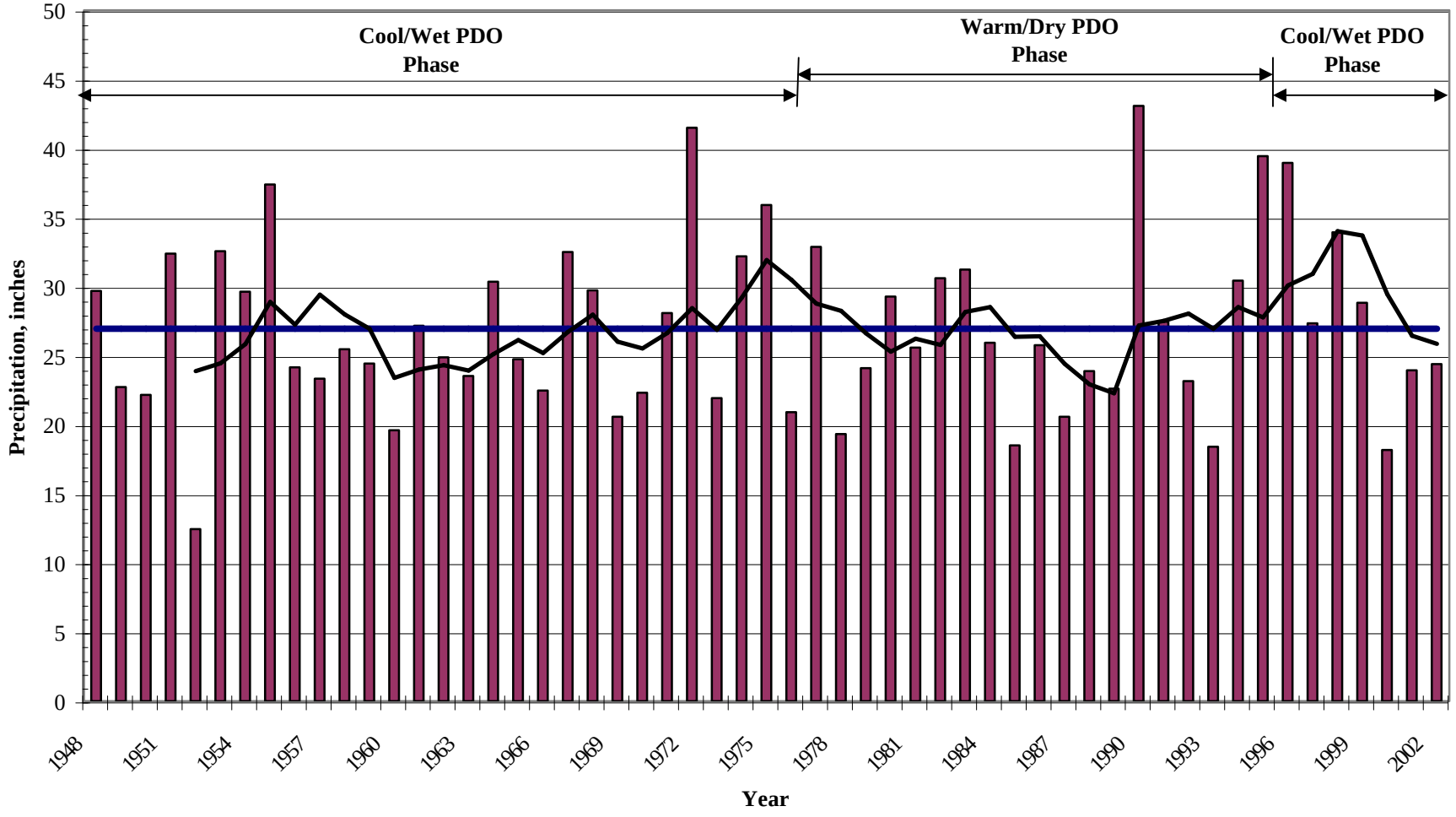
WRCC Station Number 454446
Mean Annual Precipitation = 39.3 in.
Period of Record 1948-1985

Annual Precipitation
Mean Annual Precipitation
5-Year Moving Average

Figure 3.25 Precipitation Record
Lake Wenatchee, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

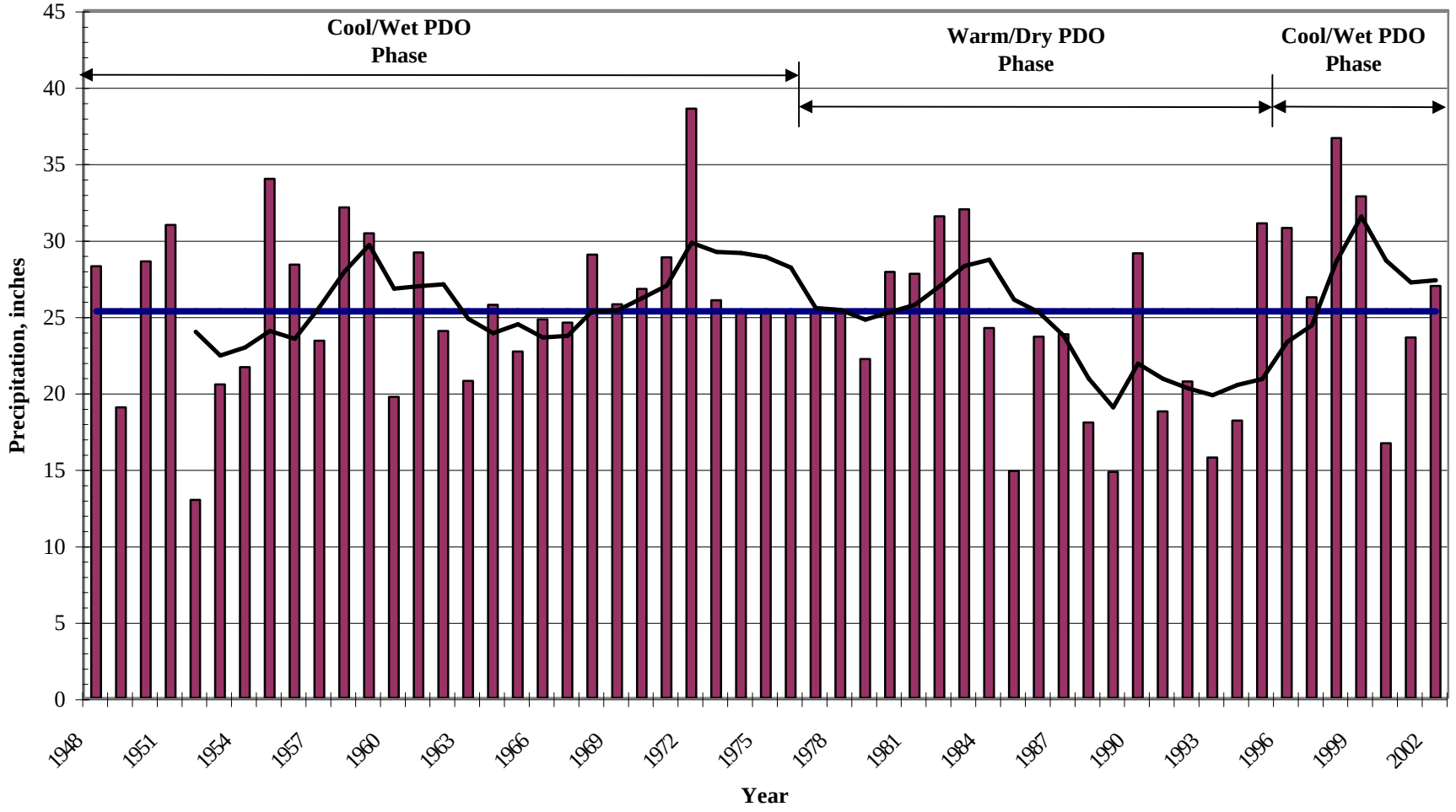
WRCC Station Number 456534
Mean Annual Precipitation = 37.0 in.
Period of Record 1948-Present

Annual Precipitation
Mean Annual Precipitation
5-Year Moving Average

Figure 3.26 Precipitation Record Plain, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

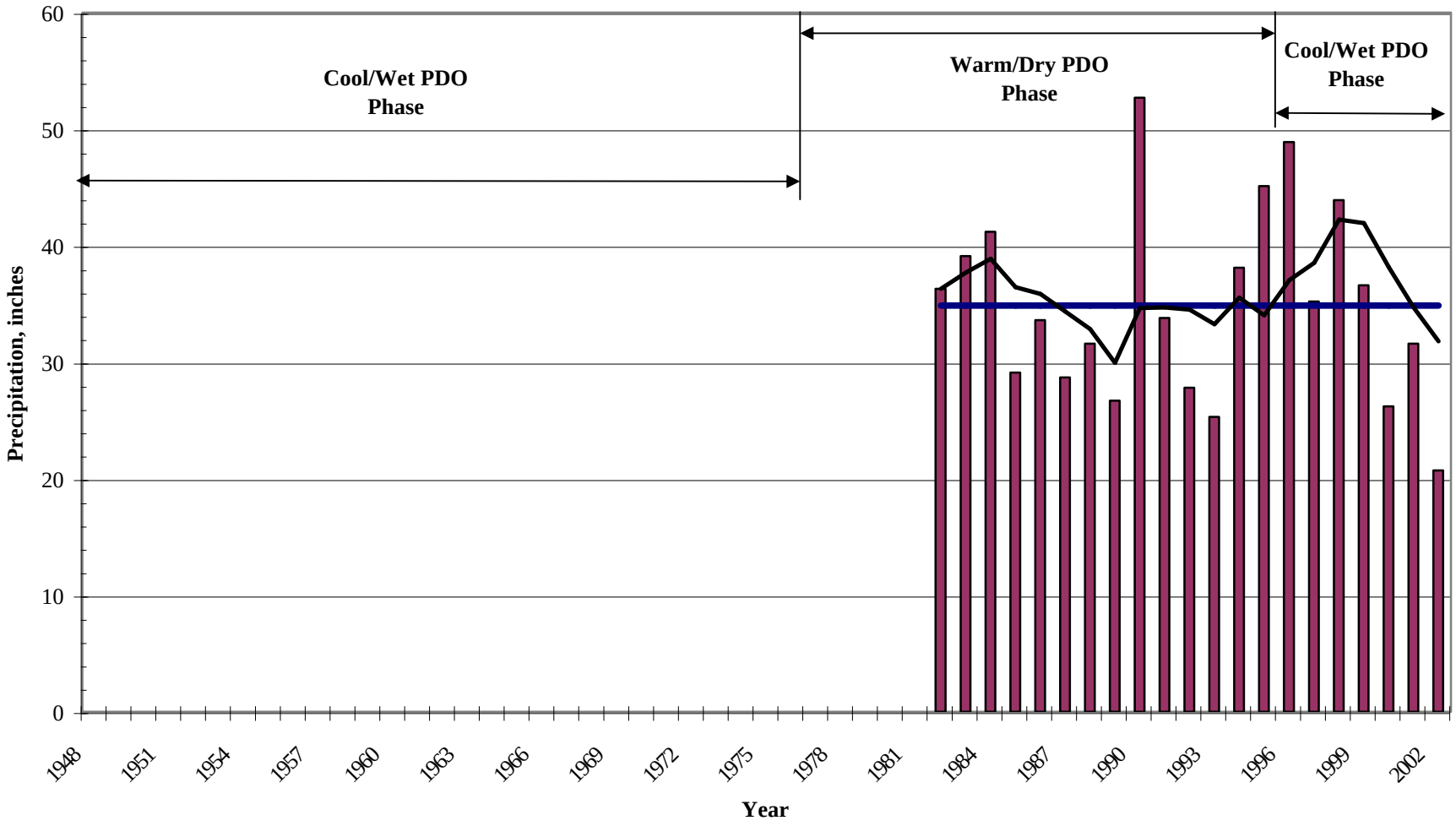
WRCC Station Number 454572
Mean Annual Precipitation = 25.3 in.
Period of Record 1948-1973, 1979-Present

Annual Precipitation
Mean Annual Precipitation
5-Year Moving Average

Figure 3.27 Precipitation Record
Leavenworth, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

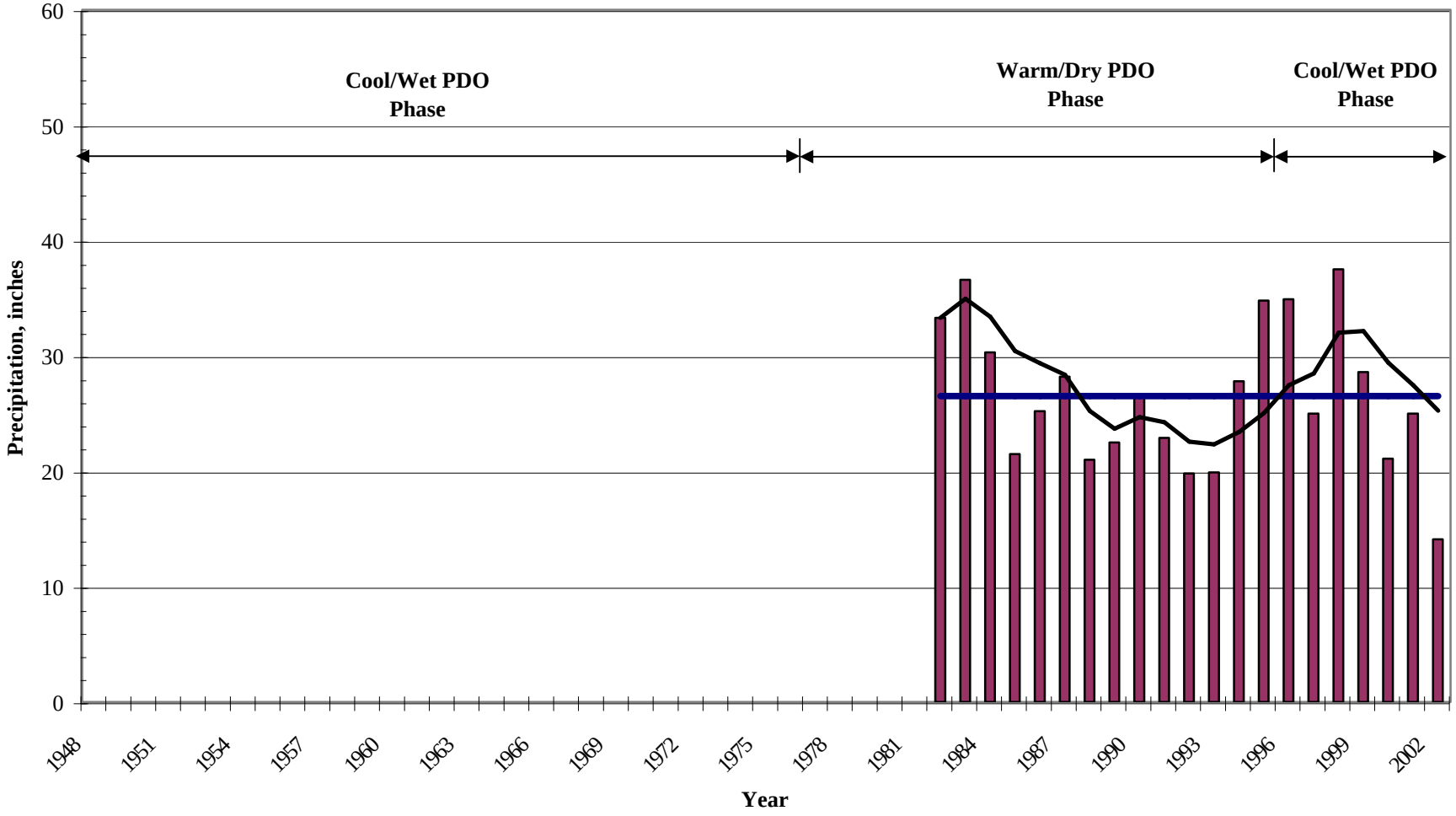
NRCS Snowtel Gage 20b20s
Mean Annual Precipitation = 35.5 in.
Period of Record 1981-Present

Annual Precipitation
Mean Annual Precipitation
5-Year Moving Average

Figure 3.28 Precipitation Record
Blewett Pass, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

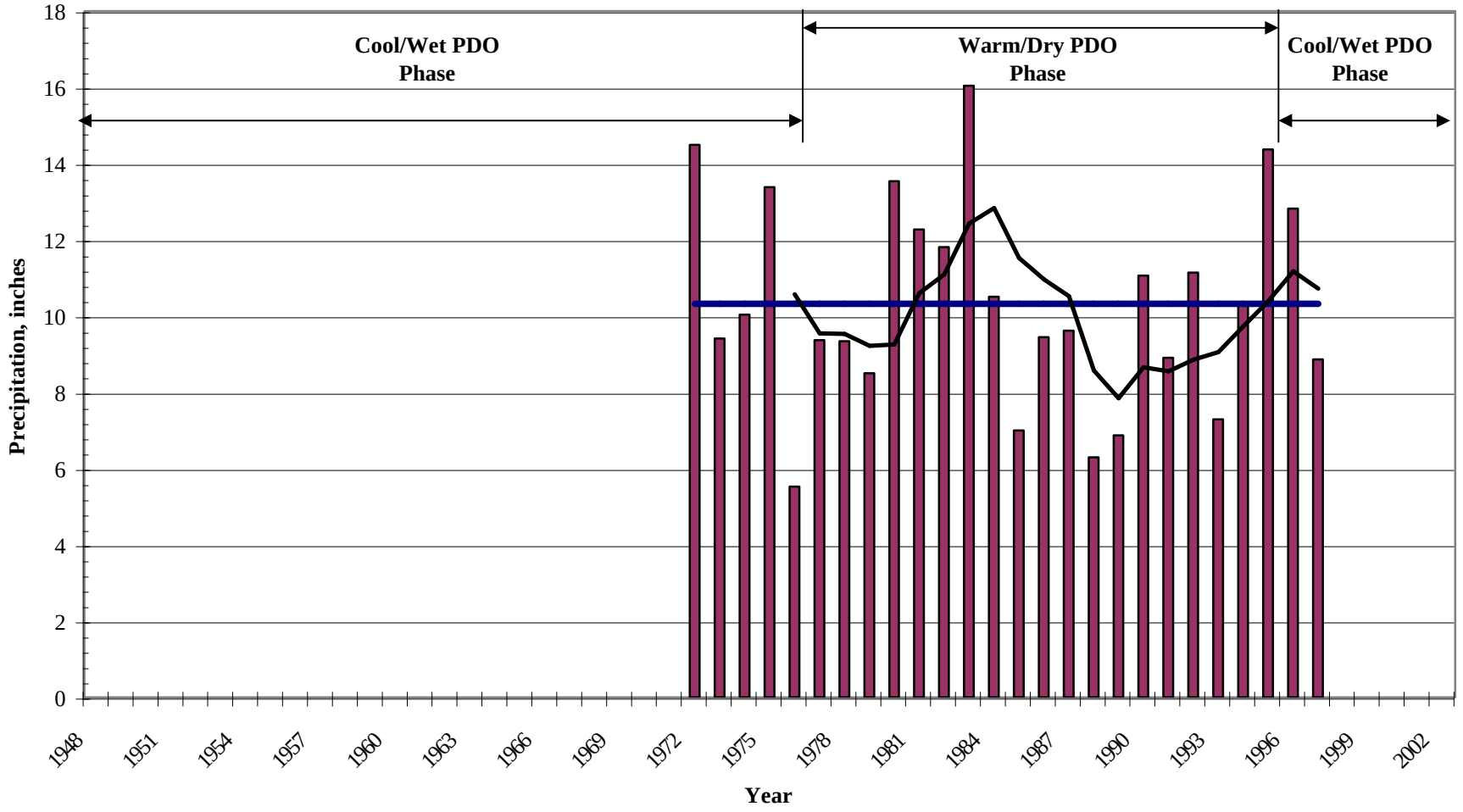
NRCS Snowtel Gage 20b07s
Mean Annual Precipitation = 27.3 in.
Period of Record 1981-Present

Annual Precipitation
Mean Annual Precipitation
5-Year Moving Average

Figure 3.29 Precipitation Record
Upper Wheeler, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

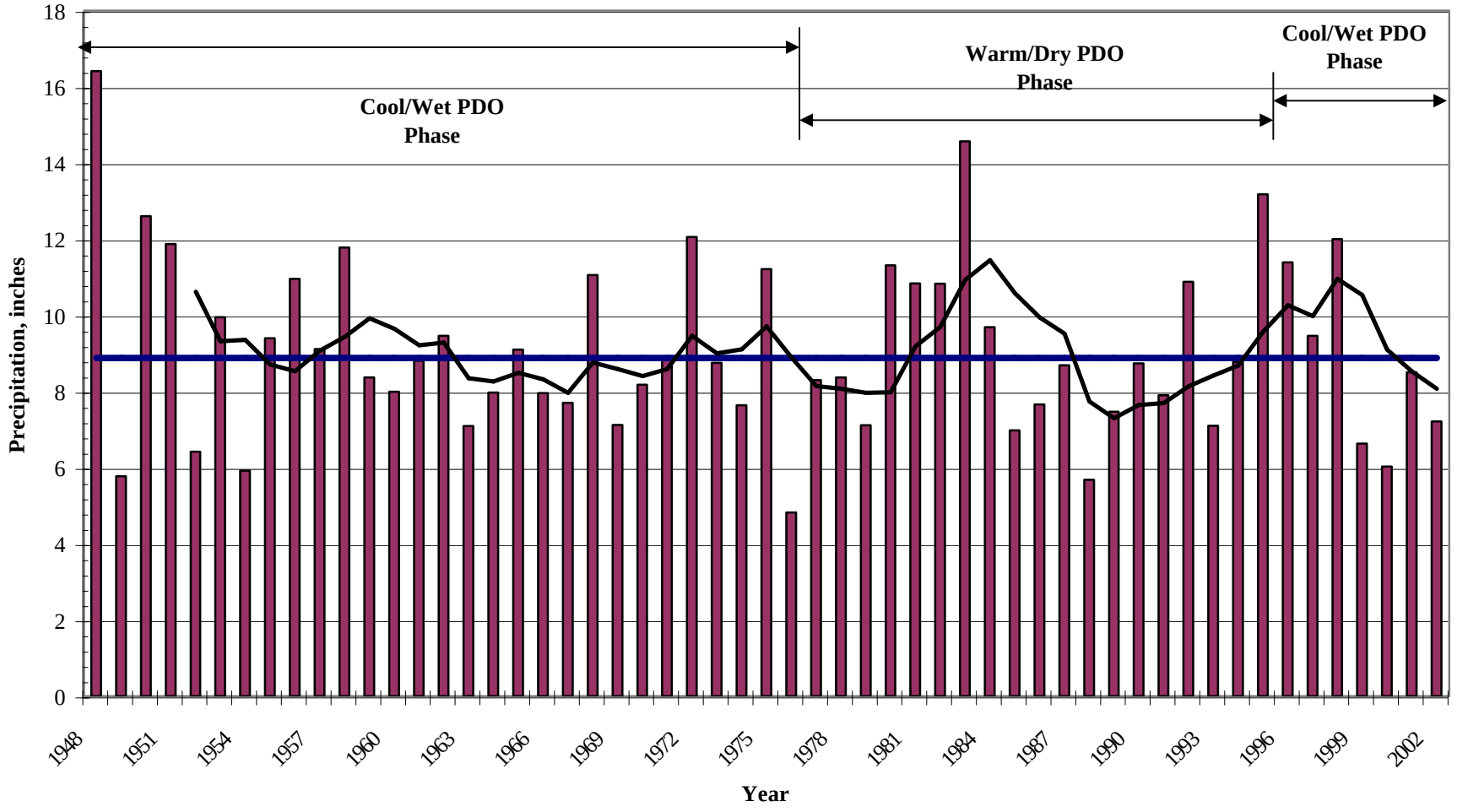
WRCC Station Number 459029
Mean Annual Precipitation = 10.3 in.
Period of Record 1950-1951, 1971-1997

Annual Precipitation
Mean Annual Precipitation
5-Year Moving Average

Figure 3.30 Precipitation Record
Wenatchee EXP STN, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

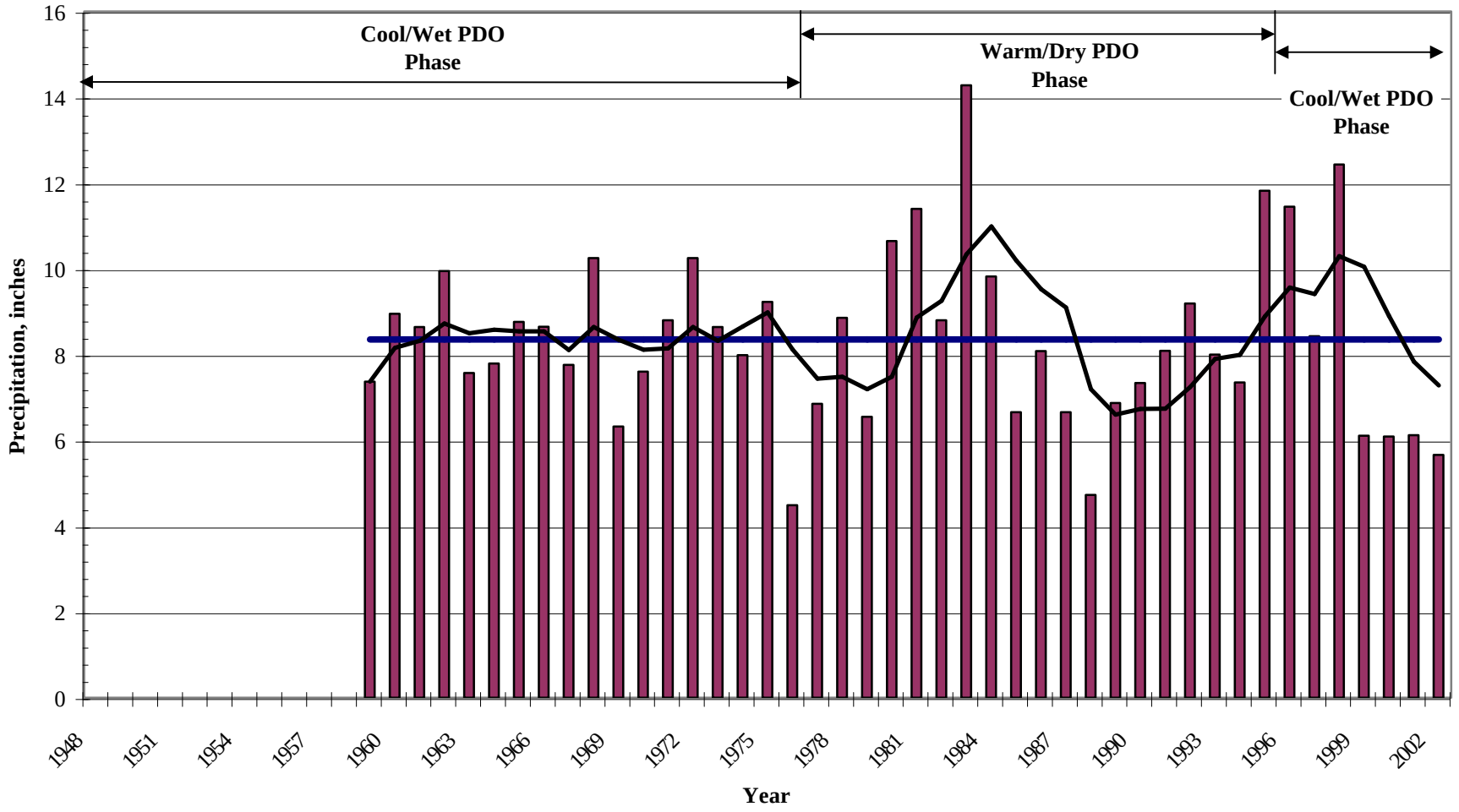
WRCC Station Number 459074
Mean Annual Precipitation = 8.9 in.
Period of Record 1931-Present

Annual Precipitation
Mean Annual Precipitation
5-Year Moving Average

Figure 3.31 Precipitation Record
Wenatchee, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

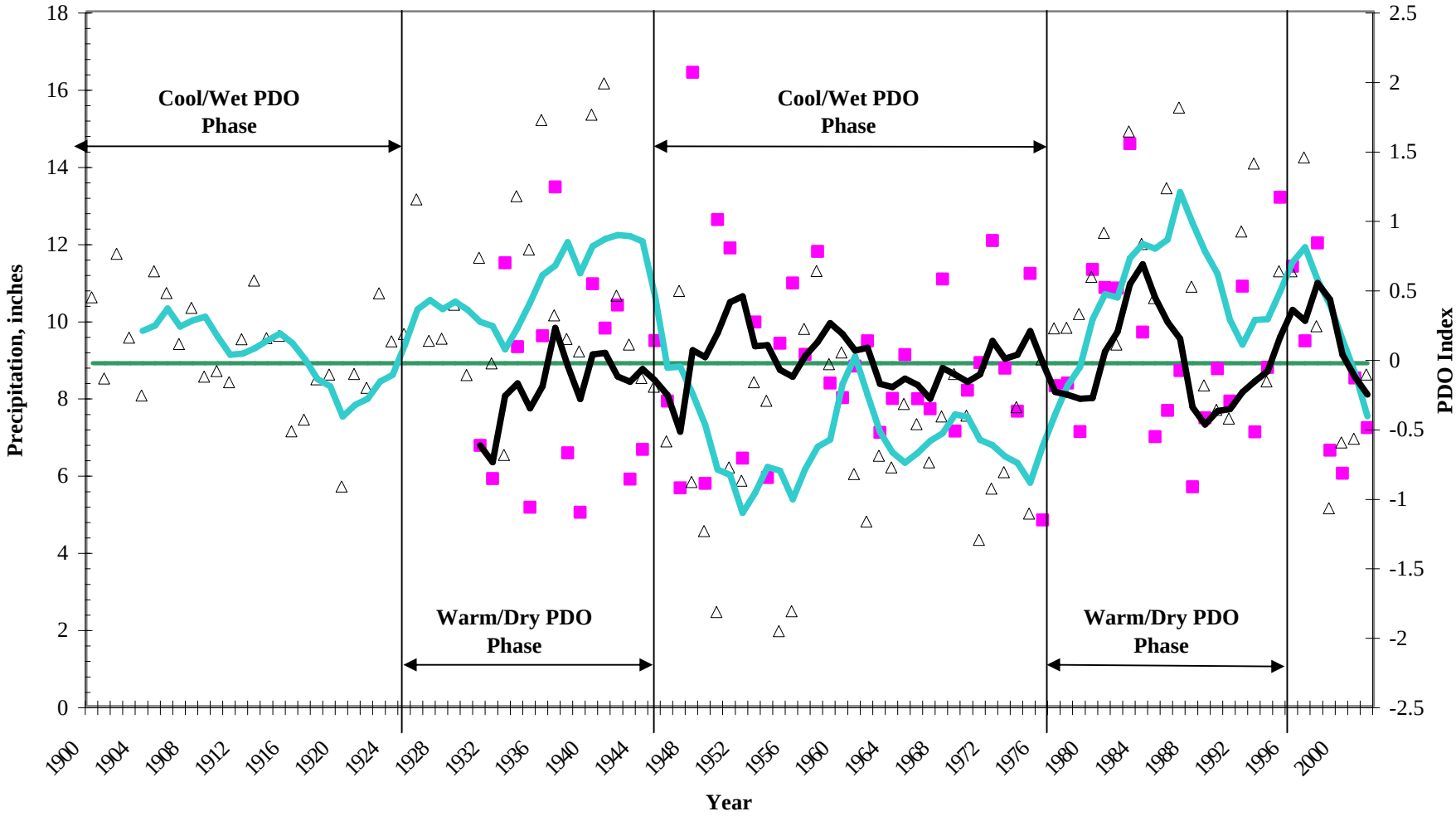
WRCC Station Number 459082
Mean Annual Precipitation = 8.4 in.
Period of Record 1959-Present

Annual Precipitation
Mean Annual Precipitation
5-Year Moving Average

Figure 3.32 Precipitation Record
Wenatchee FAA AP, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

- Wenatchee Precipitation
- Mean Annual Wenatchee Precipitation
- PDO Index: 5-Year Moving Average
- Wenatchee Precipitation: 5-Year Moving Average

Figure 3.33 Trend Analysis
PDO Index and Wenatchee Precipitation

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.

4.0 Streamflow

4.1 Streamflow Data

In the Wenatchee River watershed, precipitation falls mostly as snow. Some of the snowfall increases the volume of icefields and glaciers; the rest accumulates to the winter snowpack. The warmer temperatures and rain of spring and early summer melt the snowpack, generating water to supply streamflow. A portion of the melt water, as well as some of the rainwater, percolates through the ground to become groundwater. This same groundwater moves through the ground, re-emerging in springs, streams, and rivers, and supplies streamflow through late summer and fall.

The main surface feature of the Wenatchee River watershed is the Wenatchee River. The Wenatchee is formed by the convergence of four large tributaries, the Chiwawa, White, Little Wenatchee Rivers and Nason Creek, at or near Lake Wenatchee. The river then flows southeasterly through the Wenatchee Valley and discharges into the Columbia River at Wenatchee. The drainage area of the Wenatchee River is 1,328 square miles. The Entiat Mountains to the Northeast, the Cascade Mountains to the Northwest, and the Wenatchee Mountains to the Southwest confine the Wenatchee Watershed. The Wenatchee Watershed also includes an area west of the Columbia River from Rocky Reach Dam to just south of the City of Wenatchee.

Several data sources were searched to identify stream-gaging data available in WRIA 45 including the United States Geological Survey (USGS), the Washington Department of Ecology (Ecology), and several local organizations. A list of stations and known data availability were compiled from those sources and sorted by type of data available and subbasin. A description and discussion of specific data sources is contained within the following paragraphs.

4.1.1 United States Geological Survey

The USGS has collected stream flow data in WRIA 45 from 1907 to the present. Selected hydrologic data collected by the USGS can be downloaded from a USGS website through the Internet at the following URL: http://water.usgs.gov/. Real-time continuous data as well as historical data is available online along with descriptions and maps of the station locations. A list of stream gaging stations with known daily or monthly records is shown in Table 4-1. Map 5 shows the location of the stream gaging stations.

Table 4-1
USGS Stream Gaging Stations within WRIA 45
with Daily or Monthly Records

Agency	Station No.	Name/Location	Drainage Area (sq mi)	Data Type	Period of Record	Subbasin
USGS	12456500	Chiwawa River near Plain	170	Continuous	1911-1914, 1936-1949, 1954-1957, 1991-Present	Chiwawa
USGS	12458000	Icicle Creek above Snow Creek	193	Continuous	1936-1971, 1993-Present	Icicle
USGS	12458500	Icicle Creek near Leavenworth	211	Continuous	1911-1915	Icicle
USGS	12461400	Mission Creek above Sand Creek	39.8	Continuous	1958-1971	Mission
USGS	12451500	Sand Creek near Cashmere	18.6	Continuous	1954-1956	Mission
USGS	12462000	Mission Creek near Cashmere	81.2	Continuous	1954-1959	Mission
USGS	12456000	Phelps Creek near Plain	16.4	Continuous	1927-1931	Chiwawa
USGS	12454000	White River near Plain	150	Continuous	1954-1983	White-Little Wenatchee
USGS	12455000	Wenatchee River below Wenatchee Lake	273	Continuous	1932-1958	Wenatchee
USGS	12457000	Wenatchee River at Plain	591	Continuous	1910-1979, 1989-Present	Wenatchee
USGS	12459000	Wenatchee River at Peshastin	1,000	Continuous	1929-Present	Wenatchee
USGS	12461000	Wenatchee River at Dryden	1,155	Continuous	1907-1917	Wenatchee
USGS	12462500	Wenatchee River at Monitor	1,301	Continuous	1962-Present	Wenatchee

In addition to operating gage stations, the USGS collected miscellaneous streamflow measurements in the Wenatchee River watershed. A copy of miscellaneous USGS stream flow data for the Wenatchee watershed is provided in Appendix B.

4.1.2 Washington State Department of Ecology

Washington State Department of Ecology (Ecology) began taking streamflow measurements in WRIA 45 in 1996. They started with two stations, and now have 17 active stations and two inactive stations in the WRIA. Some of the active stations were recently installed using

Watershed Planning grant funding. Those stations include 45A240, 45E070, 45F070, 45G060, 45J070, 45K090, 45L110, and 45N060.

Real time continuous data is available from telemetry sites, while stand-alone and manual stage height sites have continuous or periodic data compiled. Table 4-2 lists the Ecology stream gaging stations with continuous recorded data while Table 4-3 lists the other stations where manual measurements are taken. Map 5 shows the location of the Ecology gaging stations. Data from those sites can be obtained from the Ecology website at: http://www.ecy.wa.gov/apps/watersheds/flows/regions/state.asp .

Table 4-2
Ecology Stream Gaging Stations within WRIA 45
with Daily Records

Agency	Station No.	Name/Location	Drainage Area (sq mi)	Data Type	Period of Record	Subbasin
DOE	45A240	Wenatchee River below Lake Wenatchee	NA	Continuous telemetered	2002-Present	Wenatchee
DOE	45B050	Icicle Creek near mouth	NA	Stand Alone	2002-Present	Icicle
DOE	45E070	Mission Creek near Cashmere	93.1	Continuous telemetered	1996-2000, 2002-Present	Mission
DOE	45F070	Peshastin Creek at Green Bridge Road	NA	Continuous telemetered	2002-Present	Peshastin
DOE	45G060	Chiwaukum Creek near mouth	50.0	Continuous telemetered	2002-Present	Wenatchee
DOE	45J070	Nason Creek near mouth	107.8	Continuous telemetered	2002-Present	Nason
DOE	45K090	White River near Plain	156.2	Continuous telemetered	2002-Present	White-Little Wen.
DOE	45L110	Little Wenatchee River below Rainy Creek	101.2	Continuous telemetered	2002-Present	White-Little Wen.
DOE	45N060	Rock Creek near mouth	NA	Continuous telemetered	2002-Present	Chiwawa

Table 4-3
Ecology Stream Gaging Stations within WRIA 45
with Daily or Monthly Records

Agency	Station No.	Name/Location	Drainage Area (sq mi)	Data Type	Period of Record	Subbasin
DOE	45A100	Wenatchee River at Leavenworth	NA	Manual Stage Height	2002-Present	Wenatchee
DOE	45A110	Wenatchee River near Leavenworth	NA	Manual Stage Height	2002-Present	Wenatchee
DOE	45C070	Chumstick Creek near Leavenworth	NA	Manual Stage Height	1998-2002	Wenatchee
DOE	45D070	Brender Creek near Cashmere	NA	Manual Stage Height	1996-2000	Mission
DOE	45H060	Chiwawa River near Schugart Flat	NA	Manual Stage Height	2002-Present	Chiwawa
DOE	45K070	White River near mouth	NA	Manual Stage Height	2002-Present	White-Little Wen.
DOE	45L070	Little Wenatchee River near mouth	NA	Manual Stage Height	2002-Present	White-Little Wen.
DOE	45M060	Rainy Creek near mouth	NA	Manual Stage Height	2002-Present	White-Little Wen.
DOE	45P050	White Pine Creek at mouth	NA	Manual Stage Height	2002-Present	Nason
DOE	45Q060	Eagle Creek near mouth	28.0	Manual Stage Height	2002-Present	Wenatchee

Because the continuous Ecology gaging stations were installed in summer 2002, sufficient data are not yet available to analyze. Streamflow data from those stations can be obtained from the Ecology website address provided on the previous page.

4.2 Analysis Of Surface Water Data

Daily streamflow data were analyzed to find seasonal, annual, and long-term climate trends. The seasonal and annual analyses were conducted by water year. The long-term climate trends were examined using data compiled into calendar years because the PDO and ENSO indices are compiled by calendar year.

4.2.1 Seasonal Data Analysis

Most WRIA 45 rivers and streams follow a snowmelt pattern of flow, where streamflow increases in spring and early summer due to melting snow in the mountains. The spring snowmelt generally begins in April, and streamflow returns to base flow by September. Figures 4.1 through 4.13 present a statistical analysis of the variation of flow throughout the year in the 13 gaged streams in the basin.

The statistical analysis uses recorded daily streamflow but analyzes that data on a weekly basis. The analysis produces low, median, and high flow exceedence probability estimates for each week during the year. Low flow is defined as the 90 percent exceedence probability, and is equal to the flow rate that occurred 9 years out of 10 for a particular period of time. The median flow is defined as the 50 percent exceedence probability, and is equal to the flow rate that occurred five years out of ten. High flow is defined as the 10 percent exceedence probability, and is equal to the flow rate that occurred one year out of ten. Tabulated summaries of the statistical analyses are provided in Appendix C.

As an example of the distribution of streamflow through the year, the percentage of streamflow in the Wenatchee River as measured at the Monitor gage is shown in Table 4-4. The greatest volume of flow (approximately 75% of the annual total) occurs in the March through July time period. In the August through October time period, less than 10% of the annual flow occurs. The lowest flow in the Wenatchee River occurs in late September and early October and ranges from approximately 500 cfs at Plain to 670 cfs at Monitor, both estimated for median streamflow years. In low flow years, streamflow ranges from 320 cfs at Plain to 370 cfs at Monitor.

Table 4-4
Distribution of Streamflow for Wenatchee River at Monitor Gage

Month	Estimated Monthly % of Annual	Cumulative %
October	3	3
November	4	7
December	4	11
January	4	15
February	3	18
March	7	25
April	11	36
May	21	57
June	27	84
July	9	93
August	4	97
September	3	100

4.2.2 Annual Data Analysis and Variations Due to Climate Cycles

A summary of annual average flows at various locations in the Wenatchee basin is presented in Table 4-5. The table includes historical streamflow records from stations no longer operating as well as stations that are still in service. Each gaged location is included, along with the percent of flow it contributes to the Wenatchee River at Monitor. Two of the major subbasins, Nason Creek and Peshastin Creek, do not have historical gages. Their annual streamflow and percent contribution was not estimated.

Table 4-5
Mean Annual Flows in WRIA 45

Name/Location	Drainage Area		Period of Record Streamflows [b]		
	Square Miles	Percent [a]	Mean Annual Flow (cfs)	Mean Annual Volume (acre-feet)	Percent [a]
Chiwawa River near Plain	170	13.1%	501	361,716	14.6%
Icicle Creek above Snow Creek	193	14.8%	620	448,385	18.1%
Icicle Creek near Leavenworth	211	16.2%	669	483,484	19.5%
Mission Creek above Sand Creek	39.8	3.1%	13	9,565	0.4%
Sand Creek near Cashmere	18.6	1.4%	5	3,403	0.1%
Mission Creek near Cashmere	81.2	6.2%	30	21,587	0.9%
Phelps Creek near Plain	16.4	1.3%	54	39,075	1.6%
Nason Creek[c]	108	8.3%	N/A	N/A	N/A
Peshastin Creek[c]	133	10.2%	N/A	N/A	N/A
White River near Plain	150	11.5%	811	586,107	23.7%
Wenatchee River below Wenatchee Lake	273	21.0%	1,319	952,977	38.5%
Wenatchee River at Plain	591	45.4%	2,285	1,651,470	66.8%
Wenatchee River at Peshastin	1,000	76.9%	3,099	2,239,941	90.5%
Wenatchee River at Dryden	1,155	88.8%	3,280	2,370,422	95.8%
Wenatchee River at Monitor	1,301	100.0%	3,423	2,474,040	100.0%

a Compared to values for the Wenatchee River at Monitor.
b From USGS for varying periods of record.
c Gage data not available, no estimate provided.

4.2.3 Effects of Climate Variability on Streamflow

Section 3.3.2 described the effects of climatic cycles on precipitation. The changes in precipitation directly affect the volume and timing of streamflow. The mean annual flow for the Wenatchee River at Peshastin, the stream gage with the longest record in the basin, is compared to the PDO index in Figure 4.14. The Wenatchee River at Peshastin generally shows a trend of lower mean annual flows during warm and dry periods and higher mean annual flows during cold and wet periods. Table 4-6 shows the mean annual streamflow during cold and wet PDO phases as well as warm and dry PDO phases. There is an approximate 300 cfs difference in flow between both PDO phases and the mean annual flow. The difference in flow between the warm, dry PDO phase and cold wet phases of the PDO cycle is almost 600 cfs.

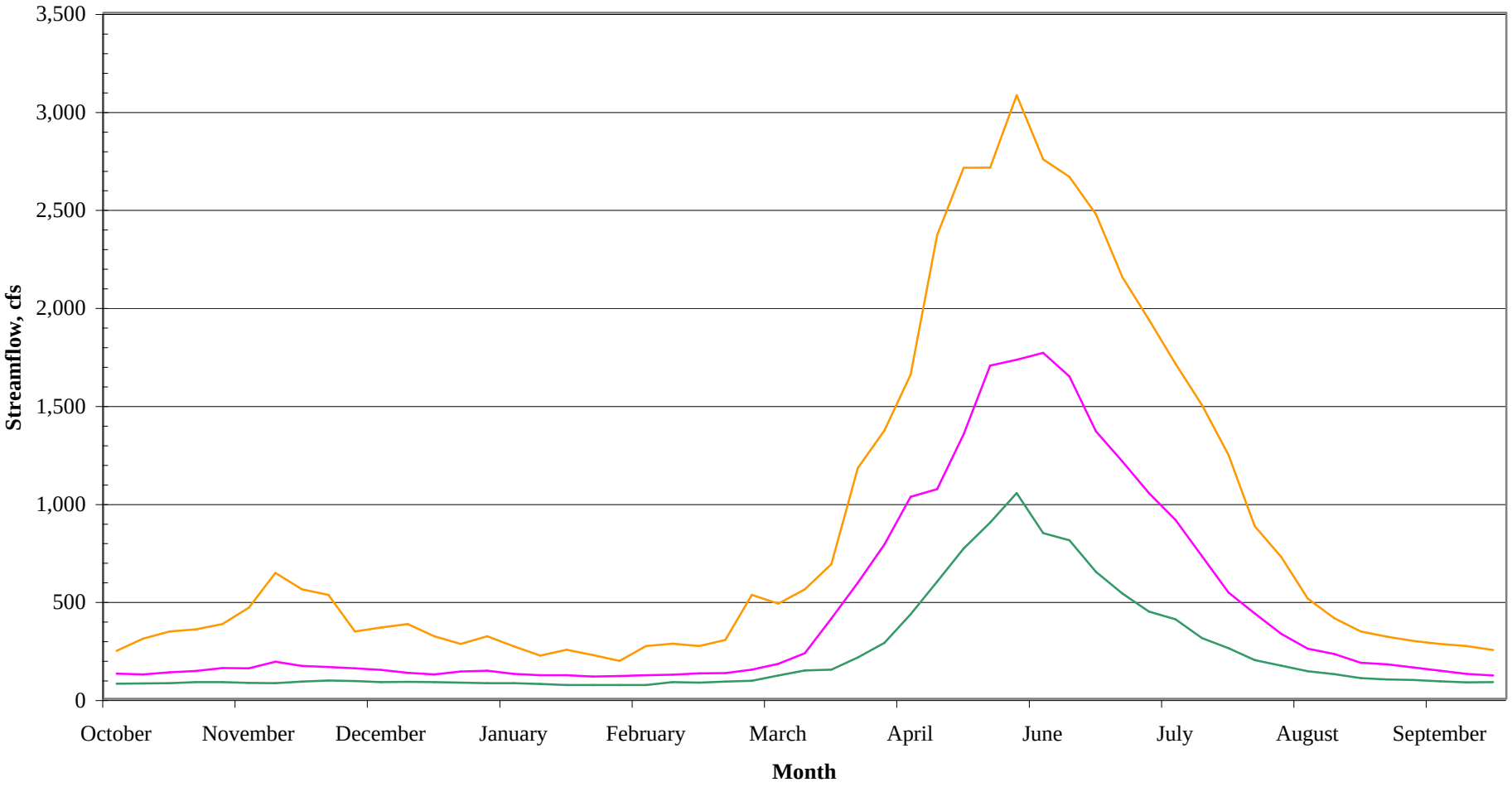
Table 4-6
Mean Annual Streamflow in the Wenatchee River at Peshastin

Entire Period of Record		Warm, Dry PDO Phase		Cool, Wet PDO Phase	
Period	**Mean Annual Streamflow, cfs**	**Period**	**Mean Annual Streamflow, cfs**	**Period**	**Mean Annual Streamflow, cfs**
1910-Present	3,112	1925-1945	2,815	1946-1976	3,424
		1977-1995	2,847	1996-Present	3,360
		All Warm, Dry Years	2,830	All Cold, Wet Years	3,404
		Difference from Entire Period of Record	-282	Difference from Entire Period of Record	+292

Trends in late summer and fall streamflows do not always correspond to trends in annual flows because the majority of runoff volume occurs during springtime. Trends in low flows were evaluated by examining the annual 7-day and 30-day low flows in the White River near Plain, Wenatchee River below Wenatchee Lake, Wenatchee River at Plain, Wenatchee River at Peshastin, and Wenatchee River at Monitor (Figures 4.15 through 4.24). Not all of the streamflow records are long enough to ascertain trends or effects on low flows from climatic cycles but the stations with the two longest records (Wenatchee River at Plain and Wenatchee River at Peshastin) generally show lower low flows in the warm, dry PDO phase than the cool, wet PDO phase. Table 4-7 presents a comparison of the means of the annual 30-day low flows during warm, dry and cold, wet PDO phases. The comparison shows the 30-day low flows during a warm, dry PDO phase are approximately 100 cfs less than the mean of the annual 30-day low flows for the entire period of record. The 30-day low flow during a cool, wet PDO phase is approximately 90 cfs greater than the mean of the annual 30-day low flows for the period of record.

