Historical Stream Flow Data by WRIA

Protocol for Creating Stream Flow Graphs

Over 65 stream flow sites were used. The number of graphs created for each site depended upon the available data. Up to eight graphs were developed per site: Historic Flows; Flow Exceedance Curve; Dry Years Trends; 30 Year Flows; Comparison of Dry, Average and Wet Years Flows to Instream Flow Rule; Water Surplus/Deficit Evaluation; Comparison of Dry Years Flow to Instream Flow Rule; Comparison of Wet Years Flow to Instream Flow Rule.

Step One: Acquire the Data

Data for the stream flow sites were obtained from either the United States Geological Survey (USGS) or Washington State's Department of Ecology (DOE) websites.

1. Go to: USGS website: http://waterdata.usgs.gov/wa/nwis and select only the parameters listed in the steps below. Ignore all other parameters.
2. Select the Data Category of **Surface Water.**
3. Select Daily data.
4. Select from the Site Selection Criteria either **Site Name** or **Site Number**.
5. Select the Water Level/Flow Parameters of Streamflow, ft^3/s.
6. Submit your request by clicking Submit.
7. USGS Surface-Water Daily Data for Washington Grouped by Hydrologic Unit will show.
8. Click on the **Site Number.**
9. Select the Available Parameter of **Discharge (mean**) and the Output Format of **Tab-separated**.
10. Select the Begin and End Dates.
11. Click **Go** to download all available daily data for this site.

If data is unavailable at USGS site:

1. Go to: DOE website: https://fortress.wa.gov/ecy/wrx/wrx/flows/regions/state.asp
2. Select region.
3. Select "show active and historical stations".
4. Place cursor over **Site** and click. Click on the site's website.
5. Select "**show historical"** in the graphic display on the right side to view all WRIA sites.
6. Click the **Flow** tab that is at the bottom of the page.
7. Download **Verified historical data** in **.txt** format by clicking **cross/tab table**. Save it as Text file (*.txt). If cross/tab table is unavailable, contact the DOE lead staff listed under "Station details."
8. Convert them in **Tab-separated** format by opening new Excel spreadsheet. Click **Open**, find where saved Text file (*txt.) located. Click on the file. Text import Wizard window with 3 steps will pop-up.
   a). Step 1-Choose the file that best describes your data: select Delimited, click Next.
   b). Step 2-Delimiters: check **Comma**, Check **Space**, and then click **Next.**

c). Step 3: Click **Finish.**

For assistance, contact the DOE lead staff listed under "Station details."

Step Two: Clean the Raw Data

All daily data in .txt format have data-value qualification codes and tags (letters, parentheses, punctuations, etc.) that need to be deleted. Read the output carefully to get basic information about those codes.

1. Use all formatting tools to make a new spreadsheet table.
2. Delete unnecessary information cell by cell.
3. Save your work and title it "Cleaned Data."

Step Three: Process the Cleaned Data

1. Use the cleaned data and convert daily flows in cfs (cubic-feet per second) to acre feet by multiplying each cell value to 1. 98 (1 cfs=1.98 ac-ft/day).
2. Create a table that shows years and daily river flow data. Using Excel function tools summarize annual flow (Sum of 365 cell values).
3. Save your work and title it "Processed Data."

Historic Flow Graph:

The yearly flows for the period of record were graphed in chronological order. This shows annual fluctuations and trends throughout the period of record. Flow is in thousand or million acre-feet.

1. Take the processed data from Step Three and click **Insert** in the Menu tab, click **Chart**, and then point to **Line.**
2. Select Legend entries: **Years** as X axis, **Flow volume** as Y Axis.
3. Format and edit the Historic Flow Graph by clicking **on Layout** and **Format** in the Menu tab.

Flow Exceedance Curve Graph:

The yearly historic flows were graphed from the driest to wettest years. Dry years are the driest 20% of all available years. Wet years are the wettest 20% of all available years. This shows the frequency of dry, average and wet years during the historic period of record. Flow is in thousand or million acre-feet.

1. Make another table by copying and pasting all data from the Processed Data table.
2. Highlight all flow values, then right click, click on **Sort** and select **Sort Smallest to Largest**.
3. Note how many years are recorded and apply the 20% assumption to determine which years fall into the dry, average and wet categories.
4. Put dry, average and wet years in different columns, otherwise the data will overlap when they are graphed
5. Use Excel's graphing options and insert **Chart**. Add X and Y values to track the exceedance cells.

6. Click **Layout** and **Format** in the Menu tab. The layout menu will guide you how to add, remove, or position titles, labels and legends.

Dry Years Trend Graph:

The historic flows' dry years were chronologically graphed. This shows whether or not dry years became drier, remained stable, or became wetter during the historic period of record. Flow is in million acre-feet.

1. Make a separate Drought Trend table using the dry years from the cleaned data.
2. Use Excel's graphing options by inserting **Chart**, select **Line** as a chat type. Add X and Y values.
3. Format and edit the Dry Years Trend Graph by clicking on Layout and Format in the Menu tab. Layout menu will guide you how to add, remove, or position titles, labels and legends.
4. Highlight data series, then right click, select Add Trendline.
5. Select Linear as a trend type, and select Display Equation on chart. Click "Close."

30 Year Flows Graph:

The yearly flows for the most recent thirty years were graphed. This shows the frequency of dry, average and wet years during the most recent thirty years. Flow is in thousand or million acre-feet.

1. Select last 30 years flow values from the cleaned data.
2. From the Menu tab, click **Insert,** then click **Chart.**
3. Add years as X values to track year by year cells.
4. Work on formatting and editing the graph by clicking on **Layout** and **Format** in the Menu tab. Layout menu will guide you how to add, remove, or position titles, labels and legends.
5. Use different colors in order to distinguish dry, average and wet years. Use 20% assumption table for guide.
6. Highlight the specific data series, then right click and select Format Data Point, select different colors.
7. Use Series Options for formatting.

Comparison of Dry, Average and Wet Flows to Instream Flow Rule Graph:

The weekly average data for the historic flows' driest, most average, and wettest years were plotted against the instream flow rule. This shows when flow rules are met, or not met during the driest, most average and wettest years. Flows are shown in thousands of cubic feet per second.

1. Download instream flow rule at: http://apps.leg.wa.gov/wac/default.aspx?cite=173
2. Select the driest, average and wettest years from the "Flow Exceedance" graph or 20% assumption table

3. Download daily flow values in cfs and convert them to weekly values since the instream flow data are based on weekly data.
4. Use Excel function tools to calculate the deficit/surplus flow by subtracting instream flow values from river flow values.
5. Summarize the deficit and surplus flows by using Excel function tools.
6. Click Insert in the Menu tab, click Chart. Add Years as X axis, and Dry, Average and Wet as Y axis. Highlight the Graph, click on the Plot Area. On the pop-up window, click Select data, add instream flow data in the Legend Entries.
7. Format and edit the graph by clicking on Layout and Format on the Menu tab. Layout menu will guide you how to add, remove, or position titles, labels and legends.

Water Surplus/Deficit Evaluation Graph:

The weekly average data for the historic flows' driest, most average, and wettest years were graphed to show when compared to the instream flow rule whether there is a surplus or deficit of water. Flow is in acre-feet.

1. Click **Insert** in the Menu tab, click **Chart**. Select **Column** as a graph type.
2. Add Years as X axis, and Dry, Average and Wet as Y axis. Highlight the Graph, Click on the Plot Area. On the pop-up window, click **Select data**, add instream flow data in the Legend Entries.
3. Work on formatting and editing the graph by clicking on **Layout** and **Format** in the Menu tab. Layout menu will guide you how to add, remove, or position titles, labels and legends.
4. Add second legend to the graph by clicking **Insert** in the Menu tab. Click **Shapes**, then click **Rectangle.**
5. Highlight the rectangle, right click, Select **Format Shape,** Select **White** color for background.
6. Select Insert, select Text Box.
7. Type Instream Deficit and Instream Surplus information based on the database table.

Comparison of Dry Years Flow to Instream Flow Rule Graph:

The historic flow's dry years were plotted against the instream flow rule. This shows a flow's magnitude when it was above or below the instream flow rule. The graph also shows if and how the hydrograph shifted. Flows are shown in cubic feet per second.

1. Make a separate table for each dry year using the Dry Years Trend and Processed Historic Flow tables.
2. Copy and Past instream flow rule table.
3. Download daily flow values in cfs and convert them to weekly values.
4. Click Insert in the Menu tab, click Chart. Select Line for a chart type. Add Years as X axis, and Dry, Average and Wet as Y axis. Highlight the Graph, click on the Plot Area. On the pop-up window, click Select data, add instream flow data in the Legend Entries.

Highlight the graph, right click, select Change Series Chart Type, on the pop-up window select Column.

5. Format and edit the graph by clicking on Layout and Format on the Menu tab. Layout menu will guide you how to add, remove, or position titles, labels and legends.

Comparison of Wet Years Flow to Instream Flow Rule Graph:

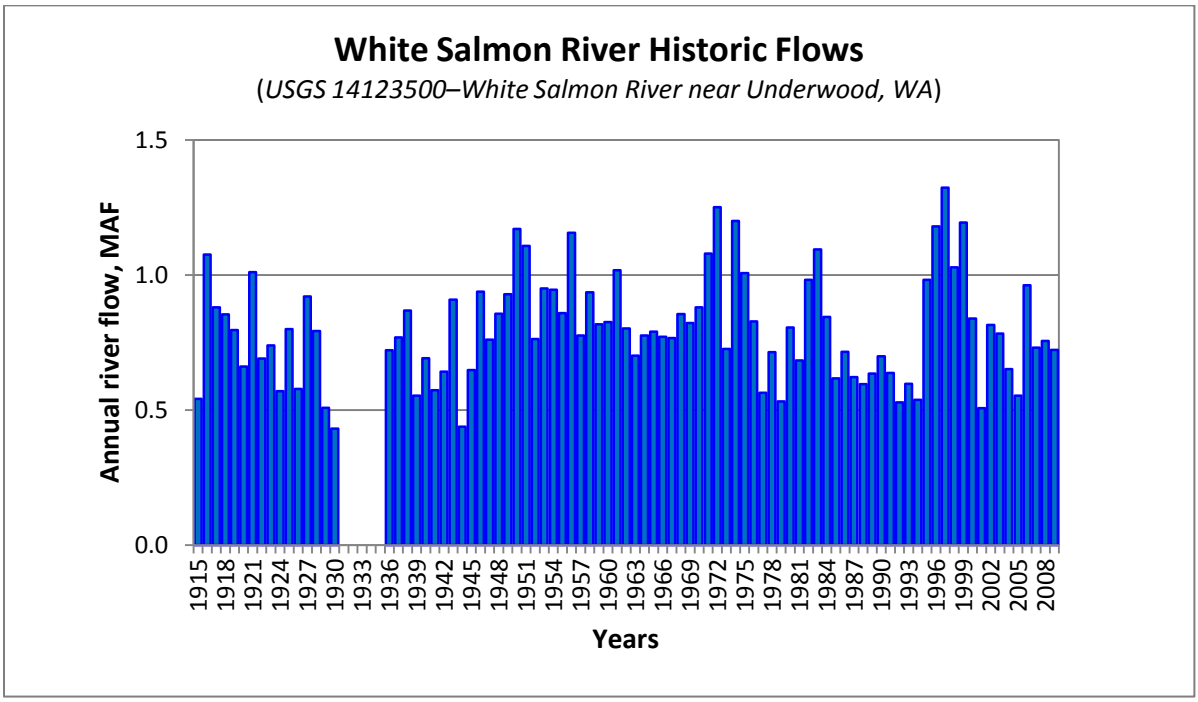
The historic flow's wet years were plotted against the instream flow rule. This shows a flow's magnitude when it was above or below the instream flow rule. The graph also shows if and how the hydrograph shifted. Flows are shown in cubic feet per second.

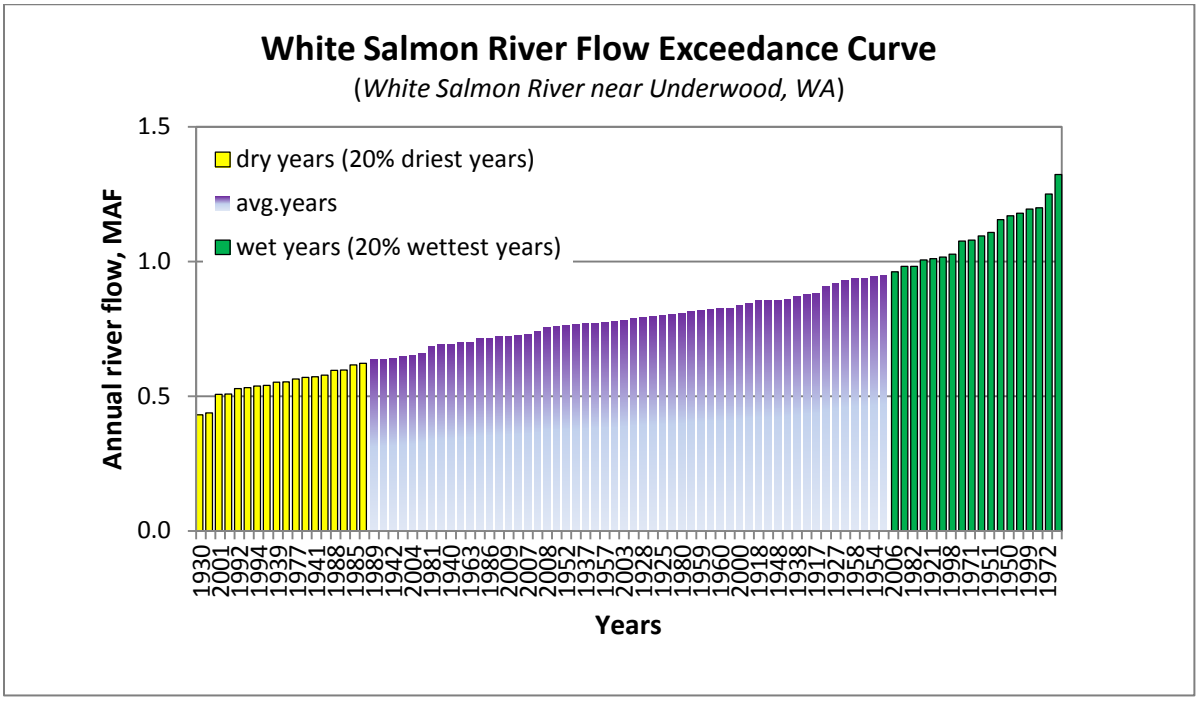
1. Make a separate table for each wet year using 20% assumption table.
2. Copy and paste instream flow rule table.
3. Copy and paste daily flow values in cfs from the Processed Historic Flow table and convert them to weekly values.
4. Click **Insert** in the Menu tab, point to **Chart**. Select **Line** for a chart type. Add Years as X axis, and Dry, Average and Wet as Y axis. Highlight the Graph, click on the Plot Area. On the pop-up window, click **Select data**, add instream flow data in the Legend Entries. Highlight the graph, right click, select **Change Series Chart Type**, and on the pop-up window select **Column.**
5. Format and edit the graph by clicking on **Layout** and **Format** on the Menu tab. Layout menu will guide you how to add, remove, or position titles, labels and legends.

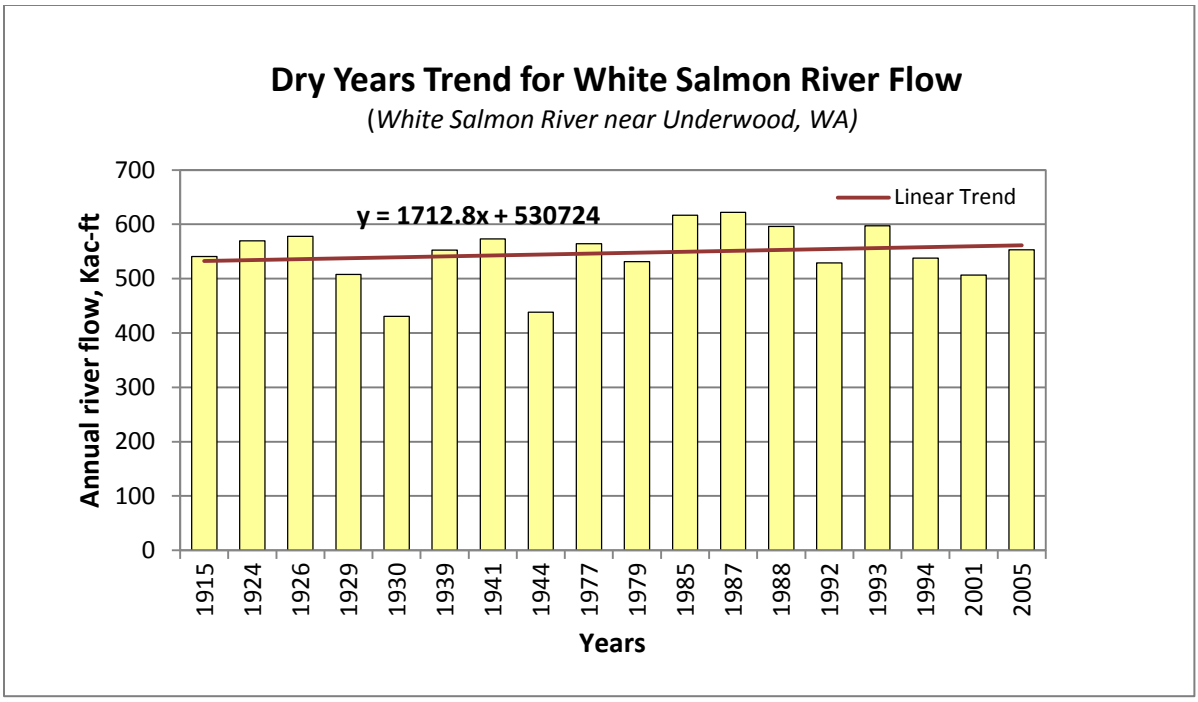
Historic Stream Flow Data by WRIA

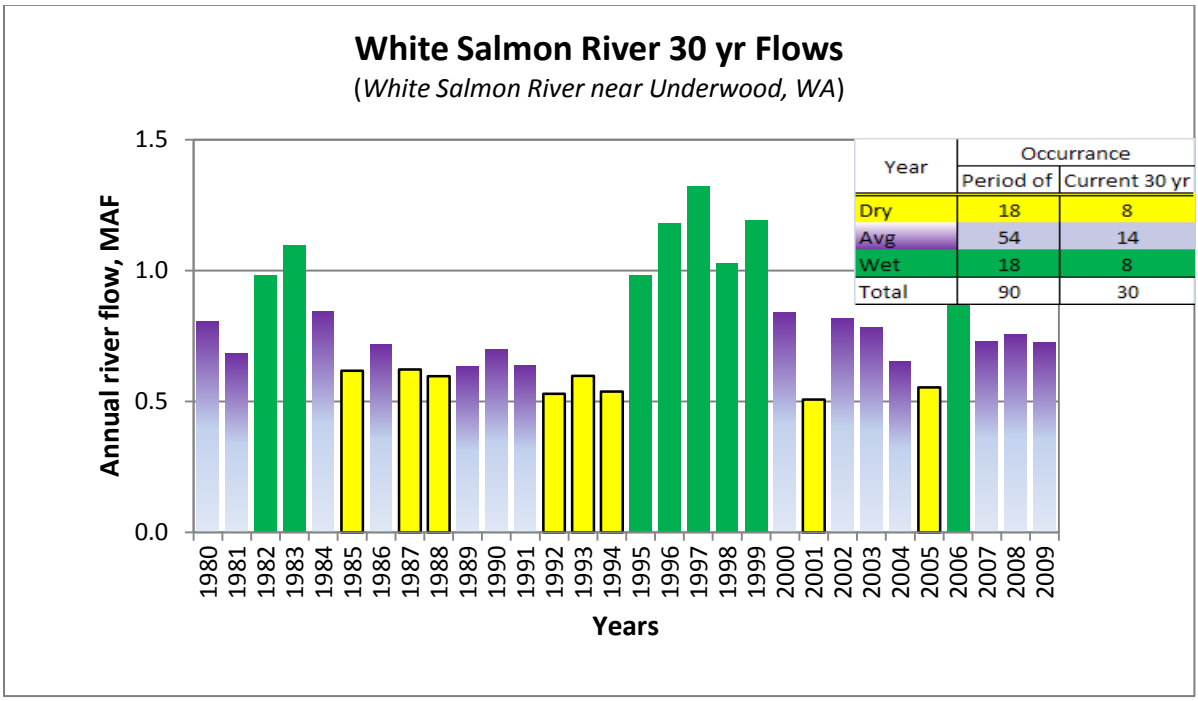
WRIA 29 (Wind-White Salmon) D-8
WRIA 30 (Klickitat) D-12
WRIA 31 (Rock-Glade) D-15
WRIA 32 (Walla Walla) D-18
WRIA 33 (Lower Snake) D-35
WRIA 34 (Palouse) D-39
WRIA 35 (Middle Snake) D-46
WRIA 36 (Esquatzel Coulee) D-53
WRIA 37 (Lower Yakima) D-56
WRIA 38 (Naches) D-67
WRIA 39 (Upper Yakima) D-71
WRIA 41 (Lower Crab) D-75
WRIA 42 (Grand Coulee) D-82
WRIA 43 (Upper Crab-Wilson) D-85
WRIA 45 (Wenatchee) D-89
WRIA 46 (Entiat) D-121
WRIA 47 (Chelan) D-133
WRIA 48 (Methow) D-143
WRIA 49 (Okanogan) D-161
WRIA 52 (Sanpoil) D-176
WRIA 54 (Lower Spokane) D-178
WRIA 55 (Little Spokane) D-186
WRIA 56 (Hangman) D-196
WRIA 57 (Middle Spokane) D-201
WRIA 59 (Colville) D-207
WRIA 60 (Kettle) D-214
WRIA 62 (Pend Oreille) D-218

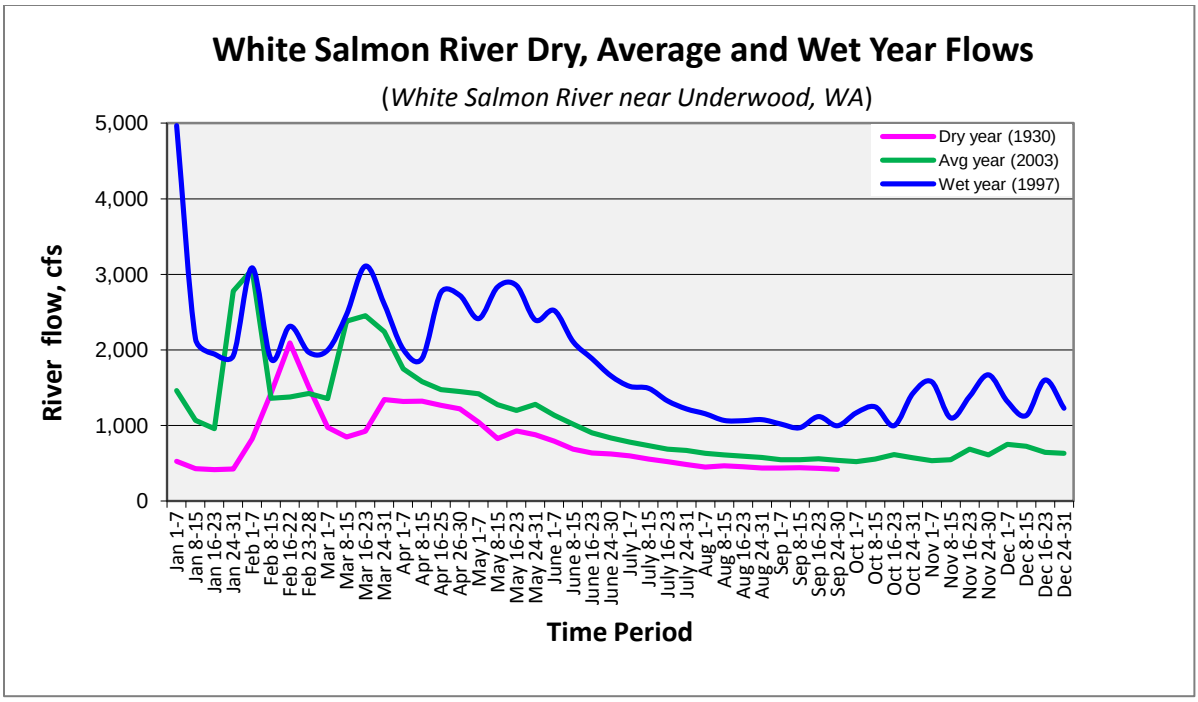
WRIA 29 (Wind-White Salmon)

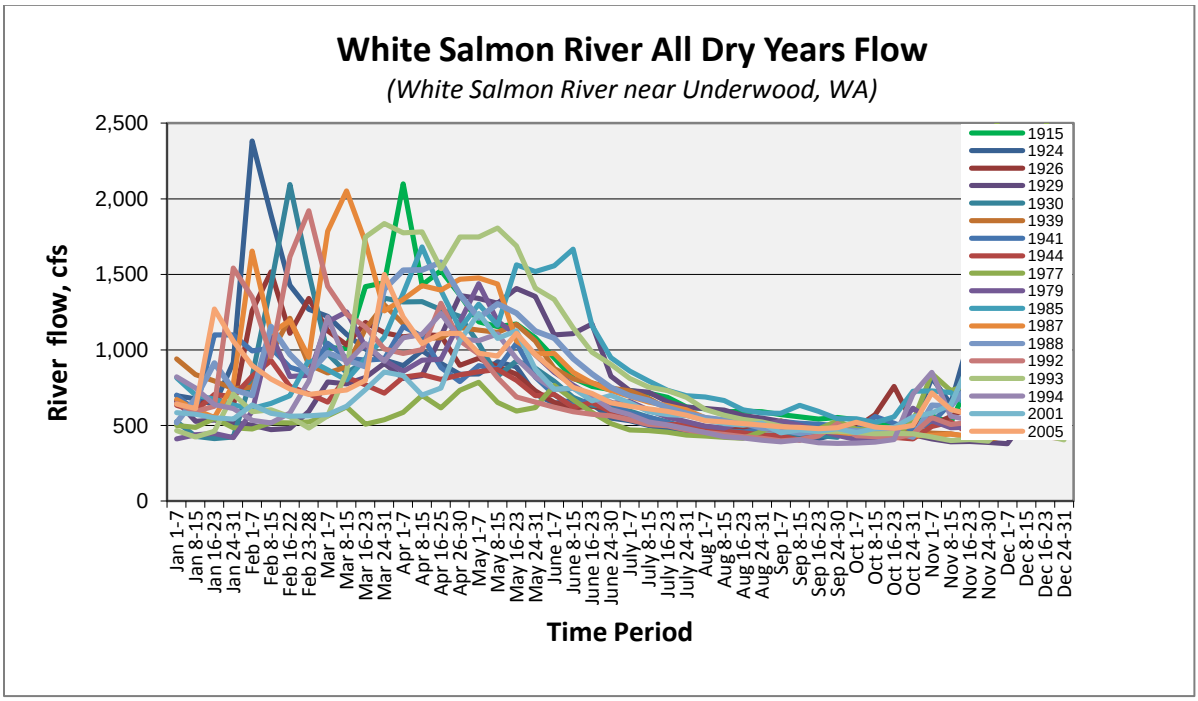


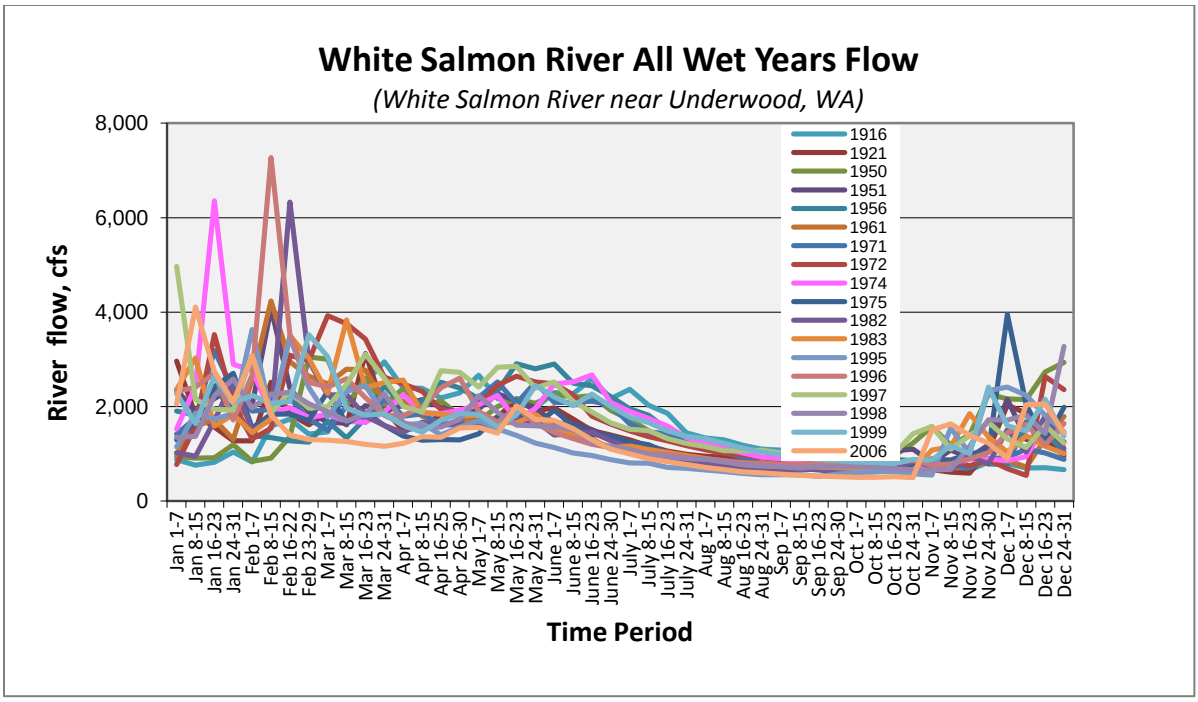



Dry Years Trend for White Salmon River Flow
(White Salmon River near Underwood, WA)
y = 1712.8x + 530724
Linear Trend
Annual river flow, Kac-ft
700
600
500
400
300
200
100
0
1915
1924
1926
1929
1930
1939
1941
1944
1977
1979
1985
1987
1988
1992
1993
1994
2001
2005
Years

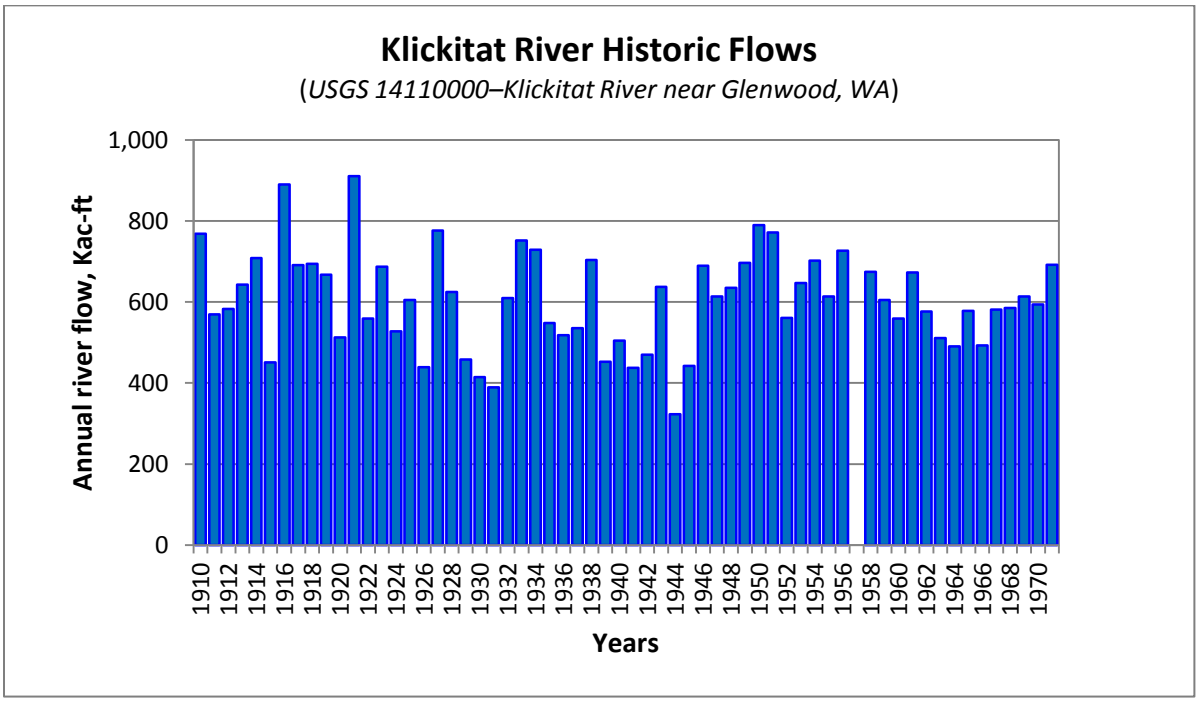

White Salmon River 30 yr Flows
(White Salmon River near Underwood, WA)
Annual river flow, MAF
1.5
1.0
0.5
0.0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 18 8
Avg 54 14
Wet 18 8
Total 90 30

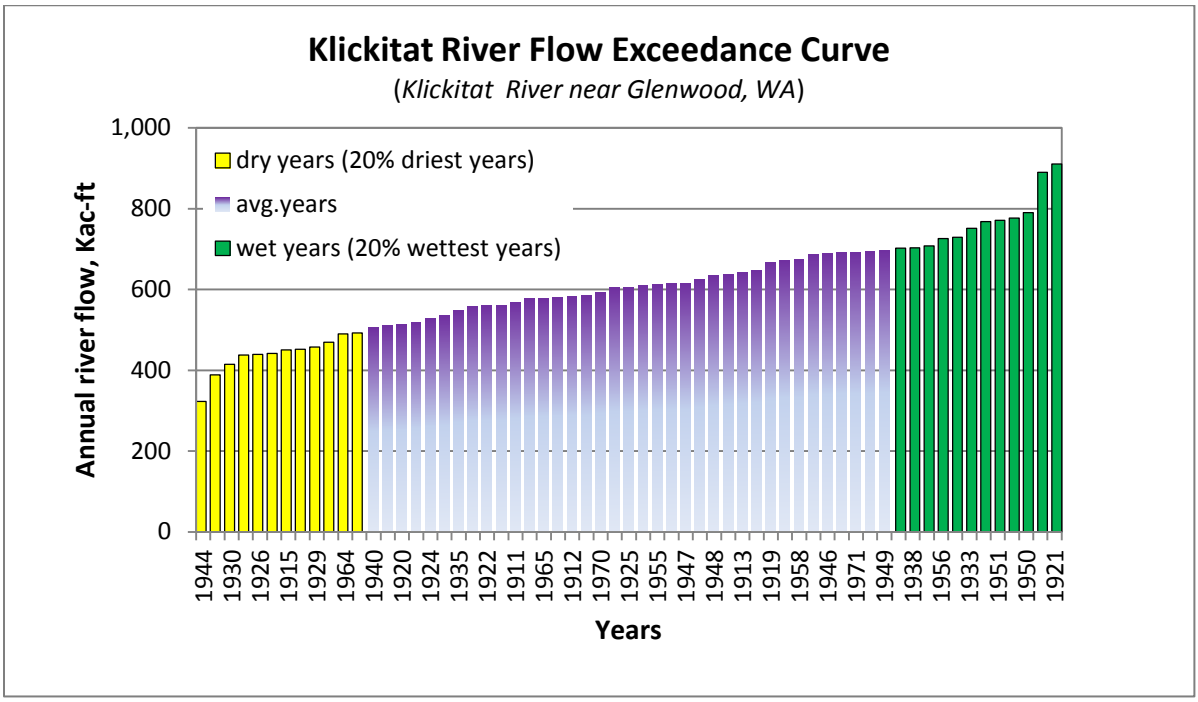

White Salmon River Dry, Average and Wet Year Flows
(White Salmon River near Underwood, WA)
River flow, cfs
5,000
4,000
3,000
2,000
1,000
0
Dry year (1930)
Avg year (2003)
Wet year (1997)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

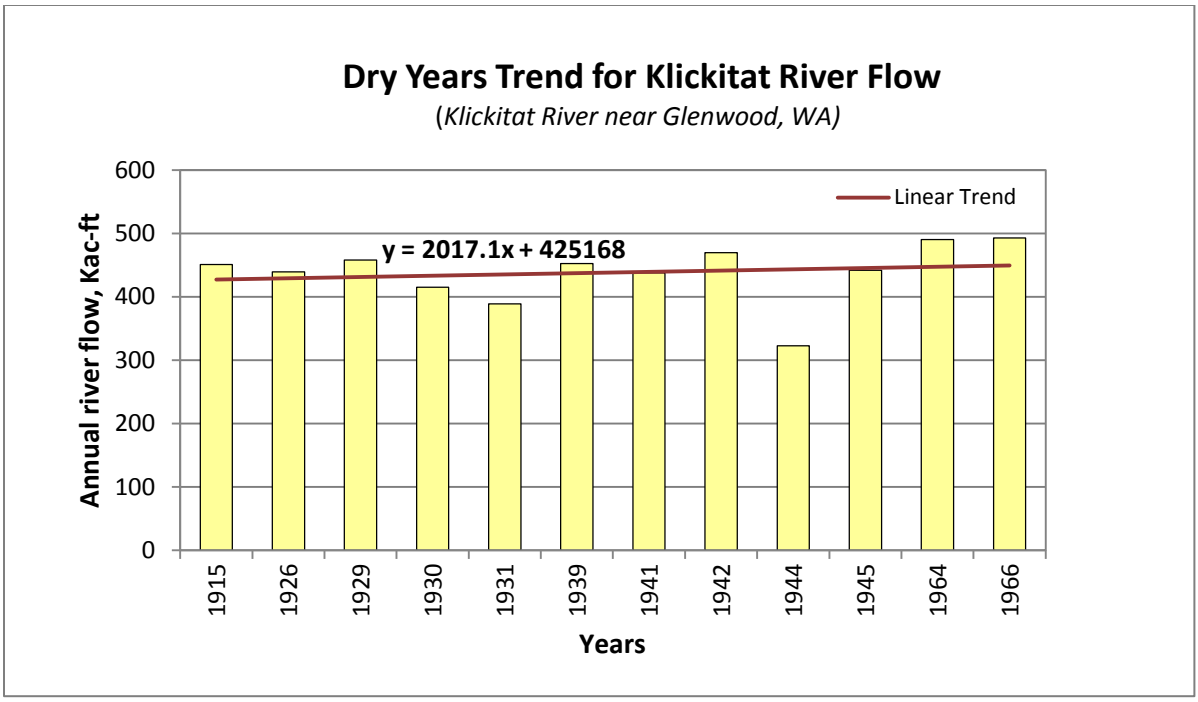

White Salmon River All Dry Years Flow
(White Salmon River near Underwood, WA)
River flow, cfs
2,500
2,000
1,500
1,000
500
0
1915
1924
1926
1929
1930
1939
1941
1944
1977
1979
1985
1987
1988
1992
1993
1994
2001
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

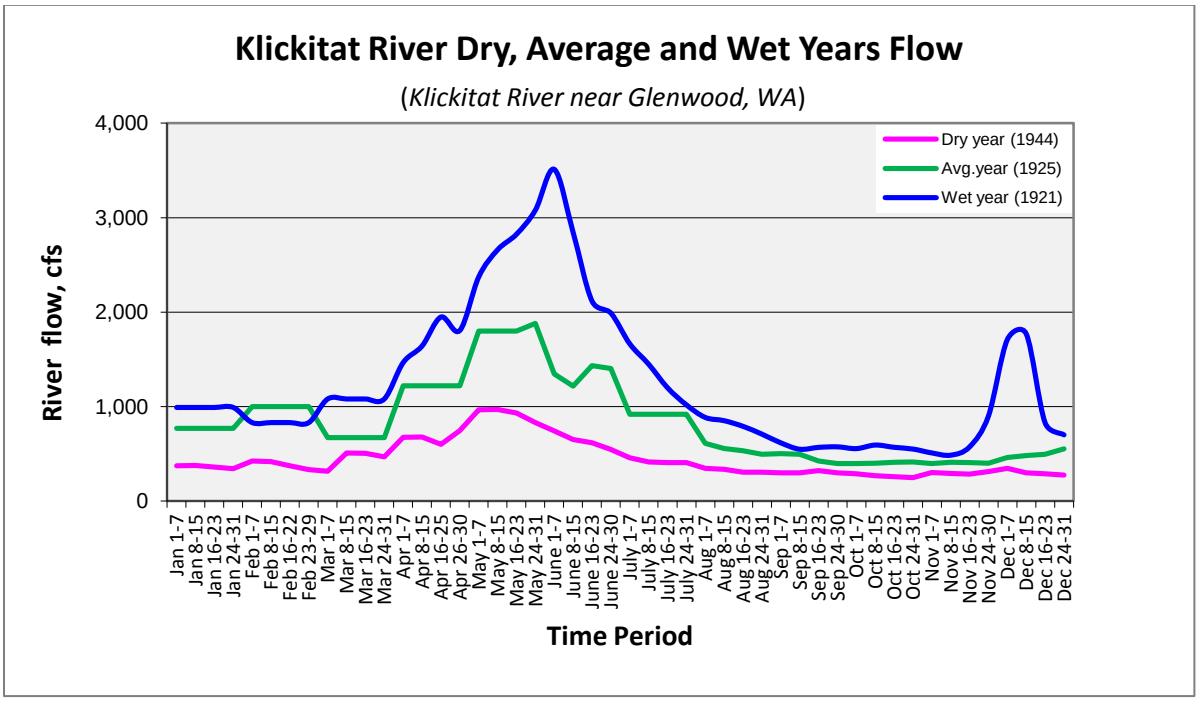

White Salmon River All Wet Years Flow
(White Salmon River near Underwood, WA)
River flow, cfs
8,000
6,000
4,000
2,000
0
1916
1921
1950
1951
1956
1961
1971
1972
1974
1975
1982
1983
1995
1996
1997
1998
1999
2006
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

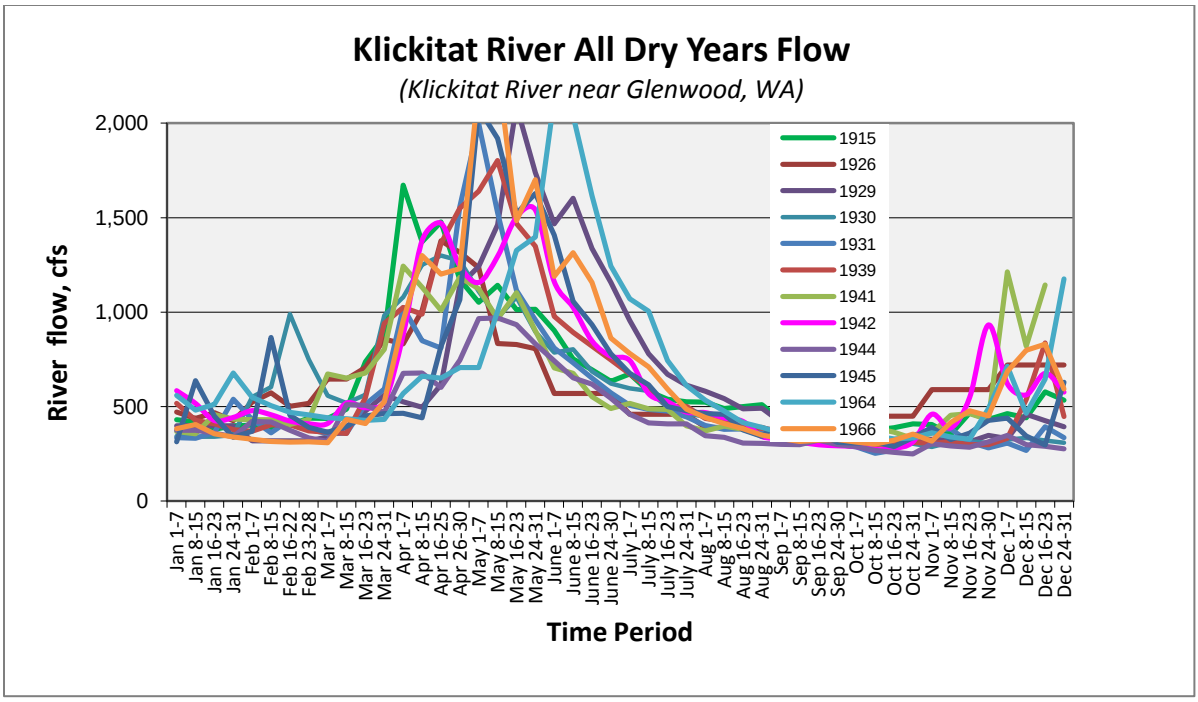
WRIA 30 (Klickitat)






Dry Years Trend for Klickitat River Flow
(Klickitat River near Glenwood, WA)
Linear Trend
y = 2017.1x + 425168
Annual river flow, Kac-ft
600
500
400
300
200
100
0
1915
1926
1929
1930
1931
1939
1941
1942
1944
1945
1964
1966
Years


Klickitat River Dry, Average and Wet Years Flow
(Klickitat River near Glenwood, WA)
Dry year (1944)
Avg.year (1925)
Wet year (1921)
River flow, cfs
4,000
3,000
2,000
1,000
0
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Klickitat River All Dry Years Flow
(Klickitat River near Glenwood, WA)
River flow, cfs
2,000
1,500
1,000
500
0
1915
1926
1929
1930
1931
1939
1941
1942
1944
1945
1964
1966
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
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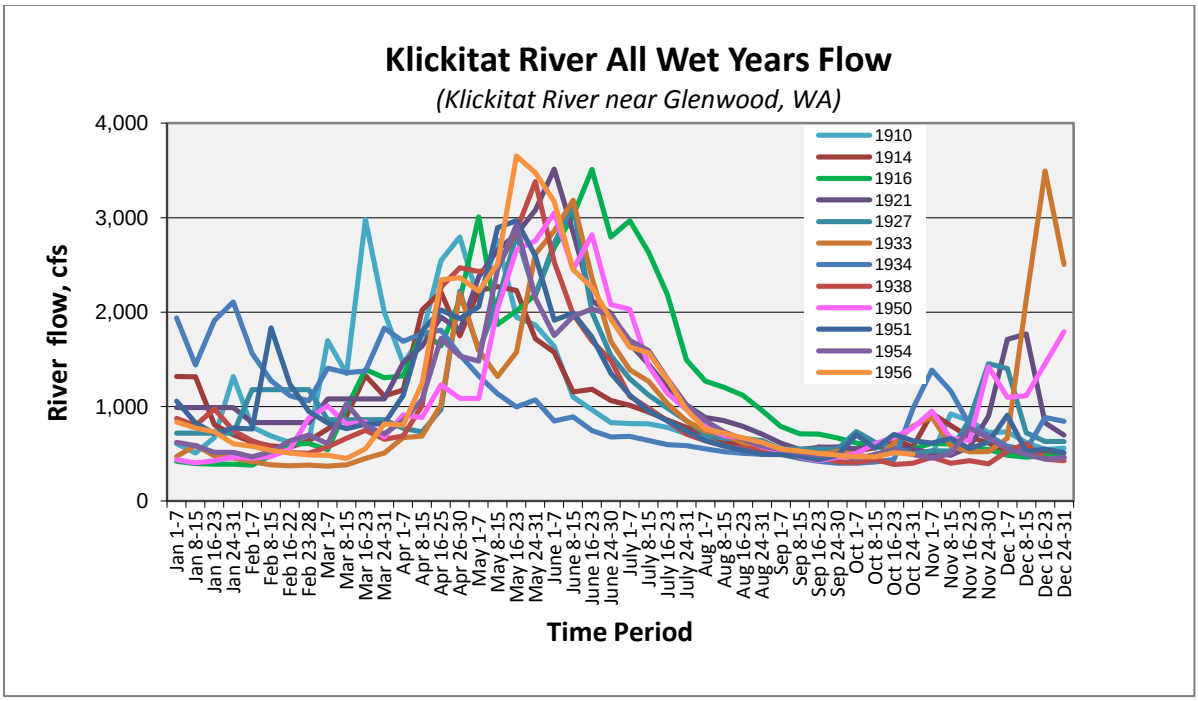
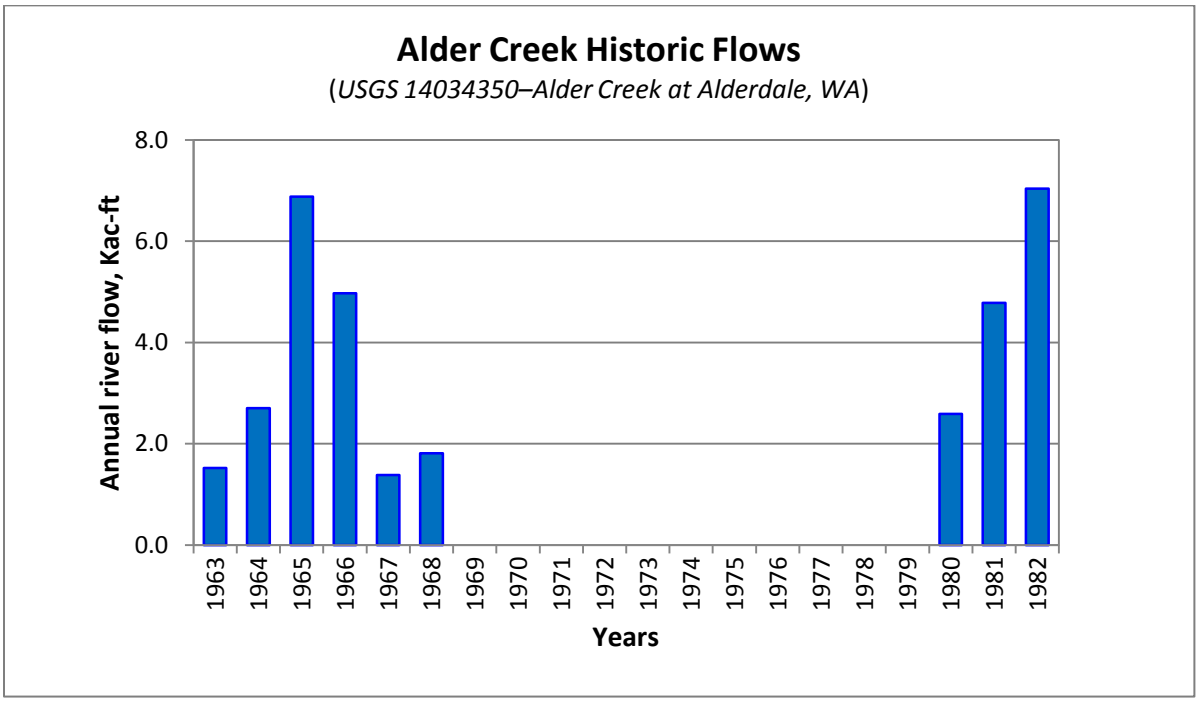
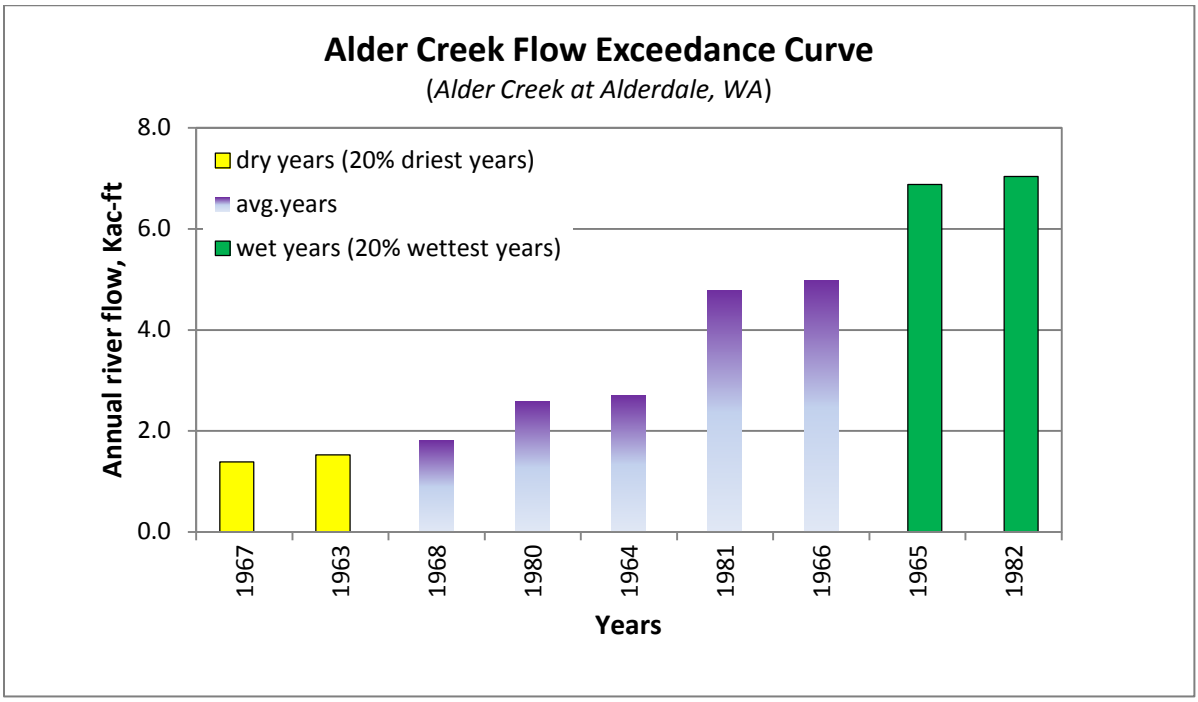
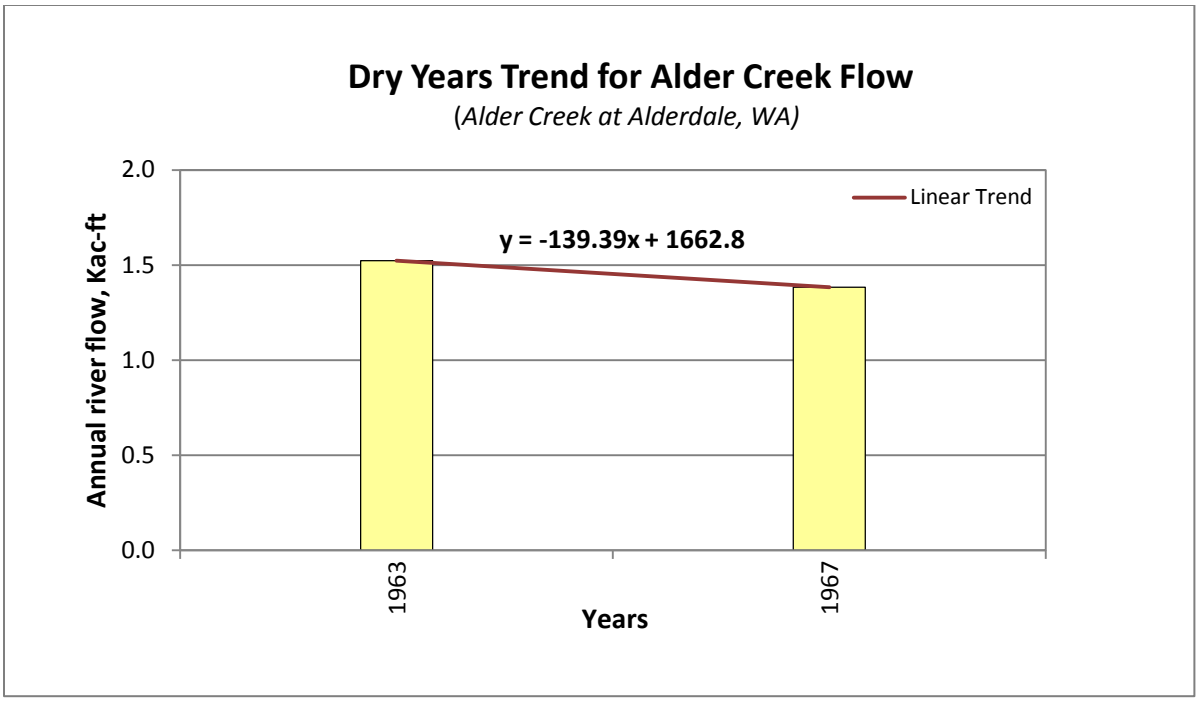
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

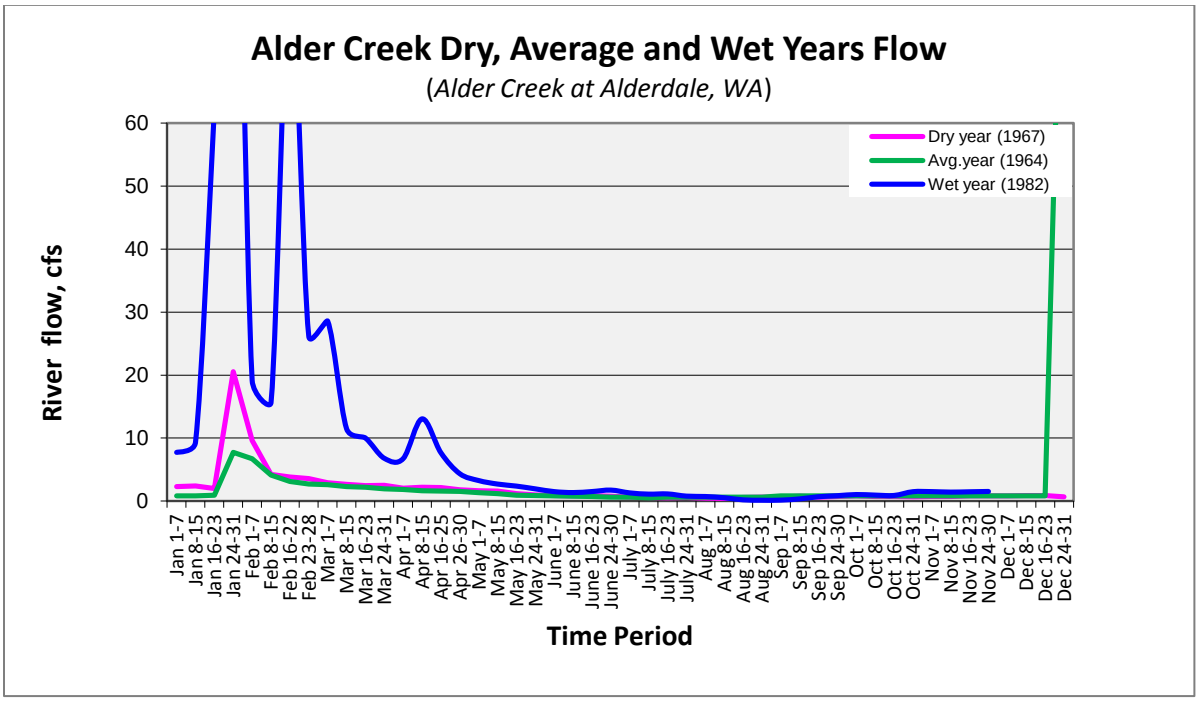

Klickitat River All Wet Years Flow
(Klickitat River near Glenwood, WA)
River flow, cfs
4,000
3,000
2,000
1,000
0
1910
1914
1916
1921
1927
1933
1934
1938
1950
1951
1954
1956
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