Table 4-7
Comparison of Mean of Annual 30-Day Low Flows
In The Wenatchee River At Peshastin

Entire Period of Record		Warm, Dry PDO Phase		Cool, Wet PDO Phase	
Period	**Mean of Annual 30-day low flow, cfs**	**Period**	**Mean of Annual 30-day low flow, cfs**	**Period**	**Mean of Annual 30-day low flow, cfs**
1910-Present	664	1925-1945	523	1946-1976	780
		1977-1995	600	1996-Present	643
		All Warm, Dry Years	565	All Cold, Wet Years	755
		Difference from Entire Period of Record	-99	Difference from Entire Period of Record	+91



Legend

USGS Gage 12456500
Period of Record 1911-1914, 1936-1950,
1954-58, 1967, 1970, 1975-1977, 1991-2002

90% Exceedence
50% Exceedence
10% Exceedence

Figure 4.1 Weekly Streamflow Exceedence Probability
Chiwawa River near Plain, WA

Wenatchee River Basin Watershed Assessment

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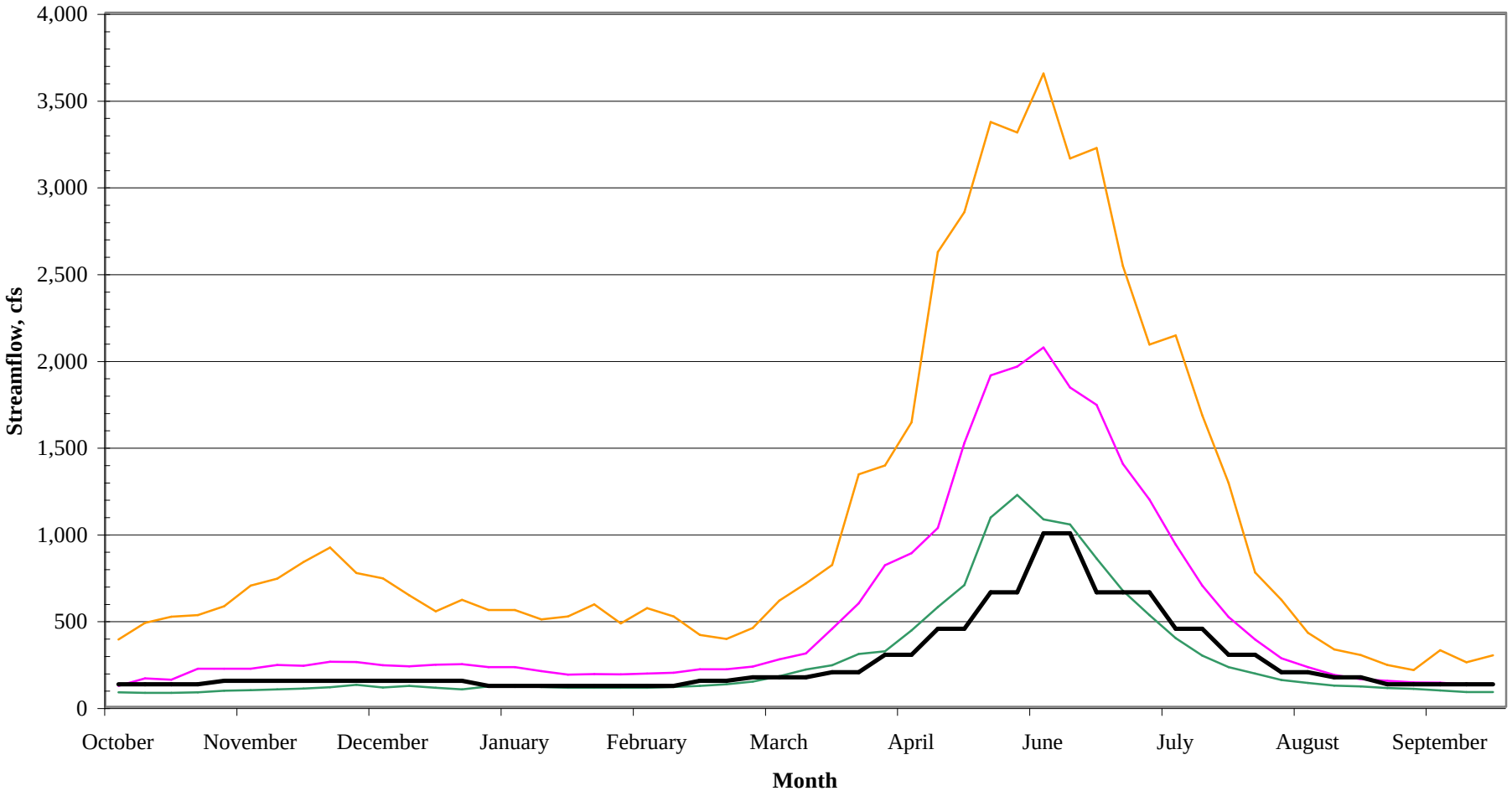

Legend

USGS Gage 12458000
Period of Record 1936-1972, 1975, 1976, 1977, 1994-2001

90% Exceedence
50% Exceedence
10% Exceedence
Minimum Flow from WAC

Figure 4.2 Weekly Streamflow Exceedence Probability
Icicle Creek above Snow Creek near Leavenworth, WA

Wenatchee River Basin Watershed Assessment

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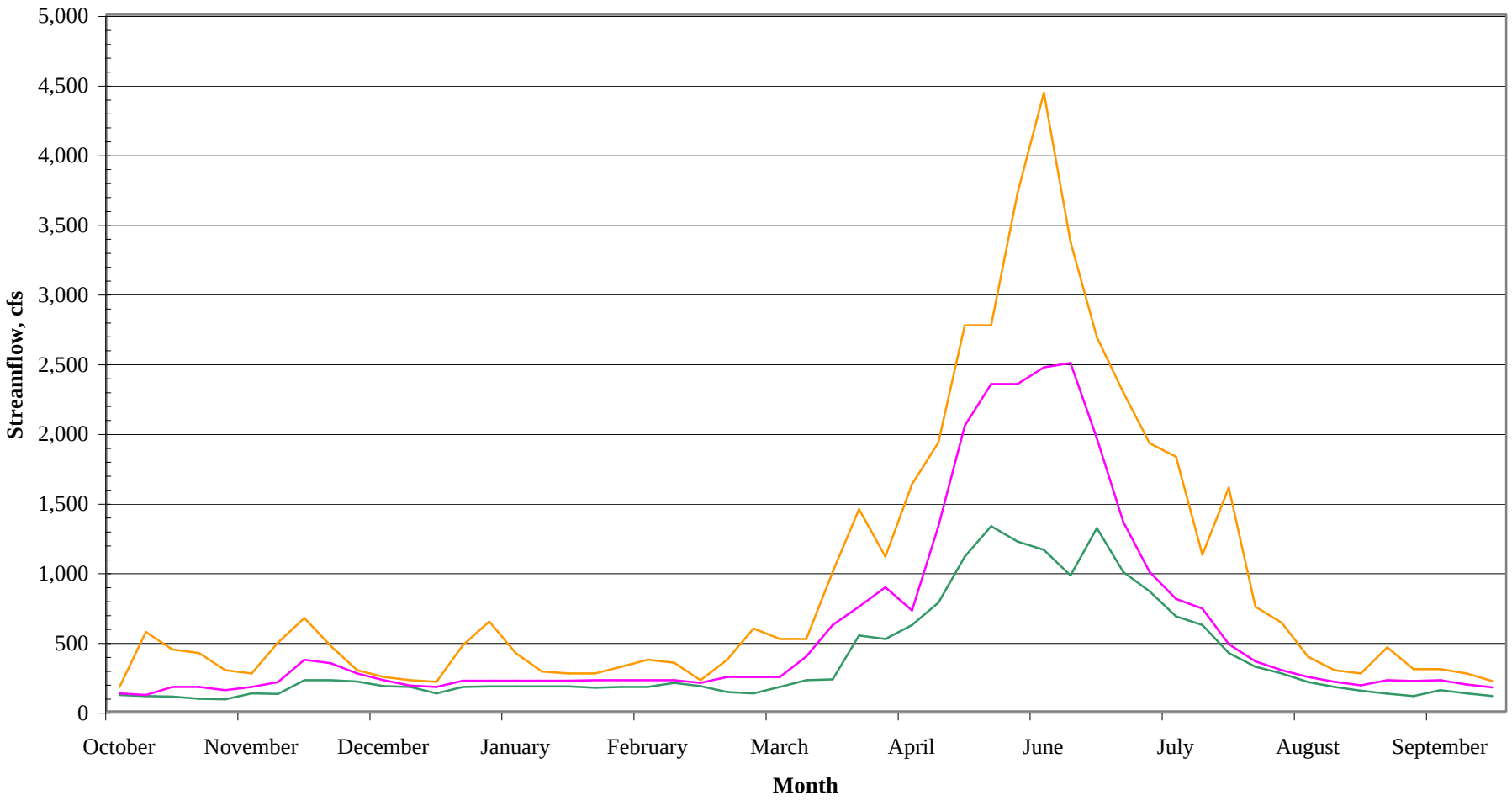

Legend

USGS Gage 12458500
Period of Record 1911-1914

90% Exceedence
50% Exceedence
10% Exceedence

Figure 4.3 Weekly Streamflow Exceedence Probability
Icicle Creek near Leavenworth, WA

Wenatchee River Basin Watershed Assessment

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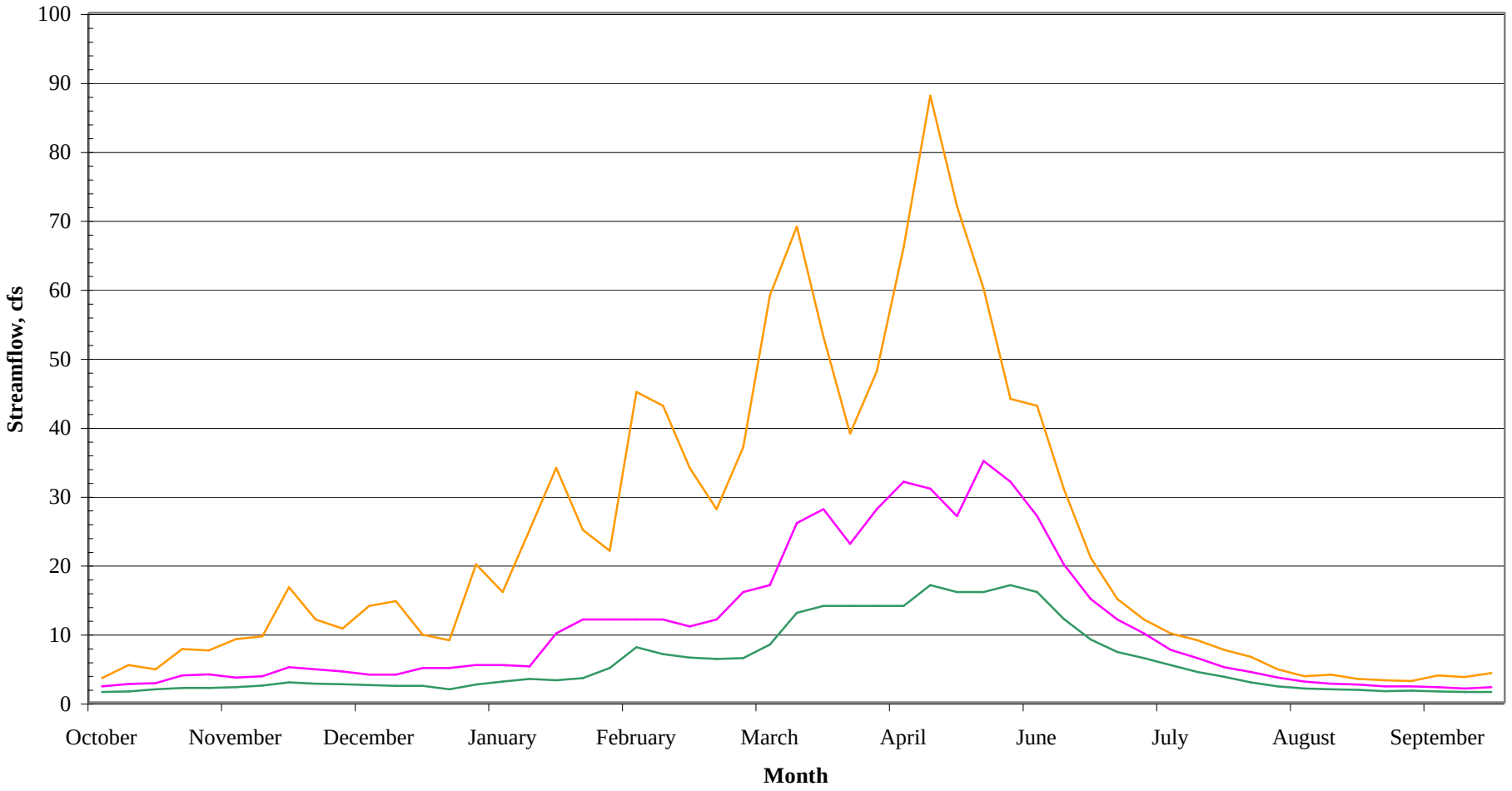

Legend

USGS Gage 12461400
Period of Record 1959-1972, 1975-1977

90% Exceedence
50% Exceedence
10% Exceedence

Figure 4.4 Weekly Streamflow Exceedence Probability
Mission Creek above Sand Creek near Cashmere, WA

Wenatchee River Basin Watershed Assessment

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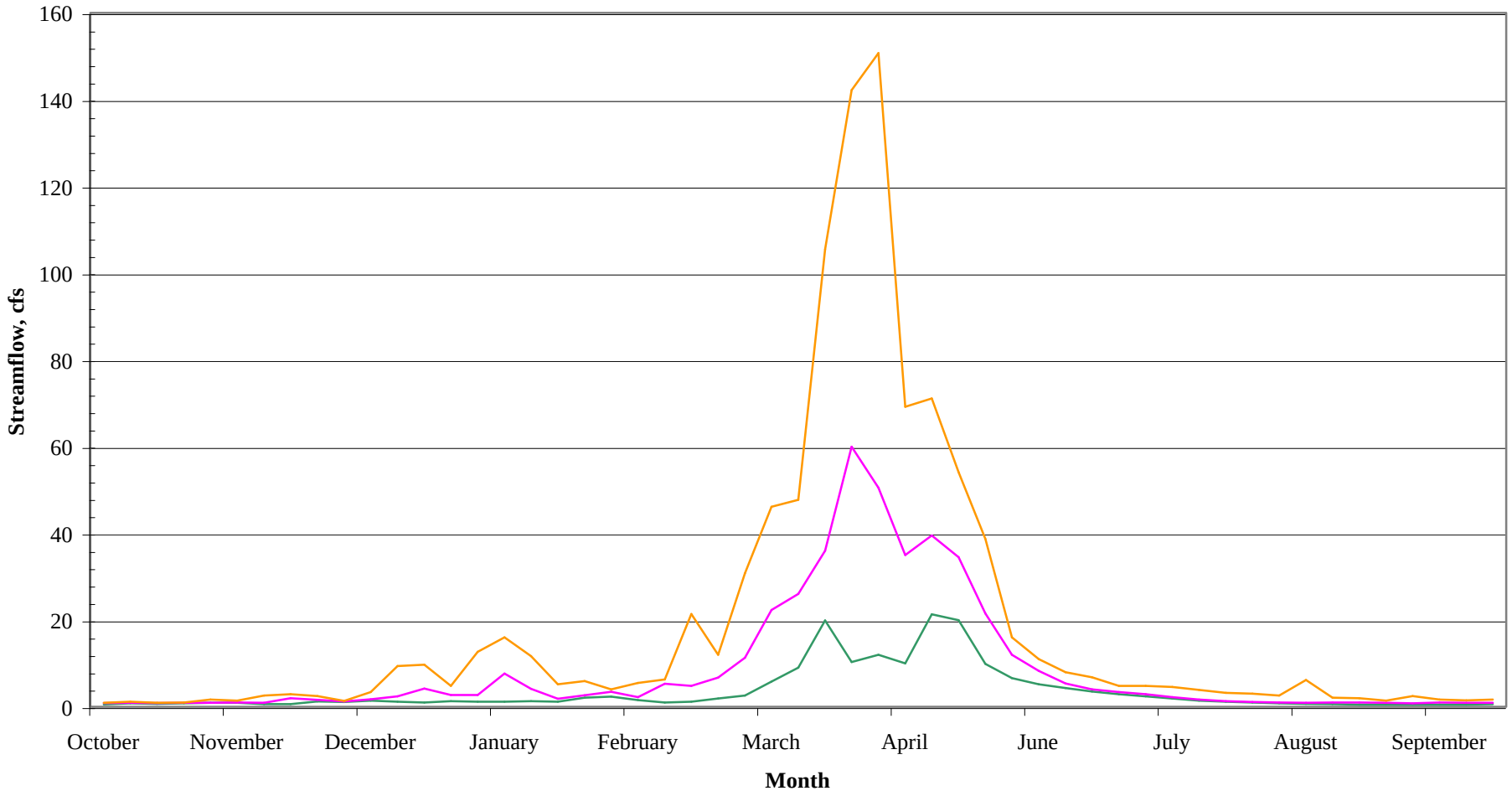

Legend

USGS Gage 12461500
Period of Record 1954-1956

90% Exceedence
50% Exceedence
10% Exceedence

Figure 4.5 Weekly Streamflow Exceedence Probability
Sand Creek near Cashmere, WA

Wenatchee River Basin Watershed Assessment

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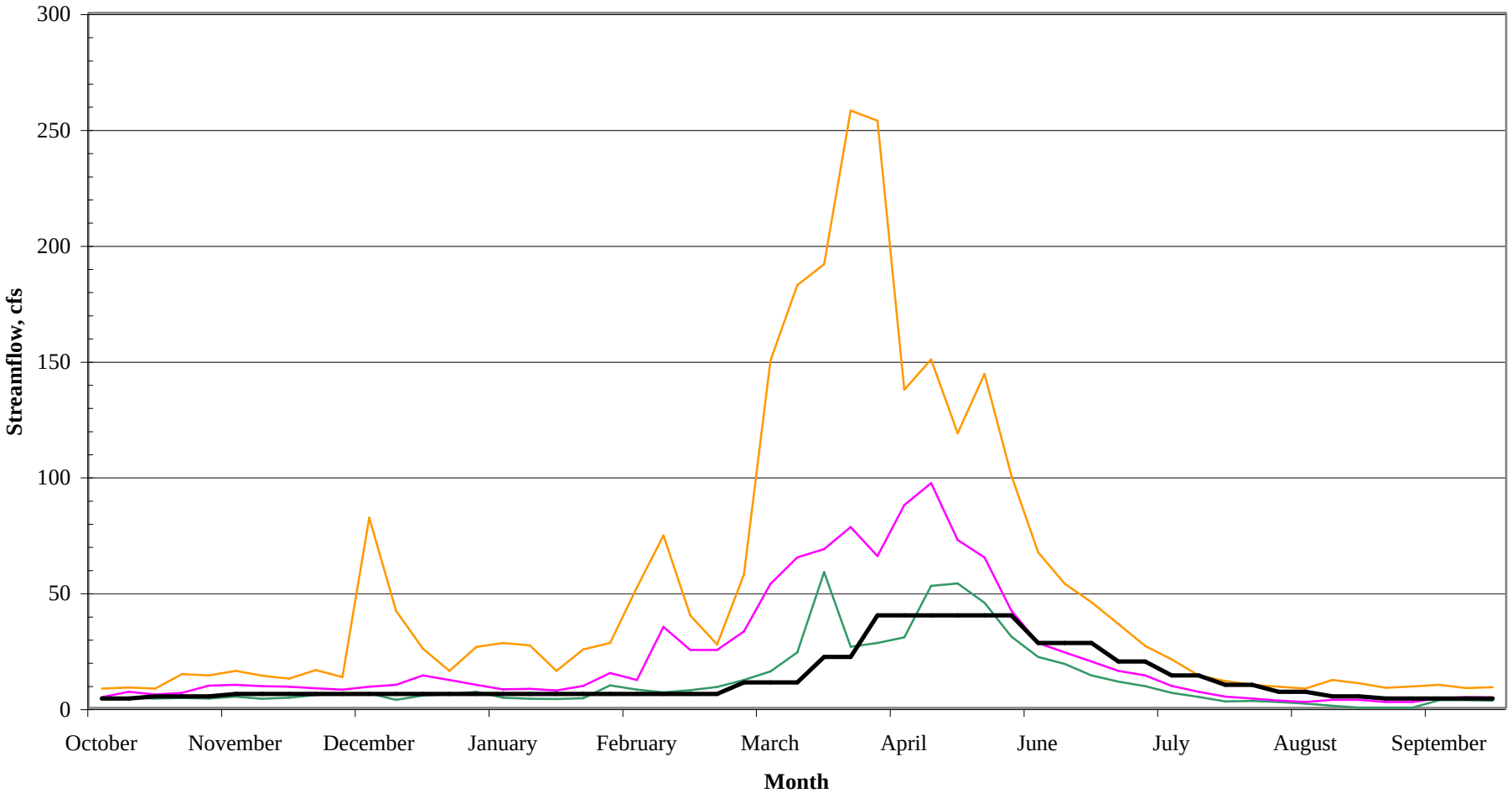

Legend

USGS Gage 12462000
Period of Record 1954-1958

90% Exceedence
50% Exceedence
10% Exceedence
Minimum Flow from WAC

Figure 4.6 Weekly Streamflow Exceedence Probability
Mission Creek near Cashmere, WA

Wenatchee River Basin Watershed Assessment

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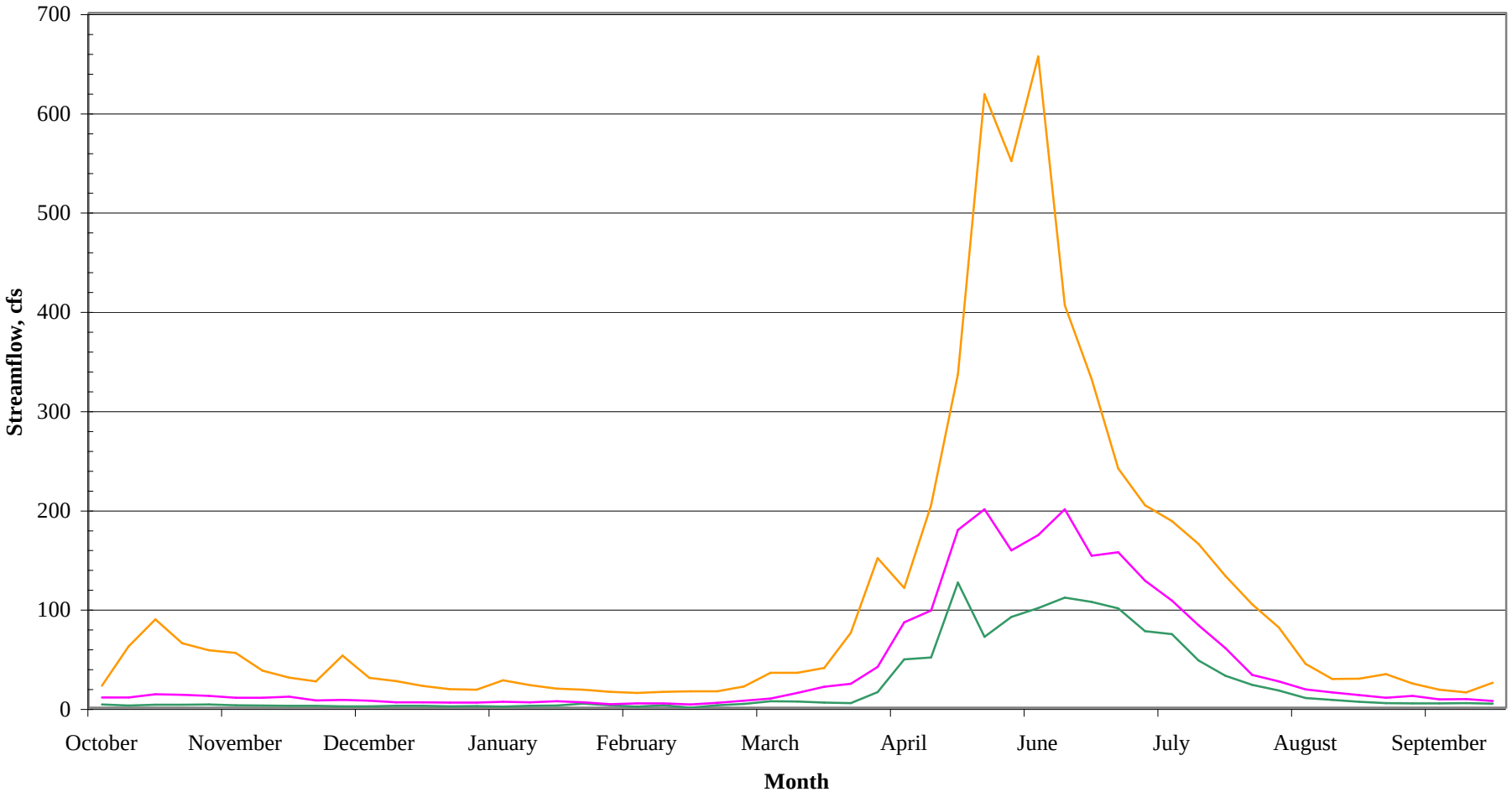

Legend

USGS Gage 12456000
Period of Record 1926-1931

90% Exceedence
50% Exceedence
10% Exceedence

Figure 4.7 Weekly Streamflow Exceedence Probability
Phelps Creek near Plain, WA

Wenatchee River Basin Watershed Assessment

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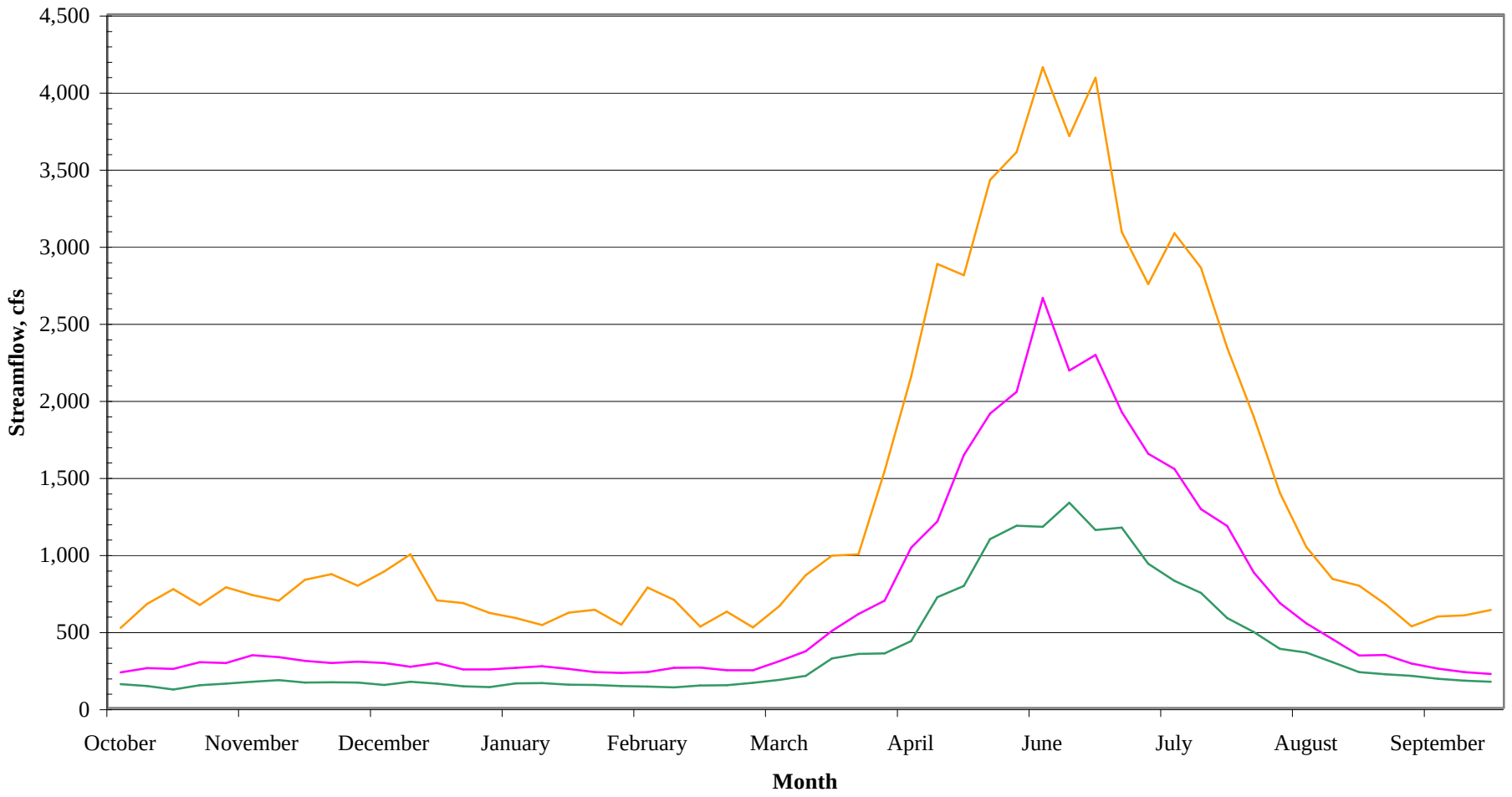

Legend

USGS Gage 12454000
Period of Record 1954-1984

90% Exceedence
50% Exceedence
10% Exceedence

Figure 4.8 Weekly Streamflow Exceedence Probability
White River near Plain, WA

Wenatchee River Basin Watershed Assessment

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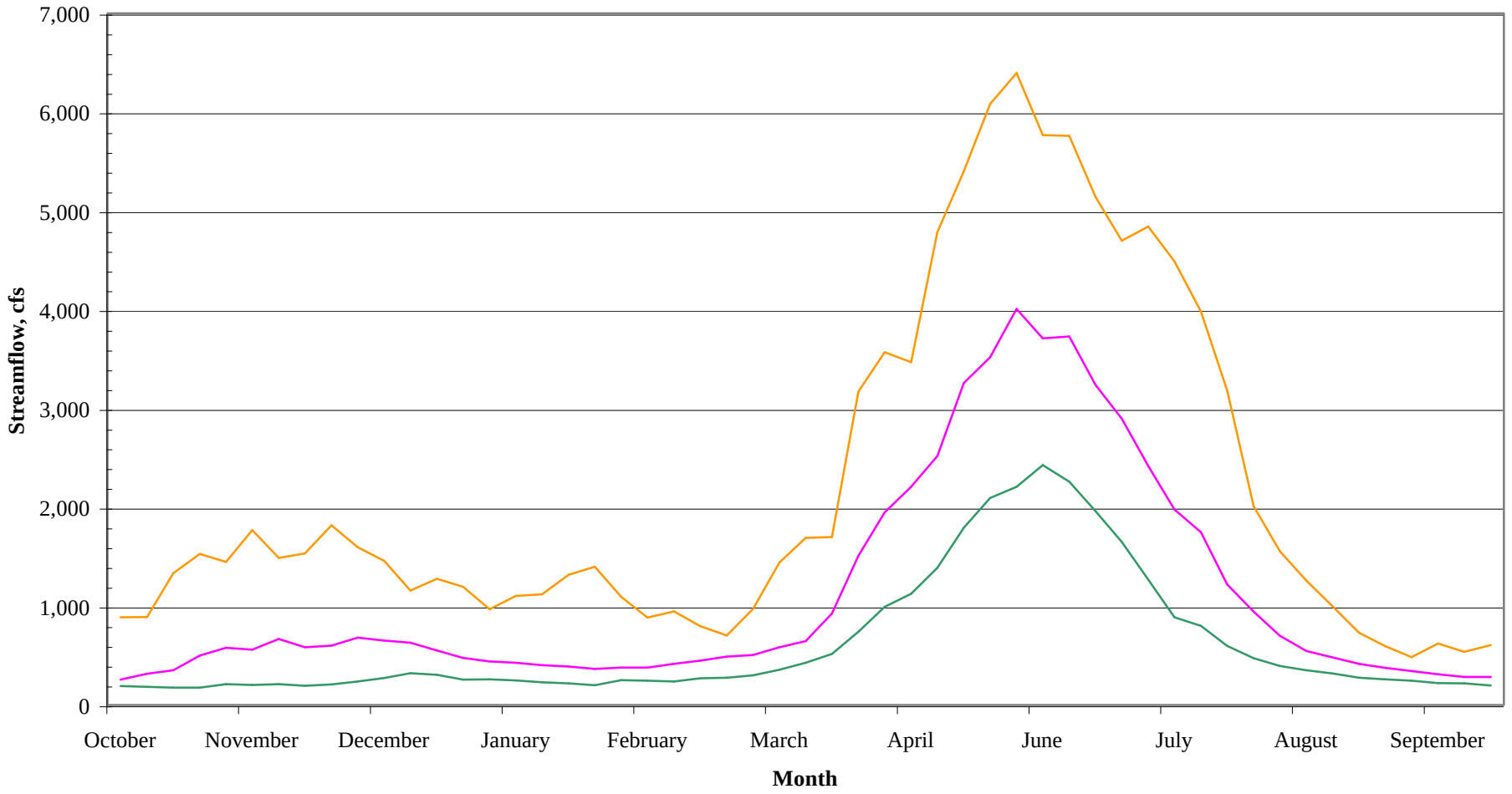


Legend

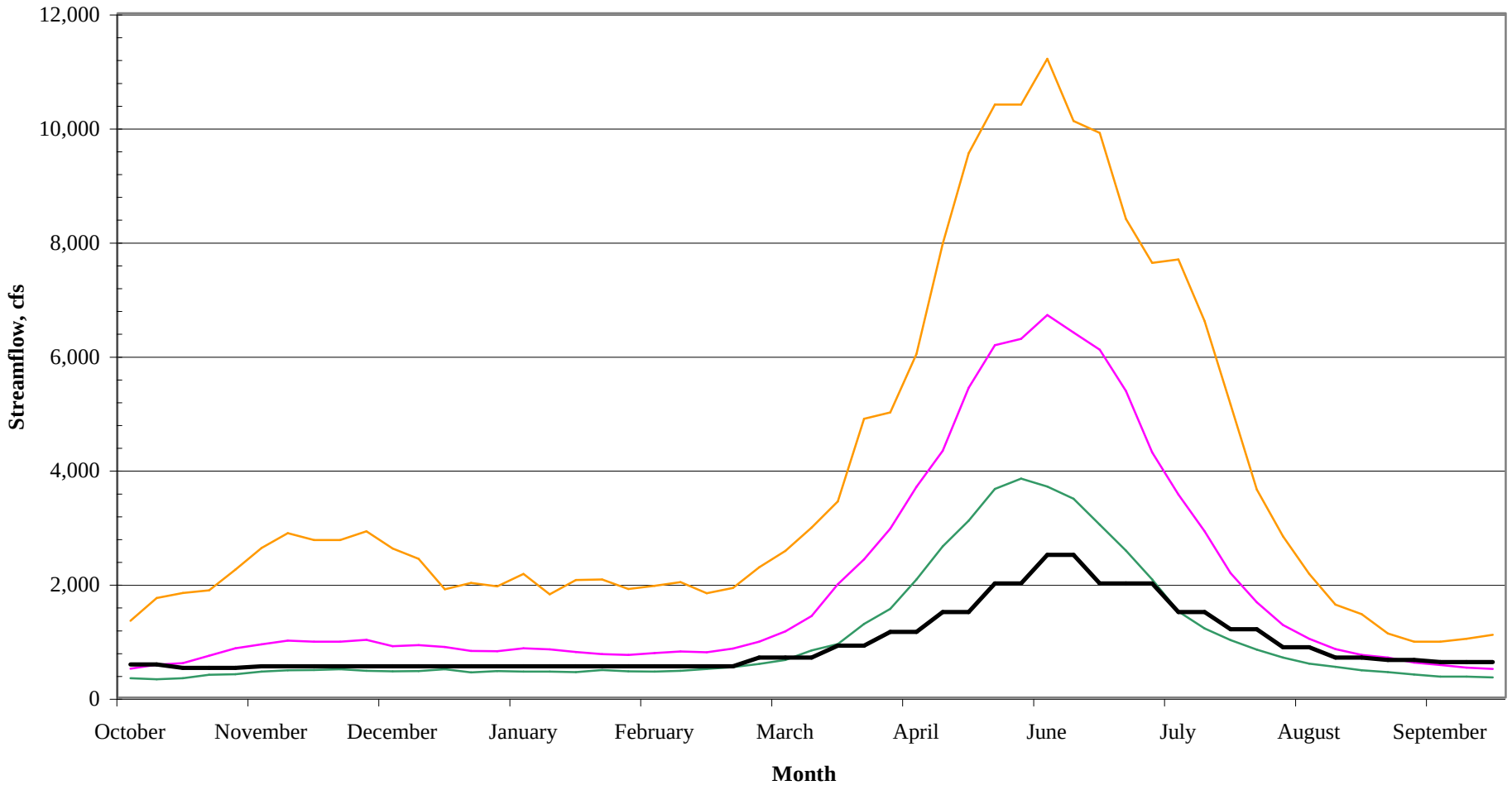
USGS Gage 12455000
Period of Record 1932-1958

90% Exceedence
50% Exceedence
10% Exceedence

Figure 4.9 Weekly Streamflow Exceedence Probability
Wenatchee River below Wenatchee Lake, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

USGS Gage 12457000
Period of Record 1911-1929,
1930-1980, 1989-2002

90% Exceedence
50% Exceedence
10% Exceedence
IRPP Flows

Figure 4.10 Weekly Streamflow Exceedence Probability
Wenatchee River at Plain, WA

Wenatchee River Basin Watershed Assessment

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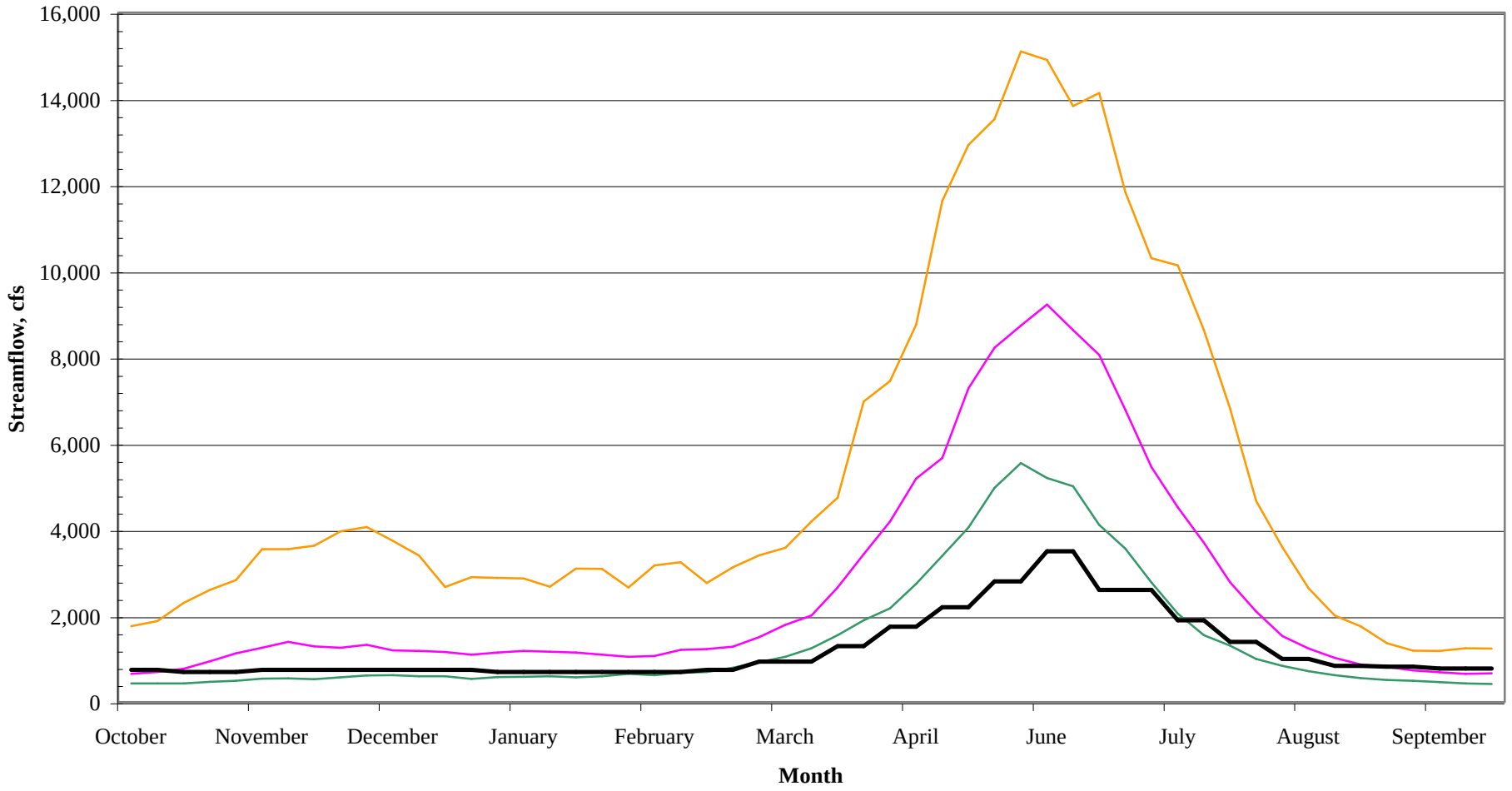


Legend

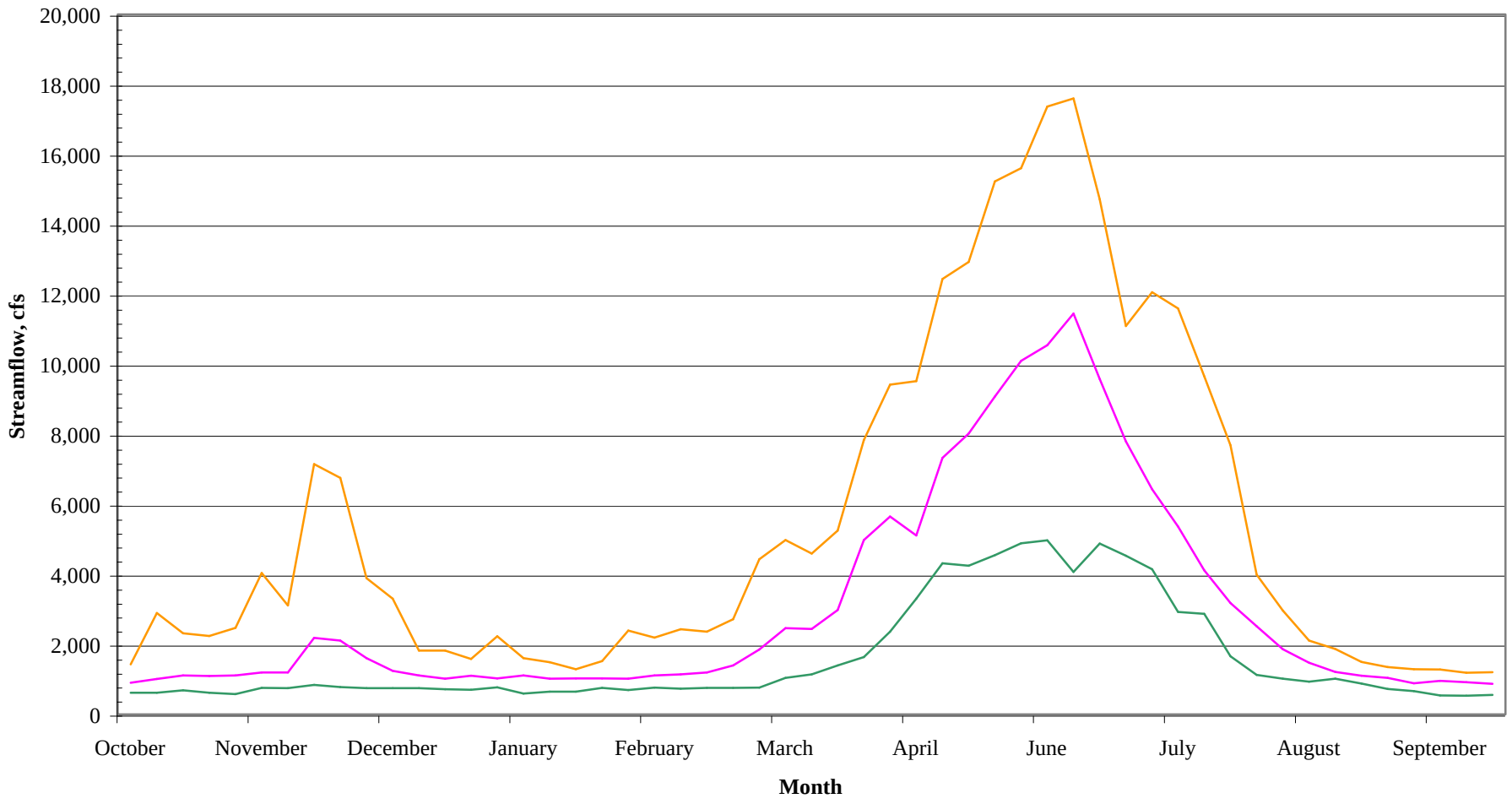
USGS Gage 12459000
Period of Record 1929-2002

- 90% Exceedence
- 50% Exceedence
- 10% Exceedence
- Minimum Flow from WAC

Figure 4.11 Weekly Streamflow Exceedence Probability
Wenatchee River at Peshastin, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

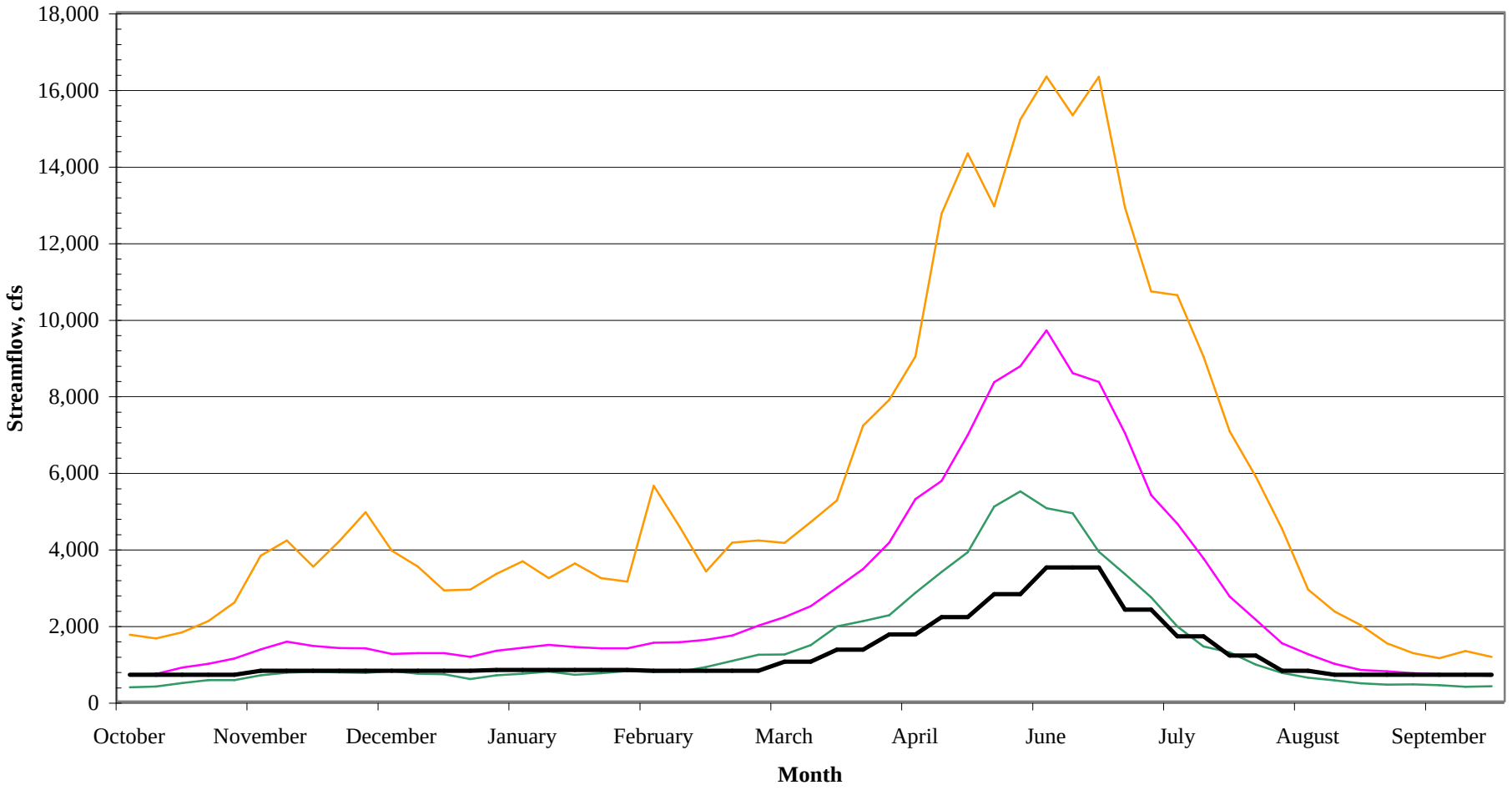
USGS Gage 12461000
Period of Record 1907-1915,1917

90% Exceedence
50% Exceedence
10% Exceedence

Figure 4.12 Weekly Streamflow Exceedence Probability
Wenatchee River at Dryden, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

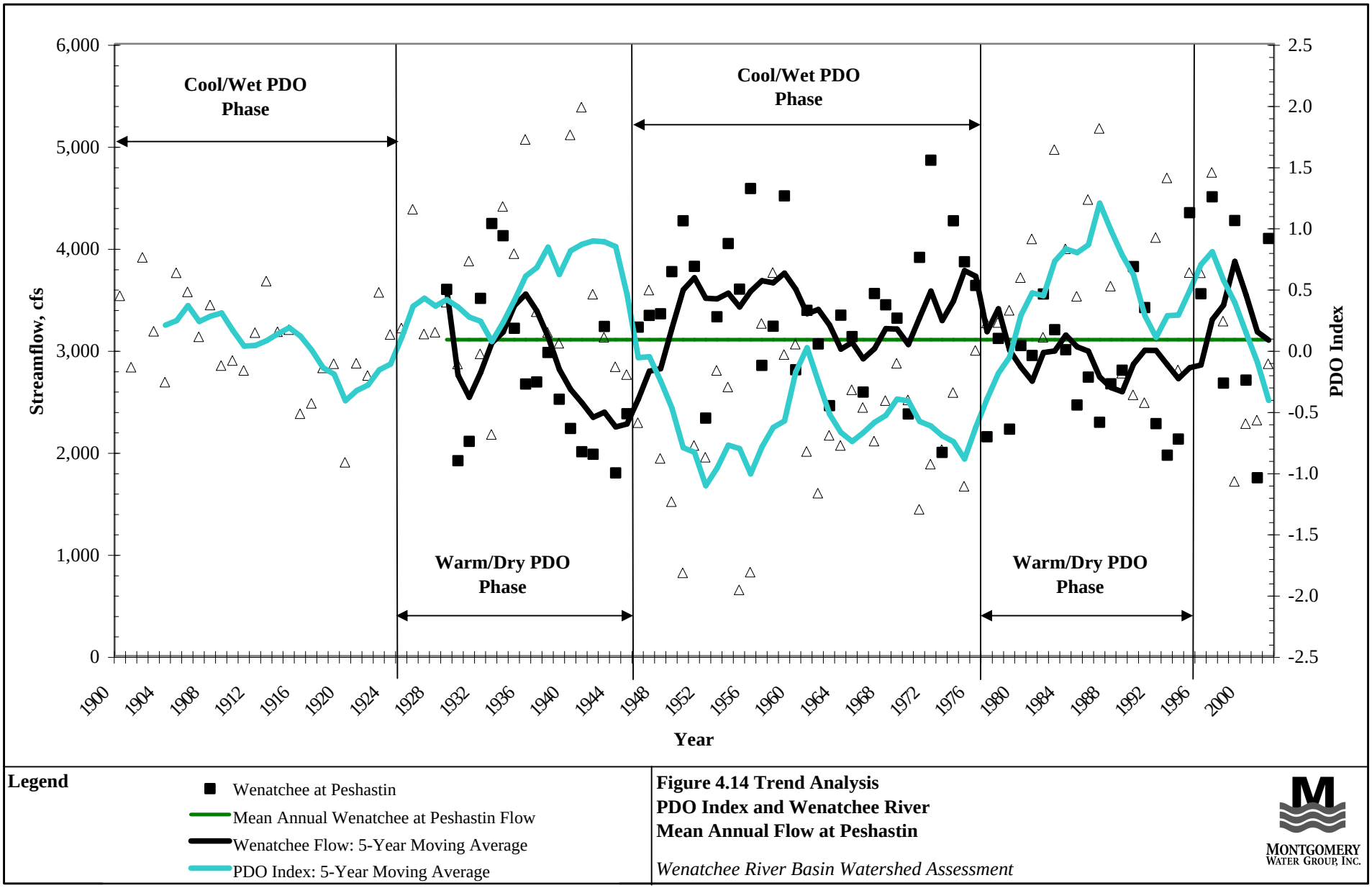
USGS Gage 12462500
Period of Record 1963-2002

90% Exceedence
50% Exceedence
10% Exceedence
Minimum Flow from WAC

Figure 4.13 Weekly Streamflow Exceedence Probability
Wenatchee River at Monitor, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Legend

- Wenatchee at Peshastin
- Mean Annual Wenatchee at Peshastin Flow
- Wenatchee Flow: 5-Year Moving Average
- PDO Index: 5-Year Moving Average

Figure 4.14 Trend Analysis
PDO Index and Wenatchee River
Mean Annual Flow at Peshastin

Wenatchee River Basin Watershed Assessment

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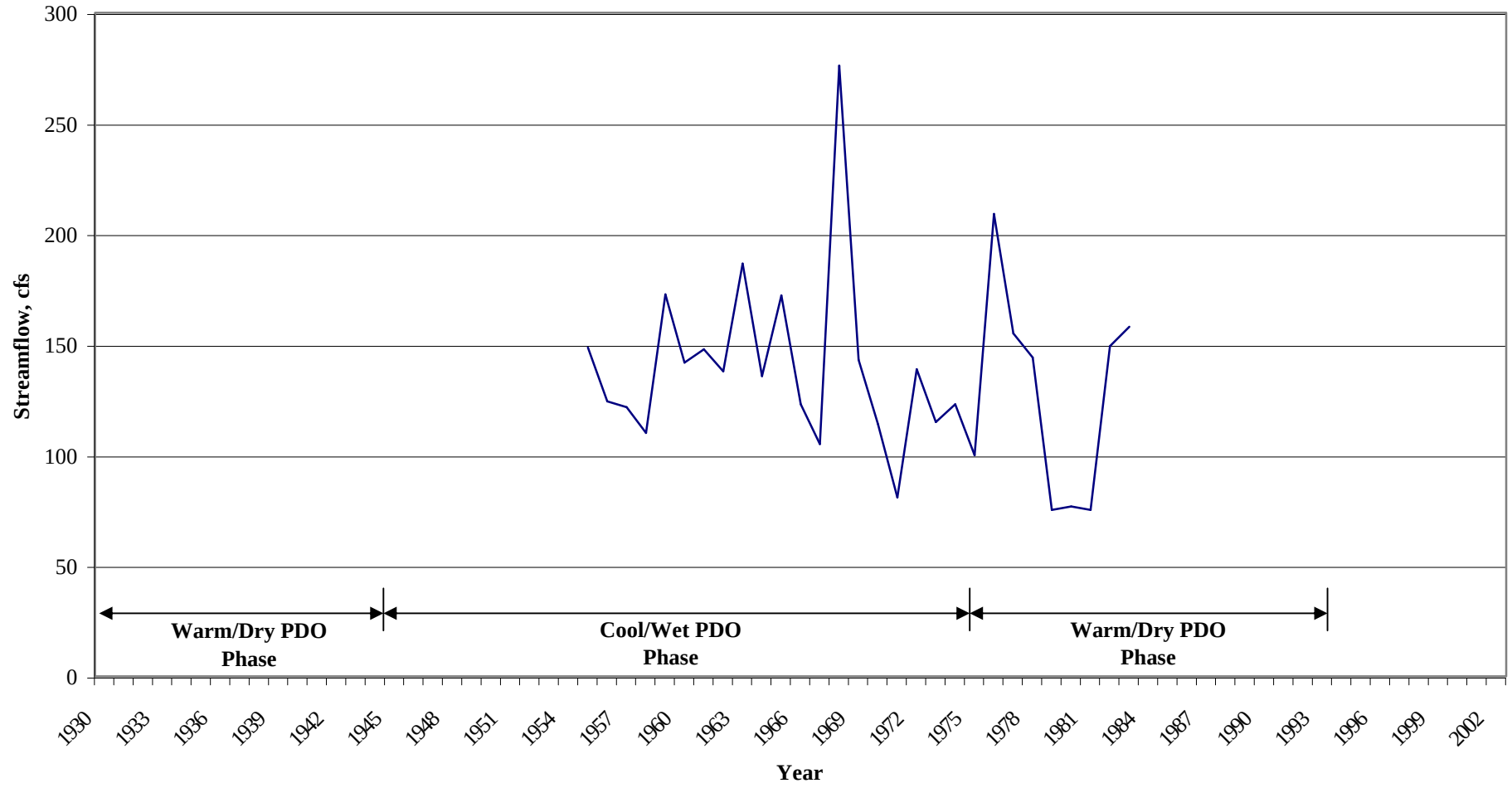


Note: Only includes years with a full data set.

Legend

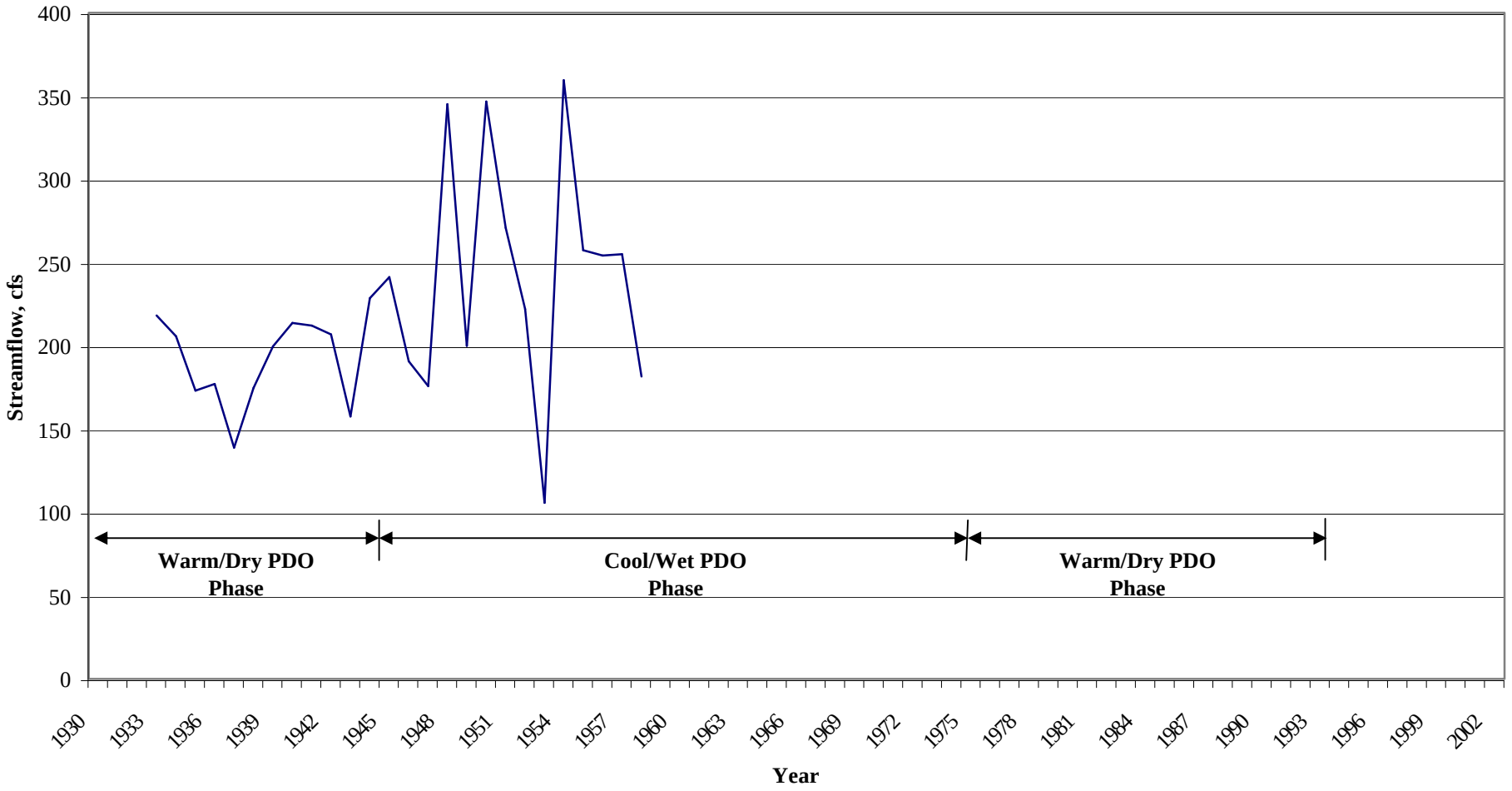
USGS Gage 12454000
Period of Record 1954-1984

Annual 7 - Day Low Flow

Figure 4.15 7-Day Low Flows
White River near Plain, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Note: Only includes years with a full data set.

Legend

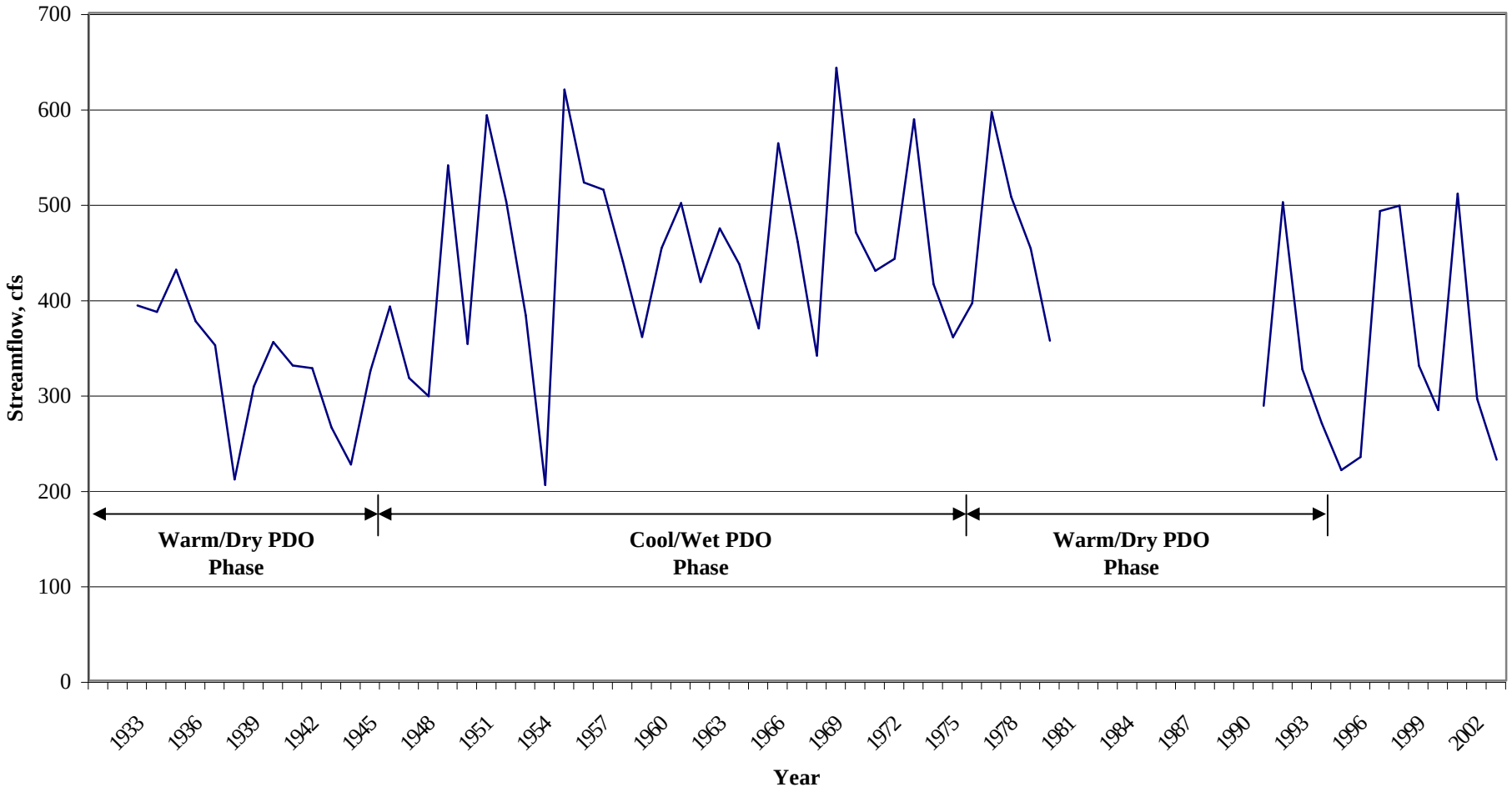
USGS Gage 12455000
Period of Record 1932-1958

Annual 7 - Day Low Flow

Figure 4.16 7-Day Low Flows
Wenatchee River below Wenatchee Lake, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Note: Only includes years with a full data set.

Legend

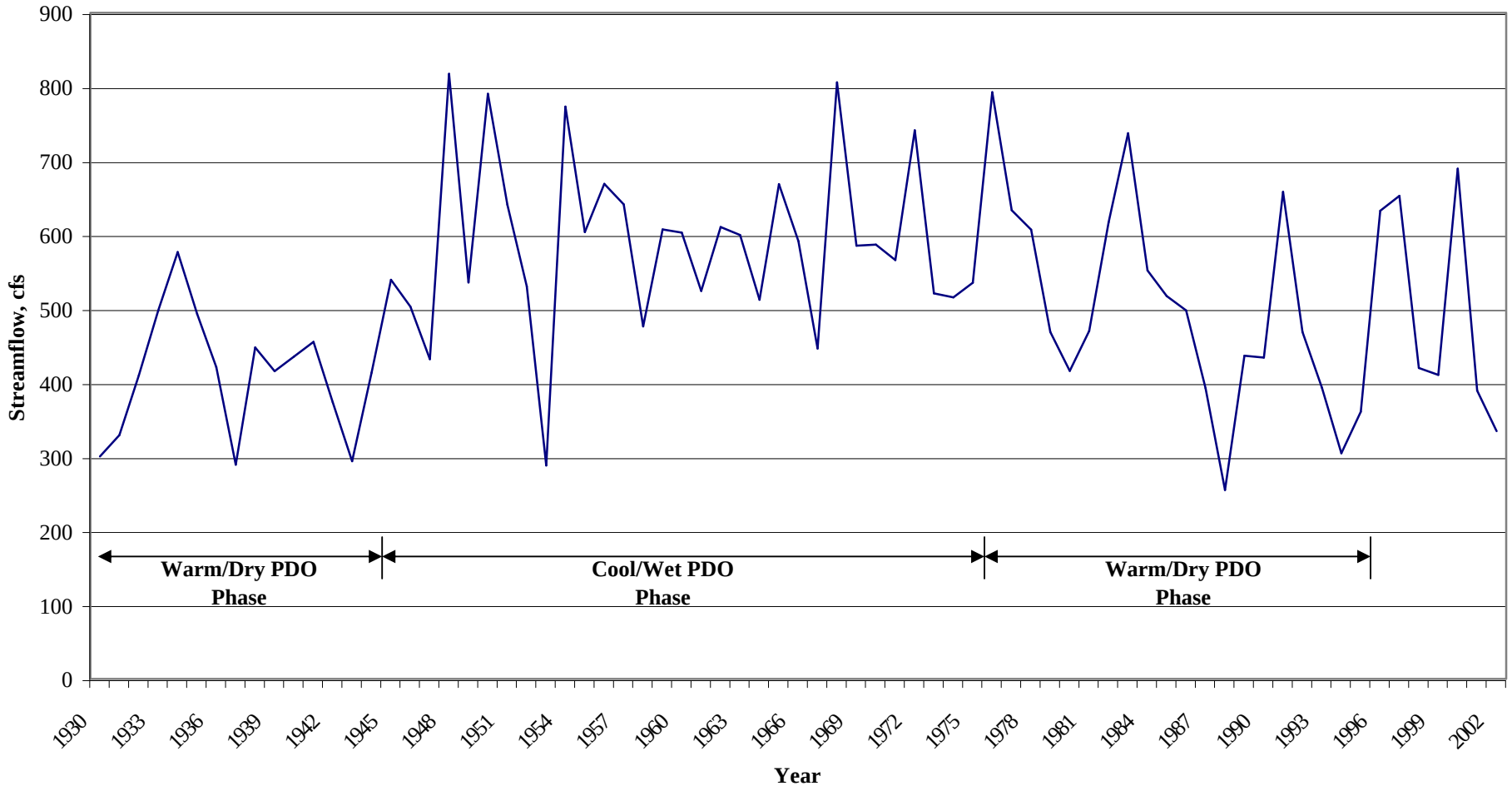
USGS Gage 12457000
Period of Record 1911-1929,
1930-1980, 1989-2002

Annual 7 - Day Low Flow

Figure 4.17 7-Day Low Flows
Wenatchee River at Plain, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Note: Only includes years with a full data set.

Legend

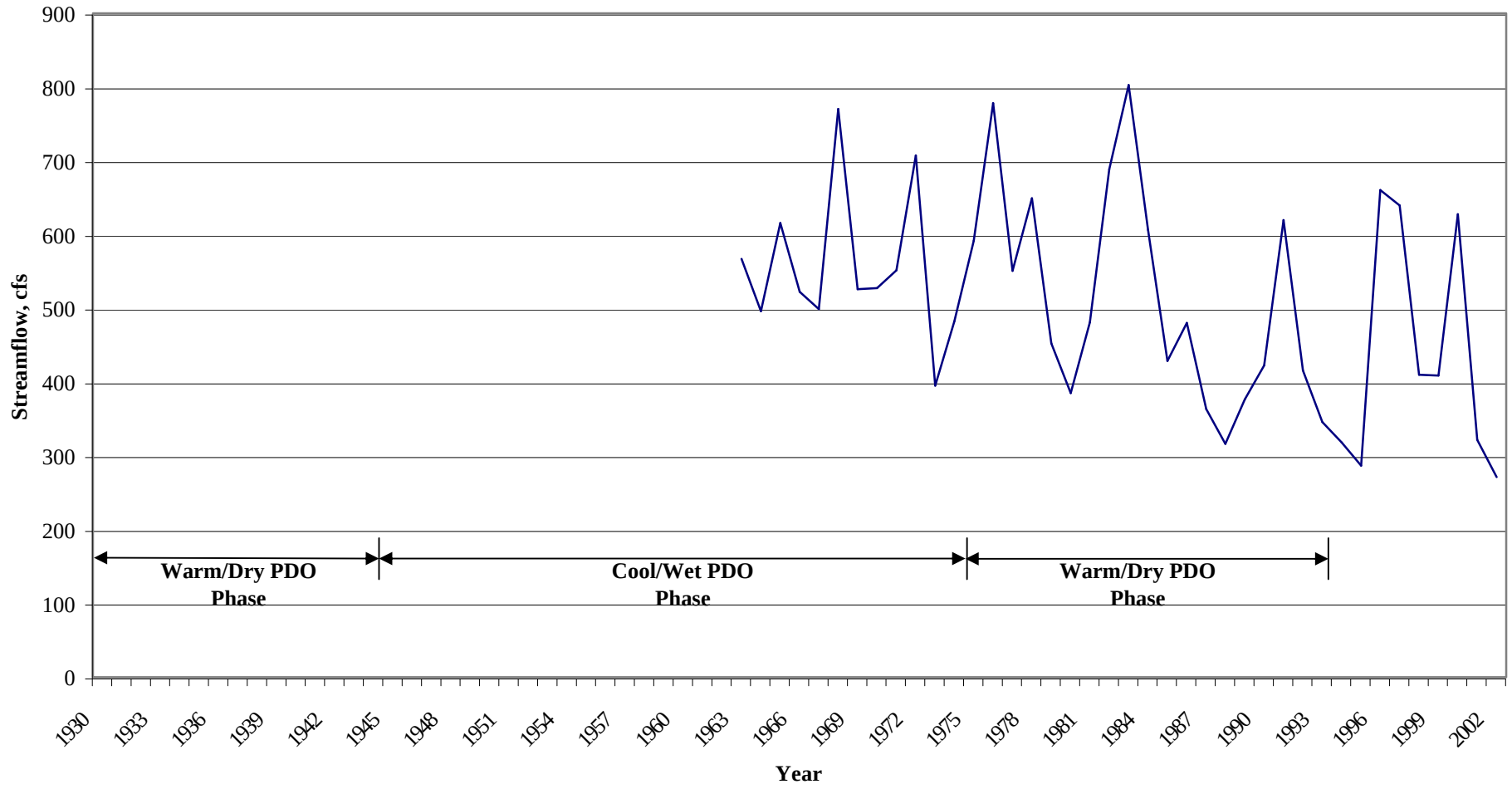
USGS Gage 12459000
Period of Record 1929-2002

Annual 7 - Day Low Flow

Figure 4.18 7-Day Low Flows
Wenatchee River at Peshastin, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Note: Only includes years with a full data set.

Legend

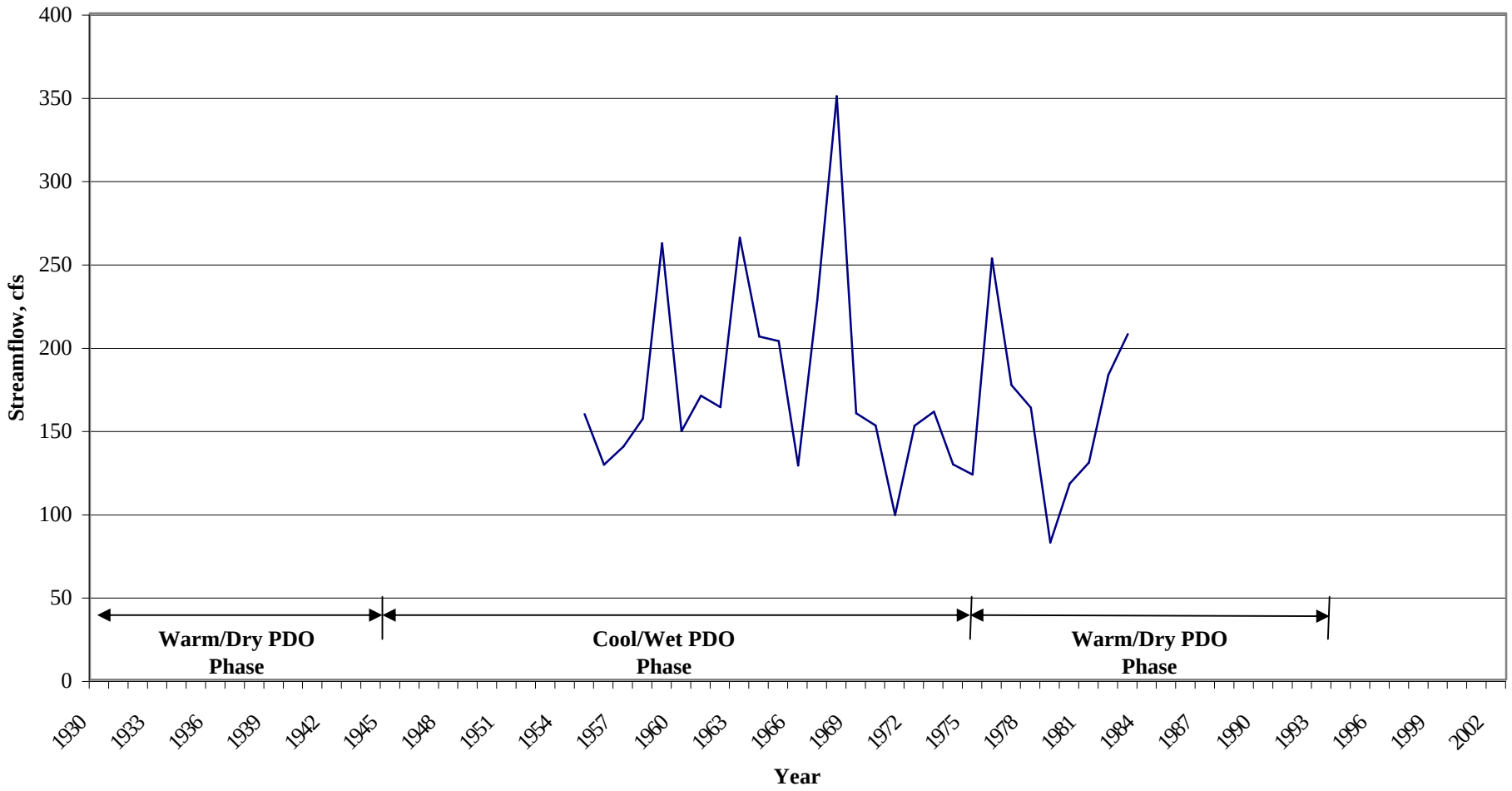
USGS Gage 12462500
Period of Record 1963-2002

Annual 7 - Day Low Flow

Figure 4.19 7-Day Low Flows
Wenatchee River at Monitor, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Note: Only includes years with a full data set.

Legend

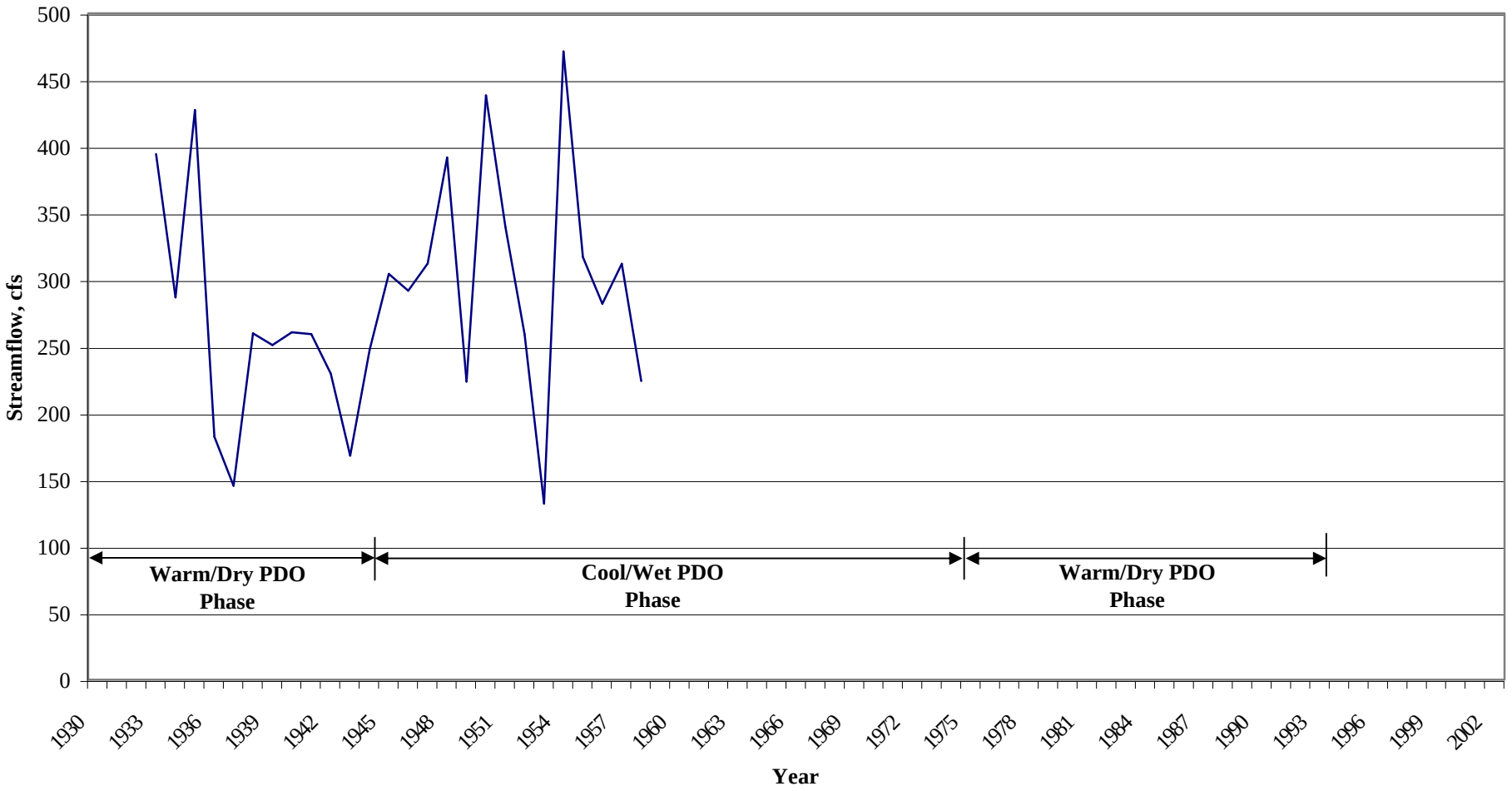
USGS Gage 12454000
Period of Record 1954-1984

Annual 30 - Day Low Flow

Figure 4.20 30-Day Low Flows
White River near Plain, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Note: Only includes years with a full data set.

Legend

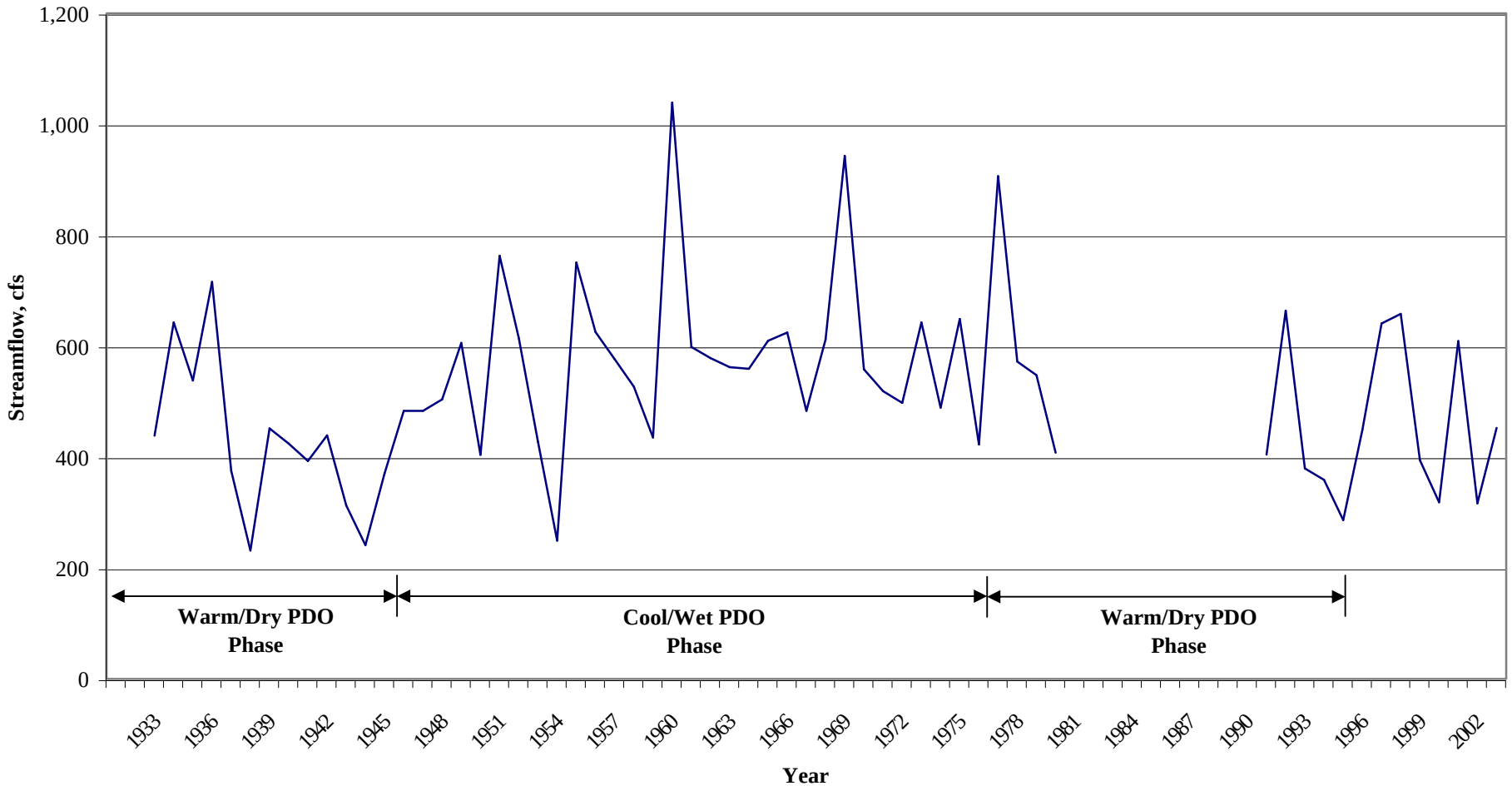
USGS Gage 12455000
Period of Record 1932-1958

Annual 30 - Day Low Flow

Figure 4.21 30-Day Low Flows
Wenatchee River below Wenatchee Lake, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Note: Only includes years with a full data set.

Legend

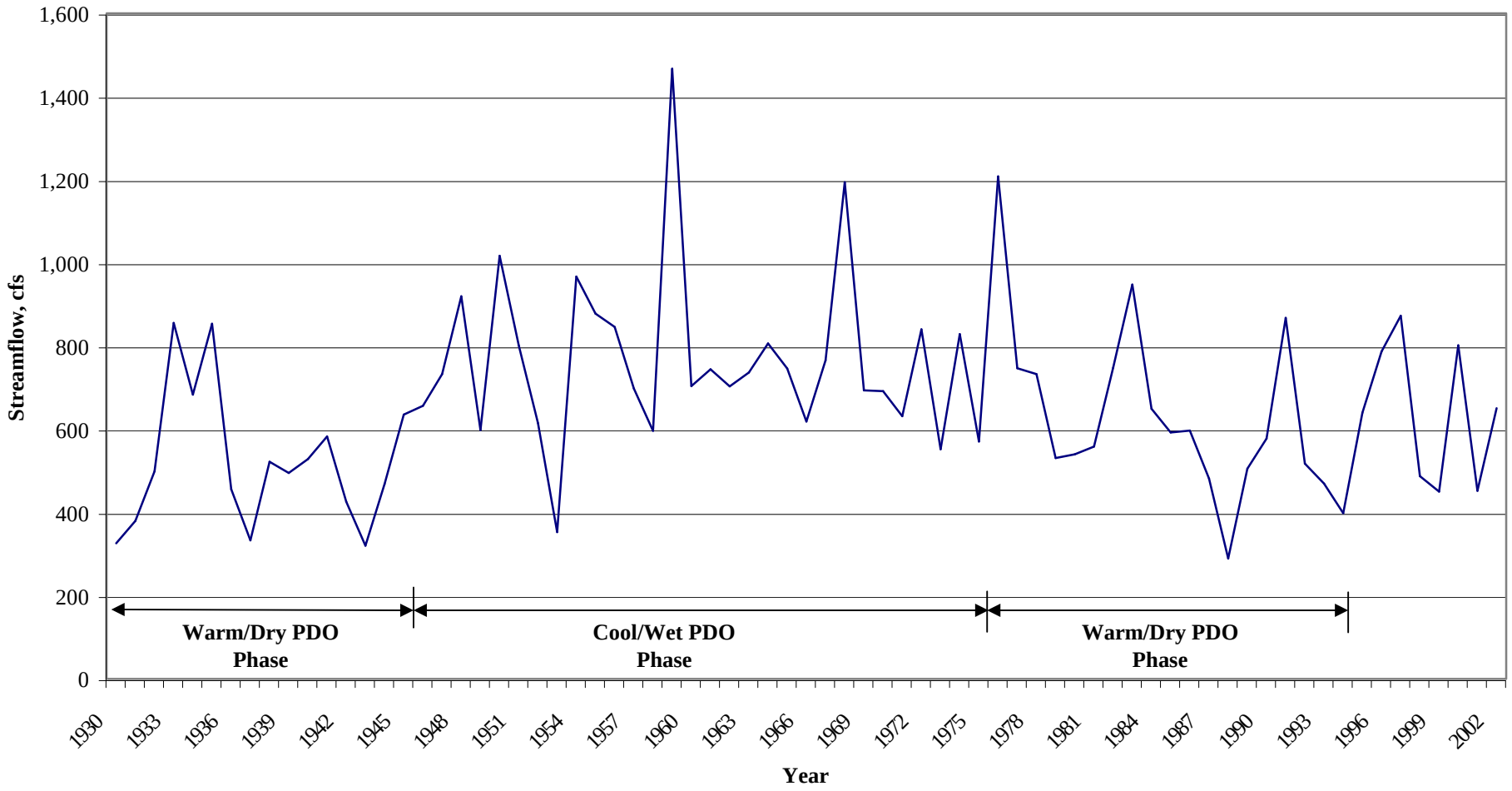
USGS Gage 12457000
Period of Record 1911-1929, 1930-1980, 1989-2002

Annual 30 - Day Low Flow

Figure 4.22 30-Day Low Flows
Wenatchee River at Plain, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Note: Only includes years with a full data set.

Legend

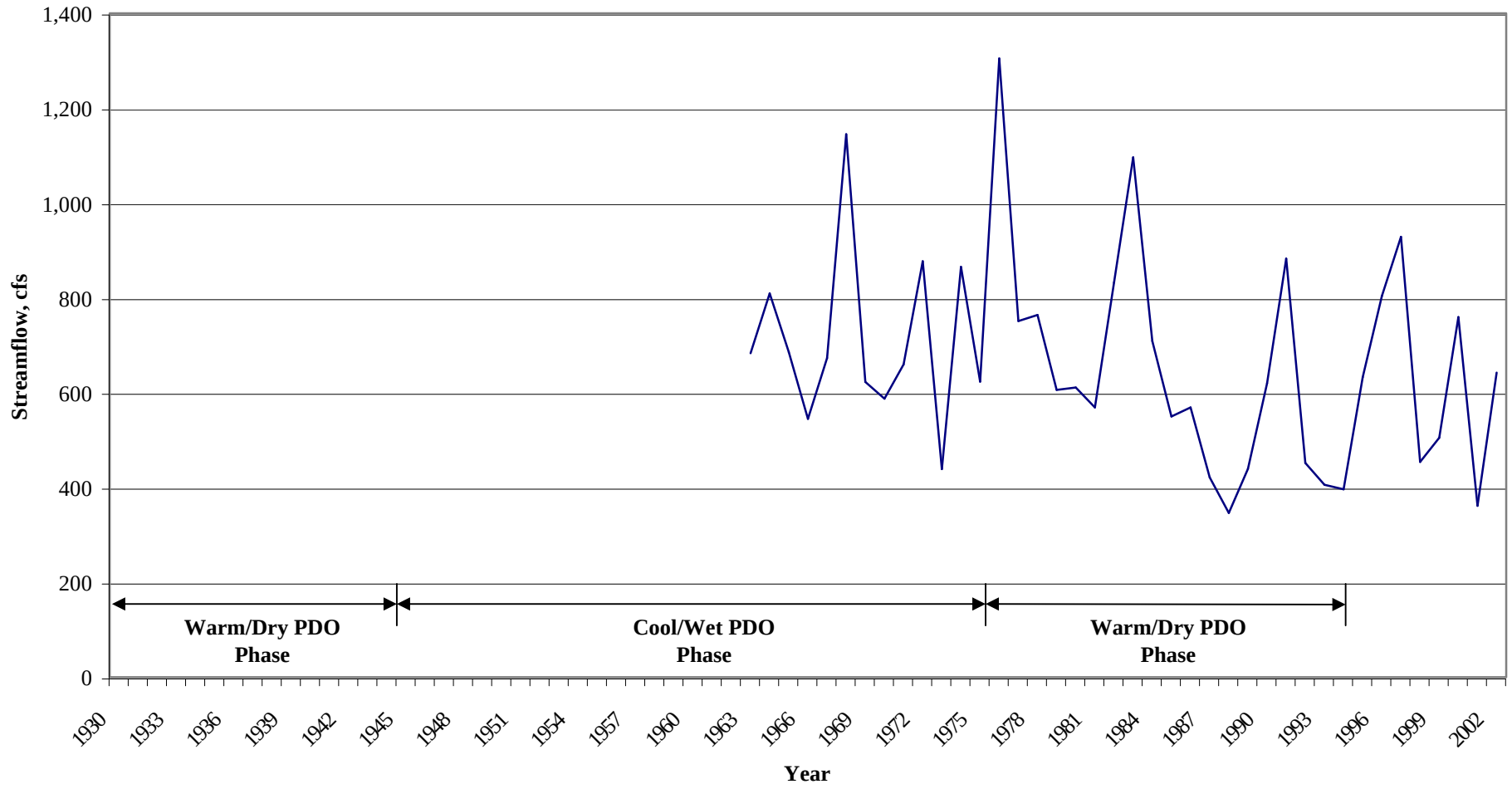
USGS Gage 12459000
Period of Record 1929-2002

Annual 30 - Day Low Flow

Figure 4.23 30-Day Low Flows
Wenatchee River at Peshastin, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.



Note: Only includes years with a full data set.

Legend

USGS Gage 12462500
Period of Record 1963-2002

Annual 30 - Day Low Flow

Figure 4.24 30-Day Low Flows
Wenatchee River at Monitor, WA

Wenatchee River Basin Watershed Assessment

MONTGOMERY WATER GROUP, INC.

5.0 Groundwater

5.1 Geologic Setting

The geology of WRIA 45 in Chelan County is predominated by igneous and metamorphic bedrock in the upland perimeter areas and by sedimentary bedrock deposited within the Chiwaukum Graben (basin) structure that forms the more central lowland areas. The regional Entiat and Leavenworth Faults form sharp, distinct boundaries that easily define the extent of the lowland sedimentary formation's sandstones and shales and distinguish it from the WRIA's upland perimeter igneous and metamorphic rocks. Geologic processes including erosion, alpine glaciation, formation of streams, etc., have transported and deposited unconsolidated sediments over the bedrock, predominately within areas of relative low relief such as valley bottoms, in the form of interbedded gravels, sands, silts and clays. The geologic description and other local information was derived from discussions with Anna Hoselton of the Department of Ecology.

5.2 Hydrogeology

Much of the precipitation in WRIA 45 occurs as snow in the winter and is retained as snow pack until spring. The generally very low primary permeability[1] characteristics of the upland metamorphic and igneous rocks result in much of the snowmelt discharging in the form of run off to surface water. In areas where the upland bedrock is fractured, some precipitation or snowmelt may percolate into the fracture systems and travel via fracture flow. In the more central and lowland areas where the primary permeability of the sandstones and shales of the Chumstick Formation tends to be moderately low, folding and faulting have primarily caused the shale members to break up or fracture. As a result, groundwater tends to move preferentially within these zones of higher "secondary" permeability. Unconsolidated sediments overlying the bedrock, particularly sands and gravels, exhibit relatively high permeability where groundwater can move easily while interbedded lower permeability silts and clays may impede groundwater flow.

Drillers' well logs indicate that wells within the WRIA are either completed in alluvial valley unconsolidated sediments where sufficient groundwater is encountered, or are drilled into bedrock. Because the majority of the WRIA's population tends to be located within the lowland regions of the Chiwaukum graben, bedrock wells are mostly completed in the sandstone/shale sequence of the Chumstick Formation. Well driller's records suggest that well yields from the alluvium ranges from about five to as much as 100 gallons per minute (gpm). Drilling records may optimistically suggest that Chumstick bedrock wells display similar yields; however, such construction-day estimates often do not reflect the actual or long-term behavior of these wells. More commonly, Chumstick bedrock wells exhibit long-term yields that range from less than one gpm up to around 15 gpm. Wells drilled in the upland igneous and metamorphic rocks, likewise tend to display relatively low yields and

[1] Primary permeability is a result of the porosity of a material, as opposed to secondary porosity, which is a product of fracturing.

are dependant on the size of and connectivity of the fracture system they intersect. As a result, these wells may display irregular yields related to volume depletion and non-laminar flow. Locally, wells completed in tributary valleys such as Brender Canyon, Peshastin Creek, and Mission Creek are more often completed in the Chumstick Formation. Wells completed near Chumstick Creek or the lower Wenatchee River are more likely to be completed in the unconsolidated alluvium.

A hydrogeologic investigation of the Chumstick Creek drainage groundwater flow system was presented in *Hydrogeology and Ground-Water Conditions in the Chumstick Drainage Basin* (Wildrick, 1979). The Chumstick Creek drainage basin is located in the central portion of the WRIA 45, and covers approximately 76 square miles (Department of Ecology, 1983). The thickness of the unconsolidated deposits within the alluvial valleys range from less than five feet to more than 150 feet toward the center of the valleys. Where the unconsolidated deposits are thickest, the report identified three types of deposits listed here in order of increasing depth:

- A thin deposit of silty sand
- Fine-grained deposits (silt and clay) with minor amounts of sand and gravel
- Coarse grained deposits (sand and gravel)

These alluvial deposits are underlain by the Chumstick sandstones and shales. The report classified three types of aquifers in the Chumstick Creek drainage basin:

- Where saturated, a shallow water-table aquifer composed of the uppermost silty sands.
- A lowermost coarse-grained sand and gravel, and
- Underlying Chumstick Formation Bedrock.

5.3 Hydraulic Conductivity

Hydraulic conductivity refers to the ability of a geologic material to transmit water. A map of surficial geology of the WRIA was modified and used to assess hydraulic conductivity. Rock types appearing on the geologic map were grouped into three categories in order of decreasing hydraulic conductivity and re-named High, Moderate to Low and Very Low. These groups were mapped along with the streams of the WRIA and depicted in Map 6.

The relatively High range hydraulic conductivity (example: unconsolidated alluvial sands and gravels) is represented in Map 6 in yellow; Moderate to Low range less conductive material (example: Chumstick formation) is represented in pink, and Very Low hydraulic conductivity (example: igneous and metamorphic bedrock) is represented in green. In general, Very Low range conductivity predominates in upland areas and valley bottoms are comprised of Moderate to Low range conductivity with some areas of High range conductivity. Most of the rivers, especially in the populated areas, flow through areas of Moderate to Low range conductivity (Map 6).

5.4 Recharge / Discharge

Typically, groundwater/surface water interaction is evaluated using field methods such as seepage runs or coincident long-term monitoring of surface water and groundwater levels at multiple locations. Computer models may also be used to assess the impacts of wells on stream flows. Because these methods are out of the scope of this report, readily available

data such as geologic maps and well logs have been used to develop the following generalized description of groundwater/surface water interaction within the WRIA.

For purposes of this discussion, the hydraulic gradient is the difference in elevation between two water bodies (i.e., the stream stage and the water table aquifer) divided by the distance between them. Where the groundwater elevation is higher than the stream surface, the gradient is toward the stream; groundwater will discharge in the direction of the stream and cause the stream to gain water. Conversely, where the groundwater elevation is lower than the stream surface, the gradient will be toward groundwater, the stream will lose water as it discharges to the surrounding aquifer. While no map exists of hydraulic gradient as it does for geology, inferences can be made about hydraulic gradient based on geology, hydrogeology, groundwater levels from well logs, and surface water elevations.

Precipitation and snowmelt recharge the WRIA's streams and aquifers. Streams generally act as drains and gain water as they pass through a basin. However, in some areas, stream water may be lost to the underlying groundwater system. The streams that drain WRIA 45 will generally lose water where they transition from low permeability bedrock or low permeability alluvial material to higher permeability alluvial material. Transitions from low to high permeability alluvial material occur along the lower reach of the Chiwawa River, Chumstick Creek near Leavenworth, and the lower reach of Peshastin Creek (Map 6).

Conversely, where bedrock becomes shallower, it tends to force groundwater out of the unconsolidated materials into the streams, creating a gaining stream condition. Where alluvial valley-fill aquifers, composed of relatively higher permeability unconsolidated materials, tend to thin, groundwater will often discharge to stream and river systems. Where alluvial valley-fill aquifers thicken, groundwater will often be recharged by surface water. The occurrence of significant amounts or definable layers of low permeable fine alluvial materials such as silt and clay may act to inhibit direct groundwater/surface water exchange.