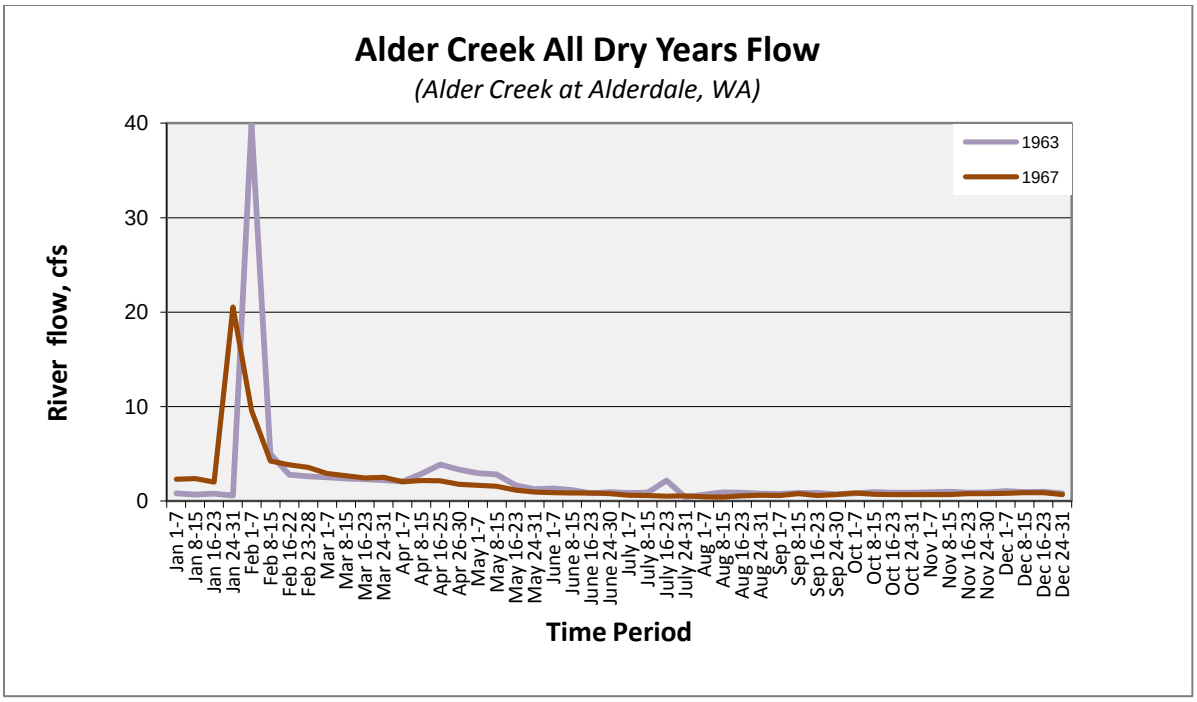
WRIA 31 (Rock-Glade)

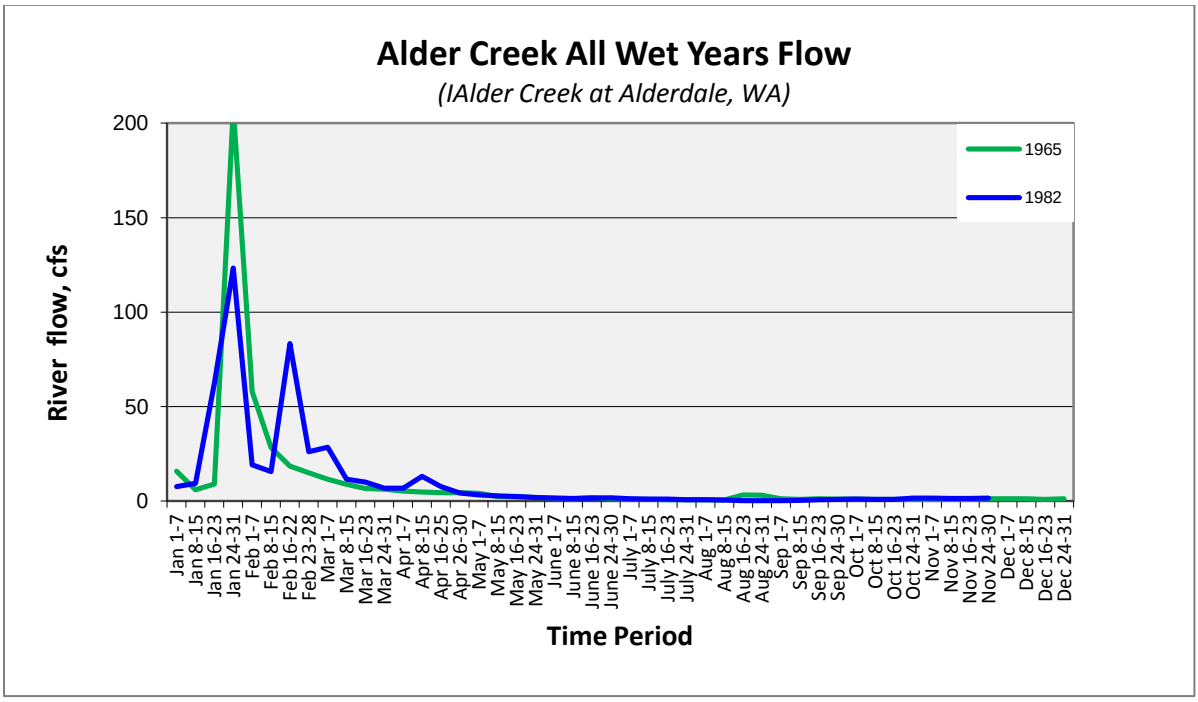





Dry Years Trend for Alder Creek Flow
(Alder Creek at Alderdale, WA)
Linear Trend
y = -139.39x + 1662.8
Annual river flow, Kac-ft
2.0
1.5
1.0
0.5
0.0
1963
1967
Years


Alder Creek Dry, Average and Wet Years Flow
(Alder Creek at Alderdale, WA)
Dry year (1967)
Avg.year (1964)
Wet year (1982)
River flow, cfs
60
50
40
30
20
10
0
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Alder Creek All Dry Years Flow
(Alder Creek at Alderdale, WA)
River flow, cfs
40
30
20
10
0
1963
1967
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

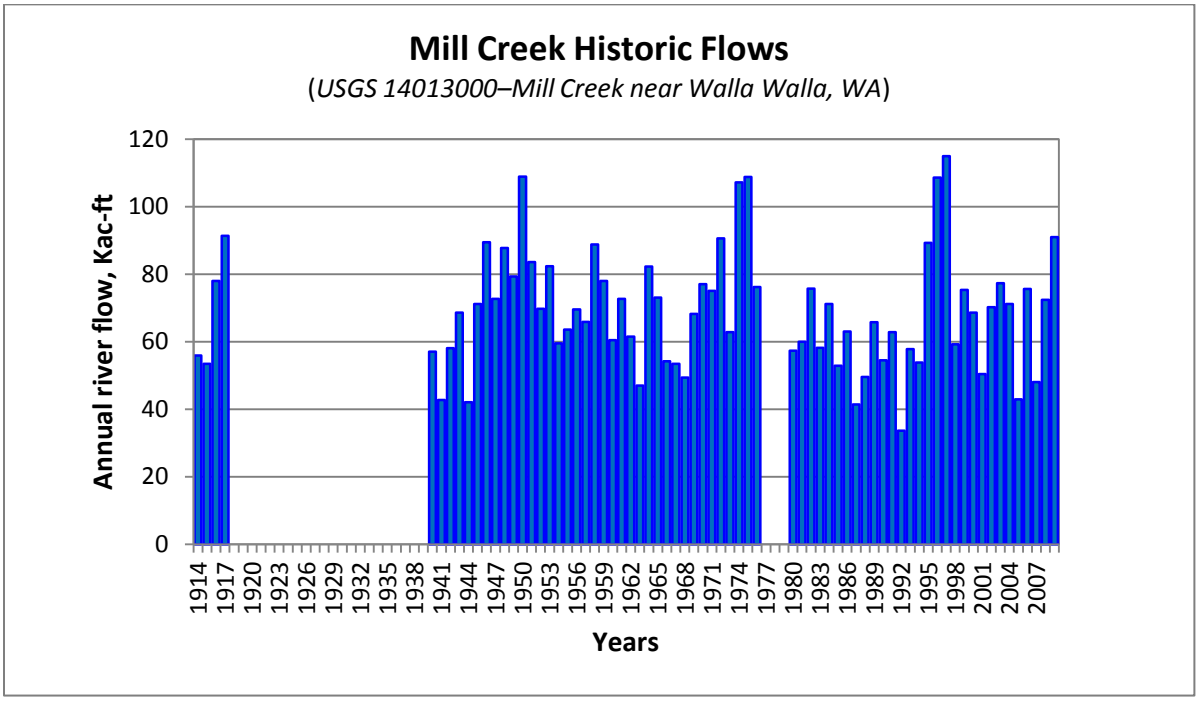

Alder Creek All Wet Years Flow
(IAlder Creek at Alderdale, WA)
River flow, cfs
200
150
100
50
0
1965
1982
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

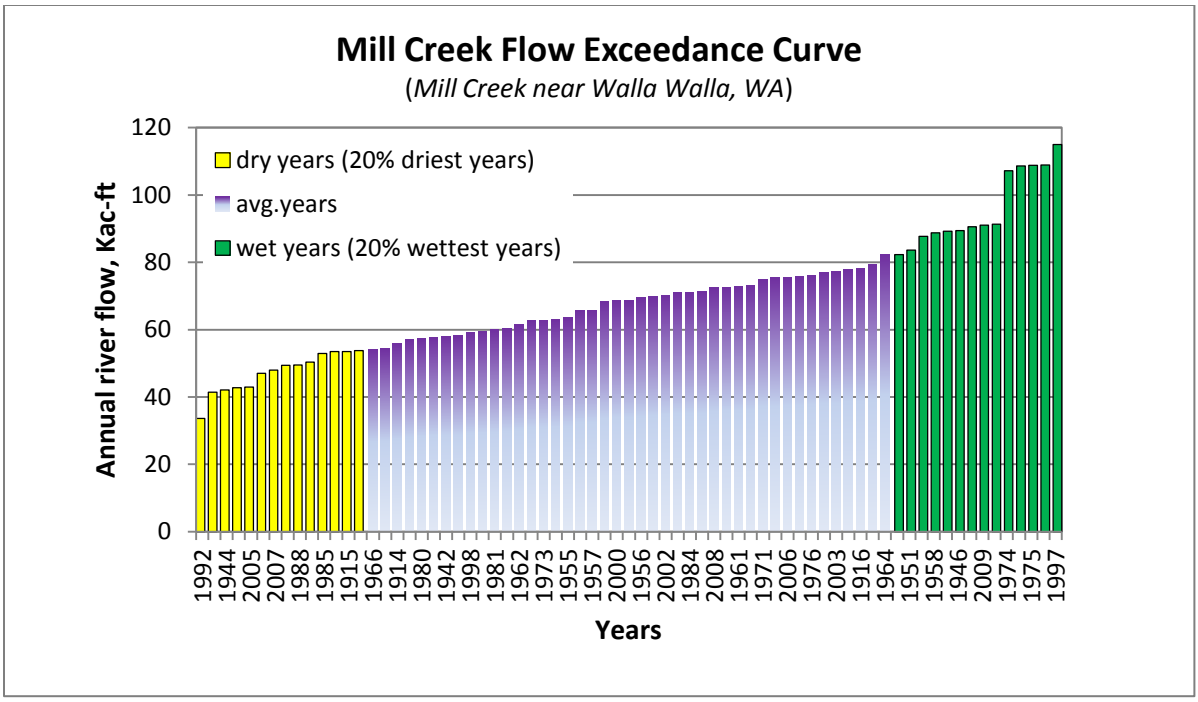
WRIA 32 (Walla Walla)

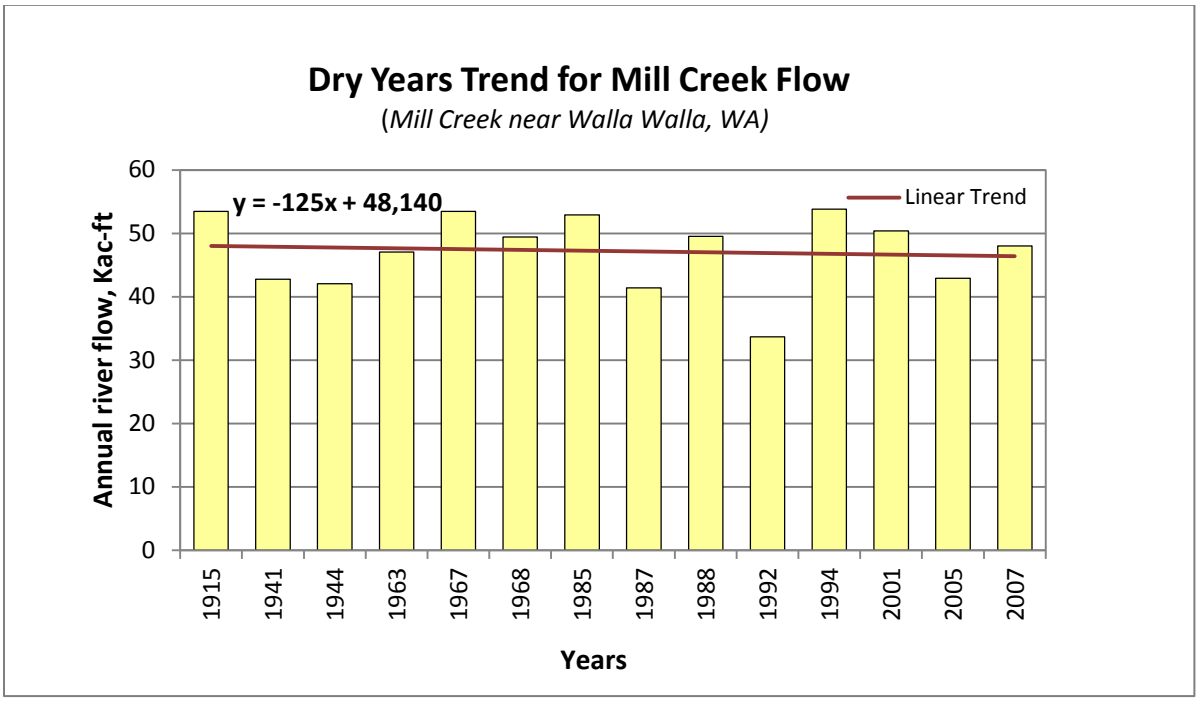
For WRIA 32, OCR graphed the flows of 6 rivers and streams. For most rivers and streams, a series of six to eight graphs were created. The results provide information on historic flow levels and drought occurrences. These data contribute to OCR's understanding of historic trends, drought patterns and hydrograph variability. For example, by graphing the 58 year (1952-2009) flows of the Walla Walla River near Touchet, gauge number 14018500, it is shown that:

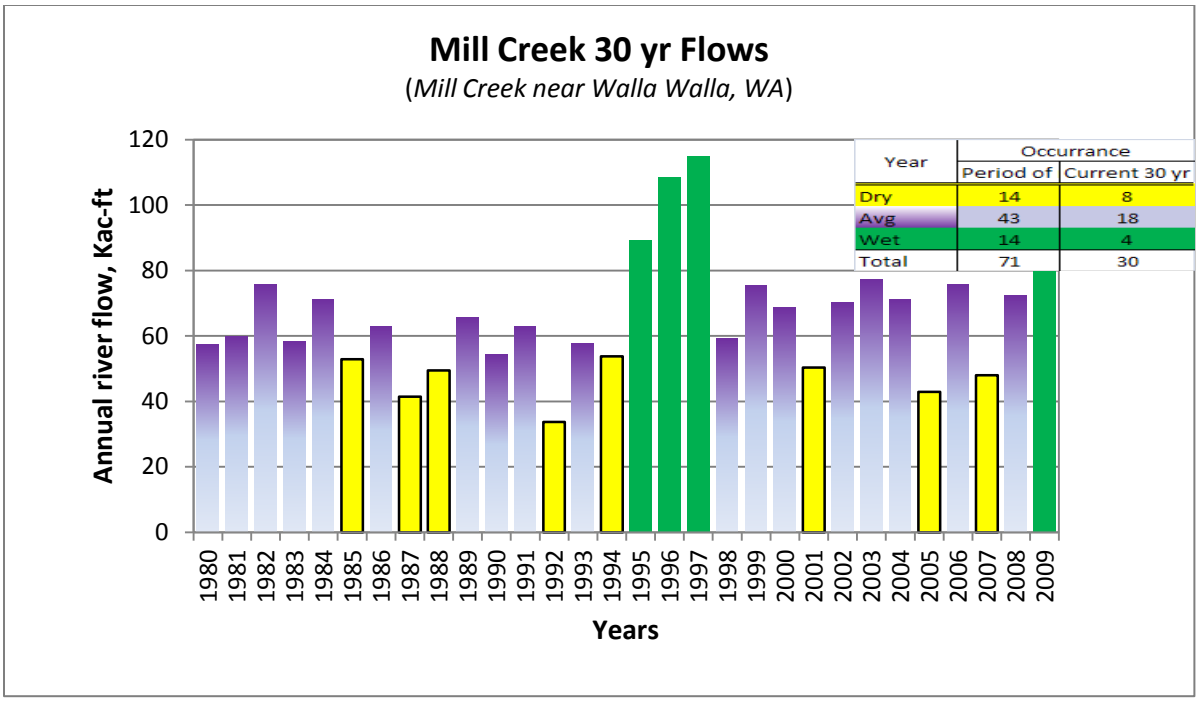
- Historic mean annual flows generally varied between 0.2 and 0.7 million acre-feet (MAF).
- Ecology defined "dry" years as the 80% exceedance value (80% of the time more water was available). Over the last 30 years, dry years occurred 7 times, with the worst stretch being 2 consecutive dry years in 1987-1988. During this same time period, the availability of water during dry years worsened by 5 %.

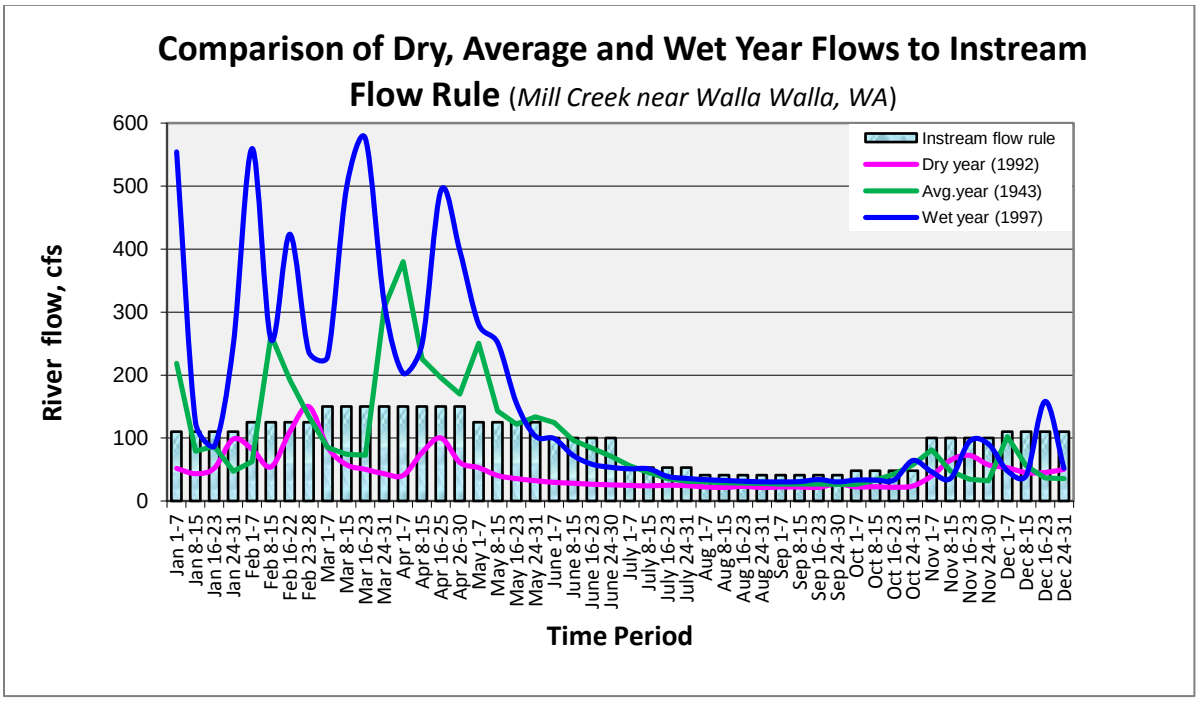
OCR can use this information to recognize where water is needed, when water is available and whether or not the in-basin or out-of-basin water supply development can help meet the WRIA's water demands.

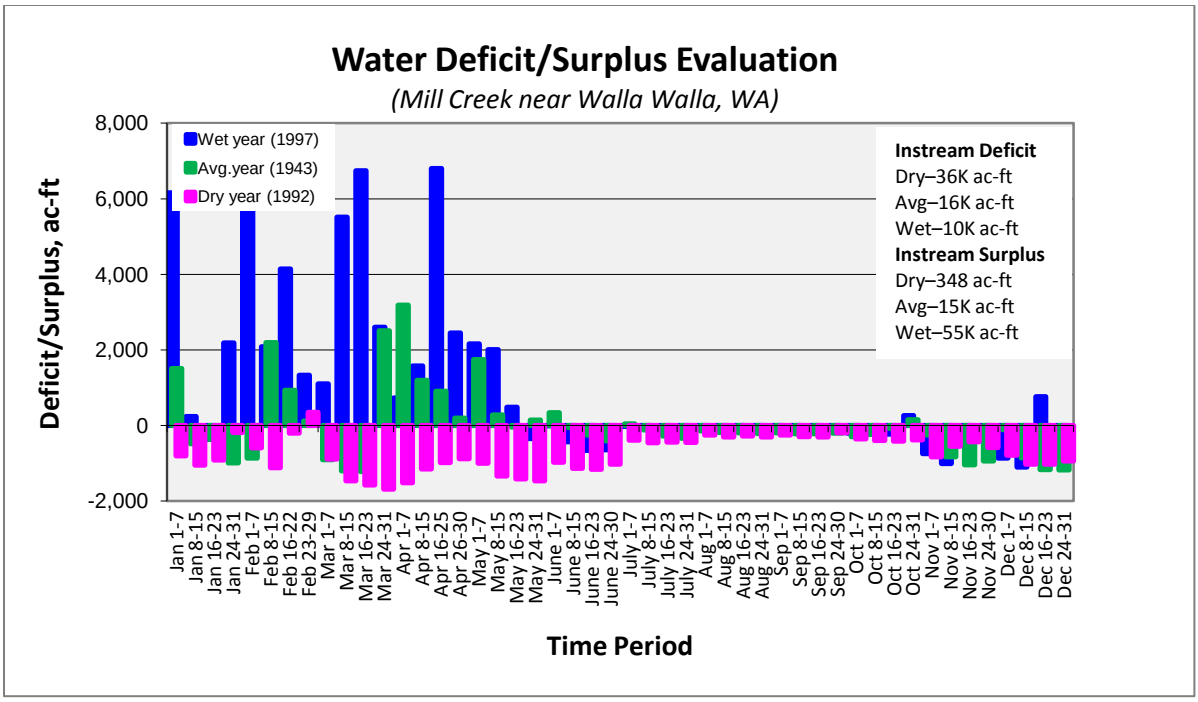


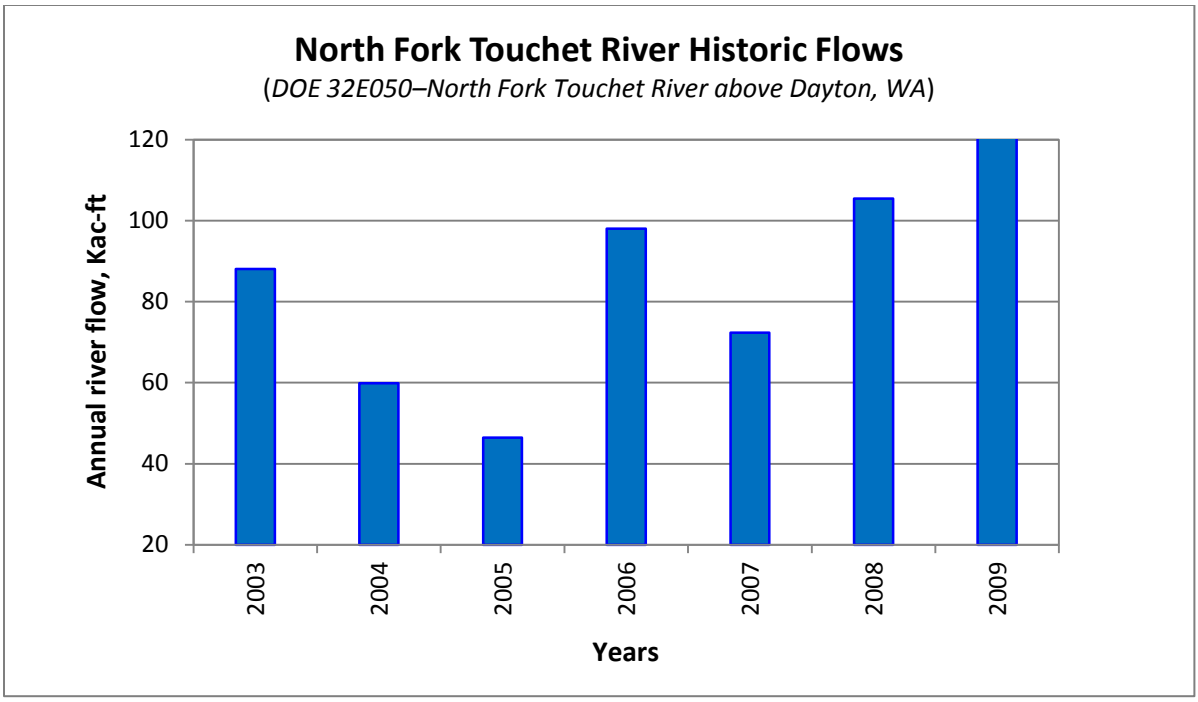

Mill Creek Flow Exceedance Curve
(Mill Creek near Walla Walla, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, Kac-ft
120
100
80
60
40
20
0
1992 1944 2005 2007 1988 1985 1915 1966 1914 1980 1942 1998 1981 1962 1973 1955 1957 2000 1956 2002 1984 2008 1961 1971 2006 1976 2003 1916 1964 1951 1958 1946 2009 1974 1975 1997
Years

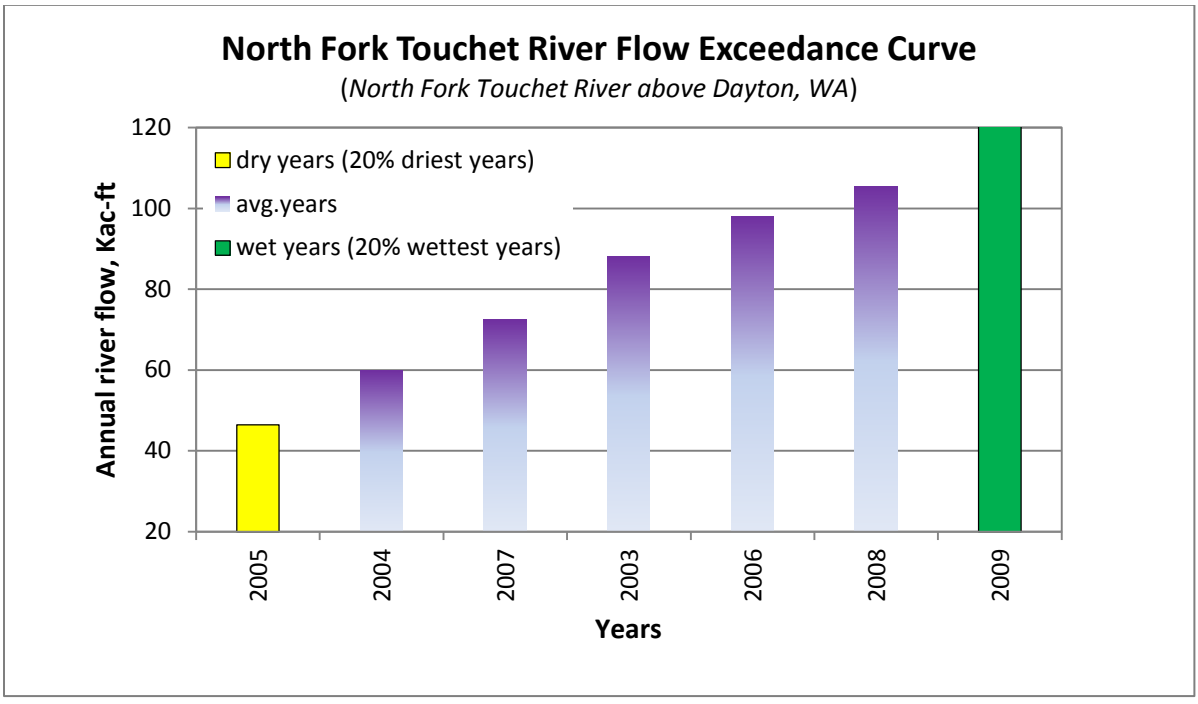

Dry Years Trend for Mill Creek Flow
(Mill Creek near Walla Walla, WA)
y = -125x + 48,140
Linear Trend
Annual river flow, Kac-ft
60
50
40
30
20
10
0
1915 1941 1944 1963 1967 1968 1985 1987 1988 1992 1994 2001 2005 2007
Years

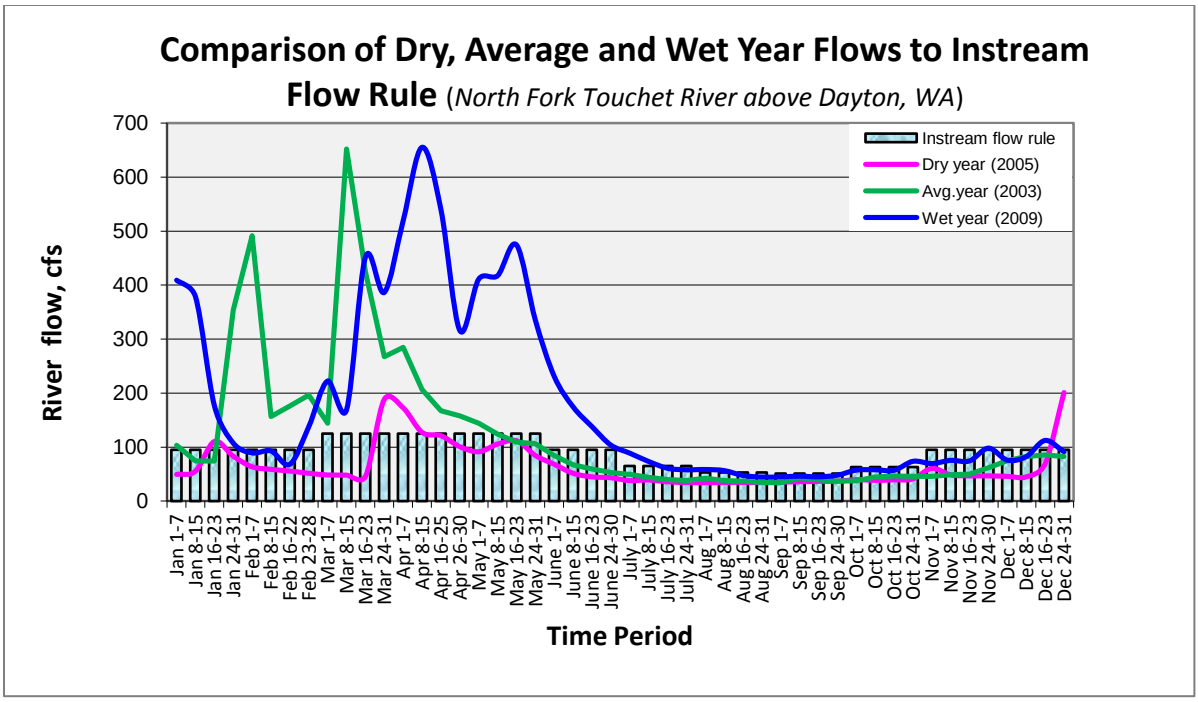

Mill Creek 30 yr Flows
(Mill Creek near Walla Walla, WA)
Annual river flow, Kac-ft
120
100
80
60
40
20
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry
14
8
Avg
43
18
Wet
14
4
Total
71
30

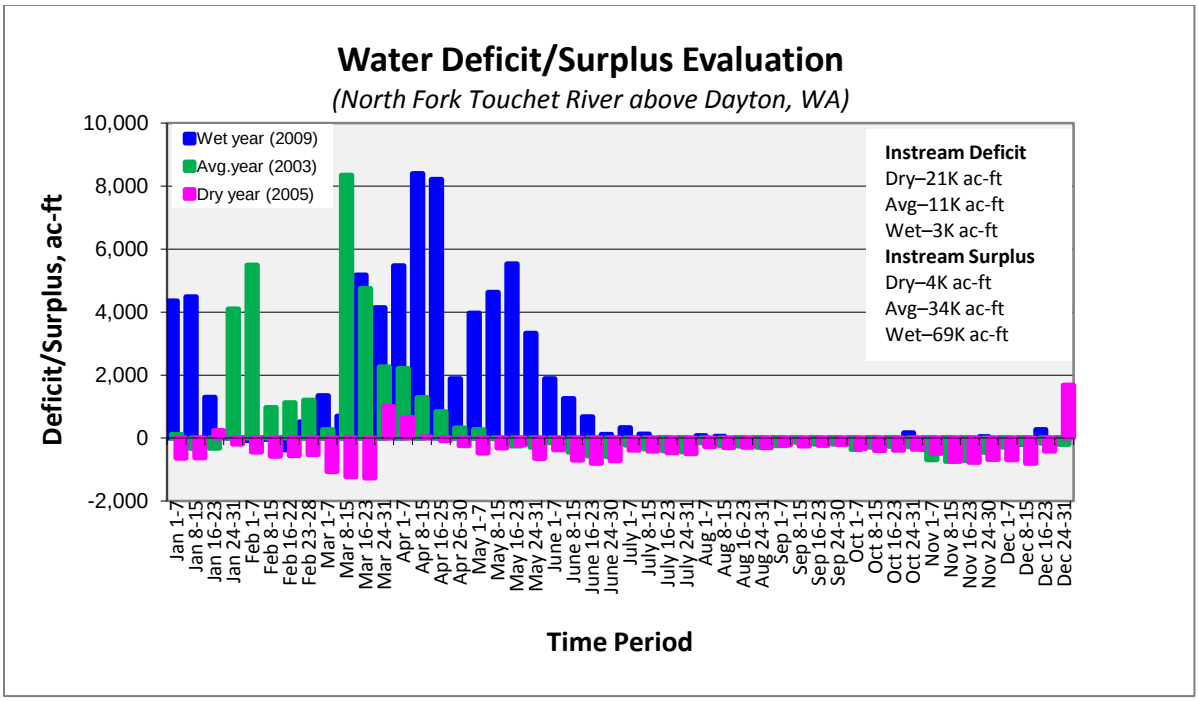

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Mill Creek near Walla Walla, WA)
River flow, cfs
600
500
400
300
200
100
0
Instream flow rule
Dry year (1992)
Avg.year (1943)
Wet year (1997)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

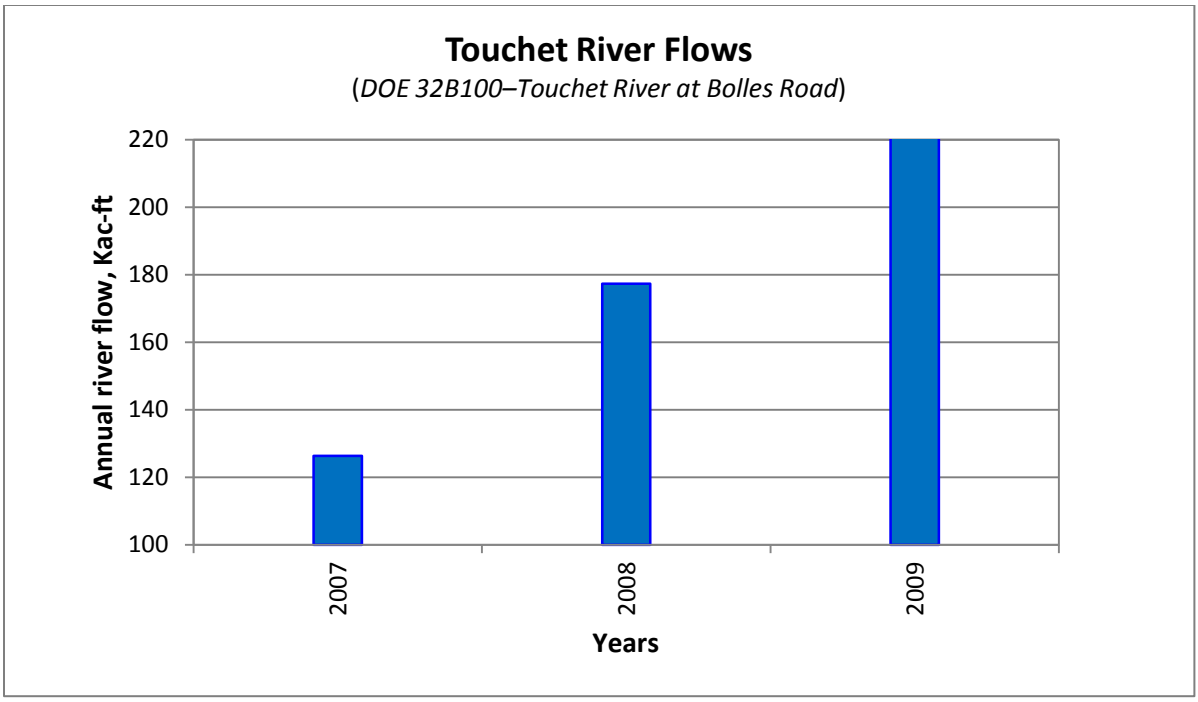

Water Deficit/Surplus Evaluation
(Mill Creek near Walla Walla, WA)
Deficit/Surplus, ac-ft
8,000
6,000
4,000
2,000
0
-2,000
Wet year (1997)
Avg.year (1943)
Dry year (1992)
Instream Deficit
Dry–36K ac-ft
Avg–16K ac-ft
Wet–10K ac-ft
Instream Surplus
Dry–348 ac-ft
Avg–15K ac-ft
Wet–55K ac-ft
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

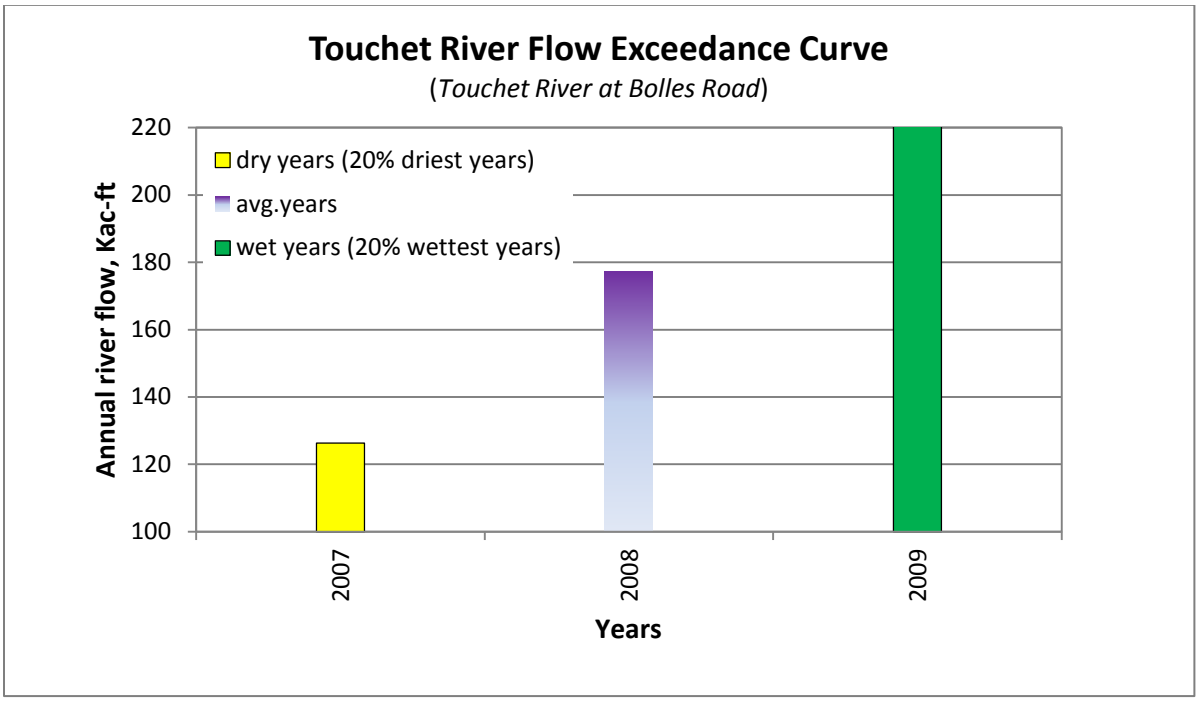

North Fork Touchet River Historic Flows
(DOE 32E050–North Fork Touchet River above Dayton, WA)
Annual river flow, Kac-ft
120
100
80
60
40
20
2003
2004
2005
2006
2007
2008
2009
Years

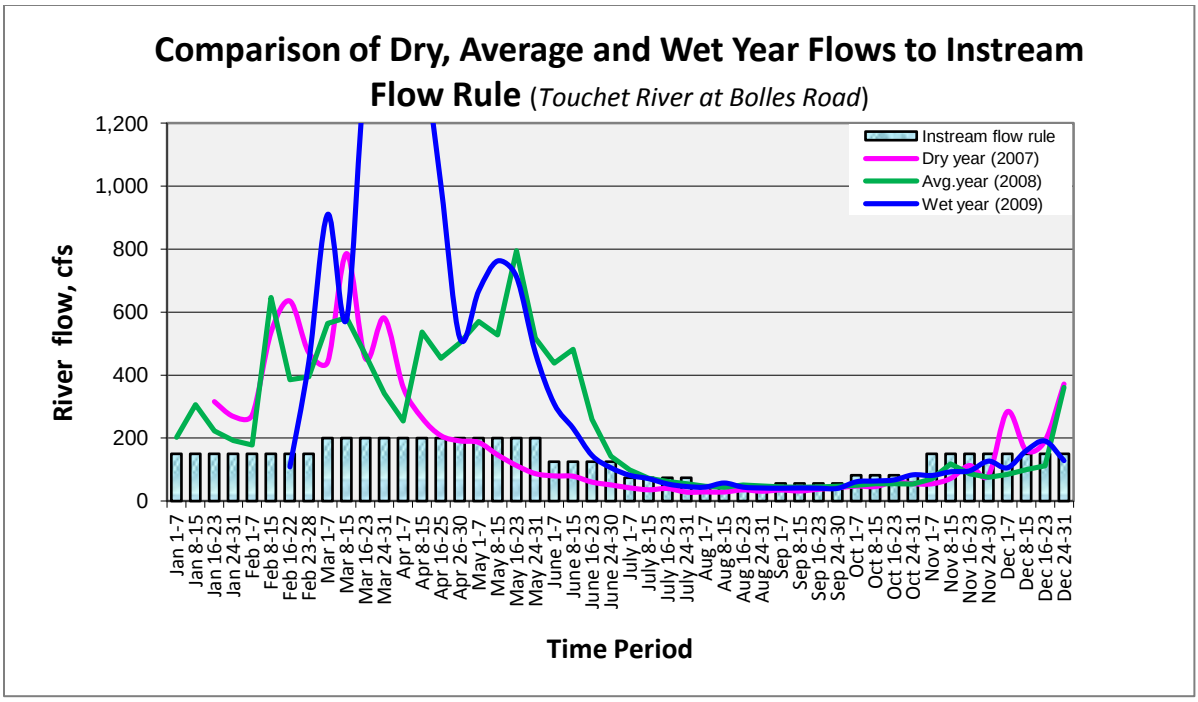

North Fork Touchet River Flow Exceedance Curve
(North Fork Touchet River above Dayton, WA)
Annual river flow, Kac-ft
120
100
80
60
40
20
dry years (20% driest years)
avg.years
wet years (20% wettest years)
2005
2004
2007
2003
2006
2008
2009
Years

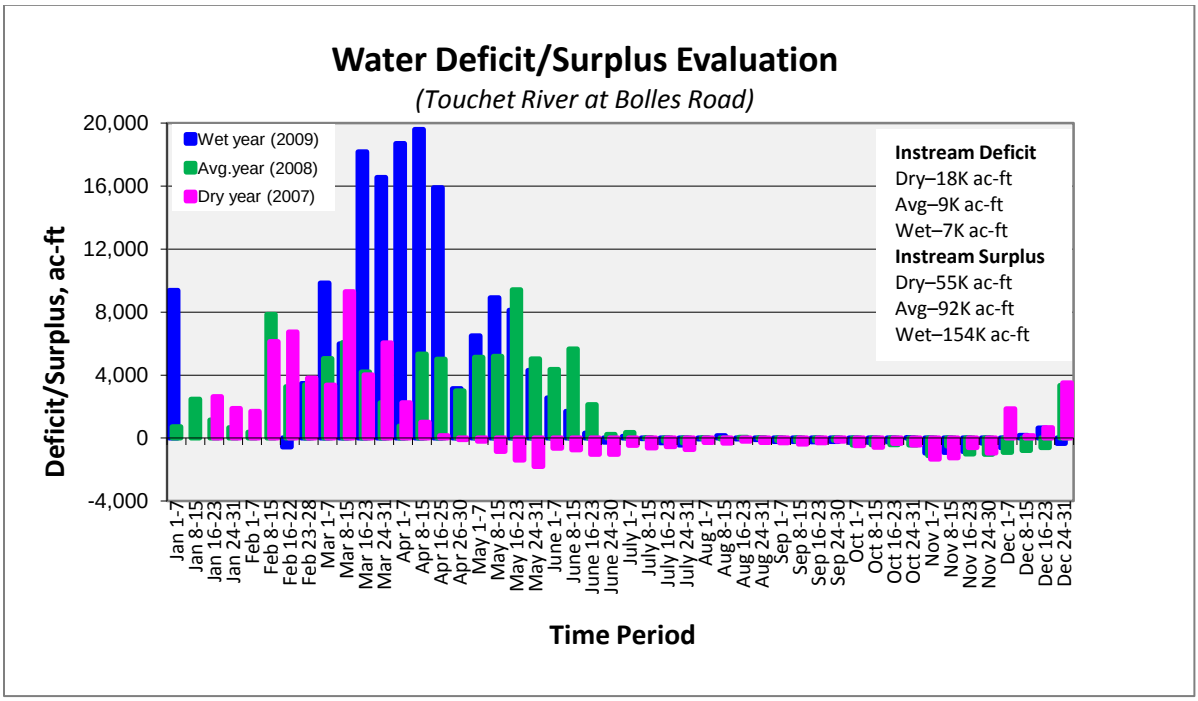

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (North Fork Touchet River above Dayton, WA)
River flow, cfs
700
600
500
400
300
200
100
0
Instream flow rule
Dry year (2005)
Avg.year (2003)
Wet year (2009)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

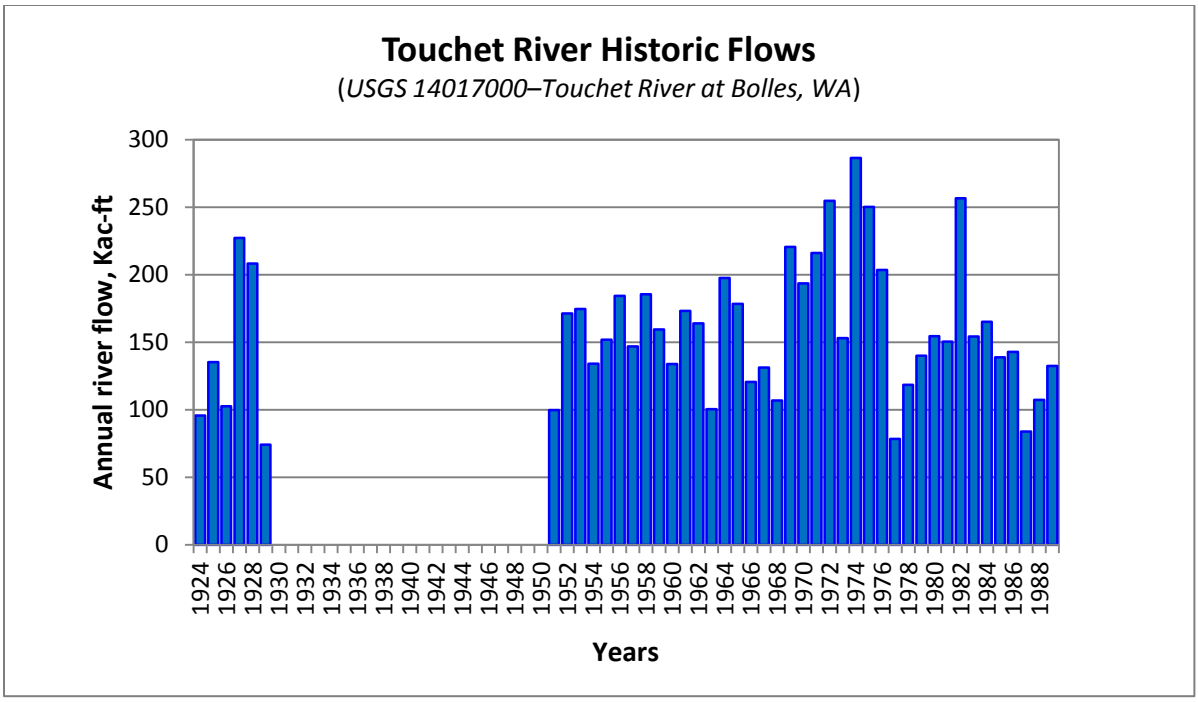

Water Deficit/Surplus Evaluation
(North Fork Touchet River above Dayton, WA)
Deficit/Surplus, ac-ft
10,000
8,000
6,000
4,000
2,000
0
-2,000
Wet year (2009)
Avg.year (2003)
Dry year (2005)
Instream Deficit
Dry–21K ac-ft
Avg–11K ac-ft
Wet–3K ac-ft
Instream Surplus
Dry–4K ac-ft
Avg–34K ac-ft
Wet–69K ac-ft
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

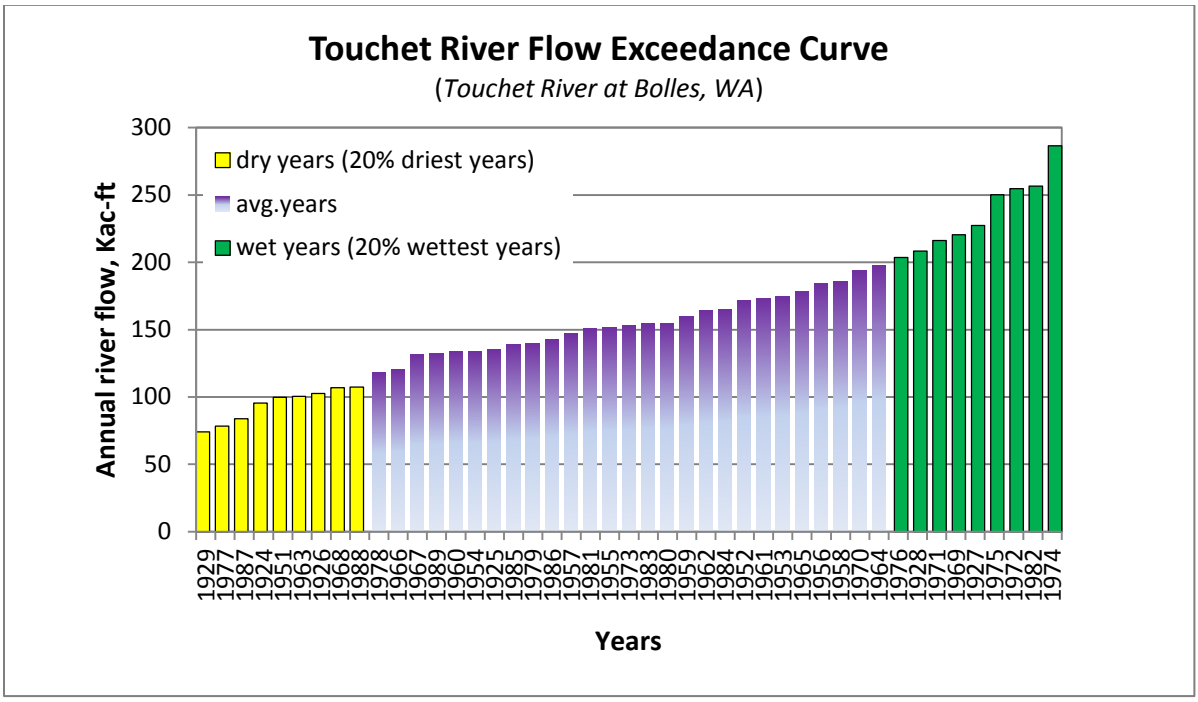

Touchet River Flows
(DOE 32B100–Touchet River at Bolles Road)
Annual river flow, Kac-ft
220
200
180
160
140
120
100
2007
2008
2009
Years

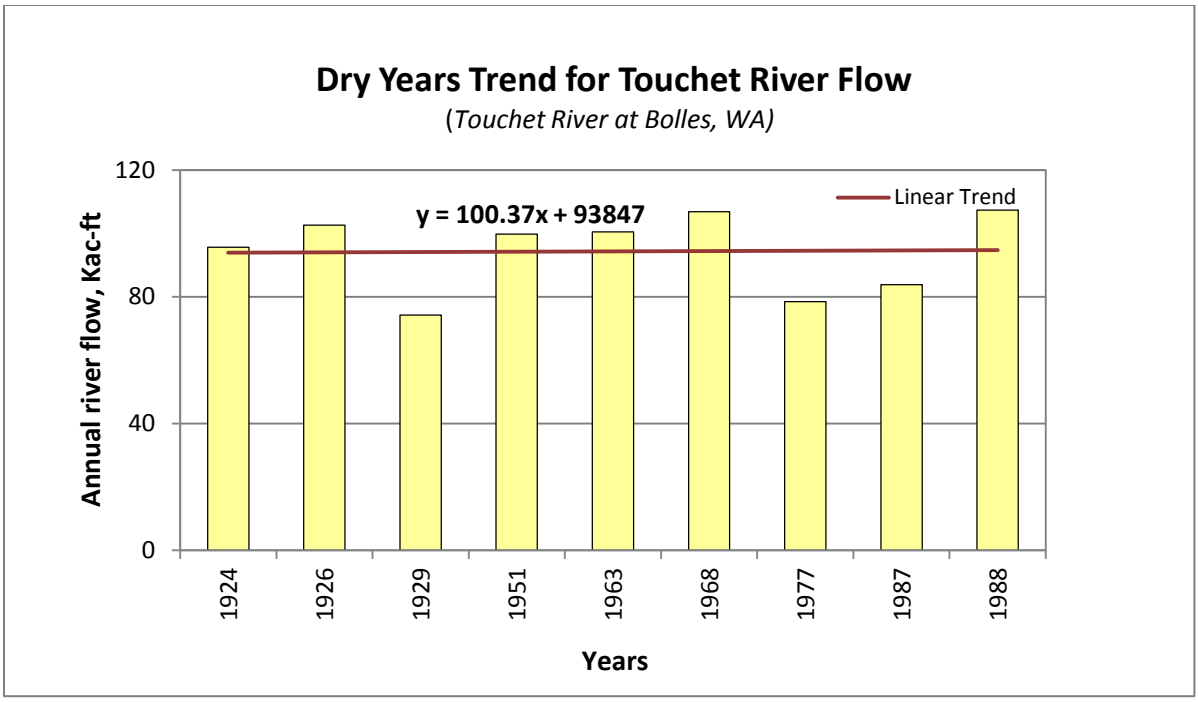

Touchet River Flow Exceedance Curve
(Touchet River at Bolles Road)
Annual river flow, Kac-ft
220
200
180
160
140
120
100
dry years (20% driest years)
avg.years
wet years (20% wettest years)
2007
2008
2009
Years

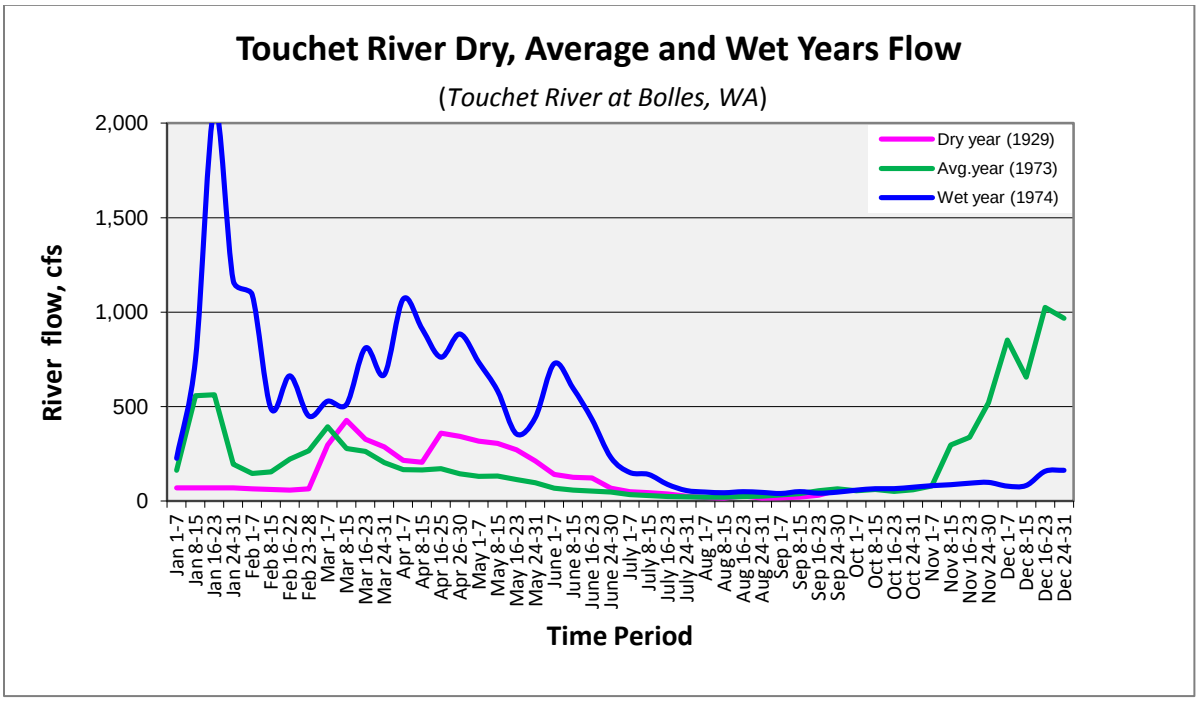

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Touchet River at Bolles Road)
River flow, cfs
1,200
1,000
800
600
400
200
0
Instream flow rule
Dry year (2007)
Avg.year (2008)
Wet year (2009)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