Ground water within the sandstone/shale bedrock, as with porous medium, discharges in the direction of high head to low head. Flow paths within the folded and faulted formation are, however, affected by preferential flow along bedding planes as well as boundary conditions formed by geologic structures. As a result, identifying potential points of groundwater discharge becomes challenging and uncertain. Identifying regions where the moderately low permeable formation is likely recharged directly or indirectly by surface water may be more intuitive, however, it should be recognized that geologic structure, secondary permeabilities, etc., would play a role in such determinations. Detailing the recharge and discharge characteristics of this unit are beyond the scope of this analysis. It is perhaps more important to simply recognize the unit as a complex low yield aquifer, generally suitable only for domestic quantities of ground water.

Similarly, fracture system aquifers in the igneous and metamorphic bedrock, discharge from high head to low head. Fracture systems form preferential flow paths that are complex and uncertain to predict. Like the Chumstick Formation, analysis of recharge/discharge characteristics of these units is impractical. It is perhaps more important to recognize these units as minor complex low yield aquifers, generally suitable only for domestic quantities of water.

5.5 Effects of Pumping on Streamflow

The relationship between a stream and adjacent groundwater can be affected by pumping wells. Where groundwater and surface water are connected, drawdown due to pumping can affect local groundwater levels in the vicinity of a stream and thus affect the gradient. The degree of influence a well has on a stream is a function of pumping rate, proximity to the stream, hydraulic conductivity of the underlying aquifer, and presence or absence of low permeable materials that may inhibit surface water – groundwater exchange. Increased pumping, close proximity, and high hydraulic conductivity will all increase stream influences. The analysis of influence is generally evaluated using a computer model. Using models, the influence of future well installations on streamflow can be performed on a case-by-case basis or to predict cumulative effects.

Much of the growth occurring within the WRIA is as small domestic wells located along smaller drainages. This growth may cause significant impact to the small streams within the drainages. A water balance could compare the withdrawals versus the amount of recharge occurring within the basin. However, water exits from a basin both as surface water and as groundwater. A water balance cannot predict whether water pumped from a well will affect water exiting as groundwater or surface water or both. As discussed above, an analytical or numeric groundwater model is required to make that assessment.

5.6 Instream Resource Protection

WAC 173-545 governs water rights within WRIA 45. This administrative code sets instream flows for the Wenatchee River at Plain, Icicle Creek near Leavenworth, and the Wenatchee River at Peshastin. In addition, Peshastin Creek is closed seasonally, from June 15 to October 15. During this time, no new consumptive appropriations are allowed. Outside this time period, instream flows as measured at the Wenatchee river gage at Monitor govern availability within the Peshastin drainage basin. There are no legislated closures to groundwater withdrawals within the basin due to groundwater/surface water continuity issues; however, Ecology evaluates groundwater permit applications and may condition those permits to instream flows or if appropriate deny an application if significant hydraulic continuity is found.

5.7 Groundwater Available

This section provides a discussion of three key terms in Watershed Planning (water present, water available and water available for further appropriation) as they relate to the availability of ground water in the Wenatchee River Watershed. The Watershed Planning Act (RCW 90.82) does not define these terms and no standard definitions have been applied throughout the State. Therefore, for the purposes of this Watershed Assessment the Water Quantity Technical Subcommittee has developed its own interpretation of what these terms mean and how they should be applied to the Wenatchee Watershed.

Very little information is available to complete an assessment of groundwater and provide estimates of groundwater present, available and available for future appropriation. Accurate quantification of these terms would require the collection and analysis of an extensive amount of additional information, which is beyond the scope and budget allotted to this assessment. The Water Quantity Technical Subcommittee decided that it would not

be beneficial to produce estimates of groundwater available with existing data, as there is no benefit to providing highly imprecise estimates that also could not be verified.

The Subcommittee's definitions of the terms are presented below, followed by a discussion of the data that would be required to quantify these terms and an approach that could be used to determine the quantity of water available for further appropriation.

5.7.1 Water Present in Context of RCW 90.82

For the purpose of this watershed assessment, the Subcommittee's interpretation of water present is the total quantity or volume of water stored in aquifers in the Wenatchee River Watershed. This volume varies seasonally and annually due to changes in recharge (precipitation, streamflow), discharge and withdrawals from the aquifers. The water present can be represented by the mean annual quantity of water stored in the aquifers. The data requirements to accurately estimate water present are extensive. In addition to reviewing available data, an extensive amount of new information on the characteristics of the aquifers would need to be collected and evaluated. Quantification of water present would require a detailed understanding of the extent and thickness, porosity, and the spatial and temporal distribution of head within each of the aquifers in the Watershed. Available data including geologic maps, wells logs, and water level data for existing wells provide some of the information needed to estimate water available. However, compilation, review and interpretation of the available data (including hundreds of boring logs, water level measurements and pumping records) on a watershed basis is beyond the scope of this watershed assessment.

5.7.2 Water Available in Context of RCW 90.82

For purposes of this Watershed Assessment, the Subcommittee's interpretation of water available is the amount of water that is physically available for withdrawal from the aquifers without impacting the ability of senior water rights holders to use their water right. Water available will vary as ground water levels in the aquifers fluctuate due to changes in recharge and discharge. Estimating water available would first require an estimate of water present. Secondly, the physical characteristics of aquifers would need to be determined. In addition to the physical limitations associated with the withdrawal of ground water there are practical, economic and legal constraints that limit the availability of ground water. For example, it is not generally considered feasible to dewater or dry-up an aquifer and it may not be cost effective to extract ground water from great depths due to the high pumping costs. Economic availability depends in part upon demand and scarcity in the intended use. In areas where water is practically and economically available, legal constraints related to the impairment of senior water rights (particularly where surface water is in continuity with ground water and surface flows are fully appropriated or below established minimums) may reduce the quantity of water available. In some cases, the quality of ground water may limit its uses so that although present, this water may not be considered available for use. Physical management of the resource within legal limits would depend on controlling the annual quantity and location of ground water withdrawals, such that long-term pumping would not lower ground water to levels that could impair other rights.

5.7.3 Water Available for Further Appropriation in Context of RCW 90.82

For the purpose of the watershed assessment, the Subcommittee's interpretation of water available for further appropriation is the additional quantity of water that can be withdrawn from aquifers using the criteria set forth in RCW 90.03.290. According to this statute, Ecology must apply the following four tests when determining whether to grant a water right.

1) The water must be available for allocation;

2) The water must be put to beneficial use;

3) The use must not impair existing rights; and,

4) The use must not be detrimental to the public welfare.

Ecology may constrain an interpretation of "water availability" under the public interest test as indicated by various court proceedings, or by other existing laws and rules. In-stream values may be a factor in Ecology's assessment.

To determine the quantity of ground water available for further appropriation, the hydraulic relationships between the aquifers and surface water need to be better understood. In addition, watershed-wide measurements of ground water levels taken over time need to be made and analyzed, and areas of continuing ground water decline located. These relationships and the existing ground water conditions in the watershed are dependent in part on the quantity of water currently being used and the locations where it is being withdrawn from the aquifers. Therefore, the quantity of water that is currently being diverted from the streams in the basin and pumped from the aquifers needs to be determined, and locations need to be identified. Then to determine the water available for further appropriation, potential impacts or impairment associated with increased ground water withdrawals need to be identified. This assessment would include a determination of the conditions required to prevent or impairment of existing water rights. The general approach used to complete this type of an assessment includes development of a conceptual hydrogeologic model for the basin including a basin-wide water budget, followed by the development and use of a numerical model to assess how the aquifers and surface water bodies respond to different pumping scenarios.

6.0 Water Rights and Water Use

This section provides a summary of water rights and water usage in WRIA 45.

6.1 Water Rights

This section addresses water rights in WRIA 45. It identifies the sources of information available for estimating the quantity of surface and ground water represented by water rights under the State Surface Water Code (RCW 90.03) and the State Groundwater Code (RCW 90.44). Water claims and applications are also summarized. Additional discussion regarding actual water uses (as distinct from water rights) is presented in Section 6.2.

6.1.1 Data Sources and Terminology Associated with Water Rights

Water rights in the State of Washington fall into two major categories. One category consists of "claims" for water based on the filing of water right claims during the time periods specified in State law for filing such claims. The other category is water rights obtained through the application process specified in the State Water Code.

The Washington State Department of Ecology (Ecology) has the responsibility for administering water rights in the State, via the application and review process set forth in the State Water Code. Ecology maintains paper files for each water right application submitted. These paper files serve as the complete record for each water right. Information from these files has also been entered into a digital database, the Water Rights Application Tracking System (WRATS). Ecology's Central Regional Office, within which jurisdiction WRIA 45 lies, has combined the WRATS data with information from other sources in developing a Geographic Information System (GIS) – based database containing water right information for the entire Central Region. Information from this product, the Geographic Water Information System (GWIS), was used in developing the WRIA 45 water rights summary for permits, certificates, and claims presented herein. Data extracted from this product were updated in August, 2002. The GWIS database has been provided to Chelan County for use in watershed planning activities.

Additional data pertaining to water right applications were obtained from Ecology's website. These data were updated in September, 2002. An application indicates an applicant has requested water, but a decision approving, modifying, or denying the application for a water right has not been made by Ecology. The date an application is filed with Ecology is the priority date for the application and any water right issued under the application. Water rights are based on "first in time is first in right," which means that earlier water rights have priority over later ones, if regulation between uses is necessary.

The GWIS information includes approximately 925 records for permits and certificates for WRIA 45. The database also includes over 1,700 claims for surface and ground water in the watershed. As of September 2002, there were 134 water right applications for the watershed awaiting an Ecology decision.

Information from GWIS that was used in this summary includes the following:

Type of Record

A "record" is simply one entry in the database. A record may represent a permit to develop a water right, a certificate indicating that the water right has been perfected (i.e., put to use); or a claim documenting water uses that existed prior to adoption of the State Water Code. In general terms, a record for an "active permit" or "active certificate" indicates the holder has the right to put the water to use. Therefore, these records offer a convenient tool for estimating the total amount of water that has been authorized for appropriation in WRIA 45.

The validity and extent of each claim registered in accordance with the Claims Registration Act (RCW 90.14) lies with the Superior Court through the adjudication process. Since only a portion of the claims within the Wenatchee Watershed have undergone adjudication, the accuracy of the claims data is unknown. However, the information in GWIS does document this information.

Instantaneous and Annual Quantities

The GWIS database indicates both the instantaneous quantity (Q_i) and the maximum annual quantity of water (Q_a). Q_i is expressed in cubic feet per second (cfs) for surface water and gallons per minute (gpm) for ground water. Q_a is expressed in acre-feet per year (AF/yr). In order to facilitate comparison between surface and ground water quantities, ground water instantaneous quantities have been converted to cfs. For purposes of analyzing total amounts of water rights in the watershed, the annual quantity is the most useful measure.

Location

The "point of withdrawal" or "point of diversion" associated with a water right is a specifically-defined location from where the water is obtained. This is different than the "place of use", which is a specifically-defined land area where the water can be used. GWIS includes the Township, Range, and Section of the well location, point of withdrawal, or point of diversion. The Township, Range and Section identifies a single, one-square-mile area within WRIA 45. Water rights have been organized geographically in this summary, based upon points of withdrawal and diversion.

Purpose of Use

Each water right is granted for a specific purpose, such as irrigation, stock watering, domestic use, municipal use, industrial use, etc. In many cases, a single water right is granted for multiple uses. For example a water right may permit use of the water for irrigation, stock watering, and domestic use.

6.1.2 Surface Water Rights Summary

This section provides a summary of the surface water data found in GWIS for WRIA 45.

Surface Water Permits and Certificates

Table 6-1 provides a summary of the surface water rights information contained in the GWIS database for WRIA 45. Certificate and permit data is sorted by purpose of use and by subbasin (according to location of point of diversion). Pertinent information regarding the number of records, and instantaneous and annual quantities, is provided. In the Wenatchee Watershed there are a total of 544 surface water right permits and certificates. The total annual quantity associated with surface water rights for WRIA 45 is 73,099 AF/yr, while the total instantaneous quantity of appropriated surface water is 811 cfs. The instantaneous quantity includes supplemental water rights[2]; therefore, the maximum amount of water allowed to be diverted at any given time may be much less than 811 cfs.

The purpose of use category having the greatest watershed-wide instantaneous quantity is irrigation. Approximately 567 cfs (70%) is appropriated for the irrigation of more than 30,000 acres. Icicle Creek is the subbasin with the largest irrigation instantaneous quantity (261 cfs) and annual quantity (29,286 AF/yr). These totals include supplemental rights.

Other purpose of use categories having substantial watershed-wide annual quantities is fish propagation and municipal. However, it should be noted that the fish propagation water rights (totaling 17,800 AF/yr) apply to a non-consumptive use of water (i.e., water is diverted from a stream for use in fish hatcheries, with the majority of water returned downstream after its use).

It is also noted that the two largest municipal water purveyors in the watershed (City of Wenatchee and Chelan County PUD No. 1) obtain their water from a source located outside of the watershed (Rocky Reach Dam Aquifer) and thus do not have significant water rights within the watershed that are exercised.

In total, 40% of the annual quantity associated with surface water rights in the watershed is diverted within the Icicle subbasin. Another 40% is associated with rights in three subbasins: Chiwawa, Chumstick, and Lower Wenatchee. Together, the Icicle and Lower Wenatchee subbasins account for 75% of the total instantaneous quantity appropriated within the watershed.

Surface Water Claims

Similar to permits and certificates, surface water claims in WRIA 45 are organized in Table 6-1 according to subbasin. In the Wenatchee Watershed there are a total of 709 surface water claims. The total annual quantity associated with surface water claims for WRIA 45 is 22,204 AF/yr, while the total instantaneous quantity of

[2] See Section 6.1.4 for a discussion of primary versus supplemental water rights.

surface water claims is 307 cfs. Lower Wenatchee is the subbasin with the largest instantaneous quantity (134 cfs). The Peshastin subbasin has the largest annual quantity (7,319 AF/yr).

Surface Water Applications

There are a total of 81 surface water right applications currently pending in the Wenatchee Watershed. The total instantaneous quantity associated with these applications is 43 cfs. No annual quantities are provided with the application data. The Lake Wenatchee subbasin has the highest number of applications (30), while the Peshastin subbasin has the largest total instantaneous quantity (18.8 cfs). Purpose of use information is not provided in the applications data used for this analysis; however, the majority of applications having this information are for irrigation and domestic use.

Reservoir (Storage) Rights

Table 6-1 excludes water rights associated with surface water bodies that are for storage purposes. Such rights are referred to as Reservoir Rights and typically have large values of annual quantities related to amounts of water appropriated for storage. These rights do not have instantaneous quantities. In the Wenatchee Watershed, there are four reservoir permits and certificates, having a combined total annual quantity of 19,000 AF/yr.

Unauthorized Uses of Surface Water

Outside the legal, appropriated use of surface water, there is a potential for unauthorized diversions to occur. Any use of surface water that is occurring and is not at least the subject of a claim could be considered to be an unauthorized use of surface water. Unlike the ground water code, there are no exemptions in the surface water code for even minimal uses of surface water. This means that every diversion of surface water must be substantiated by a water right (or claim) in order to be considered a legal use of surface water. Unfortunately, this is not always the case and history would reflect a certain amount of unauthorized diversions within any watershed. Moreover, it is nearly impossible to ascertain the exact amount of surface water that is actually being diverted and applied either beneficially or otherwise.

Consequently, there is no means for effectively tracking the potential unauthorized uses of surface water. Therefore, estimates for such quantities are not available for the Wenatchee Watershed. Moreover, getting such information in the future may be difficult and may or may not be associated with substantial quantities of water. Hence, in establishing a need for further refining such estimates, an examination may have to be made with regards to the benefits achieved in resolving these numbers versus the costs of obtaining the necessary information.

Table 6-1
Surface Water Rights, By Subbasin [1]
Wenatchee River Watershed (WRIA 45)

		White	Chiwawa	Little Wenatchee	Lake Wenatchee	Nason	Chiwaukum	Upper Wenatchee	Chumstick [4]	Icicle [5]	Lower Wenatchee	Peshastin	Mission	Drainage to Col. R.	TOTAL
Permits and Certificates															
Purpose of Use [2]															
Domestic	# of Records	5	4	1	149	13	1	8	15	6	35	11	3	4	255
	Qa (AF/yr)	4	331	0	263	26	0	6	46	10	66	136	4	5	895
	Qi (cfs)	0.1	3.6	0.1	6.4	0.3	0.0	0.3	0.6	0.1	0.7	0.5	0.1	0.1	12.7
Irrigation [6]	# of Records	2	5		15	11	1	10	49	23	92	6	18	7	239
	Qa (AF/yr)	11	4,775		139	587	0	150	1,291	29,286	2,314	129	219	246	39,145
	Qi (cfs)	0.6	34.2		1.0	2.4	0.3	2.9	12.4	260.9	243.5	4.6	3.0	1.3	567.0
Municipal	# of Records									3	7			1	11
	Qa (AF/yr)									636	3,584			7,393	11,613
	Qi (cfs)									6.2	5.4			17.7	29.3
Fish Propagation	# of Records		2						1	1	3				7
	Qa (AF/yr)		13,000						0	0	4,812				17,812
	Qi (cfs)		33.0						0.5	42.0	37.5				113.0
Comm./Ind.	# of Records										1		1	7	9
	Qa (AF/yr)										0		0	3,425	3,425
	Qi (cfs)										2.0		0.8	39.8	42.6
Other	# of Records	2	3	2	1	5	1		2	1	3	1		2	23
	Qa (AF/yr)	0	45	4	6	5	0		6	1	18	0		125	209
	Qi (cfs)	1.3	33.0	1.0	0.1	4.1	0.2		0.0	3.0	2.3	1.3		0.7	46.9
Subtotal, Permits & Certificates	# of Records	9	14	3	165	29	3	18	67	34	141	18	22	21	544
	Qa (AF/yr)	14	18,150	4	407	617	0	156	1,342	29,933	10,794	264	223	11,194	73,099
	Qi (cfs)	1.9	103.7	1.1	7.5	6.8	0.5	3.2	13.6	312.3	291.4	6.4	3.9	59.6	811.4
	Acres Irrigated	32	1,432		50	241	14	145	440	14,926	13,568	22	117	72	31,058
Claims	# of Records	7	18		99	39	4	60	16	25	228	51	135	27	709
	Qa (AF/yr)	393	4,734		288	941	46	176	336	4	3,171	7,319	3,495	1,303	22,204
	Qi (cfs)	24.4	33.2		2.8	4.6	0.0	1.5	2.5	0.1	134.1	53.1	46.2	4.5	307.0
	Acres Irrigated	172	1,501		29	287	13	7	106	427	5,671	4,103	392	150	12,858
Applications [3]	# of Records	1	4		30	3		2	5	6	16	9	2	3	81
	Qi (cfs)	0.1	0.1		15.6	1.1		0.0	0.0	1.0	6.3	18.8	0.0	0.0	43.0

Notes:
Qa = Annual Quantity; Qi = Instantaneous Quantity; AF/yr = acre-feet per year; cfs = cubic feet per second
(1) Summary of water rights data obtained from Department of Ecology's Geographic Water Information System (GWIS), except for Applications data (see Note 3). Revision date of information used in this analysis is August 2002. Data are organized geographically by point of diversion (POD) according to twelve defined subbasins. Those rights having a POD in the southeastern-most portion of WRIA 45 (i.e., the area draining to the Columbia River) are categorized as "Drainage to Columbia River." This summary does not include Reservoir water rights, of which there are four in WRIA 45 with a total Qa of 19,000 AF/yr.
(2) Some water rights have multiple purposes of use. For such rights in this analysis, the purpose listed first in the GWIS database was assumed to be the primary use. For example, if "Irrigation" and "Domestic-Single" are listed in this order as purposes of use for a given right, then that right is classified as an Irrigation water right in this table.
(3) Obtained from Ecology's website. Data current as of September 5, 2002.
(4) Includes the following revision of GWIS data: Irrigation Qi for document S4-29191C was changed from 30 (appears to be an entry error) to 3 cfs.
(5) Includes the following revision of GWIS data: Acres Irrigated for documents SWC01227, SWC01228, SWC01229, and SWC01591 are shown as 7,000 for each right in the database; however, it is known that this is the total irrigated area for all rights combined. Therefore, only 7,000 acres is included to account for these rights in the total for the sub-basin.
(6) Some water right records in the GWIS database do not provide annual quantities for irrigation rights. This is reflected most prominently in the Lower Wenatchee sub-basin, where Irrigation Qi is shown as 243.5 cfs but Irrigation Qa is only listed as 2,314 AF/yr).

6.1.3 Ground Water Rights Summary

This section provides a summary of the ground water data found in GWIS for WRIA 45.

Ground Water Permits and Certificates

Table 6-2 provides a summary of the ground water rights information contained in the GWIS database for WRIA 45. Certificate and permit data is sorted by purpose of use and by subbasin (according to location of point of withdrawal). Pertinent information regarding the number of records, and instantaneous and annual quantities, is provided. In the Wenatchee Watershed there are a total of 381 ground water right permits and certificates. The total annual quantity associated with ground water rights for WRIA 45 is 23,277 AF/yr, while the total instantaneous quantity of appropriated ground water is 73.6 cfs (33,046 gpm). These totals include supplemental water rights.

The purpose of use category having the greatest watershed-wide instantaneous quantity is irrigation. Approximately 30.3 cfs (13,605 gpm) is appropriated for the irrigation of more than 2,000 acres. Lower Wenatchee is the subbasin with the largest irrigation instantaneous quantity (14.5 cfs) and the largest irrigation annual quantity (3,003 AF/yr).

The purpose of use categories having the greatest watershed-wide annual quantities are fish propagation and irrigation. However, it should be noted that the fish propagation water rights (totaling 6,377 AF/yr) apply to a non-consumptive use of water (i.e., water is diverted from wells for use in fish hatcheries, with the majority of water returned to a receiving body after its use).

In total, 64% of the annual quantity associated with ground water rights in the watershed is withdrawn in three subbasins: Chumstick, Icicle, and Lower Wenatchee. These same three subbasins also account for 62% of the total ground water instantaneous quantity appropriated throughout the watershed.

Ground Water Claims

Similar to permits and certificates, ground water claims in WRIA 45 are organized in Table 6-2 according to subbasin. In the Wenatchee Watershed there are a total of 986 ground water claims. The total annual quantity associated with ground water claims for WRIA 45 is 23,729 AF/yr, while the total instantaneous quantity of ground water claims is 131 cfs. Lower Wenatchee is the subbasin with the largest instantaneous quantity (42.3 cfs), while the subbasin referred to as Drainage to the Columbia River has the greatest annual quantity (9,225 AF/yr). The Mission subbasin also has many claims (31.6 cfs on an instantaneous basis and 5,185 AF/yr on an annual basis).

Ground Water Applications

There are a total of 53 ground water right applications currently pending in the Wenatchee Watershed. The total instantaneous quantity associated with these

applications is 10.9 cfs. No annual quantities are provided with the application data. The Lower Wenatchee subbasin has the highest number of applications (25), while the Lake Wenatchee subbasin has the largest total instantaneous quantity (2.8 cfs).

Exempt Wells

Under the State Ground Water Code, ground water cannot be withdrawn unless the user files an application and obtains a permit from Ecology. However, certain types of use are exempted from this requirement, and a valid right to use water can be established without applying for a permit under certain conditions (RCW 90.44.050). Uses exempted from the requirement to apply for a permit are:

- Stock-watering;
- Watering a lawn or non-commercial garden up to one-half-acre in size;
- Domestic uses (single or group domestic) up to 5,000 gallons per day; and
- Industrial purposes up to 5,000 gallons per day.

The law indicates that Ecology may, from time to time, require the water user to provide information regarding the means for withdrawal and the quantity of the withdrawal.

Wells installed under this provision of the law are known as "exempt wells," because they are exempt from the requirement to obtain a permit. Because no permit is issued, Ecology does not have comprehensive data on the number and size of such wells. Therefore, different methods must be applied to estimate the number of wells and the quantity of ground water withdrawals associated with those wells. This topic is discussed in greater detail in Section 6.2.

Unauthorized Uses of Ground Water

Like surface water, there is a potential for unauthorized use of ground water. There are several ways that such withdrawals may be occurring, including:

- Simple use without a valid permit from the State (i.e., for uses that the law requires to have a permit);
- Use from a so-called exempt well that exceeds the conditions of that exemption (e.g., using more than 5,000 gallons per day for domestic purposes; watering a commercial garden; etc.)
- Use in violation of the conditions of a standing permit (e.g., use beyond what the original permit allows either with regards to point of diversion, place of use, or beneficial use).

In the Wenatchee Watershed, the quantity of ground water used without authorization is not known. Such an estimate may require substantial resources both in terms of time and potential fieldwork. Determination of this quantity may require either direct or indirect measurement of the quantities of water actually being used at specific locations, with comparisons being made with individual rights and/or the conditions associated with exempt wells.

Table 6-2
Ground Water Rights, By Subbasin [1]
Wenatchee River Watershed (WRIA 45)

		White	Chiwawa	Little Wenatchee	Lake Wenatchee	Nason	Chiwaukum	Upper Wenatchee	Chumstick	Icicle	Lower Wenatchee	Peshastin	Mission	Drainage to Col. R.	TOTAL
Permits and Certificates															
Purpose of Use [2]															
Domestic	# of Records		2		5	7	1	8	74	1	36	2	11	2	149
	Qa (AF/yr)		40		124	116	1	80	196	1	758	156	172	1,417	3,061
	Qi (cfs)		0.2		0.4	0.8	0.1	0.5	2.0	0.0	2.5	0.5	0.7	4.5	12.0
Irrigation	# of Records	2	1		2	5	1	4	54	7	75		49	7	207
	Qa (AF/yr)	139	45		23	306	9	68	1,132	106	3,003		1,368	374	6,572
	Qi (cfs)	1.0	0.2		0.1	1.1	0.1	0.3	5.0	0.4	14.5		5.8	1.8	30.3
Municipal	# of Records								2		3	1	4		10
	Qa (AF/yr)								2,000		553	75	1,227		3,855
	Qi (cfs)								6.7		1.5	0.2	3.1		11.5
Fish Propagation	# of Records									2					2
	Qa (AF/yr)									6,377					6,377
	Qi (cfs)									11.4					11.4
Comm./Ind.	# of Records										4		1	5	10
	Qa (AF/yr)										883		70	1,936	2,889
	Qi (cfs)										1.5		0.1	6.0	7.6
Other	# of Records					1		2							3
	Qa (AF/yr)					8		516							524
	Qi (cfs)					0.2		0.7							0.9
Subtotal, Permits & Certificates	# of Records	2	3	0	7	13	2	14	130	10	118	3	65	14	381
	Qa (AF/yr)	139	85	0	147	430	10	664	3,328	6,484	5,197	231	2,837	3,726	23,277
	Qi (cfs)	1.0	0.4	0.0	0.6	2.1	0.2	1.4	13.6	11.8	19.9	0.7	9.7	12.3	73.6
	Acres Irrigated	40	10		9	245	4	17	453	35	758		380	99	2,049
Claims	# of Records	1	14		48	23	2	58	15	19	391	59	312	44	986
	Qa (AF/yr)	1	150		140	209	4	234	116	1,836	6,235	394	5,185	9,226	23,729
	Qi (cfs)	0.0	0.9		0.9	3.0	0.0	4.3	1.4	11.7	42.3	10.6	31.6	24.2	131.0
	Acres Irrigated	0	30		2	23	11	54	18	69	1,064	30	956	249	2,505
Applications [3]	# of Records	1			6			2	9		25		3	7	53
	Qi (cfs)	0.0			2.8			0.0	6.7		0.9		0.1	0.4	10.9

Notes:
Qa = Annual Quantity; Qi = Instantaneous Quantity; AF/yr = acre-feet per year; cfs = cubic feet per second
(1) Summary of water rights data obtained from Department of Ecology's Geographic Water Information System (GWIS), except for Applications data (see Note 3). Revision date of information used in this analysis is August 2002. Data are organized geographically by point of withdrawal (POW) according to twelve defined subbasins. Those rights having a POW in the southeastern-most portion of WRIA 45 (i.e., the area draining to the Columbia River) are categorized as "Drainage to Columbia River." Qi converted from gallons per minute (gpm) to cubic feet per second (cfs) for ease of comparison with surface water rights.
(2) Some water rights have multiple purposes of use. For such rights in this analysis, the purpose listed first in the GWIS database was assumed to be the primary use. For example, if "Irrigation" and "Domestic-Single" are listed in this order as purposes of use for a given right, then that right is classified as an Irrigation water right in this table.
(3) Obtained from Ecology's website. Data current as of September 5, 2002.

6.1.4 Summary of All Water Rights in WRIA 45

Table 6-3 provides a summary of all surface and ground water rights in WRIA 45. In total, there are 924 permits and certificates, 1,695 claims, and 134 applications for new water rights. The Lower Wenatchee subbasin has the highest number of water right records (259 permits/certificates, 619 claims, and 41 applications).

This analysis does not distinguish between "primary" and "supplemental" water rights, as such information is not provided in GWIS. A primary right can stand alone; but a supplemental right is always associated with a primary right. The supplemental right can only be used to the extent that the primary right cannot be exercised. As an example, in a dry year, a stream, which is a primary right, may not be available, but the right-holder can pump a well with a supplemental right to replace that water. Because of this relationship, supplemental rights are not additive to primary rights. Therefore, the totals provided in Tables 6-1 through 6-3 may overstate the amount of water appropriated for use under "normal" conditions. Some rights may only be exercised under certain conditions. These totals should be considered as an upper bound, or maximum, to the amount of water appropriated throughout the watershed.

Map 8 illustrates the distribution of water right permits and certificates in WRIA 45. Map 9 illustrates the distribution when water right claims are added to those totals.

Table 6-3
Surface and Ground Water Rights, By Subbasin [(1)]
Wenatchee River Watershed (WRIA 45)

		White	Chiwawa	Little Wenatchee	Lake Wenatchee	Nason	Chiwaukum	Upper Wenatchee	Chumstick	Icicle	Lower Wenatchee	Peshastin	Mission	Drainage to Col. R.	TOTAL
Permits and Certificates															
Purpose of Use															
Domestic	# of Records	5	6	1	154	20	2	16	89	7	71	13	14	6	404
	Qa (AF/yr)	4	371	0	387	142	1	86	241	11	824	292	176	1,422	3,956
	Qi (cfs)	0.1	3.7	0.1	6.8	1.0	0.1	0.8	2.6	0.1	3.2	1.0	0.8	4.6	24.8
Irrigation	# of Records	4	6		17	16	2	14	103	30	167	6	67	14	446
	Qa (AF/yr)	150	4,819		161	893	9	218	2,423	29,391	5,317	129	1,587	619	45,717
	Qi (cfs)	1.6	34.3		1.1	3.6	0.4	3.1	17.4	261.4	258.1	4.6	8.8	3.0	597.2
Municipal	# of Records								2	3	10		4	1	20
	Qa (AF/yr)								2,000	636	4,137		1,227	7,393	15,393
	Qi (cfs)								6.7	6.2	6.9		3.1	17.7	40.6
Fish Propagation	# of Records		2						1	3	3			0	9
	Qa (AF/yr)		13,000						0	6,377	4,812			0	24,189
	Qi (cfs)		33.0						0.5	53.4	37.5			0.0	124.3
Comm./Ind.	# of Records										5		2	12	19
	Qa (AF/yr)										883		70	5,361	6,314
	Qi (cfs)										3.5		0.9	45.8	50.2
Other	# of Records	2	3	2	1	6	1	2	2	1	3	1		2	26
	Qa (AF/yr)	0	45	4	6	13	0	516	6	1	18	0		125	733
	Qi (cfs)	1.3	33.0	1.0	0.1	4.3	0.2	0.7	0.0	3.0	2.3	1.3		0.7	47.8
Subtotal, Permits & Certificates	# of Records	11	17	3	172	42	5	32	197	44	259	20	87	35	924
	Qa (AF/yr)	153	18,235	4	554	1,047	10	820	4,670	36,417	15,991	420	3,061	14,920	96,301
	Qi (cfs)	2.9	104.0	1.1	8.0	8.9	0.7	4.6	27.2	324.1	311.3	6.8	13.6	71.8	884.9
	Acres Irrigated	72	1,442	0	59	486	18	162	892	14,961	14,326	22	497	171	33,107
Claims	# of Records	8	32		147	62	6	118	31	44	619	110	447	71	1,695
	Qa (AF/yr)	394	4,884		427	1,149	50	409	452	1,840	9,406	7,712	8,680	10,529	45,933
	Qi (cfs)	24.4	34.1		3.7	7.6	0.1	5.9	3.9	11.7	176.4	63.7	77.8	28.7	438.0
	Acres Irrigated	172	1,531		31	309	24	61	124	496	6,735	4,133	1,348	400	15,363
Applications	# of Records	2	4		36	3		4	14	6	41	9	5	10	134
	Qi (cfs)	0.1	0.1		18.4	1.1		0.0	6.7	1.0	7.2	18.8	0.1	0.4	53.9

Notes:
Qa = Annual Quantity; Qi = Instantaneous Quantity; AF/yr = acre-feet per year; cfs = cubic feet per second
(1) Total of Surface Water Rights (see Table 6-1) and Ground Water Rights (see Table 6-2).

6.2 Water Use Estimates

This section provides an estimate of actual current water usage for various types of water use in WRIA 45. Having been performed on an assessment level, this summary is limited to compilation and review of readily available, existing information.

6.2.1 Municipal and Domestic Uses

This section addresses water provided by public water systems and individual household wells. The Department of Health (DOH) regulates public water systems under two main categories. Group A systems are those systems regulated under the federal Safe Drinking Water Act (SDWA). Group B systems are regulated under state law, but are not regulated under SDWA. Group A systems are further divided into two categories, as described below.

- Group A, Community Water Systems provide water to 15 or more service connections used by year-round residents for 180 days or more in a year, or provide water to less than 15 connections that serve at least 25 year-round residents. These systems serve cities, subdivisions, mobile home parks, and other types of communities.

- Group A, Non-Community Water Systems provide water to the public, but not to residential communities. DOH regulates two sub-categories: transient and non-transient. Examples include campgrounds, restaurants, motels, day-care centers, and some businesses.

- Group B systems are those that meet the definition of a public water system under state law, but do not fall into one of the categories listed above. These include systems serving smaller communities and subdivisions ranging from 2 to 14 residential service connections.

For the portion of the population not receiving water from a public water system, it is assumed that water for domestic use is primarily obtained via individual household wells, although a small subset of the population may obtain water via individual surface water diversions (e.g., some property owners in the Lake Wenatchee area). For the purposes of estimating water usage in this analysis, however, all such surface water users are assumed to be utilizing groundwater wells. This approach is taken because the number of individual surface water users is unknown and the amount of usage is likely similar to that of individual well users. Therefore, the entire population not served by public water systems is categorized as individual household well users.

As noted in Section 5.1.3, these wells are exempt from the requirement to obtain permits from Ecology. As such, there is limited information available on the number of these wells and their associated production.

Table 6-4 presents the estimate of population and the number of connections or equivalent residential units[3] (ERUs) served by the various categories of water supply and delivery for Year 2002. Also provided are estimates of average day and maximum day demands. Average day demand is equal to the total annual demand allocated evenly to each day of the year. Maximum day demand is the day of the year having the highest water demand. The following subsections describe the methodology used to determine the populations served by the various types of municipal and domestic water supplies, and summarize the estimates of Year 2002 water production by these supplies.

[3] An equivalent residential unit (ERU) is a measure of water use equal to the amount consumed by an average single-family household, and is often used in water system planning. One single-family residential connection equals one ERU, while one multi-family residential connection or a commercial connection may equal more than one ERU.

Table 6-4
Estimate of Current Population and Municipal/Domestic Water Use, by Water Use Category

				2002 Water Use			2002 Water Use (AF/yr), by Type of Source [14]	
Water Use Category	**Notes**	**2002 Population [1]**	**Number of Connections or ERUs [2]**	**ADD (mgd)**	**MDD (mgd)**	**Annual (AF/yr) [3]**	**Ground Water**	**Surface Water**
Wenatchee CCD								
PWS Serving > 100 People								
City of Wenatchee	(4), (15)	24,057	7,250	NA	NA	NA	NA	NA
Chelan County PUD No. 1 - Wenatchee	(5), (15)	8,542	3,726	NA	NA	NA	NA	NA
Other Community & Group B PWS	(6)	40	14	0.005	0.013	6	6	0
Non-Community PWS	(7)	NA	82	0.008	0.019	9	9	0
Households with Exempt Well	(8)	3,256	1,252	0.476	1.190	534	534	0
Wenatchee CCD Sub-Total	(9)	35,895	12,324	0.489	1.223	548	548	0
Cashmere CCD								
PWS Serving > 100 People								
City of Cashmere	(10)	3,045	1,860	0.697	1.255	781	195	586
Peshastin Water District	(6)	445	202	0.077	0.192	86	86	0
Valley Hi Community Club	(6)	219	98	0.037	0.093	42	42	0
Chelan County PUD No. 1 - Dryden	(5)	125	64	0.017	0.044	20	20	0
Peshastin Domestic Water Assoc.	(6)	117	52	0.020	0.049	22	22	0
Other Community & Group B PWS	(6)	1,353	512	0.195	0.486	218	218	0
Non-Community PWS	(7)	NA	285	0.027	0.068	30	30	0
Households with Exempt Well	(8)	5,913	2,274	0.864	2.161	969	969	0
Cashmere CCD Sub-Total	(9)	11,217	5,347	1.934	4.347	2,168	1,582	586
Leavenworth CCD								
PWS Serving > 100 People								
City of Leavenworth	(11)	3,269	2,170	1.011	2.629	1,133	397	737
Ponderosa Community Club	(6)	330	111	0.042	0.105	47	47	0
Chiwawa Communities Association	(12)	150	60	0.055	0.138	62	62	0
Other Community & Group B PWS	(6)	775	299	0.114	0.284	127	112	15
Non-Community PWS	(7)	NA	657	0.062	0.156	70	55	15
Households with Exempt Well	(8)	1,545	594	0.226	0.564	253	253	0
Leavenworth CCD Sub-Total	(9)	6,068	3,891	1.510	3.876	1,693	926	767
WRIA 45 Total								
Community & Group B PWS	(13)	42,466	16,418	2.270	5.288	2,544	1,207	1,338
Non-Community PWS		NA	1,024	0.097	0.243	109	94	15
Households with Exempt Well		10,714	4,121	1.566	3.915	1,755	1,755	0
WRIA 45 Total		53,181	21,563	3.933	9.446	4,409	3,056	1,353

Notes:
CCD = Census County Division; PWS = Public Water System; ADD = Average Day Demand; MDD = Maximum Day Demand
mgd = million gallons per day; AF/yr = acre-feet per year

(1) Estimated population served by each water supplier and water supply category in 2002. See further notes below for sources of estimates.
(2) Where public water systems use equivalent residential units (ERUs) for planning purposes, ERUs are listed. Otherwise, the number of connections served is listed.
(3) Average day demand converted to AF/yr by multiplying by 1,121.
(4) Population data obtained from City of Wenatchee planning staff. Connections data obtained from Department of Health (DOH) Drinking Water Automated Information Network (DWAIN) database, January 2003.
(5) Population data obtained from DWAIN. ERU and water demand data obtained from Chelan County PUD No. 1 Water and Wastewater Utility Plan, September 2001.
(6) Population and connections (residential) data obtained from DWAIN. ADD calculated as number of connections times 380 gpd/connection (average water production factor for WRIA 45). MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45).
(7) Assumed no population served year-round by Non-Community PWS. Connections (total) data obtained from DWAIN. ADD calculated as number of connections times 95 gpd/connection (i.e., 380/4, assuming use occurs only half of the year and at half the rate of average residential water production). MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45).
(8) Population calculated as total CCD population minus population served by PWS. Number of connections calculated as population served divided by 2.6 (average number of persons per household in Chelan County, as obtained from Census 2000 data). ADD calculated as number of connections times 380 gpd/connection (average water production factor for WRIA 45). MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45).
(9) CCD total population for 2000 and 2025 obtained from Chelan County planning staff. Year 2002 population determined via interpolation.
(10) Information obtained from City of Cashmere Water System Plan Update, to be finalized May 2003.
(11) Information obtained from City of Leavenworth Water System Plan - Final Draft, November 2002.
(12) Population and connections (residential) data obtained from DWAIN. ADD obtained from water system operator, personal comm.; includes usage by lot owners in addition to those listed in DWAIN and who are not present full year. MDD calculated as ADD times 2.5 (average peaking factor for WRIA 45).
(13) Total of all Community and Group B PWS.
(14) Based upon data obtained from PWS and DWAIN.
(15) Source of water supply located outside of WRIA 45; therefore, no estimate of demand is provided.

Estimate of Year 2002 Population

An estimate of population served by the various types of municipal and domestic water supplies is necessary in order to calculate the number of exempt household wells located within WRIA 45. The following approach was used in analyzing population data:

1. Estimates of population for 2000 and 2025 were obtained from Chelan County Department of Long Range Planning staff. The Year 2000 population estimates are based on results of Census 2000 and are organized by US Census Bureau Census County Divisions (CCDs). Three Chelan County CCDs comprise WRIA 45: the Wenatchee, Cashmere, and Leavenworth-Lake Wenatchee CCDs. Map 7 depicts the boundaries of these CCDs. The Year 2025 population estimates are forecasts generated by County staff, based upon Office of Financial Management projections. Year 2002 population estimates were derived via interpolation between the 2000 population estimate and 2025 population forecast for each CCD. In total, the 2002 population for WRIA 45 is estimated to be 53,181.

2. Estimates of the portion of WRIA 45 population served by the largest public water systems were obtained directly from water purveyors. This approach was followed with the Cities of Wenatchee, Cashmere, and Leavenworth, as well as Chelan County PUD No. 1, which serves portions of the City of Wenatchee as well as rural areas to the west. This information was organized by CCD.

3. Estimates of the population served by other public water systems were obtained from the Department of Health (DOH) Drinking Water Automated Information Network (DWAIN) database, as updated January 2003. This information was organized by CCD.

4. Estimates of the population served by exempt wells were calculated for each CCD by subtracting the population served by public water systems from the total CCD population.

Of the total watershed population of 53,181, approximately 67 percent (35,895) reside within the Wenatchee CCD. Twenty-one percent of the population (11,217) resides within the Cashmere CCD, and 11 percent (6,068) live in the Leavenworth CCD. Within the entire watershed, 80 percent of the population obtains water from public water systems, with the other 20 percent utilizing exempt wells.

Estimate of Year 2002 Municipal and Domestic Water Use

Table 6-4 summarizes the estimate of 2002 municipal and domestic water use throughout WRIA 45. Information for specific public water systems serving more than 100 people is shown in detail. Data pertaining to other public water systems and household wells are shown in totals for these categories. The following approach was used in developing the water use information in Table 6-4:

1. Analysis of current water use associated with public water systems was performed using data obtained from water system plans and DOH's DWAIN database. Large Group A public water systems are required to submit water system plans to DOH, which include water use estimates and projections. For

large communities such as Cashmere and Leavenworth, these plans are the most reliable source of usage information. These cities were contacted and current water use information was obtained from city staff. Such information was also directly obtained from the Chelan County PUD No.1 for its Dryden Water System, and from the Chiwawa Communities Association. The other large systems (i.e., those serving more than 100 people) did not respond to requests for water use data. Average day and maximum day demands were tabulated, as well as the annual amount of water used, in acre-feet per year (AF/yr). The average daily water use factor for these systems was calculated to be 380 gallons per day (gpd) per residential connection, based upon usage and connections data. The average peaking factor (i.e., ratio of maximum day to average day usage) was determined to be 2.5.

2. Although the City of Wenatchee and Chelan County PUD No.1 – Wenatchee Area are listed in Table 6-4 for population estimation purposes, no water use information is provided, since these two purveyors share a regional source of supply located outside of WRIA 45 (the Rocky Reach Dam Aquifer).

3. Estimates of water use for the other systems listed individually in Table 6-4, as well as all other Community and Group B public water systems, were developed using connections information in DWAIN, in conjunction with the average water use and peaking factors mentioned above. Average daily demand was calculated as the number of residential connections listed in DWAIN multiplied by the average daily water use factor (380 gpd). Maximum day demand was calculated as the average day demand multiplied by the average peaking factor (2.5).

4. There is little readily available data pertaining to water use by Non-Community public water systems. Therefore, an estimate was made, based upon the average water use and peaking factors described above. However, it is noted that there is a high degree of uncertainty associated with these estimates, as they are predicated on multiple assumptions. For the purposes of this analysis, water use by Non-Community public water systems is assumed to occur for only half of the year, and at half of the average daily rate of a typical residence, given that most such systems are campgrounds, parks, etc. Therefore, estimates of water use by Non-Community public water systems were calculated as the number of total connections listed in DWAIN multiplied by 95 gpd per connection (i.e., 380 gpd/4). A peaking factor of 2.5 was used to generate maximum day demands.

5. Water use estimates for households with exempt wells were developed using the same method used for the smaller Community and Group B public water systems, applying average daily water use and peaking factors.

6. Also provided in Table 6-4 is an estimate of the amount of municipal and domestic water use obtained from groundwater versus surface water sources. This distinction is based upon information provided by water purveyors and type of source data available from DWAIN.

Based on this approach, total municipal and domestic water use for WRIA 45 is estimated to be approximately 3.9 million gallons per day (mgd) on an average daily basis and 9.4 mgd on a maximum daily basis. This equates to 6.0 cfs on an average day and 14.6 cfs on a maximum day. The total annual amount used is 4,400 AF/yr.

The Cashmere CCD contains the highest water use, at 2,170 AF/yr annually. Of this amount, 45% is associated with exempt well use. In the Leavenworth CCD, the majority of water usage is accounted for by the City of Leavenwoth, with less than 15 percent of total usage associated with individual household wells. As noted earlier, the majority of the population residing within the Wenatchee CCD receives water from outside the watershed. However, 548 AF/yr is produced from within the watershed, the majority of which is associated with exempt wells.

Considering the entire watershed, public water systems comprise 58 percent of the total municipal and domestic water use, with 42 percent of usage accounted for by exempt wells.

Estimate of 2025 Population

The Washington State Office of Financial Management (OFM) prepares forecasts of future population that are used for growth management planning by cities and counties in Washington State. The forecasts are provided at five-year intervals between 2000 and 2010 and single-year intervals between 2010 and 2025. The projections provide high, intermediate, and low growth expectations for each county. The high and low projected population forecasts generally reflect assumptions as to the uncertainty regarding growth over the next 25 years. These assumptions are based on the historical high and low decade migration patterns for each county and on current factors affecting the economic base and attractiveness of specific areas in the state. The alternative forecasts are a means of taking the fundamental unpredictability of long-range projections into account. The OFM population forecasts for Chelan County are summarized in Table 6-5.

Table 6-5
Forecasted Population Growth in Chelan County

Projection	Year			
	2000	2010	2020	2025
High	66,616	81,009	94,966	101,859
Medium	66,616	75,993	85,864	90,461
Low	66,616	71,015	76,848	79,176

Counties may select a growth management planning target within the high and low projections. Chelan County Planning Department has adopted the high growth projection for use in growth management planning. For 2025, the population forecast for Chelan County is 101,859, an increase of 35,243 from the population found in the 2000 Census.

The projected 2025 population within each County Census Division was obtained from Chelan County Planning and is summarized in Table ~~6~~6 along with 2000 Census results and 2002 estimates. The population within the Wenatchee River Watershed is projected to grow from 53,180 in 2002 to about 79,600 in 2025, an

increase of about 26,500. Most of the growth will occur in the Wenatchee CCD, with a population increase of about 18,200. The population increase in the Cashmere CCD is projected at about 5,900 and the population increase in the Leavenworth-Lake Wenatchee CCD is projected at about 2,550.

Table 6-6
Forecasted Population Growth in Wenatchee River Watershed

Census County Divisions	2000 Census	2002	2025
Cashmere	10,824	11,217	17,092
Leavenworth - Lake Wenatchee	5,902	6,068	8,453
Wenatchee	34,678	35,895	54,061
Total Population of CCDs located in Wenatchee River Watershed	51,404	53,180	79,606

Estimate of Year 2025 Municipal and Domestic Water Use

Future Municipal and Domestic Water Use was estimated using the population growth estimates contained in the previous sections as well as estimates contained in Water System Plans for the Cities of Leavenworth and Cashmere. Table 6-7 summarizes those estimates. The Average Daily Demand is forecast to increase 1.7 mgd (2.6 cfs) by 2025. The Maximum Daily Demand, which occurs in summertime, is forecast to increase 4.7 mgd (7.3 cfs) by 2025. The annual volume of water use is forecast to increase by about 1,900 acre-feet by 2025.

The future water demands include both surface water and groundwater. An estimate of the split of use between surface water and groundwater was not attempted however most of the additional demand will likely be obtained from groundwater sources. The exception may be the Cities of Leavenworth and Cashmere, who currently use surface water for a portion of their supply and may use additional surface water if they have adequate surface water rights.

Table 6-7
Wenatchee River Watershed Projected Municipal and Domestic Water Use in 2025

		Estimated 2002 Population	Estimated 2025 Population	Est. No. of Connections or ERUs	ADD (mgd)	MDD (mgd)	Annual (afy)
Wenat-chee CCD	City of Wenatchee, PUD and other community systems	32,639	47,925	n/a	n/a	n/a	n/a
	Households with exempt wells	3,256	5,404	2,078	0.790	1.975	885
	Wenatchee CCD sub-total supplied with water from WRIA 45	3,256	5,404	2,078	0.790	1.975	885
Cashmere CCD	City of Cashmere	3,045	10,225	6,391	1.592	3.980	1,785
	Others including Community and Exempt wells	8,172	6,867	2,641	1.004	2.509	1,125
	Cashmere CCD sub-total	11,217	17,092	9,032	2.596	6.489	2,910
Leaven-worth CCD	City of Leavenworth	3,269	6,012	3,989	1.857	4.817	2,082
	Others including Community and Exempt wells	2,800	2,441	939	0.357	0.892	400
	Leavenworth CCD sub-total	6,068	8,453	4,928	2.214	5.709	2,482
WRIA 45 Total (Does not include population served by Wenatchee)		20,541	30,949	16,038	5.599	14.173	6,277
Estimated 2002 Totals					3.933	9.446	4,409
Estimated Increase in Demand 2002-2025 in mgd and acre-feet					**1.666**	**4.727**	**1,868**
Estimated Increase in Demand 2002-2025 in cfs and acre-feet					**2.6**	**7.3**	**1,868**

6.2.2 Self-Supplied Commercial/Industrial Water Use

Some industries have their own water rights and sources of supply, which are considered here separately from municipal usage. For the purposes of this analysis, annual water usage for such users was assumed to equal the annual amount of their commercial/industrial water rights, as summarized in Section 6.1. This approach, therefore, does not identify the actual water usage by such users; rather, it identifies the maximum authorized use by each user. In the case of commercial/industrial surface water rights, no annual quantity is provided in the GWIS data. The only information provided for these rights is instantaneous quantity. Therefore, annual water usage by commercial/industrial surface water right holders is considered unknown. Estimation of annual use based upon instantaneous water rights (i.e., assuming constant use of the instantaneous quantity) is not a viable approach, as most such users do not use water constantly throughout the year.