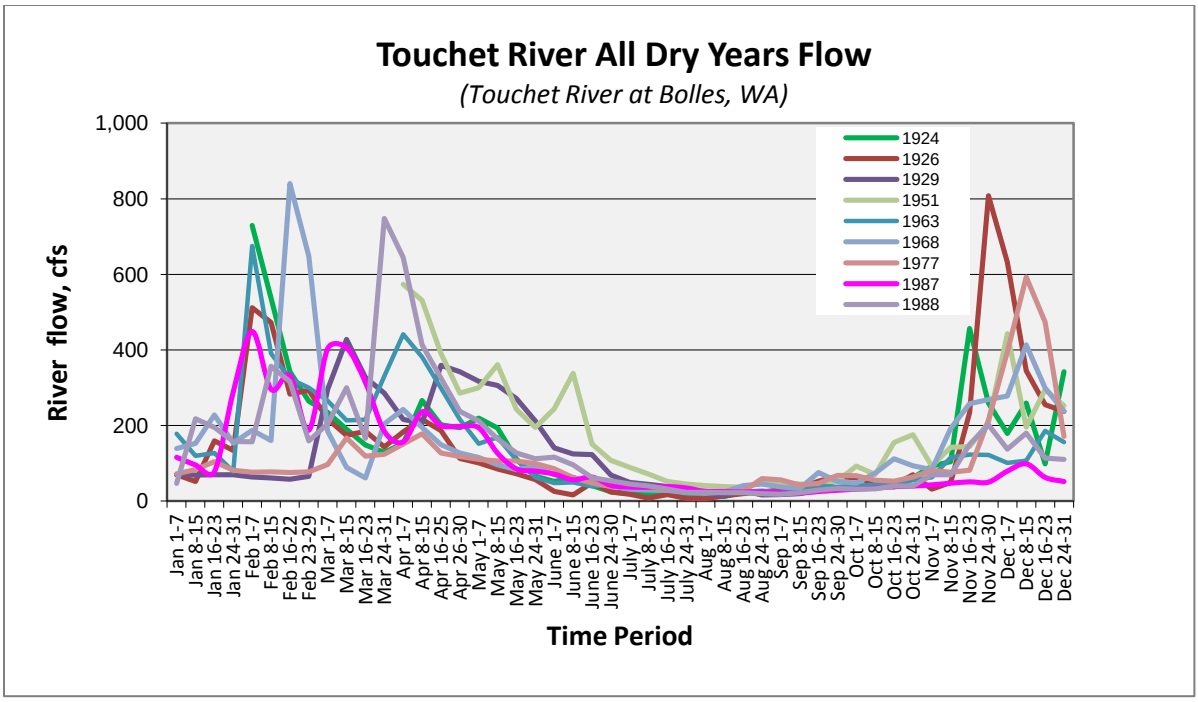

Water Deficit/Surplus Evaluation
(Touchet River at Bolles Road)
Deficit/Surplus, ac-ft
20,000
16,000
12,000
8,000
4,000
0
-4,000
Wet year (2009)
Avg.year (2008)
Dry year (2007)
Instream Deficit
Dry–18K ac-ft
Avg–9K ac-ft
Wet–7K ac-ft
Instream Surplus
Dry–55K ac-ft
Avg–92K ac-ft
Wet–154K ac-ft
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

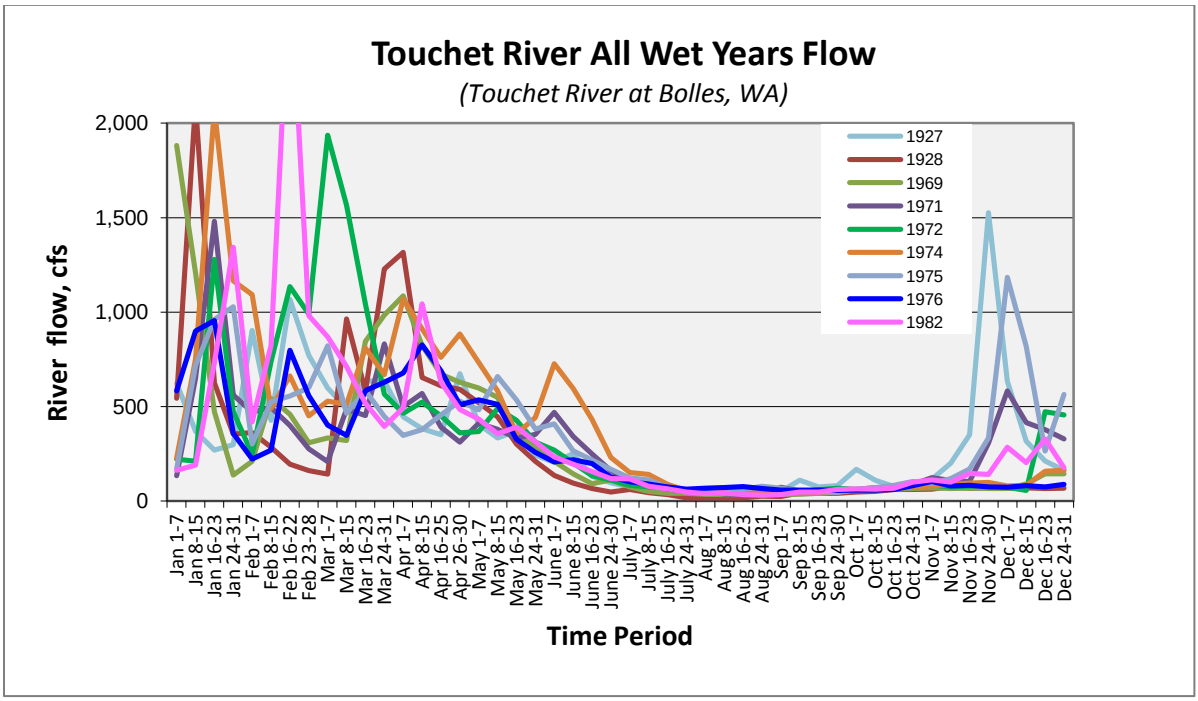

Touchet River Historic Flows
(USGS 14017000–Touchet River at Bolles, WA)
Annual river flow, Kac-ft
300
250
200
150
100
50
0
1924 1926 1928 1930 1932 1934 1936 1938 1940 1942 1944 1946 1948 1950 1952 1954 1956 1958 1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988
Years

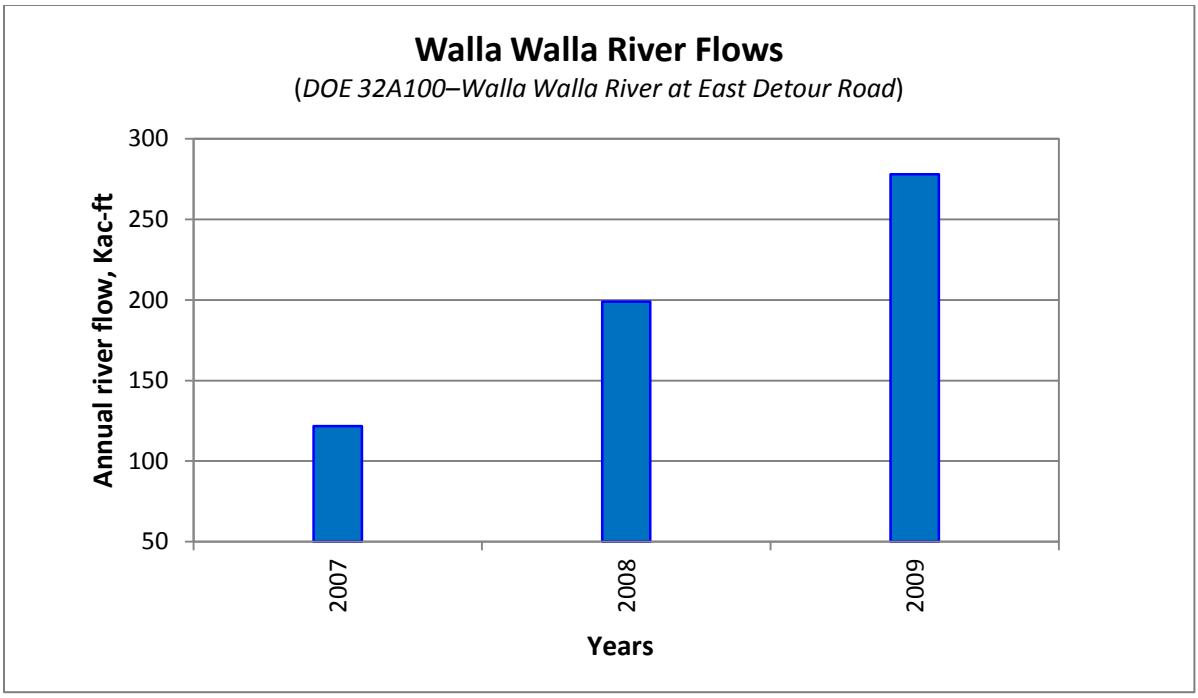

Touchet River Flow Exceedance Curve
(Touchet River at Bolles, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, Kac-ft
300
250
200
150
100
50
0
1929 1977 1987 1924 1951 1963 1926 1968 1988 1976 1966 1967 1989 1960 1954 1925 1985 1979 1986 1957 1981 1955 1973 1983 1980 1959 1962 1984 1952 1961 1953 1965 1956 1958 1970 1964 1976 1928 1971 1969 1927 1975 1972 1982 1974
Years

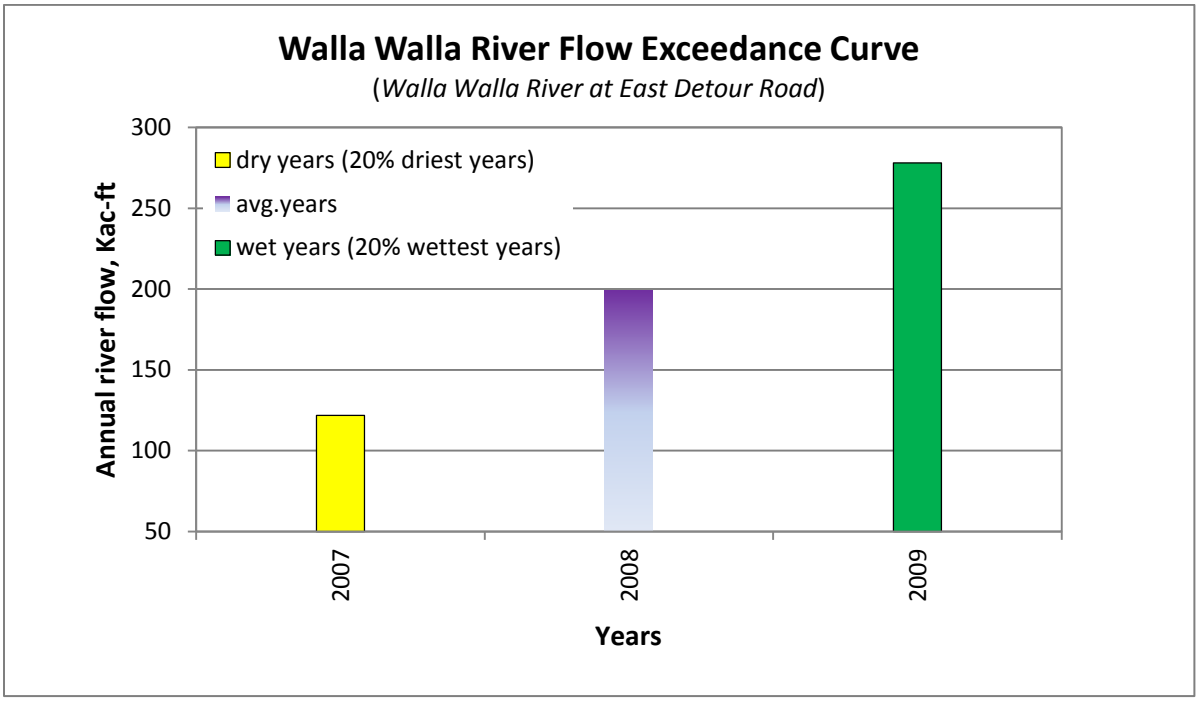

Dry Years Trend for Touchet River Flow
(Touchet River at Bolles, WA)
y = 100.37x + 93847
Linear Trend
Annual river flow, Kac-ft
120
80
40
0
1924
1926
1929
1951
1963
1968
1977
1987
1988
Years

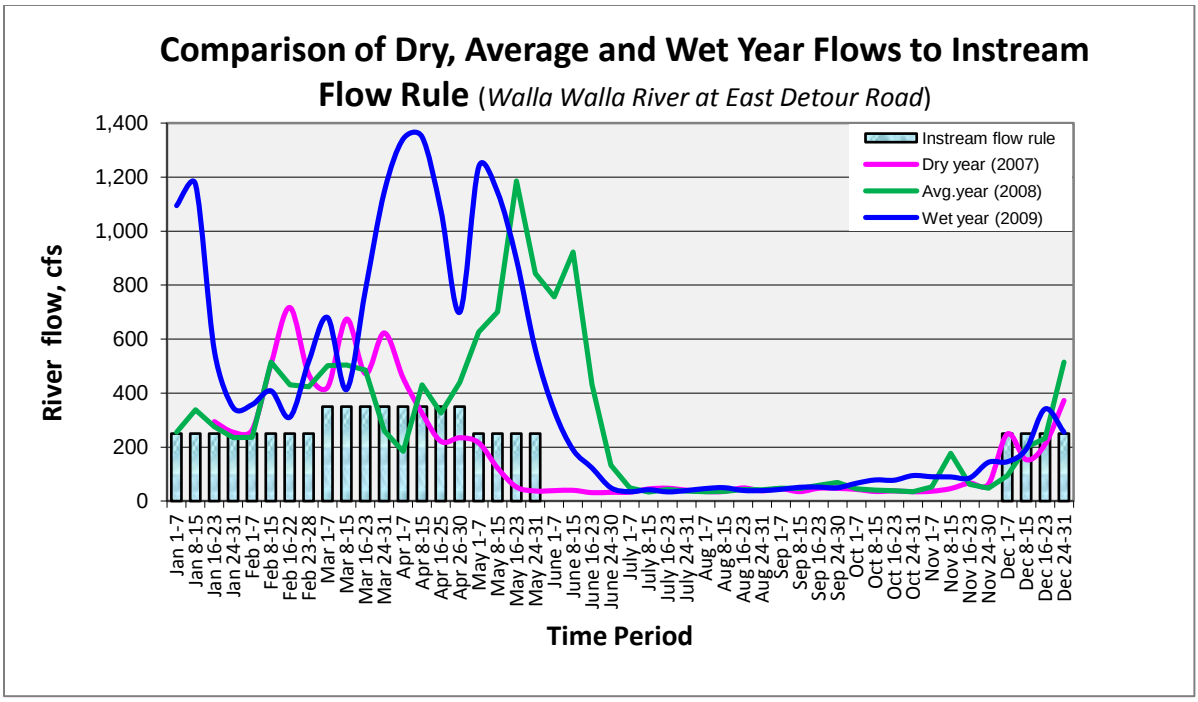

Touchet River Dry, Average and Wet Years Flow
(Touchet River at Bolles, WA)
Dry year (1929)
Avg.year (1973)
Wet year (1974)
River flow, cfs
2,000
1,500
1,000
500
0
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

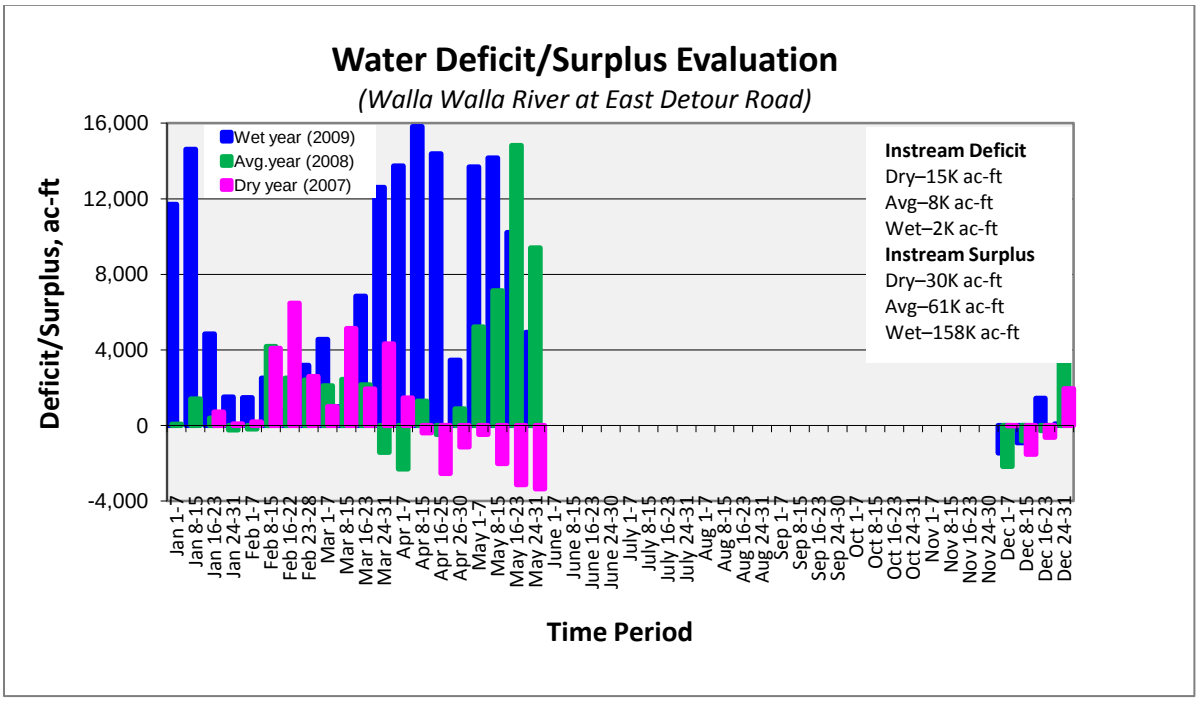

Touchet River All Dry Years Flow
(Touchet River at Bolles, WA)
River flow, cfs
1,000
800
600
400
200
0
1924
1926
1929
1951
1963
1968
1977
1987
1988
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

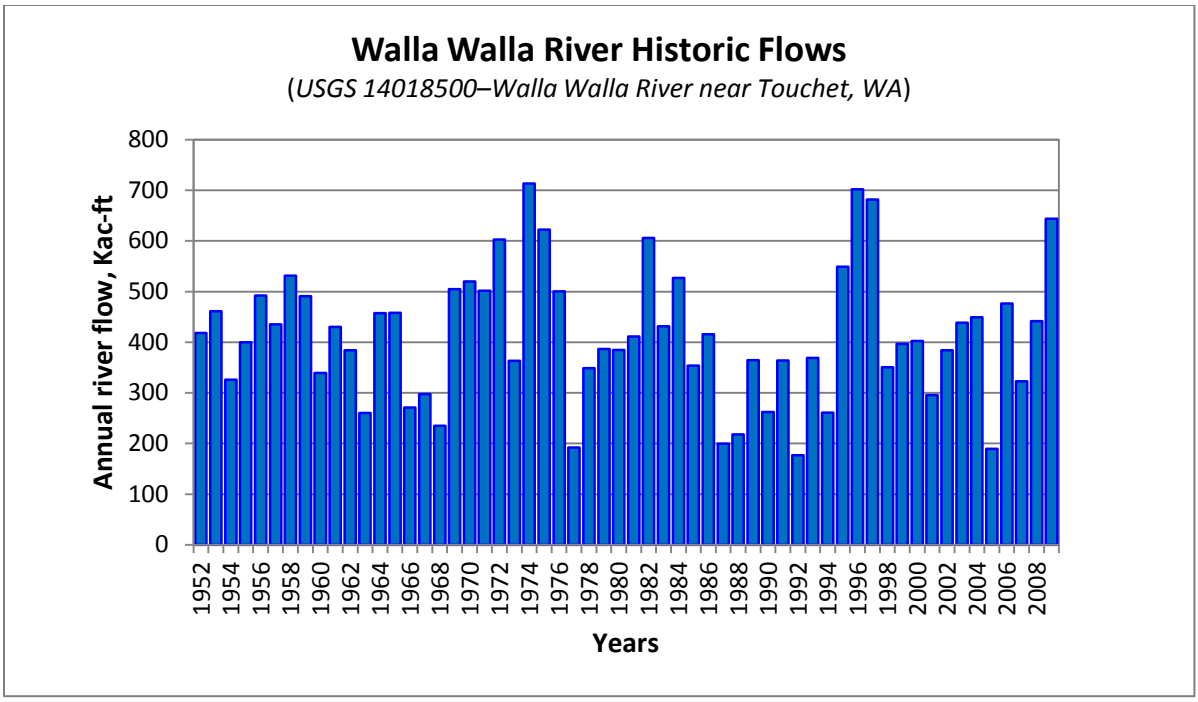

Touchet River All Wet Years Flow
(Touchet River at Bolles, WA)
River flow, cfs
2,000
1,500
1,000
500
0
1927
1928
1969
1971
1972
1974
1975
1976
1982
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

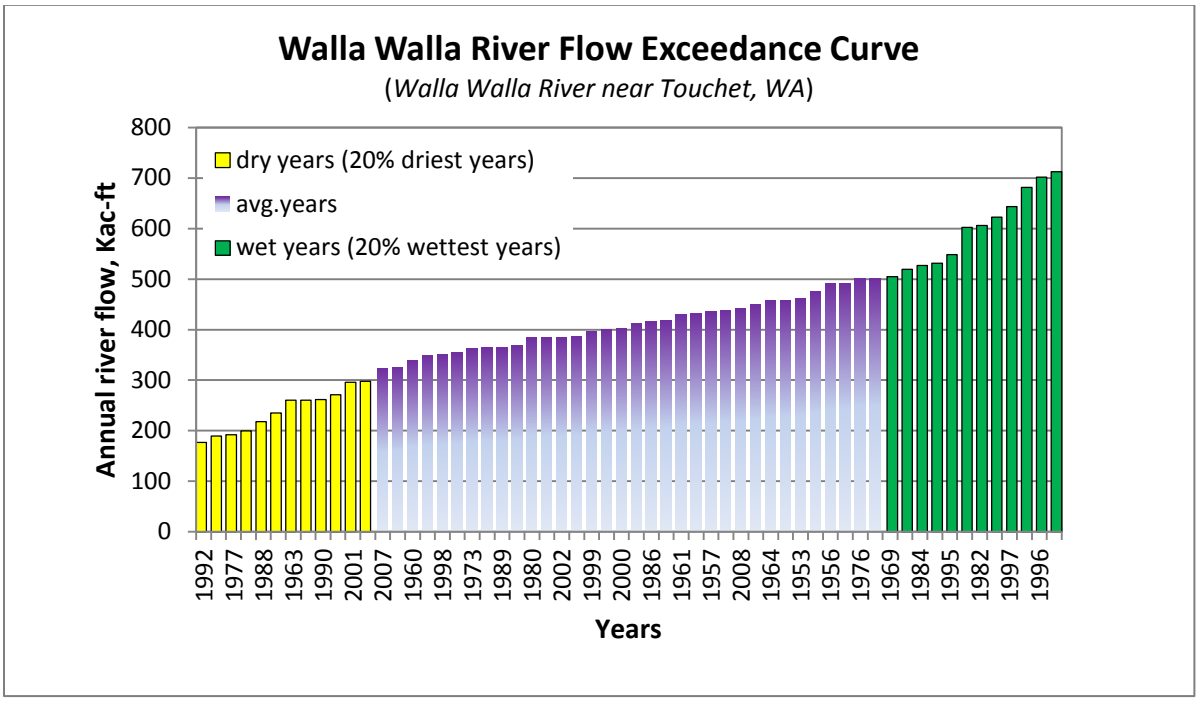

Walla Walla River Flows
(DOE 32A100–Walla Walla River at East Detour Road)
Annual river flow, Kac-ft
300
250
200
150
100
50
2007
2008
2009
Years

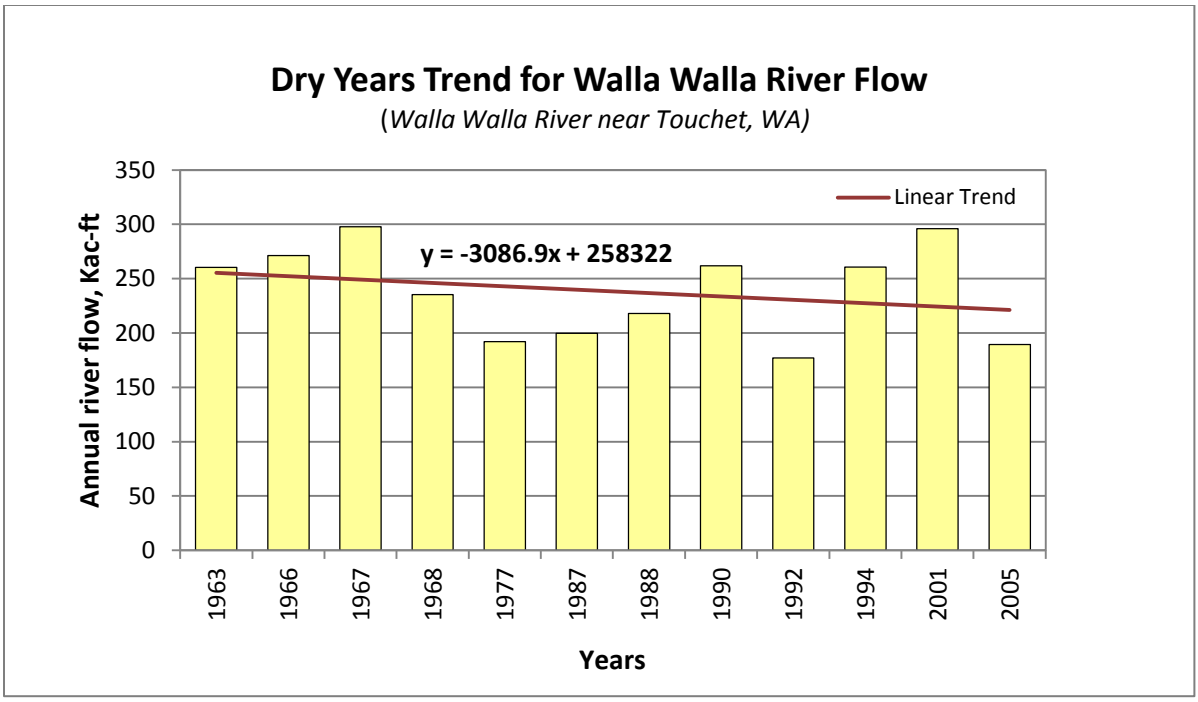

Walla Walla River Flow Exceedance Curve
(Walla Walla River at East Detour Road)
Annual river flow, Kac-ft
300
250
200
150
100
50
dry years (20% driest years)
avg.years
wet years (20% wettest years)
2007
2008
2009
Years

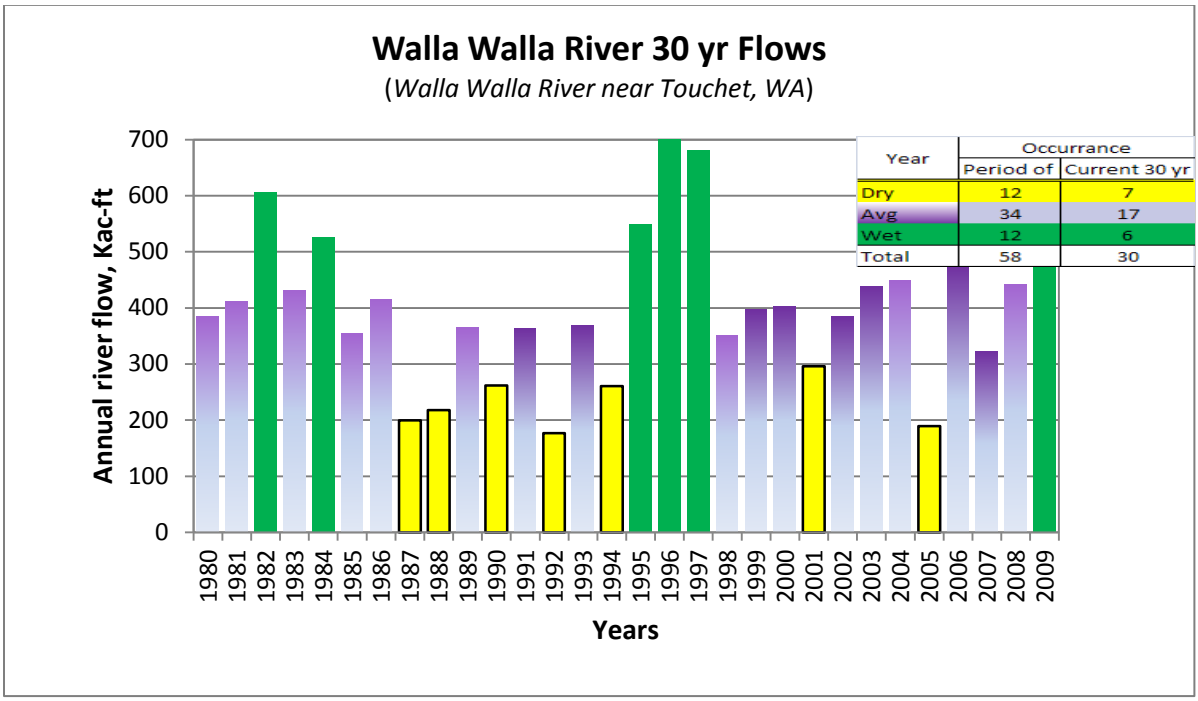

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Walla Walla River at East Detour Road)
River flow, cfs
1,400
1,200
1,000
800
600
400
200
0
Instream flow rule
Dry year (2007)
Avg.year (2008)
Wet year (2009)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

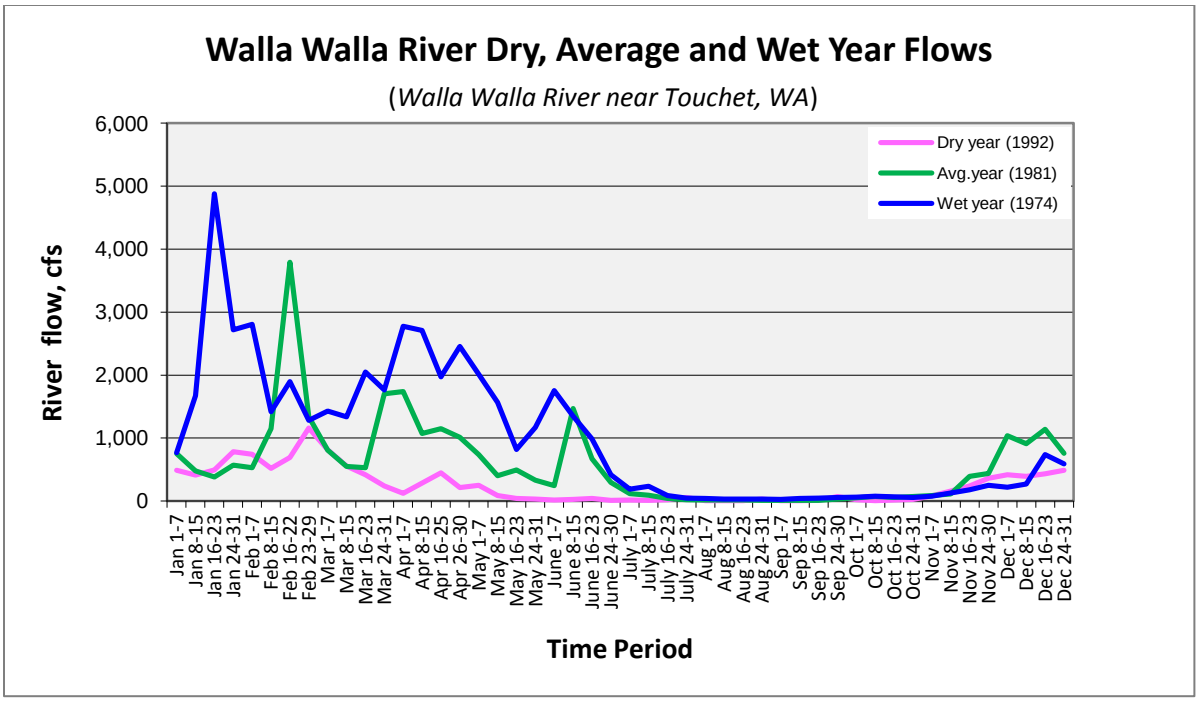

Water Deficit/Surplus Evaluation
(Walla Walla River at East Detour Road)
Deficit/Surplus, ac-ft
16,000
12,000
8,000
4,000
0
-4,000
Wet year (2009)
Avg.year (2008)
Dry year (2007)
Instream Deficit
Dry–15K ac-ft
Avg–8K ac-ft
Wet–2K ac-ft
Instream Surplus
Dry–30K ac-ft
Avg–61K ac-ft
Wet–158K ac-ft
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

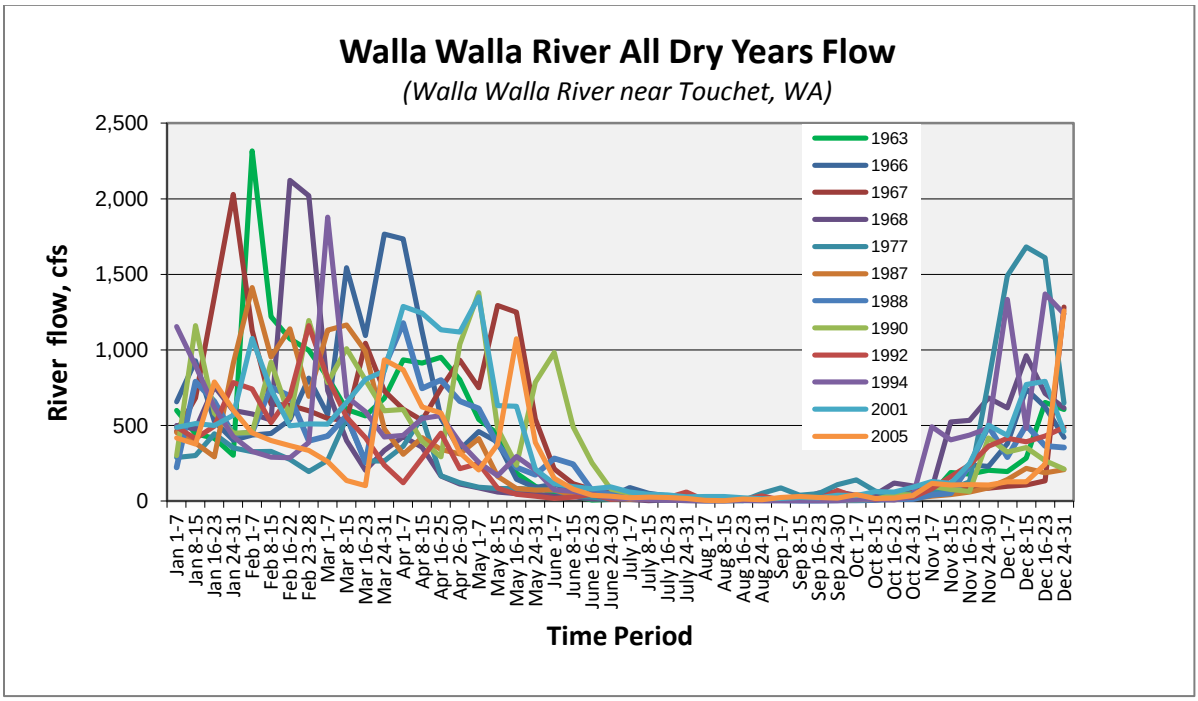

Walla Walla River Historic Flows
(USGS 14018500–Walla Walla River near Touchet, WA)
Annual river flow, Kac-ft
800
700
600
500
400
300
200
100
0
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
Years

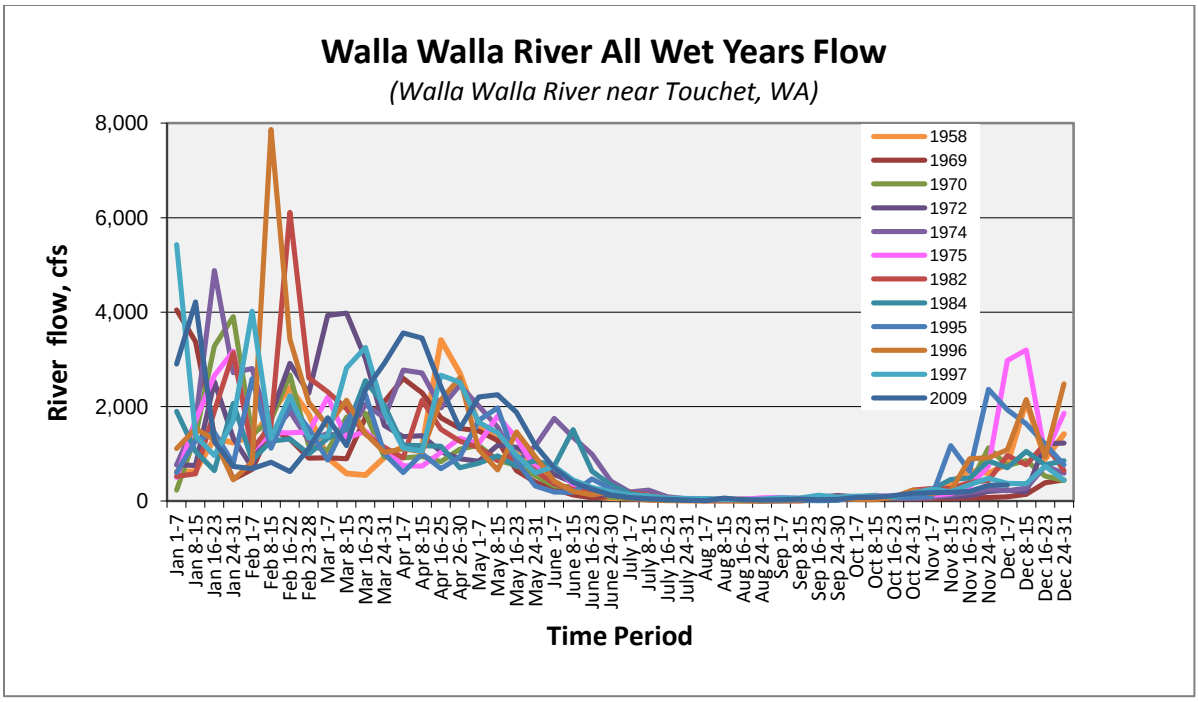

Walla Walla River Flow Exceedance Curve
(Walla Walla River near Touchet, WA)
Annual river flow, Kac-ft
dry years (20% driest years)
avg.years
wet years (20% wettest years)
800
700
600
500
400
300
200
100
0
1992
1977
1988
1963
1990
2001
2007
1960
1998
1973
1989
1980
2002
1999
2000
1986
1961
1957
2008
1964
1953
1956
1976
1969
1984
1995
1982
1997
1996
Years


Dry Years Trend for Walla Walla River Flow
(Walla Walla River near Touchet, WA)
Linear Trend
y = -3086.9x + 258322
Annual river flow, Kac-ft
350
300
250
200
150
100
50
0
1963
1966
1967
1968
1977
1987
1988
1990
1992
1994
2001
2005
Years

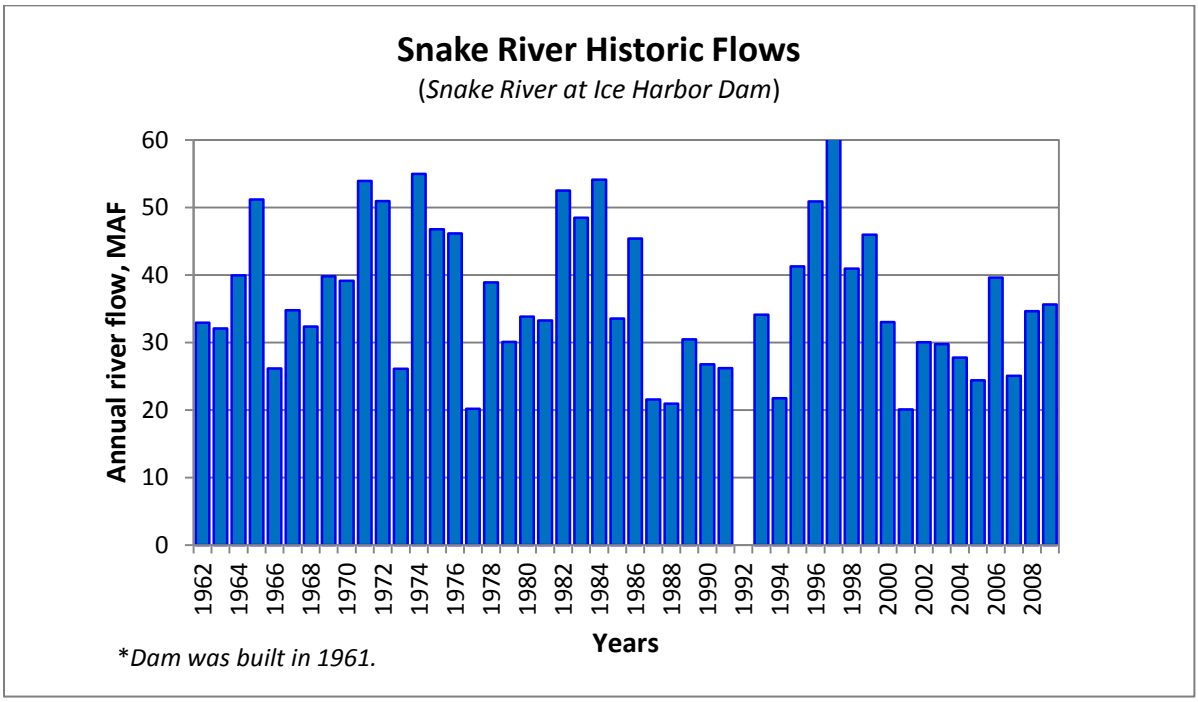

Walla Walla River 30 yr Flows
(Walla Walla River near Touchet, WA)
Annual river flow, Kac-ft
700
600
500
400
300
200
100
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 12 7
Avg 34 17
Wet 12 6
Total 58 30

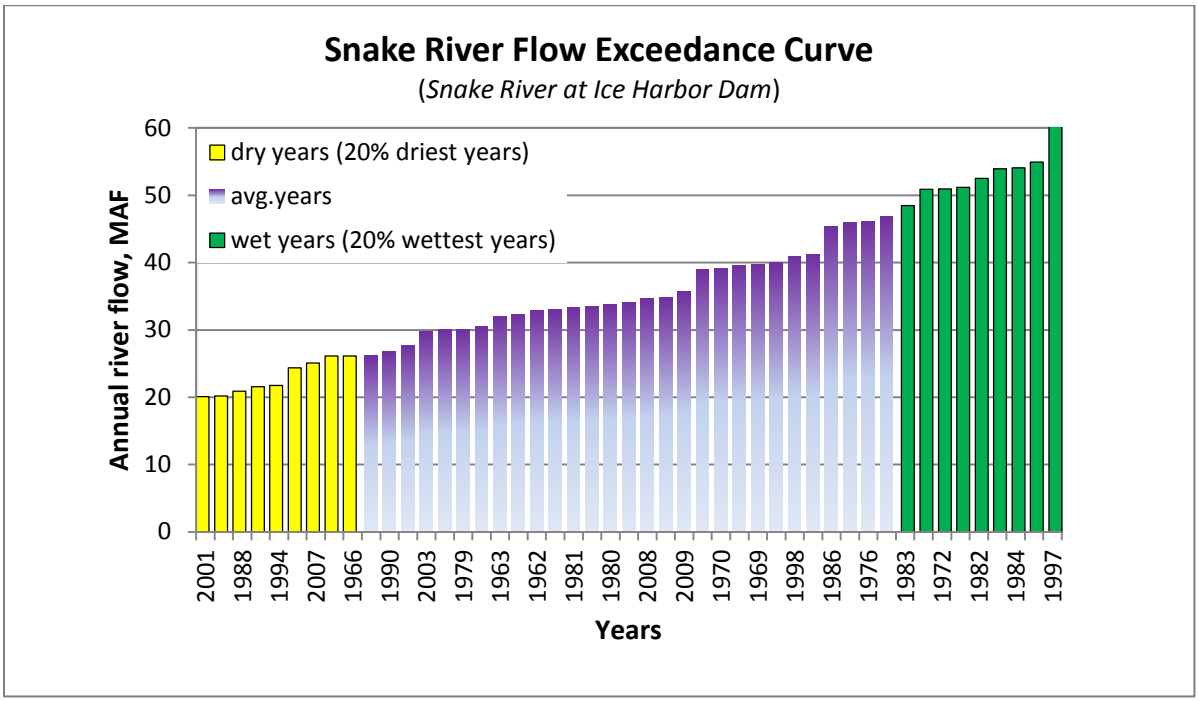

Walla Walla River Dry, Average and Wet Year Flows
(Walla Walla River near Touchet, WA)
River flow, cfs
6,000
5,000
4,000
3,000
2,000
1,000
0
Dry year (1992)
Avg.year (1981)
Wet year (1974)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

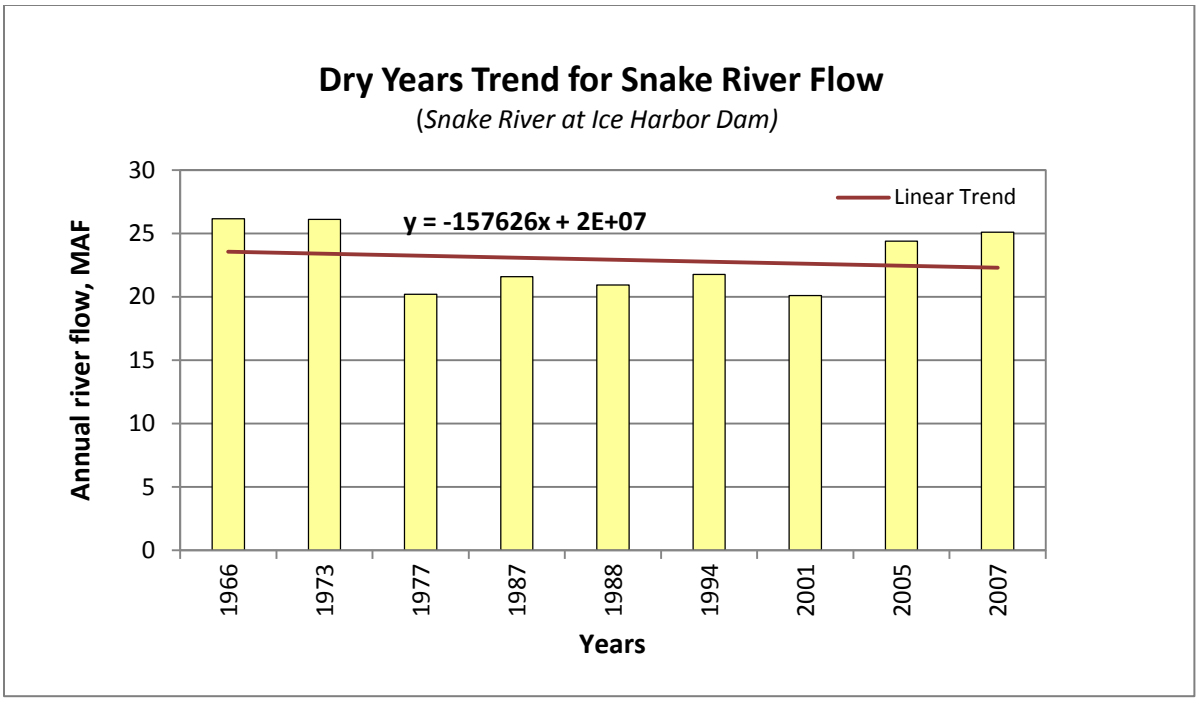

Walla Walla River All Dry Years Flow
(Walla Walla River near Touchet, WA)
River flow, cfs
2,500
2,000
1,500
1,000
500
0
1963
1966
1967
1968
1977
1987
1988
1990
1992
1994
2001
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

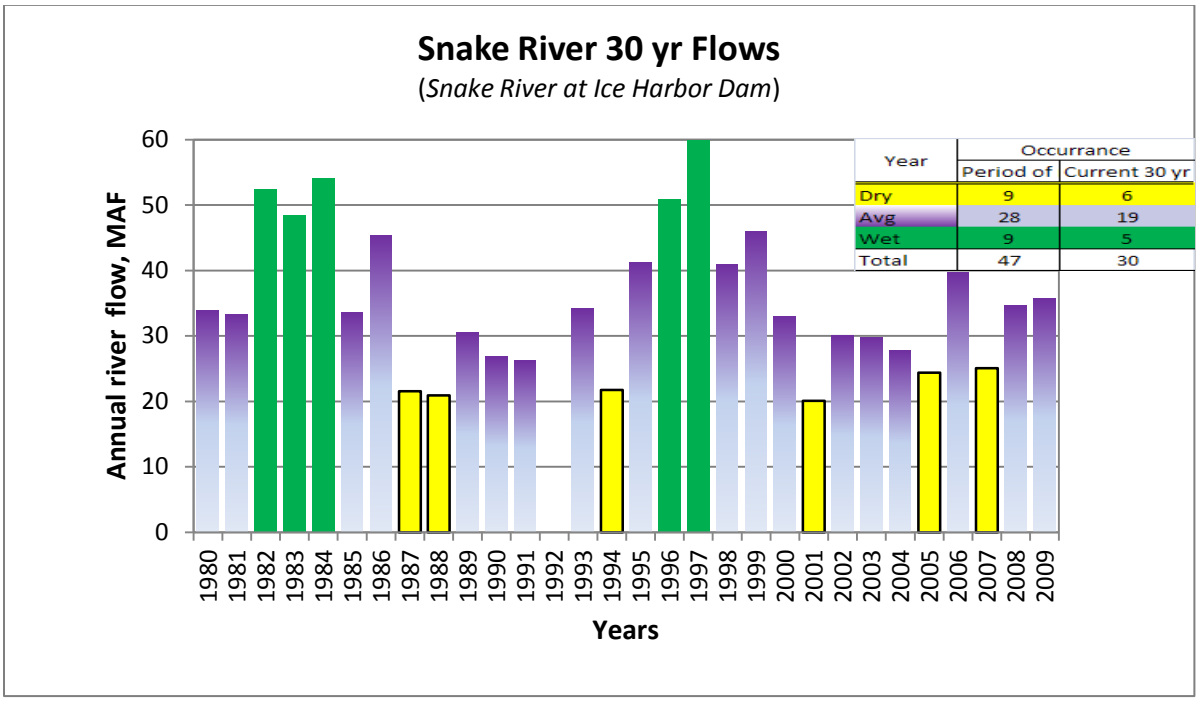

Walla Walla River All Wet Years Flow
(Walla Walla River near Touchet, WA)
River flow, cfs
8,000
6,000
4,000
2,000
0
1958
1969
1970
1972
1974
1975
1982
1984
1995
1996
1997
2009
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

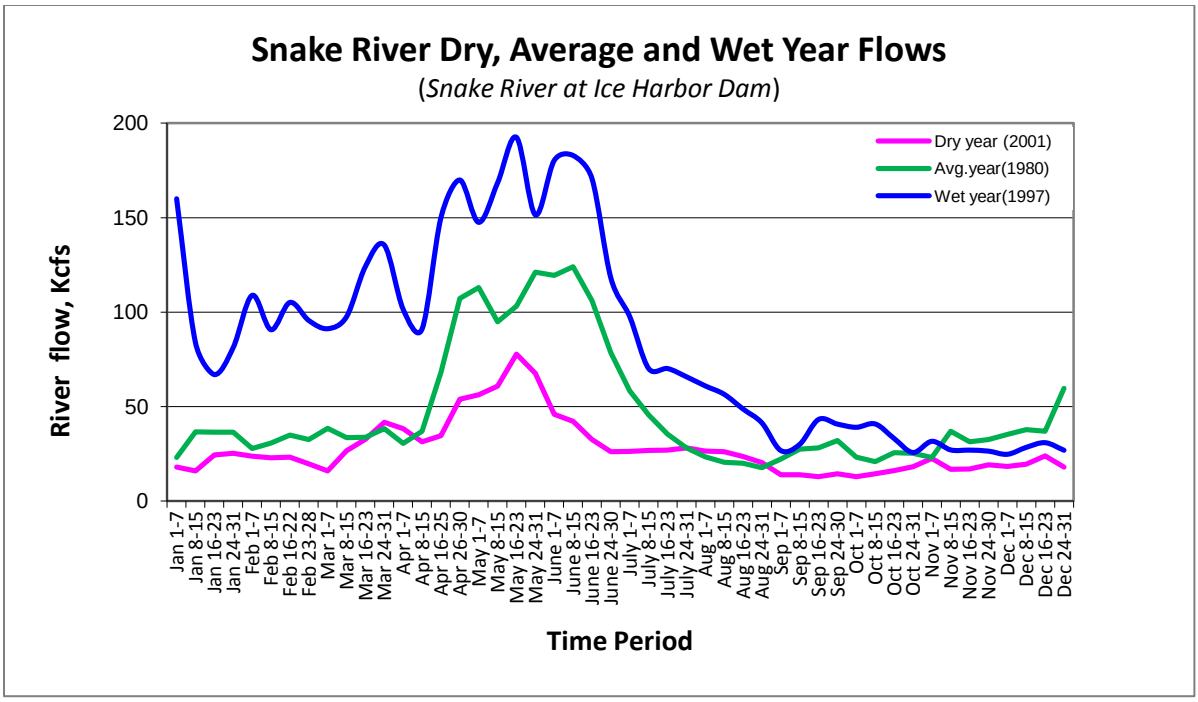
WRIA 33 (Lower Snake)

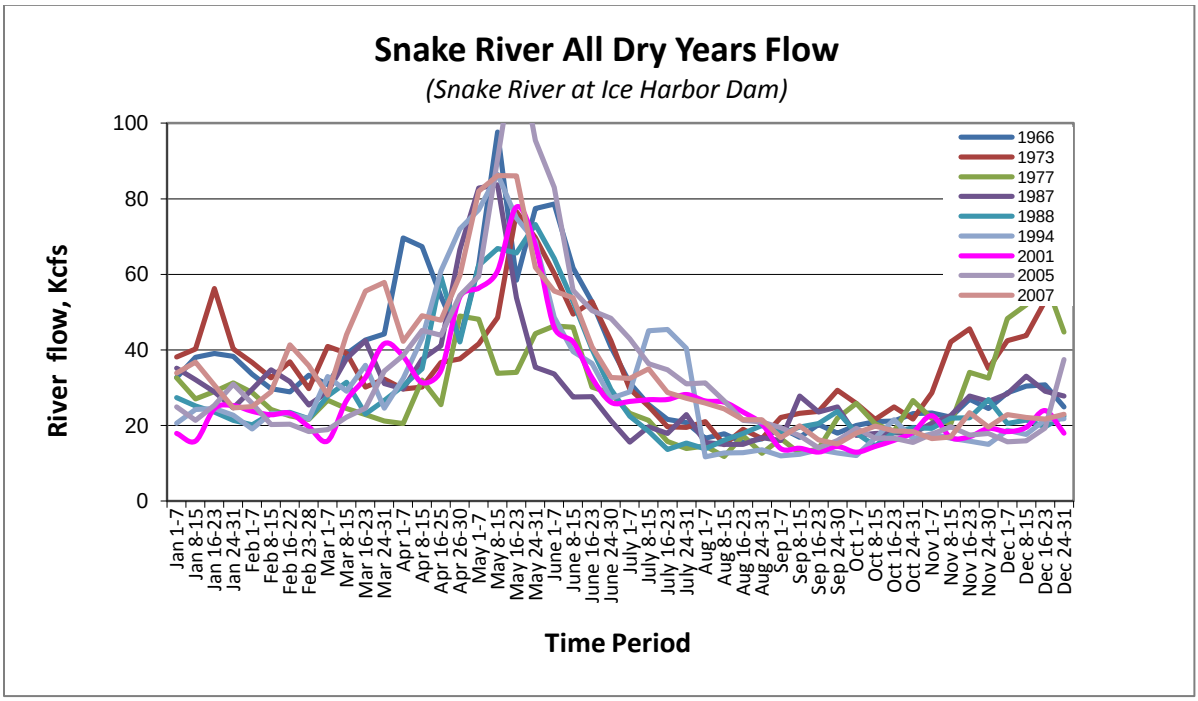


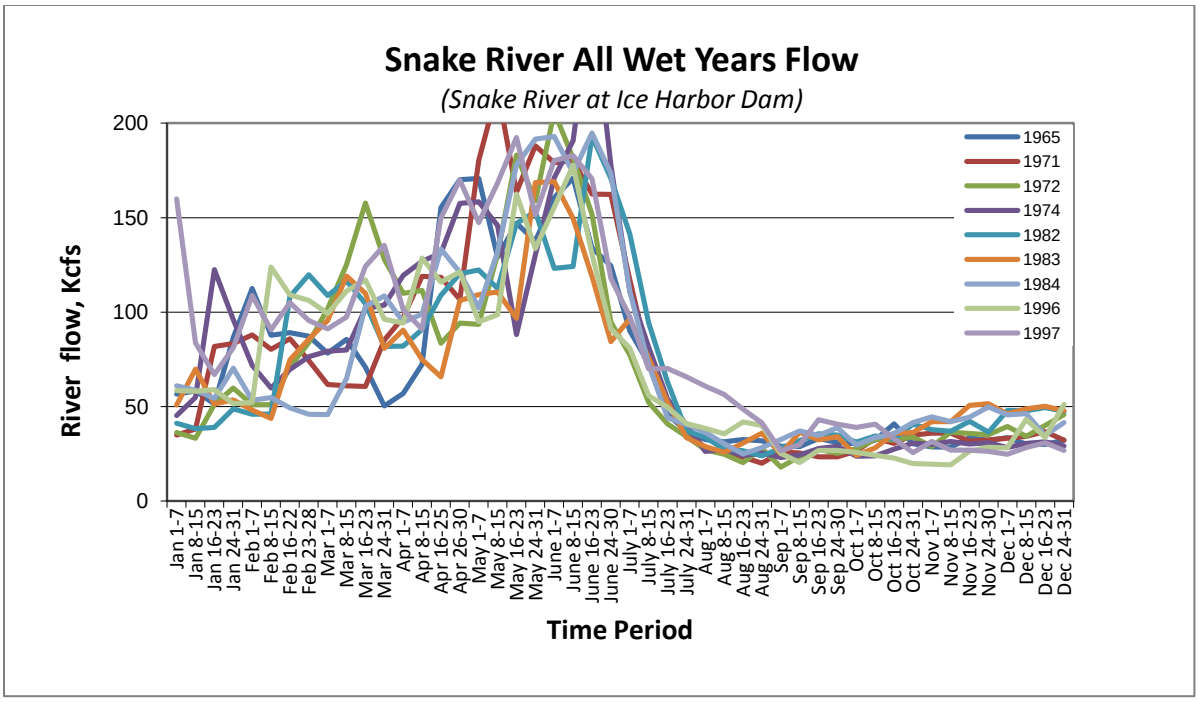



Dry Years Trend for Snake River Flow
(Snake River at Ice Harbor Dam)
Linear Trend
y = -157626x + 2E+07
Annual river flow, MAF
30
25
20
15
10
5
0
1966
1973
1977
1987
1988
1994
2001
2005
2007
Years

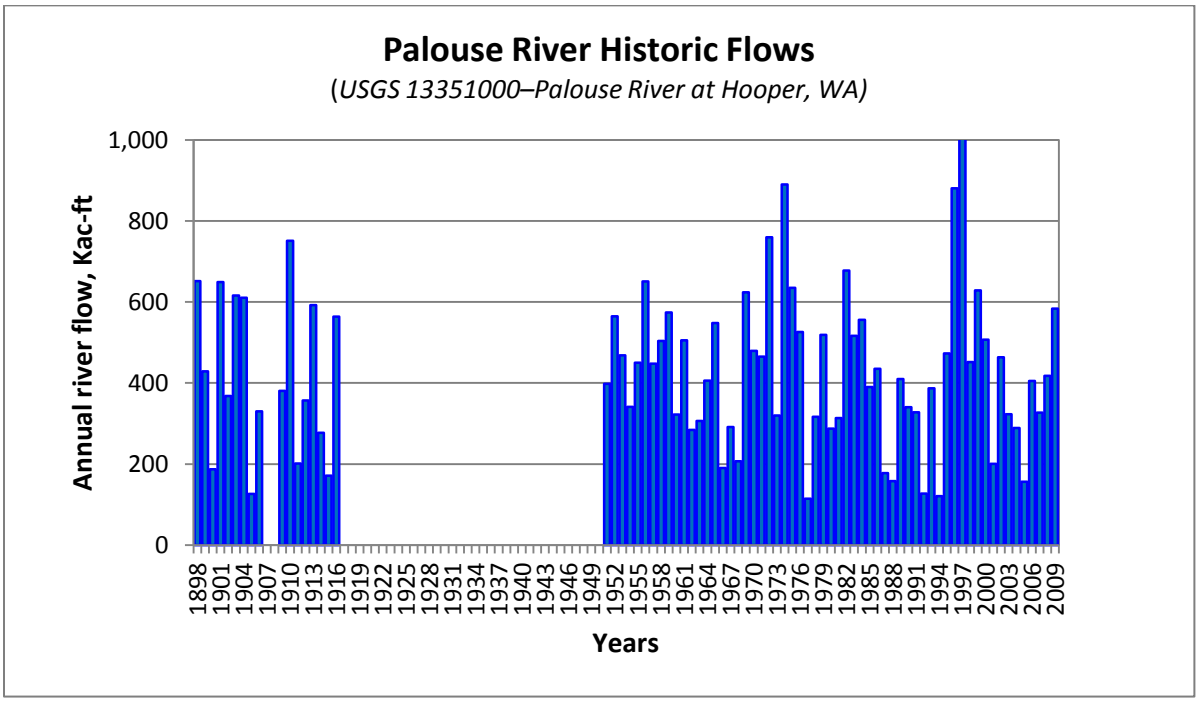

Snake River 30 yr Flows
(Snake River at Ice Harbor Dam)
Year
Occurrance
Period of
Current 30 yr
Dry 9 6
Avg 28 19
Wet 9 5
Total 47 30
Annual river flow, MAF
60
50
40
30
20
10
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years

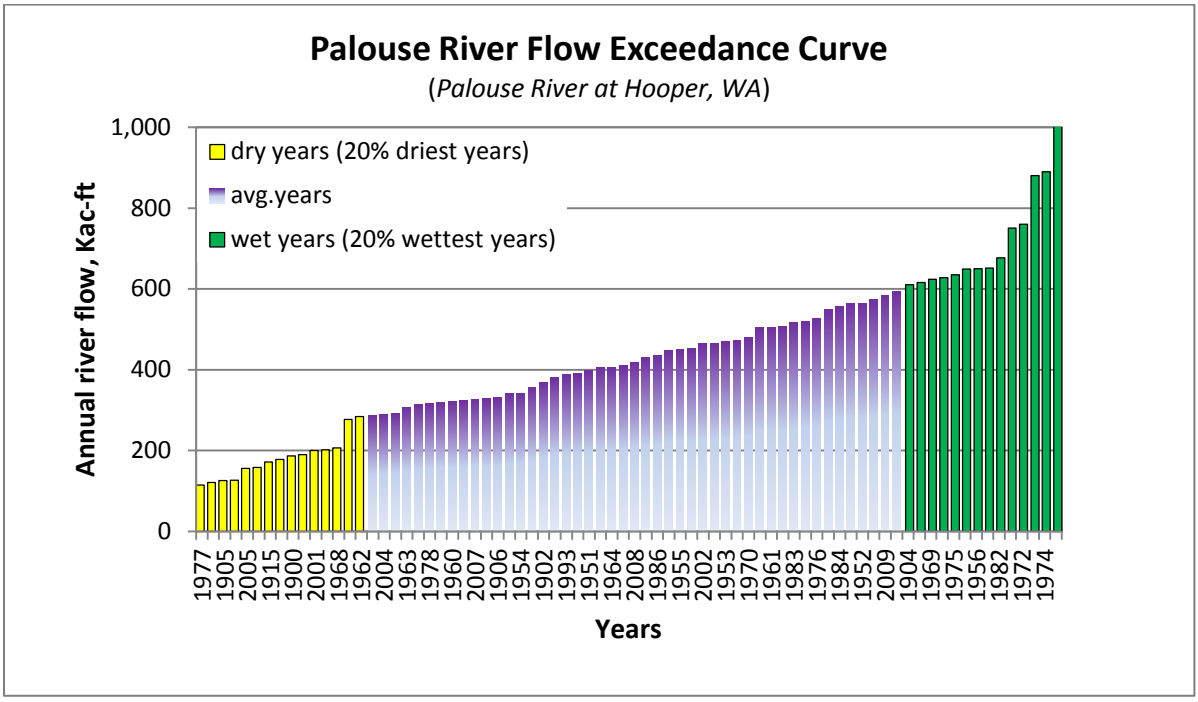

Snake River Dry, Average and Wet Year Flows
(Snake River at Ice Harbor Dam)
River flow, Kcfs
200
150
100
50
0
Dry year (2001)
Avg.year(1980)
Wet year(1997)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

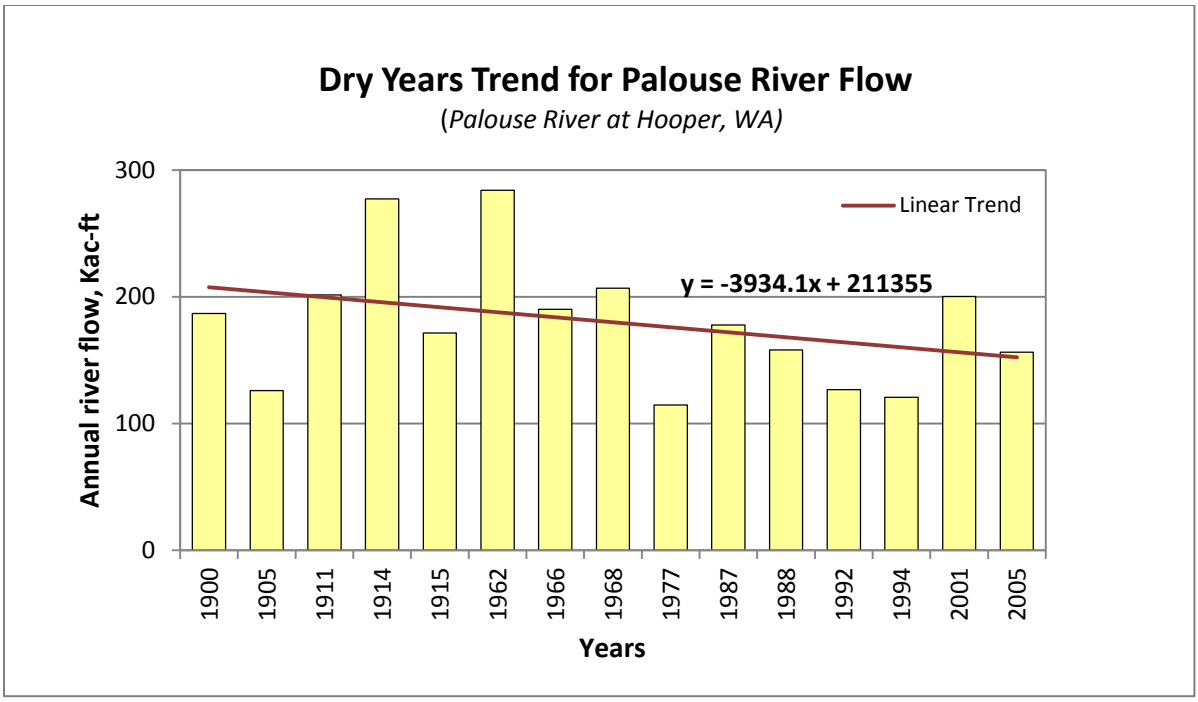

Snake River All Dry Years Flow
(Snake River at Ice Harbor Dam)
River flow, Kcfs
100
80
60
40
20
0
1966
1973
1977
1987
1988
1994
2001
2005
2007
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

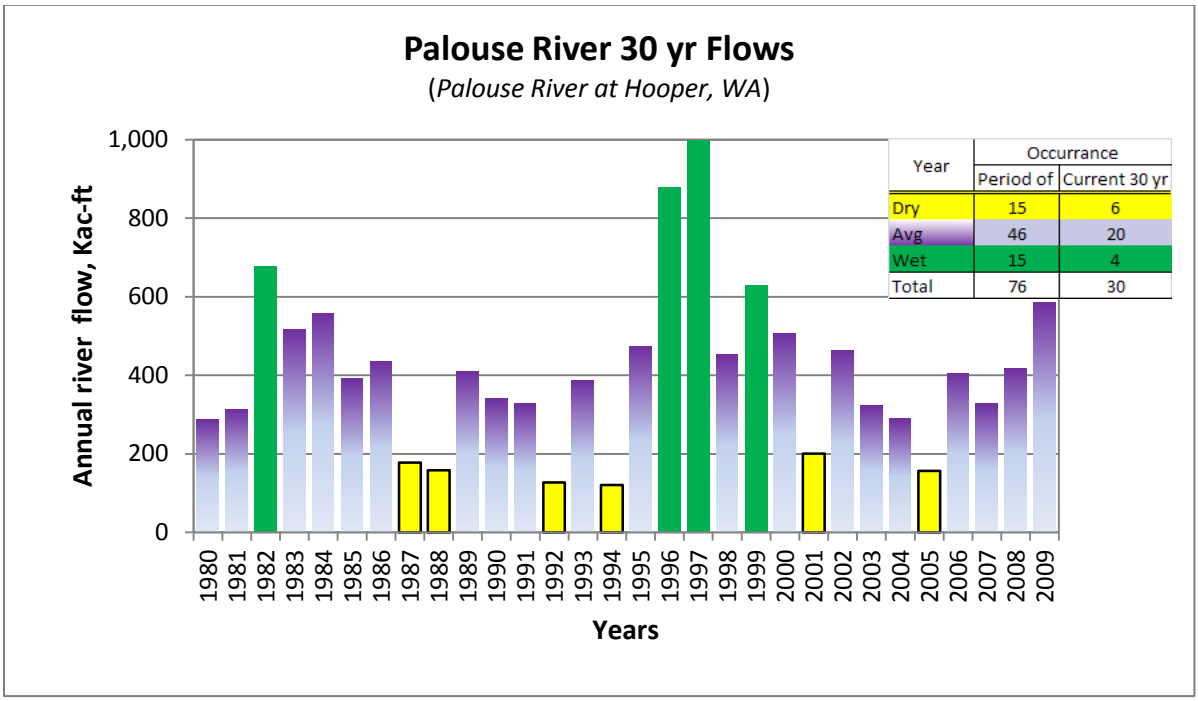

Snake River All Wet Years Flow
(Snake River at Ice Harbor Dam)
River flow, Kcfs
200
150
100
50
0
1965
1971
1972
1974
1982
1983
1984
1996
1997
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

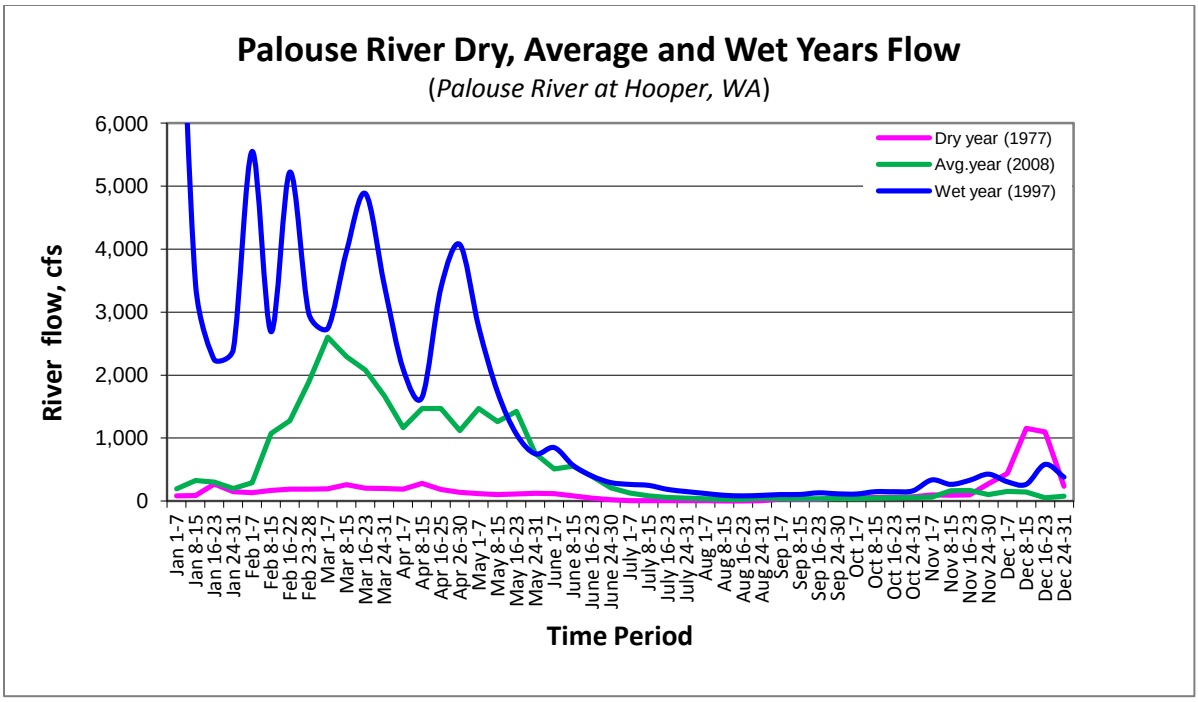
WRIA 34 (Palouse)

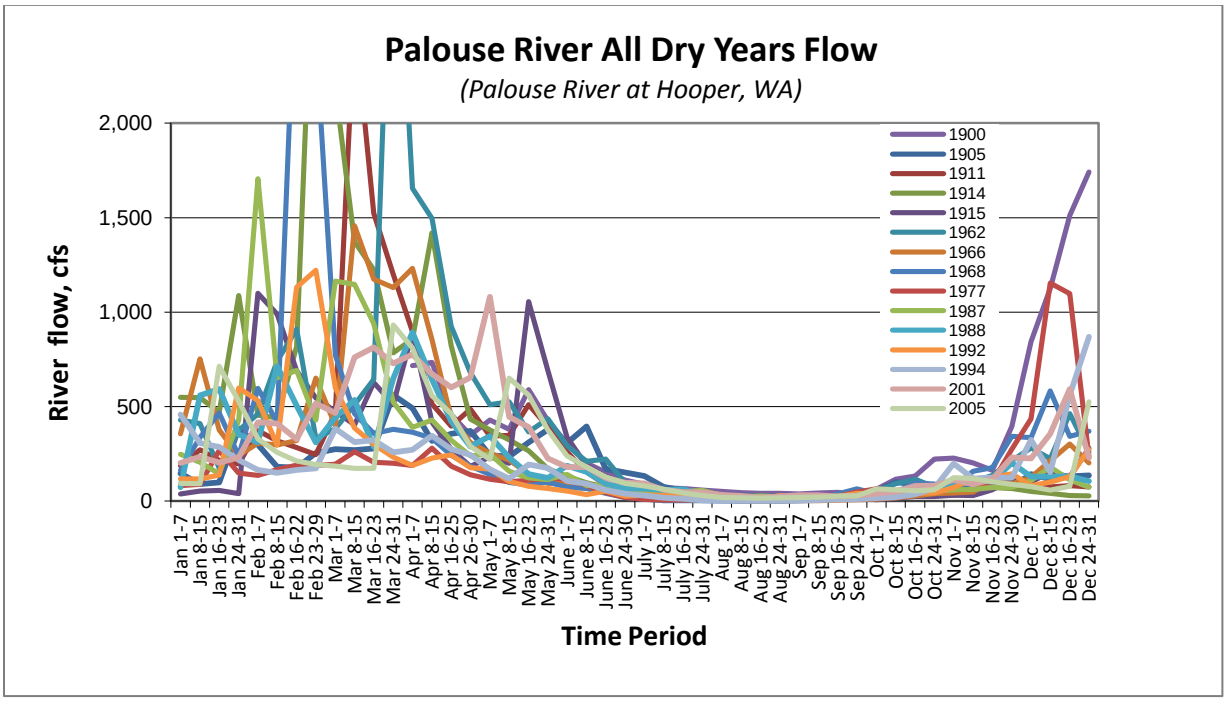


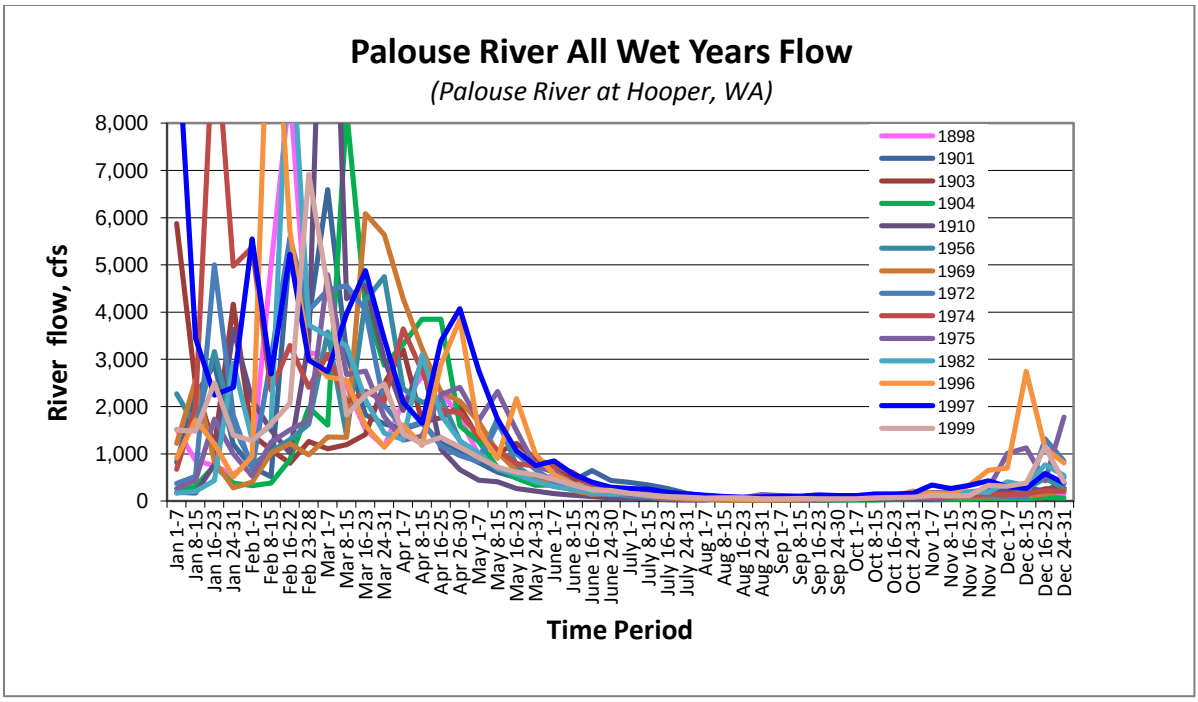


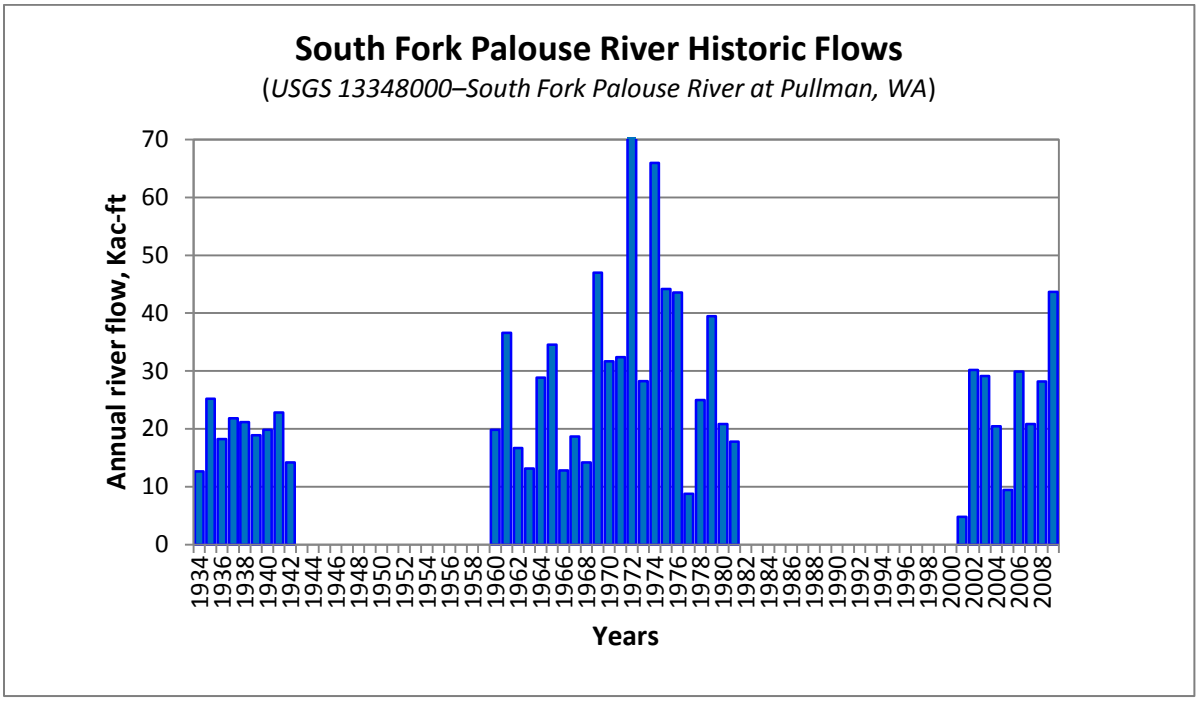

Dry Years Trend for Palouse River Flow
(Palouse River at Hooper, WA)
Annual river flow, Kac-ft
300
200
100
0
Linear Trend
y = -3934.1x + 211355
1900
1905
1911
1914
1915
1962
1966
1968
1977
1987
1988
1992
1994
2001
2005
Years

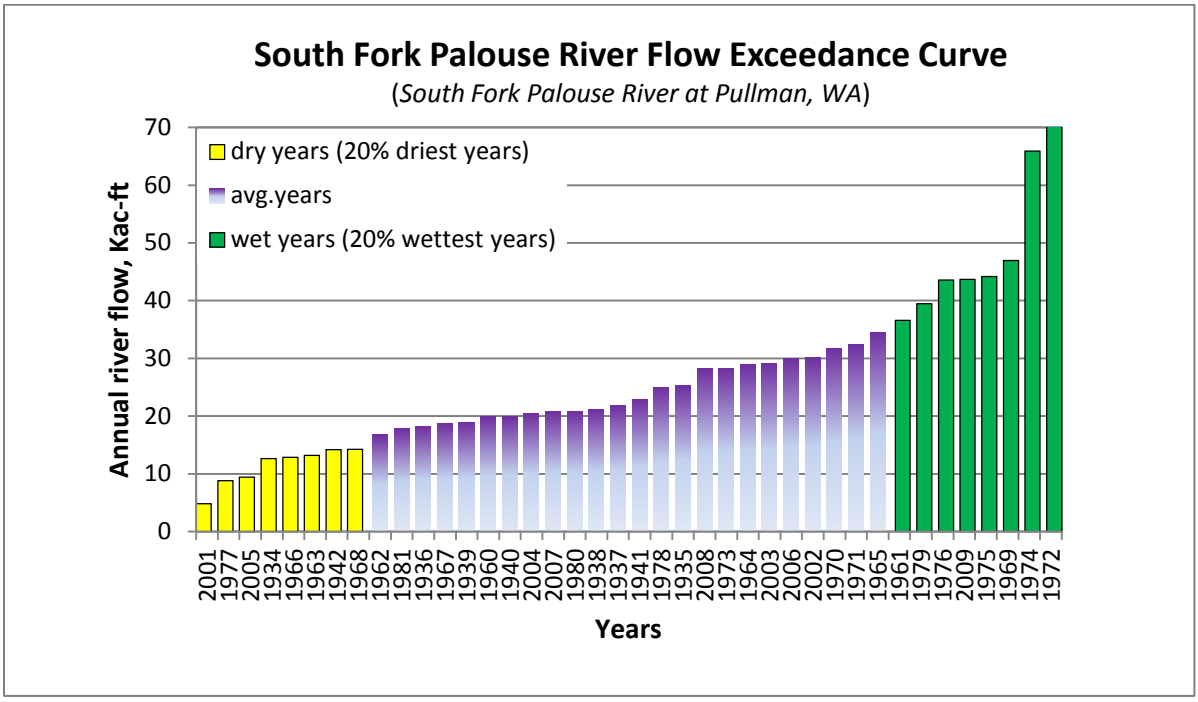

Palouse River 30 yr Flows
(Palouse River at Hooper, WA)
Annual river flow, Kac-ft
1,000
800
600
400
200
0
Year
Occurrance
Period of
Current 30 yr
Dry 15 6
Avg 46 20
Wet 15 4
Total 76 30
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years

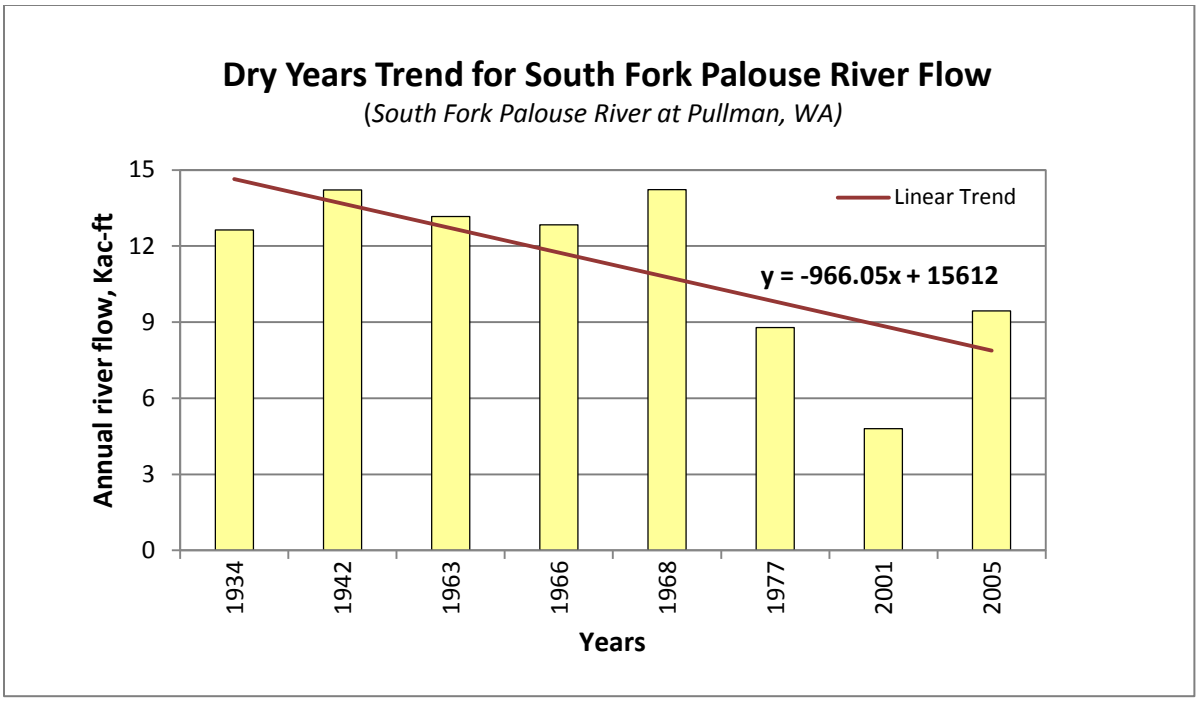

Palouse River Dry, Average and Wet Years Flow
(Palouse River at Hooper, WA)
River flow, cfs
6,000
5,000
4,000
3,000
2,000
1,000
0
Dry year (1977)
Avg.year (2008)
Wet year (1997)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

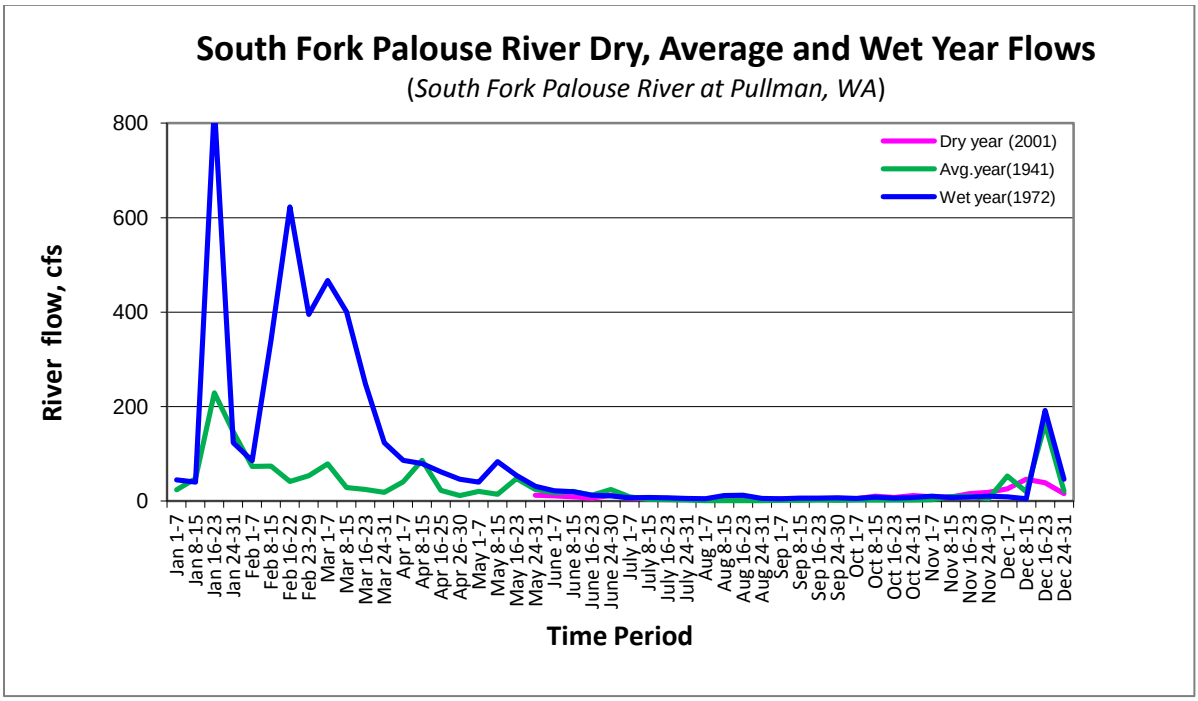

Palouse River All Dry Years Flow
(Palouse River at Hooper, WA)
River flow, cfs
2,000
1,500
1,000
500
0
1900
1905
1911
1914
1915
1962
1966
1968
1977
1987
1988
1992
1994
2001
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

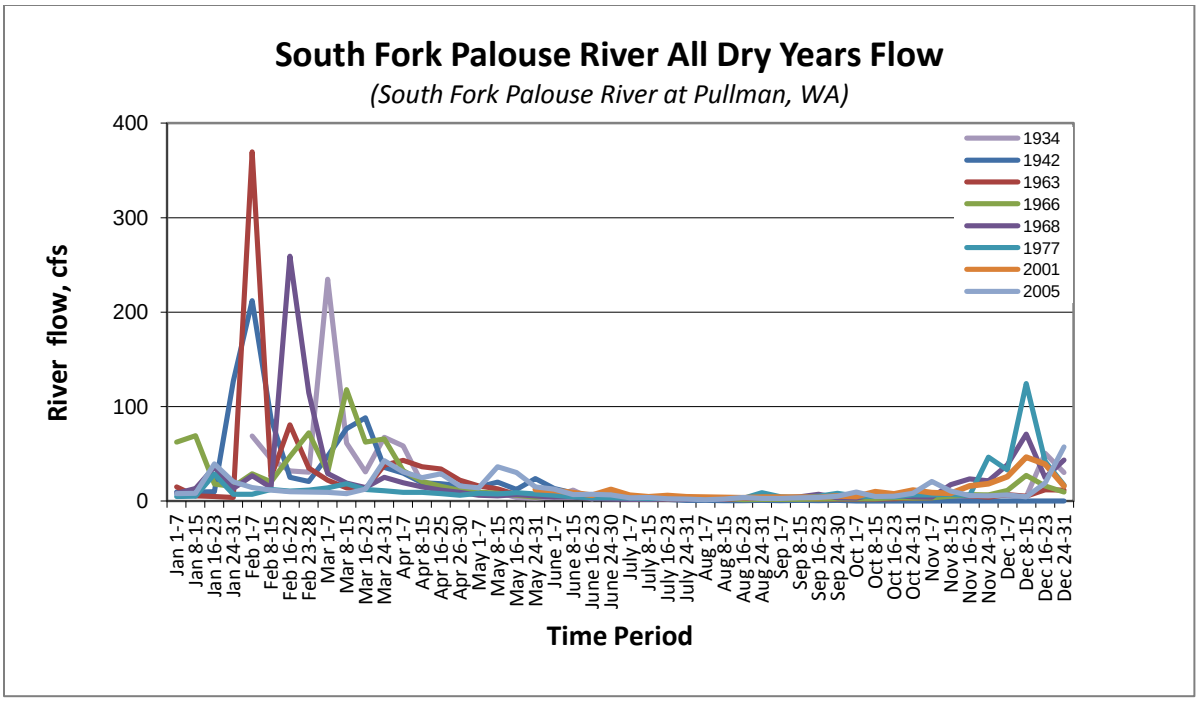

Palouse River All Wet Years Flow
(Palouse River at Hooper, WA)
River flow, cfs
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1898
1901
1903
1904
1910
1956
1969
1972
1974
1975
1982
1996
1997
1999
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

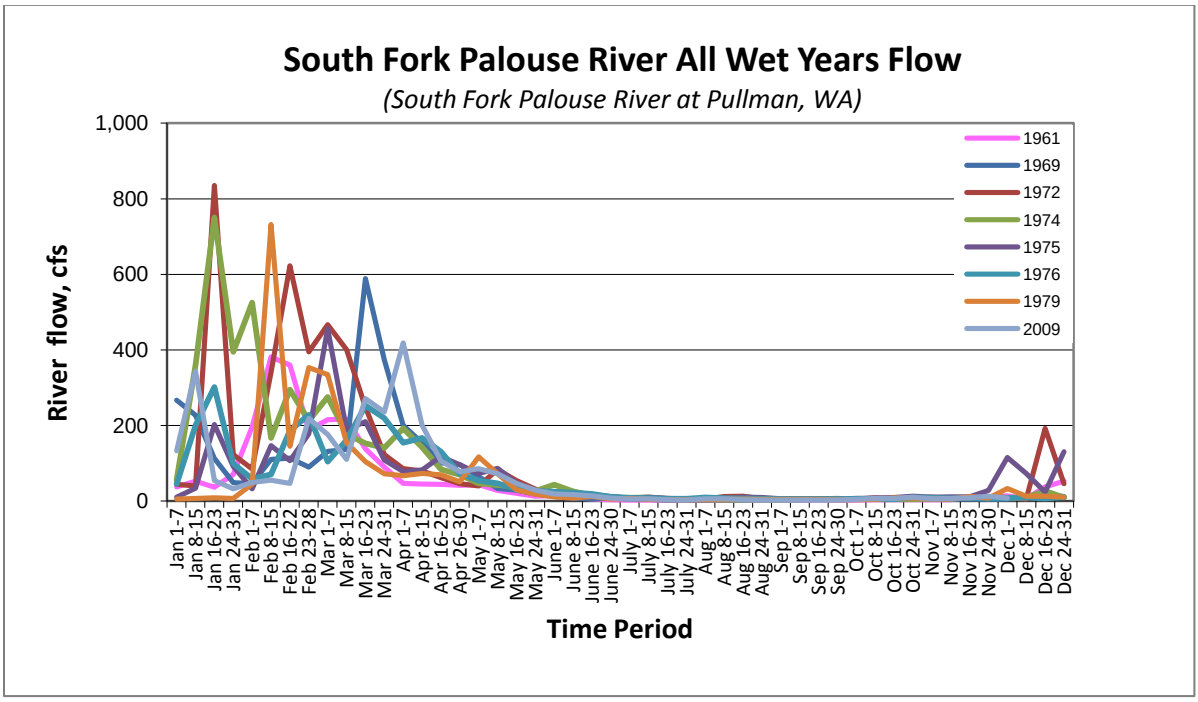

South Fork Palouse River Historic Flows
(USGS 13348000–South Fork Palouse River at Pullman, WA)
Annual river flow, Kac-ft
0
10
20
30
40
50
60
70
1934 1936 1938 1940 1942 1944 1946 1948 1950 1952 1954 1956 1958 1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008
Years


South Fork Palouse River Flow Exceedance Curve
(South Fork Palouse River at Pullman, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, Kac-ft
0
10
20
30
40
50
60
70
2001 1977 2005 1934 1966 1963 1942 1968 1962 1981 1936 1967 1939 1960 1940 2004 2007 1980 1938 1937 1941 1978 1935 2008 1973 1964 2003 2006 2002 1970 1971 1965 1961 1979 1976 2009 1975 1969 1974 1972
Years

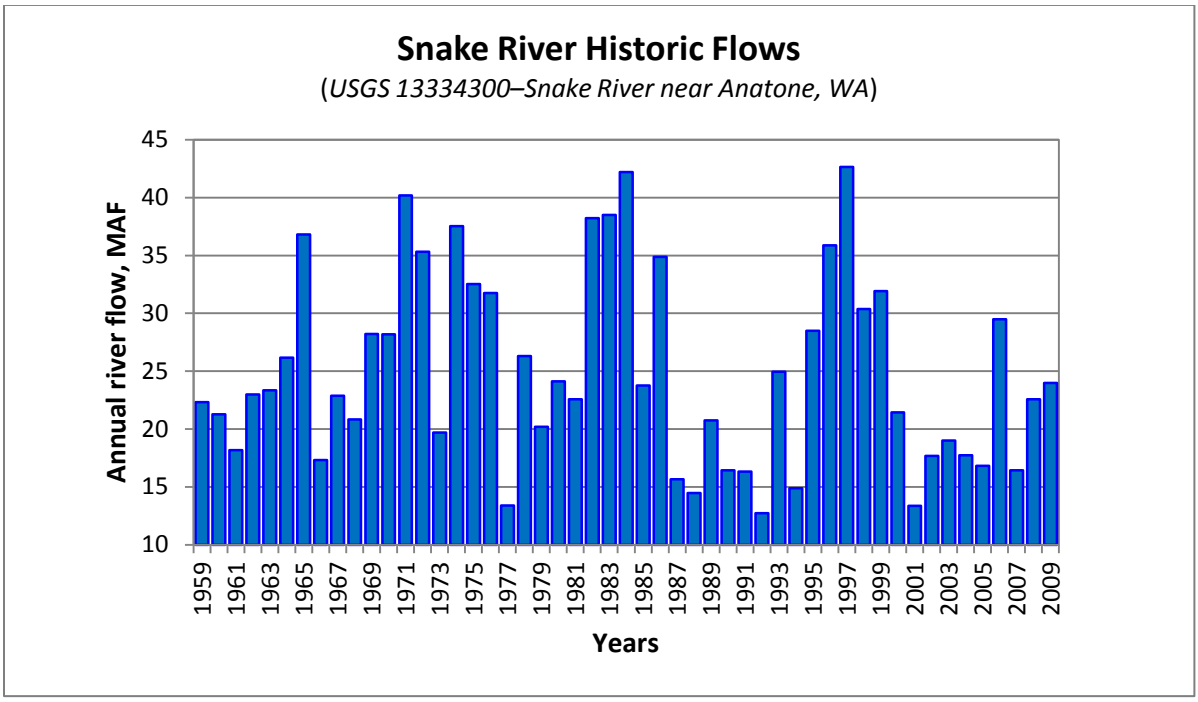

Dry Years Trend for South Fork Palouse River Flow
(South Fork Palouse River at Pullman, WA)
Annual river flow, Kac-ft
15
12
9
6
3
0
Linear Trend
y = -966.05x + 15612
1934
1942
1963
1966
1968
1977
2001
2005
Years

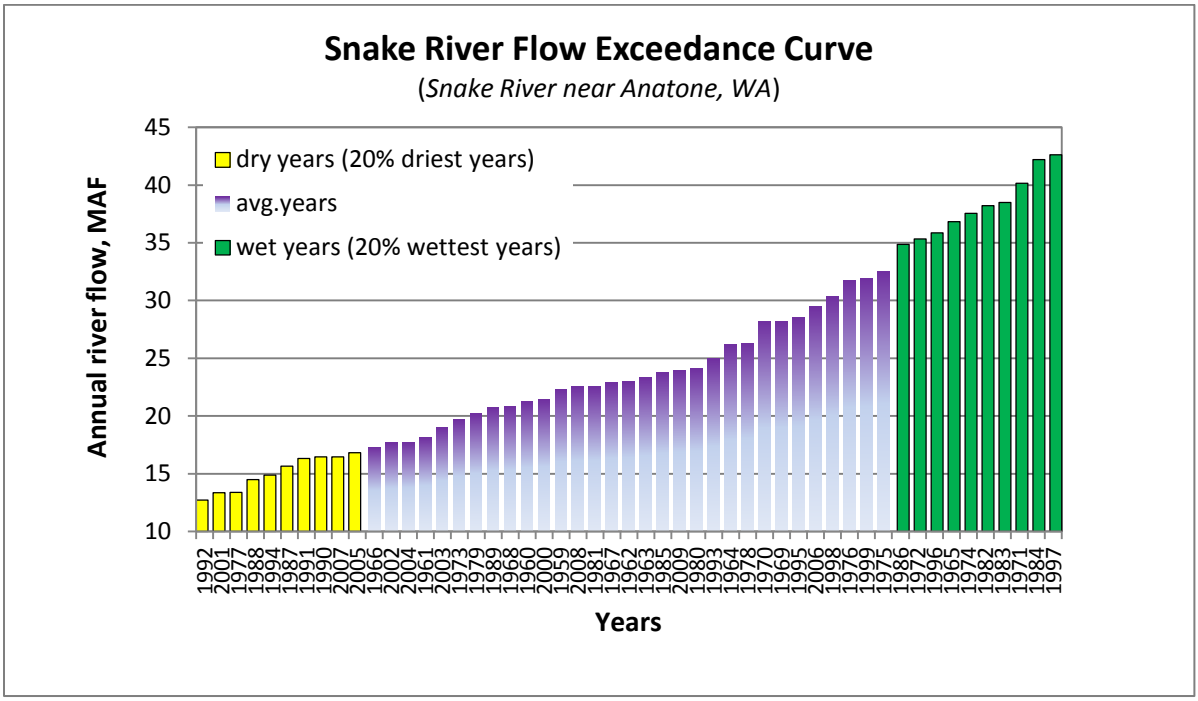

South Fork Palouse River Dry, Average and Wet Year Flows
(South Fork Palouse River at Pullman, WA)
River flow, cfs
800
600
400
200
0
Dry year (2001)
Avg.year(1941)
Wet year(1972)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

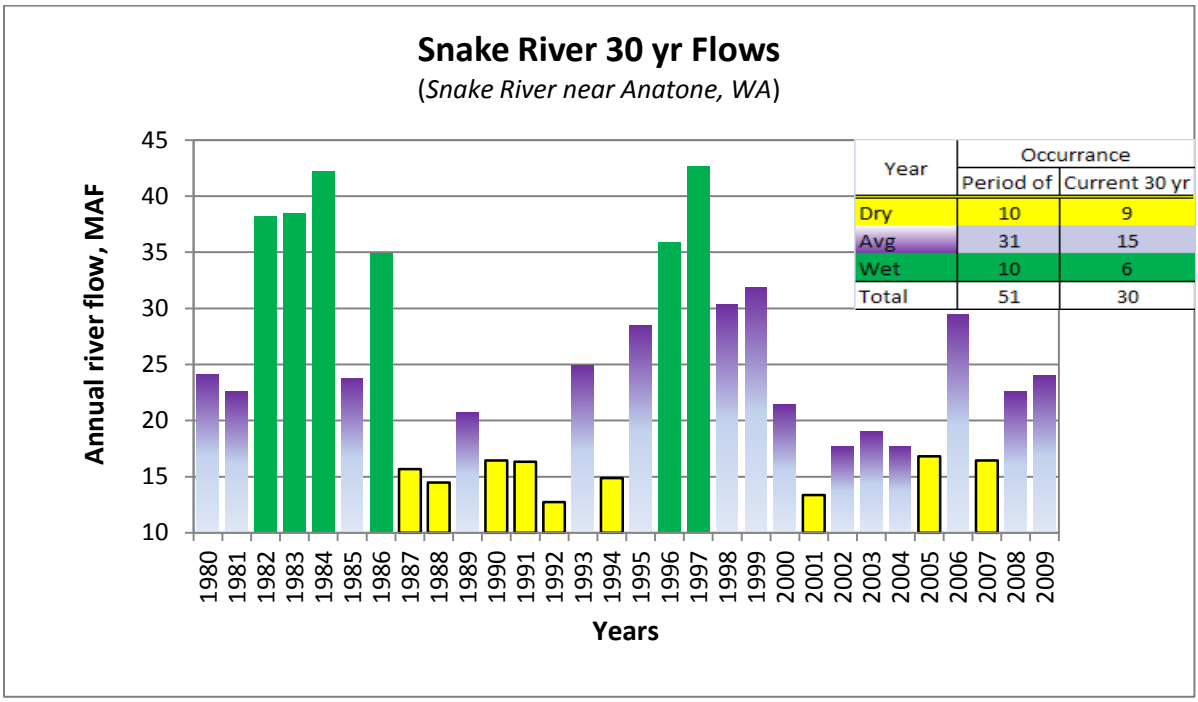

South Fork Palouse River All Dry Years Flow
(South Fork Palouse River at Pullman, WA)
River flow, cfs
400
300
200
100
0
1934
1942
1963
1966
1968
1977
2001
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

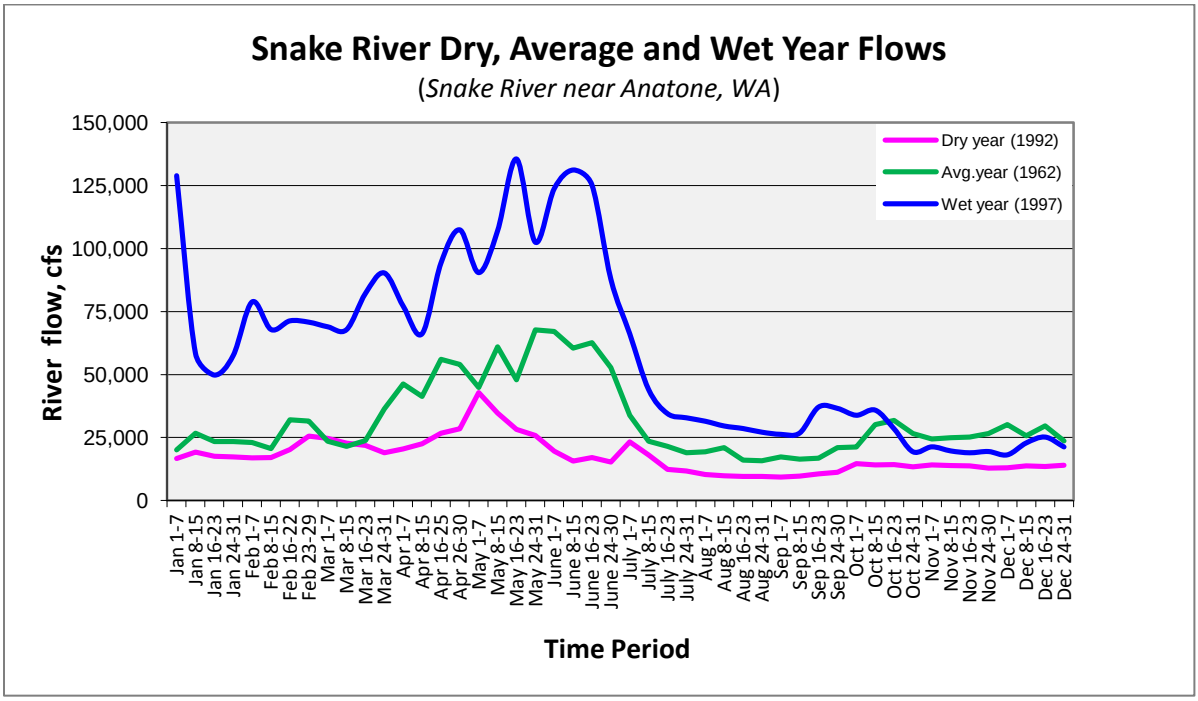

South Fork Palouse River All Wet Years Flow
(South Fork Palouse River at Pullman, WA)
River flow, cfs
1,000
800
600
400
200
0
1961
1969
1972
1974
1975
1976
1979
2009
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

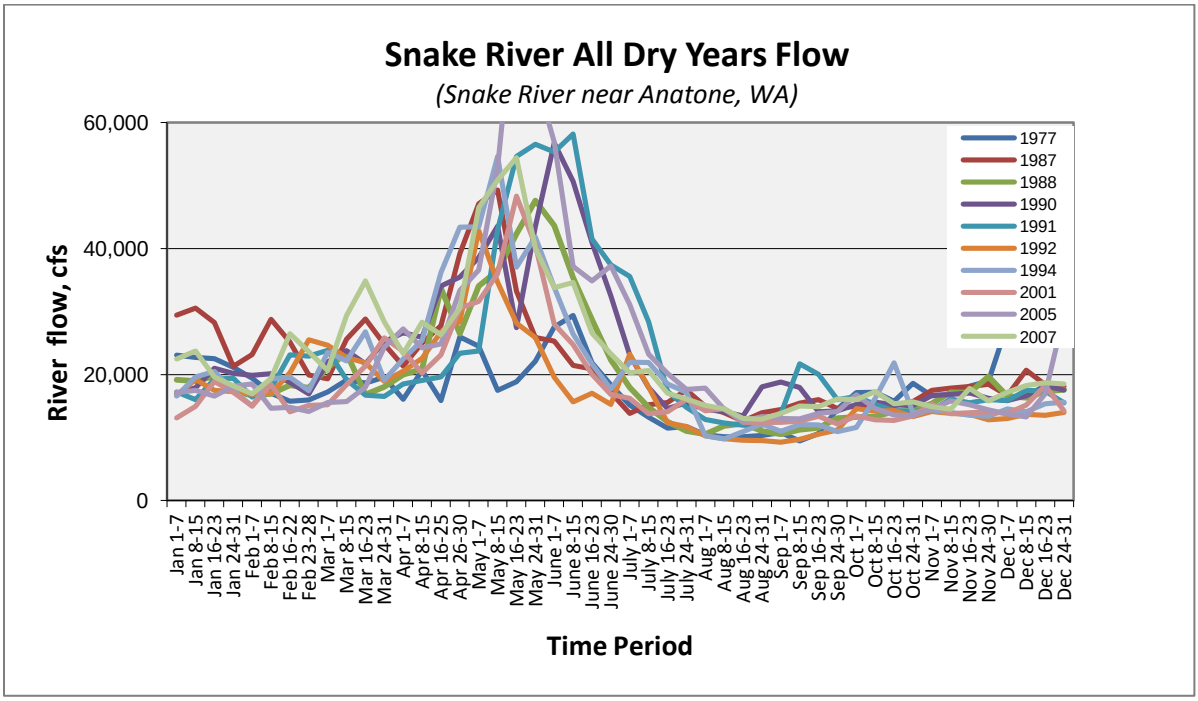
WRIA 35 (Middle Snake)

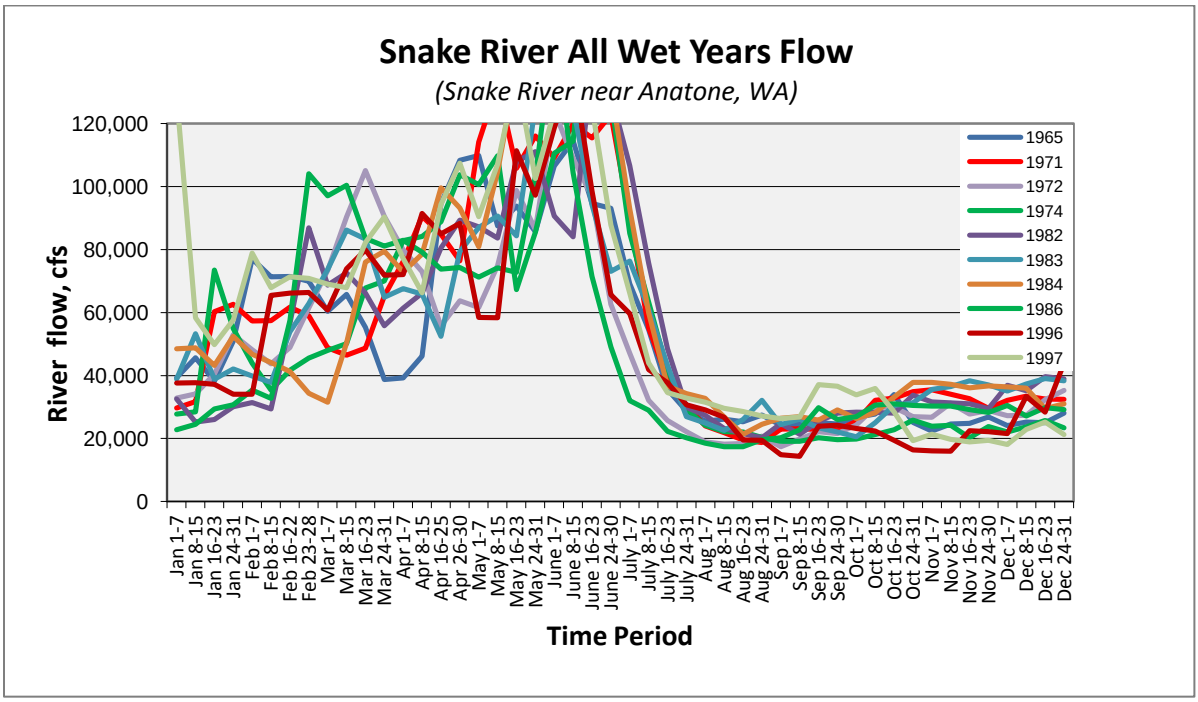


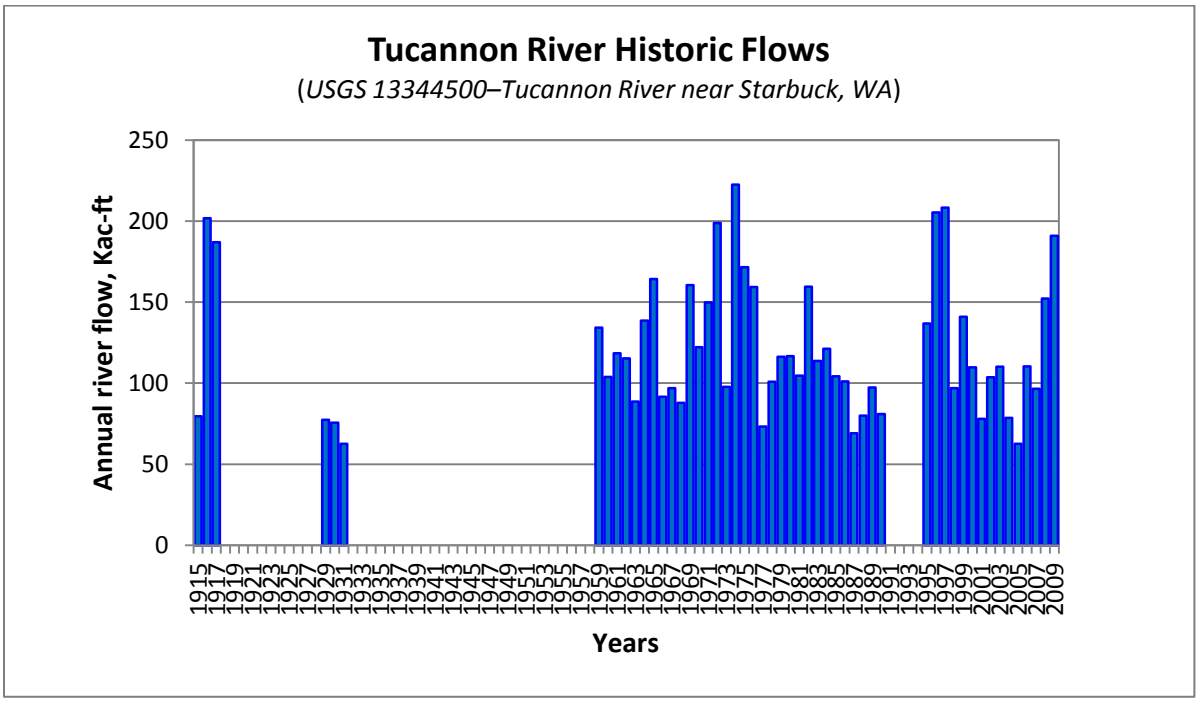


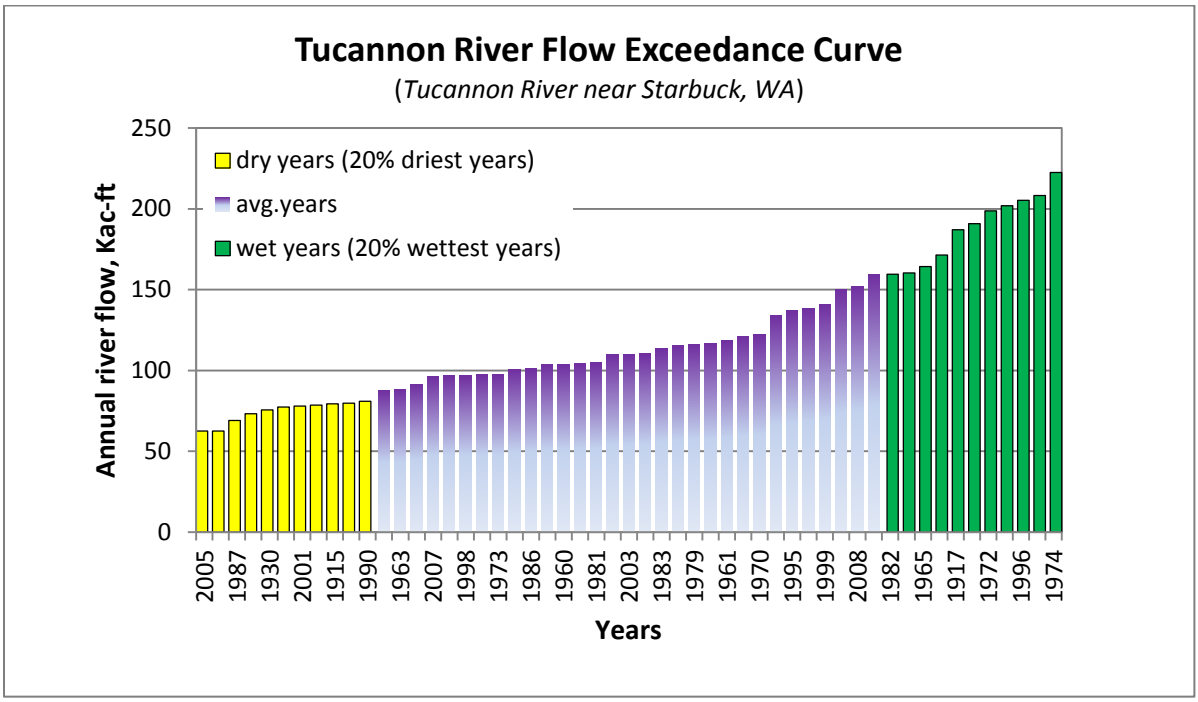

Snake River 30 yr Flows
(Snake River near Anatone, WA)
Annual river flow, MAF
45
40
35
30
25
20
15
10
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 10 9
Avg 31 15
Wet 10 6
Total 51 30