Table 6-8 summarizes the water usage associated with self-supplied commercial/industrial users. The points of withdrawal and diversion of all WRIA 45 commercial/industrial water right holders listed in Table 6-8 are located within the Cashmere CCD, near the Cities of Cashmere and Peshastin. These users are fruit grower associations or unions, with the exception of one lumber company. In most cases, water is used by fruit grower associations and packers for non-consumptive purposes such as fruit washing, process transport, and water-cooled refrigeration. In total, the amount of ground water estimated to be used for self-supplied commercial/industrial purposes is 933 AF/yr.

Not included in Table 6-8 are industries around the City of Wenatchee, which obtain surface water from the Columbia River and ground water from outside of any of the subbasins described in Section 6.4.1. These industries include: Pacific Pulp Molding, Columbia Concrete Pipe Company, Spring Builders Inc., Keyes Fibre Company, Western Cold Storage Company, JM Smucker Company, Wenatchee Wenoka Growers, Glico Apple Corporation, and Stemilt Growers, Inc.

Table 6-8
Estimate of Current Self-Supplied Commercial/Industrial Water Use

	2002 Water Use (1)				
	Annual Water Use (AF/yr), by Type of Source				
Water Right Holder	**ADD (3) (mgd/cfs)**	**MDD (4) (mgd/cfs)**	**Ground Water**	**Surface Water**	**Total**
Wenatchee CCD - Subtotal	*0/0*	*0/0*	*0*	*0*	*0*
Cashmere CCD - Subtotal	*0.833/1.29*	*2.806/4.35*	*933*	*Unknown (2)*	*933*
Peshastin Fruit Growers Assoc.	0.357/0.55	0.361/0.56	400	0	400
Central Packers	0.225/0.35	0.258/0.4	252	0	252
Peshastin Cooperative Growers	0.206/0.32	0.323/0.5	231	0	231
Cashmere Fruit Growers Union	0.045/0.07	0.574/0.89	50	Unknown (2)	50
Schmitten Lumber Co.	Unknown (2)	1.290/2.0	0	Unknown (2)	Unknown
Leavenworth CCD - Subtotal	*0/0*	*0/0*	*0*	*0*	*0*
TOTAL-WRIA 45	0.833/1.29	2.806/ 4.35	933	Unknown (2)	933

Notes:
CCD = Census County Division; ADD = Average Day Demand; MDD = Maximum Day Demand
mgd = million gallons per day; cfs = cubic feet per second; AF/yr = acre-feet per year

(1) Based on water right information presented in Section 6.1.
(2) No annual quantities are associated with the two surface water commercial/industrial water rights (Cashmere Fruit Growers Union and Schmitten Lumber Co.).
(3) Calculated as annual water right (Q_a) divided by 365 days/year.
(4) Instantaneous water right (Q_i).

Estimate of Future Self-Supplied Commercial/Industrial Water Use

The growth in self-supplied commercial and industrial water use is limited because of difficulty in obtaining new water rights and the potential for interruptions in supply when instream flows are not met if water rights are obtained. These types of water users will locate where a reliable water supply is available. This sector may increase water use in the Wenatchee River Watershed but would likely need to purchase the water from another user, such as an irrigator or municipality. No change in total diversions or streamflow would likely result from that scenario.

6.2.3 Irrigation Water Use

This section presents estimates of water diverted for irrigation use and water applied to crops in the study area.

Records of Water Diverted for Irrigation Use

Tables 6-1 through 6-3 summarize the volume of Water Right Permits, Certificates and Claims for various purposes including irrigation. The volume of water rights stated in those tables may overstate the volume of water diverted and used for irrigation purposes because supplemental rights are included, limitations to use of the water rights are not described and the quantities associated with claims have not been reviewed or adjudicated. The totals should be considered to be an upper bound, or maximum potential irrigation use. To verify those totals and obtain a more accurate estimate of water diversions, water measurement data is used.

Most of the irrigation water users in the study area are located within the Wenatchee Reclamation District and the Icicle and Peshastin Irrigation District. Approximately 12,000 acres are irrigated in the Wenatchee Watershed with water delivered by those districts. Water diversion records for those districts were requested and obtained. The data from the Wenatchee Reclamation District is for 2002 (Smith, pers. comm.) while the Icicle and Peshastin Irrigation Districts requested that data published in Water Conservation Plans for the Districts be used in this report. That data is from 1990 and 1991, however they stated the water diversion patterns have not changed significantly since that time (Teeley, pers. comm.).

Table 6-9 lists the average weekly diversions by the Wenatchee Reclamation District for 2002. The diversions listed in the table should not be construed to be long-term averages as diversions change both annually and seasonally due to weather conditions, cropping patterns, acreage irrigated and other factors. Figure 6-1 illustrates the weekly diversions. The District starts diversions in early April and stops in mid-October. At the beginning and end of the irrigation season the District typically diverts about one-half of their water right of 200 cfs. Peak diversions occur during July and August in response to hot weather and peak crop irrigation requirements.

Water use records are not available for smaller water users, although their water use is limited to their water right. The diversion patterns that occur for the

Wenatchee Reclamation District are probably typical for small irrigation water users in the Wenatchee River Watershed.

Table 6-9
Pattern and Quantity of Diversions for Wenatchee Reclamation District, 2002

Date	Flowrate (cfs)	Weekly Volume (ac-ft)
4/8/02	91.6	1,272
4/15/02	94.3	1,309
4/22/02	92.9	1,290
4/29/02	98.3	1,364
5/6/02	96.9	1,346
5/13/02	91.6	1,272
5/20/02	118.3	1,643
5/27/02	119.6	1,661
6/3/02	119.6	1,661
6/10/02	143.7	1,995
6/17/02	151.7	2,106
6/24/02	149.0	2,069
7/1/02	155.7	2,162
7/8/02	181.1	2,514
7/15/02	167.7	2,329
7/22/02	169.1	2,347
7/29/02	167.7	2,329
8/5/02	165.1	2,292
8/12/02	157.0	2,180
8/19/02	163.7	2,273
8/26/02	155.7	2,162
9/2/02	146.4	2,032
9/9/02	129.0	1,791
9/16/02	114.3	1,587
9/23/02	114.3	1,587
9/30/02	113.0	1,568
10/7/02	113.0	1,568
10/14/02	92.9	1,290
Total Diversion		**51,000**

Data from the Icicle and Peshastin Irrigation Districts is summarized in Table 6-10. Their records show the peak diversions occurring in the period of June through August with water use increasing to a peak in April and May and declining in September towards the end of the irrigation season.

Table 6-10
Monthly Diversions
Icicle and Peshastin Irrigation Districts - Average of 1990 and 1991

Month	Icicle Creek Diversion		Peshastin Creek Diversion	
	Rate (cfs)	Volume (acre-feet)	Rate (cfs)	Volume (acre-feet)
April	69	4,106	30.5	1,812
May	88.5	5,443	35.0	2,154
June	96.5	5,742	37.0	2,199
July	99.5	6,120	39.5	2,427
August	98.5	6,058	36.6	2,248
Sept	78.5	4,671	28.0	1,666
Totals		**32,139**		**12,505**

The total diversion by the Wenatchee Reclamation District and the Icicle and Peshastin Irrigation District is estimated to be approximately 96,000 acre-feet per year, based upon the limited data available. It is likely that additional data will be available in the future for analyzing irrigation diversions with the implementation in 2003 of WAC 173-173, *Requirements for Measuring and Reporting Water Use.* The WAC contains new requirements for the measurement and reporting of water diversions. In the future, water users will be required to record diversions using standard measuring devices and report annually the rate and volume of water diverted to the Department of Ecology.

Volume of Water Needed to Meet Crop Irrigation Requirements

An indirect method of estimating water use for irrigation is to count the acreage irrigated and estimate the amount of water needed to productively grow crops. This method will not provide an estimate of the amount of water diverted or pumped but will provide an estimate of the volume of water consumptively used for irrigation in the watershed.

Crop Irrigation Requirements (CIRs) for representative crops grown in the Wenatchee River Basin are listed in Table 6-11. The CIRs were obtained from the Washington Irrigation Guide (WSU, SCS 1985) and represent average annual consumptive water use for different crops and locations in the basin. The actual crop water demands can vary substantially depending on weather conditions, soil type, location, and other factors. Two locations are documented in Table 6-11; Leavenworth and Wenatchee. The CIR for Leavenworth is a fair representation of the upper subbasins while the CIR for Wenatchee represents the three lower subbasins; Lower Wenatchee, Mission and Peshastin. For each location, CIRs for different crop types representing the types of crops grown in the area. The CIRs are provided in inches per month and annually in inches per year and feet per year.

Table 6-11
Average Crop Irrigation Requirements

Location/Crop Type	Typical Crop Irrigation Period	Monthly Water Demand (inches)							Seasonal Water Demand (inches)	Seasonal Water Demand (feet)
		April	May	Jun	July	Aug.	Sept.	Oct.		
Leavenworth										
Alfalfa	6/3-10/7	0	0	3.37	6.42	4.77	2.56	0	17.12	**1.43**
Pasture/Turf	6/3-10/7	0	0	3.58	6.78	5.05	2.77	0	18.18	**1.52**
Apples w/Cover	6/3-10/7	0	0	4.52	8.54	6.44	3.6	0	23.10	**1.93**
Pears & Plums w/Cover	5/24-10/7	0	0.47	4.53	7.83	5.89	3.19	0	21.91	**1.83**
Winter Wheat	4/22-10/7	0.11	3.44	5.01	7.78	2.78	0	0	19.12	**1.59**
Wenatchee										
Alfalfa	5/7-10/10		3.82	6.71	7.98	5.59	3.91	0.47	28.48	**2.37**
Pasture/Turf	5/7-10/10		4.04	7.09	8.41	5.91	4.12	0.51	30.08	**2.51**
Apples w/Cover	5/7-10/10		3.37	8.23	10.55	7.52	5	0.47	35.14	**2.93**
Pears & Plums w/Cover	5/7-10/10		3.97	7.47	9.69	6.88	4.56	0.4	32.97	**2.75**
Winter Wheat	4/2-10/10	2.21	6.33	8.23	7.53	0.57	0.31	0.7	25.88	**2.16**

In addition to average CIRs from the Washington Irrigation Guide, data from the WSU Tree Fruit Research Extension Center is available for apple trees with cover. The Research Center is located in Wenatchee. The average CIR measured at the Research Center for the period of 1972-2000 was 35 inches. That corresponds to and confirms the CIR contained in the Washington Irrigation Guide.

The CIR is one component of the on-farm irrigation water requirement. The other component is the efficiency of irrigation, called the field application efficiency. The field application efficiency varies with the type of irrigation practiced (surface or pressurized), the field configuration, size, slope, soils, and other factors. The Washington Irrigation Guide published approximate field application efficiencies for various types of irrigation practiced, which are listed in Table 6-12.

Table 6-12
Expected Field Application Efficiencies in Washington

Irrigation Method	Efficiency (percent)
Level Border	75
Graded Border	70
Flood Irrigation	50
Contour Ditch	50
Level furrow	65
Graded Straight furrow	60
Graded Contour Furrow	60
Corrugations	60
Subirrigation - Water Table Control	65
Subirrigation - Trickle	70
Trickle - Point Source Emitter	90
Trickle - Spray Emitter	85
Trickle - Continuous Tape	90
Handline/Wheel Line	65
Big Gun (Fixed Place)	60
Traveling Gun	65
Solid Set (Above Canopy)	65
Solid Set (Below Canopy)	70
Center Pivot	70
Linear Move	70

The irrigation method most used in the Wenatchee River Watershed is solid set sprinklers with varying emitter sizes from Rainbird type sprinklers to micro-spray nozzles. The average field application efficiency in the Wenatchee River Watershed is likely about 70%.

The volume of water required by a grower for a particular crop type, when considering their method of irrigation is equal to the CIR for the crop type divided by the field application efficiency for their method of irrigation. For example, an apple grower in the Lower Wenatchee Valley that uses solid set sprinklers may require 4.19 acre-feet of water per acre (2.93 ft CIR/0.70 field application efficiency) to meet the CIR during an average year.

Irrigation water users may also require additional water to make up for conveyance losses in irrigation canals or ditches that are used to convey water from the point of diversion to the farm. The magnitude of conveyance loss depends on the type of canal or ditch (lined or unlined), their length, the degree of maintenance and other factors. In our experience in North Central Washington, we have found conveyance losses to range from zero (for piped systems) to more than 50%. The only data on efficiency found in the Wenatchee Watershed was from the *Icicle Irrigation District Comprehensive Water Conservation Plan* (Klohn Leonoff, 1993a) and the *Peshastin Irrigation District Comprehensive Water Conservation Plan* (Klohn Leonoff, 1993b). Those reports indicate conveyance losses averaging 10-15%.

Estimated Consumptive Use of Water for Irrigation

To estimate the total consumptive water use for irrigation in the Wenatchee River Basin, irrigated land cover area and types were determined and average CIRs applied to those crop types. Irrigation areas and land cover types were estimated from the National Land Cover Dataset for 1992 (NLCD) (USGS, http://landcover.usgs.gov/natllandcover). The analysis was performed for each subbasin. Table 6-13 shows the estimated area of irrigated land types in each subbasin and the entire Wenatchee River Basin. Five subbasins, White, Little Wenatchee, Nason, Chiwaukum, and Lake Wenatchee showed no irrigated land use types in the NLCD. The total irrigated area estimated using the 1992 NLCD data is 12,836 acres; of that 11,573 acres were classified as orchards. A shortcoming of the NLCD data is that irrigated area (lawns, landscaping) is also contained within urbanized or developed area. Because the predominant land cover within an area classified as urban may be housing or streets the irrigated area within those areas is not accounted for. If the urban area water supply is solely from a municipal supplier, such as the City of Cashmere, that water use is accounted for in Section 6.2.1 Municipal and Domestic Use. If an irrigation district or company serves them, that consumptive use of water is not accounted for in this analysis. Other uncertainties and discrepancies in the data exist such as the classification of orchard land in the Chiwawa and Upper Wenatchee subbasins. It was reported by water users (pers. comm. with Dennis Pobst) that the area of orchard shown does not reflect actual conditions. The difference is likely due to the resolution of the data and uncertainties in typing land cover. The 1992 data set is the most recent land coverage data set from the NLCD although additional color infrared photos were taken in 2002. The 2002 photos have not yet been analyzed by the USGS.

The number and type of irrigated acreage was then multiplied by the corresponding CIR value for the land use type. The area of orchards was multiplied by the CIR for apples, because it is a more conservative number than the CIR for pears. The area of pasture and hay was multiplied by the CIR for alfalfa. The area of small grains was multiplied by the CIR of winter wheat. The remaining irrigated areas were multiplied by the CIR for pasture/turf. Table 6-14 shows the estimated irrigation water demand for each subbasin and the Wenatchee River Watershed. The total estimated consumptive use of water for irrigation purposes is 35,000 acre-feet per year. The on-farm demand, including field application efficiency, would likely be 30-40% greater. Most of the additional water used will seep into shallow groundwater

Table 6-13

Estimate of Irrigated Lands
Based Upon 1992 Land Cover Database (acres)

Land Cover Type	Chiwawa	Upper Wenatchee	Chumstick	Icicle	Peshastin	Mission	Lower Wenatchee	Wenatchee River Watershed
Orchards, Vineyards, Other	49	278	652	216	645	1,807	7,926	11,573
Pasture, Hay	93	320	118	86	17	0	299	933
Row Crops	0	0	0	0	1	0	27	28
Small Grains	0	0	3	0	1	0	253	257
Fallow	0	0	0	0	0	0	8	8
Urban, Recreational Grasses	0	0	37	0	0	0	1	38
Potentially Irrigated Land	**142**	**598**	**810**	**302**	**664**	**1,807**	**8,513**	**12,836**

Note: Data obtained from National Land Cover Data set. Potential limitations of the dataset include not distinguishing between urban land covers with irrigated area and urban land covers without irrigated area. Limitation underestimates irrigated area. Other uncertainties and discrepancies in the data exist such as the classification of orchard land in the Chiwawa and Upper Wenatchee subbasins. The data likely overestimates those areas.

Table 6-14
Estimated Irrigation Water Demand for Consumptive Use
Based Upon 1992 Land Cover Data (acre-feet)

Land Cover Type	Chiwawa	Upper Wenatchee	Chumstick	Icicle	Peshastin	Mission	Lower Wenatchee	Wenatchee River Watershed
Orchards, Vineyards, Other	94	536	1,255	416	1,889	5,290	23,210	32,690
Pasture, Hay	133	457	168	122	42	0	709	1,631
Row Crops	0	0	0	0	2	0	69	71
Small Grains	0	0	5	0	2	0	545	552
Fallow	0	0	0	0	0	0	20	20
Urban, Recreational Grasses	0	0	56	0	0	0	1	57
Total Consumptive Use	**227**	**992**	**1,485**	**538**	**1,934**	**5,290**	**24,554**	**35,020**

Note: Estimated demands based upon land cover data set from Table 6-13. Limitations and uncertainties described in Table6-13 also apply to the estimated irrigation demands.

aquifers and may be a source of water supply for groundwater users or may return to surface water via a stream or wetland.

Additional quantities of water are diverted from the Wenatchee River for use outside of the watershed. The Wenatchee Reclamation District delivers water to 12,500 acres; approximately 8,114 acres are located outside of the Wenatchee Watershed and water delivered to them would not return to the Wenatchee River. It is assumed that the diversion of flow for those water users represents a consumptive use to the Wenatchee River. The estimated consumptive use for those users is estimated by pro-rating that acreage to the quantity of flow diverted (51,000 acre-feet in 2002). The estimated consumptive use is 33,000 acre-feet (8,114/12,500 * 51,000). The consumptive use for remainder of the District that lies within the Wenatchee Watershed is covered by the estimate contained in Table 6-14.

Summary of Agricultural Census of Irrigated Acreage

Although the 1992 land cover data set is the most recent comprehensive data found agricultural census data is available to review changes in irrigated acreage that have occurred since that time. The *2001 Washington Fruit Survey* (Washington Agricultural Statistics Service, 2001) was consulted to estimate the trend in tree fruit acreage in recent years. The Washington Agricultural Statistics Service is part of the Washington State Department of Agriculture and conducts periodic statewide fruit acreage surveys. The most recent survey completed was in 2001. Data is also available from the National Agricultural Statistics Service (NASS) for previous years, such as 1982, 1987, 1992 and 1997. The results of the tree fruit survey are compiled and reported by Fruit Reporting District (FRD). The Wenatchee FRD, which comprises Chelan, Douglas and Okanogan Counties, contains the Wenatchee River Watershed. Table 6-15 presents a comparison of fruit acreage in the Wenatchee FRD since 1982.

Table 6-15
Tree Fruit Acreage in Wenatchee Fruit Reporting District

Year	Apple Acreage	Pear Acreage	Cherry Acreage
1982	58,865	8,733	3,716
1987	59,022	10,694	3,991
1992	57,346	11,684	4,923
1997	55,643	12,682	6,533
2001	54,000	14,650	9,500

Source: 2001 Washington Fruit Survey (Washington Agricultural Statistics Service, 2001)
Wenatchee Fruit Reporting District includes Chelan, Douglas and Okanogan Counties

The total acreage of apples, pears and cherries planted in the Wenatchee FRD increased by 4,197 acres in the period of 1992 to 2001. A decline in the acreage planted in apples has been offset by increases in pear and cherry acreage. Additional data on the acreage with different varieties of fruit is also available but is not presented in this report.

The tree fruit acreage by County or Watershed within the Wenatchee FRD was not available from the *2001 Washington Fruit Survey*. However estimates of irrigated orchards and irrigated farmland located in Chelan County were published in the 1997 *Census of Agriculture* (NASS, 1999). Those estimates are summarized in Table 6-16.

Table 6-16
Irrigated Farmland in Chelan County

Year	Irrigated Orchard Acreage	Other Irrigated Acreage	Total Irrigated Acreage
1987	28,923	2,356	31,279
1992	28,775	1,233	30,008
1997	28,603	1,959	30,562

Source: 1997 Census of Agriculture (NASS, 1999)

An overall decrease of about 700 irrigated acres has occurred since 1987 but an increase of about 550 acres occurred from 1992 to 1997. The agricultural statistics for both the Wenatchee FRD and Chelan County indicate that tree fruit acreage has increased since 1992. The change within the Wenatchee River Watershed is not available from those publications. The Washington State Department of Agriculture (WSDA) was consulted and it was found they performed mapping of crops in Chelan County in 2002 (pers. communication with Perry Beale). The data was obtained from the WSDA and analyzed for the Wenatchee River Watershed. Map 10 presents that analysis. The WSDA data estimates the area of orchard in the Wenatchee Watershed at 16,169 acres. The WSDA mapping did not include irrigated areas beyond crops, such as parks and landscaping. Although there are differences between the 1992 NLCD and the 2002 WSDA mapping, a comparison of those data sources and the agricultural census indicates irrigated orchard acreage has not decreased in the Wenatchee River Watershed. The consumptive use estimate presented in the previous section is likely representative of current conditions also.

Table 6-17
Crop Acreage within Wenatchee River Watershed (2002)

Crop Type	Chumstick (ac)	Lower Wenatchee (ac)	Mission (ac)	Peshastin (ac)	Totals (ac)
Alfalfa	---	24	16	---	40
Apples	358	740	---	---	1,098
Cherries	---	575	---	---	575
Christmas Trees	---		22	---	22
Peaches	---	147	---	---	147
Pears	37	10,437	2,655	1,220	14,349

Source: WSDA, 2003

Future Agricultural Water Use

The potential for change in irrigated agriculture exists due to market conditions for fruit and the proximity of farmland to desirable areas to live. A review of the long-term potential change in land use was performed by analyzing zoning data and comparing the area zoned agriculture to that currently used for farming. Table 6-18 presents estimates of land area zoned for agriculture and residential uses in the Wenatchee River Watershed.

A large difference in land area exists between the current agricultural land use and the area zoned for agriculture. The area zoned for agriculture is in the range of 4 – 6,000 acres less than current irrigated area. However the availability of the land for residential use does not mean that it will be converted from agricultural use; the conversion will depend on the value of the land for residential property and the economics of continuing to farm. The previous section reviewed the changes in irrigated acreage that has occurred since 1982 and found the agricultural land base in Chelan County to be fairly stable and not declining. Most of the growth in the watersheds will occur in or near urban growth areas such as Cashmere and Leavenworth. Farms in the vicinity of those towns are most susceptible to development pressure.

When farms are converted to residential uses, the water rights associated with their properties are still owned by the property owner and can be used to irrigate lawns and landscaping as those water uses are defined as a beneficial use in the State Water Code. If the property is within an irrigation district, the district is obligated to deliver the same quantity of water as previously delivered to the property. The rate of delivery is fixed by the water rights appurtenant to the property and usually varies from 5 to about 10 gallons per minute per acre. Since irrigation districts are obligated to deliver that rate of flow even to a residential water user, the peak rate

of diversion by the irrigation district from a stream will often not change. The total volume of water may be reduced because of less land area to irrigate or less interest in maintaining fields properly irrigated. An example is the Greater Wenatchee Irrigation District, which has units in East Wenatchee, Brays Landing and at Howard Flat near Chelan. The East Wenatchee unit has experienced the conversion of agricultural land to residential purposes. The Brays Landing and Howard Flat units are almost entirely agricultural. The district estimated the percentage of residential land to be 7% as of 2000 (Montgomery Water Group, 2000). The water demand in the Brays Landing unit is approximately 4% higher per acre than in the East Wenatchee unit. The water demand in the Howard Flat unit is approximately 8% higher per acre than in the Brays Landing unit and 13% higher per acre than in the East Wenatchee unit. However the demands at peak periods have not declined and therefore reductions in peak diversions have not occurred.

It is our opinion the peak rate of water use for agricultural use may not change significantly for the reasons described above. However the overall volume of water used for irrigation may be slightly reduced.

Although there is agricultural land that is converting to residential land, there are still some areas where additional water supply could be used to irrigate acreage that may be contiguous with an existing orchard but does not currently have water rights. That occurs in the Wenatchee River valley as most irrigation water supplies were developed a century ago using gravity delivery systems. Lands lying above the canals or lands with poor drainage could not be irrigated. With pumping systems and more advanced sprinkler systems, more land can be irrigated. In the Water Rights section (6.1) the review of Water Right Applications shows that a number of applications have been made for additional irrigation. It is not known how much of the water applied for would be used for agricultural use or for landscaping purposes. A number of applicants in the Lower Wenatchee subbasin are fruit growers, which indicates the desire to plant additional acreage. The information available in the water rights database does not indicate the acreage applied for. The Water Right Applications would need to be reviewed individually to glean that information. A limitation to the use of water from new water rights is the interruptibility of those rights when streamflow is less than regulatory minimum flow. Most agricultural enterprises such as orchards cannot economically operate with interruptible supplies unless an alternate source is available (through a lease or temporary transfer of water). Landscape irrigation can withstand interruption without significant economic losses.

Table 6-18
Estimates of Land Area and Zoning within Wenatchee River Watershed
Area within each Subbasin (acres)

Land Use Classfication	Chiwaukum	Chiwawa	Chumstick	Icicle	Lake Wenatchee	Little Wenatchee	Lower Wenatchee	Mission	Nason	Peshastin	Upper Wenatchee	White	Totals
Commercial Agricultural	0	0	0	0	0	0	6,161	1,412	0	622	0	0	8,195
Commercial Forest	30,243	123,758	39,454	131,586	10,322	64,146	16,079	46,288	63,407	81,923	30,104	94,899	732,209
Public	0	0	4	171	801	0	179	0	71	0	0	0	1,226
Rural Residential /Resource 2.5	42	324	199	371	112	0	1,578	372	220	397	774	22	4,411
Rural Residential /Resource 5	706	732	4,749	854	149	0	5,039	2,122	1,417	1,627	1,717	115	19,227
Rural Residential /Resource 10	433	534	1,666	447	294	0	6,480	1,928	1,137	873	400	426	14,619
Rural Residential /Resource 20	474	1,527	5,309	3,763	982	816	29,705	6,935	2,565	604	2,458	4,438	59,576
Total Rural Residential /Resource	1,655	3,118	11,924	5,436	1,536	816	42,802	11,356	5,339	3,501	5,349	5,001	97,833
Rural Village	0	0	100	1	59	0	1,628	71	0	0	0	0	1,860
Rural Commercial	0	0	0	0	3	0	83	0	105	34	10	0	236
Rural Industrial	155	0	0	0	0	0	221	0	0	0	0	0	376
Rural Recreational and Resource	0	183	20	0	212	0	0	0	322	108	8	0	853
Rural Waterfront	0	387	57	11	402	0	32	0	0	0	581	15	1,484
Urban Residential 1	0	0	0	0	0	0	8	0	0	0	0	0	8
Urban Residential 2	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Residential 3	0	0	0	0	0	0	2	0	0	0	0	0	2
Total Urban Residential	0	0	0	0	0	0	10	0	0	0	0	0	10
Pedestrian Oriented Commercial	0	0	0	0	0	0	0	0	0	0	0	0	0
Peshastin Village Commercial	0	0	0	0	0	0	2	0	0	0	0	0	2
General Commercial	0	0	0	0	0	0	5	0	0	0	0	0	5
Tourist Commercial	0	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	4	0	0	0	0	0	4
Commercial Mineral	31	0	0	0	0	0	0	0	0	181	0	30	241
Urban Waterfront Residential	0	0	0	0	0	0	0	0	0	0	0	0	0
Indian Allotment Land	0	0	0	0	0	0	0	0	0	0	0	0	0
City Urban Growth Area	0	0	1,315	0	0	0	667	668	0	0	19	0	2,669
Open Water	8	73	95	120	2,984	1	438	0	7	0	438	159	4,325
Totals	32,092	127,518	52,969	137,325	16,321	64,963	68,311	59,794	69,252	86,369	36,509	100,104	851,527

6.2.4 Other Water Use

Aside from municipal, domestic, self-supplied commercial/industrial, and irrigation uses, water is used for other purposes throughout WRIA 45. Such other uses of surface water include fish propagation, recreation, power generation, frost protection, and fire suppression. The majority of water rights associated with these uses are for fish propagation, recreation, and power generation, all of which are non-consumptive, meaning that water is returned to the surface water body within a short distance of where it is diverted. The quantity of water rights associated with frost protection and fire suppression is minimal. Other uses of ground water in the watershed include highway maintenance and fire protection. The quantities associated with the water rights for these uses are small and are likely not fully utilized.

6.2.5 Total Water Use in WRIA 45

Total Municipal/Domestic and Self-Supplied Commercial/Industrial Water Use

Table 6-19 presents a summary of all municipal/domestic and self-supplied commercial/industrial water use in WRIA 45. Also presented is an estimate of consumptive water use.

Consumptive water use is that portion of total water usage that is actually consumed, and not returned to a receiving body. Little data is available to determine the consumptive percentage of total water use. For the purposes of this analysis, the following assumptions are used:

- A range of 25-45% is used to characterize the consumptive portion of municipal, domestic, and self-supplied commercial/industrial use. In other watersheds throughout the state, typical consumption percentages are on the order of 25%. This is based on evaluation of wastewater flow data in comparison with water production data for municipalities. In most cases, approximately 75% of all water withdrawn or diverted is returned to a receiving body (via a wastewater treatment plant or septic drain fields). However, data from the Cities of Cashmere and Leavenworth indicate that consumptive use is approximately 45-60%. Therefore, for the purposes of estimating consumptive use, a range of percentages is used to approximate upper and lower bounds of consumptive use, based upon a combination of the local and statewide data.

- All other water use is assumed to be non-consumptive, as it is composed primarily of fish propagation, recreation, and power generation, all of which involve the return of water to a receiving body.

In total, annual municipal/domestic and self-supplied commercial/industrial water use throughout WRIA 45 is on the order of 5,300 AF/yr, with 25-45 percent (1,340 - 2,400 AF/yr) being consumptively used. Total average day and maximum day usage is approximately 4.77 mgd (7.39 cfs) and 12.25 mgd (18.99 cfs), respectively.

Table 6-19
Estimate of Current Municipal/Domestic and Self-Supplied Commercial/Industrial Water Use – WRIA 45

	2002 Water Use				
	Annual Water Use (AF/yr), by Type of Source				
Census County Division	**ADD (mgd/cfs)**	**MDD (mgd/cfs)**	**Ground Water**	**Surface Water**	**Total**
Wenatchee CCD					
Municipal/Domestic	0.489/0.76	1.223/1.90	548	0	548
Commercial/Industrial	0/0	0/0	0	0	0
Wenatchee CCD Sub-Total	0.489/0.76	1.223/1.90	548	0	548
Wenatchee CCD Consumptive Use (1)	0.122-0.220/0.19-0.34	0.306-0.550/0.48-0.86	137-247	0	137-247
Cashmere CCD					
Municipal/Domestic	1.934/3.00	4.347/6.74	1,582	586	2,168
Commercial/Industrial	0.833/1.29	2.806/4.35	933	Unknown (2)	933
Cashmere CCD Sub-Total	2.767/4.29	7.153/11.09	2,515	586	3,101
Cashmere CCD Consumptive Use (1)	0.692-1.245/1.07-1.93	1.788-3.219/2.77-4.99	629-1,132	147-264	776-1,396
Leavenworth CCD					
Municipal/Domestic	1.510/2.34	3.876/6.01	926	767	1,693
Commercial/Industrial	0/0	0/0	0	0	0
Cashmere CCD Sub-Total	1.510/2.34	3.876/6.01	926	767	1,693
Cashmere CCD Consumptive Use (1)	0.378-0.680/0.59-1.05	0.969-1.744/1.50-2.70	232-417	192-345	424-762
WRIA 45 Total					
Municipal/Domestic	3.933/6.10	9.446/14.64	3,056	1,353	4,409
Commercial/Industrial	0.833/1.29	2.806/4.35	933	Unknown	933
WRIA 45 Total	4.766/7.39	12.252/18.99	3,989	1,353	5,342
WRIA 45 Total Consumptive Use (1)	1.192-2.145/1.85-3.33	3.063-5.513/4.75-8.55	997-1,795	339-609	1,336-2,404

Notes:
CCD = Census County Division; ADD = Average Day Demand; MDD = Maximum Day Demand
mgd = million gallons per day; cfs = cubic feet per second; AF/yr = acre-feet per year

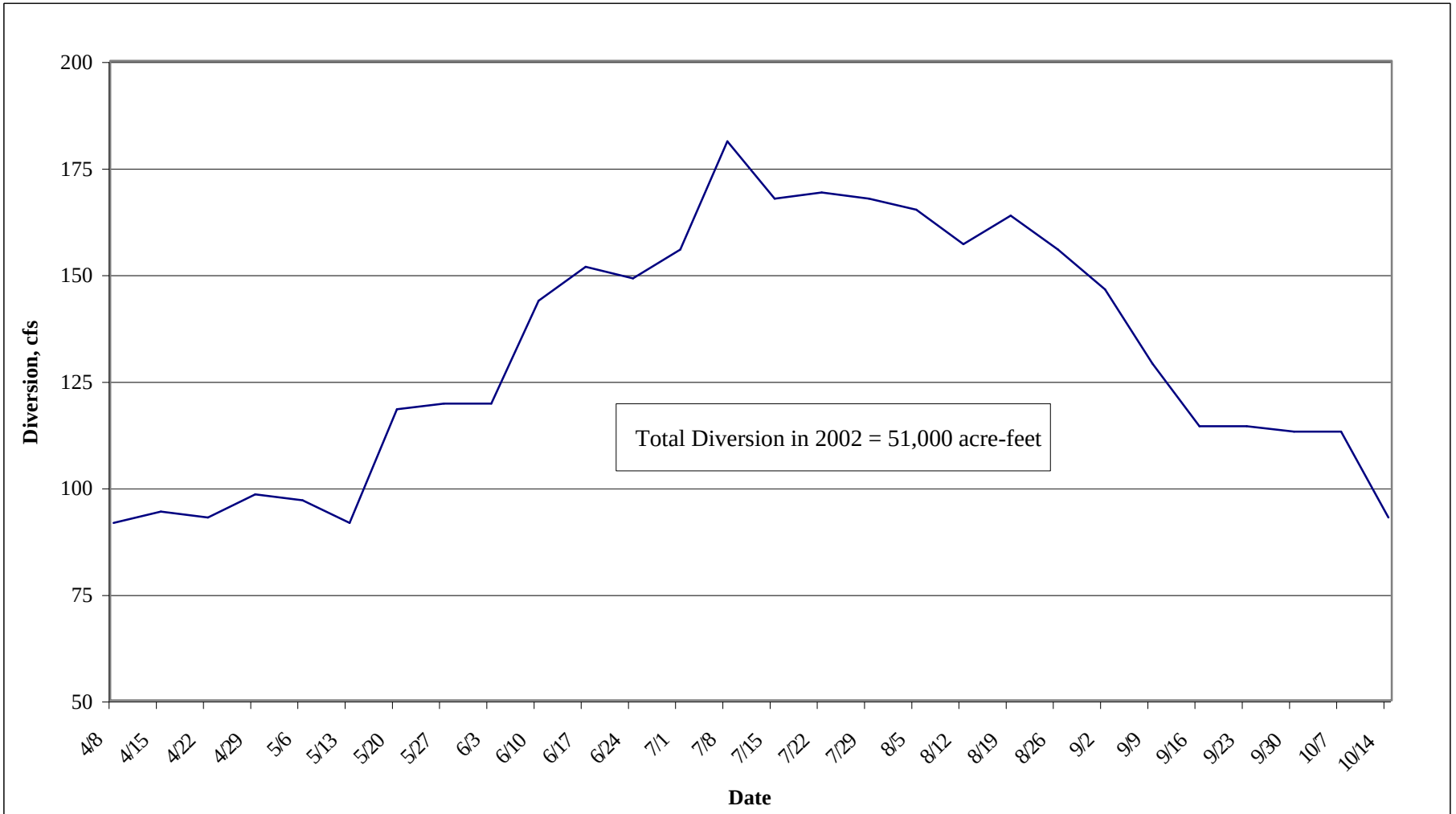
(1) Consumptive use is calculated as a range of 25-45% of total use.

(2) No annual quantities are associated with the two surface water commercial/industrial water rights.

Total Agricultural Use

The total estimated on-farm consumptive use of water for irrigation purposes is 35,000 acre-feet per year. The on-farm demand, including field application efficiency, would likely be 30-40% greater. Most of the additional water used will seep into shallow groundwater aquifers and may be a source of water supply for groundwater users or may return to surface water via a stream or wetland. That return is typically delayed by a month or so depending on its proximity to surface water and geological conditions and use by other water users.

Additional water is diverted out of the watershed for irrigation in the Cities of Wenatchee and East Wenatchee. That quantity is estimated to be about 33,000 acre-feet per year. The total out-of-stream consumptive use of water from the Wenatchee River Watershed is then estimated to be 68,000 acre-feet per year.



Data Provided by Wenatchee Reclamation District

Figure 6.1
Wenatchee Reclamation District
Diversions for 2002

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7.0 Instream Flows

Instream flows were established by rule in 1983 for three reaches on the Wenatchee River, one reach on Icicle Creek and one reach on Mission Creek. The instream flows are set in Chapter 173-545 WAC. Future consumptive Water Rights for diversion of surface water from the main stem of the Wenatchee River and perennial tributaries are subject to these instream flows as measured at the appropriate stream gage, preferably the nearest one downstream. Chapter 173-545 WAC also stipulates that Peshastin Creek is subject to a June 15 to October 15 closure for protection of instream values. These instream flows do not affect water rights that were in existence prior to 1983. Single domestic and stockwater use are exempt, and nonconsumptive uses that are compatible with the purposes of the instream flows may be approved.

Table 7-1 lists the five stream reaches (called stream management units) affected by the instream flow criteria set in Chapter 173-545 WAC. Control stations are USGS streamflow gaging stations. Instream flow rates for each reach are tabulated in Table 7-2.

Table 7-1
WAC Stream Management Units in Wenatchee River Watershed

Control Station	Stream Gage	River Mile	Stream Management Reach
Wenatchee River at Plain	12-457000	46.2	From Plain Road Bridge RM 46.2, to headwaters
Icicle Creek near Leavenworth	12-458500	1.5	From headwaters to Icicle Creek to its mouth
Wenatchee River at Peshastin	12-459000	21.5	From confluence of Derby Creek to Plain Road Bridge, RM 46.2 excluding Derby Creek and Icicle Creek
Wenatchee River at Monitor	12-462500	7.0	From mouth to confluence of Derby Creek, including Derby Creek and excluding Mission Creek
Mission Creek near Cashmere	12-462000	1.5	From Mission Creek headwaters to its mouth

Table 7-2
WAC Instream Flow Requirements in Wenatchee River Watershed

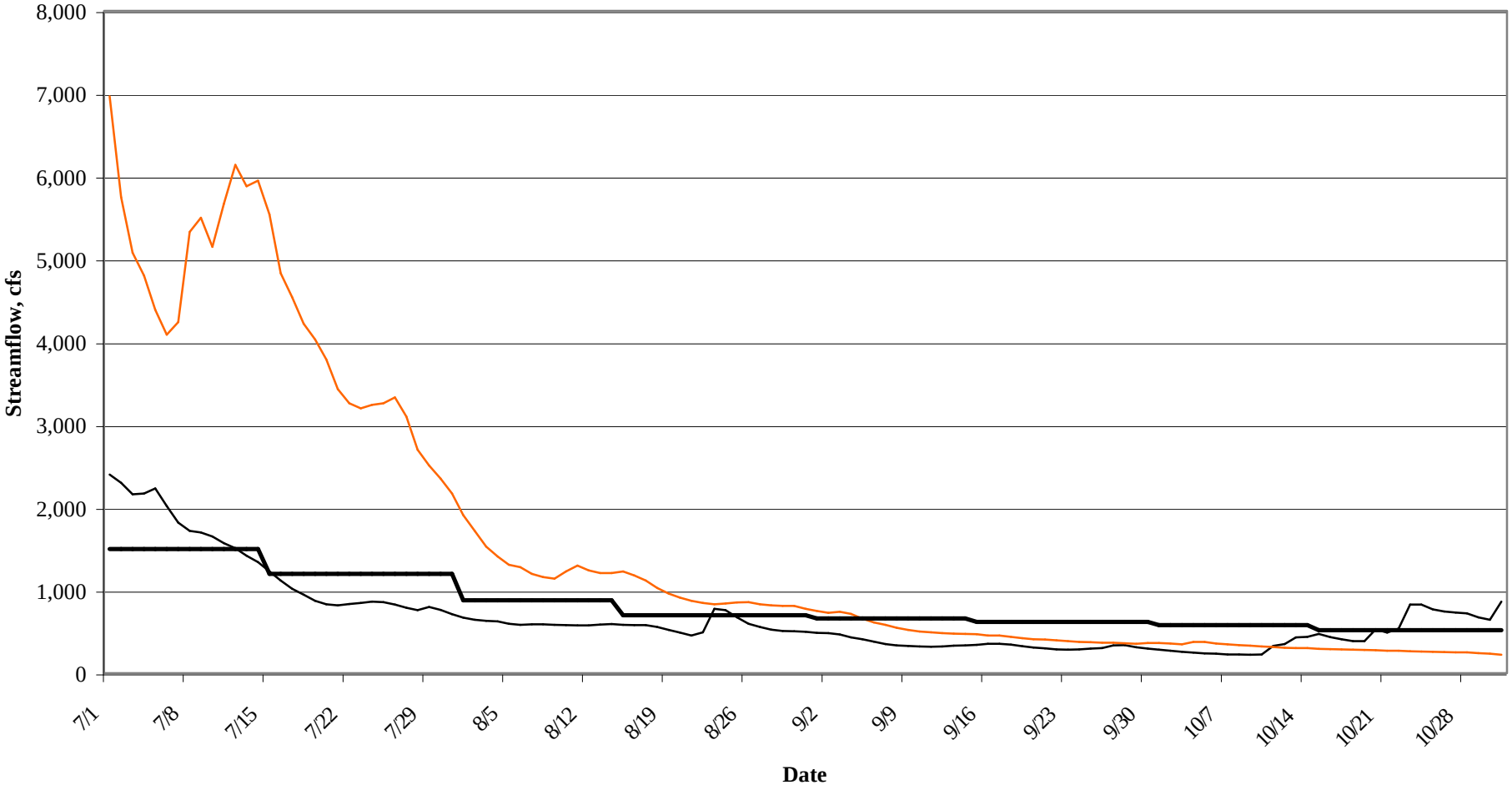
Month	Day	Instream Flow from WAC (cfs)				
		12-457000 Wenatchee River at Plain	12-458000 Icicle Creek near Leavenworth	12-459000 Wenatchee River at Peshastin	12-462000 Mission Creek near Cashmere	12-462500 Wenatchee River at Monitor
Jan	1	550	120	700	6	820
	15	550	120	700	6	820
Feb	1	550	120	700	6	820
	15	550	120	700	6	800
Mar	1	550	150	750	6	800
	15	700	170	940	11	1040
Apr	1	910	200	1300	22	1350
	15	1150	300	1750	40	1750
May	1	1500	450	2200	40	2200
	15	2000	660	2800	40	2800
Jun	1	2500	1000	3500	28	3500
	15	2000	660	2600	20	2400
Jul	1	1500	450	1900	14	1700
	15	1200	300	1400	10	1200
Aug	1	880	200	1000	7	800
	15	700	170	840	5	700
Sep	1	660	130	820	4	700
	15	620	130	780	4	700
Oct	1	580	130	750	4	700
	15	520	130	700	5	700
Nov	1	550	150	750	6	800
	15	550	150	750	6	800
Dec	1	550	150	750	6	800
	15	550	150	750	6	800

Figures 4.1, 4.2, 4.6, 4.10, 4.11 and 4.13 present statistical analyses of streamflow compared to the IRPP flows for gaging stations in the Wenatchee Watershed. The IRPP flows generally fall between the 50% and 90% exceedence values for streamflow on the affected streams except in September when the IRPP flows exceed the 50% exceedence flow values.

Figures 7.1 and 7.2 show a comparison of Wenatchee River flow at Plain and Monitor to IRPP flows for the last two July-October time periods. The flow volume which Wenatchee River flows are less than IRPP flows are listed in the figures. In 2002, the Wenatchee River flows were 15,700 – 24,700 ac-ft below IRPP flows. In 2001, the Wenatchee River flows were

46,100 – 50,400 ac-ft below the IRPP flows. 2001 was a drought year with an extended period of low streamflow. In 2002, the annual runoff was average but a late summer dry period caused streamflow to decline to 2001 levels.

Analyses presented in the *Lake Wenatchee Water Storage Feasibility Study* (MWH/MWG, 2003) show that, on average, there are 87 days per year that the IRPP flows are not met at the Wenatchee River at Plain gaging station and 78 days per year at the Peshastin gaging station. During the low flow periods of August through October, the IRPP flows are not met almost one-half of the time. In dry years, it appears that IRPP flows are not met for almost one-half of the entire year.



USGS Gage 12457000

2001 Wenatchee River Flow
2002 Wenatchee River Flow
IRPP

Figure 7.1 Comparison of 2001/2002 Flows to IRPP
Wenatchee River at Plain, WA

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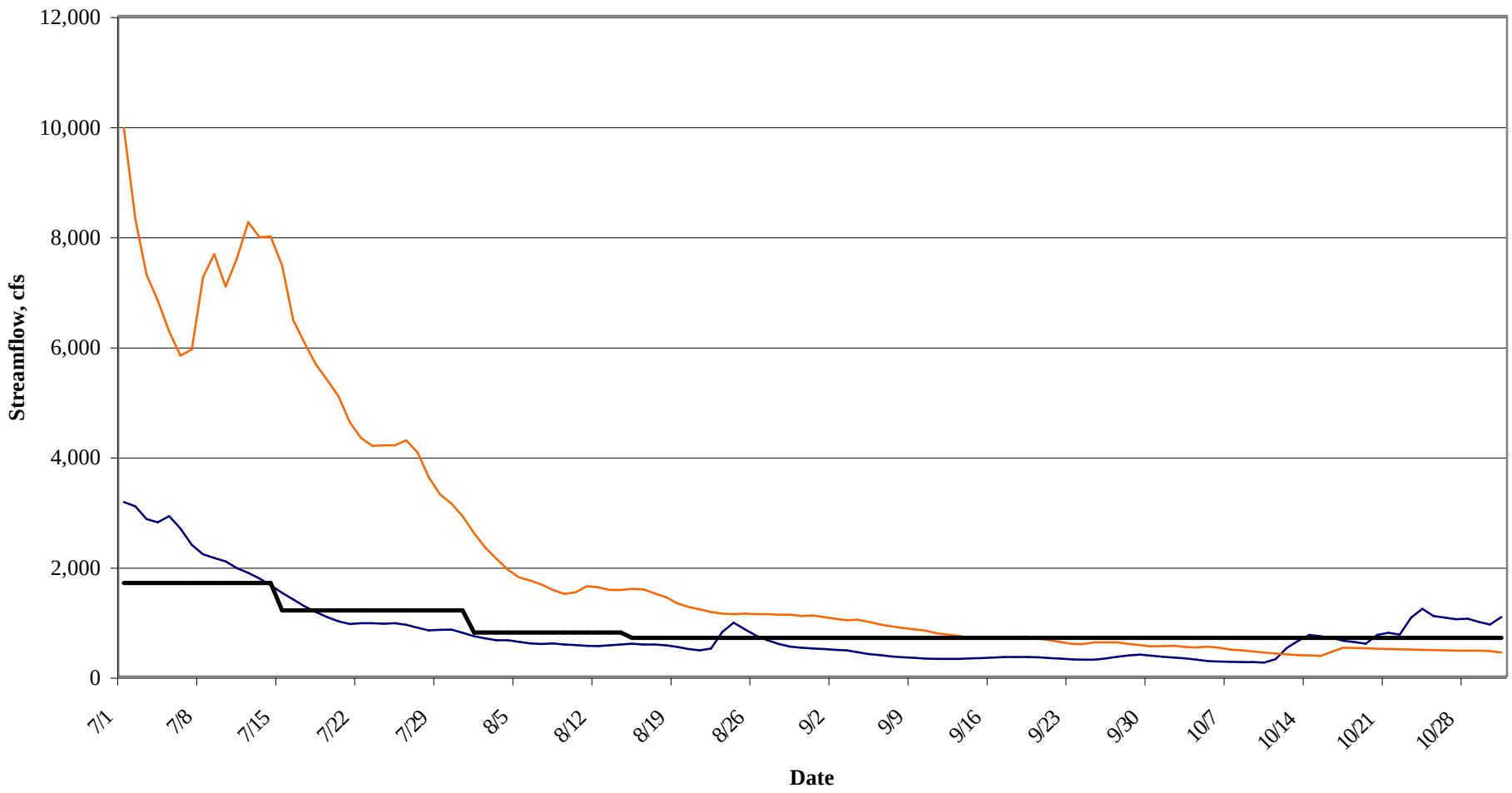

USGS Gage 12462500

2001 Wenatchee River Flow
2002 Wenatchee River Flow
IRPP

Figure 7.2 Comparison of 2001/2002 Flows to IRPP
Wenatchee River at Monitor, WA

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8.0 DATA GAPS AND RECOMMENDED STUDIES

Based on water quantity data presented in this report, we have identified the following data gaps with corresponding recommendations for ongoing study effort of the Watershed Management Plan:

- Water rights data may not be complete and water right claims data is likely not representative of actual use. Additional work is required to ensure all water rights data is correct within the GWIS database by verifying quantities and place of use. Claims data would also need verification by comparing water rights and use on a parcel-by-parcel basis.

- It is unknown how well water rights data represents water use. Additional data will need to be compiled to prepare more accurate estimates of water use. Water use variations on a seasonal and annual basis are also not represented by water rights data.

- The irrigated acreage and cropping patterns are not well documented. Additional mapping of crops is warranted to help determine water use patterns.

- The extent and quantity of unauthorized water uses is not known.

- The readily available groundwater data are insufficient to accurately estimate water available, water present, and water available for further appropriation. Data gaps for ground water resources include information on aquifer properties (e.g., dimensions, transmissivity, vertical hydraulic conductivity, storativity, and specific yield), seasonal variations in water levels and the relationship between surface water and groundwater. Periodic ground water level measurements in aquifers on are needed to assess seasonal changes due to recharge and discharge (e.g., ground water withdrawals and contribution to surface water). Hydraulic relationships between the aquifers in and adjacent to the basin and the hydraulic relationships between aquifers and surface water bodies need to be understood so that the quantity of water exchanged between aquifers and between the aquifers and surface water can be estimated.

- Information on the long-term patterns of surface water sources is not available as sufficient stream gaging data is not yet available. Chelan County has recently installed stream gaging stations at a number of locations. The data collected from those stations will be valuable in assessing and managing water resources in the Wenatchee Watershed. However, the streamflow record at this time is short preventing much use of the data collected to date in estimates of long-term streamflow patterns. The County should maintain the stations for as long as possible to ensure adequate data is compiled.

The distribution of water use and availability is not well known in the watershed. A method to assess that is through the preparation of a water budget. A water budget compares two quantities: input to the hydrologic system via precipitation and recharge, and output

(withdrawals) from the system via groundwater and surface use, surface water flow out of the area, and evapotranspiration. We recommend that the Watershed Planning Unit prioritize areas for additional in-depth, site-specific analyses of water rights, recharge, water use and streamflow through a water budget approach. These studies should focus on collecting and analyzing information required to refine water budget estimates in areas where:

- Existing or future demand exceeds local groundwater recharge
- Water right allocations exceed local ground-water recharge
- Water quality problems pose a risk to human health
- Streamflow is low or affected by groundwater withdrawals
- Areas of high interest by habitat, instream flow and water quality groups within the Watershed Planning Unit.

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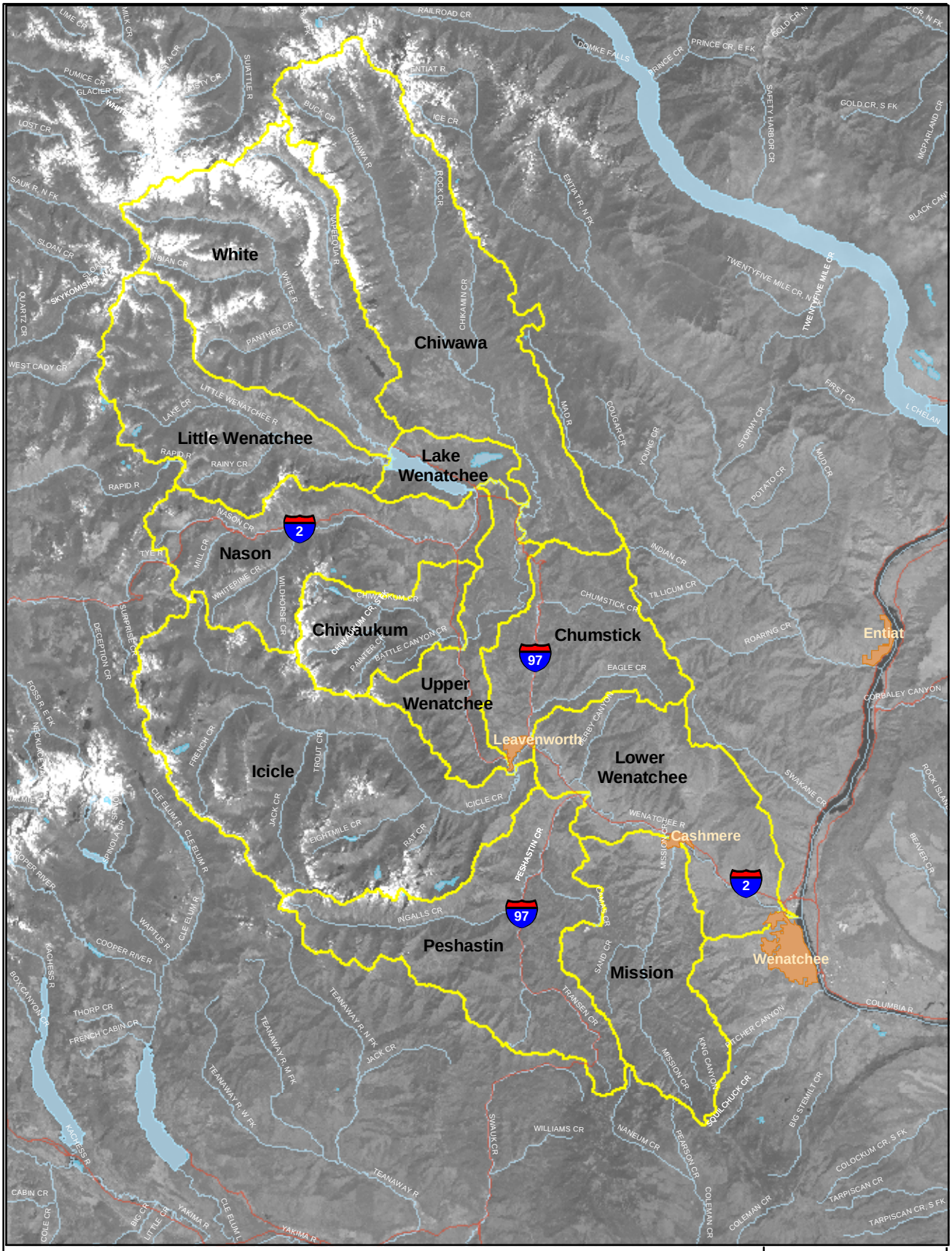

Sub-Basins
Highways
Rivers
Lakes
Cities

Map 1
Sub-Basins in Wenatchee Watershed
WRIA 45 Watershed Assessment

0 8 Miles

MONTGOMERY WATER GROUP, INC.
Water Resources Engineering

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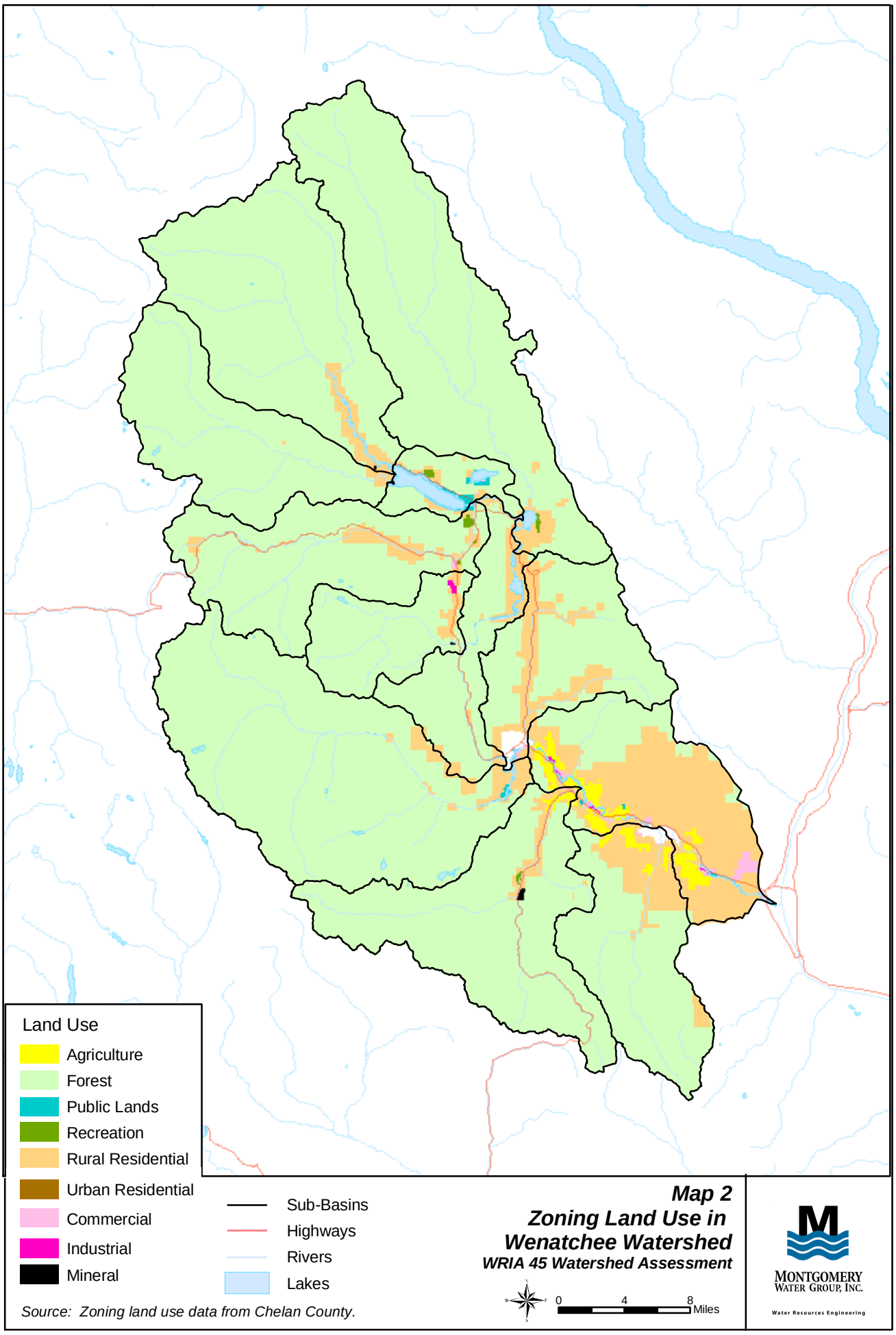
Land Use
Agriculture
Forest
Public Lands
Recreation
Rural Residential
Urban Residential
Commercial
Industrial
Mineral
Sub-Basins
Highways
Rivers
Lakes
Source: Zoning land use data from Chelan County.
Map 2
Zoning Land Use in
Wenatchee Watershed
WRIA 45 Watershed Assessment
0
4
8
Miles
MONTGOMERY
WATER GROUP, INC.
Water Resources Engineering
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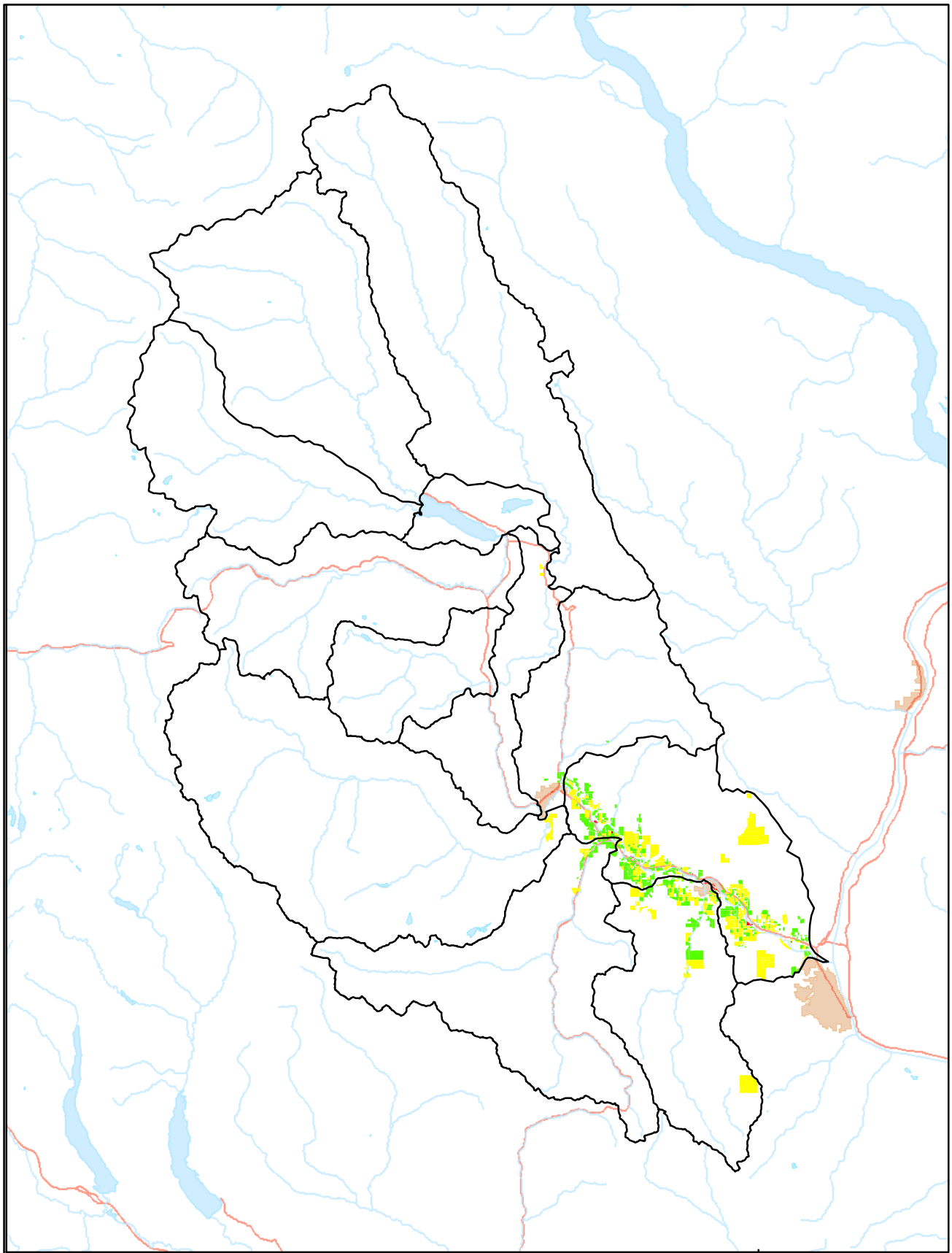

Agricultural Land Use

Open Space

Not in Open Space

Source: Taxlot land use from Chelan County.

Highways

Rivers

Lakes

Cities

Sub-Basins

0 4 8 Miles

Map 3

Taxlots Land Use in Wenatchee Watershed

WRIA 45 Watershed Assessment

MONTGOMERY WATER GROUP, INC.

Water Resources Engineering

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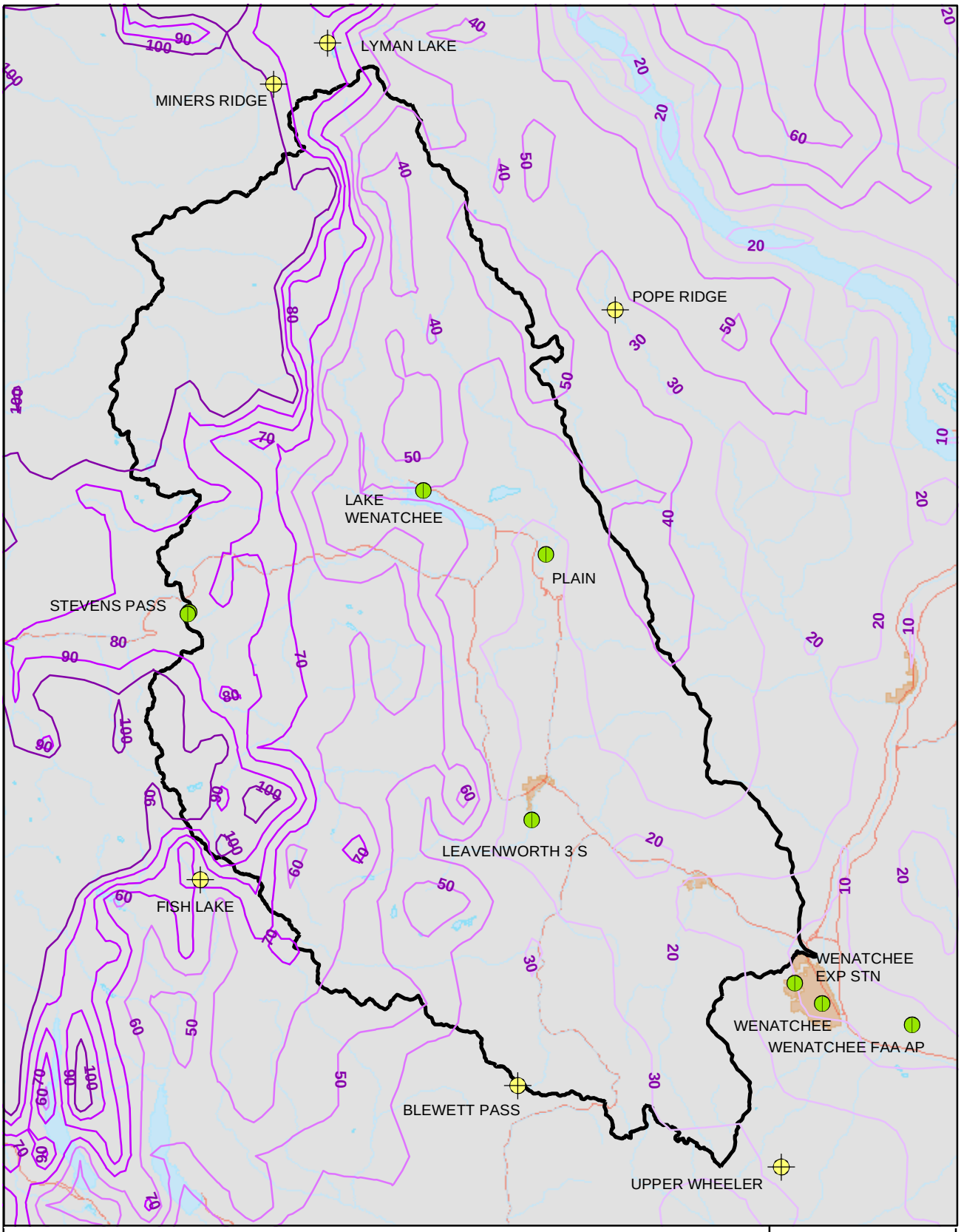


Precipitation (inches)

- 100
- 90
- 80
- 70
- 60
- 50
- 40
- 30
- 20
- 10
- Wenatchee Watershed

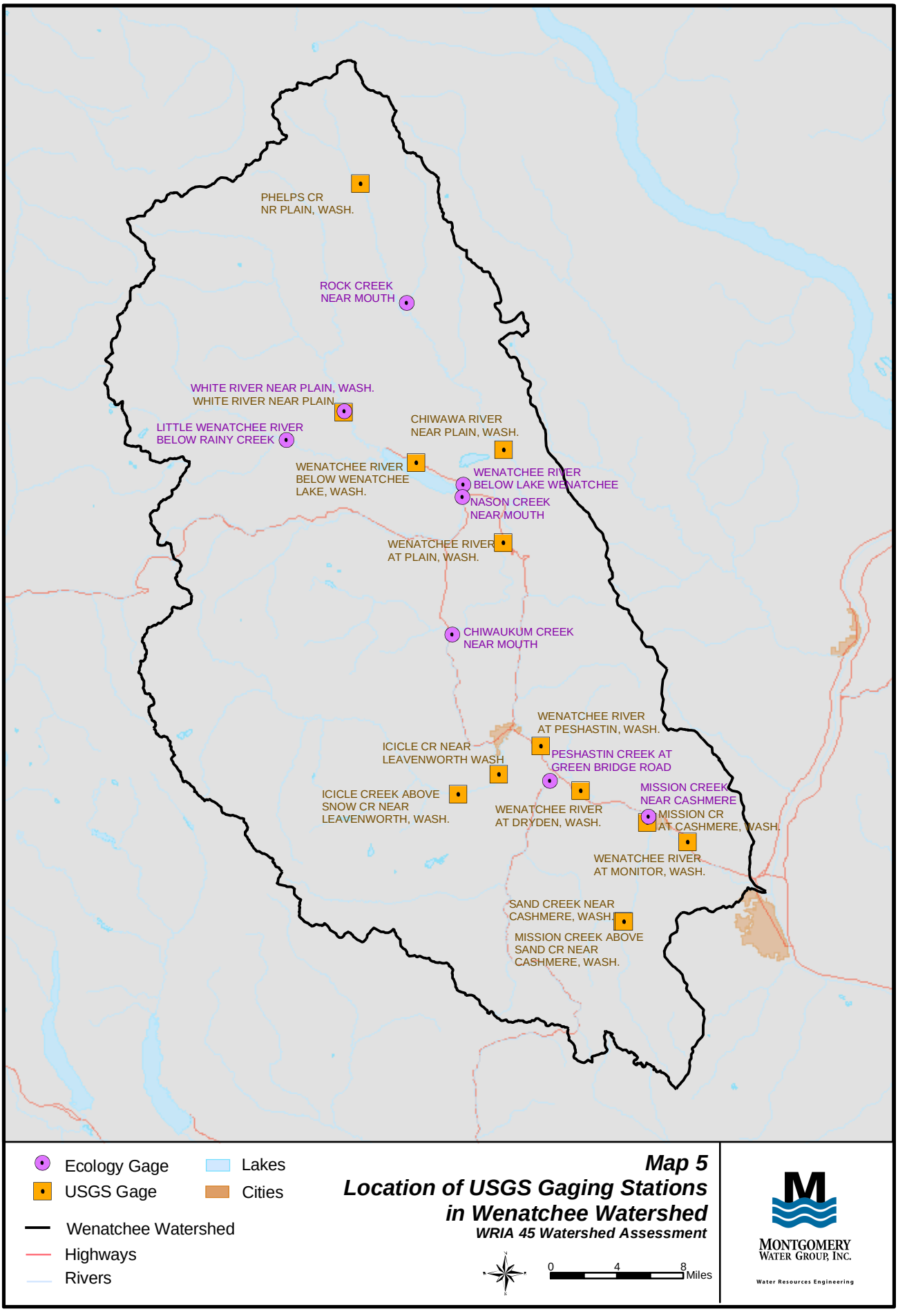
- SNOTEL Gage
- WRCC Gage
- Highways
- Rivers
- Lakes
- Cities

0 4 8 Miles

Map 4
Wenatchee Watershed Precipitation Map
WRIA 45 Watershed Assessment

MONTGOMERY WATER GROUP, INC.
Water Resources Engineering

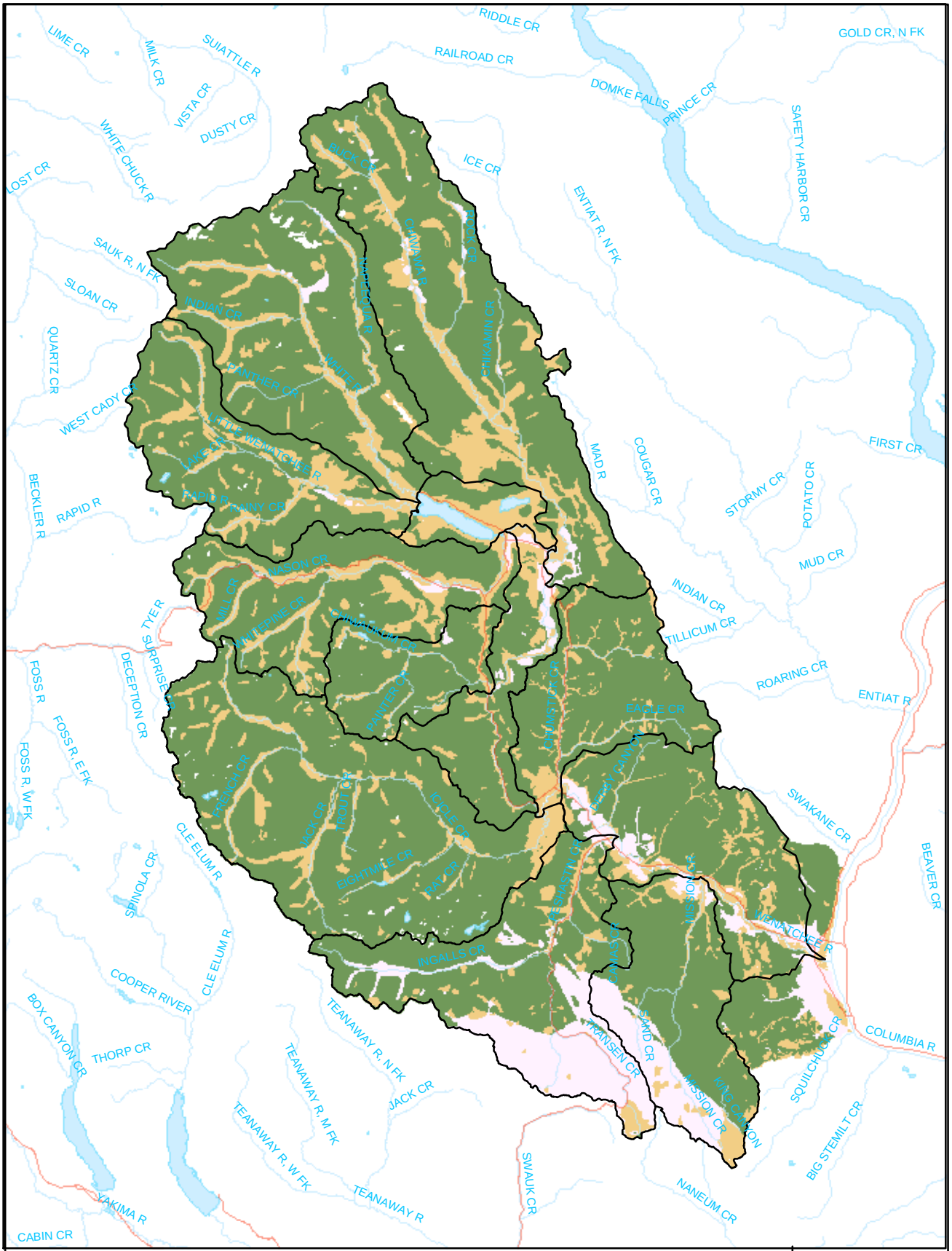
Y:\10001026_WRIA_45\GIS\PGGwork\mxd\map2_precipitation.mxd, 6/3/03

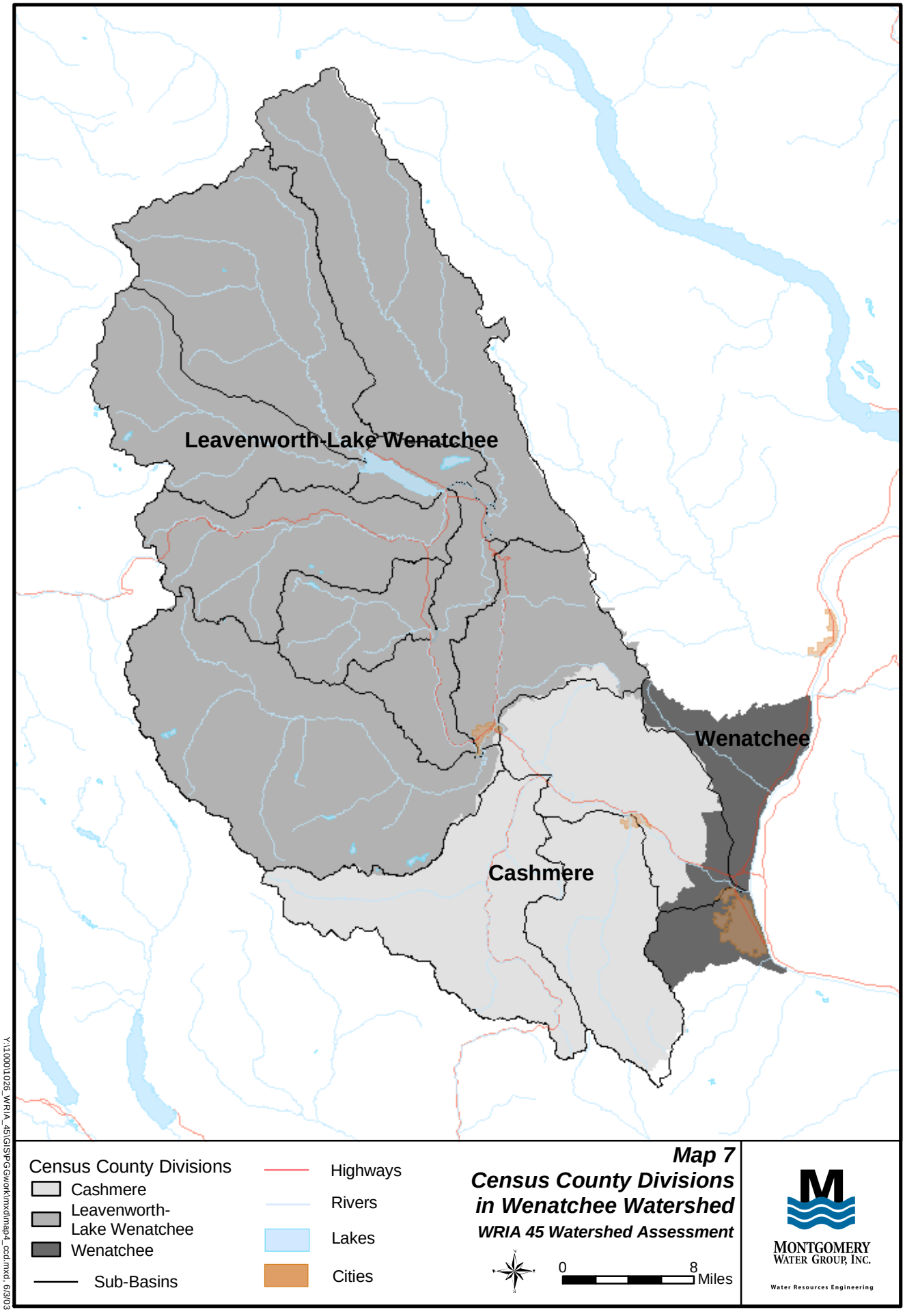


Map 5
Location of USGS Gaging Stations in Wenatchee Watershed
WRIA 45 Watershed Assessment

MONTGOMERY WATER GROUP, INC.
Water Resources Engineering

Y:\10001026_WRIA_45\GIS\PGGworkl\mxd\map3_streamgages.mxd, 5/29/03


LIME CR
MILK CR
SUIATTLE R
VISTA CR
DUSTY CR
WHITE CHUCK R
LOST CR
RIDDLE CR
RAILROAD CR
DOMKE FALLS
PRINCE CR
GOLD CR, N FK
SAFETY HARBOR CR
ICE CR
BUCK CR
ENTIAT R, N FK
SAUK R, N FK
SLOAN CR
INDIAN CR
QUARTZ CR
WEST CADY CR
PANTHER CR
WHITE R
CHIWAWA R
ROCK CR
CHIWAWA CR
LITTLE WENATCHEE R
LAKE CR
RAPID R
FANNY CR
BECKLER R
RAPID R
MASON CR
MILL CR
NAHAHUM CR
TYE R
SURPRISE CR
DECEPTION CR
FOSS R
FOSS R, E FK
FOSS R, W FK
PANTHER CR
FRENCH CR
WACK CR
ICICLE CR
BIGTIMBER CR
CLE ELUM R
SPINOLA CR
COOPER RIVER
BOX CANYON CR
THORP CR
CLE ELUM R
TEANAWAY R, N FK
TEANAWAY R, M FK
TEANAWAY R, W FK
TEANAWAY R
JACK CR
YAKIMA R
CABIN CR
SWAUK CR
NANEUM CR
MAD R
COUGAR CR
STORMY CR
POTATO CR
FIRST CR
MUD CR
INDIAN CR
TILLICUM CR
ROARING CR
ENTIAT R
EAGLE CR
SWAKANE CR
BEAVER CR
WENATCHEE R
ENTIAT R
MISSION CR
SAND CR
HANSEN CR
MAD CANYON
SQUILCHUCK CR
COLUMBIA R
BIG STEMILT CR
Hydraulic Conductivity
Very Low
High
Moderate to Low
Sub-Basins
Highways
Rivers
Lakes
Source: Modified from USGS Surficial Geology Map.
Map 6
Relative Hydraulic Conductivity in Wenatchee Watershed
WRIA 45 Watershed Assessment
0
4
8
Miles
MONTGOMERY WATER GROUP, INC.
Water Resources Engineering
Y:\10001026_WRIA_45\GIS\PGGwork\mxd\map_surfgeology.mxd, 6/3/03



Map 7
Census County Divisions in Wenatchee Watershed
WRIA 45 Watershed Assessment

MONTGOMERY WATER GROUP, INC.
Water Resources Engineering

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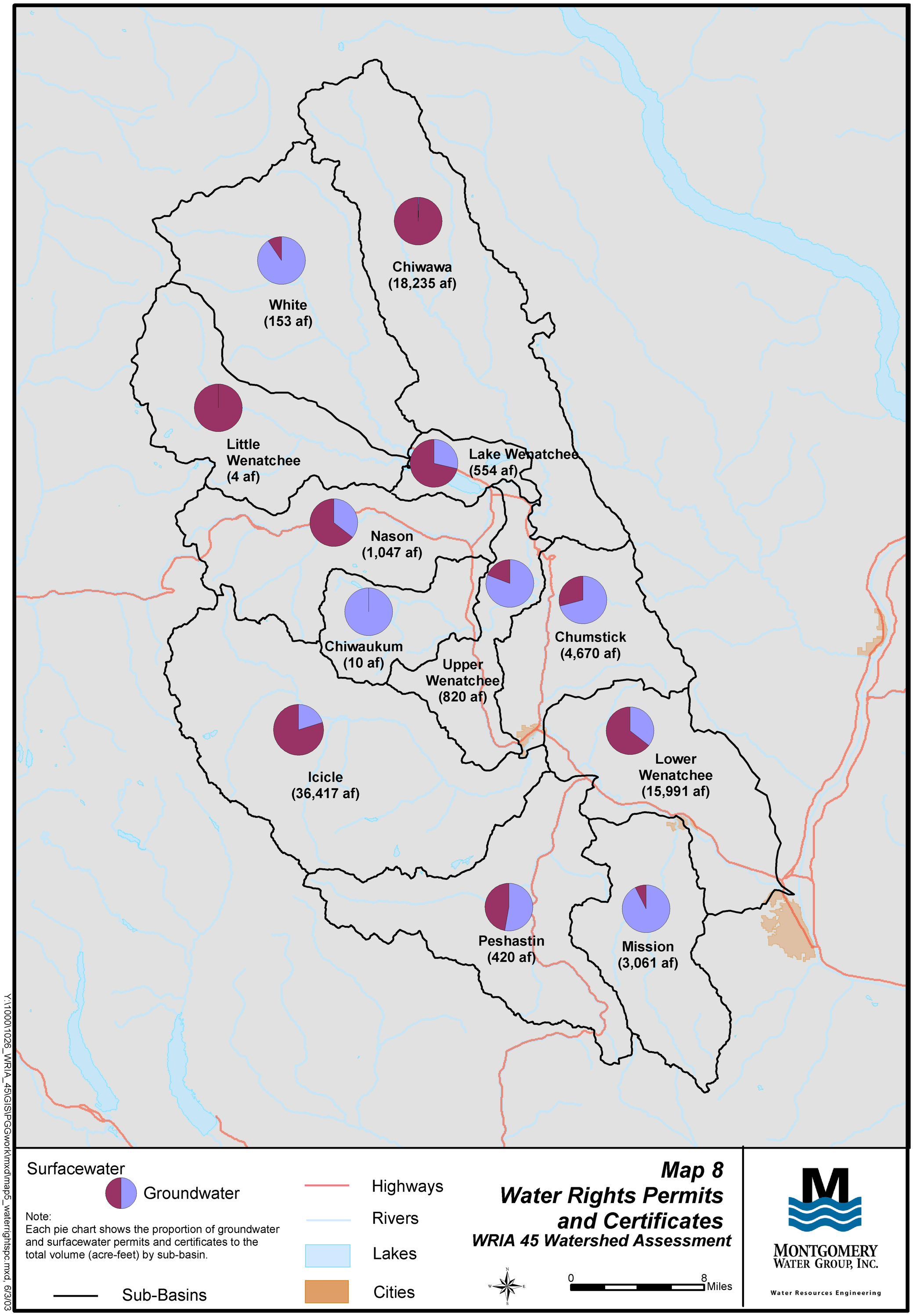
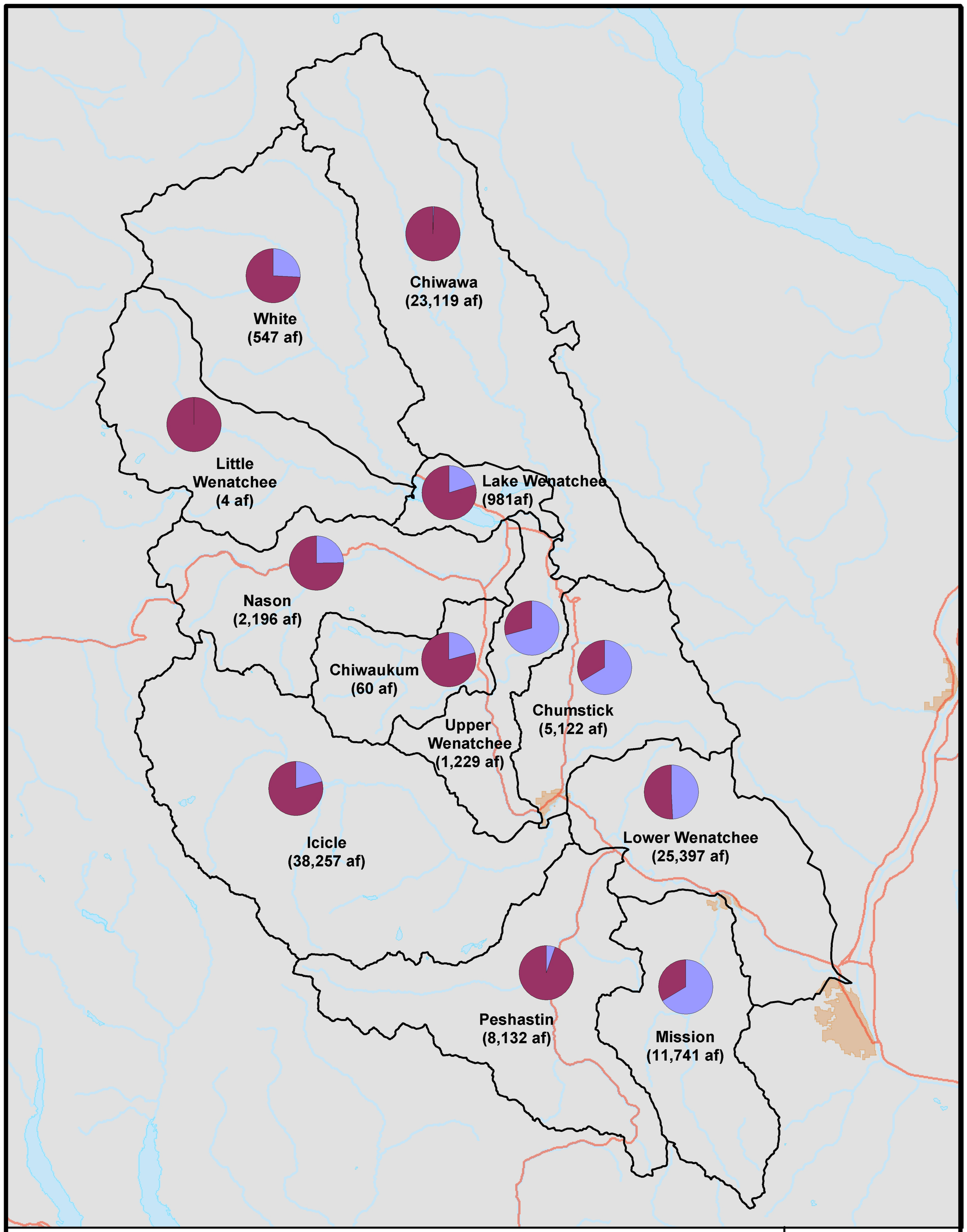

Chiwawa
(18,235 af)
White
(153 af)
Little
Wenatchee
(4 af)
Lake Wenatchee
(554 af)
Nason
(1,047 af)
Chiwaukum
(10 af)
Upper
Wenatchee
(820 af)
Chumstick
(4,670 af)
Icicle
(36,417 af)
Lower
Wenatchee
(15,991 af)
Peshastin
(420 af)
Mission
(3,061 af)
Surfacewater
Groundwater
Note:
Each pie chart shows the proportion of groundwater and surfacewater permits and certificates to the total volume (acre-feet) by sub-basin.
Sub-Basins
Highways
Rivers
Lakes
Cities
Map 8
Water Rights Permits and Certificates
WRIA 45 Watershed Assessment
N
W
E
S
0
8
Miles
MONTGOMERY WATER GROUP, INC.
Water Resources Engineering
Y:\10001\026_WRIA_45\GIS\PGGwork\mxd\map5_waterrightspc.mxd, 6/3/03


White
(547 af)
Chiwawa
(23,119 af)
Little
Wenatchee
(4 af)
Lake Wenatchee
(981af)
Nason
(2,196 af)
Chiwaukum
(60 af)
Chumstick
(5,122 af)
Upper
Wenatchee
(1,229 af)
Icicle
(38,257 af)
Lower Wenatchee
(25,397 af)
Peshastin
(8,132 af)
Mission
(11,741 af)
Surfacewater
Groundwater
Note:
Each pie chart shows the proportion of groundwater and surfacewater permits, claims, and certificates to the total volume (acre-feet) by sub-basin.
Sub-Basins
Highways
Rivers
Lakes
Cities
N
W
E
S
0
8
Miles
Map 9
Water Rights Permits, Claims, and Certificates
WRIA 45 Watershed Assessment
MONTGOMERY WATER GROUP, INC.
Water Resources Engineering
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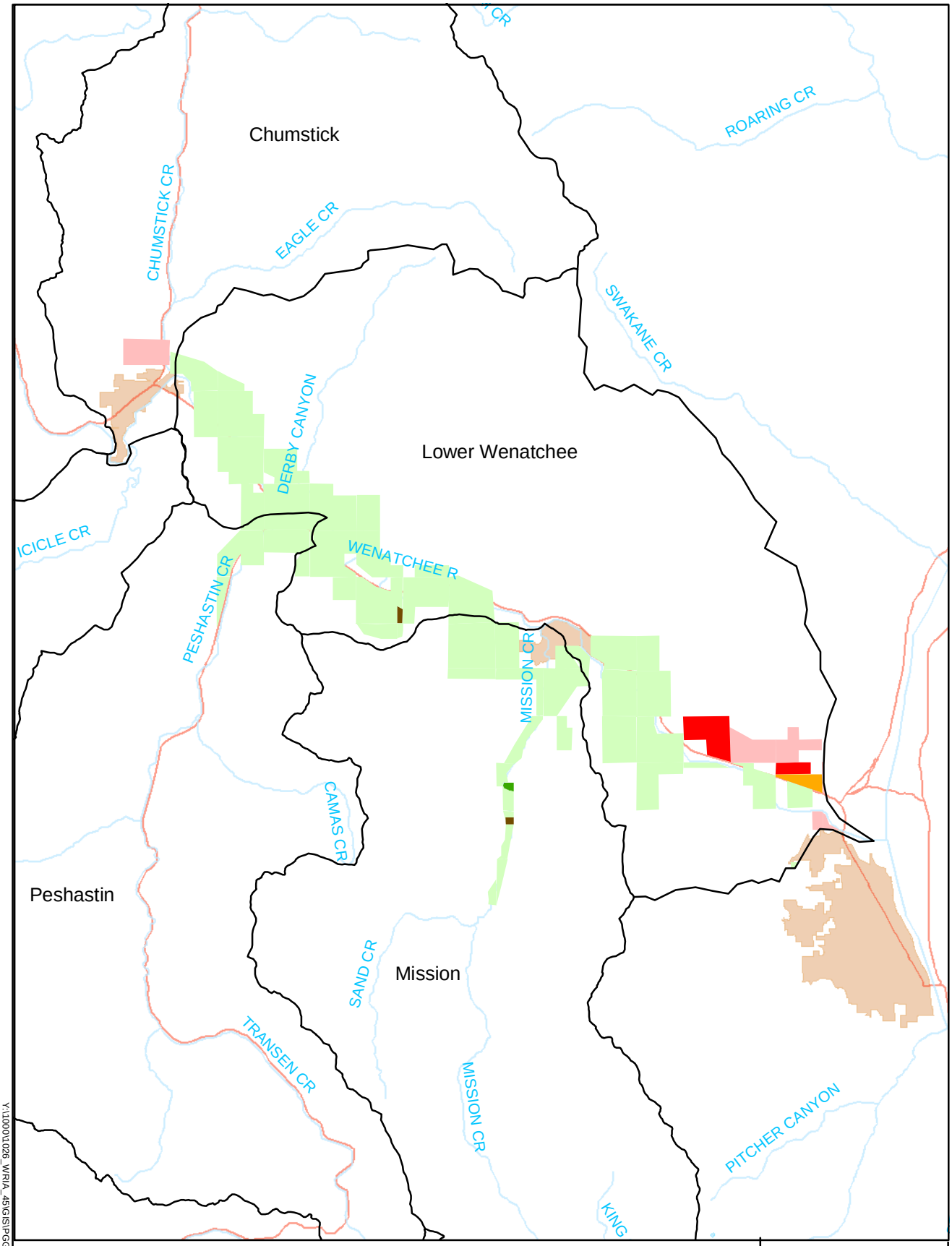

Crops

- Alfalfa
- Apples
- Cherries
- Christmas Trees
- Peaches
- Pears

Source: Crop data from Washington Department of Agriculture.