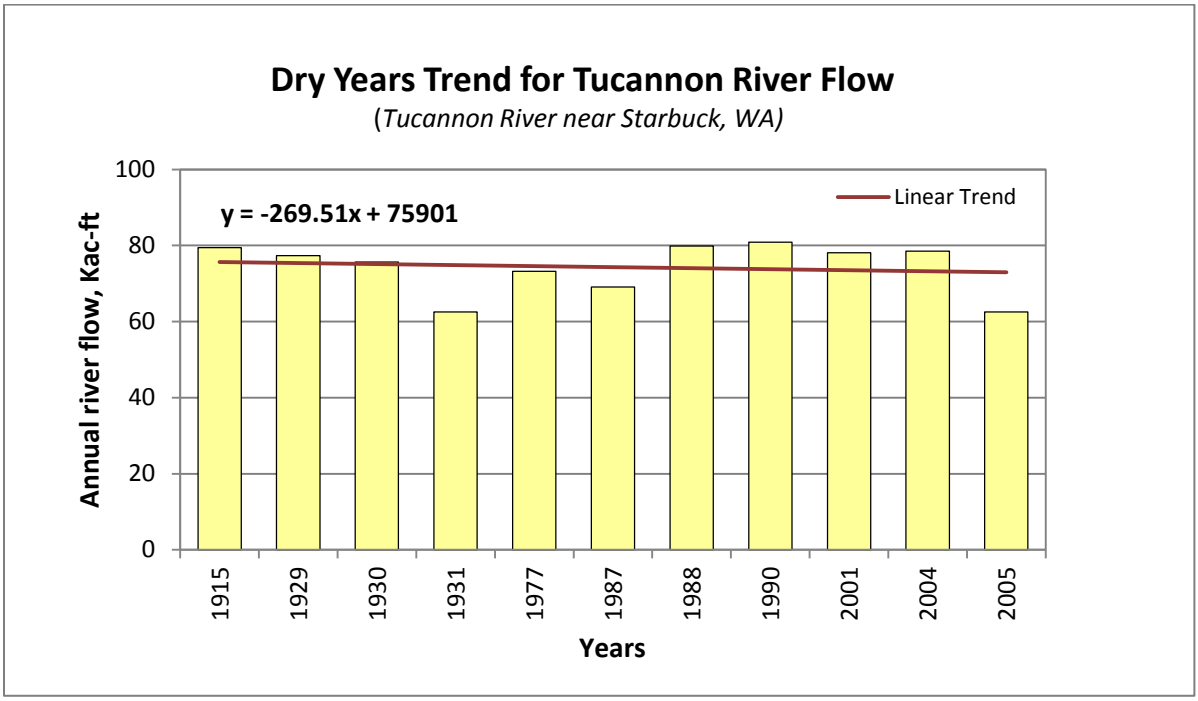

Snake River Dry, Average and Wet Year Flows
(Snake River near Anatone, WA)
River flow, cfs
150,000
125,000
100,000
75,000
50,000
25,000
0
Dry year (1992)
Avg.year (1962)
Wet year (1997)
Jan 1-7 Jan 8-15 Jan 16-23 Jan 24-31 Feb 1-7 Feb 8-15 Feb 16-22 Feb 23-29 Mar 1-7 Mar 8-15 Mar 16-23 Mar 24-31 Apr 1-7 Apr 8-15 Apr 16-25 Apr 26-30 May 1-7 May 8-15 May 16-23 May 24-31 June 1-7 June 8-15 June 16-23 June 24-30 July 1-7 July 8-15 July 16-23 July 24-31 Aug 1-7 Aug 8-15 Aug 16-23 Aug 24-31 Sep 1-7 Sep 8-15 Sep 16-23 Sep 24-30 Oct 1-7 Oct 8-15 Oct 16-23 Oct 24-31 Nov 1-7 Nov 8-15 Nov 16-23 Nov 24-30 Dec 1-7 Dec 8-15 Dec 16-23 Dec 24-31
Time Period

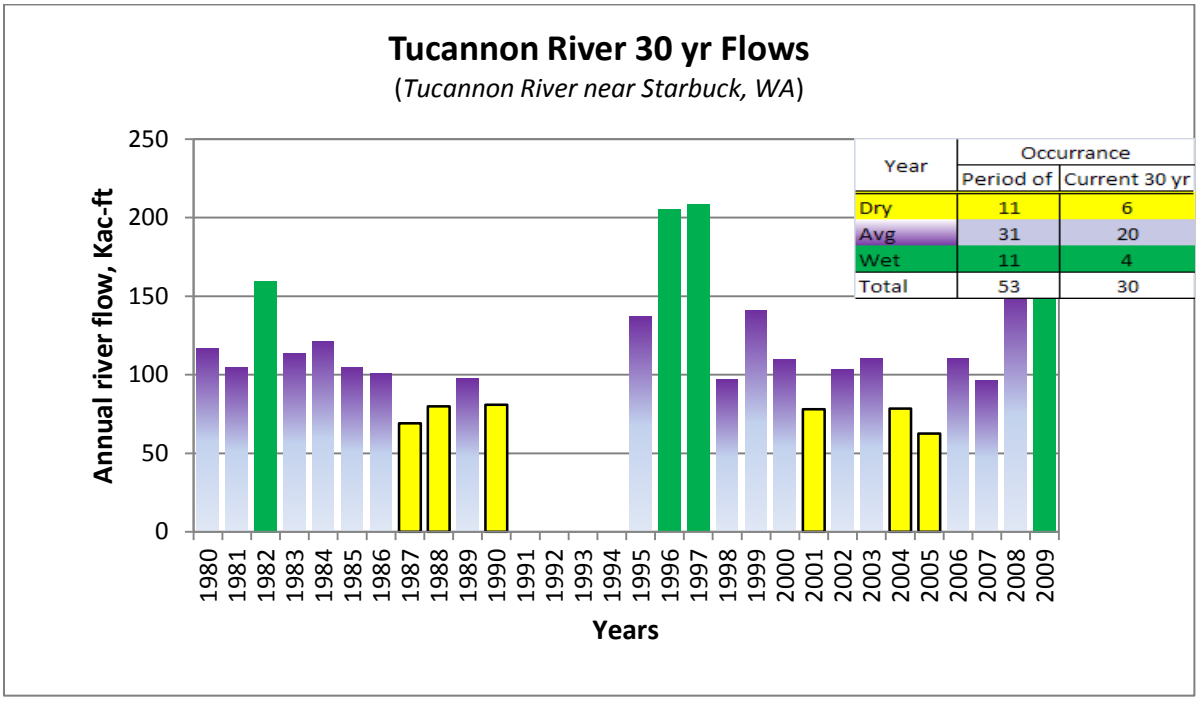

Snake River All Dry Years Flow
(Snake River near Anatone, WA)
River flow, cfs
60,000
40,000
20,000
0
1977
1987
1988
1990
1991
1992
1994
2001
2005
2007
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

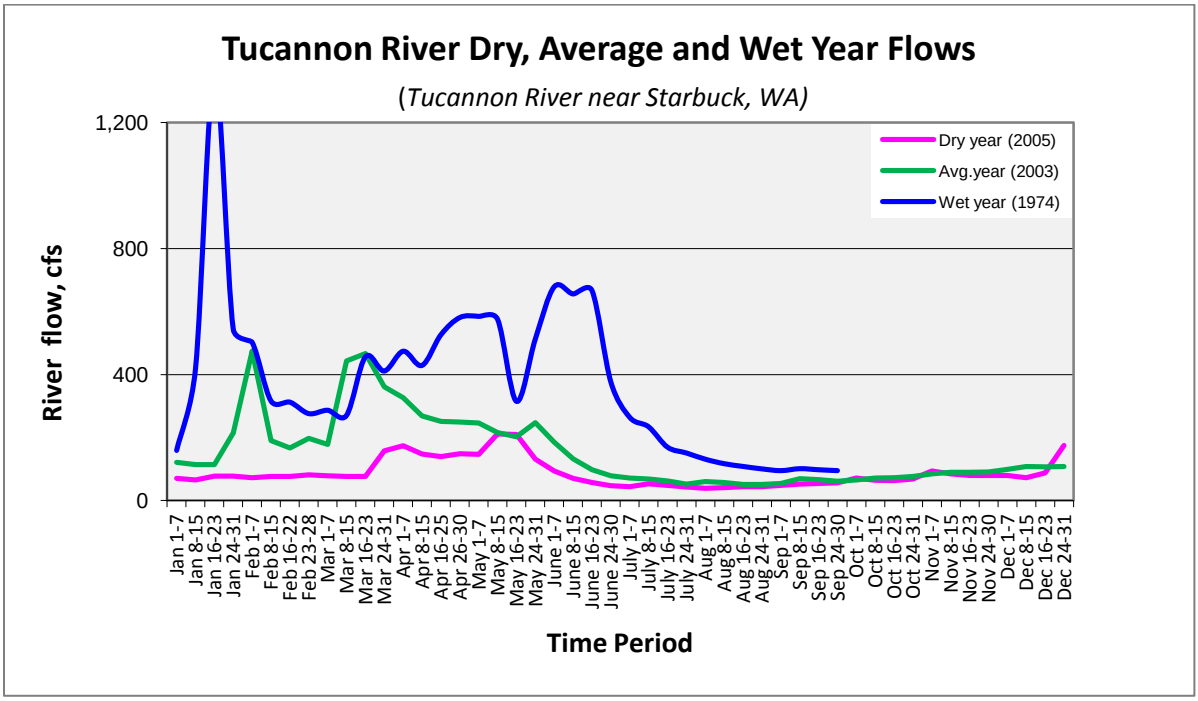

Snake River All Wet Years Flow
(Snake River near Anatone, WA)
River flow, cfs
120,000
100,000
80,000
60,000
40,000
20,000
0
1965
1971
1972
1974
1982
1983
1984
1986
1996
1997
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

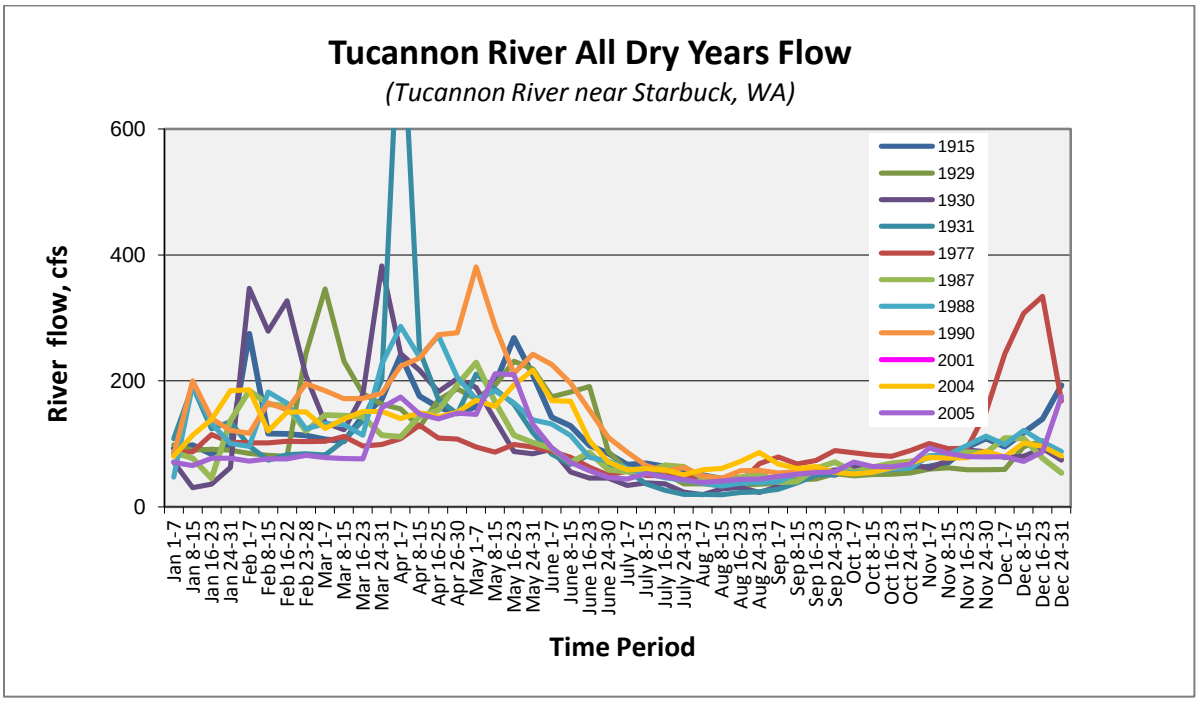

Tucannon River Historic Flows
(USGS 13344500–Tucannon River near Starbuck, WA)
Annual river flow, Kac-ft
250
200
150
100
50
0
1915 1917 1919 1921 1923 1925 1927 1929 1931 1933 1935 1937 1939 1941 1943 1945 1947 1949 1951 1953 1955 1957 1959 1961 1963 1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009
Years

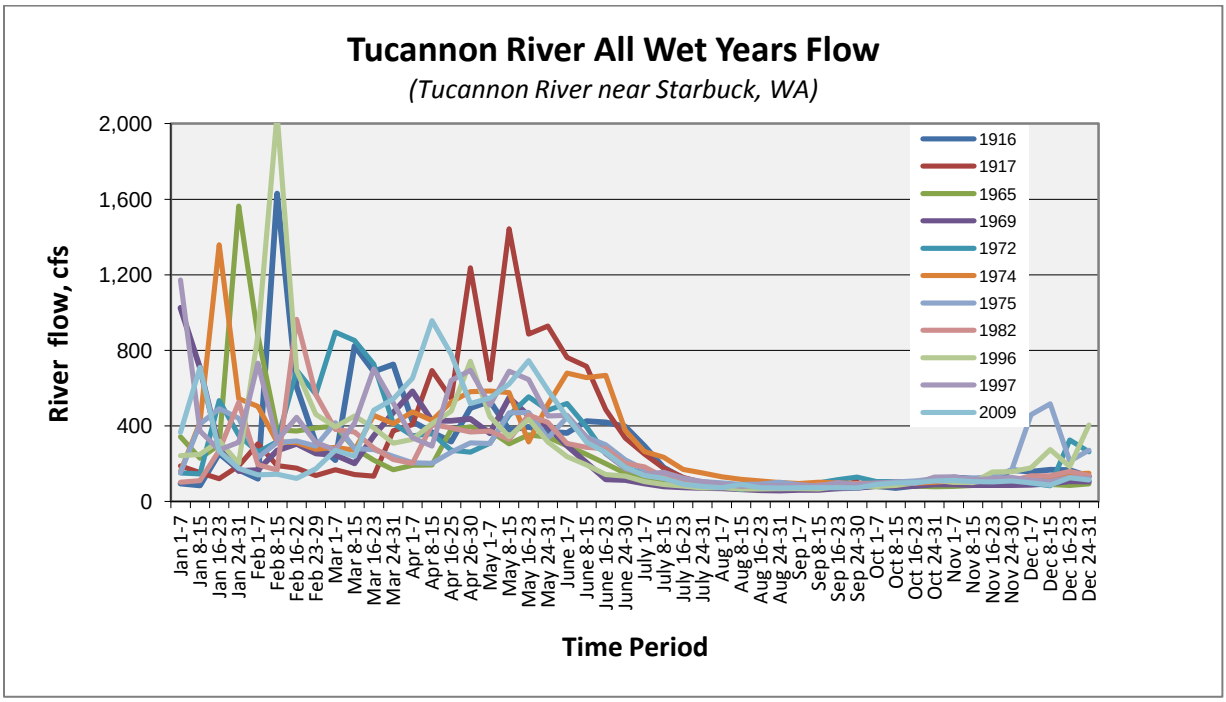

Tucannon River Flow Exceedance Curve
(Tucannon River near Starbuck, WA)
Annual river flow, Kac-ft
250
200
150
100
50
0
dry years (20% driest years)
avg.years
wet years (20% wettest years)
2005 1987 1930 2001 1915 1990 1963 2007 1998 1973 1986 1960 1981 2003 1983 1979 1961 1970 1995 1999 2008 1982 1965 1917 1972 1996 1974
Years


Dry Years Trend for Tucannon River Flow
(Tucannon River near Starbuck, WA)
y = -269.51x + 75901
Linear Trend
Annual river flow, Kac-ft
100
80
60
40
20
0
1915
1929
1930
1931
1977
1987
1988
1990
2001
2004
2005
Years

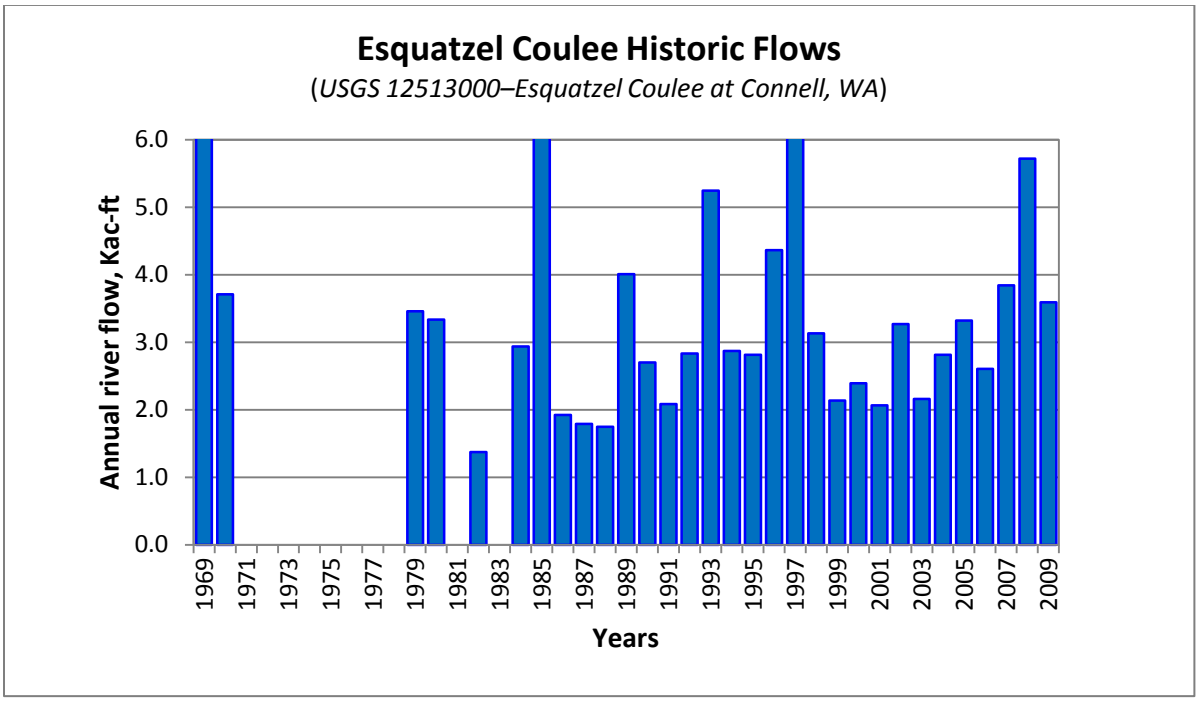

Tucannon River 30 yr Flows
(Tucannon River near Starbuck, WA)
Annual river flow, Kac-ft
250
200
150
100
50
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 11 6
Avg 31 20
Wet 11 4
Total 53 30

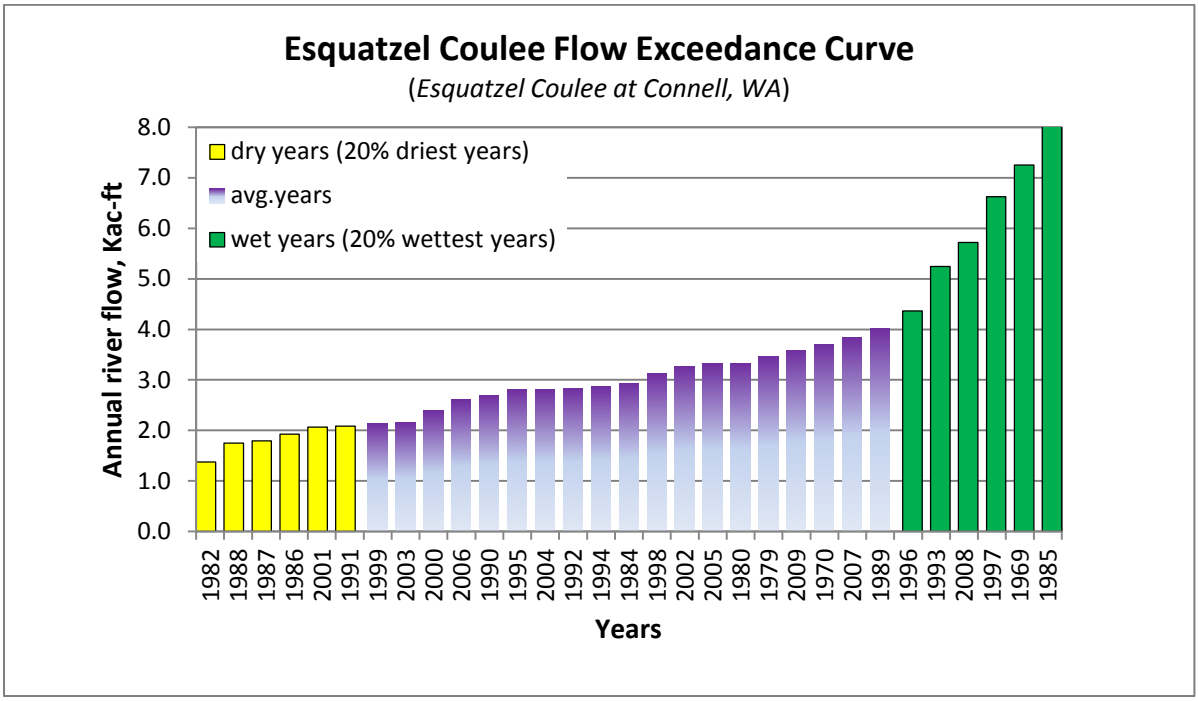

Tucannon River Dry, Average and Wet Year Flows
(Tucannon River near Starbuck, WA)
River flow, cfs
1,200
800
400
0
Dry year (2005)
Avg.year (2003)
Wet year (1974)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

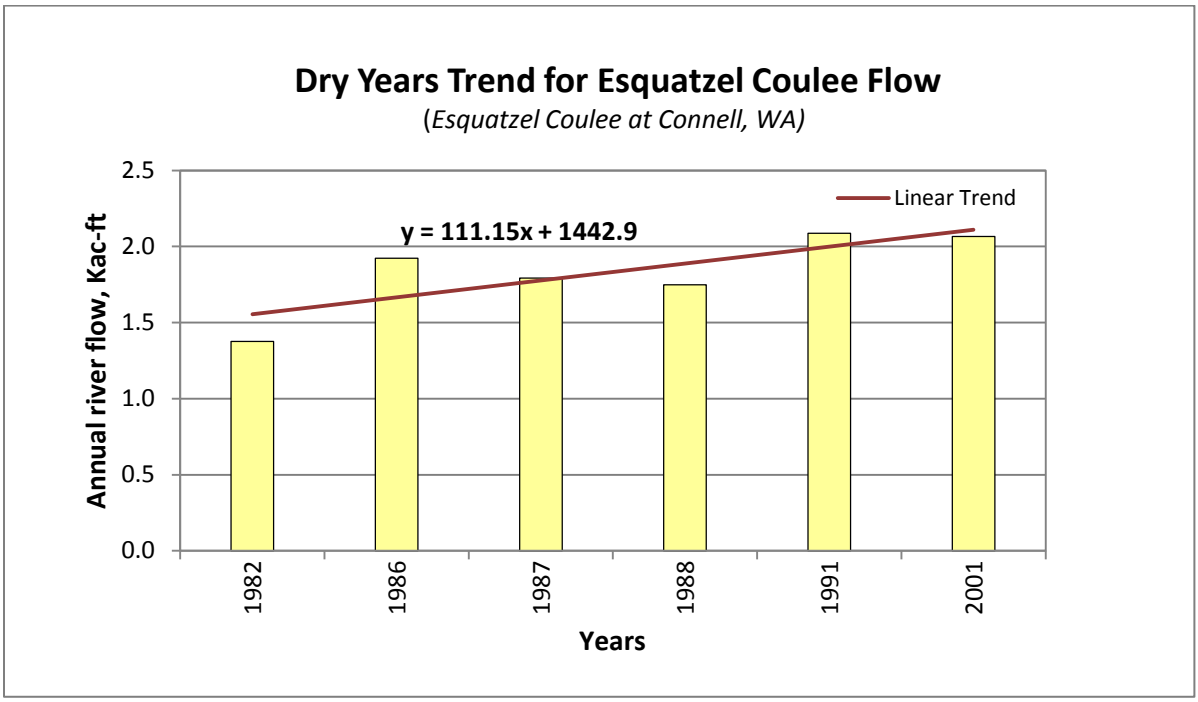

Tucannon River All Dry Years Flow
(Tucannon River near Starbuck, WA)
River flow, cfs
600
400
200
0
1915
1929
1930
1931
1977
1987
1988
1990
2001
2004
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

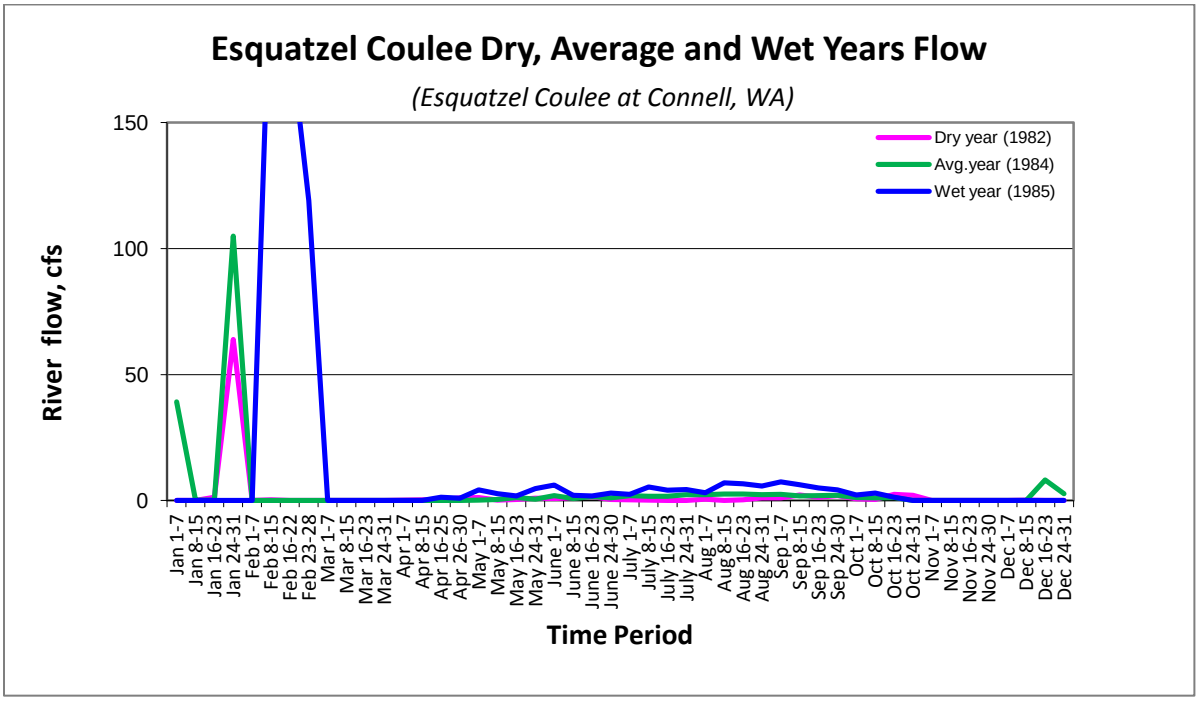

Tucannon River All Wet Years Flow
(Tucannon River near Starbuck, WA)
River flow, cfs
2,000
1,600
1,200
800
400
0
1916
1917
1965
1969
1972
1974
1975
1982
1996
1997
2009
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

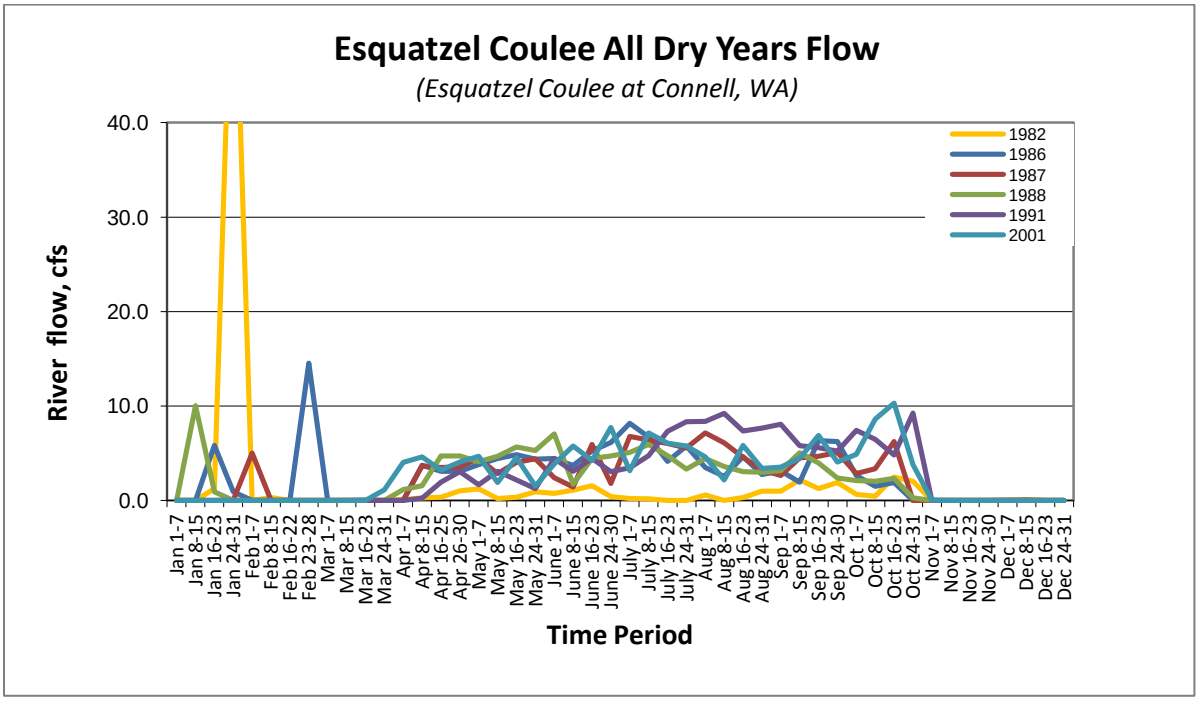
WRIA 36 (Esquatzel Coulee)

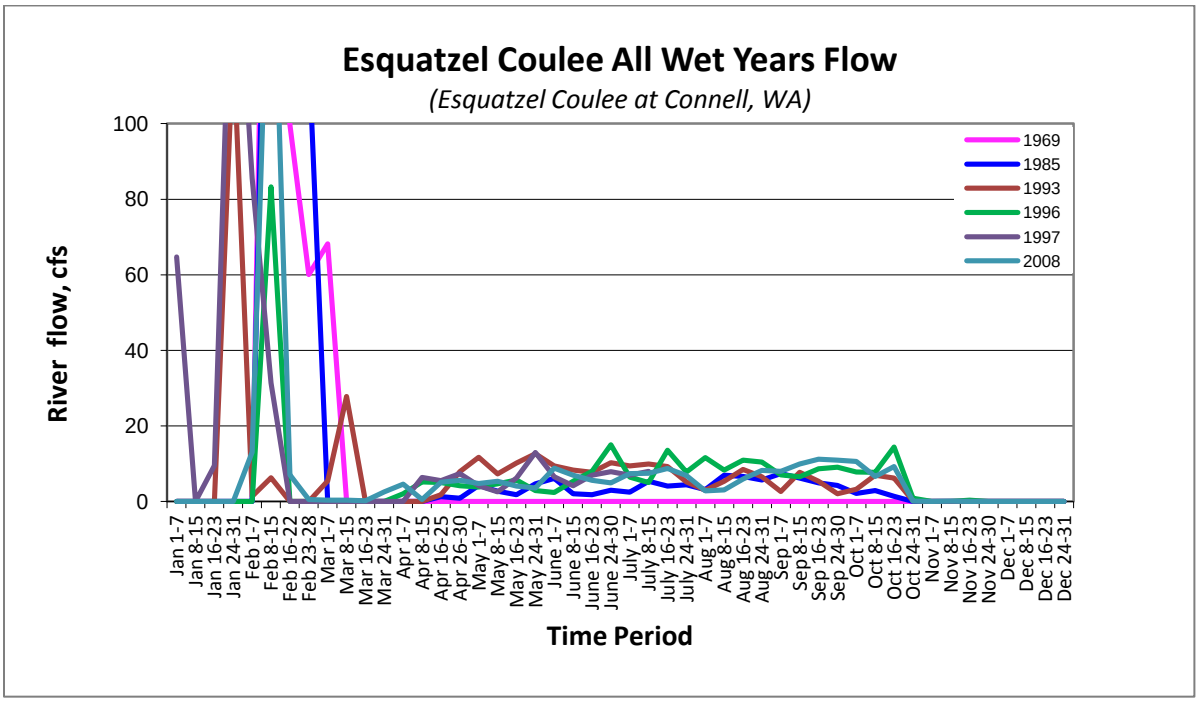





Dry Years Trend for Esquatzel Coulee Flow
(Esquatzel Coulee at Connell, WA)
Annual river flow, Kac-ft
2.5
2.0
1.5
1.0
0.5
0.0
y = 111.15x + 1442.9
Linear Trend
1982
1986
1987
1988
1991
2001
Years


Esquatzel Coulee Dry, Average and Wet Years Flow
(Esquatzel Coulee at Connell, WA)
River flow, cfs
150
100
50
0
Dry year (1982)
Avg.year (1984)
Wet year (1985)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Esquatzel Coulee All Dry Years Flow
(Esquatzel Coulee at Connell, WA)
River flow, cfs
40.0
30.0
20.0
10.0
0.0
1982
1986
1987
1988
1991
2001
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

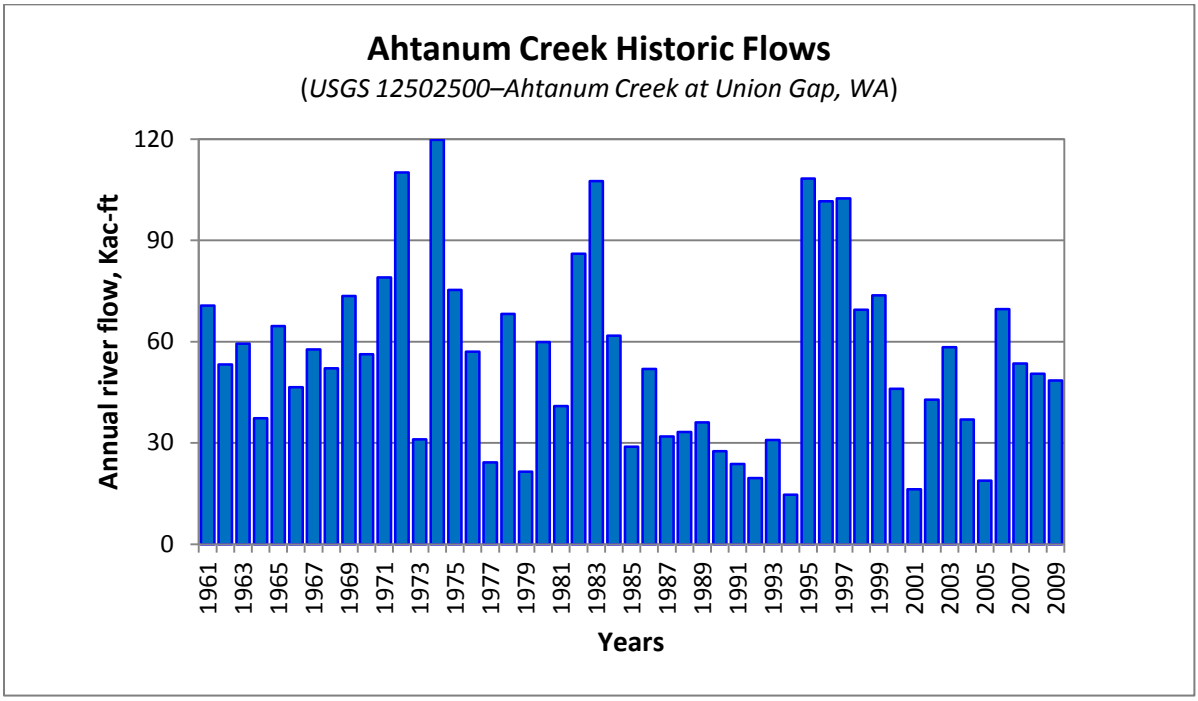

Esquatzel Coulee All Wet Years Flow
(Esquatzel Coulee at Connell, WA)
River flow, cfs
100
80
60
40
20
0
1969
1985
1993
1996
1997
2008
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

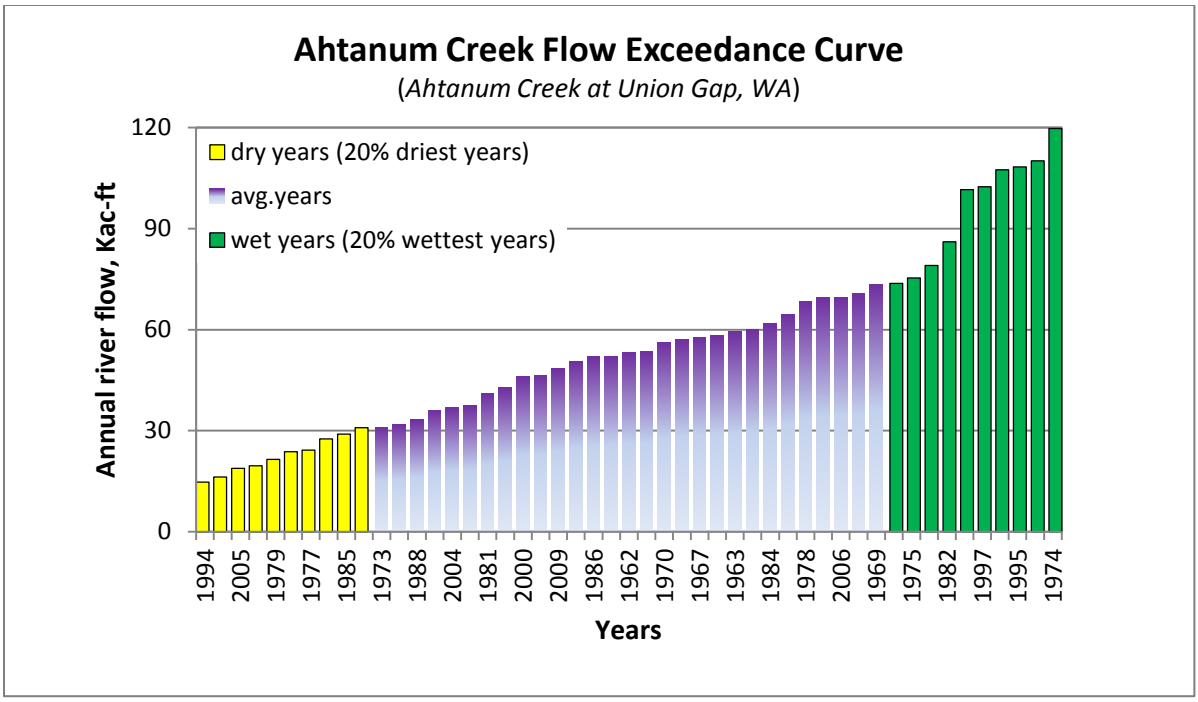
WRIA 37 (Lower Yakima)

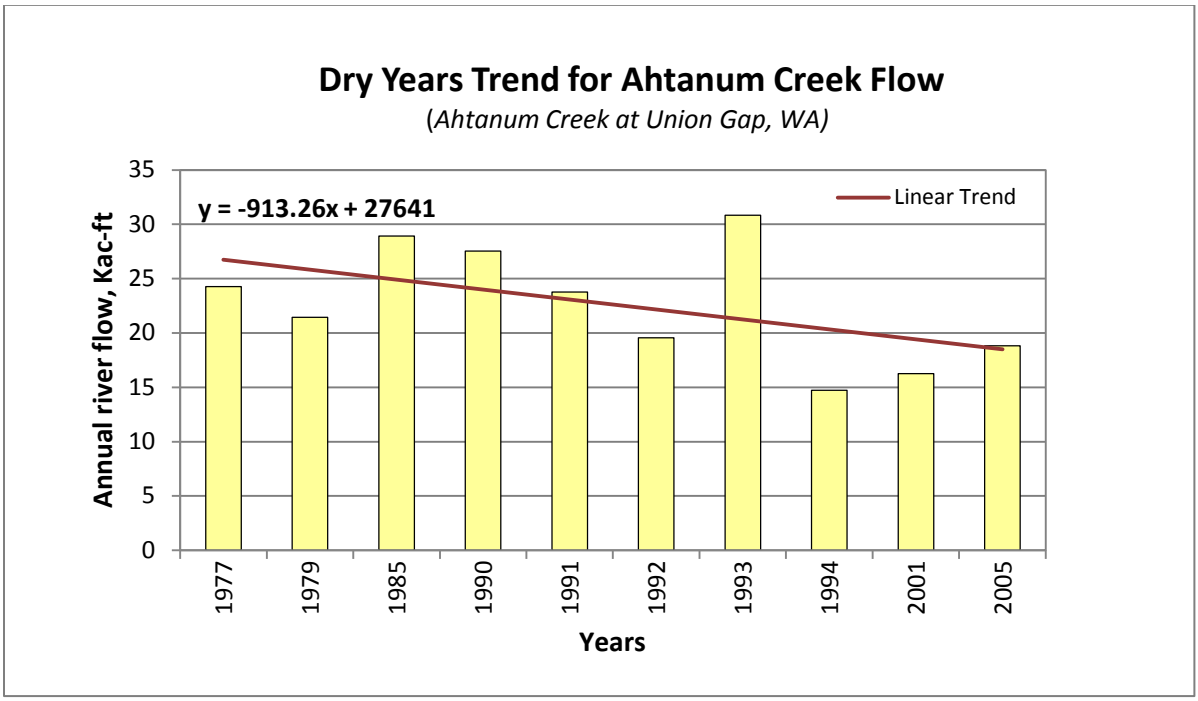
For WRIA 37, OCR graphed the flows of 3 rivers and streams. For most rivers and streams, a series of six to eight graphs were created. The results provide information on historic flow levels and drought occurrences. These data contribute to OCR's understanding of historic trends, drought patterns and hydrograph variability. For example, by graphing the 104 year (1906–2009) flows of the Yakima River near Kiona, gauge number 12510500, it is shown that:

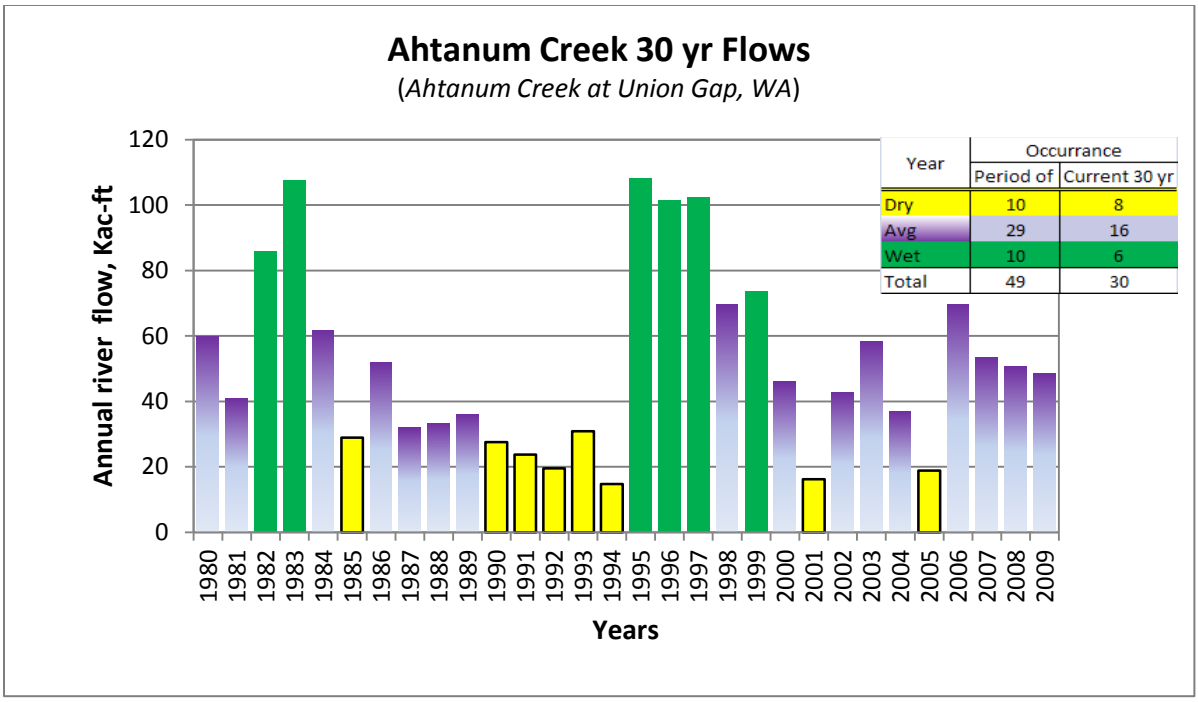
- Historic mean annual flows generally varied between 1.0 and 5.0 million acre-feet (MAF).
- Ecology defined "dry" years as the 80% exceedance value (80% of the time more water was available). Over the last 30 years, dry years occurred 8 times, with the worst stretch being 3 consecutive dry years in 1992-1994. During this same time period, the availability of water during dry years worsened by 26 %.

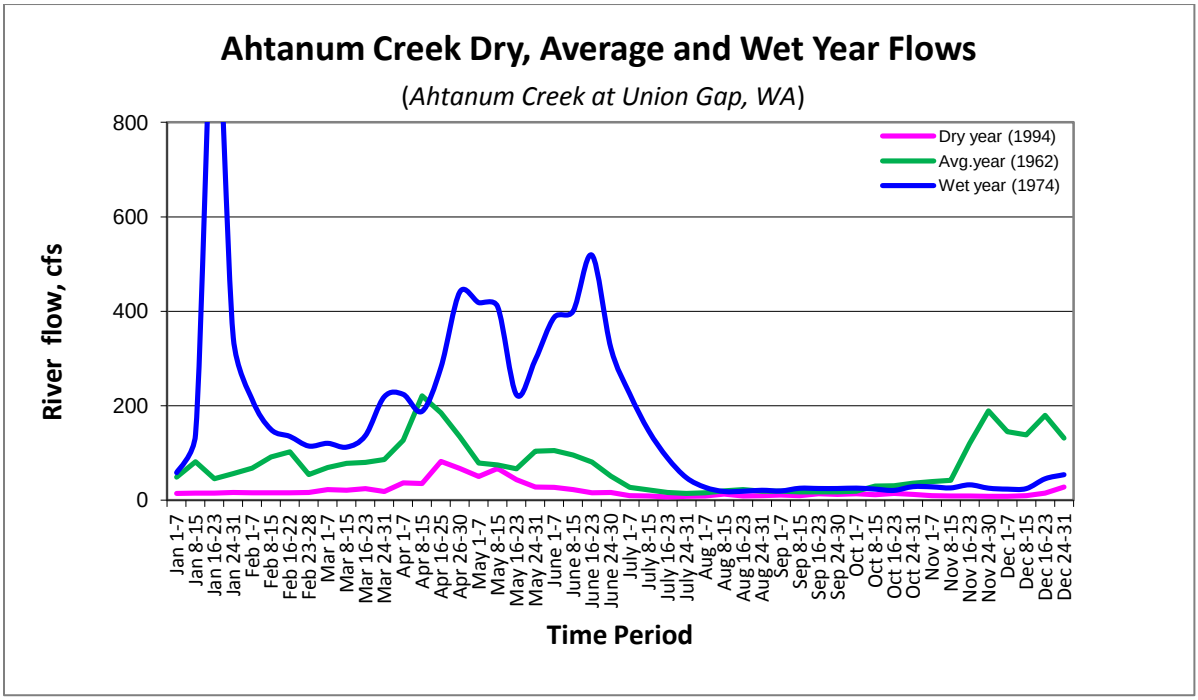
OCR can use this information to recognize where water is needed, when water is available and whether or not the in-basin or out-of-basin water supply development can help meet the WRIA's water demands.