- Sub-Basins
- Highways
- Rivers
- Lakes
- Cities

0 1.5 3 Miles

Map 10
Crop Data for Wenatchee Watershed
WRIA 45 Watershed Assessment

MONTGOMERY WATER GROUP, INC.
Water Resources Engineering

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APPENDIX A
LAND USE AND LAND COVER BY SUBBASIN

Land Cover in the Wenatchee River Watershed

Land Cover	Wenatchee Watershed		Subbasins					
			Chiwawa			White		
	Area (acres)	% of Basin Area	Area (acres)	% of Basin Area	% of Land Cover	Area (acres)	% of Basin Area	% of Land Cover
Water	8448.8	1.0%	668.8	0.5%	7.9%	552.5	0.6%	6.5%
Perennial Ice, Snow	2943.5	0.3%	512.6	0.4%	17.4%	1636.2	1.7%	55.6%
Low Intensity Residential	1759.3	0.2%	30.3	0.0%	1.7%	0.0	0.0%	0.0%
Commercial, Industrial, and/or Transportation	1496.5	0.2%	55.9	0.0%	3.7%	9.3	0.0%	0.6%
Bare Rock, Sand or Clay	45251.7	5.3%	6944.0	5.5%	15.3%	12229.0	12.5%	27.0%
Quarries, Strip Mines, or Gravel	28.0	0.0%	2.3	0.0%	8.3%	0.0	0.0%	0.0%
Transitional	15196.3	1.8%	4324.9	3.4%	28.5%	598.8	0.6%	3.9%
Decidious Forest	17416.7	2.1%	1067.2	0.8%	6.1%	2941.4	3.0%	16.9%
Evergreen Forest	567650.2	67.0%	98057.5	77.4%	17.3%	58786.5	59.9%	10.4%
Mixed Forest	7907.1	0.9%	421.8	0.3%	5.3%	751.8	0.8%	9.5%
Shrubland	66487.8	7.9%	6268.3	4.9%	9.4%	9184.7	9.4%	13.8%
Orchards, Vineyards, Other	11572.9	1.4%	48.9	0.0%	0.4%	0.0	0.0%	0.0%
Grasslands, Herbaceous	98054.2	11.6%	7820.2	6.2%	8.0%	10927.5	11.1%	11.1%
Pasture, Hay	933.1	0.1%	93.2	0.1%	10.0%	0.0	0.0%	0.0%
Row Crops	28.1	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0%
Small Grains	256.8	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0%
Fallow	8.0	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0%
Urban, Recreational Grasses	37.5	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0%
Woody Wetlands	1401.6	0.2%	403.1	0.3%	28.8%	549.7	0.6%	39.2%
Emergent Herbaceous Wetlands	72.5	0.0%	2.3	0.0%	3.2%	9.3	0.0%	12.8%
Total	846950.5	100.0%	126721.4	100.0%	15.0%	98176.5	100.0%	11.6%

Data obtained from USGS National Land Cover Data Set

Land Cover in the Wenatchee River Watershed

Land Cover	Little Wenatchee			Nason			Lake Wenatchee		
	Area (acres)	% of Basin Area	% of Land Cover	Area (acres)	% of Basin Area	% of Land Cover	Area (acres)	% of Basin Area	% of Land Cover
Water	298.7	0.5%	3.5%	366.7	0.5%	4.3%	3025.8	18.6%	35.8%
Perennial Ice, Snow	14.8	0.0%	0.5%	22.6	0.0%	0.8%	0.0	0.0%	0.0%
Low Intensity Residential	0.0	0.0%	0.0%	5.6	0.0%	0.3%	6.3	0.0%	0.4%
Commercial, Industrial, and/or Transportation	41.2	0.1%	2.8%	126.4	0.2%	8.4%	40.4	0.2%	2.7%
Bare Rock, Sand or Clay	1569.3	2.4%	3.5%	2772.2	4.0%	6.1%	277.4	1.7%	0.6%
Quarries, Strip Mines, or Gravel	12.6	0.0%	45.1%	3.2	0.0%	11.3%	0.0	0.0%	0.0%
Transitional	3046.9	4.7%	20.1%	3976.9	5.8%	26.2%	578.7	3.6%	3.8%
Decidious Forest	1607.7	2.5%	9.2%	1728.4	2.5%	9.9%	334.8	2.1%	1.9%
Evergreen Forest	52343.9	80.7%	9.2%	50512.3	73.2%	8.9%	11437.4	70.5%	2.0%
Mixed Forest	710.0	1.1%	9.0%	598.4	0.9%	7.6%	132.7	0.8%	1.7%
Shrubland	2799.8	4.3%	4.2%	3624.5	5.3%	5.5%	176.4	1.1%	0.3%
Orchards, Vineyards, Other	0.0	0.0%	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0%
Grasslands, Herbaceous	2183.7	3.4%	2.2%	5217.0	7.6%	5.3%	166.5	1.0%	0.2%
Pasture, Hay	0.0	0.0%	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0%
Row Crops	0.0	0.0%	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0%
Small Grains	0.0	0.0%	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0%
Fallow	0.0	0.0%	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0%
Urban, Recreational Grasses	0.0	0.0%	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0%
Woody Wetlands	196.0	0.3%	14.0%	48.9	0.1%	3.5%	26.6	0.2%	1.9%
Emergent Herbaceous Wetlands	4.9	0.0%	6.8%	7.5	0.0%	10.4%	22.3	0.1%	30.7%
Total	64829.8	100.0%	7.7%	69010.5	100.0%	8.1%	16225.5	100.0%	1.9%

Data obtained from USGS National Land Cover Data Set

Land Cover in the Wenatchee River Watershed

Land Cover	Chiwaukum			Upper Wenatchee			Chumstick		
	Area (acres)	% of Basin Area	% of Land Cover	Area (acres)	% of Basin Area	% of Land Cover	Area (acres)	% of Basin Area	% of Land Cover
Water	263.2	0.8%	3.1%	584.6	1.6%	6.9%	83.3	0.2%	1.0%
Perennial Ice, Snow	302.1	0.9%	10.3%	24.2	0.1%	0.8%	0.0	0.0%	0.0%
Low Intensity Residential	0.0	0.0%	0.0%	93.6	0.3%	5.3%	213.1	0.4%	12.1%
Commercial, Industrial, and/or Transportation	5.9	0.0%	0.4%	39.3	0.1%	2.6%	211.1	0.4%	14.1%
Bare Rock, Sand or Clay	2727.0	8.5%	6.0%	983.2	2.7%	2.2%	31.8	0.1%	0.1%
Quarries, Strip Mines, or Gravel	1.1	0.0%	4.0%	0.0	0.0%	0.0%	6.5	0.0%	23.2%
Transitional	980.2	3.1%	6.5%	257.3	0.7%	1.7%	117.8	0.2%	0.8%
Decidious Forest	928.9	2.9%	5.3%	741.7	2.0%	4.3%	2690.2	5.1%	15.4%
Evergreen Forest	21263.1	66.4%	3.7%	26893.5	74.1%	4.7%	35574.3	67.4%	6.3%
Mixed Forest	266.7	0.8%	3.4%	443.8	1.2%	5.6%	1401.1	2.7%	17.7%
Shrubland	1846.8	5.8%	2.8%	1103.0	3.0%	1.7%	1628.3	3.1%	2.4%
Orchards, Vineyards, Other	0.0	0.0%	0.0%	278.2	0.8%	2.4%	652.1	1.2%	5.6%
Grasslands, Herbaceous	3420.1	10.7%	3.5%	4495.1	12.4%	4.6%	9973.0	18.9%	10.2%
Pasture, Hay	0.0	0.0%	0.0%	320.1	0.9%	34.3%	117.8	0.2%	12.6%
Row Crops	0.0	0.0%	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0%
Small Grains	0.0	0.0%	0.0%	0.0	0.0%	0.0%	3.4	0.0%	1.3%
Fallow	0.0	0.0%	0.0%	0.0	0.0%	0.0%	0.0	0.0%	0.0%
Urban, Recreational Grasses	0.0	0.0%	0.0%	0.0	0.0%	0.0%	36.9	0.1%	98.5%
Woody Wetlands	7.0	0.0%	0.5%	41.9	0.1%	3.0%	46.1	0.1%	3.3%
Emergent Herbaceous Wetlands	0.0	0.0%	0.0%	2.0	0.0%	2.7%	3.1	0.0%	4.2%
Total	32012.2	100.0%	3.8%	36301.4	100.0%	4.3%	52790.0	100.0%	6.2%

Data obtained from USGS National Land Cover Data Set

Land Cover in the Wenatchee River Watershed

Land Cover	Icicle			Peshastin		
	Area (acres)	% of Basin Area	% of Land Cover	Area (acres)	% of Basin Area	% of Land Cover
Water	1767.3	1.3%	20.9%	91.3	0.1%	1.1%
Perennial Ice, Snow	411.1	0.3%	14.0%	19.8	0.0%	0.7%
Low Intensity Residential	94.2	0.1%	5.4%	24.3	0.0%	1.4%
Commercial, Industrial, and/or Transportation	53.3	0.0%	3.6%	261.6	0.3%	17.5%
Bare Rock, Sand or Clay	13045.6	9.5%	28.8%	4260.0	4.9%	9.4%
Quarries, Strip Mines, or Gravel	0.0	0.0%	0.0%	0.0	0.0%	0.0%
Transitional	768.0	0.6%	5.1%	510.3	0.6%	3.4%
Decidious Forest	977.4	0.7%	5.6%	958.3	1.1%	5.5%
Evergreen Forest	92555.5	67.6%	16.3%	57744.8	66.9%	10.2%
Mixed Forest	688.1	0.5%	8.7%	900.5	1.0%	11.4%
Shrubland	8237.7	6.0%	12.4%	5105.7	5.9%	7.7%
Orchards, Vineyards, Other	216.0	0.2%	1.9%	645.0	0.7%	5.6%
Grasslands, Herbaceous	17995.3	13.1%	18.4%	15711.9	18.2%	16.0%
Pasture, Hay	85.7	0.1%	9.2%	17.5	0.0%	1.9%
Row Crops	0.0	0.0%	0.0%	0.8	0.0%	2.7%
Small Grains	0.0	0.0%	0.0%	0.8	0.0%	0.3%
Fallow	0.0	0.0%	0.0%	0.0	0.0%	0.0%
Urban, Recreational Grasses	0.0	0.0%	0.0%	0.0	0.0%	0.0%
Woody Wetlands	9.5	0.0%	0.7%	38.8	0.0%	2.8%
Emergent Herbaceous Wetlands	11.4	0.0%	15.7%	0.0	0.0%	0.0%
Total	136916.1	100.0%	16.2%	86291.3	100.0%	10.2%

Data obtained from USGS National Land Cover Data Set

Land Cover in the Wenatchee River Watershed

Land Cover	Mission			Lower Wenatchee		
	Area (acres)	% of Basin Area	% of Land Cover	Area (acres)	% of Basin Area	% of Land Cover
Water	20.0	0.0%	0.2%	726.5	1.1%	8.6%
Perennial Ice, Snow	0.0	0.0%	0.0%	0.0	0.0%	0.0%
Low Intensity Residential	467.7	0.8%	26.6%	824.0	1.2%	46.8%
Commercial, Industrial, and/or Transportation	114.4	0.2%	7.6%	537.8	0.8%	35.9%
Bare Rock, Sand or Clay	382.6	0.6%	0.8%	29.7	0.0%	0.1%
Quarries, Strip Mines, or Gravel	0.0	0.0%	0.0%	2.3	0.0%	8.1%
Transitional	30.0	0.1%	0.2%	6.3	0.0%	0.0%
Decidious Forest	1155.1	1.9%	6.6%	2285.6	3.4%	13.1%
Evergreen Forest	39529.5	66.4%	7.0%	22951.8	33.7%	4.0%
Mixed Forest	661.6	1.1%	8.4%	930.7	1.4%	11.8%
Shrubland	6359.6	10.7%	9.6%	20153.0	29.6%	30.3%
Orchards, Vineyards, Other	1806.6	3.0%	15.6%	7926.0	11.6%	68.5%
Grasslands, Herbaceous	9004.4	15.1%	9.2%	11139.5	16.4%	11.4%
Pasture, Hay	0.0	0.0%	0.0%	298.8	0.4%	32.0%
Row Crops	0.0	0.0%	0.0%	27.4	0.0%	97.3%
Small Grains	0.0	0.0%	0.0%	252.6	0.4%	98.4%
Fallow	0.0	0.0%	0.0%	8.0	0.0%	100.0%
Urban, Recreational Grasses	0.0	0.0%	0.0%	0.6	0.0%	1.5%
Woody Wetlands	15.7	0.0%	1.1%	18.2	0.0%	1.3%
Emergent Herbaceous Wetlands	0.0	0.0%	0.0%	9.7	0.0%	13.4%
Total	59547.4	100.0%	7.0%	68128.4	100.0%	8.0%

Data obtained from USGS National Land Cover Data Set

Summary of Land Use Classifications for Zoning Purposes

Land Use Classfication	Area within each Subbasin (acres)												Totals
	Chiwaukum	Chiwawa	Chumstick	Icicle	Lake Wenatchee	Little Wenatchee	Lower Wenatchee	Mission	Nason	Peshastin	Upper Wenatchee	White	
Commercial Agricultural	0	0	0	0	0	0	6,161	1,412	0	622	0	0	8,195
Commercial Forest	30,243	123,758	39,454	131,586	10,322	64,146	16,079	46,288	63,407	81,923	30,104	94,899	732,209
Public	0	0	4	171	801	0	179	0	71	0	0	0	1,226
Rural Residential /Resource 2.5	42	324	199	371	112	0	1,578	372	220	397	774	22	4,411
Rural Residential /Resource 5	706	732	4,749	854	149	0	5,039	2,122	1,417	1,627	1,717	115	19,227
Rural Residential /Resource 10	433	534	1,666	447	294	0	6,480	1,928	1,137	873	400	426	14,619
Rural Residential /Resource 20	474	1,527	5,309	3,763	982	816	29,705	6,935	2,565	604	2,458	4,438	59,576
Total Rural Residential /Resource	1,655	3,118	11,924	5,436	1,536	816	42,802	11,356	5,339	3,501	5,349	5,001	97,833
Rural Village	0	0	100	1	59	0	1,628	71	0	0	0	0	1,860
Rural Commercial	0	0	0	0	3	0	83	0	105	34	10	0	236
Rural Industrial	155	0	0	0	0	0	221	0	0	0	0	0	376
Rural Recreational and Resource	0	183	20	0	212	0	0	0	322	108	8	0	853
Rural Waterfront	0	387	57	11	402	0	32	0	0	0	581	15	1,484
Urban Residential 1	0	0	0	0	0	0	8	0	0	0	0	0	8
Urban Residential 2	0	0	0	0	0	0	0	0	0	0	0	0	0
Urban Residential 3	0	0	0	0	0	0	2	0	0	0	0	0	2
Total Urban Residential	0	0	0	0	0	0	10	0	0	0	0	0	10
Pedestrian Oriented Commercial	0	0	0	0	0	0	0	0	0	0	0	0	0
Peshastin Village Commercial	0	0	0	0	0	0	2	0	0	0	0	0	2
General Commercial	0	0	0	0	0	0	5	0	0	0	0	0	5
Tourist Commercial	0	0	0	0	0	0	0	0	0	0	0	0	0
Industrial	0	0	0	0	0	0	4	0	0	0	0	0	4
Commercial Mineral	31	0	0	0	0	0	0	0	0	181	0	30	241
Urban Waterfront Residential	0	0	0	0	0	0	0	0	0	0	0	0	0
Indian Allotment Land	0	0	0	0	0	0	0	0	0	0	0	0	0
City Urban Growth Area	0	0	1,315	0	0	0	667	668	0	0	19	0	2,669
Open Water	8	73	95	120	2,984	1	438	0	7	0	438	159	4,325
Totals	32,092	127,518	52,969	137,325	16,321	64,963	68,311	59,794	69,252	86,369	36,509	100,104	851,527

Summary of Land Use Classifications Within County Parcel Database

Area within each Subbasin (acres)

Land Use Classfication	Chiwaukum	Chiwawa	Chumstick	Icicle	Lake Wenatchee	Little Wenatchee	Lower Wenatchee	Mission	Nason	Peshastin	Upper Wenatchee	White	Totals
AGRIC IN OPEN SPACE RCW 84.34			3.0	304.8			6,480.8	2,240.1		215.7	55.8		9,300.1
AGRICULTURE RELATED ACTIVITIES			3.2				77.5	6.6					87.2
AGRICULTURE-NOT IN OPEN SPACE			130.6				4,369.0	1,614.3		448.8			6,562.7
AIRCRAFT TRANSPORTATION							0.4	20.1					20.5
ALL OTHER RESIDENTIAL		238.2	77.1	36.5	131.2		97.3		149.2		739.8	87.6	1,556.9
AMUSEMENTS			4.8										4.8
AUTOMOBILE PARKING			1.6				0.6	0.3	0.1				2.6
BUSINESS SERVICES			1.1		2.9		0.9	3.5		1.1			9.5
COMMUNICATION			0.1		1.0		18.6	0.1	0.1				19.9
CONTRACT CONST SERVICES			1.4				36.2	0.3		1.3			39.3
CULTURAL ACTIVITIES							0.0						0.0
DESIG FOREST LAND RCW 84.33	2,104.9	2,865.4	12,904.0	2,177.4	344.3	184.5	5,288.2	9,659.0	9,875.5	16,537.9	1,896.3	769.3	64,606.6
EDUCATIONAL SERVICES			47.2				21.5	28.8				1.0	98.4
FABRICATED METAL PRODUCTS							1.4						1.4
FINANCE, INS/REAL ESTATE SERV			1.9				1.4	1.0					4.2
FOOD/KINDRED PRODUCTS							8.3	0.5					8.8
FURNITURE AND FIXTURES								0.6					0.6
GOVERNMENTAL SERVICES	18,961.0	54,524.5	27,324.1	54,806.2	9,760.7	5,235.7	13,118.0	35,730.0	29,582.5	58,694.9	20,739.2	16,280.2	344,757.1
HIGHWAY/STREET RIGHT-OF-WAY			1.4				8.4	5.7					15.4
HOTELS/MOTELS		6.8	36.7	21.2	3.0		27.4		21.2	3.3	0.1		119.7
HOUSEHOLD 2-4 UNITS			6.0				4.0	3.8					13.8
INSTITUTIONAL LODGING		74.9	3.1					4.5					82.5
LUMBER/WOOD PROD EXC FURNITURE	21.3		1.7				92.3	32.8					148.2
MINING ACTIVITIES		306.8								181.1			487.9
MISCELLANEOUS MANUFACTURING							1.7	0.8					2.5
MISCELLANEOUS SERVICES	272.1		7.1				1,077.1	1,211.3	0.1	513.4	203.7		3,284.8
MOBILE HOME PARKS/COURTS			2.1	45.8	3.9		6.6	0.8		17.0			76.2
MULTI-UNITS 5 OR MORE			5.0				4.2	5.3					14.5
NON-RESIDENTIAL CONDOMINIUMS			0.2										0.2
NONCOMMERCIAL FOREST	1,297.9	442.3	2,679.4	393.4	1,285.5	1,207.3	6,451.7	1,378.8	3,049.4	2,349.6	2,659.2	396.3	23,590.9
OPEN SPACE RCW 84.34			46.0	4.5			252.2	54.5	65.7	42.7	78.5		544.0
OTHER CULTURAL & RECREATIONAL										3.0			3.0
OTHER RESOURCE PRODUCTION	41.8	184.1	476.5	30.9	0.1		3,660.9	78.1	21.5	30.7	288.1		4,812.7
OTHER RETAIL TRADE			3.5				3.6				3.1		10.1
OTHER TRANS, COMM, & UTILITIES			0.2					2.7					2.9
OTHER UNDEVELOPED LAND		8.9	2.5				239.1	0.4	1.0	2.3	0.8	4.2	259.2
PARKS					364.4		21.9	0.6	48.7				435.5
PERSONAL SERVICES			3.5				1.8	0.9					6.2
PETROLEUM REFINING/RELATED IND				9.5				0.1					9.6
PRIMARY METAL INDUSTRIES							7.9						7.9
PROFESSIONAL SERVICES			2.9				1.7	11.3					15.9
PUBLIC ASSEMBLY		123.0	122.9				19.2	5.3	62.8	19.9	3.7		356.7
RAILROAD/TRANSIT TRANS	16.7		2.9				48.4	3.3	47.6				118.9
RECREATIONAL ACTIVITIES		18.2	4.0		111.4		27.1	1.8	65.3		14.5	185.9	428.2
REPAIR SERVICES			0.9				7.7	2.0					10.6
RESIDENTIAL HOTELS-CONDOMINIUM			5.0	0.1			0.2	0.2	1.9				7.3
RESORTS AND GROUP CAMPS		118.5	191.9	44.0	27.5								382.0
RETAIL TRADE-APPAREL/ACCESS			0.2										0.2
RETAIL TRADE-BLD MAT,FARM EQPT			12.1				5.8	0.9					18.8
RETAIL TRADE-EATING/DRINKING			4.6				3.1	0.1	27.5	2.1	4.3		41.8
RETAIL TRADE-FOOD			8.6				10.2	0.3	3.2	6.8	2.0		31.1
RETAIL TRADE-FURNITURE			0.1	658.0			7.2	1.2					666.5
RETAIL TRADE-GEN MERCHANDISE			1.3				1.8			1.5			4.6
RETAIL TRADE-TRANS/ACCESSORIES			1.6				1.5			0.1			3.2
RUBBER/MISC PLASTIC PRODUCTS			1.1										1.1
SINGLE FAMILY UNITS	79.6	127.2	3,314.7	1,098.0	224.0		7,862.2	2,350.6	197.9	841.5	653.7	57.7	16,807.1
STONE, CLAY & GLASS PRODUCTS							2.4						2.4
TIMBERLAND IN OPEN SP RCW84.34			171.9	45.0				1,519.6	39.0	124.5	64.0	53.7	2,017.7
UNDEVELOPED LAND	6,002.9	106.5	2,374.7	2,911.9	110.6		15,162.6	3,343.8	488.9	1,227.3	6,199.8	111.4	38,040.6
UTILITIES			194.8				285.3		2.1		577.6		1,059.8
VACATION AND CABIN	28.8	675.3	1,576.6	408.1	683.5	2.0	349.0	0.7	1,461.3	795.3	1,073.2	291.2	7,345.0
Subtotal from above	**28,827.2**	**59,820.6**	**51,767.3**	**62,995.2**	**13,054.0**	**6,629.6**	**65,176.0**	**59,327.4**	**45,212.5**	**82,061.9**	**35,257.4**	**18,238.4**	**528,367.4**
Total area from other GIS analysis	**32,092.1**	**127,518.4**	**52,969.1**	**137,325.4**	**16,320.5**	**64,963.5**	**68,311.1**	**59,793.9**	**69,251.6**	**86,369.0**	**36,508.9**	**100,103.8**	**851,527.3**

Data obtained from Chelan County GIS

APPENDIX B
MISCELLANEOUS STREAMFLOW DATA

UPPER COLUMBIA RIVER BASINS

STREAM / TRIBUTARY TO	LAT/LONG DEG,MIN,SEC	CNTY CODE	HYDROLOGIC UNIT CODE	LOCATION	DRAINAGE AREA (SQ MI)	MEASURED PRIOR TO 1961	MEASUREMENTS DATE	MEASUREMENTS DISCHARGE (FT3/S)	
ENTIAT RIVER BASIN -continued									
MAD RIVER / ENTIAT RIVER	47 43 40 120 21 12	007	17020010	NW,NE,SEC29,T26N,R20E, 200 FT UPSTREAM FROM MOUTH, AT ARDENVOIR.	92.4	1912	9-13-67 9-15-70 8-21-73 3- 1-77 4-28-77 8-24-77	26.0 16.7 23.9 30.9 115 14.5	
RINGSTEAD CANYON / ENTIAT RIVER	47 42 52 120 19 46	007	17020010	NW,NE,SEC33,T26N,R20E, 0.2 MI ABOVE MOUTH, 0.3 MI UPSTREAM FROM CRUM CANYON, AND 2.4 MI SE OF ARDENVOIR.	0.56	--	6-13-77	1260	+
CRUM CANYON / ENTIAT RIVER	47 42 39 120 19 00	007	17020010	SE,NW,SEC34,T26N,R20E, 0.2 MI DOWNSTREAM FROM NORTH FORK CRUM CANYON, 0.6 MI ABOVE MOUTH, AND 3 MI SE OF ARDENVOIR.	8.39	--	6-13-77	5050	+
ENTIAT RIVER / COLUMBIA RIVER	47 39 48 120 14 58	007	17020010	NW,SE,SEC18,T25N,T21E, AT BRIDGE 1.2 MI W OF ENTIAT HIGH SCHOOL AND AT MI 1.5.	418	--	11-11-71 12- 1-71 3-30-72 5-25-72 10- 9-75 12-12-75 1-30-76 3-22-76 5-20-76 3- 1-77 8-24-77 2-15-78 4-12-78 3-30-79 10- 9-79 6-10-80 10- 2-80 1-15-81 4-29-81 6- 5-81 9-16-81 4-20-82 6-18-82 8-12-82 10-26-82 12- 8-82 5-19-83 6- 1-83 7-19-83 9-14-83 11-17-83 3- 1-84 4-25-84 8-16-84 10-17-84 3-22-85 7-25-85	136 101 702 2340 148 828 355 269 1790 136 115 156 734 188 84.2 1180 118 343 763 1600 108 289 4270 398 218 102 1360 4880 555 203 320 215 502 294 154 168 229	
MINOR BASINS BETWEEN THE ENTIAT AND WENATCHEE RIVERS									
PINE CANYON CREEK / COLUMBIA RIVER	47 40 19 120 06 41	017	17020010	SW,SW,SEC8,T25N,R22E, 2.5 MI NW OF WATERVILLE, AT GAGING STATION "NEAR WATERVILLE" (12-4535).	11.1	1947-48	2-28-77 4-28-77 8-25-77	0.20 0.20 0.10	
WENATCHEE RIVER BASIN									
WHITE RIVER / WENATCHEE LAKE	47 59 33 120 57 41	007	17020011	SE,SEC22,T29N,R15E, ABOVE INDIAN CREEK.	41.4	1911	9-12-67	88.5	

STREAM / TRIBUTARY TO	LAT/LONG DEG,MIN,SEC	CNTY CODE	HYDROLOGIC UNIT CODE	LOCATION	DRAINAGE AREA (SQ MI)	MEASURED PRIOR TO 1961	MEASUREMENTS DATE	MEASUREMENTS DISCHARGE (FT3/S)
				WENATCHEE RIVER BASIN -continued				
WHITE RIVER / WENATCHEE LAKE	47 57 50 120 56 35	007	17020011	SW,SEC35,T29N,R15E, WENATCHEE NATIONAL FOREST, AT ROAD CROSSING 10.6 MI NW OF TELMA AT MI 15.3.	66.3	--	9-16-70 7-31-73 9- 6-73 8-20-75 9-16-75 9- 8-76 9-20-76 6-30-77 9-20-77	67.3 308 163 290 167 259 258 352 139
PANTHER CREEK / WHITE RIVER	47 56 24 120 55 41	007	17020011	E1/2,SEC11,T28N,R15E, WENATCHEE NATIONAL FOREST, 8.8 MI NW OF TELMA, AND 100 FT UPSTREAM FTOM MOUTH.	19.1	1911	8-20-75 9-16-75 9- 8-76 9-20-76 6-28-77 9-20-77	25.5 12.4 131 32.3 44.9 13.2
NAPEEQUA RIVER / WHITE RIVER	47 55 17 120 53 38	007	17020011	SW,SE,SEC18,T28N,R16E, 6.8 MI NW OF TELMA, AND 200 FT UPSTREAM FROM MOUTH.	40.0	1911	8-20-75 9-16-75 9- 8-76 9-20-76 6-28-77 9-20-77	246 140 152 232 260 108
CANYON CREEK / WHITE RIVER	47 54 27 120 53 38	007	17020011	SW,SE,SEC19,T28N,R16E, WENATCHEE NATIONAL FOREST, 6 MI NW OF TELMA, AND ABOUT 500 FT UPSTREAM FROM MOUTH.	4.27	--	8-20-75 9-16-75 9- 8-76 9-21-76 6-28-77 9-20-77	2.09 0.71 1.85 1.22 4.48 1.13
SEARS CREEK / WHITE RIVER	47 53 10 120 53 13	007	17020011	E1/2,NE,SEC31,T28N,R16E, WENATCHEE NATIONAL FOREST, AT ROAD CROSSING 4.8 MI NE OF TELMA, AND 0.3 MI UPSTREAM FROM MOUTH.	0.75	--	8-20-75 9-16-75 9- 8-76 9-21-76 6-28-77 9-20-77	0.44 0.25 0.12 0.31 0.96 0.35
LITTLE WENATCHEE R / WENATCHEE LAKE	47 55 08 121 05 13	007	17020011	NE,SEC14,T28N,R13E, WENATCHEE NATIONAL FOREST, AT BRIDGE 15.2 MI NW OF TELMA, AND 0.5 MI UPSTREAM FROM CADY CREEK.	10.9	--	8-19-75 9-17-75 9-10-76 9-21-76 6-29-77 9-21-77	27.5 17.5 20.9 17.0 34.0 22.2
CADY CREEK / LITTLE WENATCHEE R	47 54 50 121 05 33	007	17020011	SE,SEC14,T28N,R13E, WENATCHEE NATIONAL FOREST, 15 MI NW OF TELMA, AND 20 FT UPSTREAM FROM MOUTH.	7.65	--	8-19-75 9-17-75 9-10-76 9-21-76 6-29-77 9-21-77	18.1 8.91 13.9 9.07 18.8 20.2
FISH CREEK / LITTLE WENATCHEE R	47 54 20 121 05 04	007	17020011	NW,SEC24,T28N,R13E, WENATCHEE NATIONAL FOREST, 13.9 MI NW OF TELMA, AND 30 FT UPSTREAM FROM MOUTH.	7.92	--	8-19-75 9-17-75 9-11-76 9-21-76 6-29-77 9-21-77	17.6 12.3 16.7 10.4 28.4 19.6
FOURTEENMILE CREEK / LITTLE WENATCHEE R	47 53 47 121 04 11	007	17020011	SE,SEC24,T28N,R13E, WENATCHEE NATIONAL FOREST, 13 MI NW OF TELMA, AT ROAD CROSSING 0.1 MI UPSTREAM FROM MOUTH.	0.09	--	8-19-75 9-17-75 9-10-76 9-21-76 6-29-77 9-21-77	0.16 0.08 0.10 0.14 0.18 0.25e
LAKE CREEK / LITTLE WENATCHEE R	47 52 35 121 02 04	007	17020011	SW,SW,SEC31,T28N,R15E, WENATCHEE NATIONAL FOREST, AT ROAD CROSSING 0.2 MI UPSTREAM FROM MOUTH, AND 10.9 MI NW OF TELMA.	16.5	1911	8-20-75 9-17-75 9-10-76 9-21-76 6-28-77	30.1 16.6 21.1 17.8 47.5

STREAM / TRIBUTARY TO	LAT/LONG DEG,MIN,SEC	CNTY CODE	HYDROLOGIC UNIT CODE	LOCATION	DRAINAGE AREA (SQ MI)	MEASURED PRIOR TO 1961	MEASUREMENTS DATE	MEASUREMENTS DISCHARGE (FT3/S)
WENATCHEE RIVER BASIN -continued								
							9-21-77	26.8
THESEUS CREEK / LITTLE WENATCHEE R	47 52 24 121 00 58	007	17020011	NE,SEC6,T27N,R15E, WENATCHEE NATIONAL FOREST 11 MI NW OF TELMA, AND AT ROAD CROSSING 150 FT UPSTREAM FROM MOUTH.	1.05	--	8-20-75 9-17-75 9-10-76 9-21-76 6-28-77 9-21-77	1.38 0.66 1.06 0.73 1.45 0.85
RAINY CREEK / LITTLE WENATCHEE R	47 51 03 120 57 35	007	17020011	S1/2,SEC10,T27N,R15E, WENATCHEE NATIONAL FOREST, AT ROAD CROSSING, 0.3 MI UPSTREAM FROM MOUTH, 7.2 MI W OF TELMA.	17.2	1912	7-31-73 8-20-75 9-16-75 9-10-76 9-21-76 6-28-77 9-22-77	29.4 67.8 17.6 33.4 25.5 49.4 72.8
LITTLE WENATCHEE R / WENATCHEE RIVER	47 50 58 120 56 39	007	17020011	IN CENTER OF SW,SEC11,T27N,R15E, WENATCHEE NATIONAL FOREST, AT RIVERSIDE CAMPGROUND, 5.5 MI W OF TELMA.	84.0	--	9-16-75 9-10-76 9-21-76 6-29-77 9-22-77	77.4 143 93.2 196 118
LITTLE WENATCHEE RIVER TRIBUTARY / LITTLE WENATCHEE R	47 50 25 120 55 50	007	17020011	SE,NE,SEC14,T27N,R15E, AT LOGGING ROAD 0.2 MI ABOVE MOUTH AND 6 MI W OF TELMA, AT CREST-STAGE GAGE "NEAR TELMA" (12-454290).	1.02	--	8-10-65 5-18-66 6-23-66 5-24-67 7-26-67 5-26-69 6- 2-70 6-14-72 6-10-75 9-10-76 9-21-76 6-28-77 9-21-77	2.68 4.89 6.13 17.2 7.17 14.5 33.8 15.0 15.8 0.50 0.85 2.83 0.66
LITTLE WENATCHEE R / WENATCHEE LAKE	47 50 02 120 50 11	007	17020011	SE,SW,SEC15,T27N,R16E, WENATCHEE NATIONAL FOREST, 0.8 MI UPSTREAM FROM WENATCHEE LAKE, 1.5 MI SW OF TELMA.	100	1911-13	9-12-67 9-16-70 7-31-73 8-20-75 9-16-75 9-11-76 9-22-76 6-29-77 9-20-77	95.5 58.3 106 182 96.8 168 113 221 119
WHITEPINE CREEK (FORMERLY WILD HORSE CREEK) / NASON CREEK	47 46 29 120 54 55	007	17020011	SW,SE,SEC1,T26N,R15E, AT ROAD CROSSING NEAR MOUTH, AND 3.7 MI W OF MERRITT.	24.5	1911	8-20-75 9-16-75 9-11-76 9-22-76 6-29-77 9-21-77	50.8 25.6 34.4 0.48 2.60 0.59
NASON CREEK / WENATCHEE RIVER	47 46 37 120 54 22	007	17020011	SW,SW,SEC6,T26N,R16E, WENATCHEE NATIONAL FOREST, 0.4 MI DOWNSTREAM FROM WHITEPINE CREEK AND 8 MI W OF COLES CORNER AT MI 14.8.	61.6	--	4-24-73 5-10-73 6-15-73 6-25-73 7- 3-73 7-10-73 7-18-73 7-25-73 8- 1-73 8- 7-73 8-22-73 8-20-75 9-16-75 9-11-76 9-22-76 6-29-77 9-21-77	232 294 334 409 197 148 111 82.4 63.9 50.8 33.7 96.7 48.8 70.9 56.6 137 92.9

STREAM / TRIBUTARY TO	LAT/LONG DEG,MIN,SEC	CNTY CODE	HYDROLOGIC UNIT CODE	LOCATION	DRAINAGE AREA (SQ MI)	MEASURED PRIOR TO 1961	MEASUREMENTS DATE	MEASUREMENTS DISCHARGE (FT3/S)
WENATCHEE RIVER BASIN -continued								
MAHAR CREEK / NASON CREEK	47 47 09 120 52 33	007	17020011	NE,NW,SEC5,T26N,R16E, AT ROAD CROSSING 1.9 MI W OF MERRITT, AND 0.1 MI UPSTREAM FROM MOUTH.	1.83	--	8-20-75 9-16-75 9-11-76 9-23-76 6-29-77 9-21-77	1.11 0.28 0.10 0.20 0.63 0.30
NASON CREEK / WENATCHEE RIVER	47 47 12 120 51 23	007	17020011	NE,NW,SEC4,T26N,R16E, WENATCHEE NATIONAL FOREST, 0.9 MI DOWNSTREAM FROM MAHAR CREEK AND 6 MI W OF COLES CORNER AT MI 12.2.	69.9	--	4-25-73 5-10-73 6-15-73 7- 3-73 7-10-73 7-18-73 7-25-73 8- 1-73 8- 7-73 8-22-73	230 314 365 224 173 120 81.4 66.9 56.4 39.6
NASON CREEK / WENATCHEE RIVER	47 46 11 120 47 58	007	17020011	SE,NE,SEC11,T26N,R16E, WENATCHEE NATIONAL FOREST, AT U.S. HWY 2 CROSSING, AT MOUTH OF ROARING CREEK, 6.8 MI W OF PLAIN, AT GAGING STATION "NEAR NASON" (12-4555).	84.8	1912-13, 1958	9-12-67 9-16-70	56.9 19.9
KAHLER CREEK / NASON CREEK	47 46 02 120 45 14	007	17020011	SW,NW,SEC8,T26N,R17E, AT POWER LINE SERVICE ROAD CROSSING 3.9 MI E OF MERRITT, AND 500 FT UPSTREAM FROM MOUTH.	3.26	--	8-20-75 9-16-75 9-11-76 9-22-76 6-29-77 9-21-77	1.89 0.71 1.03 0.74 1.02 0.10
NASON CREEK / WENATCHEE RIVER	47 47 26 120 42 55	007	17020011	SE,SE,SEC33,T27N,R17E, WENATCHEE NATIONAL FOREST, 2.6 MI NE OF COLES CORNER AT MI 1.6.	107	--	4-25-73 5-10-73 6-15-73 7- 3-73 7-10-73 7-18-73 7-25-73 8- 1-73 8- 7-73 8-22-73 8-21-75 9-16-75 9- 8-76 9-22-76 6-28-77 9-21-77	252 388 424 261 196 134 98.6 81.5 67.4 48.1 137 72.8 135 83.0 196 131
NASON CREEK / WENATCHEE RIVER	47 48 29 120 42 48	007	17020011	SW,NW,SEC27,T27N,R17E, WENATCHEE NATIONAL FOREST, 0.4 MI UPSTREAM FROM MOUTH, AT STATE HWY 207 CROSSING, 4 MI NW OF PLAIN.	--	--	9-12-67 9-16-70	66.0 46.5
WENATCHEE RIVER / COLUMBIA RIVER	47 48 38 120 42 39	007	17020011	SW,NW,SEC27,T27N,R17E, WENATCHEE NATIONAL FOREST, AT STATE HWY 207 CROSSING, 4.2 MI NW OF PLAIN.	382	1947	9-12-67 9-16-70	489 276
FISH LAKE RUN (FORMERLY FISH LAKE OUTLET) / WENATCHEE RIVER	47 49 08 120 41 43	007	17020011	SE,SE,SEC22,T27N,R17E, WENATCHEE NATIONAL FOREST, AT FISH LAKE ROAD, 4.3 MI NW OF PLAIN.	5.51	--	4-17-74 5-23-74 7-18-74 8-20-75 9-15-75 9- 8-76 9-22-76 6-28-77 9-21-77	19.0 10.2 2.16 0.74 0.69 1.24 0.90 1.39 0.11
CHIWAWA RIVER / WENATCHEE RIVER	48 04 12 120 51 04	007	17020011	NE,SEC28,T30N,R16E, 500 FT UPSTREAM FROM PHELPS CREEK, AND 15.9 MI N OF TELMA.	26.0	--	8-19-75 9-16-75 9- 9-76 9-21-76 9-20-77	145 62.3 108 116 55.6

STREAM / TRIBUTARY TO	LAT/LONG DEG,MIN,SEC	CNTY CODE	HYDROLOGIC UNIT CODE	LOCATION	DRAINAGE AREA (SQ MI)	MEASURED PRIOR TO 1961	MEASUREMENTS DATE	MEASUREMENTS DISCHARGE (FT3/S)
				WENATCHEE RIVER BASIN -continued				
PHELPS CREEK / CHIWAWA RIVER	48 04 24 120 50 58	007	17020011	NW,SEC27,T30N,R16E, AT ROAD CROSSING, 0.3 MI UPSTREAM FROM MOUTH, 16 MI N OF TELMA, AT GAGING STATION "NEAR PLAIN" (12-4560).	16.4	1926,1948	8-19-75 9-16-75 9- 9-76 9-21-76 6-28-77 9-20-77	43.5 26.8 37.4 38.0 57.8 14.5
CHIWAWA RIVER / WENATCHEE RIVER	48 02 48 120 50 04	007	17020011	NE,SEC3,T29N,R16E, WENATCHEE NATIONAL FOREST 1.7 MI DOWNSTREAM FROM PHELPS CREEK, 2.1 MI SE OF TRINITY AT MI 28.5.	50.0	--	9- 1-72 9- 7-72 9-12-72 9-28-72 10-25-72	176 129 101 86.3 61.2
MAPLE CREEK / CHIWAWA RIVER	48 01 30 120 49 42	007	17020011	NE,SEC11,T29N,R16E, WENATCHEE NATIONAL FOREST, 500 FT UPSTREAM FROM MOUTH, AND 12.7 MI N OF TELMA.	5.31	--	8-19-75 9-16-75 9- 9-76 9-22-76 6-28-77 9-20-77	3.44 0.62 2.19 2.35 2.90 0.86
CHIWAWA RIVER / WENATCHEE RIVER	47 59 49 120 48 59	007	17020011	NE,SW,SEC23,T29N,R16E, WENATCHEE NATIONAL FOREST, 2.6 MI DOWNSTREAM FROM MAPLE CREEK 5.7 MI SW OF TRINITY AT MI 24.4.	64.4	--	9- 1-72 9- 7-72 9-12-72 9-28-72 10-25-72	230 166 132 116 79.2
ROCK CREEK / CHIWAWA RIVER	47 58 13 120 47 18	007	17020011	SW,NE,SEC36,T29N,R16E, WENATCHEE NATIONAL FOREST, AT ROAD CROSSING 0.6 MI UPSTREAM FROM MOUTH, AND 8.9 MI N OF TELMA.	21.3	--	8-19-75 9-16-75 9- 7-76 9-21-76 6-28-77 9-20-77	28.8 16.5 25.0 20.4 62.0 11.0
CHIWAWA RIVER / WENATCHEE RIVER	47 57 34 120 47 16	007	17020011	NW,NE,SEC1,T28N,R16E, WENATCHEE NATIONAL FOREST, 0.5 MI DOWNSTREAM FROM ROCK CREEK, 8.6 MI SE OF TRINITY AT MI 20.8.	95.3	--	9- 1-72 9- 7-72 9-12-72 9-28-72 10-25-72	277 210 166 153 108
CHIWAWA R TRIBUTARY/ CHIWAWA RIVER	47 57 07 120 46 10	007	17020011	NE,SW,SEC6,T28N,R17E, WENATCHEE NATIONAL FOREST, 0.3 MI NW OF ROCK CREEK GUARD STATION, AND 7.8 MI N OF TELMA.	0.41	--	8-19-75 9-16-75 9- 7-76 9-21-76 6-28-77 9-20-77	0.00 0.00 0.00 0.00 0.00 0.00
UNNAMED TRIBUTARY / CHIWAWA RIVER	47 57 01 120 46 01	007	17020011	NE,SW,SEC6,T28N,R17E, WENATCHEE NATIONAL FOREST, AT ROCK CREEK GUARD STATION, 7.7 MI N OF TELMA.	0.41	--	8-19-75 9-16-75 9- 7-76 9-21-76 6-28-77 9-20-77	0.80 0.37 0.60 0.47 0.29 0.18
MINNOW CREEK / CHIKAMIN CREEK	47 54 36 120 43 11	007	17020011	NW,SE,SEC21,T28N,R17E, WENATCHEE NATIONAL FOREST, 100 FT UPSTREAM FROM MOUTH, AND 10.9 MI NW OF PLAIN.	3.10	--	9-16-75 9- 9-76 9-20-76 6-28-77 9-20-77	0.99 1.30 1.05 0.74 0.32
CHIKAMIN CREEK / CHIWAWA RIVER	47 54 31 120 43 16	007	17020011	NW,SE,SEC21,T28N,R17E, WENATCHEE NATIONAL FOREST, AT ROAD CROSSING 0.5 MI UPSTREAM FROM MOUTH, AND 4.2 MI NE OF TELMA.	20.5	--	8-19-75 9-16-75 9- 9-76 9-20-76 6-28-77 9-20-77	19.9 8.74 11.6 11.2 17.5 6.47
BRUSH CREEK / CHIWAWA RIVER	47 53 20 120 43 15	007	17020011	NW,NE,SEC33,T28N,R17E, WENATCHEE NATIONAL FOREST, AT LOGGING ROAD 1 MI UPSTREAM FROM MOUTH, AND 6.2 MI NE OF TELMA, AT CREST-STAGE GAGE "NEAR TELMA" (12-4563).	3.34	--	8-11-65 5-18-66 6-23-66 10- 6-66 5-24-67	1.15 8.16 2.52 0.42 23.7

STREAM / TRIBUTARY TO	LAT/LONG DEG,MIN,SEC	CNTY CODE	HYDROLOGIC UNIT CODE	LOCATION	DRAINAGE AREA (SQ MI)	MEASURED PRIOR TO 1961	MEASUREMENTS DATE	MEASUREMENTS DISCHARGE (FT3/S)
				WENATCHEE RIVER BASIN -continued				
							7-27-67	1.67
							5-22-68	9.70
							5-27-69	20.3
							6- 8-71	20.4
							6-13-72	18.4
							8-19-75	1.74
							9-16-75	0.79
							9-10-76	0.93
							9-21-76	0.86
							6-28-77	0.82
							9-20-77	0.37
GATE CREEK / CHIWAWA RIVER	47 53 55 120 42 12	007	17020011	SE,NW,SEC27,T28N,R17E, WENATCHEE NATIONAL FOREST, 0.1 MI UPSTREAM FROM MOUTH, AND 6.3 MI NE OF TELMA.	3.01	--	8-19-75	1.56
							9-16-75	0.69
							9- 9-76	0.90
							9-20-76	0.66
							6-28-77	0.00
							9-20-77	0.06
BIG MEADOW CREEK / CHIWAWA RIVER	47 52 04 120 41 44	007	17020011	NE,SE,SEC3,T27N,R17E, WENATCHEE NATIONAL FOREST, AT ROAD CROSSING, 0.2 MI UPSTREAM FROM MOUTH, 7.5 MI NW OF PLAIN.	16.5	1954	7-31-73	2.60
							8-19-75	13.6
							9-15-75	4.35
							9-10-76	5.88
							9-21-76	4.63
							6-28-77	8.73
							9-20-77	5.03
ALDER CREEK / CHIWAWA RIVER	47 50 55 120 39 31	007	17020011	SW,SE,SEC12,T27N,R17E, WENATCHEE NATIONAL FOREST AT ROAD CROSSING 0.4 MI UPSTREAM FROM MOUTH, AND 6 MI N OF PLAIN.	16.5	1954	8-19-75	3.73
							9-15-75	1.98
							9- 9-76	2.84
							9-20-76	2.47
							6-28-77	2.48
							9-20-77	1.20
CHIWAWA RIVER / WENATCHEE RIVER	47 50 16 120 39 34	007	17020011	NE,SW,SEC13,T27N,R17E, WENATCHEE NATIONAL FOREST, 0.6 MI UPSTREAM FROM GOOSE CREEK, 5 MI N OF PLAIN AT MI 6.2.	170	--	9-12-72	214
CHIWAWA RIVER / WENATCHEE RIVER	47 50 21 120 39 27	007	17020011	NW,SE,SEC13,T27N,R17E, WENATCHEE NATIONAL FOREST, AT COUNTY ROAD CROSSING, 0.5 MI UPSTREAM FROM GOOSE CREEK, 5.2 MI N OF PLAIN, AT GAGING STATION "NEAR PLAIN" (12-4565).	172	--	9-12-67	161
							9-16-70	48.9
							8-19-75	451
							9-15-75	190
							9- 9-76	373
							9-20-76	270
							9-21-77	194
GOOSE CREEK / CHIWAWA RIVER	47 50 21 120 38 46	007	17020011	NW,SW,SEC18,T27N,R17E, WENATCHEE NATIONAL FOREST, 0.4 MI UPSTREAM FROM MOUTH, AND 5.3 MI N OF PLAIN.	2.43	--	8-19-75	0.90
							9-15-75	0.65
							9- 9-76	0.90
							9-20-76	0.99
							6-28-77	0.47
							9-21-77	0.33
DEEP CREEK / CHIWAWA RIVER	47 49 12 120 38 00	007	17020011	SW,SE,SEC19,T27N,R18E, WENATCHEE NATIONAL FOREST, AT ROAD CROSSING 0.3 MI UPSTREAM FROM MOUTH, AND 4 MI NE OF PLAIN.	2.82	--	8-19-75	1.89
							9-15-75	1.09
							9- 9-76	1.41
							9-20-76	1.31
							6-28-77	0.30
							9-21-77	0.33
BEAVER CREEK / WENATCHEE RIVER	47 45 53 120 39 18	007	17020011	NW,SE,SEC12,T26N,R17E, WENATCHEE NATIONAL FOREST, AT ROAD CROSSING 0.3 MI UPSTREAM FROM MOUTH, AT PLAIN.	10.0	1910-11	8-19-75	5.86
							8-21-75	4.63
							9-15-75	3.42
							9- 9-76	3.64
							9-20-76	3.82
							6-28-77	1.69
							9-21-77	1.44
SKINNEY CREEK / CHIWAUKUM CREEK	47 43 23 120 44 06	007	17020011	NW,SW,SEC28,T26N,R17E, AT U.S. HWY 2, 0.7 MI S OF WINTON, AT CREST-STAGE GAGE "AT WINTON" (12-4573).	2.55	--	3-11-65	11.6
							4-21-65	21.7
							3- 9-67	3.59
							5-24-67	1.82

STREAM / TRIBUTARY TO	LAT/LONG DEG,MIN,SEC	CNTY CODE	HYDROLOGIC UNIT CODE	LOCATION	DRAINAGE AREA (SQ MI)	MEASURED PRIOR TO 1961	MEASUREMENTS DATE	MEASUREMENTS DISCHARGE (FT3/S)
				WENATCHEE RIVER BASIN -continued				
							6- 8-71	1.56
							6-14-72	1.77
CHIWAUKUM CREEK / WENATCHEE RIVER	47 41 16 120 44 24	007	17020011	SE,SE,SEC5,T25N,R17E, WENATCHEE NATIONAL FOREST, AT COUNTY ROAD CROSSING, 7.2 MI NW OF LEAVENWORTH. REMARKS: DRAINAGE AREA IS APPROXIMATE.	48.5	--	9-17-70	17.1
							7-31-73	57.4
CHIWAUKUM CREEK / WENATCHEE RIVER	47 40 44 120 43 39	007	17020011	SE,NW,SEC9,T25N,R17E, WENATCHEE NATIONAL FOREST, 1 MI SE OF CHIWAUKUM, 0.1 MI UPSTREAM FROM MOUTH, AT GAGING STATION "NEAR CHIWAUKUM" (12-4575).	49.6	1912-13, 1926,1958	9-14-67	21.0
							8-20-75	80.7
							9-16-75	31.3
							9-10-76	55.8
							9-22-76	52.9
							9-21-77	32.3
WENATCHEE RIVER / COLUMBIA RIVER	47 40 34 120 43 58	007	17020011	NE,SW,SEC9,T25N,R17E, WENATCHEE NATIONAL FOREST, AT U.S. HWY CROSSING AND TUMWATER CAMPGROUND, 0.4 MI DOWNSTREAM FROM CHIWAUKUM CREEK, 4.1 MI S OF WINTON, AND AT MI 35.5.	663	--	11-29-77	4820
							2-14-78	884
							4-11-78	3610
							6- 6-78	13800
							10-13-78	684
							3-28-79	2000
							10-10-79	362
							6-11-80	5010
							10- 1-80	668
							1- 6-81	3650
							8-17-82	1420
							10-13-82	696
							9-13-83	973
							3- 7-84	944
							8-21-84	1020
							10-16-84	956
							3-26-85	806
							7-30-85	1040
WENATCHEE RIVER / COLUMBIA RIVER	47 38 22 120 43 10	007	17020011	NE,SEC28,T25N,R17E, 0.5 MI ABOVE DRURY CREEK AND 4.5 MI NW OF LEAVENWORTH.	672	1958	6- 5-61	15900
							6-16-61	10500
							7-17-62	2890
WENATCHEE RIVER / COLUMBIA RIVER	47 34 38 120 40 26	007	17020011	SW,NE,SEC14,T24N,R17E, AT ICICLE CREEK ROAD BRIDGE 0.8 MI UPSTREAM FROM ICICLE CREEK, AND 0.9 MI S OF LEAVENWORTH.	--	--	10- 8-76	663
							12-11-76	6480
							1-27-77	2880
							3-30-77	1170
							2-17-78	945
							4-11-78	4300
ICICLE CREEK / WENATCHEE RIVER	47 36 46 120 56 40	007	17020011	NW,NW,SEC2,T24N,R15E, WENATCHEE NATIONAL FOREST, 100 FT UPSTREAM FROM BLACK PINE CREEK, AND 13.3 MI W OF LEAVENWORTH.	74.3	--	8-20-75	174
							9-15-75	69.4
							9- 9-76	145
							9-22-76	95.8
							9-20-77	72.6
BLACK PINE CREEK / ICICLE CREEK	47 36 42 120 56 39	007	17020011	NW,NW,SEC2,T24N,R15E, WENATCHEE NATIONAL FOREST, 13.3 MI W OF LEAVENWORTH, AND 0.1 MI UPSTREAM FROM MOUTH.	3.33	--	8-20-75	2.58
							9-15-75	0.00
							9- 9-76	1.46
							9-22-76	0.32
							6-29-77	4.05
							9-20-77	0.07
GRINDSTONE CREEK / ICICLE CREEK	47 36 43 120 56 32	007	17020011	NW,NW,SEC2,T24N,R15E, WENATCHEE NATIONAL FOREST, AT MOUTH, AND 13.3 MI W OF LEAVENWORTH.	0.94	--	8-20-75	0.10e
							9- 9-76	0.00
							9-22-76	0.00
							10- 7-77	0.03
JACK CREEK / ICICLE CREEK	47 36 30 120 54 02	007	17020011	NW,SEC6,T24N,R16E, WENATCHEE NATIONAL FOREST AT END OF ROAD NEAR MOUTH, AND 11.3 MI W OF LEAVENWORTH.	29.1	1911	8-20-75	32.5
							9-15-75	14.4
							9- 9-76	25.0
							9-22-76	18.5
							6-29-77	21.8
							9-20-77	20.2

STREAM / TRIBUTARY TO	LAT/LONG DEG,MIN,SEC	CNTY CODE	HYDROLOGIC UNIT CODE	LOCATION	DRAINAGE AREA (SQ MI)	MEASURED PRIOR TO 1961	MEASUREMENTS DATE	MEASUREMENTS DISCHARGE (FT3/S)
				WENATCHEE RIVER BASIN -continued				
TROUT CREEK / ICICLE CREEK	47 36 23 120 53 33	007	17020011	NW,SEC6,T24N,R16E, WENATCHEE NATIONAL FOREST AT FOOT TRAIL CROSSING NEAR MOUTH AND 10.7 MI W OF LEAVENWORTH.	8.43	1911	8-20-75 9-15-75 9- 9-76 9-22-76 9-20-77	15.9 8.89 9.17 6.65 0.70
CHATTER CREEK / ICICLE CREEK	47 36 27 120 53 16	007	17020011	N1/2,SEC6,T24N,R16E, WENATCHEE NATIONAL FOREST, AT ICICLE CREEK ROAD 11 MI W OF LEAVENWORTH, AT CREST-STAGE GAGE "NEAR LEAVENWORTH" (12-4570).	2.25	--	8- 9-65 5-17-66 6-24-66 5-25-67 7-26-67 6-26-68 5-27-69 6- 9-71 5-22-72 6-14-72 6-11-75 8-20-75 9-15-75 9- 9-76 9-21-76 6-29-77 9-20-77	1.64 9.58 7.59 18.8 4.02 16.8 24.9 21.7 35.0 15.3 23.7 2.40 0.53 1.31 1.02 0.96 0.10e
CHATTER CREEK / ICICLE CREEK	47 36 27 120 52 54	007	17020011	SW,NW,SEC5,T24N,R16E, WENATCHEE NATIONAL FOREST, AT CHATTER CREEK GUARD STATION, 10.5 MI W OF LEAVENWORTH.	--	--	9-17-70	0.44
DOCTOR CREEK / ICICLE CREEK	47 36 26 120 51 54	007	17020011	SE,NE,SEC5,T24N,R16E, WENATCHEE NATIONAL FOREST, 200 FT UPSTREAM FROM MOUTH, AND 9.6 MI W OF LEAVENWORTH.	1.97	--	8-20-75 9-15-75 9- 9-76 9-22-76 6-29-77 9-20-77	6.22 1.74 2.34 3.15 0.00 0.00
IDA CREEK / ICICLE CREEK	47 36 26 120 50 53	007	17020011	SW,NE,SEC4,T24N,R16E, WENATCHEE NATIONAL FOREST, 8.8 MI W OF LEAVENWORTH, AND 10 FT UPSTREAM FROM MOUTH.	1.42	--	8-20-75 9-15-75 9- 9-76 9-21-76 6-29-77 9-20-77	0.53 0.62 0.72 0.44 1.39 0.06
JOHNNY CREEK / ICICLE CREEK	47 35 54 120 49 01	007	17020011	NW,SW,SEC2,T24N,R16E, WENATCHEE NATIONAL FOREST, 25 FT UPSTREAM FROM MOUTH, AND 7.4 MI W OF LEAVENWORTH.	1.24	--	8-20-75 9-15-75 9- 9-76 9-21-76 6-29-77 9-20-77	1.28 0.48 0.95 0.81 0.36 0.39
BRIDGE CREEK / ICICLE CREEK	47 33 41 120 46 44	007	17020011	NE,NE,SEC24,T24N,R16E, WENATCHEE NATIONAL FOREST, 50 FT UPSTREAM FROM MOUTH, AND 6.1 MI W OF LEAVENWORTH.	1.16	--	8-18-75 8-20-75 9-15-75 9- 9-76 9-21-76 6-29-77	0.79 0.11 0.26 0.40 0.13 0.43
ICICLE CREEK / WENATCHEE RIVER	47 32 28 120 43 08	007	17020011	SE,SE,SEC28,T24N,R17E, WENATCHEE NATIONAL FOREST, 1000 FT UPSTREAM FROM ICICLE CANAL DIVERSION DAM, 4.8 MI SW OF LEAVENWORTH, AT MI 5.8, AT GAGING STATION "ABOVE SNOW CREEK, NEAR LEAVENWORTH" (12-4580).	193	1926	6-12-72 8-21-75 9-17-75 9-21-76 6-30-77 9-21-77	2810 467 181 231 492 296
SNOW CREEK / ICICLE CREEK	47 32 32 120 42 38	007	17020011	SW,SW,SEC27,T24N,R17E, WENATCHEE NATIONAL FOREST, AT ICICLE IRRIGATION DITCH CROSSING, 4.5 MI SW OF LEAVENWORTH, AND 0.1 MI UPSTREAM FROM MOUTH.	11.4	1911, 1945-51, 1953,1957	8-20-75 9-17-75 9-10-76	23.6 4.37 11.9

STREAM / TRIBUTARY TO	LAT/LONG DEG,MIN,SEC	CNTY CODE	HYDROLOGIC UNIT CODE	LOCATION	DRAINAGE AREA (SQ MI)	MEASURED PRIOR TO 1961	MEASUREMENTS DATE	MEASUREMENTS DISCHARGE (FT3/S)
				WENATCHEE RIVER BASIN -continued				
ICICLE CREEK / WENATCHEE RIVER	47 33 30 120 40 00	007	17020011	NE,SE,SEC23,T24N,R17E, 150 FT DOWNSTREAM FROM LEAVENWORTH NATIONAL FISH HATCHERY AND 2.5 MI S OF LEAVENWORTH, AT GAGING STATION "NEAR LEAVENWORTH" (12-4585).	211	1948-49, 1951,1953, 1955	2-15-66	97.9
CHUMSTICK CREEK / WENATCHEE RIVER	47 42 51 120 38 07	007	17020011	NW,NE,SEC31,T26N,R18E, WENATCHEE NATIONAL FOREST, 8.2 MI N OF LEAVENWORTH, AND 0.2 MI DOWNSTREAM FROM LITTLE CHUMSTICK CREEK.	24.9	1926	8-19-75 9-15-75 9-10-76 9-22-76 6-29-77 9-20-77	5.07 1.70 2.32 2.28 0.44 0.39
VAN CREEK / EAGLE CREEK	47 39 24 120 32 29	007	17020011	NW,NW,SEC24,T25N,R18E, WENATCHEE NATIONAL FOREST, AT ROAD CROSSING AT MOUTH, 6.9 MI NE OF LEAVENWORTH.	8.09	--	8-19-75 9-18-75 9-10-76 9-22-76 6-29-77 9-20-77	1.02 0.97 1.43 1.36 0.49 0.36
EAGLE CREEK / CHUMSTICK CREEK	47 37 28 120 38 36	007	17020011	NE,NW,SEC31,T25N,R18E, 50 FT UPSTREAM FROM MOUTH, AND 2.1 MI NE OF LEAVENWORTH.	28.4	--	8-19-75 9-18-75 9-10-76 9-22-76 6-29-77 9-20-77	3.01 1.01 1.66 1.28 0.00 0.00
CHUMSTICK CREEK / WENATCHEE RIVER	47 36 18 120 38 50	007	17020011	SE,NE,SEC1,T24N,R17E, 0.8 MI NE OF LEAVENWORTH, AND 0.2 MI UPSTREAM FROM MOUTH.	79.3	--	8-19-75 9-18-75 9-10-76 9-22-76 6-29-77 9-20-77	16.7 9.64 8.63 10.6 2.54 3.85
POSEY CANYON / WENATCHEE RIVER	47 36 01 120 37 22	007	17020011	SW,SW,SEC5,T24N,R18E, AT ROAD CROSSING, 1.8 MI E OF LEAVENWORTH, 0.6 MI UPSTREAM FROM MOUTH, AT CREST-STAGE GAGE "NEAR LEAVENWORTH" (12-4589).	1.36	--	3-10-65 3- 8-67 6- 9-71 8-20-75 9-18-75 9-10-76 9-22-76 6-29-77 9-20-77	0.52 0.13 0.21 0.15e 0.08 0.08e 0.00 0.01e 0.05e
DERBY CANYON / WENATCHEE RIVER	47 34 11 120 35 10	007	17020011	SE,SE,SEC16,T24N,R18E, 0.8 MI E OF PESHASTIN AND 0.1 MI UPSTREAM FROM MOUTH.	12.6	--	8-20-75 9-18-75 9-10-76 9-22-76 6-29-77 9-19-77	4.07 3.12 1.67 1.42 0.18 4.13
SCOTTY CREEK / PESHASTIN CREEK	47 22 40 120 38 41	007	17020011	SW,SE,SEC24,T22N,R17E, WENATCHEE NATIONAL FOREST, 3.2 MI S OF BLEWETT AND 100 FT UPSTREAM FROM MOUTH.	7.15	--	8-19-75 9-17-75 9- 8-76 9-20-76 6-29-77 9-19-77	4.00 0.76 0.66 0.62 0.38 0.24
SHASER CREEK / PESHASTIN CREEK	47 23 28 120 39 28	007	17020011	SW,SW,SEC13,T22N,R17E, WENATCHEE NATIONAL FOREST, 2.2 MI S OF BLEWETT, AND 40 FT UPSTREAM FROM MOUTH.	8.92	--	8-19-75 9-17-75 9- 8-76 9-20-76 6-29-77 9-19-77	4.32 1.25 1.46 1.60 1.34 0.71
TRONSEN CREEK / PESHASTIN CREEK	47 20 18 120 33 58	007	17020011	NE,SW,SEC3,T21N,R18E, AT FOREST CAMPGROUND, 0.6 MI NE OF SWAUK PASS AND 17 MI S OF PESHASTIN, AT CREST-STAGE GAGE "NEAR PESHASTIN" (12-4594).	3.96	1960	6-24-66 3-25-67 5-28-69 6-14-72 6- 5-74 6-13-75 9- 8-76	1.75 14.5 12.0 11.1 21.9 7.76 0.90

STREAM / TRIBUTARY TO	LAT/LONG DEG,MIN,SEC	CNTY CODE	HYDROLOGIC UNIT CODE	LOCATION	DRAINAGE AREA (SQ MI)	MEASURED PRIOR TO 1961	MEASUREMENTS DATE	MEASUREMENTS DISCHARGE (FT3/S)
				WENATCHEE RIVER BASIN -continued				
							9-20-76	0.69
							6-29-77	0.46
							9-19-77	0.43
TRONSEN CREEK / PESHASTIN CREEK	47 23 52 120 39 03	007	17020011	SE,NW,SEC13,T22N,R17E, WENATCHEE NATIONAL FOREST, 12.3 MI S OF PESHASTIN, AND 100 FT UPSTREAM FROM MOUTH.	16.2	--	8-19-75	7.71
							9-17-75	1.62
							9- 8-76	1.49
							9-20-76	0.91
							6-29-77	0.45
							9-19-77	0.14
CULVER SPRINGS / PESHASTIN CREEK	47 25 15 120 39 28	007	17020011	SW,SW,SEC1,T22N,R17E, WENATCHEE NATIONAL FOREST, 0.2 MI S OF BLEWETT, AND 75 FT UPSTREAM FROM MOUTH.	0.66	--	8-19-75	0.30
							9-17-75	0.10
							9- 8-76	0.00
							9-20-76	0.00
							6-27-77	0.04
							9-19-77	0.03
NIGGER CREEK / PESHASTIN CREEK	47 26 37 120 39 38	007	17020011	NE,SW,SEC36,T23N,R17E, WENATCHEE NATIONAL FOREST, 9.2 MI SW OF PESHASTIN, AND 30 FT UPSTREAM FROM MOUTH.	12.2	1911	8-19-75	8.29
							9-17-75	3.89
							9- 8-76	6.43
							9-20-76	3.90
							6-27-77	6.31
							9-19-77	2.90
RUBY CREEK / PESHASTIN CREEK	47 26 59 120 39 10	007	17020011	NE,NE,SEC36,T23N,R17E, WENATCHEE NATIONAL FOREST, AT STATE HWY 97 CROSSING, 1.8 MI N OF BLEWETT, AND 300 FT UPSTREAM FROM MOUTH	4.59	--	8-19-75	1.25
							9-17-75	0.29
							9- 8-76	0.41
							9-20-76	0.39
							6-27-77	0.11
							9-19-77	0.06
INGALLS CREEK / PESHASTIN CREEK	47 27 48 120 39 38	007	17020011	SE,NW,SEC25,T23N,R17E, WENATCHEE NATIONAL FOREST, 9.4 MI S OF LEAVENWORTH, 300 FT UPSTREAM FROM MOUTH.	36.8	1911	8- 1-73	39.6
							8-19-75	42.6
							9-17-75	30.4
							9- 8-76	45.6
							9-20-76	31.2
							6-27-77	47.5
							9-19-77	23.8
PESHASTIN CREEK / WENATCHEE RIVER	47 28 09 120 39 24	007	17020011	SW,SE,SEC24,T23N,R17E, WENATCHEE NATIONAL FOREST, 0.4 MI DOWNSTREAM FROM INGALLS CREEK, AT GAGING STATION "BELOW INGALLS CREEK, NEAR LEAVENWORTH" (12-4600).	97.2	1911-13, 1926,1958	9-14-67	24.8
							9-15-70	24.5
							8- 1-73	36.2
HANSEL CREEK / PESHASTIN CREEK	47 28 17 120 39 21	007	17020011	NW,SE,SEC24,T23N,R17E, WENATCHEE NATIONAL FOREST, 7.3 MI S OF PESHASTIN, AND 50 FT UPSTREAM FROM MOUTH.	3.76	1927	8-19-75	2.44
							9-17-75	0.32
							9- 8-76	0.73
							9-21-76	1.12
							6-27-77	0.63
							9-19-77	0.56
CAMAS CREEK / PESHASTIN CREEK	47 29 39 120 37 59	007	17020011	NW,NE,SEC18,T23N,R18E, AT STATE HWY 97 CROSSING 5 MI N OF BLEWETT, AND 0.3 MI UPSTREAM FROM MOUTH.	9.12	--	8-19-75	0.66
							9-17-75	0.15
							9- 8-76	0.16
							9-21-76	0.12
							6-27-77	0.00
							9-19-77	0.00
HILL CREEK / PESHASTIN CREEK	47 30 39 120 37 49	007	17020011	SW,SE,SEC6,T23N,R18E, 4.3 MI SW OF PESHASTIN AND 20 FT UPSTREAM FROM MOUTH.	5.36	--	8-19-75	1.90
							9-17-75	1.15
							9- 8-76	0.50
							9-21-76	0.00
							6-29-77	0.00
							9-19-77	0.00
PESHASTIN CREEK / WENATCHEE RIVER	47 33 09 120 36 07	007	17020011	NW,NW,SEC28,T24N,R18E, AT ROAD CROSSING 1.3 MI S OF PESHASTIN, AND 1.4 MI UPSTREAM FROM MOUTH. REMARKS: 9-8-76 MEASUREMENT INCLUDED 23.7 CFS IN IRRIGATION CANAL. 6-29-77 MEASUREMENT INCLUDED 32.3	133	1904,1914, 1948	8-20-75	79.7
							9-17-75	33.1
							9- 8-76	51.7
							9-21-76	31.2
							6-29-77	50.0
							9-19-77	18.7

STREAM / TRIBUTARY TO	LAT/LONG DEG,MIN,SEC	CNTY CODE	HYDROLOGIC UNIT CODE	LOCATION	DRAINAGE AREA (SQ MI)	MEASURED PRIOR TO 1961	MEASUREMENTS DATE	MEASUREMENTS DISCHARGE (FT3/S)
				WENATCHEE RIVER BASIN -continued				
				CFS IN IRRIGATION CANAL 9-19-77 MEASUREMENT INCLUDED 5.63 CFS IN IRRIGATION CANAL.				
PESHASTIN CREEK / WENATCHEE RIVER	47 33 21 120 35 26	007	17020011	SE,SW,SEC21,T24N,R18E, 0.2 MI UPSTREAM FROM BRIDGE ON U.S. HWY 2 AND 97, 4 MI SE OF LEAVENWORTH.	--	--	9-14-67 9-15-70 8- 1-73	4.75 9.60 1.63
EAST BRANCH MISSION CREEK / MISSION CREEK	47 22 51 120 29 16	007	17020011	NE,SW,SEC20,T22N,R19E, WENATCHEE NATIONAL FOREST, AT U.S. FOREST SERVICE ROAD CROSSING 9.7 MI S OF CASHMERE, AT CREST-STAGE GAGE "NEAR CASHMERE" (12-4611).	15.4	--	5-18-61 5-23-61 6-12-61 5- 6-63 4-18-66 3- 7-67 5-23-67 6- 6-74 4-30-75 8-20-75 9-17-75 9- 7-76 9-21-76 6-27-77 9-19-77	6.31 10.5 4.52 3.69 3.75 1.02 11.2 11.4 1.96 2.90 1.16 1.26 0.92 0.19 0.45
EAST BRANCH MISSION CREEK TRIBUTARY / E.B. MISSION CREEK	47 22 54 120 29 20	007	17020011	NE,SW,SEC20,T22N,R19E, WENATCHEE NATIONAL FOREST, AT U.S. FOREST SERVICE ROAD CROSSING 9.7 MI S OF CASHMERE, AT CREST-STAGE GAGE "NEAR CASHMERE" (12-4612).	2.49	--	4-20-65 4-18-66 5-23-67 6- 6-74 8-20-75 9-17-75 9- 7-76 9-21-76 6-27-77 9-19-77 4- 1-83 5- 2-84 6-22-84	2.52 0.92 0.93 0.18 0.28 0.02 0.05e 0.05e 0.00 0.00 3.03 0.60 0.36
MISSION CREEK / WENATCHEE RIVER	47 25 48 120 30 28	007	17020011	SE,NW,SEC6,T22N,R19E, WENATCHEE NATIONAL FOREST, 6.5 MI S OF CASHMERE, AND 400 FT UPSTREAM FROM SAND CREEK, AT GAGING STATION "ABOVE SAND CREEK, NEAR CASHMERE" (12-4614).	39.8	--	10- 5-71 6-13-75 8-18-75 8-20-75 9-17-75 9- 7-76 9-21-76 6-27-77 9-19-77	2.18 25.1 212 14.8 3.84 4.73 3.58 0.81 1.62
LITTLE CAMAS CREEK / SAND CREEK	47 26 02 120 32 19	007	17020011	NE,SEC2,T22N,R18E, WENATCHEE NATIONAL FOREST AT MOUTH, 7 MI SW OF CASHMERE.	5.59	--	8-20-75 9-17-75 9- 7-76 9-21-76 6-27-77 9-19-77	1.28 0.40 0.51 0.33 0.04 0.11
POISON CREEK / SAND CREEK	47 26 00 120 31 04	007	17020011	NW,SEC6,T22N,R19E, WENATCHEE NATIONAL FOREST AT ROAD CROSSING AT MOUTH, 6.5 MI S OF CASHMERE.	3.44	--	8-20-75 9-17-75 9- 7-76 9-21-76 6-27-77 9-19-77	0.17 0.08 0.15e 0.08e 0.03e 0.00
SAND CREEK / MISSION CREEK	47 25 48 120 30 26	007	17020011	SW,NE,SEC6,T22N,R19E, 60 FT UPSTREAM FROM MOUTH, 6.5 MI S OF CASHMERE, AT CREST-STAGE GAGE "NEAR CASHMERE" (12-4615).	18.6	1957-58	7-10-63 4-20-65 5-23-67 9-11-67 9-15-70 8- 1-73 8-20-75 9-17-75 9- 7-76 9-21-76	1.28 44.1 9.83 0.23 0.33 0.45 2.20 1.02 1.17 1.20

STREAM / TRIBUTARY TO	LAT/LONG DEG,MIN,SEC	CNTY CODE	HYDROLOGIC UNIT CODE	LOCATION	DRAINAGE AREA (SQ MI)	MEASURED PRIOR TO 1961	MEASUREMENTS DATE	MEASUREMENTS DISCHARGE (FT3/S)
WENATCHEE RIVER BASIN -continued								
							6-27-77	0.17
							9-19-77	0.38
MISSION CREEK / WENATCHEE RIVER	47 31 00 120 28 30	007	17020011	NW,NW,SEC9,T23N,R19E, 0.4 MI BELOW FORMER GAGE "AT CASHMERE" (12-4620), AND 1 MI S OF CASHMERE.	81.2	--	4-20-65	119
							3- 9-67	9.11
							8-20-75	20.4
							9-17-75	15.0
							9- 7-76	10.4
							9-21-76	13.7
							6-27-77	0.86
							9-19-77	5.43
MINOR BASINS BETWEEN THE WENATCHEE RIVER AND DOUGLAS CREEK								
SQUILLCHUCK CREEK / COLUMBIA RIVER	47 20 09 120 20 11	007	17020010	SW,SEC4,T21N,R20E, 0.5 MI BELOW HALVERSON ROAD, 1 MI ABOVE SCHOOL NO. 14, AND 2.5 MI NE OF SQUILLCHUCK STATE PARK.	12.4	1926	9-11-67	3.47
SQUILLCHUCK CREEK / COLUMBIA RIVER	47 21 09 120 19 54	007	17020010	NW,SE,SEC33,T22N,R20E, AT COUNTY ROAD CROSSING, 4 MI S OF WENATCHEE.	--	--	9-15-70	2.46
SQUILLCHUCK CREEK / COLUMBIA RIVER	47 23 42 120 17 38	007	17020010	SE,SW,SEC14,T22N,R20E, 0.3 MI ABOVE MOUTH IN SOUTH WENATCHEE.	27.8	1926	2-28-77	2.23
							8-25-77	0.01
DRY GULCH / COLUMBIA RIVER	47 18 38 120 05 47	007	17020010	SE,NE,SEC17,T21N,R22E, AT COLOCKUM ROAD, 0.4 MI ABOVE MOUTH AND 6.2 MI SE OF MALAGA, AT CREST-STAGE GAGE "NEAR MALAGA" (12-462610)	12.0	--	5- 1-75	0.11
DOUGLAS CREEK BASIN								
UNNAMED TRIBUTARY / DOUGLAS DRAW	47 42 00 119 54 25	017	17020012	SW,SE,SEC35,T26N,R23E, AT COUNTY ROAD CROSSING, AND 4.5 MI W OF WITHROW.	15.8	--	8-30-79	494 +
UNNAMED TRIBUTARY / DOUGLAS DRAW	47 43 39 119 56 19	017	17020012	NW,NW,SEC27,T26N,R23E, 500 FT BELOW COUNTY ROAD, 6.3 MI NW OF WITHROW AND 8 MI NE OF WATERVILLE.	5.40	--	7-27-62	806 +
UNNAMED TRIBUTARY / DOUGLAS DRAW	47 42 08 119 57 25	017	17020012	SE,SW,SEC33,T26N,R23E, 6.7 MI W OF WITHROW.	10.7	--	8-30-79	548 +
UNNAMED TRIBUTARY / DOUGLAS DRAW	47 43 44 119 59 10	017	17020012	SE,SEC19,T26N,R23E, AT COUNTY ROAD 6.8 MI NE OF WATERVILLE.	0.93	--	7-27-62	635 +
UNNAMED TRIBUTARY / DOUGLAS DRAW	47 42 08 119 57 35	017	17020012	SW,SW,SEC33,T26N,R23E, 6.8 MI W OF WITHROW.	9.34	--	8-30-79	962 +
MOSES CREEK / DOUGLAS CREEK	47 36 49 120 00 10	017	17020012	NE,SE,SEC36,T25N,R22E, AT COUNTY ROAD, 0.3 MI SE OF DOUGLAS, AT CREST-STAGE GAGE "AT DOUGLAS" (12-4628).	15.4	--	3- 8-65	0.54
							4-19-65	0.38
							4- 6-76	110
							2-28-77	0.68
							4-28-77	0.58
							8-25-77	0.01
DOUGLAS CREEK / COLUMBIA RIVER	47 35 03 120 01 19	017	17020012	SW,SW,SEC12,T24N,R22E, 1.5 MI NW OF ALSTOWN, AT GAGING STATION "NEAR ALSTOWN" (12-4630)	99.9	1948, 1956-60	2-28-77	2.33
							4-28-77	1.02
							8-25-77	0.00
RATTLESNAKE TRIB / RATTLESNAKE CREEK	47 26 30 119 35 45	017	17020012	SW,SEC32,T23N,R26E, AT COUNTY ROAD, 6 MI NW OF SOAP LAKE, AT CREST-STAGE GAGE "NEAR SOAP LAKE" (12-4636).	2.22	--	3-11-76	0.05
RATTLESNAKE SPRINGS/ RATTLESNAKE CREEK	47 27 03 119 45 29	017	17020012	NW,NE,SEC36,T23N,R24E, AT SPRING, 7.8 MI NE OF PALISADES.	--	--	6- 6-78	0.16
							7-26-78	0.07
							8- 7-78	0.04
							9-26-78	0.07
							10-17-78	0.15
							11- 8-78	0.23
							11-30-78	0.18

APPENDIX C
TABULATED STATISTICAL STREAMFLOW ANALYSES

Chiwawa River Weekly Exceedence Probability			
Week	90% Exceedence	50% Exceedence	10% Exceedence
10/1	77	129	244.2
10/8	77.9	124.5	307.1
10/15	80	135	344
10/22	84.8	142	353.7
10/29	84.8	157	380.8
11/5	80.9	156	464.9
11/12	79.8	189	642.1
11/19	88	168	559.2
11/26	92.7	162.5	530.3
12/3	91	155	344
12/10	85	148	363.2
12/17	86	132	381.6
12/24	85.2	125	319.4
12/31	82.4	139	280
1/7	80.4	144	319.8
1/14	80.2	127	268.2
1/21	75.2	120	221
1/28	70	120	250
2/4	71	114	222.8
2/11	70	116	192.8
2/18	70	120	269.4
2/25	85	123	281.8
3/3	82	130	269
3/10	88	131	300.8
3/17	92	149	530
3/24	119.2	179	485.8
3/31	145.2	232	558.4
4/7	148.4	410	687.6
4/14	211.2	592	1178
4/21	285.2	787	1368
4/28	431	1030	1654
5/5	598	1070	2365
5/12	766.6	1350	2709
5/19	899.6	1700	2710
5/26	1050	1730	3080
6/2	844.8	1765	2752
6/9	809.3	1645	2663
6/16	648.3	1365	2472
6/23	536.8	1210	2150
6/30	445.2	1050	1934
7/7	406	913	1710
7/14	309.8	728	1498
7/21	258.2	542	1244
7/28	197.8	435.5	880.4
8/4	169	331	723.9
8/11	141.3	255.5	511.1
8/18	126	228.5	411.1
8/25	105	184.5	344
9/1	99.1	176	316.8
9/8	95.6	159	294.4
9/15	89	143	280
9/22	84.4	127	269.4
9/29	85.5	118.5	249.5

Icicle Creek above Snow Creek				
	Exceedence Probability			
Week	90% Exceedence	50% Exceedence	10% Exceedence	Minimum Flow from WAC
10/1	84	120.5	388	130
10/8	80	164	484	130
10/15	80	156	519	130
10/22	83	220	529	130
10/29	93	220	580	150
11/5	96	220	699	150
11/12	100	241	738	150
11/19	105	237	835	150
11/26	113	260	918	150
12/3	127	258	771	150
12/10	112	240	740	150
12/17	120	233	642	150
12/24	110	242	550	150
12/31	100	246	617	150
1/7	118	228	558	120
1/14	122	228	558	120
1/21	115	205	503	120
1/28	110	186	520	120
2/4	110	189	590	120
2/11	110	187	481	120
2/18	110	192	568	120
2/25	114	196	520.9	120
3/3	121	216	414	150
3/10	130	216	391	150
3/17	145	232	455	170
3/24	176	273	612	170
3/31	214	307	710	170
4/7	240	450	818	200
4/14	304	596	1340	200
4/21	320	816	1390	300
4/28	440	885	1640	300
5/5	574	1030	2620	450
5/12	702	1520	2850	450
5/19	1090	1910	3370	660
5/26	1220	1960	3310	660
6/2	1080	2070	3650	1000
6/9	1050	1840	3160	1000
6/16	854	1740	3220	660
6/23	669.4	1400	2540	660
6/30	529.1	1195	2088	660
7/7	396	934	2140	450
7/14	295	698	1680	450
7/21	228	517	1290	300
7/28	192	388	774	300
8/4	154	280	617	200
8/11	138	228	427	200
8/18	121.4	184	330	170
8/25	118	159	298	170
9/1	108.1	150	241.7	130
9/8	103	140	212.2	130
9/15	94	139	325.4	130
9/22	85	128	256	130
9/29	85	128	296.5	130

Icicle Creek nr. Leavenworth			
	Exceedence Probability		
Week	90% Exceedence	50% Exceedence	10% Exceedence
10/1	118	130	176
10/8	110	118	570
10/15	106	176	445
10/22	90	176	420
10/29	87	153	296
11/5	130	176	272
11/12	126	210	495
11/19	224	370	670
11/26	224	345	470
12/3	214	272	296
12/10	181	224	248
12/17	176	186	224
12/24	130	176	213
12/31	176	220	476
1/7	180	220	645
1/14	180	220	420
1/21	180	220	286
1/28	180	220	272
2/4	170	224	272
2/11	176	224	320
2/18	176	224	370
2/25	204	224	350
3/3	181	205	224
3/10	139	248	370
3/17	130	248	595
3/24	176	248	520
3/31	224	395	520
4/7	229	620	1000
4/14	545	752	1450
4/21	520	890	1110
4/28	620	725	1630
5/5	780	1330	1930
5/12	1110	2050	2770
5/19	1330	2350	2770
5/26	1220	2350	3720
6/2	1160	2470	4440
6/9	976	2500	3369
6/16	1315	1960	2686
6/23	1000	1360	2290
6/30	862	1000	1924
7/7	682.1	808	1828
7/14	620	738.5	1125
7/21	420	482.5	1606
7/28	320	360	752
8/4	272	296	635
8/11	210	248	392.5
8/18	176	212	296
8/25	148	188	272
9/1	127.6	224	460
9/8	110	219	303.2
9/15	153	224	303.2
9/22	130	193	272
9/29	110	172	217

Mission Creek abv. Sand Creek			
	Exceedence Probability		
Week	90% Exceedence	50% Exceedence	10% Exceedence
10/1	1.5	2.3	3.5
10/8	1.6	2.65	5.4
10/15	1.9	2.8	4.8
10/22	2.1	3.9	7.74
10/29	2.1	4.05	7.54
11/5	2.2	3.6	9.14
11/12	2.43	3.8	9.57
11/19	2.9	5.1	16.7
11/26	2.7	4.8	12
12/3	2.63	4.5	10.7
12/10	2.5	4	14
12/17	2.4	4	14.7
12/24	2.4	5	9.82
12/31	1.9	5	9.02
1/7	2.6	5.4	20
1/14	3	5.4	16
1/21	3.4	5.2	25
1/28	3.2	10	34
2/4	3.5	12	25
2/11	5	12	22
2/18	8	12	45
2/25	7	12	43
3/3	6.5	11	34
3/10	6.3	12	28
3/17	6.4	16	37
3/24	8.4	17	59
3/31	13	26	69
4/7	14	28	53
4/14	14	23	39
4/21	14	28	48
4/28	14	32	66
5/5	17	31	88
5/12	16	27	72
5/19	16	35	60
5/26	17	32	44
6/2	16	27	43
6/9	12.1	20	31
6/16	9.1	15	21
6/23	7.32	12	15
6/30	6.4	10	12
7/7	5.4	7.6	10
7/14	4.4	6.4	9
7/21	3.7	5.1	7.6
7/28	2.9	4.4	6.6
8/4	2.3	3.6	4.8
8/11	2	3	3.8
8/18	1.9	2.7	4.02
8/25	1.8	2.6	3.4
9/1	1.61	2.3	3.2
9/8	1.7	2.3	3.08
9/15	1.6	2.2	3.91
9/22	1.5	2	3.66
9/29	1.5	2.2	4.25

Sand Creek nr. Cashmere			
	Exceedence Probability		
Week	90% Exceedence	50% Exceedence	10% Exceedence
10/1	0.53	0.85	0.9
10/8	0.8	0.9	1.17
10/15	0.7	0.85	0.9
10/22	0.8	0.9	0.97
10/29	0.9	0.9	1.64
11/5	0.9	1	1.44
11/12	0.6	0.9	2.58
11/19	0.6	1.95	2.88
11/26	1.26	1.6	2.47
12/3	1.13	1.25	1.37
12/10	1.4	1.75	3.41
12/17	1.2	2.4	9.4
12/24	1	4.2	9.7
12/31	1.3	2.7	4.85
1/7	1.2	2.7	12.7
1/14	1.2	7.65	16
1/21	1.3	4.15	11.7
1/28	1.2	1.85	5.2
2/4	2.09	2.65	5.91
2/11	2.36	3.45	4
2/18	1.53	2.2	5.51
2/25	1.02	5.3	6.3
3/3	1.16	4.85	21.4
3/10	1.93	6.75	12
3/17	2.6	11.3	30.8
3/24	5.8	22.3	46.1
3/31	9.02	26	47.7
4/7	19.9	36	105.5
4/14	10.3	60	142.2
4/21	12	50.5	150.7
4/28	10	35	69.2
5/5	21.3	39.5	71.1
5/12	20	34.5	54.1
5/19	9.92	21.5	38.7
5/26	6.6	12	16
6/2	5.2	8.3	11
6/9	4.3	5.4	8
6/16	3.5	4	6.8
6/23	2.9	3.4	4.8
6/30	2.4	2.9	4.8
7/7	1.9	2.2	4.6
7/14	1.4	1.7	3.9
7/21	1.2	1.3	3.2
7/28	1	1.1	3
8/4	0.8	1	2.6
8/11	0.7	0.9	6.2
8/18	0.6	1	2.1
8/25	0.5	1	2
9/1	0.5	0.9	1.4
9/8	0.5	0.8	2.5
9/15	0.5	1	1.7
9/22	0.5	0.9	1.5
9/29	0.6	0.9	1.65

Mission Creek nr Cashmere				
	Exceedence Probability			
Week	90% Exceedence	50% Exceedence	10% Exceedence	Minimum Flow from WAC
10/1	4.0	4.6	8.4	4
10/8	4.4	7.0	8.8	4
10/15	4.0	5.8	8.4	5
10/22	4.3	6.5	14.6	5
10/29	4.1	9.7	14.0	5
11/5	4.8	10.0	16.0	6
11/12	4.0	9.4	13.9	6
11/19	4.4	9.2	12.6	6
11/26	5.6	8.5	16.3	6
12/3	6.0	7.9	13.3	6
12/10	6.2	9.2	82.1	6
12/17	3.5	10.0	41.9	6
12/24	5.4	14.0	25.6	6
12/31	5.9	12.0	16.0	6
1/7	7.0	10.0	26.3	6
1/14	4.4	8.0	28.0	6
1/21	4.0	8.3	27.0	6
1/28	3.9	7.5	16.0	6
2/4	4.2	9.5	25.2	6
2/11	9.8	15.0	28.0	6
2/18	7.9	12.0	52.0	6
2/25	6.8	35.0	74.4	6
3/3	7.7	25.0	40.0	6
3/10	9.0	25.0	27.3	6
3/17	12.0	33.0	57.6	11
3/24	15.7	53.5	150.0	11
3/31	24.0	65.0	182.5	11
4/7	58.6	68.5	191.5	22
4/14	26.4	78.0	257.9	22
4/21	28.0	65.5	253.4	40
4/28	30.5	87.5	137.3	40
5/5	52.7	97.0	150.4	40
5/12	53.7	72.5	118.6	40
5/19	45.4	65.0	144.2	40
5/26	30.8	42.0	100.4	40
6/2	22.0	28.0	67.2	28
6/9	19.0	24.0	53.6	28
6/16	14.0	20.0	45.6	28
6/23	11.4	16.0	36.2	20
6/30	9.4	14.0	26.8	20
7/7	6.5	9.5	21.0	14
7/14	4.7	7.0	14.0	14
7/21	2.8	4.9	11.6	10
7/28	3.0	4.0	10.0	10
8/4	2.6	3.1	9.2	7
8/11	1.8	2.6	8.4	7
8/18	1.0	3.5	12.0	5
8/25	0.1	3.5	10.6	5
9/1	0.1	2.5	8.7	4
9/8	0.1	2.5	9.3	4
9/15	3.4	4.2	9.9	4
9/22	3.4	4.6	8.6	4
9/29	3.1	4.6	8.9	4

Phelps Creek			
	Exceedence Probability		
Week	90% Exceedence	50% Exceedence	10% Exceedence
10/1	3.2	10.35	22.3
10/8	2.29	10.25	61.6
10/15	2.97	13.5	89.1
10/22	3	13	64.8
10/29	3.3	12	58
11/5	2.3	10	55.2
11/12	2.04	9.9	37.2
11/19	1.8	11	30.2
11/26	1.94	7.2	26.6
12/3	1.48	7.8	52.6
12/10	1.3	6.9	30
12/17	1.8	5.4	26.8
12/24	1.88	5.4	22
12/31	1.4	5.1	18.6
1/7	1.6	5.1	18
1/14	1.1	6	27.6
1/21	1.8	5.4	22.6
1/28	2.16	6.5	19.2
2/4	4	5.3	18
2/11	2.5	3.6	16
2/18	1.12	4.3	15
2/25	2.5	4.3	16
3/3	0	3.2	16.6
3/10	2.32	5	16.6
3/17	3.74	6.9	21.4
3/24	6.38	9.2	35.2
3/31	6.2	15	35.2
4/7	5.13	21	40
4/14	4.71	24	75.5
4/21	15.8	41	150.6
4/28	48.7	86	120.5
5/5	50.7	98	203.9
5/12	126.1	179	335.8
5/19	71.4	200	618
5/26	91.3	158.5	550.7
6/2	100.3	174	656.1
6/9	110.8	200	405.5
6/16	106.5	153	331
6/23	100	156.5	241
6/30	77.1	128	203.9
7/7	74	108	188
7/14	47.7	83	165
7/21	32.1	60	132.9
7/28	23	33	104
8/4	17.4	26.5	81
8/11	9.85	18.5	44.1
8/18	7.87	15.5	29
8/25	5.96	12.6	29.3
9/1	4.6	10.1	33.8
9/8	4.27	12	24.3
9/15	4.24	8.4	18
9/22	4.7	8.7	15.3
9/29	4.1	6.75	25.1

White River nr. Plain			
	Exceedence Probability		
Week	90% Exceedence	50% Exceedence	10% Exceedence
10/1	155	232	519
10/8	142	258	676
10/15	120	253	770
10/22	147	297	668
10/29	158	292	783
11/5	171	342	732
11/12	180	330	696
11/19	166	305	832
11/26	166	292	868
12/3	165	300	794
12/10	150	292	885
12/17	170	268	996
12/24	158	292	698
12/31	140	250	681
1/7	135	250	616
1/14	160	260	583
1/21	161	270	537
1/28	151	253	618
2/4	150	233	638
2/11	142	227	540
2/18	139	232	780
2/25	134	260	702
3/3	146	263	528
3/10	148	244	624
3/17	163	245	522
3/24	183	304	661
3/31	208	368	862
4/7	322	500	988
4/14	350	609	997
4/21	354	696	1,538
4/28	433	1,040	2,150
5/5	719	1,210	2,880
5/12	791	1,640	2,808
5/19	1,096	1,910	3,426
5/26	1,182	2,050	3,606
6/2	1,176	2,660	4,156
6/9	1,332	2,190	3,710
6/16	1,154	2,290	4,088
6/23	1,170	1,920	3,088
6/30	936	1,650	2,750
7/7	824	1,550	3,080
7/14	746	1,290	2,856
7/21	584	1,180	2,336
7/28	494	880	1,890
8/4	384	680	1,396
8/11	360	549	1,044
8/18	297	446	837
8/25	232	341	794
9/1	220	344	673
9/8	209	289	530
9/15	190	255	594
9/22	177	232	601
9/29	170	220	635

Wenatchee River blw Lake Wenatchee			
	Exceedence Probability		
Week	90% Exceedence	50% Exceedence	10% Exceedence
10/1	191	257	888
10/8	184	317	892
10/15	177	353	1,334
10/22	177	501	1,530
10/29	211	580	1,449
11/5	203	561	1,770
11/12	212	669	1,490
11/19	194	585	1,535
11/26	209	601	1,819
12/3	239	683	1,598
12/10	273	653	1,459
12/17	321	632	1,158
12/24	307	552	1,279
12/31	257	476	1,196
1/7	259	441	969
1/14	250	428	1,104
1/21	230	404	1,122
1/28	220	391	1,318
2/4	200	365	1,400
2/11	253	380	1,094
2/18	246	380	885
2/25	239	416	947
3/3	270	448	798
3/10	277	491	704
3/17	302	505	972
3/24	358	584	1,442
3/31	427	647	1,692
4/7	518	925	1,700
4/14	742	1,510	3,172
4/21	994	1,950	3,570
4/28	1,126	2,210	3,470
5/5	1,388	2,520	4,786
5/12	1,794	3,260	5,402
5/19	2,094	3,520	6,082
5/26	2,210	4,010	6,396
6/2	2,428	3,710	5,768
6/9	2,260	3,730	5,760
6/16	1,962	3,240	5,144
6/23	1,652	2,900	4,698
6/30	1,270	2,420	4,842
7/7	887	1,980	4,492
7/14	802	1,750	3,982
7/21	598	1,220	3,184
7/28	473	946	2,012
8/4	396	700	1,556
8/11	353	548	1,260
8/18	319	483	1,000
8/25	277	416	732
9/1	260	377	595
9/8	245	344	485
9/15	222	312	623
9/22	220	285	538
9/29	198	283	605

Wenatchee River at Plain				
	Exceedence Probability			
Week	90% Exceedence	50% Exceedence	10% Exceedence	IRPP Flows
10/1	340	507	1,344	580
10/8	320	575	1,746	580
10/15	340	604	1,833	520
10/22	400	732	1,880	520
10/29	410	866	2,242	520
11/5	456	934	2,623	550
11/12	476	998	2,881	550
11/19	484	980	2,761	550
11/26	496	979	2,764	550
12/3	468	1,010	2,913	550
12/10	458	900	2,614	550
12/17	462	921	2,431	550
12/24	496	888	1,900	550
12/31	442	816	2,011	550
1/7	462	815	1,951	550
1/14	453	866	2,170	550
1/21	456	846	1,810	550
1/28	446	799	2,061	550
2/4	484	759	2,070	550
2/11	458	747	1,905	550
2/18	457	781	1,960	550
2/25	471	808	2,022	550
3/3	500	796	1,830	550
3/10	534	861	1,920	550
3/17	592	979	2,284	700
3/24	660	1,160	2,572	700
3/31	827	1,430	2,982	700
4/7	938	1,985	3,440	910
4/14	1,289	2,425	4,890	910
4/21	1,556	2,960	5,000	1150
4/28	2,070	3,695	6,024	1150
5/5	2,649	4,325	7,958	1500
5/12	3,100	5,430	9,542	1500
5/19	3,660	6,180	10,400	2000
5/26	3,840	6,290	10,400	2000
6/2	3,700	6,710	11,200	2500
6/9	3,487	6,400	10,110	2500
6/16	3,030	6,100	9,900	2000
6/23	2,578	5,375	8,394	2000
6/30	2,070	4,300	7,623	2000
7/7	1,507	3,560	7,683	1500
7/14	1,210	2,915	6,601	1500
7/21	1,009	2,180	5,141	1200
7/28	842	1,670	3,650	1200
8/4	701	1,270	2,828	880
8/11	596	1,030	2,170	880
8/18	537	850	1,630	700
8/25	480	746	1,460	700
9/1	444	700	1,124	660
9/8	405	615	981	660
9/15	367	570	980	620
9/22	368	523	1,030	620
9/29	353	503	1,101	620

Wenatchee River at Peshastin				
	Exceedence Probability			
Week	90% Exceedence	50% Exceedence	10% Exceedence	Minimum Flow from WAC
10/1	432	658	1760	750
10/8	430	699	1880	750
10/15	430	770	2300	700
10/22	468	946	2600	700
10/29	496	1130	2830	700
11/5	546	1260	3550	750
11/12	553	1400	3550	750
11/19	532	1290	3630	750
11/26	574	1260	3960	750
12/3	620	1330	4060	750
12/10	625	1200	3740	750
12/17	600	1190	3400	750
12/24	600	1160	2670	750
12/31	540	1100	2900	750
1/7	580	1150	2880	700
1/14	586	1190	2870	700
1/21	600	1170	2680	700
1/28	575	1150	3100	700
2/4	600	1100	3090	700
2/11	653	1050	2660	700
2/18	625	1070	3170	700
2/25	679.7	1210	3245	700
3/3	701.5	1230	2763	750
3/10	800.4	1285	3130	750
3/17	929.7	1510	3409	940
3/24	1050	1790	3580	940
3/31	1250	2010	4190	940
4/7	1550	2660	4740	1300
4/14	1901	3430	6973	1300
4/21	2175	4190	7451	1750
4/28	2747	5190	8759	1750
5/5	3397	5660	11630	2200
5/12	4050	7275	12930	2200
5/19	4971	8220	13530	2800
5/26	5544	8735	15100	2800
6/2	5197	9225	14900	3500
6/9	5010	8630	13830	3500
6/16	4111	8055	14130	2600
6/23	3560	6780	11830	2600
6/30	2777	5455	10300	2600
7/7	2055	4520	10130	1900
7/14	1551	3700	8632	1900
7/21	1310	2780	6810	1400
7/28	999.7	2105	4665	1400
8/4	838.8	1535	3596	1000
8/11	715.7	1240	2638	1000
8/18	627.1	1025	2009	840
8/25	554.7	874	1756	840
9/1	515	814	1366	820
9/8	491.7	736	1193	820
9/15	466.7	693.5	1189	780
9/22	430	656.5	1246	780
9/29	421.6	669	1240	780

Wenatchee River at Dryden			
	Exceedence Probability		
Week	90% Exceedence	50% Exceedence	10% Exceedence
10/1	620	905	1430
10/8	620	1012.5	2895
10/15	685	1110	2320
10/22	620	1100	2240
10/29	580	1110	2470
11/5	760	1200	4040
11/12	750	1200	3115
11/19	845	2185	7150
11/26	780	2110	6760
12/3	750	1605	3895
12/10	750	1245	3305
12/17	750	1115	1820
12/24	720	1020	1820
12/31	701	1105	1583
1/7	770	1030	2232
1/14	596	1110	1608
1/21	650	1020	1490
1/28	652	1030	1290
2/4	760	1030	1520
2/11	694	1020	2396
2/18	764	1110	2190
2/25	730	1145	2430
3/3	760	1200	2360
3/10	760	1400	2716
3/17	764	1850	4434
3/24	1046	2460	4978
3/31	1146	2440	4596
4/7	1398	2980	5250
4/14	1636	4980	7840
4/21	2360	5650	9420
4/28	3303	5115	9518
5/5	4320	7330	12440
5/12	4247	8025	12930
5/19	4550	9080	15230
5/26	4890	10100	15610
6/2	4976	10550	17370
6/9	4073	11450	17600
6/16	4879	9580	14720
6/23	4531	7800	11100
6/30	4149	6430	12060
7/7	2925	5370	11600
7/14	2874	4115	9659
7/21	1659	3180	7692
7/28	1128	2520	3990
8/4	1020	1860	2962
8/11	934	1475	2110
8/18	1015.5	1210	1870
8/25	880	1105	1496
9/1	725	1040	1350
9/8	662	890	1290
9/15	542	960	1280
9/22	532	920	1190
9/29	559	870	1205

Wenatchee River at Monitor				
	Exceedence Probability			
Week	90% Exceedence	50% Exceedence	10% Exceedence	Minimum Flow from WAC
10/1	369.8	690	1740	700
10/8	388.8	716.5	1648	700
10/15	481.8	883	1805	700
10/22	556.3	979.5	2098	700
10/29	559.7	1125	2585	700
11/5	686.4	1360	3803	800
11/12	756.2	1560	4203	800
11/19	774.5	1450	3520	800
11/26	762.1	1395	4190	800
12/3	744.5	1385	4940	800
12/10	795.6	1240	3941	800
12/17	725.9	1260	3523	800
12/24	710	1265	2903	800
12/31	587.9	1165	2924	800
1/7	679.8	1325	3331	820
1/14	726	1400	3663	820
1/21	780	1475	3222	820
1/28	698	1420	3605	820
2/4	741	1385	3222	820
2/11	797.9	1390	3133	820
2/18	774.7	1535	5630	800
2/25	783.4	1545	4554	800
3/3	901.5	1610	3392	800
3/10	1058	1720	4146	800
3/17	1218	1980	4204	800
3/24	1229	2200	4143	1040
3/31	1470	2490	4686	1040
4/7	1958	2970	5252	1350
4/14	2097	3455	7198	1350
4/21	2250	4145	7876	1750
4/28	2837	5285	9005	1750
5/5	3379	5755	12740	2200
5/12	3895	6955	14310	2200
5/19	5087	8340	12930	2800
5/26	5489	8755	15200	2800
6/2	5046	9690	16320	3500
6/9	4917	8575	15310	3500
6/16	3909	8345	16310	3500
6/23	3322	7005	12900	2400
6/30	2717	5390	10710	2400
7/7	1962	4640	10610	1700
7/14	1439	3735	9009	1700
7/21	1280	2740	7054	1200
7/28	962	2130	5870	1200
8/4	747.5	1520	4510	800
8/11	622.2	1235	2923	800
8/18	552.8	983	2350	700
8/25	472.7	821.5	1991	700
9/1	439.8	786	1520	700
9/8	444.9	736.5	1261	700
9/15	422.7	713.5	1131	700
9/22	385.5	690	1321	700
9/29	398.4	666	1162	700