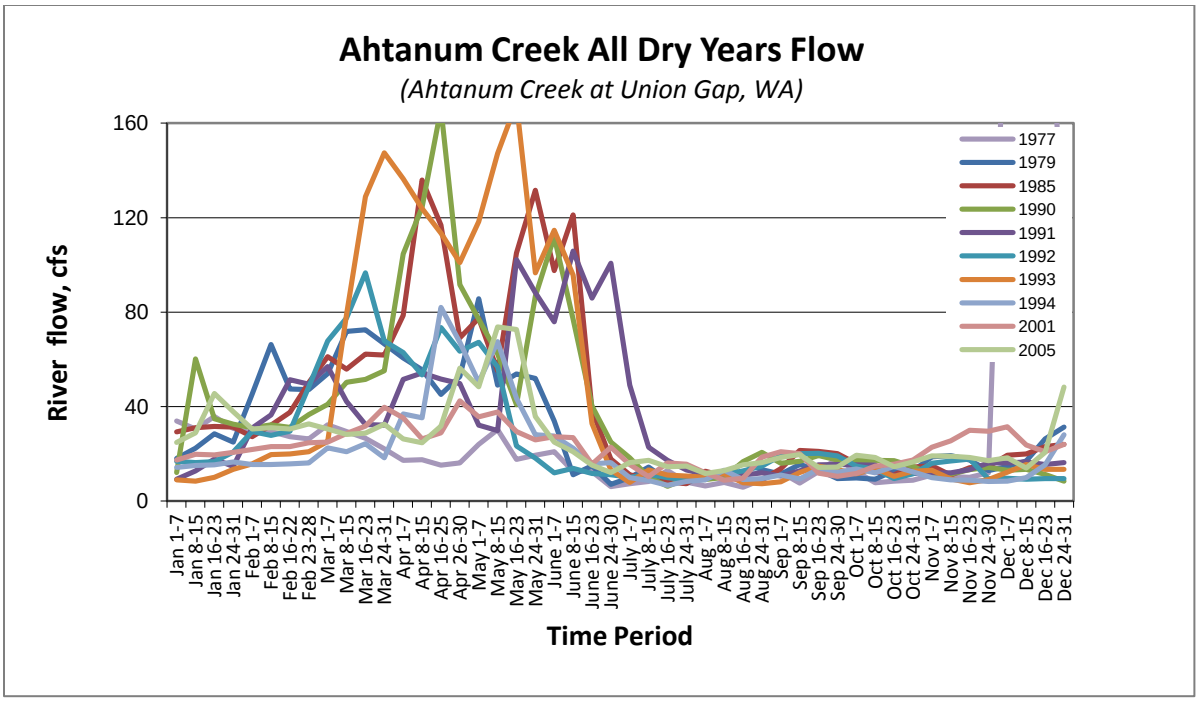


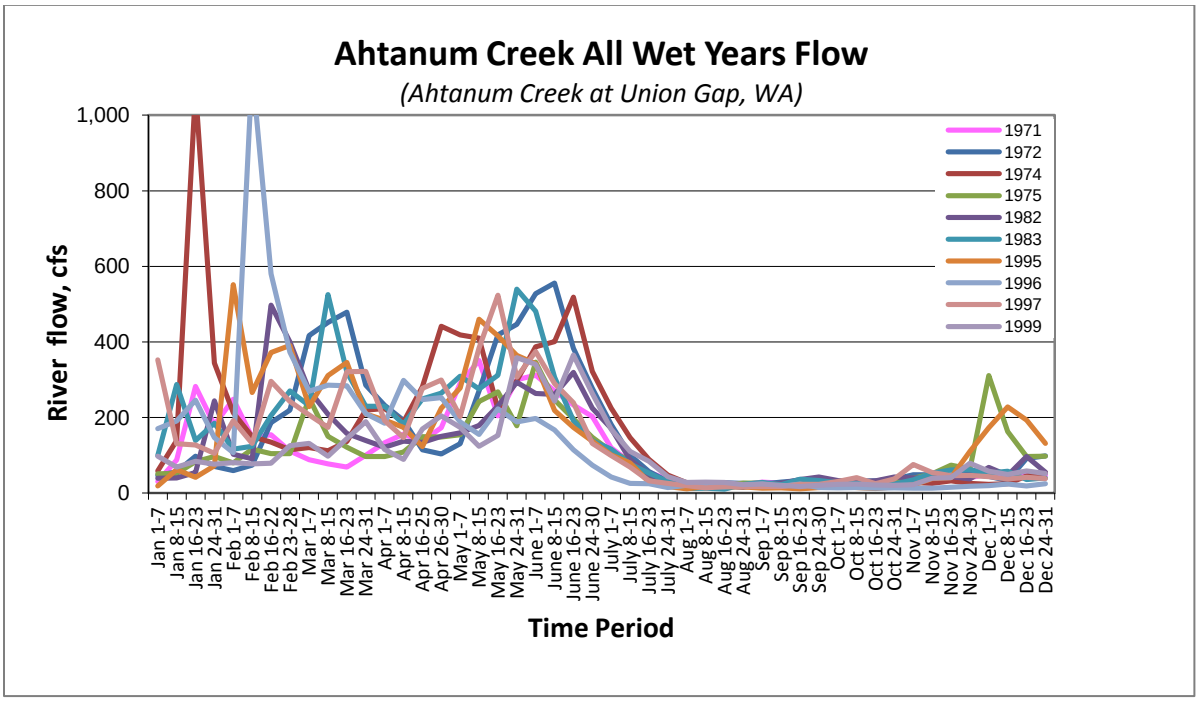

Ahtanum Creek Flow Exceedance Curve
(Ahtanum Creek at Union Gap, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, Kac-ft
120
90
60
30
0
1994 2005 1979 1977 1985 1973 1988 2004 1981 2000 2009 1986 1962 1970 1967 1963 1984 1978 2006 1969 1975 1982 1997 1995 1974
Years

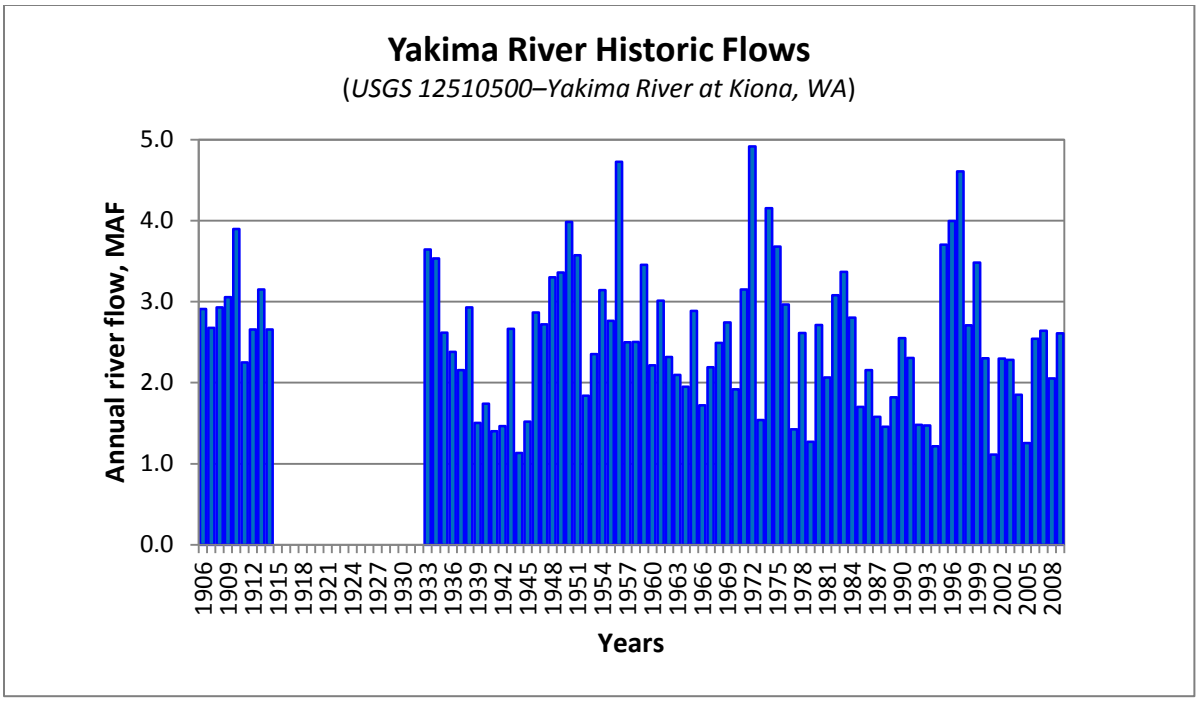

Dry Years Trend for Ahtanum Creek Flow
(Ahtanum Creek at Union Gap, WA)
y = -913.26x + 27641
Linear Trend
Annual river flow, Kac-ft
35
30
25
20
15
10
5
0
1977 1979 1985 1990 1991 1992 1993 1994 2001 2005
Years

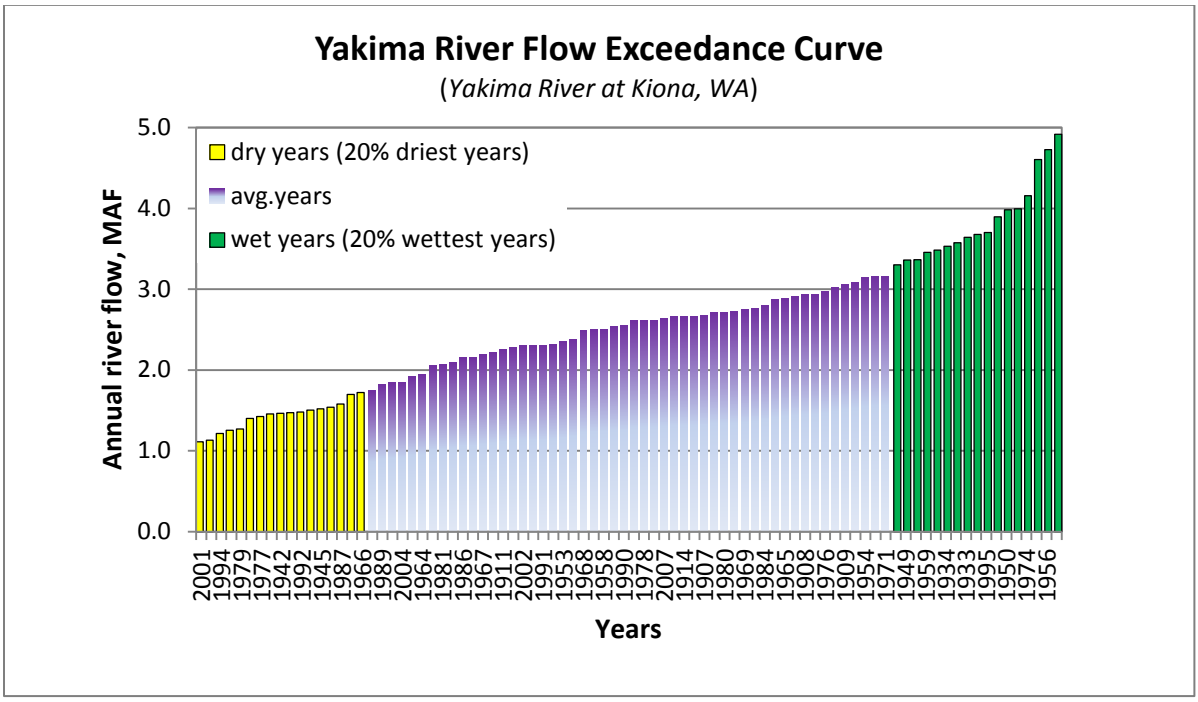

Ahtanum Creek 30 yr Flows
(Ahtanum Creek at Union Gap, WA)
Annual river flow, Kac-ft
120
100
80
60
40
20
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry
10
8
Avg
29
16
Wet
10
6
Total
49
30

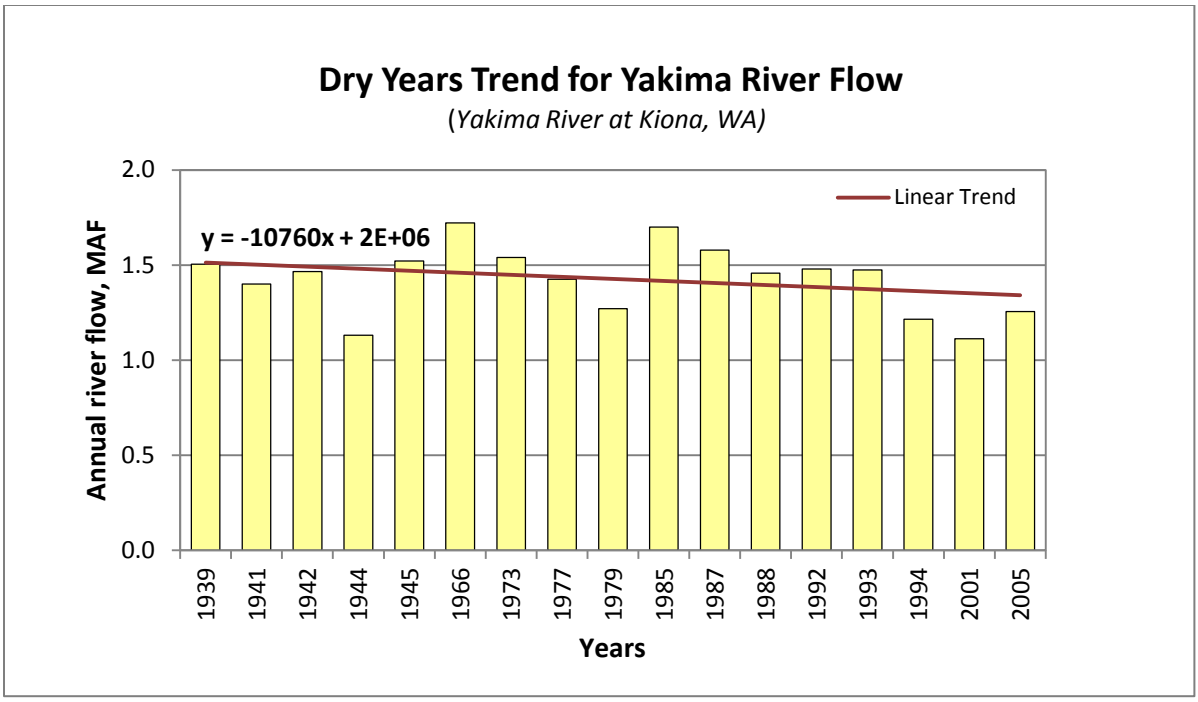

Ahtanum Creek Dry, Average and Wet Year Flows
(Ahtanum Creek at Union Gap, WA)
River flow, cfs
800
600
400
200
0
Dry year (1994)
Avg.year (1962)
Wet year (1974)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

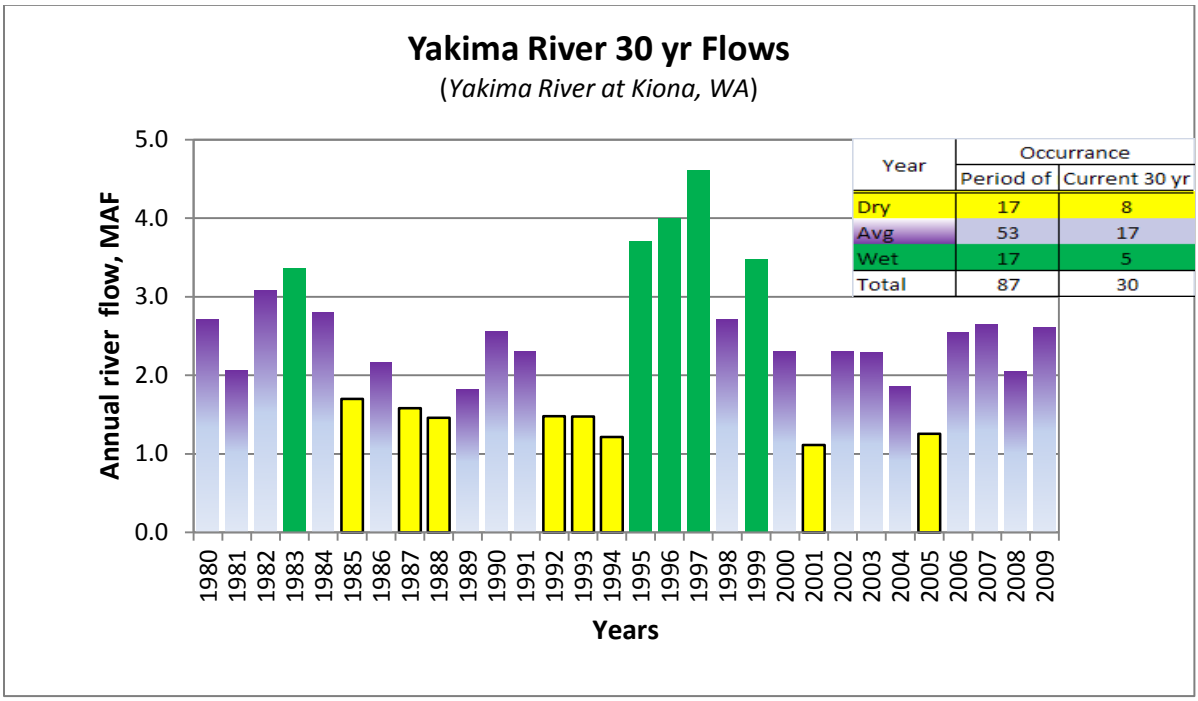

Ahtanum Creek All Dry Years Flow
(Ahtanum Creek at Union Gap, WA)
River flow, cfs
160
120
80
40
0
1977
1979
1985
1990
1991
1992
1993
1994
2001
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

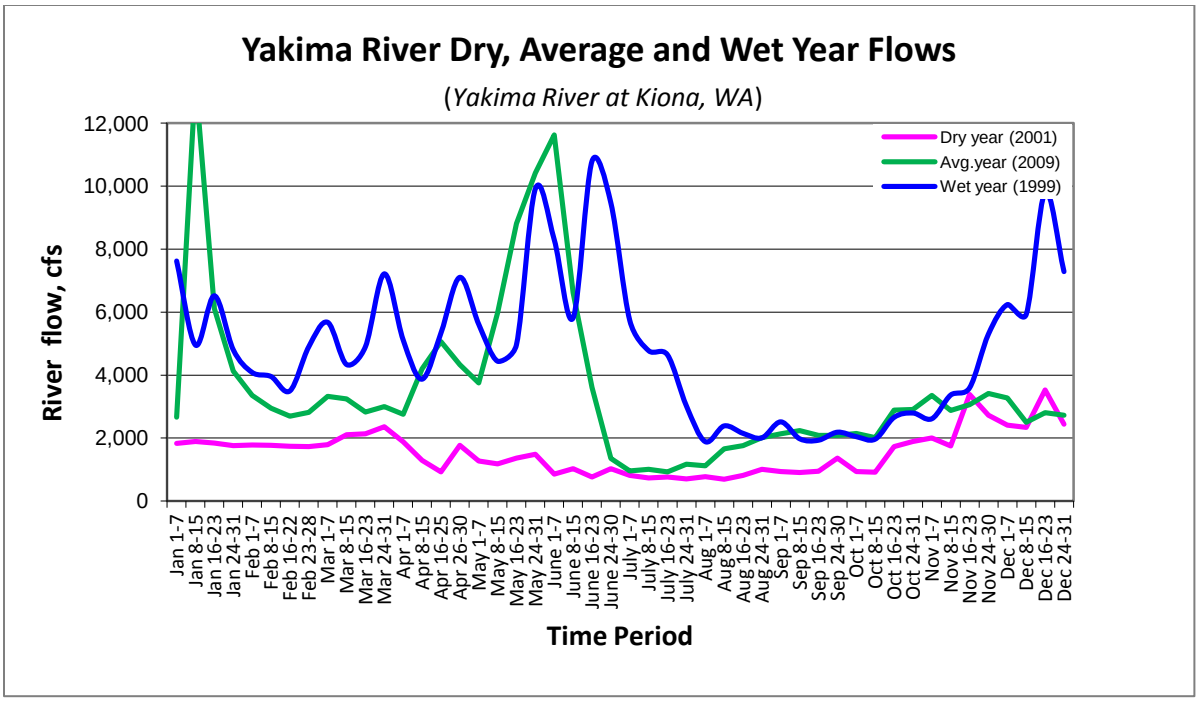

Ahtanum Creek All Wet Years Flow
(Ahtanum Creek at Union Gap, WA)
River flow, cfs
1,000
800
600
400
200
0
1971
1972
1974
1975
1982
1983
1995
1996
1997
1999
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

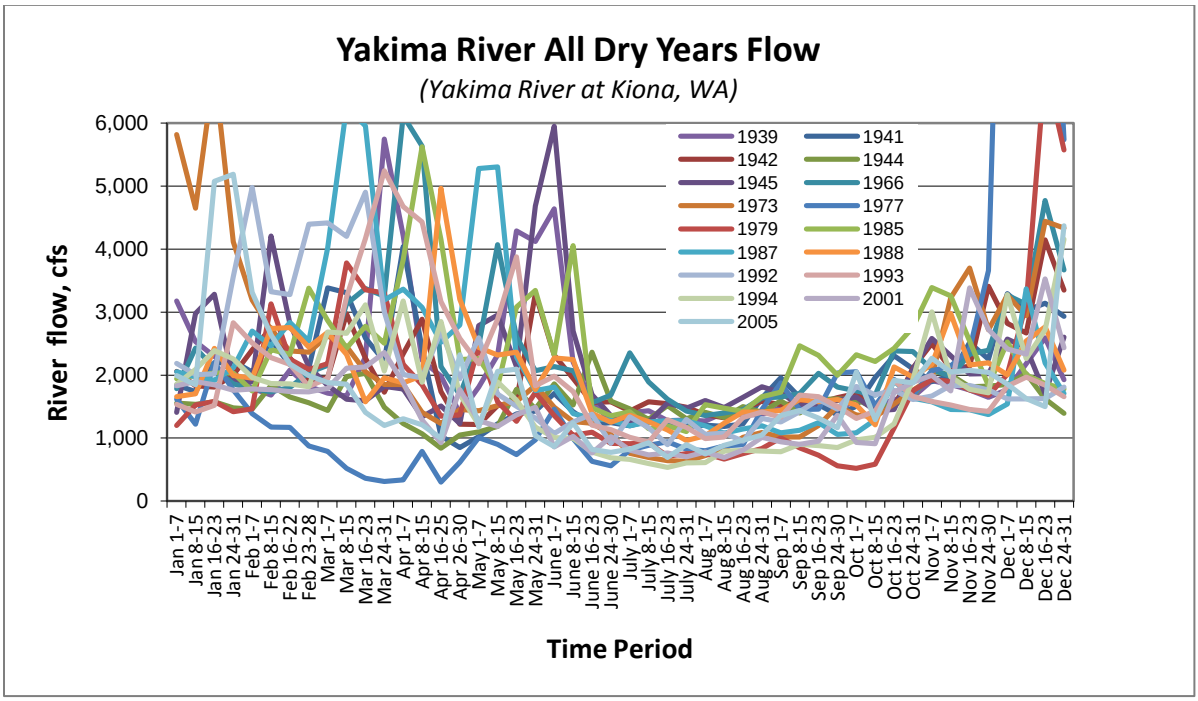

Yakima River Historic Flows
(USGS 12510500–Yakima River at Kiona, WA)
Annual river flow, MAF
5.0
4.0
3.0
2.0
1.0
0.0
1906 1909 1912 1915 1918 1921 1924 1927 1930 1933 1936 1939 1942 1945 1948 1951 1954 1957 1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999 2002 2005 2008
Years

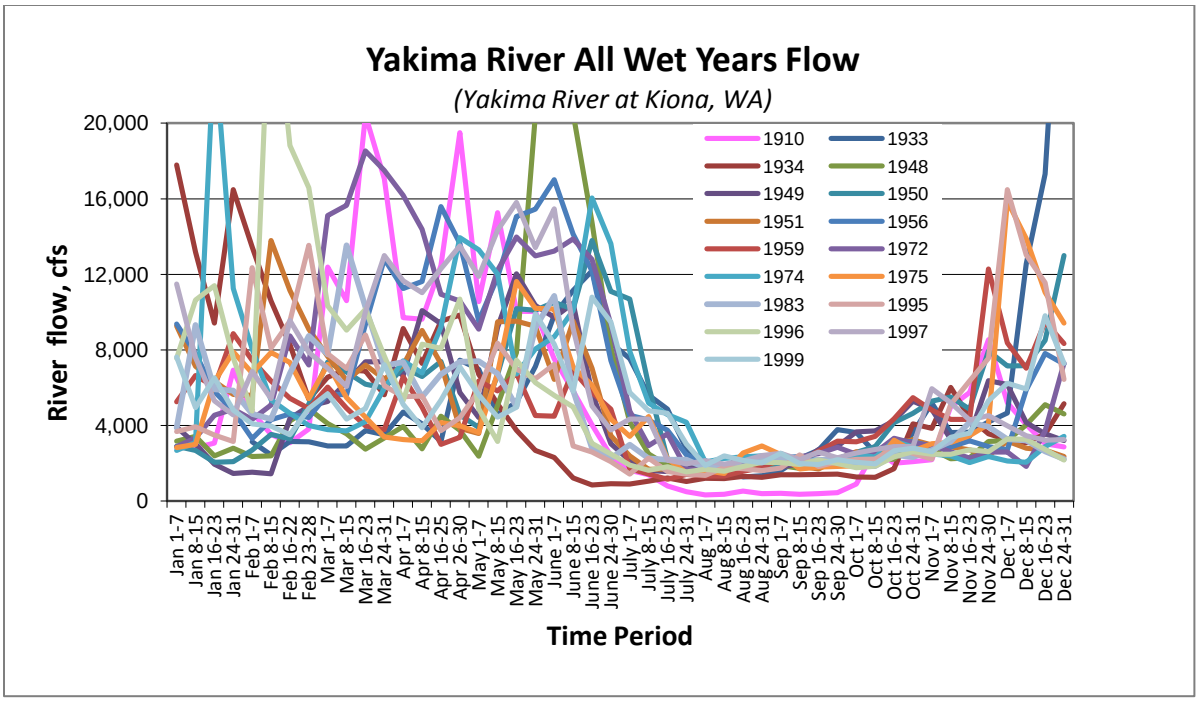

Yakima River Flow Exceedance Curve
(Yakima River at Kiona, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, MAF
5.0
4.0
3.0
2.0
1.0
0.0
2001 1994 1979 1977 1942 1992 1945 1987 1966 1989 2004 1964 1981 1986 1967 1911 2002 1991 1953 1968 1958 1990 1978 2007 1914 1907 1980 1969 1984 1965 1908 1976 1909 1954 1971 1949 1959 1934 1935 1995 1950 1974 1956
Years

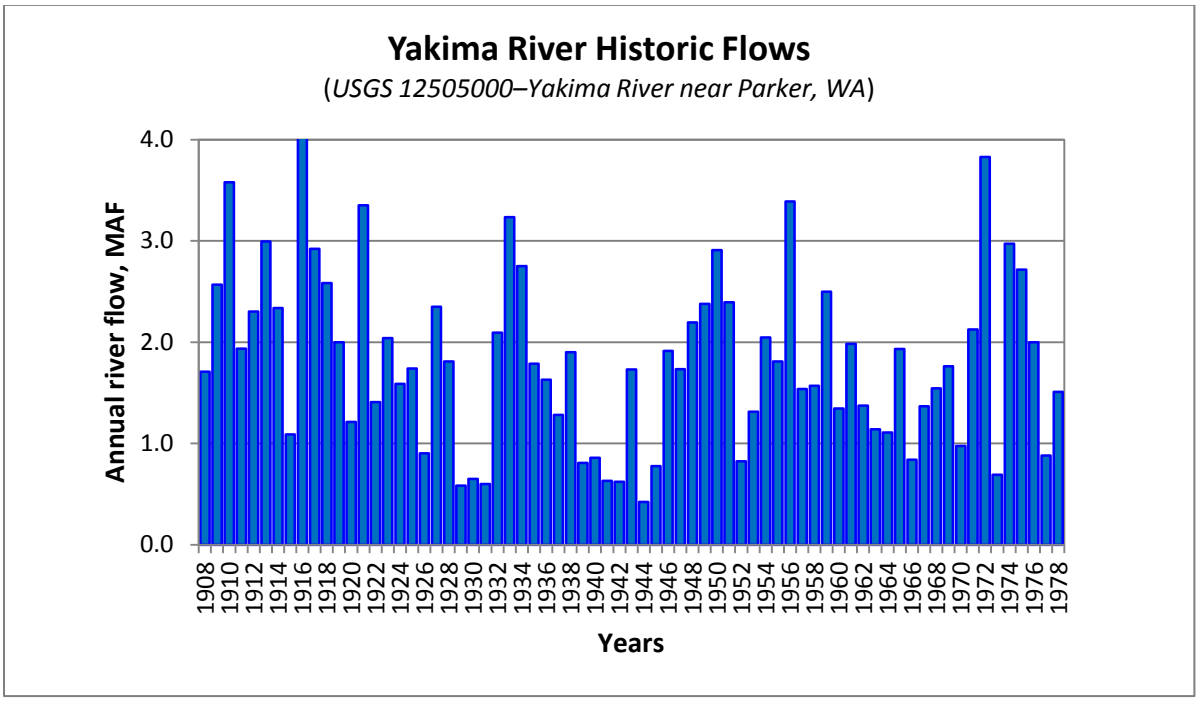

Dry Years Trend for Yakima River Flow
(Yakima River at Kiona, WA)
Linear Trend
y = -10760x + 2E+06
Annual river flow, MAF
2.0
1.5
1.0
0.5
0.0
1939
1941
1942
1944
1945
1966
1973
1977
1979
1985
1987
1988
1992
1993
1994
2001
2005
Years

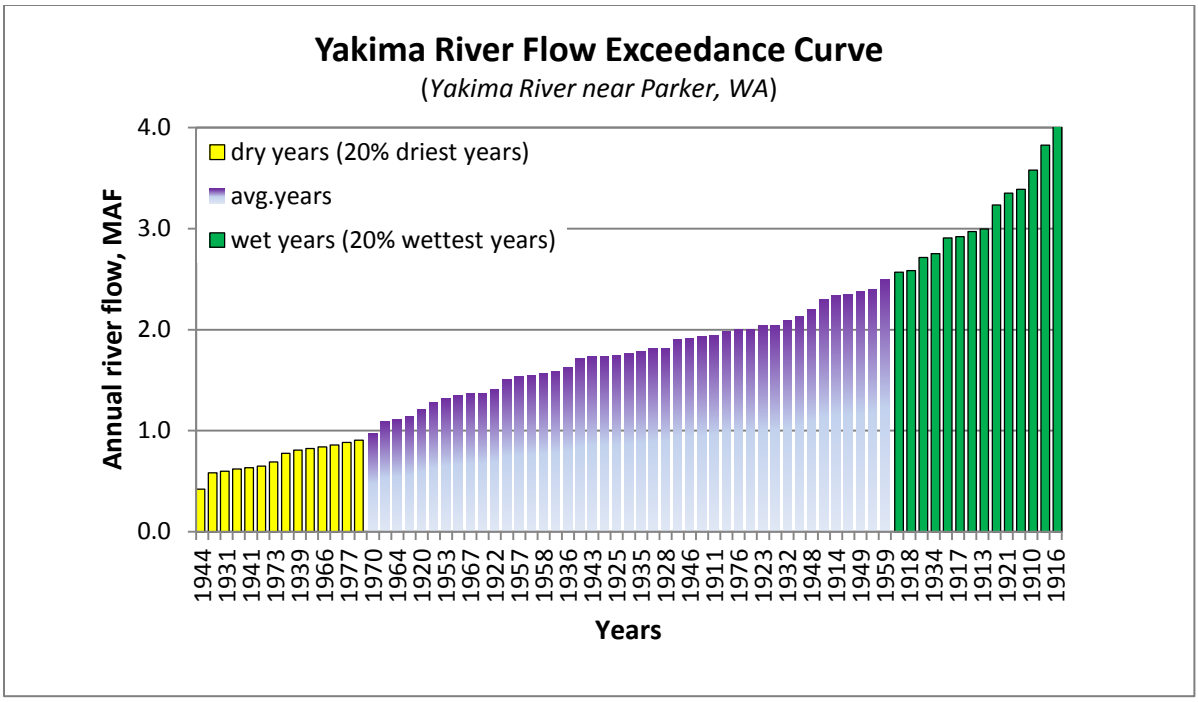

Yakima River 30 yr Flows
(Yakima River at Kiona, WA)
Year
Occurrance
Period of
Current 30 yr
Dry 17 8
Avg 53 17
Wet 17 5
Total 87 30
Annual river flow, MAF
5.0
4.0
3.0
2.0
1.0
0.0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years

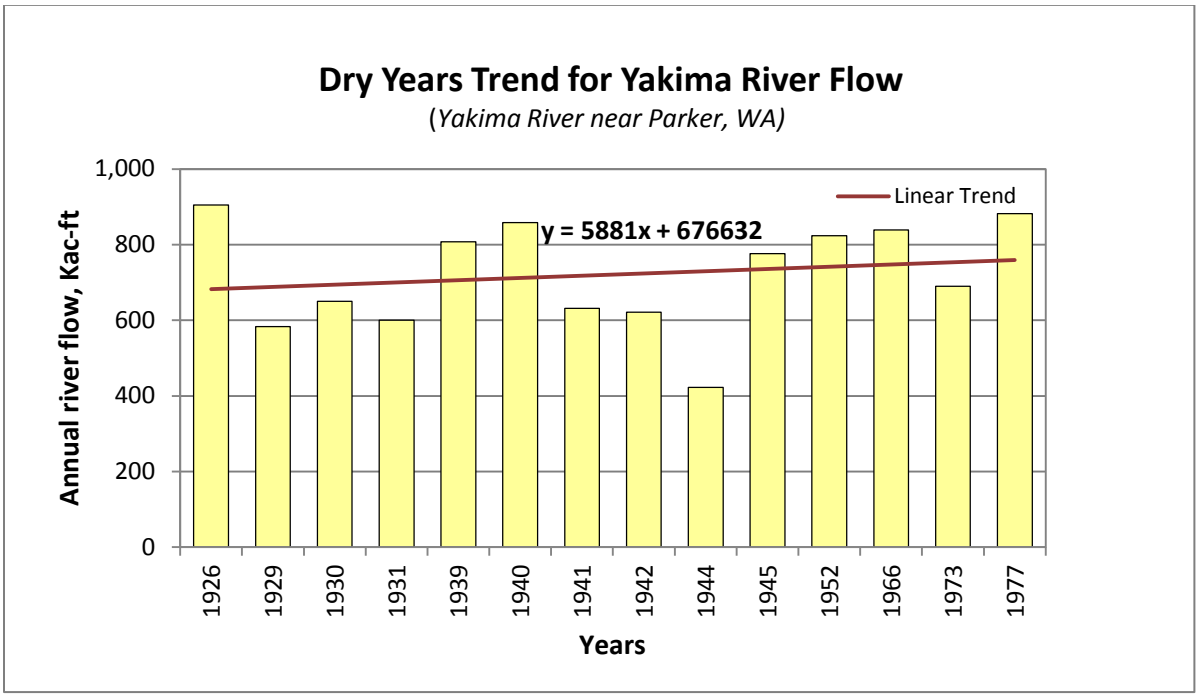

Yakima River Dry, Average and Wet Year Flows
(Yakima River at Kiona, WA)
Dry year (2001)
Avg.year (2009)
Wet year (1999)
River flow, cfs
12,000
10,000
8,000
6,000
4,000
2,000
0
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

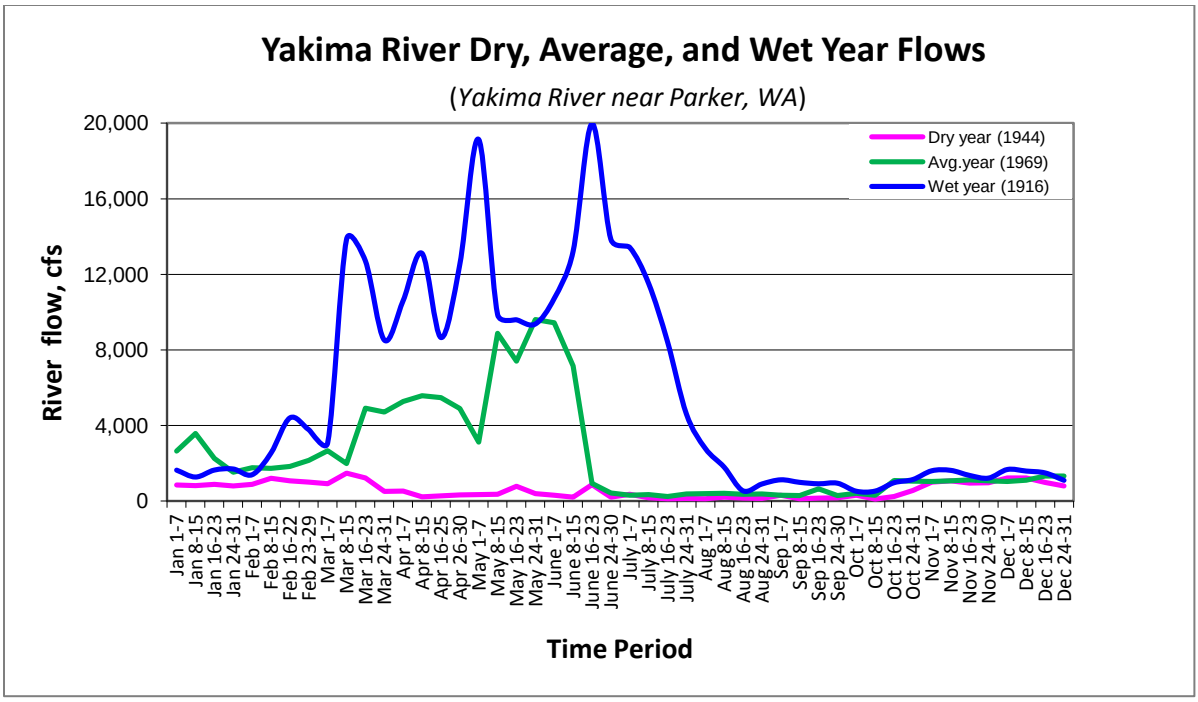

Yakima River All Dry Years Flow
(Yakima River at Kiona, WA)
1939
1941
1942
1944
1945
1966
1973
1977
1979
1985
1987
1988
1992
1993
1994
2001
2005
River flow, cfs
6,000
5,000
4,000
3,000
2,000
1,000
0
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

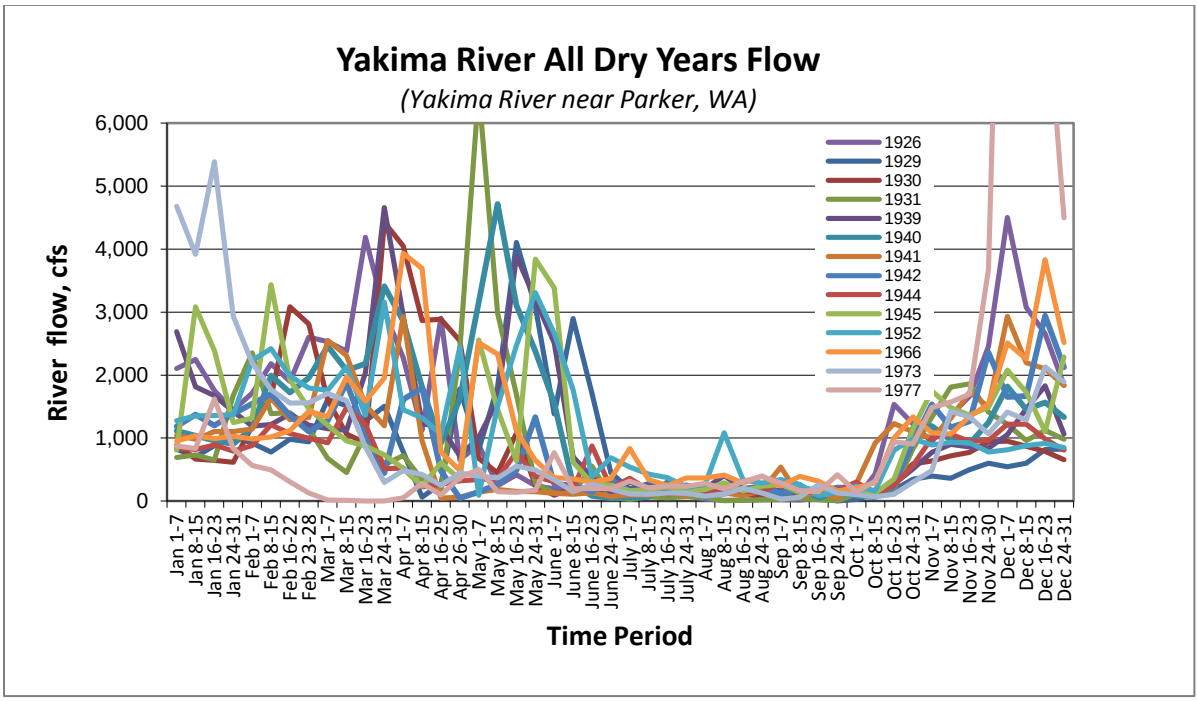

Yakima River All Wet Years Flow
(Yakima River at Kiona, WA)
River flow, cfs
20,000
16,000
12,000
8,000
4,000
0
1910
1933
1934
1948
1949
1950
1951
1956
1959
1972
1974
1975
1983
1995
1996
1997
1999
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

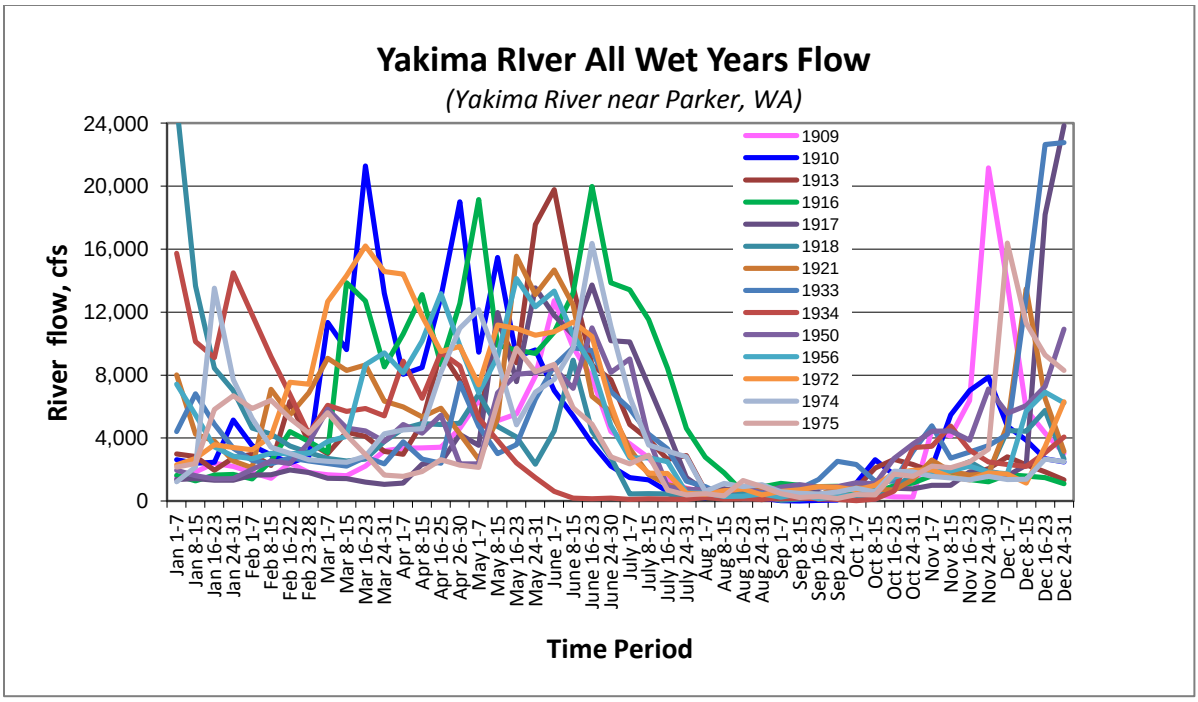

Yakima River Historic Flows
(USGS 12505000–Yakima River near Parker, WA)
Annual river flow, MAF
4.0
3.0
2.0
1.0
0.0
1908
1910
1912
1914
1916
1918
1920
1922
1924
1926
1928
1930
1932
1934
1936
1938
1940
1942
1944
1946
1948
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
Years


Yakima River Flow Exceedance Curve
(Yakima River near Parker, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, MAF
4.0
3.0
2.0
1.0
0.0
1944 1931 1941 1973 1939 1966 1977 1970 1964 1920 1953 1967 1922 1957 1958 1936 1943 1925 1935 1928 1946 1911 1976 1923 1932 1948 1914 1949 1959 1918 1934 1917 1913 1921 1910 1916
Years


Dry Years Trend for Yakima River Flow
(Yakima River near Parker, WA)
Linear Trend
y = 5881x + 676632
Annual river flow, Kac-ft
1,000
800
600
400
200
0
1926 1929 1930 1931 1939 1940 1941 1942 1944 1945 1952 1966 1973 1977
Years


Yakima River Dry, Average, and Wet Year Flows
(Yakima River near Parker, WA)
River flow, cfs
20,000
16,000
12,000
8,000
4,000
0
Dry year (1944)
Avg.year (1969)
Wet year (1916)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Yakima River All Dry Years Flow
(Yakima River near Parker, WA)
River flow, cfs
6,000
5,000
4,000
3,000
2,000
1,000
0
1926
1929
1930
1931
1939
1940
1941
1942
1944
1945
1952
1966
1973
1977
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

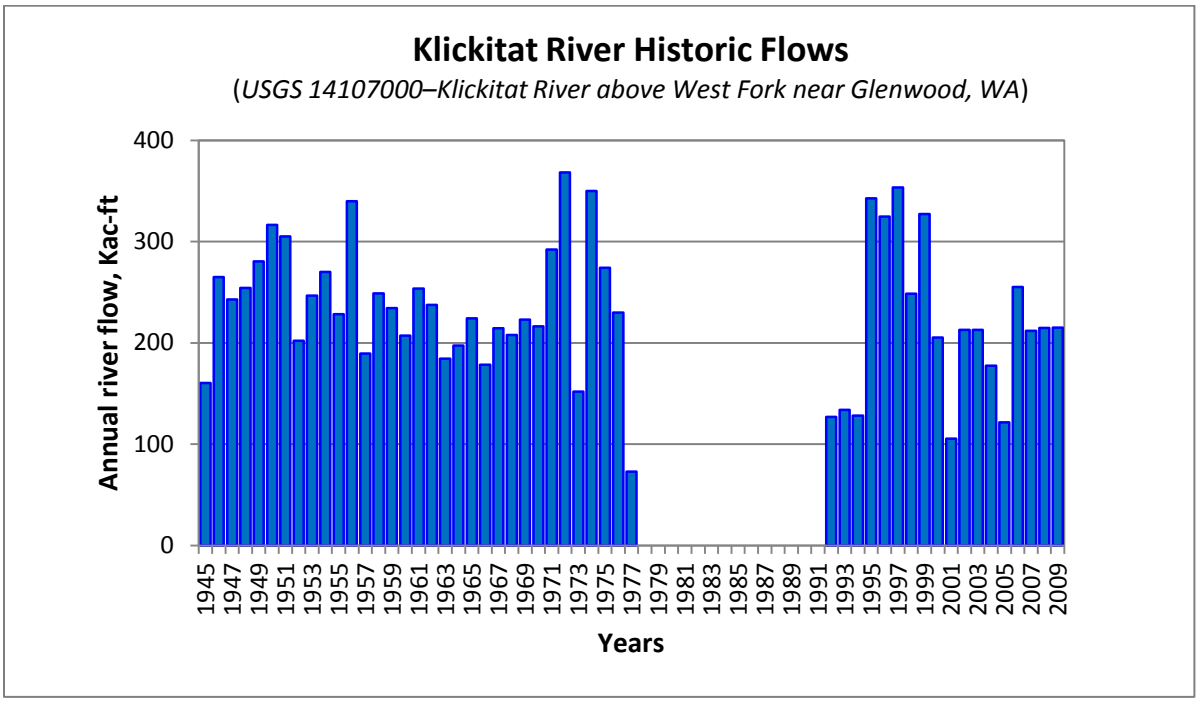

Yakima RIver All Wet Years Flow
(Yakima River near Parker, WA)
River flow, cfs
24,000
20,000
16,000
12,000
8,000
4,000
0
1909
1910
1913
1916
1917
1918
1921
1933
1934
1950
1956
1972
1974
1975
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

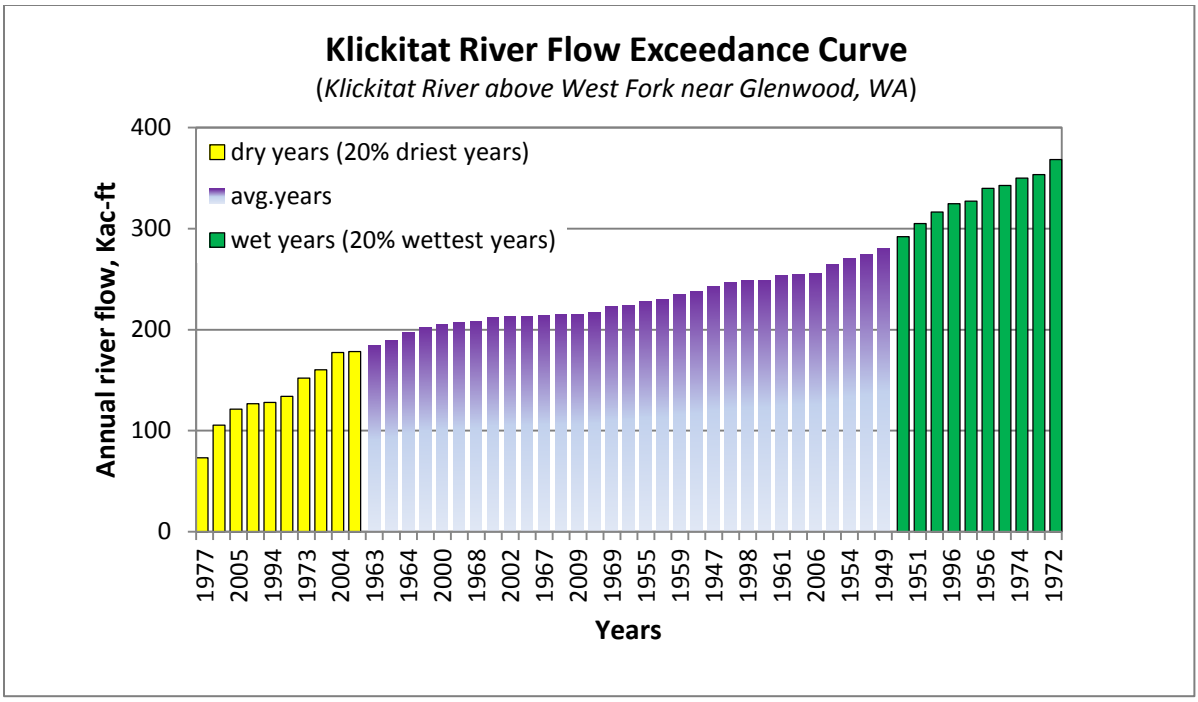
WRIA 38 (Naches)

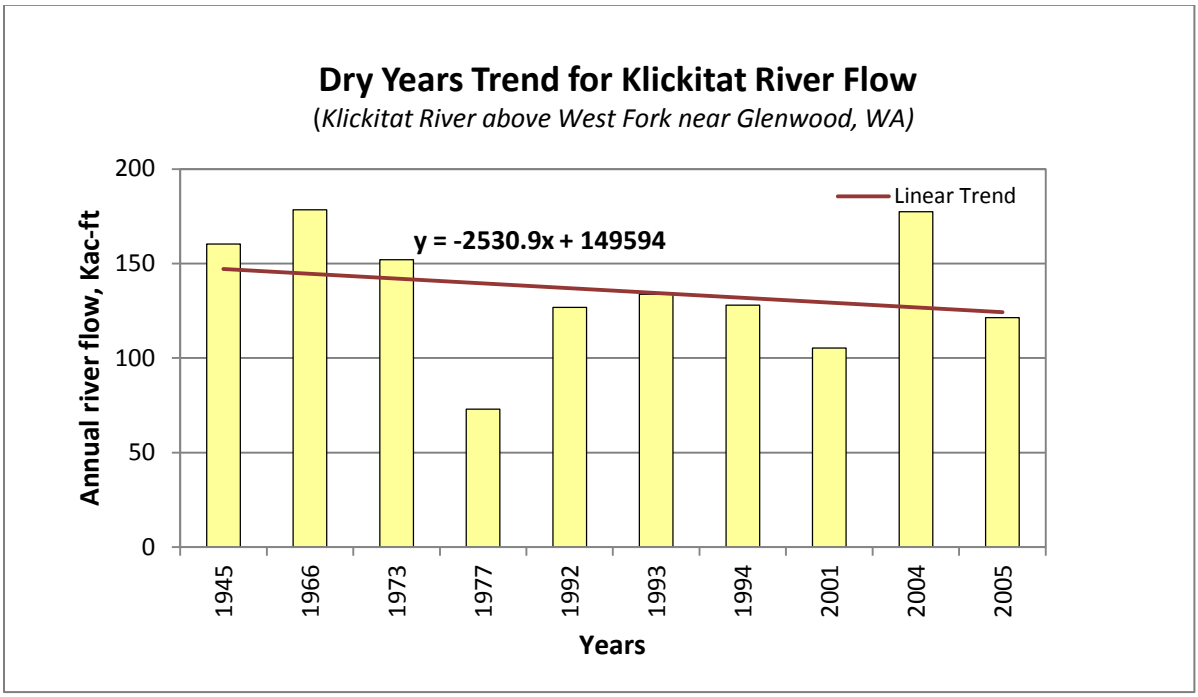
For WRIA 38, OCR graphed the flows of 2 rivers and streams. For most rivers and streams, a series of six to eight graphs were created. The results provide information on historic flow levels and drought occurrences. These data contribute to OCR's understanding of historic trends, drought patterns and hydrograph variability. For example, by graphing the 65 year (1945–2009) flows of the Klickitat River above West Fork near Glenwood, gauge number 14107000, it is shown that:

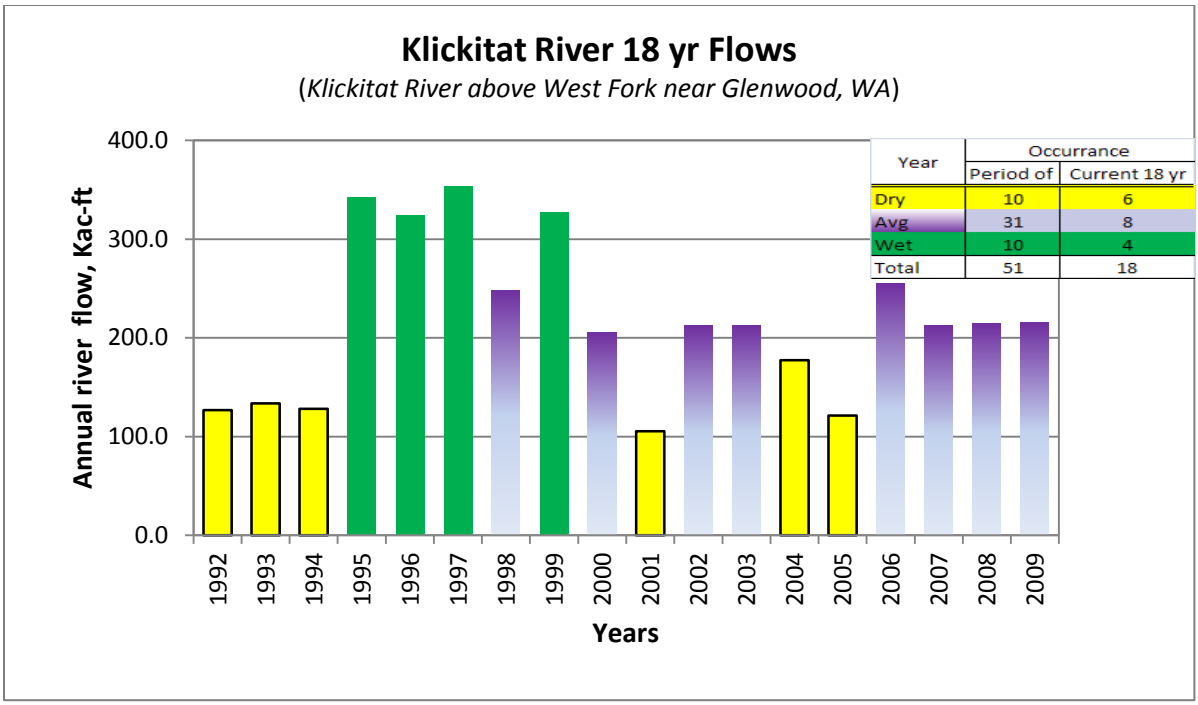
- Historic mean annual flows generally varied between 0.07 and 0.4 million acre-feet (MAF).
- Ecology defined "dry" years as the 80% exceedance value (80% of the time more water was available). Over the last 18 years, dry years occurred 6 times, with the worst stretch being 3 consecutive dry years in 1992-1994 and 2 consecutive dry years in 2004-2005, resulting in a stable incline.

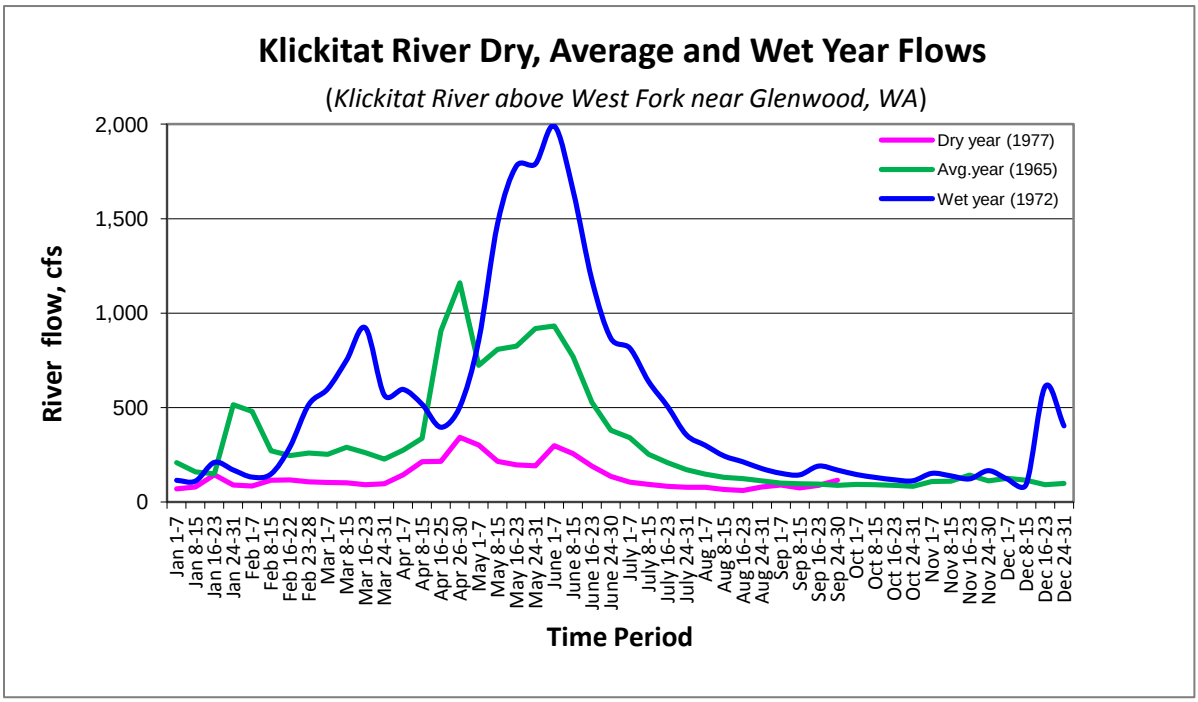
OCR can use this information to recognize where water is needed, when water is available and whether or not the in-basin or out-of-basin water supply development can help meet the WRIA's water demands.

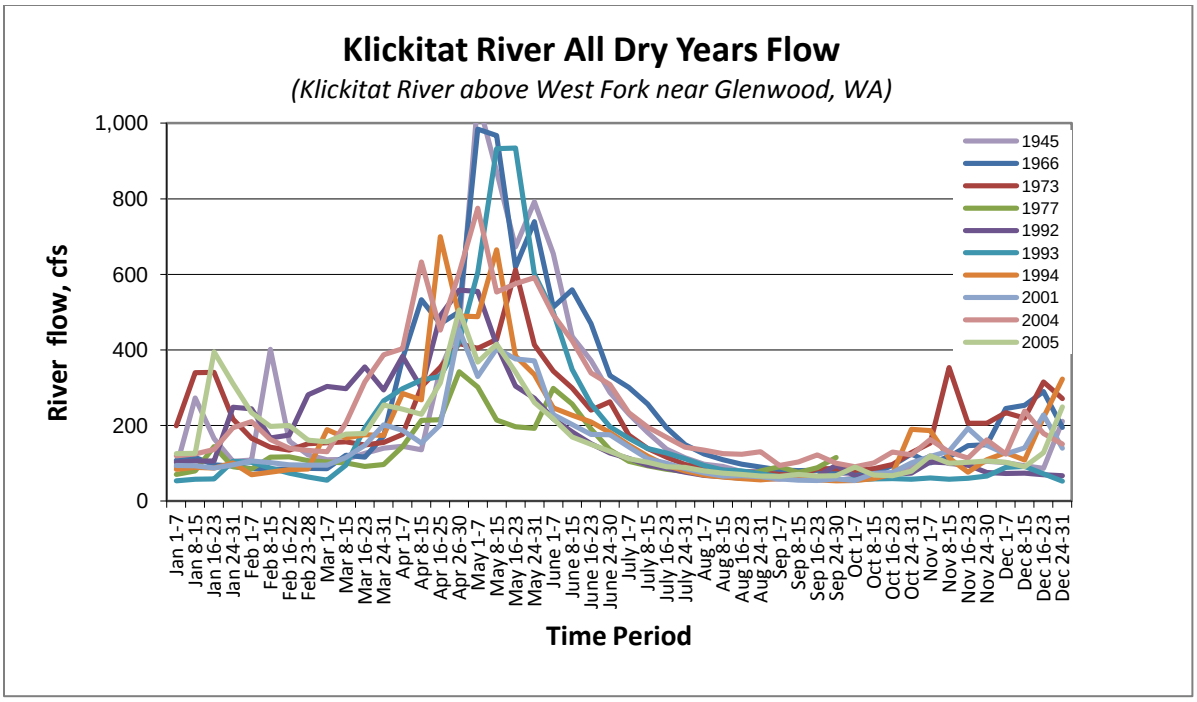


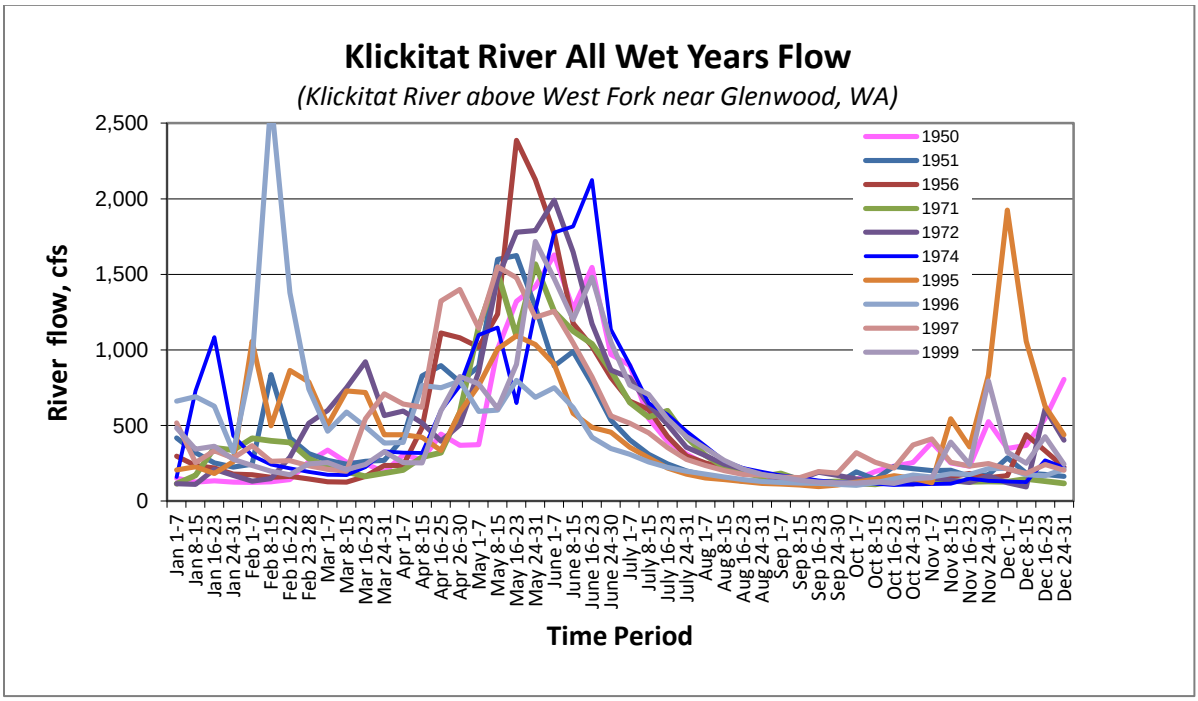

Klickitat River Flow Exceedance Curve
(Klickitat River above West Fork near Glenwood, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, Kac-ft
400
300
200
100
0
1977 2005 1994 1973 2004 1963 1964 2000 1968 2002 1967 2009 1969 1955 1959 1947 1998 1961 2006 1954 1949 1951 1996 1956 1974 1972
Years


Dry Years Trend for Klickitat River Flow
(Klickitat River above West Fork near Glenwood, WA)
Linear Trend
y = -2530.9x + 149594
Annual river flow, Kac-ft
200
150
100
50
0
1945 1966 1973 1977 1992 1993 1994 2001 2004 2005
Years


Klickitat River 18 yr Flows
(Klickitat River above West Fork near Glenwood, WA)
Annual river flow, Kac-ft
400.0
300.0
200.0
100.0
0.0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 18 yr
Dry 10 6
Avg 31 8
Wet 10 4
Total 51 18


Klickitat River Dry, Average and Wet Year Flows
(Klickitat River above West Fork near Glenwood, WA)
River flow, cfs
2,000
1,500
1,000
500
0
Dry year (1977)
Avg.year (1965)
Wet year (1972)
Time Period


Klickitat River All Dry Years Flow
(Klickitat River above West Fork near Glenwood, WA)
River flow, cfs
1,000
800
600
400
200
0
1945
1966
1973
1977
1992
1993
1994
2001
2004
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

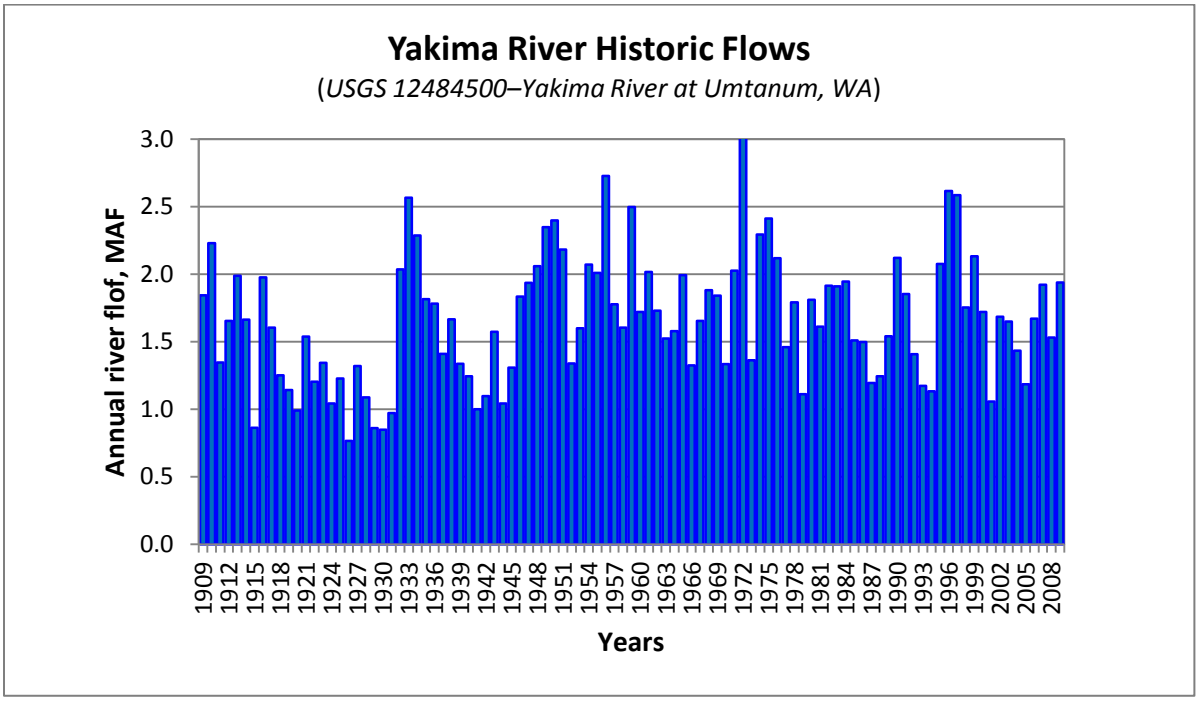

Klickitat River All Wet Years Flow
(Klickitat River above West Fork near Glenwood, WA)
River flow, cfs
2,500
2,000
1,500
1,000
500
0
1950
1951
1956
1971
1972
1974
1995
1996
1997
1999
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

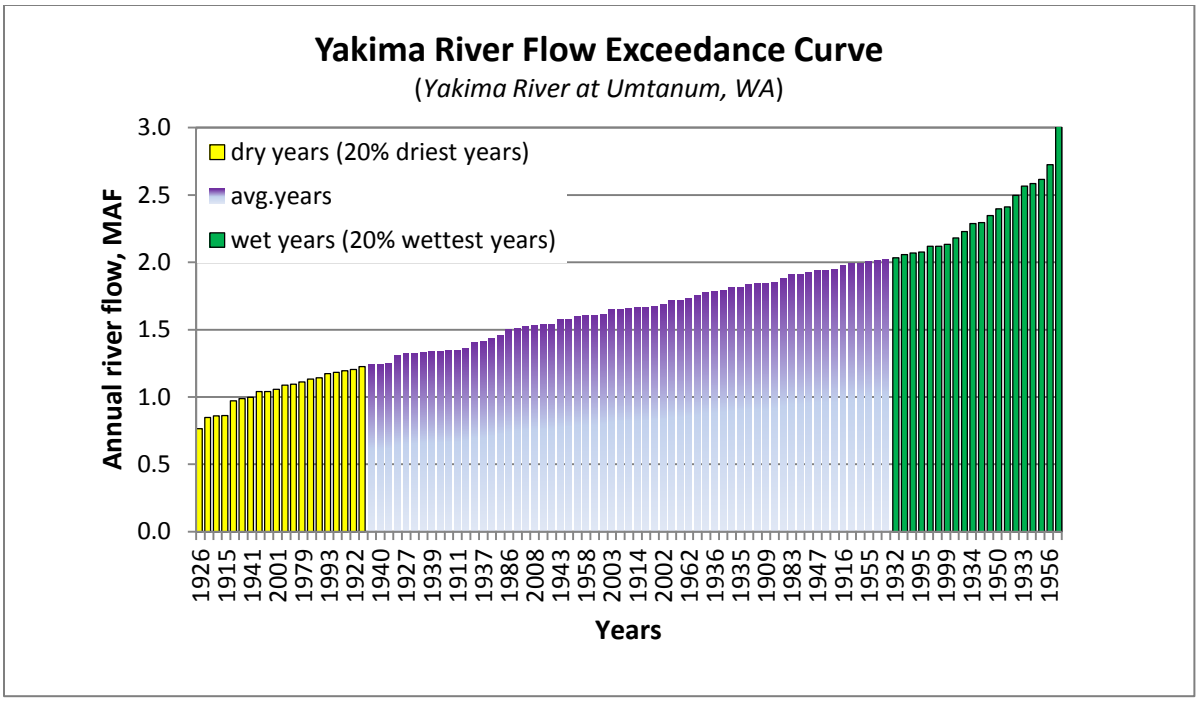
WRIA 39 (Upper Yakima)

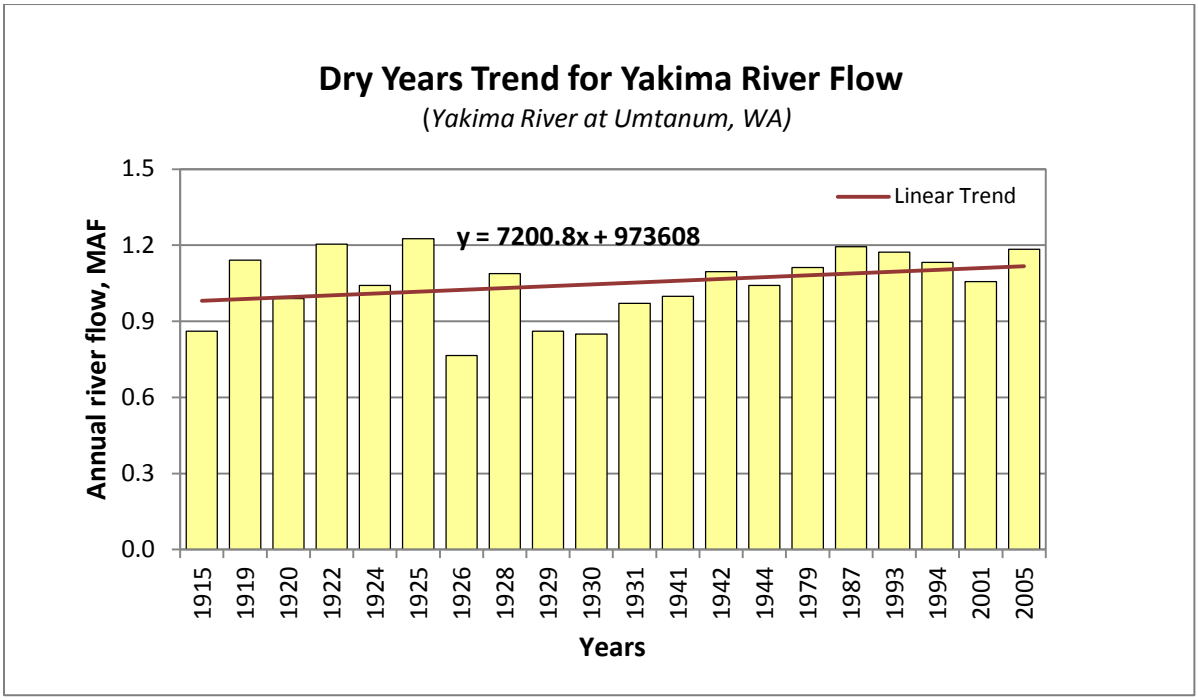
For WRIA 39, OCR graphed the flows of the Yakima River. A series of seven graphs were created. The results provide information on historic flow levels and drought occurrences. These data contribute to OCR's understanding of historic trends, drought patterns and hydrograph variability. For example, by graphing the 101 year (1909–2009) flows of the Yakima River at Umtanum, gauge number 12484500, it is shown that:

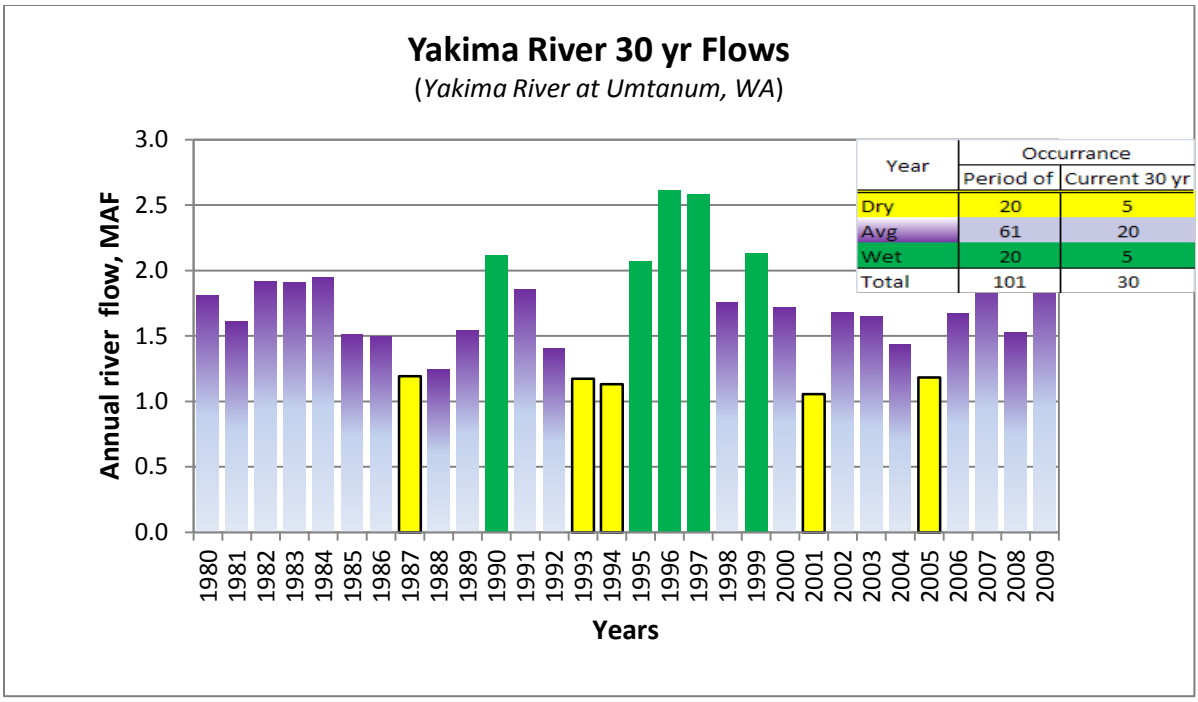
- Historic mean annual flows generally varied between 0.8 and 3.0 million acre-feet (MAF).
- Ecology defined "dry" years as the 80% exceedance value (80% of the time more water was available). Over the last 30 years, dry years occurred 5 times, with the worst stretch being 2 consecutive dry years in 1993-1994, resulting in a stable to slight incline.

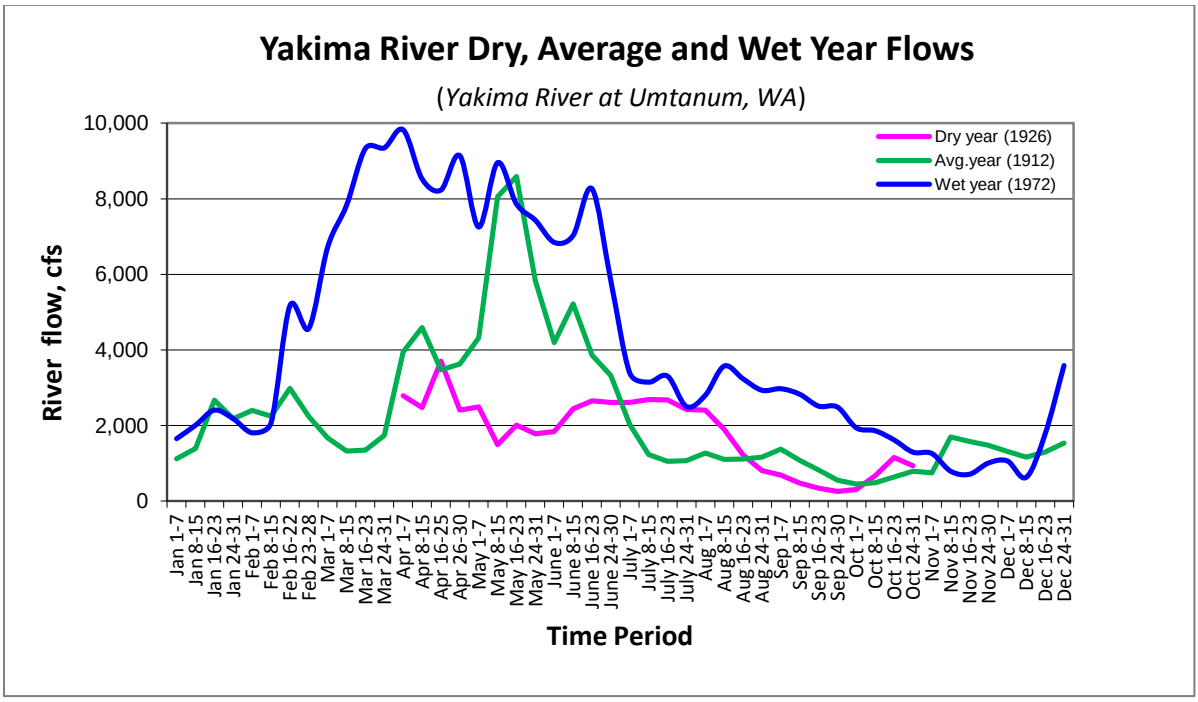
OCR can use this information to recognize where water is needed, when water is available and whether or not the in-basin or out-of-basin water supply development can help meet the WRIA's water demands.

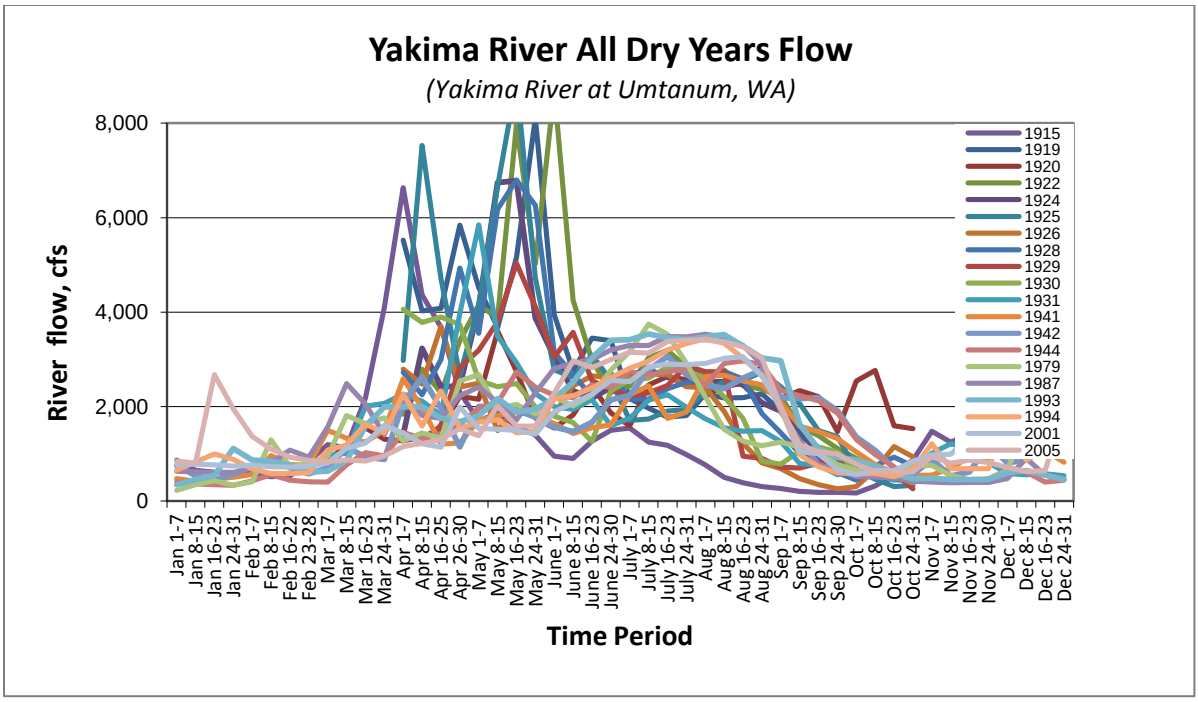


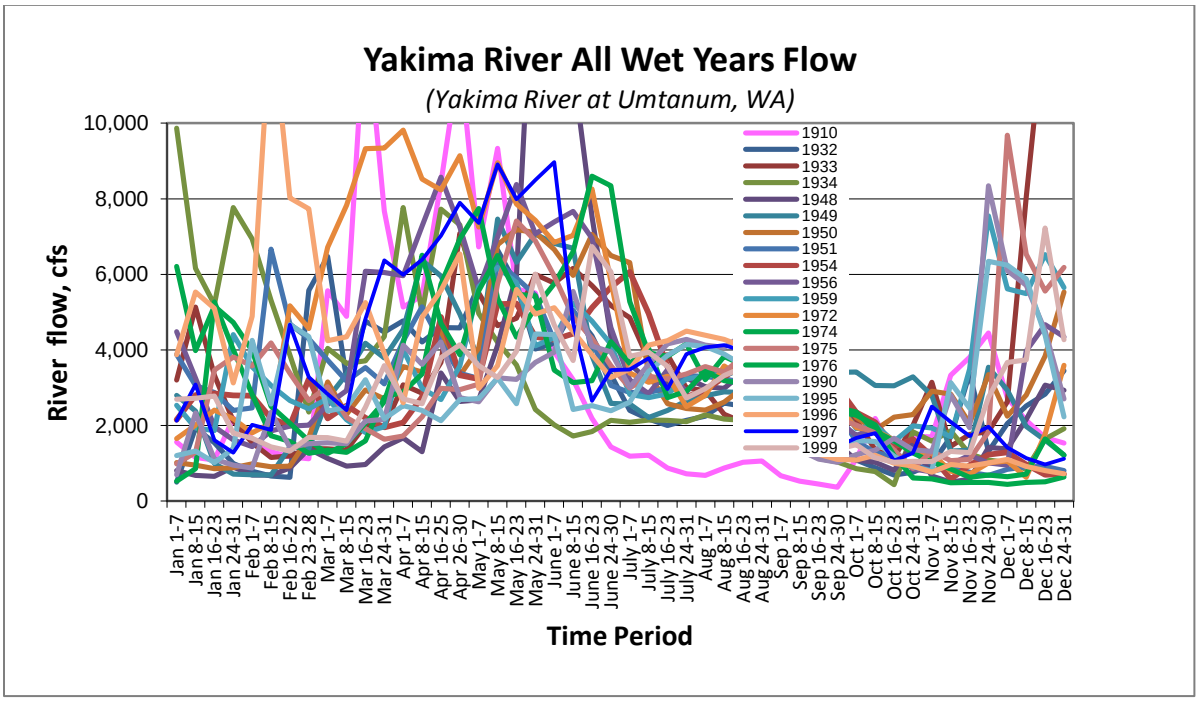

Yakima River Flow Exceedance Curve
(Yakima River at Umtanum, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, MAF
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1926 1915 1941 2001 1979 1993 1922 1940 1927 1939 1911 1937 1986 2008 1943 1958 2003 1914 2002 1962 1936 1935 1909 1983 1947 1916 1955 1932 1995 1999 1934 1950 1933 1956
Years


Dry Years Trend for Yakima River Flow
(Yakima River at Umtanum, WA)
Linear Trend
y = 7200.8x + 973608
Annual river flow, MAF
1.5
1.2
0.9
0.6
0.3
0.0
1915 1919 1920 1922 1924 1925 1926 1928 1929 1930 1931 1941 1942 1944 1979 1987 1993 1994 2001 2005
Years

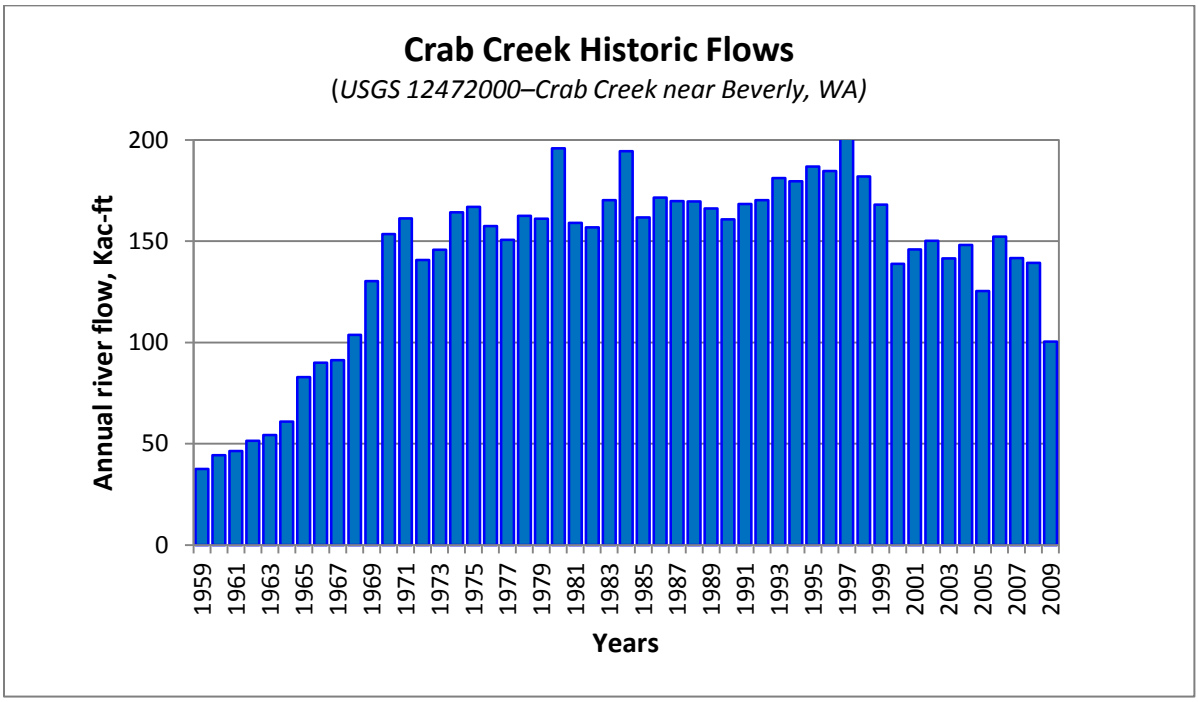

Yakima River 30 yr Flows
(Yakima River at Umtanum, WA)
Annual river flow, MAF
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 20 5
Avg 61 20
Wet 20 5
Total 101 30

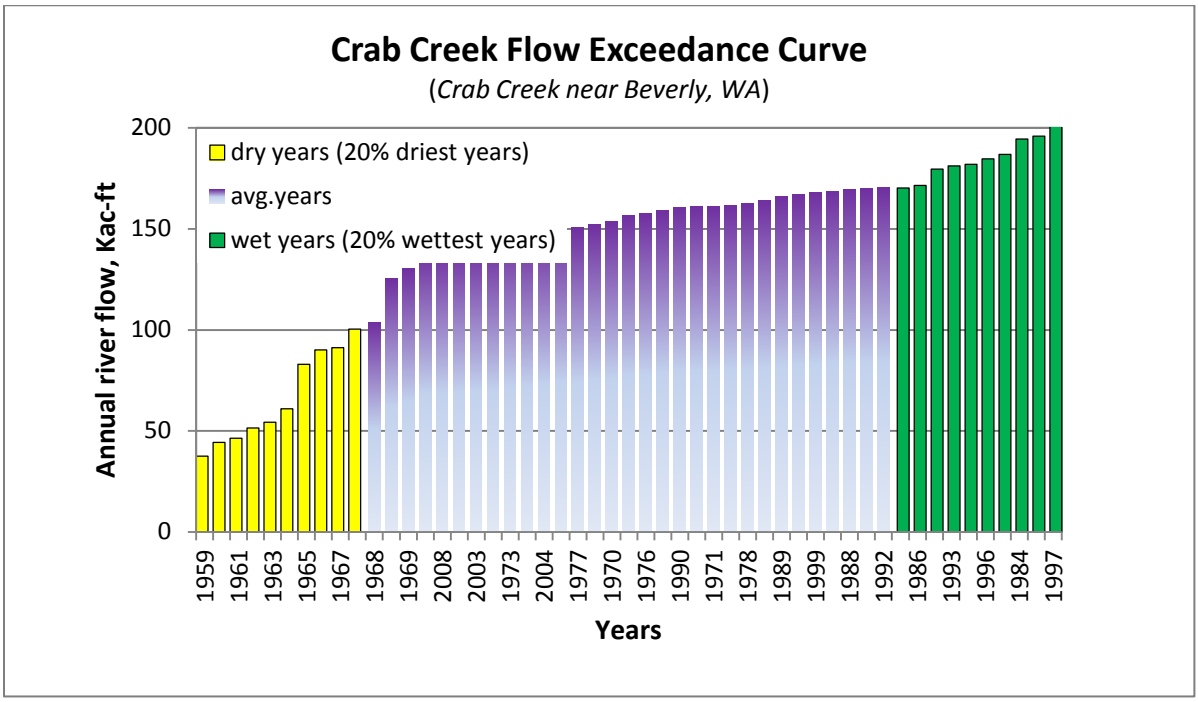

Yakima River Dry, Average and Wet Year Flows
(Yakima River at Umtanum, WA)
River flow, cfs
10,000
8,000
6,000
4,000
2,000
0
Dry year (1926)
Avg.year (1912)
Wet year (1972)
Jan 1-7 Jan 8-15 Jan 16-23 Jan 24-31 Feb 1-7 Feb 8-15 Feb 16-22 Feb 23-28 Mar 1-7 Mar 8-15 Mar 16-23 Mar 24-31 Apr 1-7 Apr 8-15 Apr 16-25 Apr 26-30 May 1-7 May 8-15 May 16-23 May 24-31 June 1-7 June 8-15 June 16-23 June 24-30 July 1-7 July 8-15 July 16-23 July 24-31 Aug 1-7 Aug 8-15 Aug 16-23 Aug 24-31 Sep 1-7 Sep 8-15 Sep 16-23 Sep 24-30 Oct 1-7 Oct 8-15 Oct 16-23 Oct 24-31 Nov 1-7 Nov 8-15 Nov 16-23 Nov 24-30 Dec 1-7 Dec 8-15 Dec 16-23 Dec 24-31
Time Period

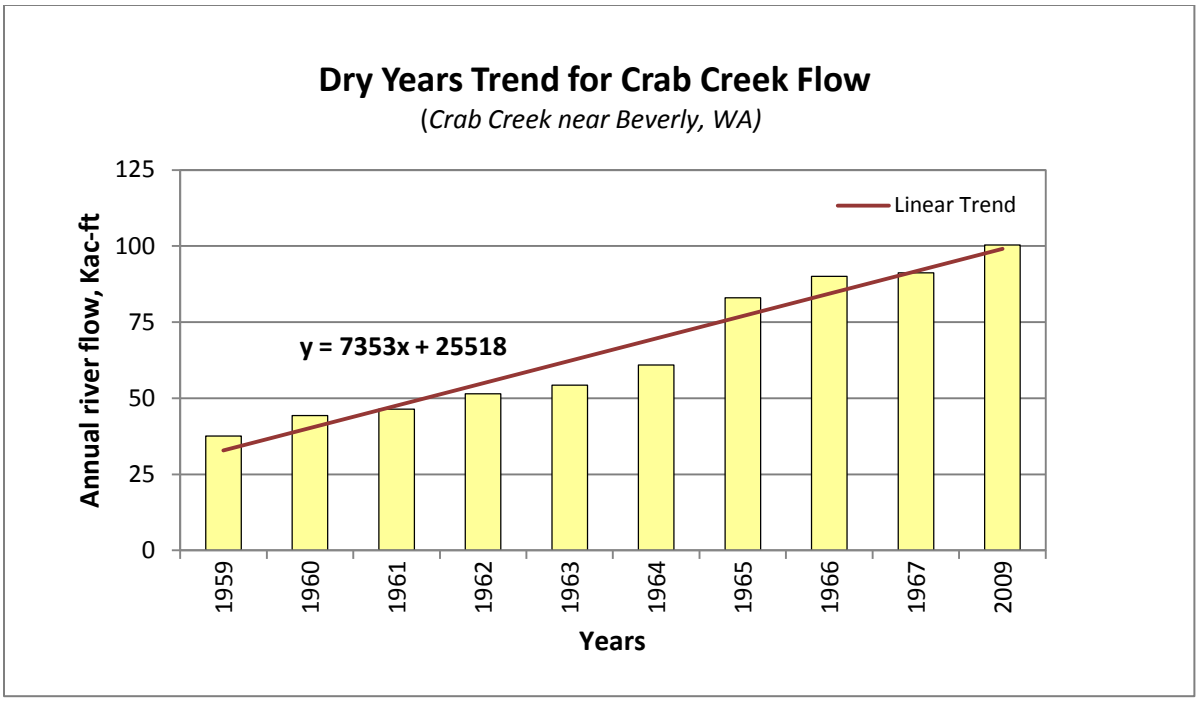

Yakima River All Dry Years Flow
(Yakima River at Umtanum, WA)
River flow, cfs
8,000
6,000
4,000
2,000
0
1915
1919
1920
1922
1924
1925
1926
1928
1929
1930
1931
1941
1942
1944
1979
1987
1993
1994
2001
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

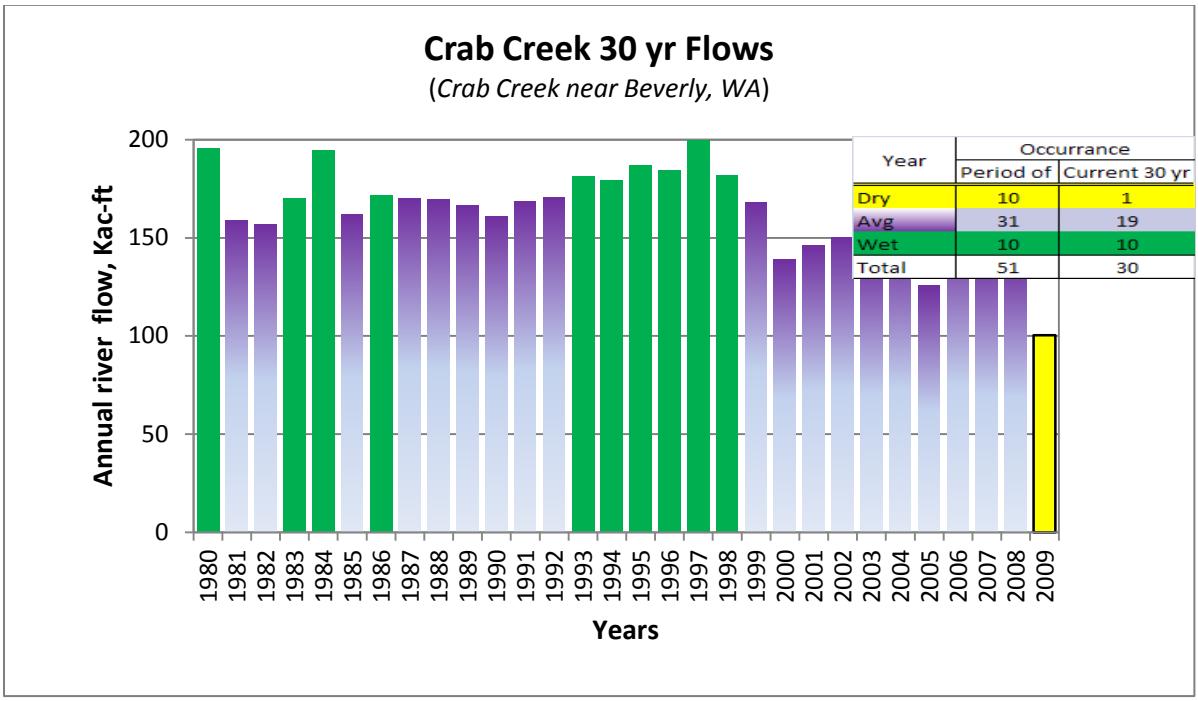

Yakima River All Wet Years Flow
(Yakima River at Umtanum, WA)
River flow, cfs
10,000
8,000
6,000
4,000
2,000
0
1910
1932
1933
1934
1948
1949
1950
1951
1954
1956
1959
1972
1974
1975
1976
1990
1995
1996
1997
1999
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

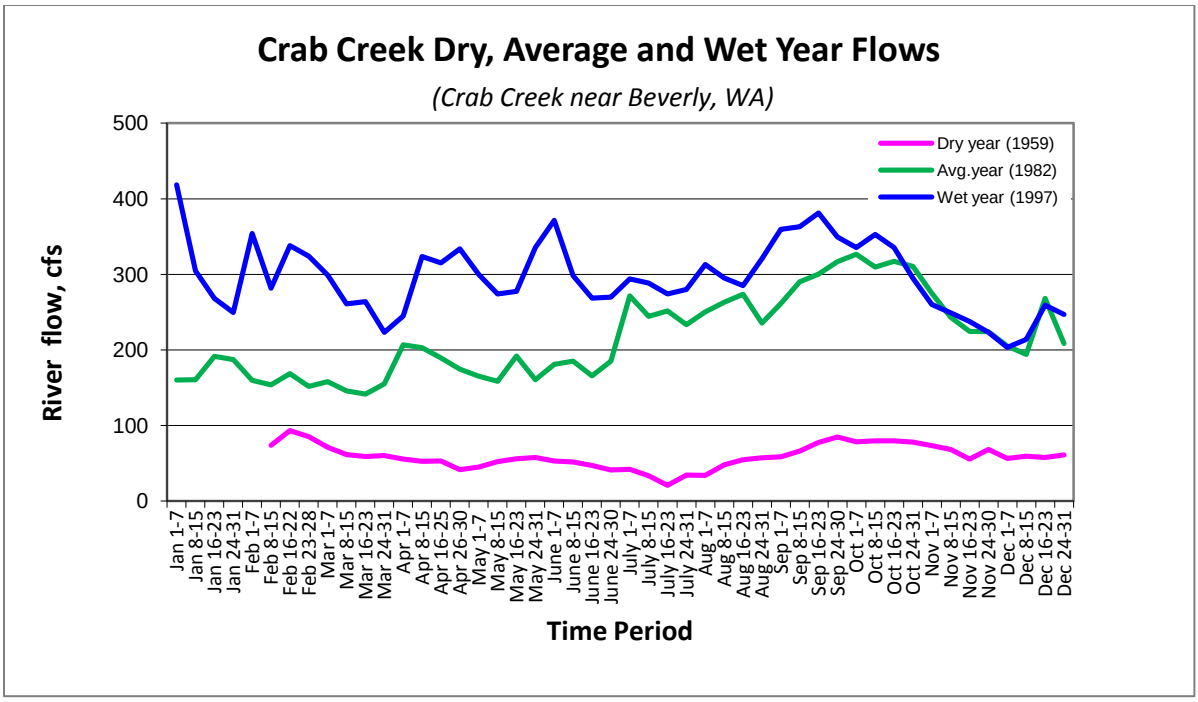
WRIA 41 (Lower Crab)

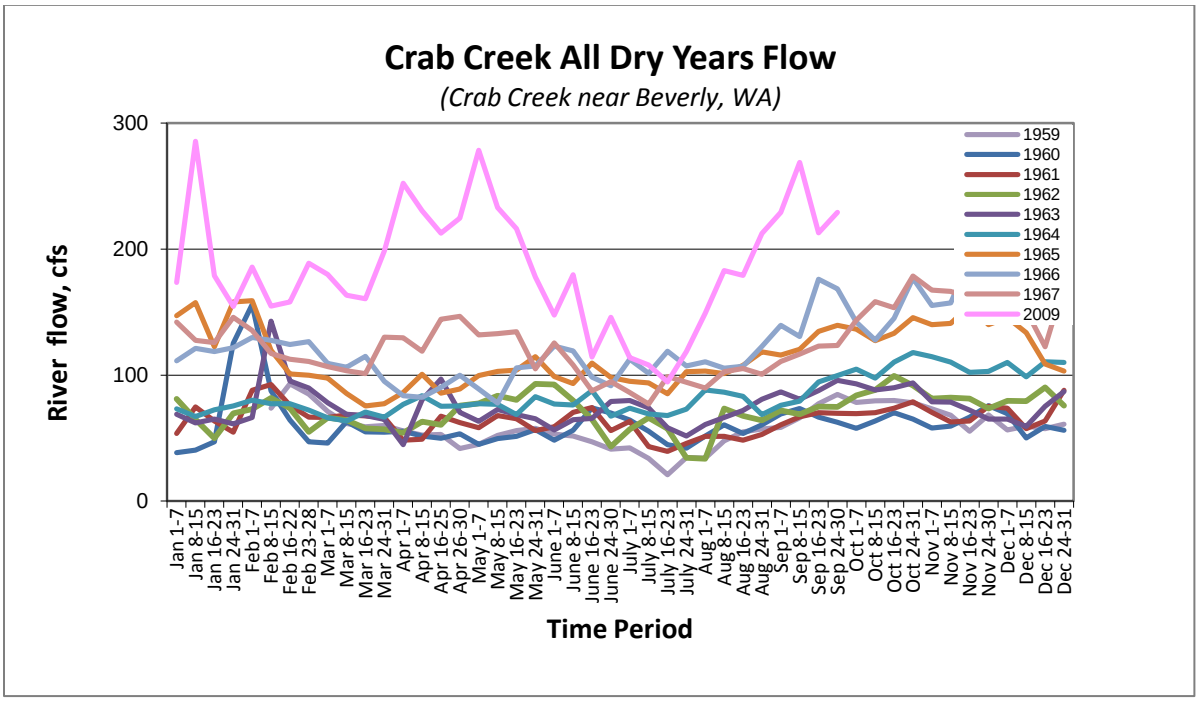


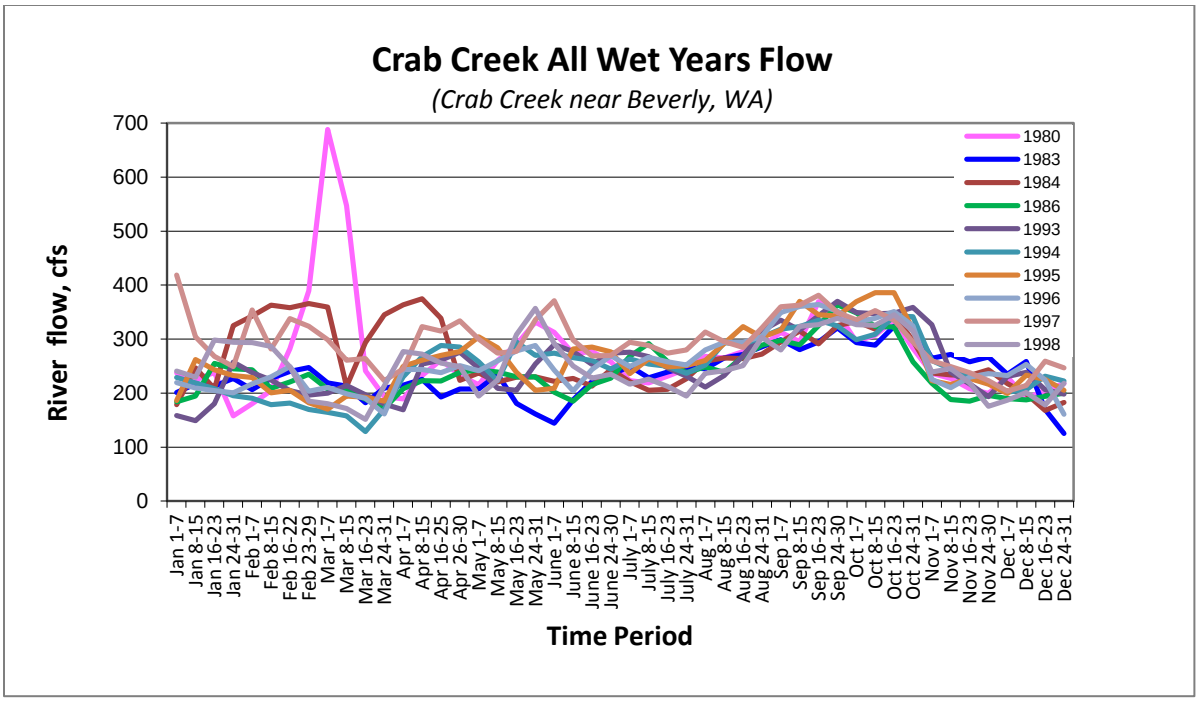


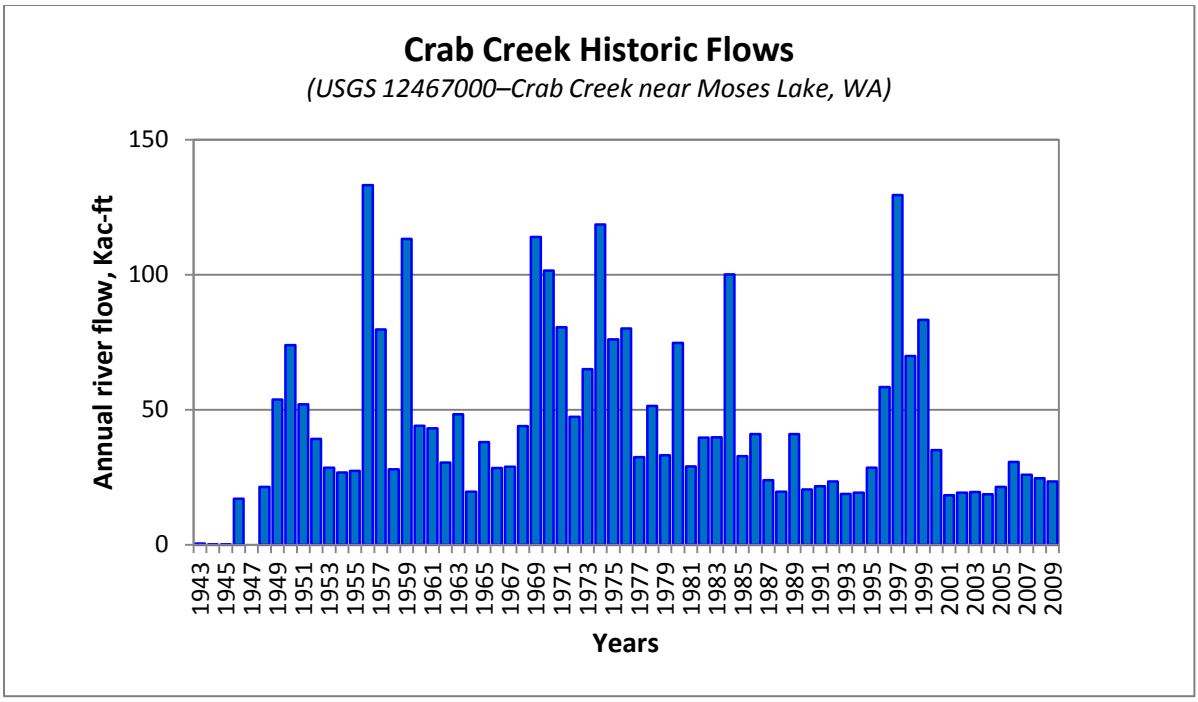

Dry Years Trend for Crab Creek Flow
(Crab Creek near Beverly, WA)
Annual river flow, Kac-ft
125
100
75
50
25
0
Linear Trend
y = 7353x + 25518
1959
1960
1961
1962
1963
1964
1965
1966
1967
2009
Years

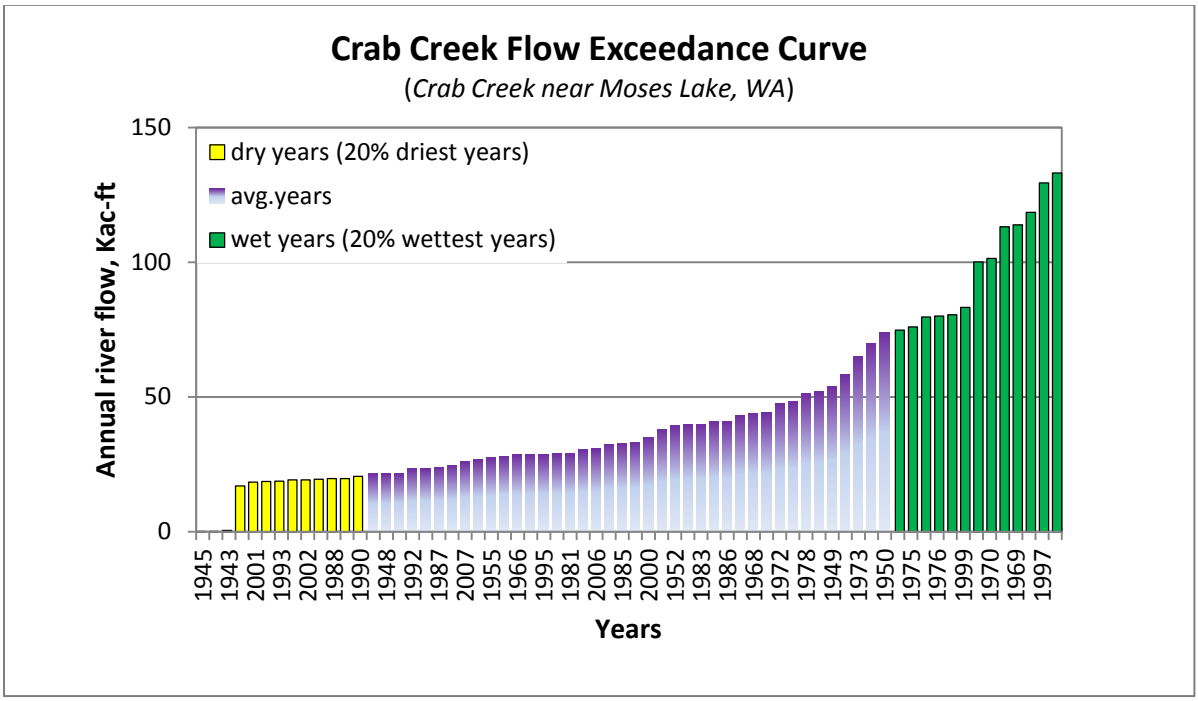

Crab Creek 30 yr Flows
(Crab Creek near Beverly, WA)
Annual river flow, Kac-ft
200
150
100
50
0
Year
Occurrance
Period of
Current 30 yr
Dry 10 1
Avg 31 19
Wet 10 10
Total 51 30
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years

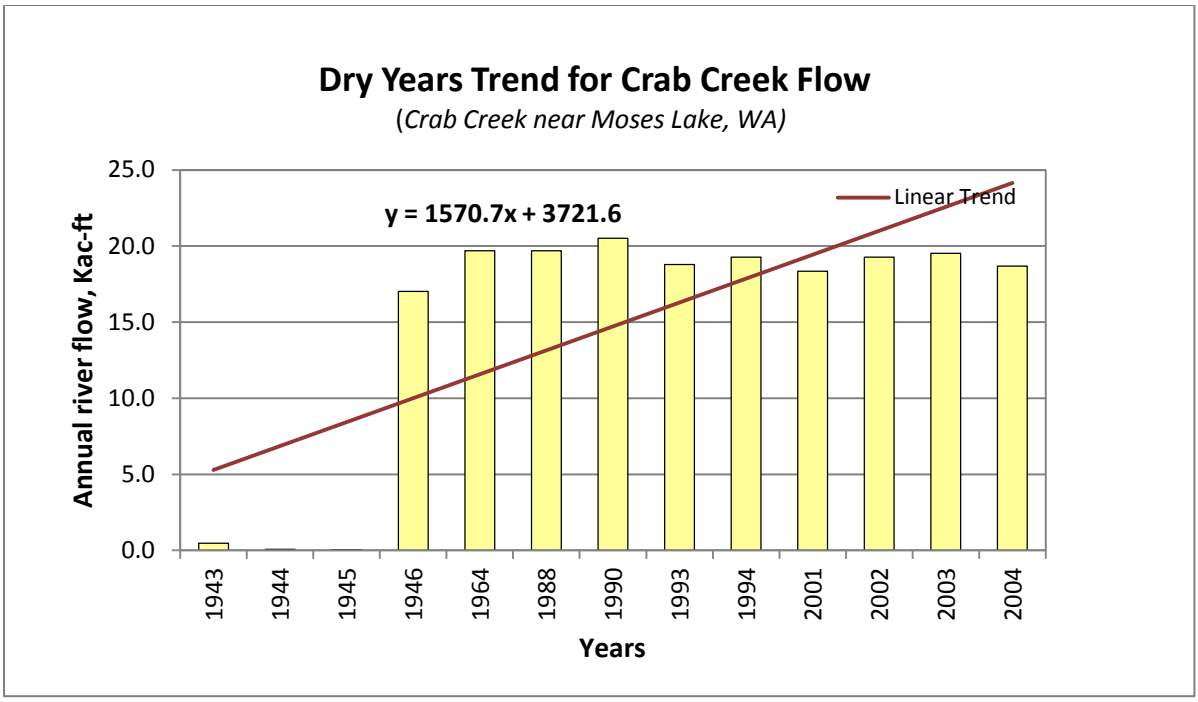

Crab Creek Dry, Average and Wet Year Flows
(Crab Creek near Beverly, WA)
River flow, cfs
500
400
300
200
100
0
Dry year (1959)
Avg.year (1982)
Wet year (1997)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

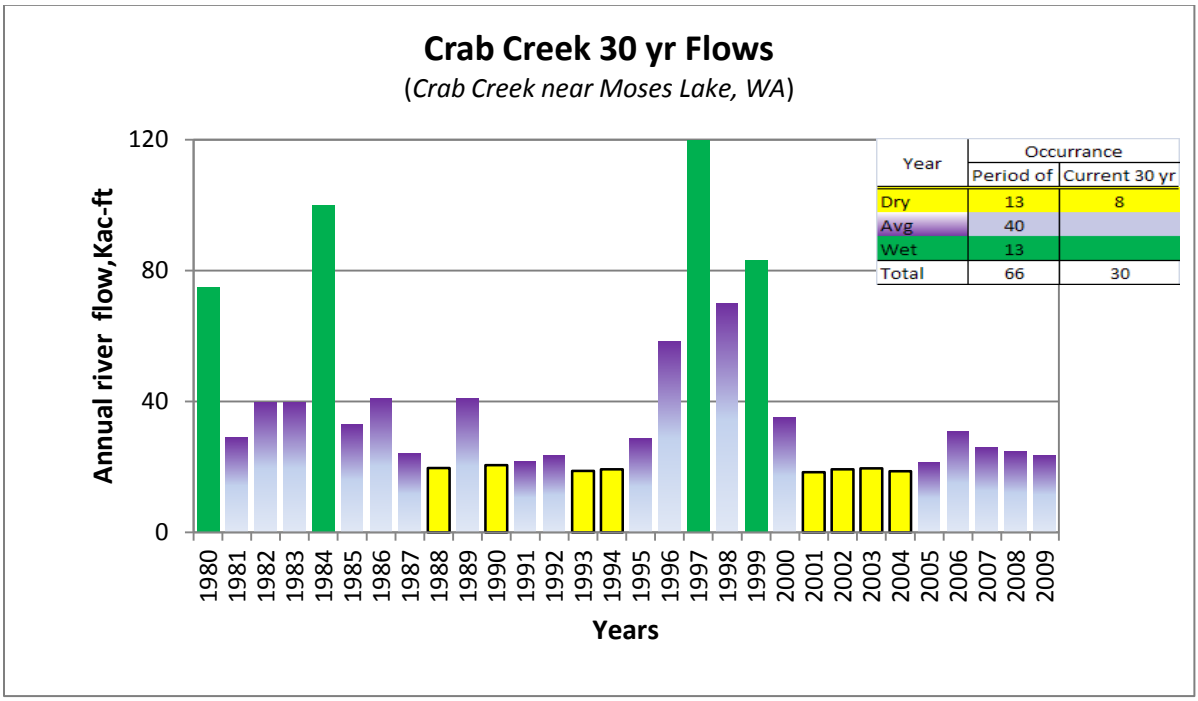

Crab Creek All Dry Years Flow
(Crab Creek near Beverly, WA)
River flow, cfs
300
200
100
0
1959
1960
1961
1962
1963
1964
1965
1966
1967
2009
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

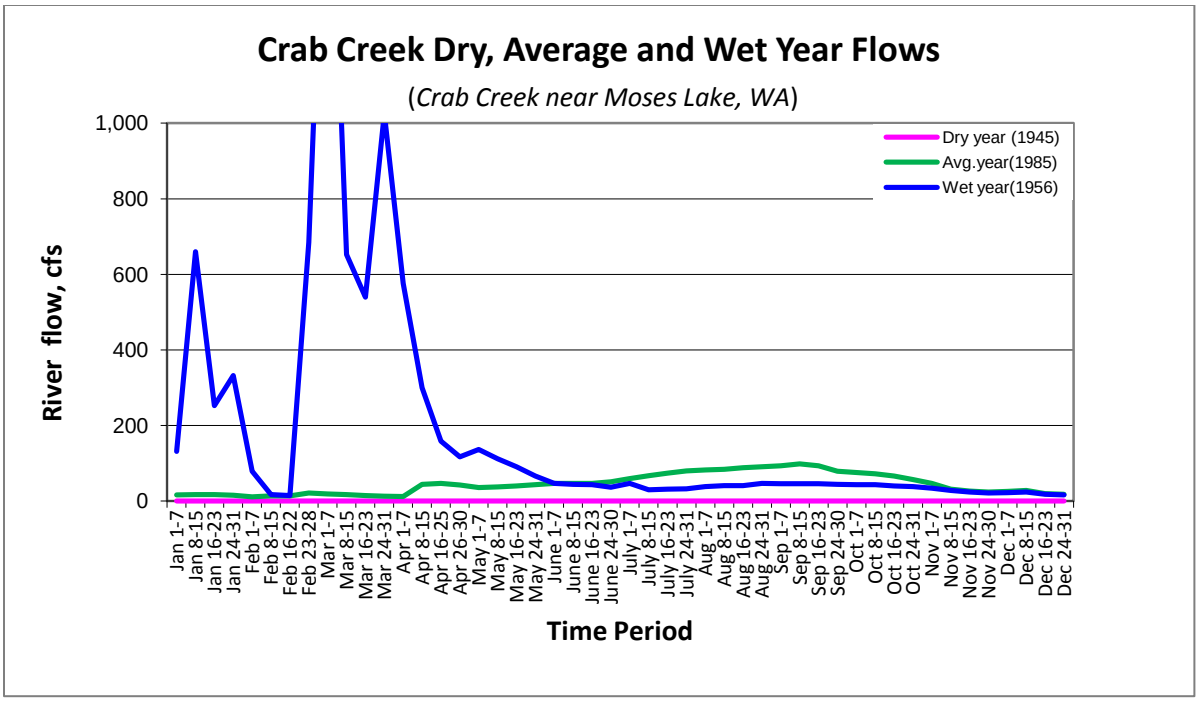

Crab Creek All Wet Years Flow
(Crab Creek near Beverly, WA)
River flow, cfs
700
600
500
400
300
200
100
0
1980
1983
1984
1986
1993
1994
1995
1996
1997
1998
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Crab Creek Historic Flows
(USGS 12467000–Crab Creek near Moses Lake, WA)
Annual river flow, Kac-ft
150
100
50
0
1943
1945
1947
1949
1951
1953
1955
1957
1959
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Years

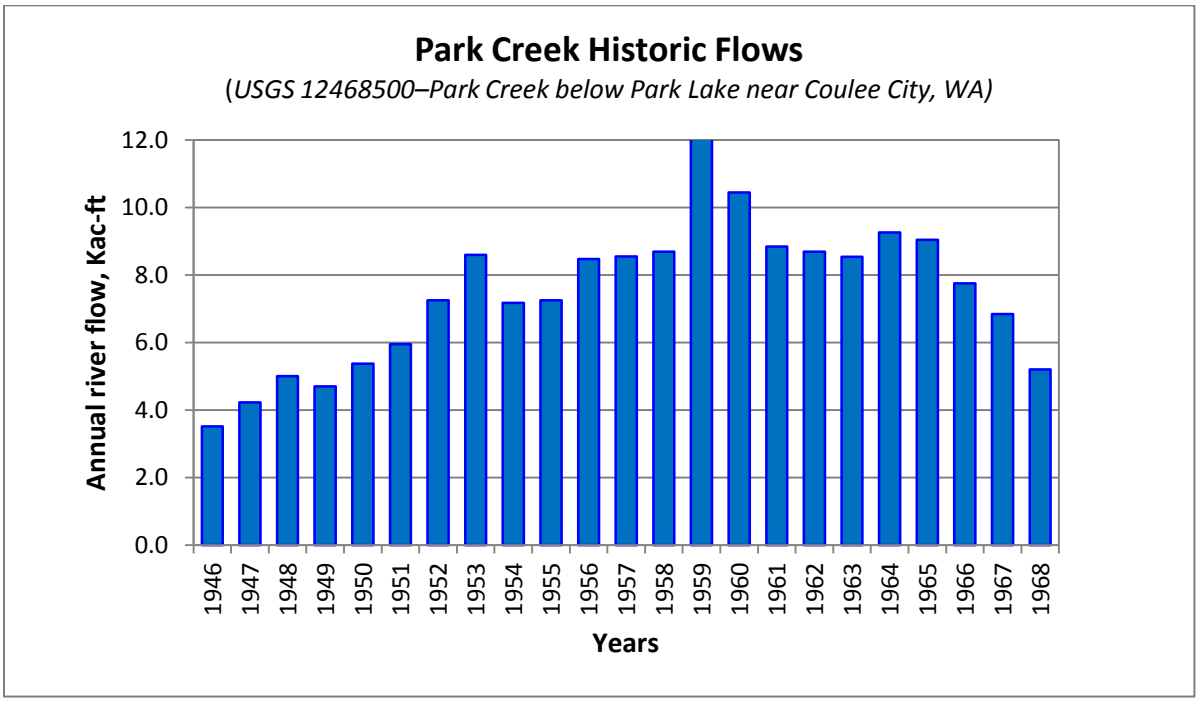

Crab Creek Flow Exceedance Curve
(Crab Creek near Moses Lake, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, Kac-ft
150
100
50
0
1945
1943
2001
1993
2002
1988
1990
1948
1992
1987
2007
1955
1966
1995
1981
2006
1985
2000
1952
1983
1986
1968
1972
1978
1949
1973
1950
1975
1976
1999
1970
1969
1997
Years

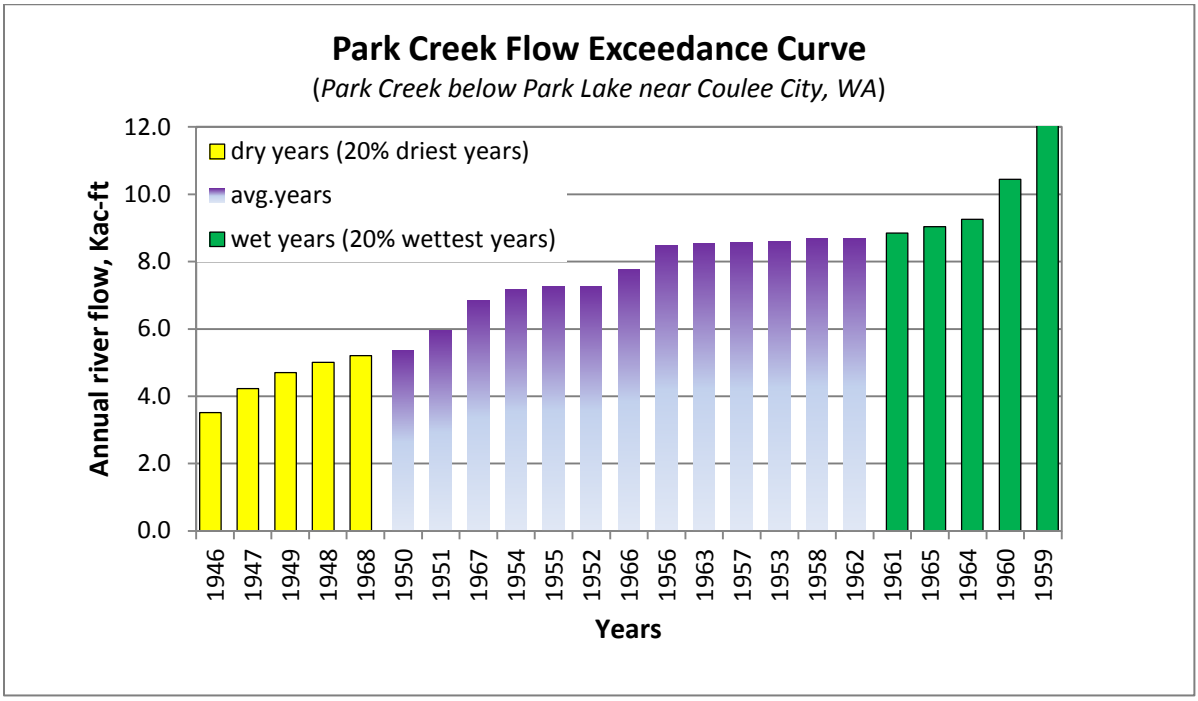

Dry Years Trend for Crab Creek Flow
(Crab Creek near Moses Lake, WA)
y = 1570.7x + 3721.6
Linear Trend
Annual river flow, Kac-ft
25.0
20.0
15.0
10.0
5.0
0.0
1943
1944
1945
1946
1964
1988
1990
1993
1994
2001
2002
2003
2004
Years

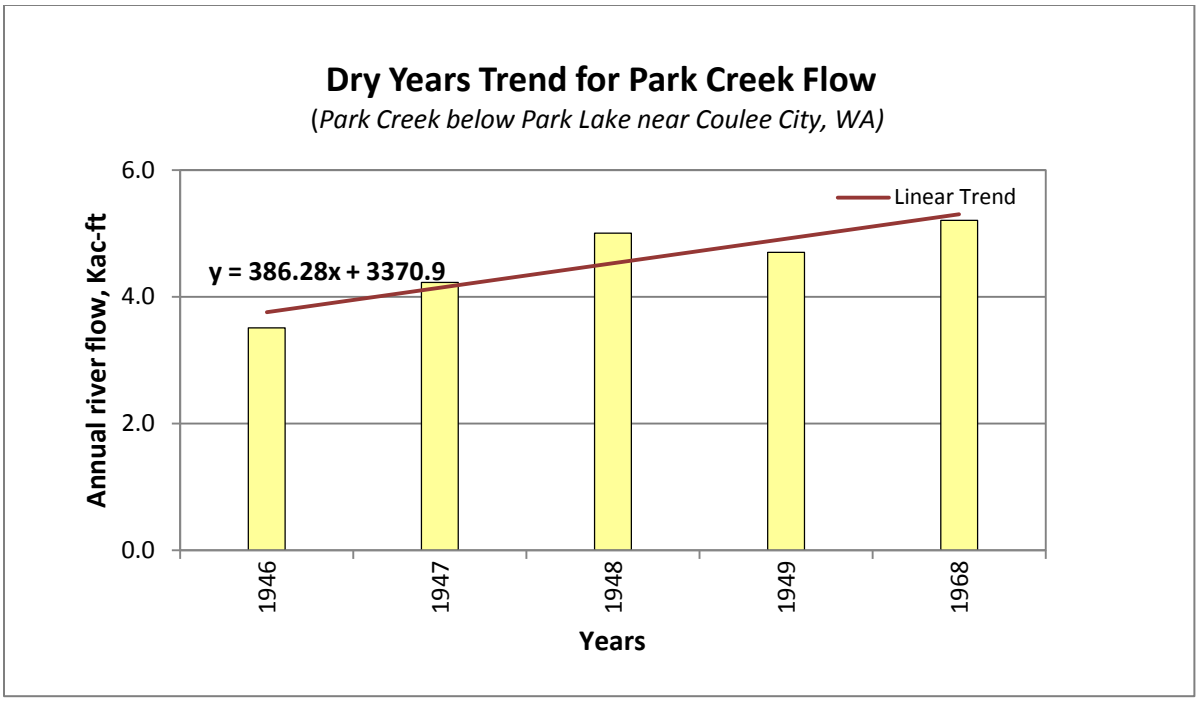

Crab Creek 30 yr Flows
(Crab Creek near Moses Lake, WA)
Annual river flow,Kac-ft
120
80
40
0
Year
Occurrance
Period of
Current 30 yr
Dry
13
8
Avg
40
Wet
13
Total
66
30
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years

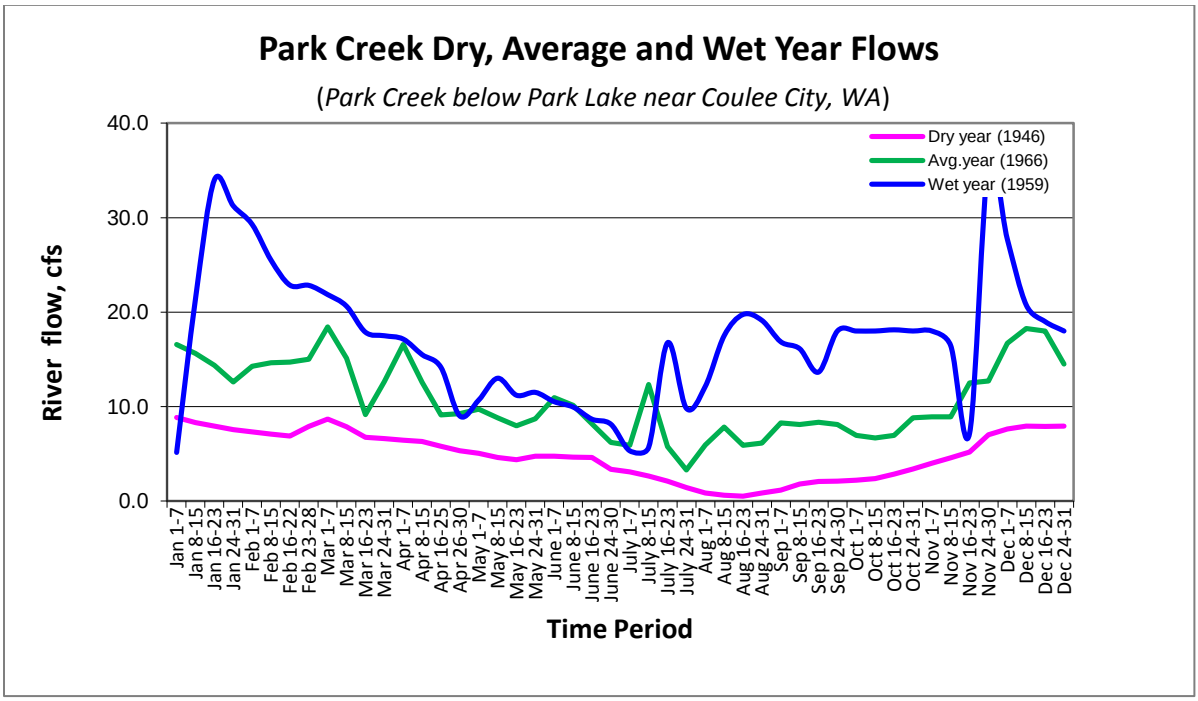

Crab Creek Dry, Average and Wet Year Flows
(Crab Creek near Moses Lake, WA)
River flow, cfs
1,000
800
600
400
200
0
Dry year (1945)
Avg.year(1985)
Wet year(1956)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

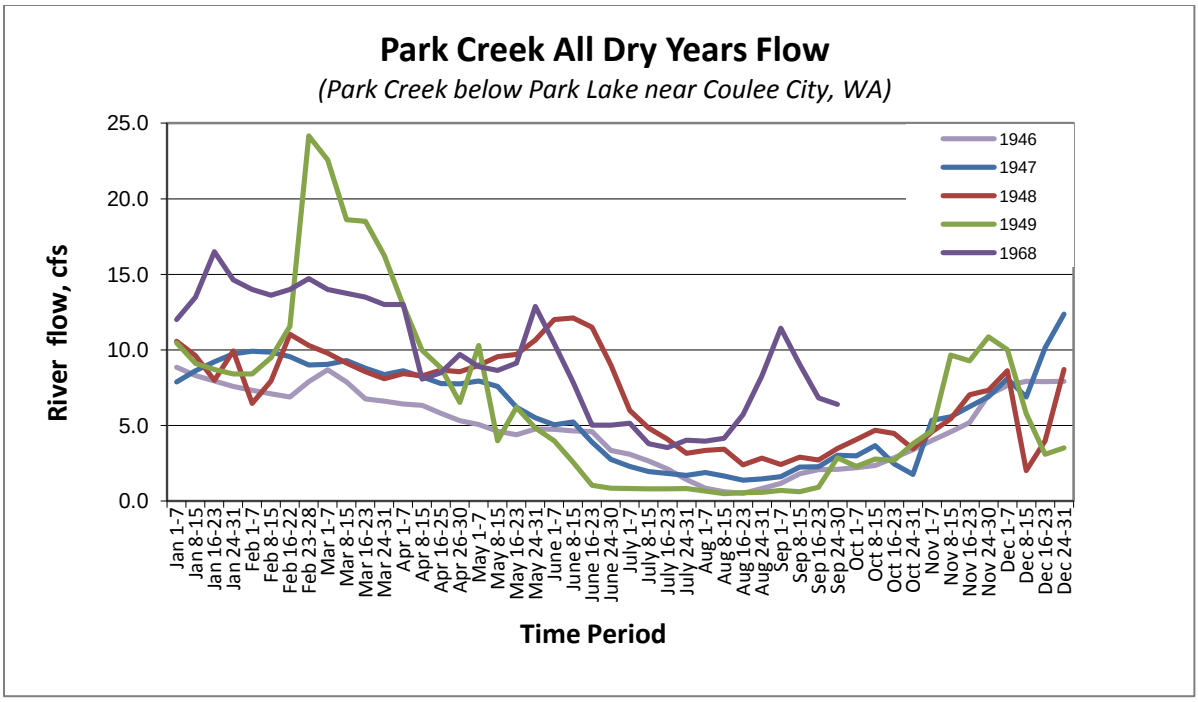
WRIA 42 (Grand Coulee)

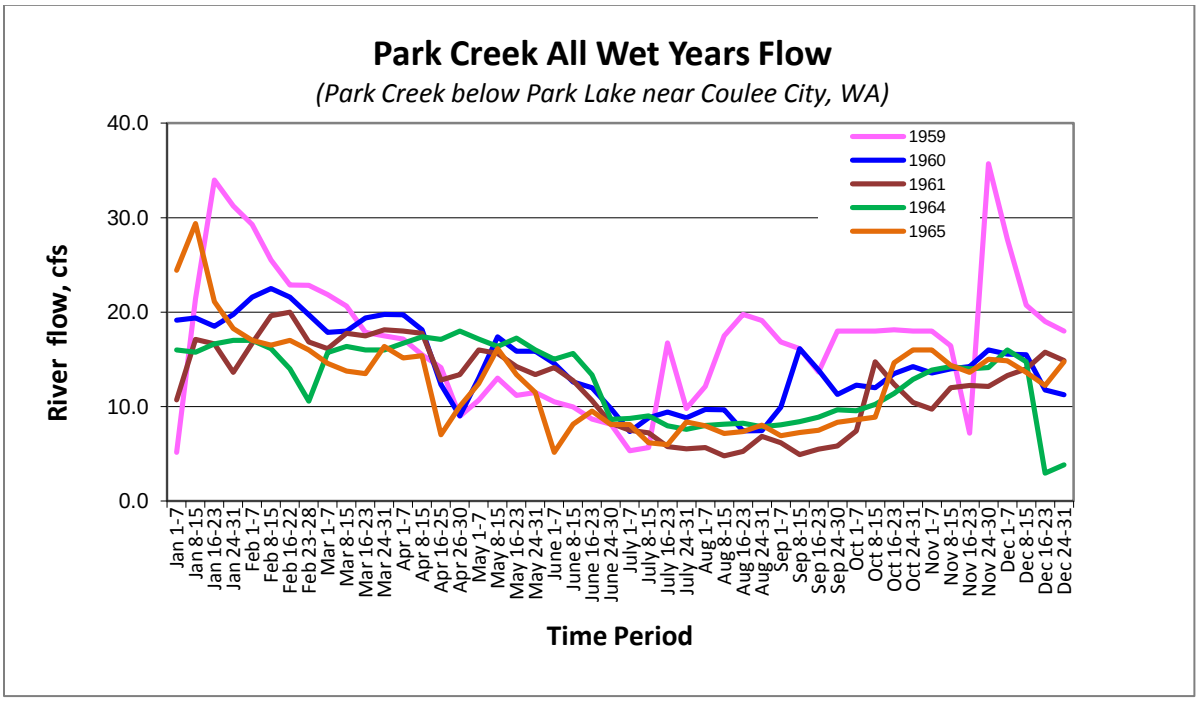




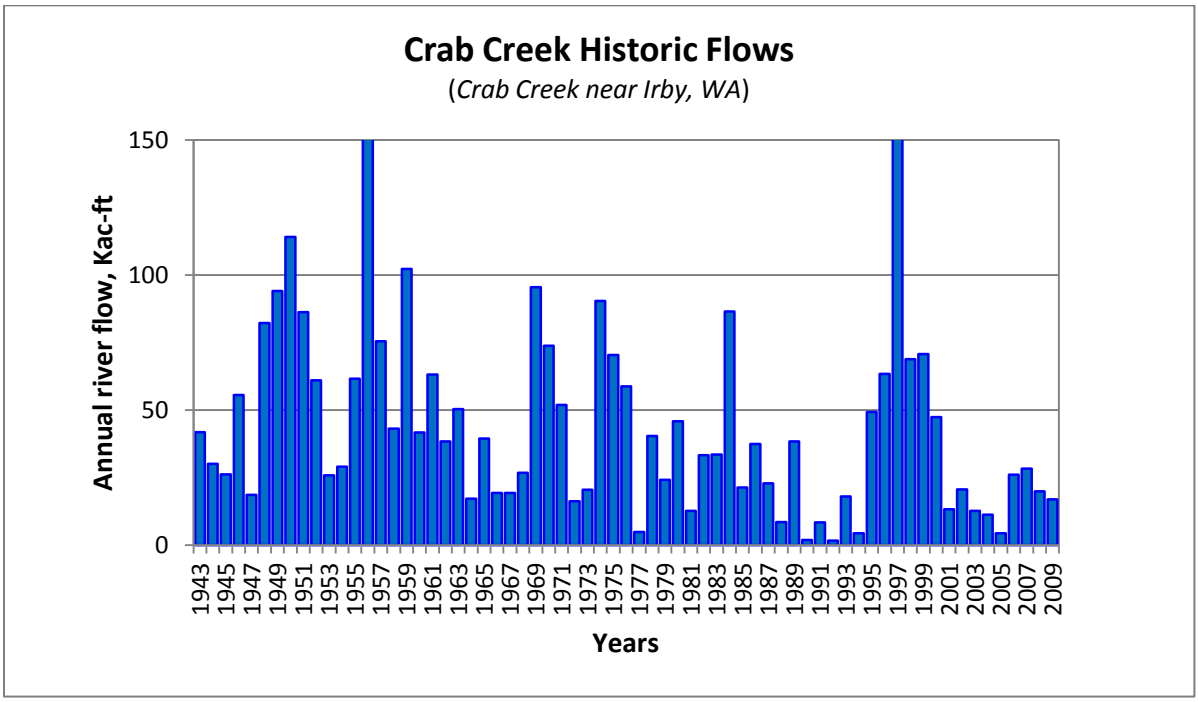

Dry Years Trend for Park Creek Flow
(Park Creek below Park Lake near Coulee City, WA)
Linear Trend
y = 386.28x + 3370.9
Annual river flow, Kac-ft
6.0
4.0
2.0
0.0
1946
1947
1948
1949
1968
Years

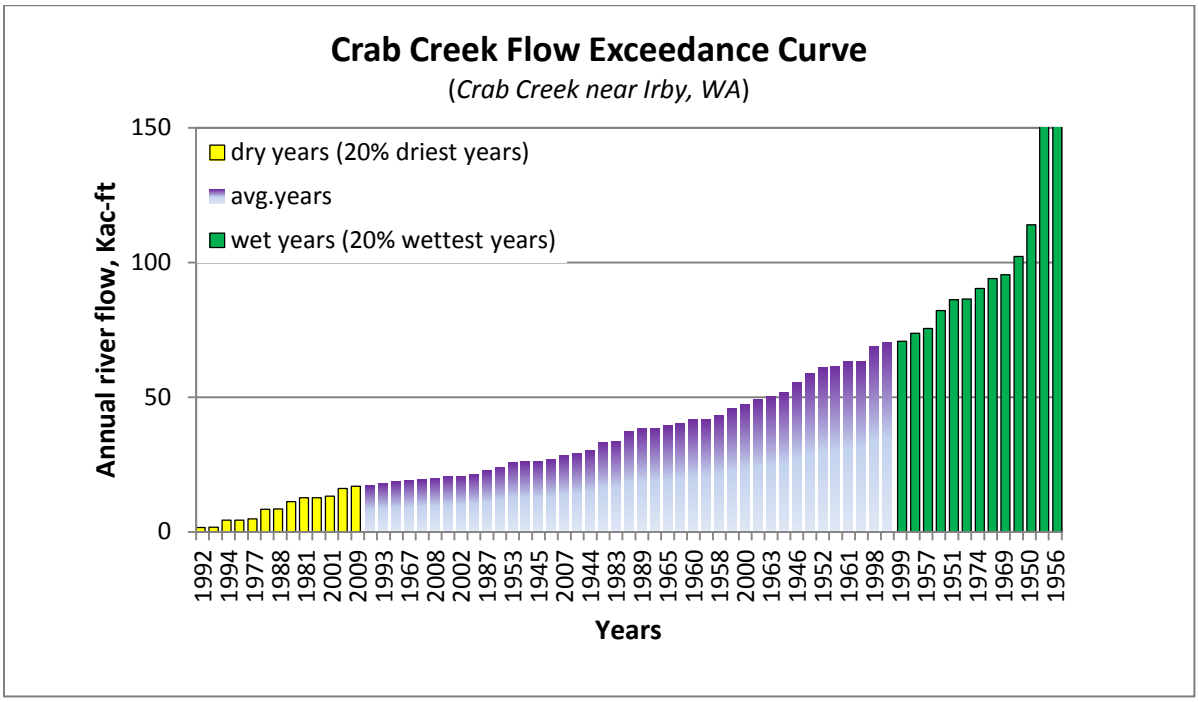

Park Creek Dry, Average and Wet Year Flows
(Park Creek below Park Lake near Coulee City, WA)
Dry year (1946)
Avg.year (1966)
Wet year (1959)
River flow, cfs
40.0
30.0
20.0
10.0
0.0
Time Period

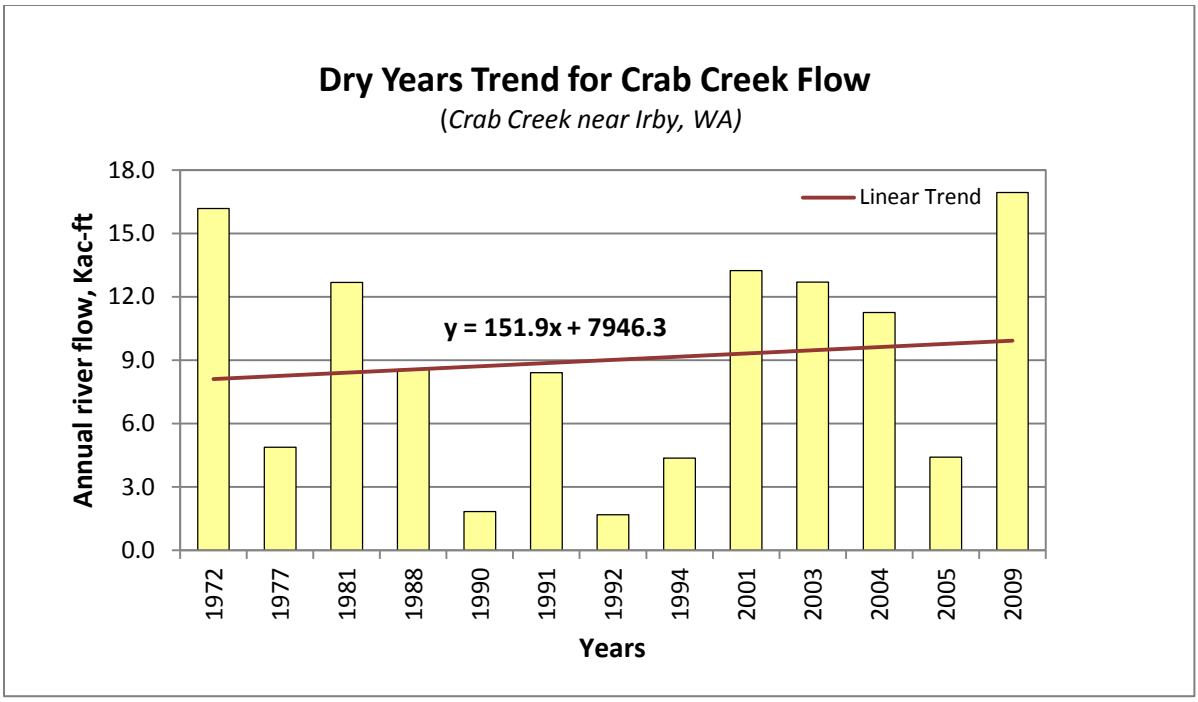

Park Creek All Dry Years Flow
(Park Creek below Park Lake near Coulee City, WA)
River flow, cfs
25.0
20.0
15.0
10.0
5.0
0.0
1946
1947
1948
1949
1968
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

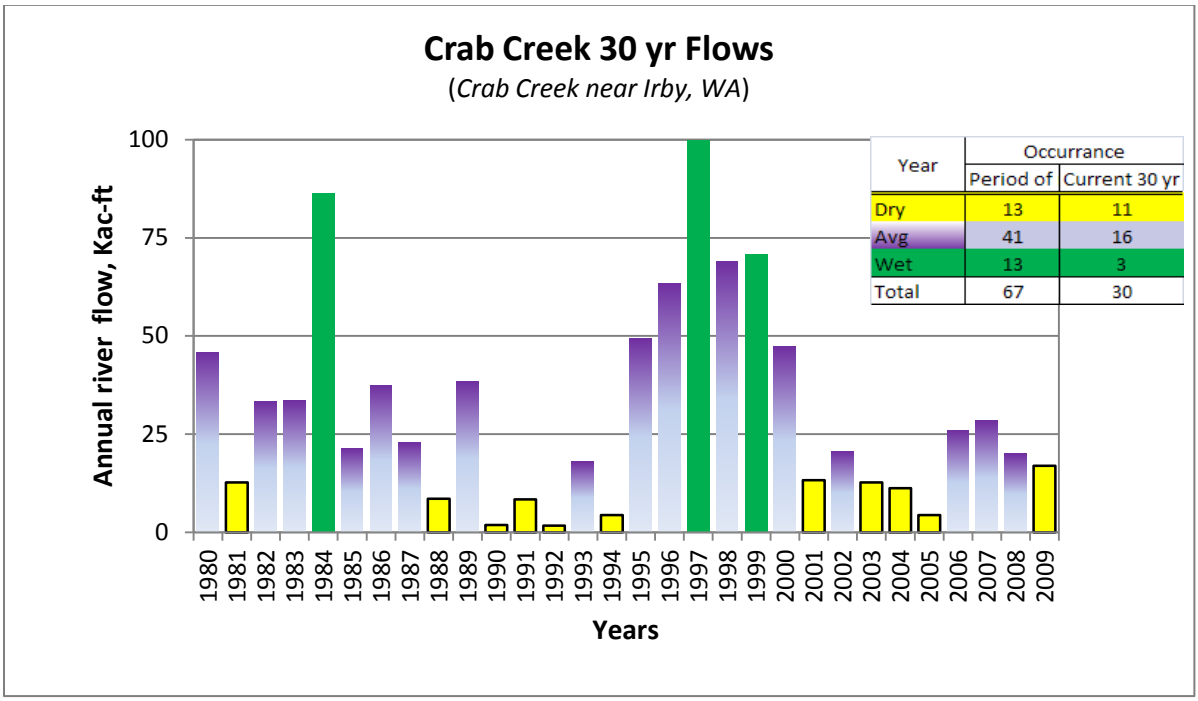

Park Creek All Wet Years Flow
(Park Creek below Park Lake near Coulee City, WA)
River flow, cfs
40.0
30.0
20.0
10.0
0.0
1959
1960
1961
1964
1965
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

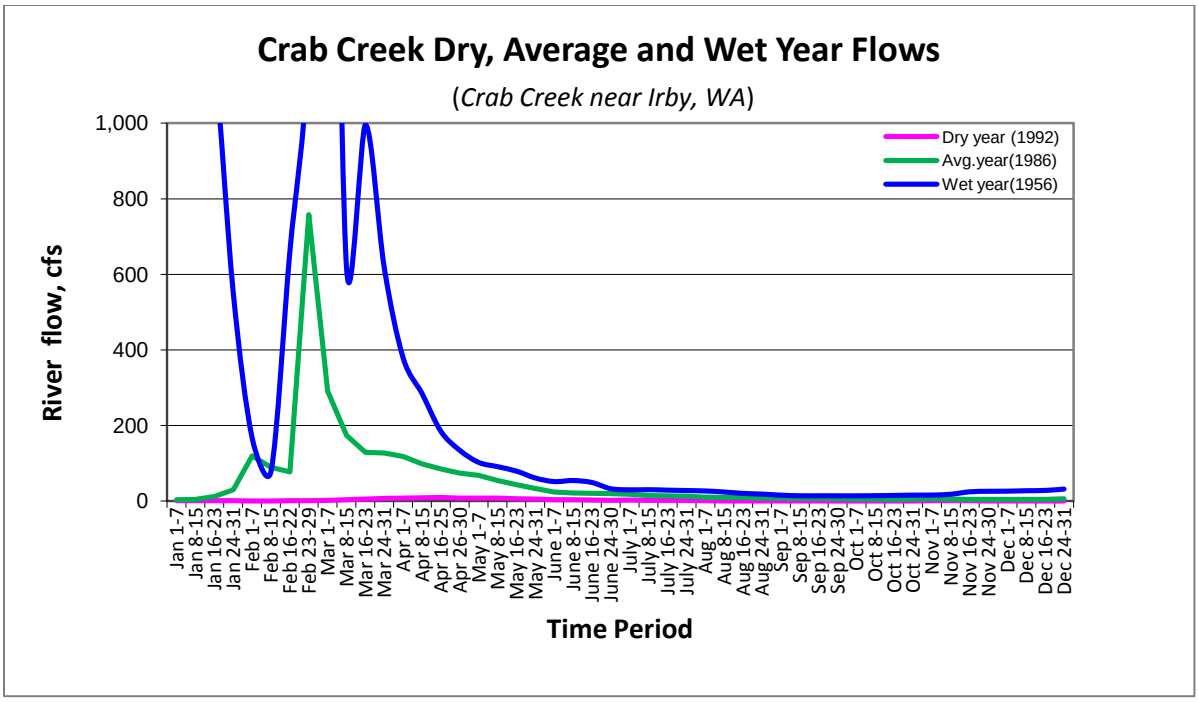
WRIA 43 (Upper Crab-Wilson)

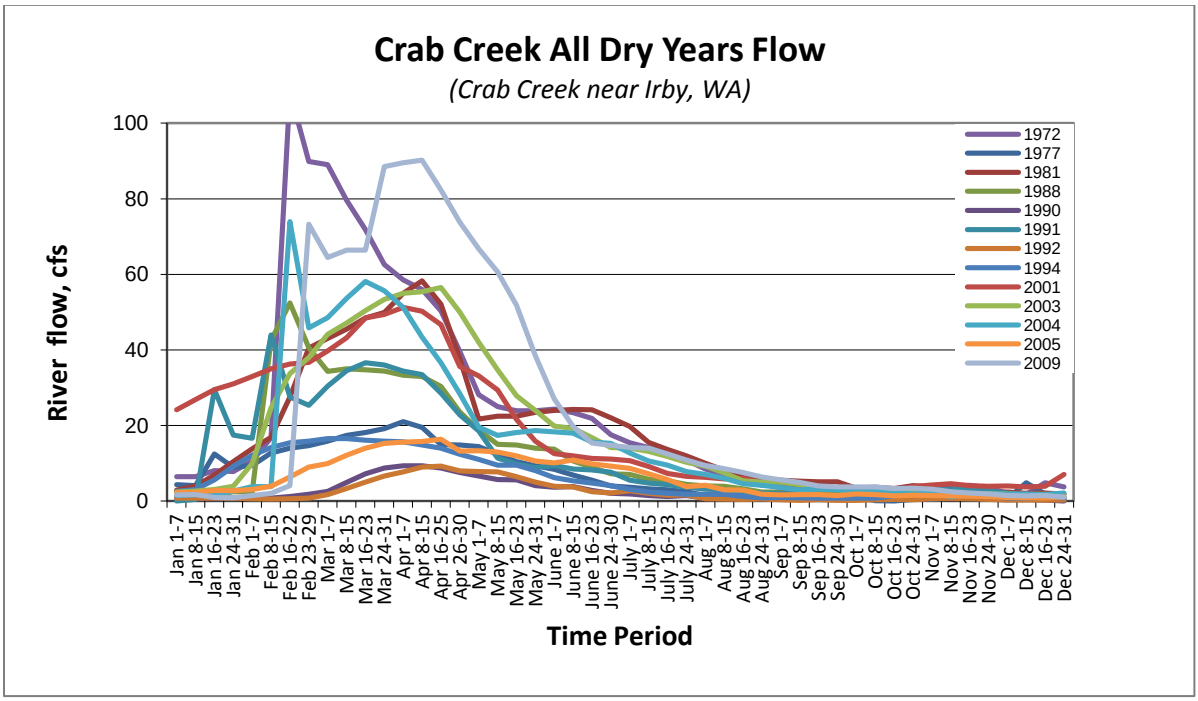


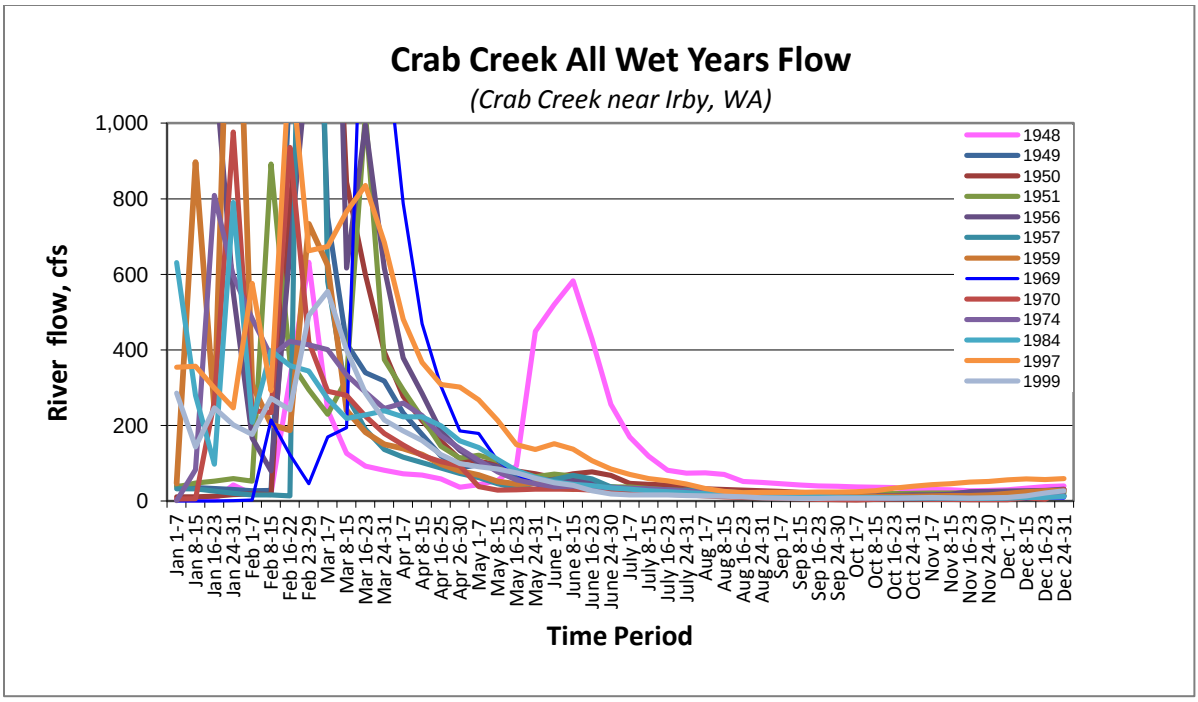



Dry Years Trend for Crab Creek Flow
(Crab Creek near Irby, WA)
Annual river flow, Kac-ft
18.0
15.0
12.0
9.0
6.0
3.0
0.0
Linear Trend
y = 151.9x + 7946.3
1972
1977
1981
1988
1990
1991
1992
1994
2001
2003
2004
2005
2009
Years


Crab Creek 30 yr Flows
(Crab Creek near Irby, WA)
Annual river flow, Kac-ft
100
75
50
25
0
Year
Occurrance
Period of
Current 30 yr
Dry 13 11
Avg 41 16
Wet 13 3
Total 67 30
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years


Crab Creek Dry, Average and Wet Year Flows
(Crab Creek near Irby, WA)
River flow, cfs
1,000
800
600
400
200
0
Dry year (1992)
Avg.year(1986)
Wet year(1956)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Crab Creek All Dry Years Flow
(Crab Creek near Irby, WA)
River flow, cfs
100
80
60
40
20
0
1972
1977
1981
1988
1990
1991
1992
1994
2001
2003
2004
2005
2009
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

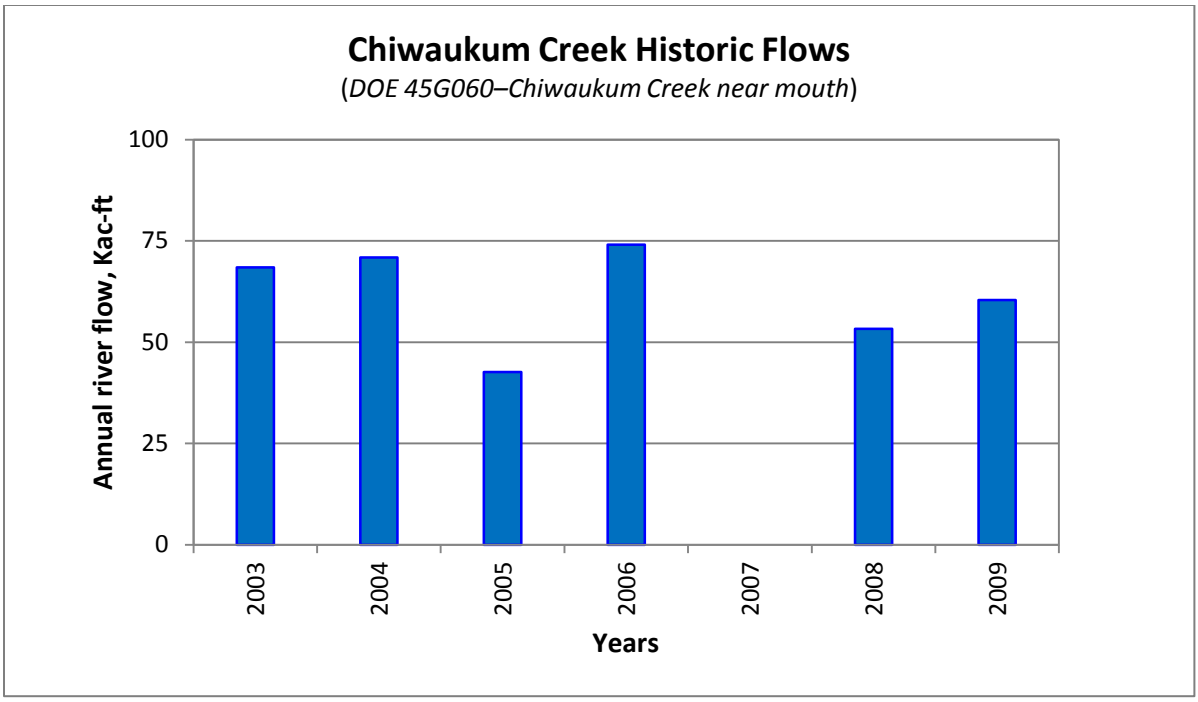

Crab Creek All Wet Years Flow
(Crab Creek near Irby, WA)
River flow, cfs
1,000
800
600
400
200
0
1948
1949
1950
1951
1956
1957
1959
1969
1970
1974
1984
1997
1999
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

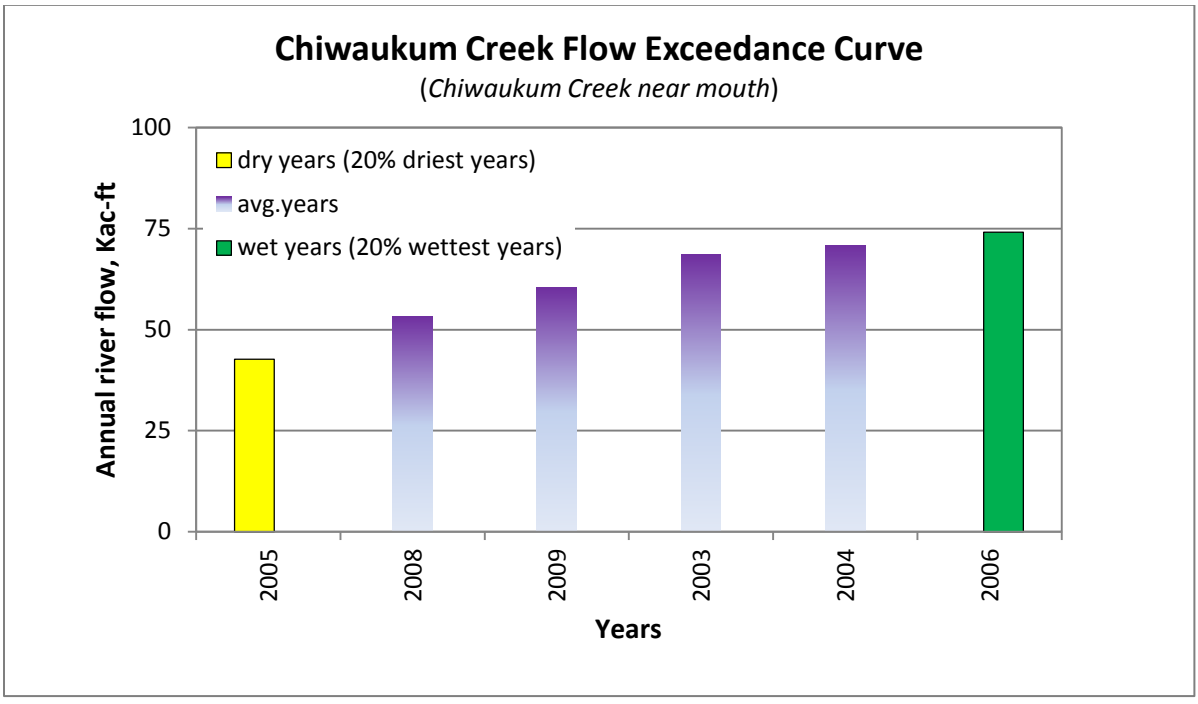
WRIA 45 (Wenatchee)

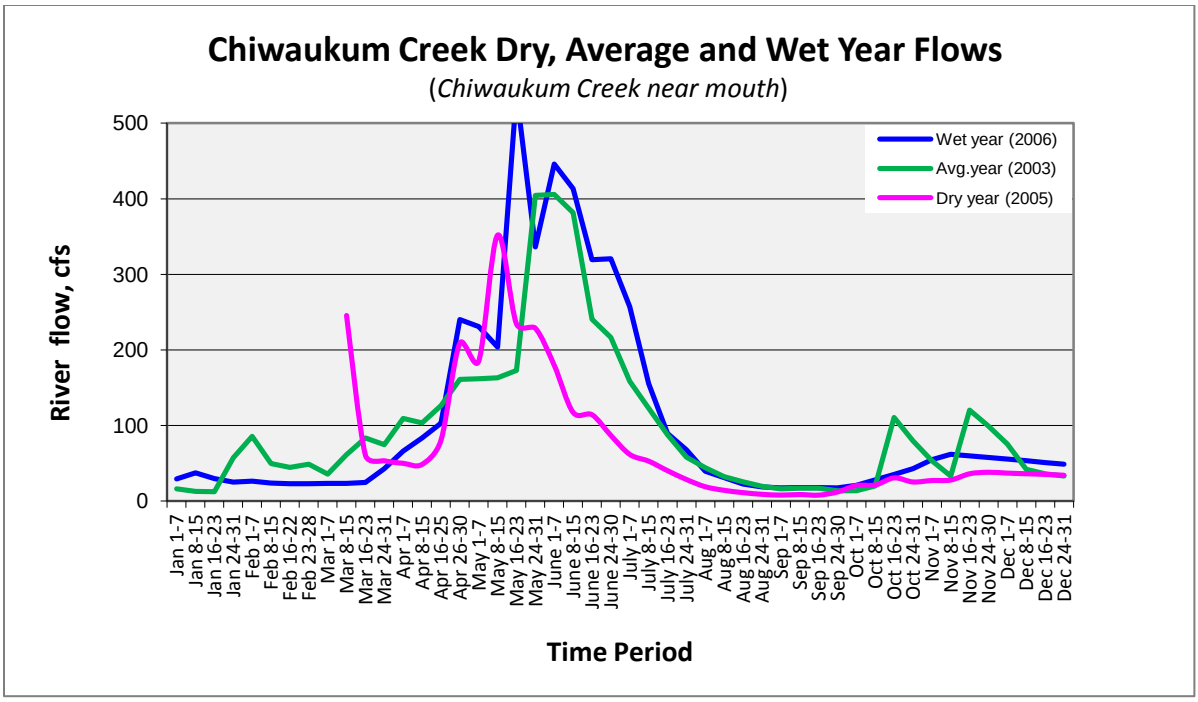
For WRIA 45, OCR graphed the flows of 12 rivers and streams. For most rivers and streams, a series of six to eight graphs were created. The results provide information on historic flow levels, drought occurrences and when instream flow rules are or are not met. These data contribute to OCR's understanding of historic trends, drought patterns and hydrograph variability. For example, by graphing the 47 year (1963–2009) flows of the Wenatchee River at Monitor, gauge number 1246200, it is shown that:

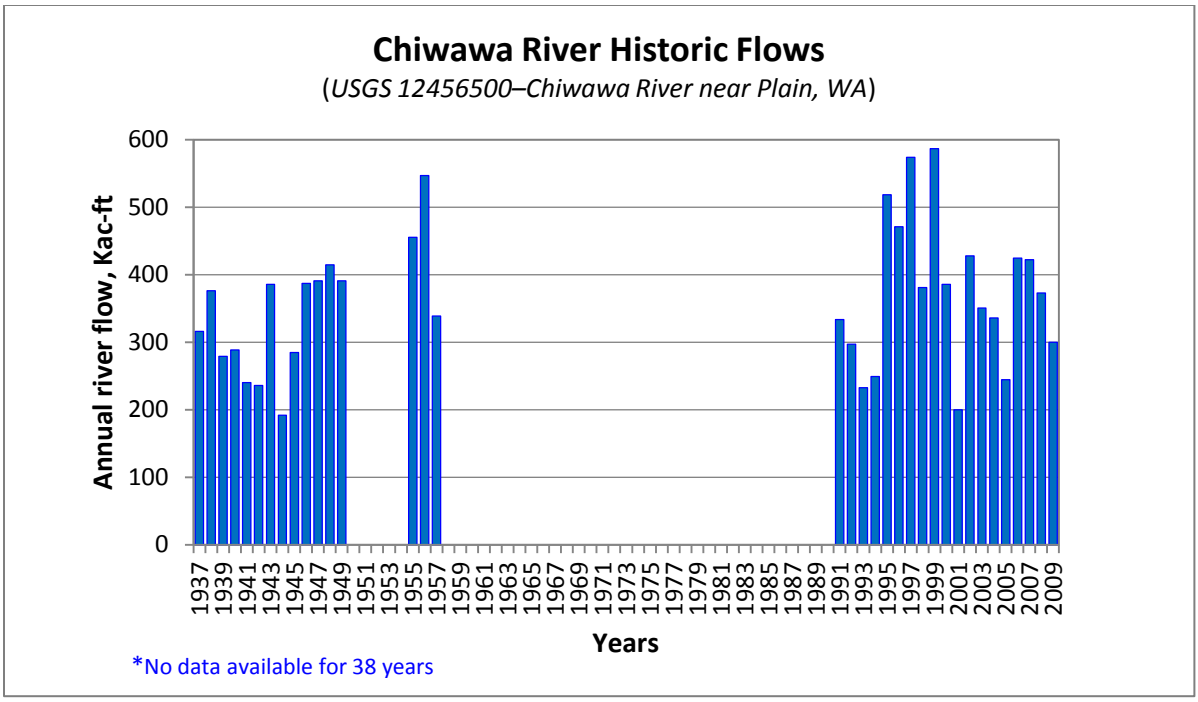
- Historic mean annual flows generally varied between 1.3 and 3.9 million acre-feet (MAF).
- Ecology defined "dry" years as the 80% exceedance value (80% of the time more water was available). Over the last 30 years, dry years occurred 6 times, with the worst stretch being 3 consecutive dry years in 1992-1994. During this same time period, the availability of water during dry years worsened by 18%.
- Ecology compared different water years (dry, average, wet) to the instream flow rule. The instream flow rule is almost always met in average years except in late summer. In dry years, the instream flow is also met in early summer and in the winter.
- The magnitude of unmet instream flows is small. For example, in average years, the instream flow deficit for the entire year totals 2,000 acre-feet, which grows to 84,000 acre-feet in dry years.
- Water is available in-basin to address instream shortages through OCR-funded projects (e.g. storage, conservation, pump exchanges). For example, the average water year surplus is 1.5 MAF.

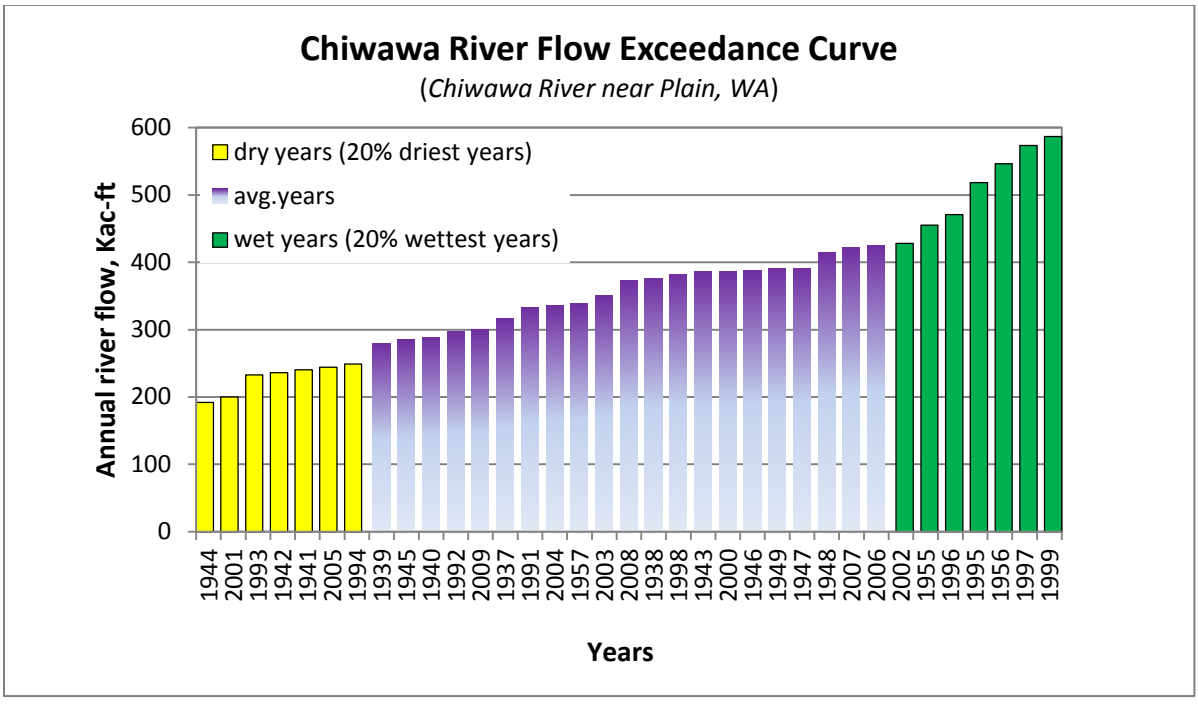
OCR can use this information to recognize where water is needed, when water is available and whether or not the in-basin or out-of-basin water supply development can help meet the WRIA's water demands.

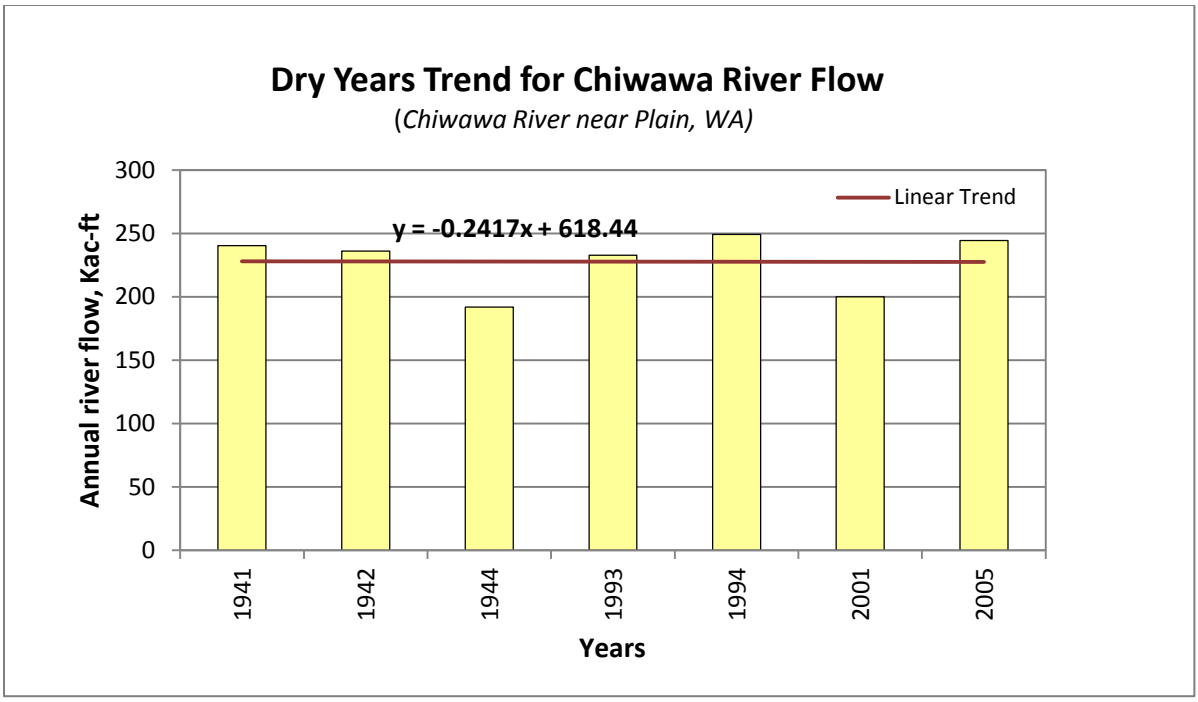

Chiwaukum Creek Historic Flows
(DOE 45G060–Chiwaukum Creek near mouth)
Annual river flow, Kac-ft
100
75
50
25
0
2003
2004
2005
2006
2007
2008
2009
Years

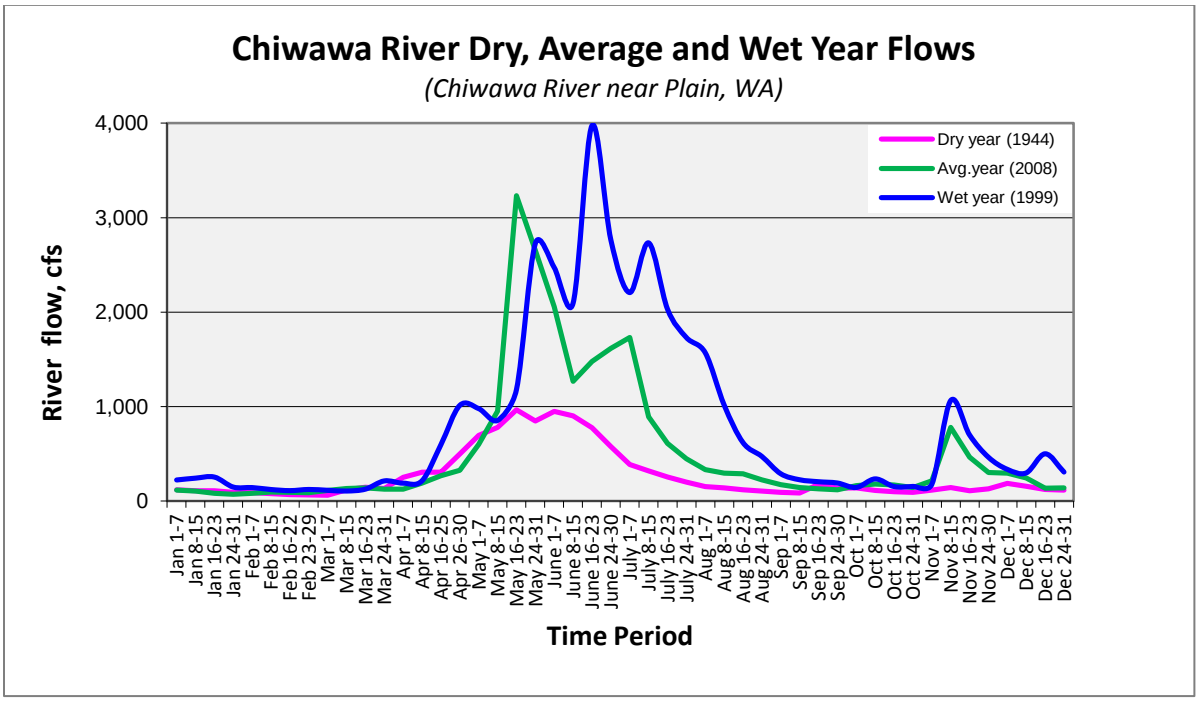

Chiwaukum Creek Flow Exceedance Curve
(Chiwaukum Creek near mouth)
Annual river flow, Kac-ft
100
75
50
25
0
dry years (20% driest years)
avg.years
wet years (20% wettest years)
2005
2008
2009
2003
2004
2006
Years

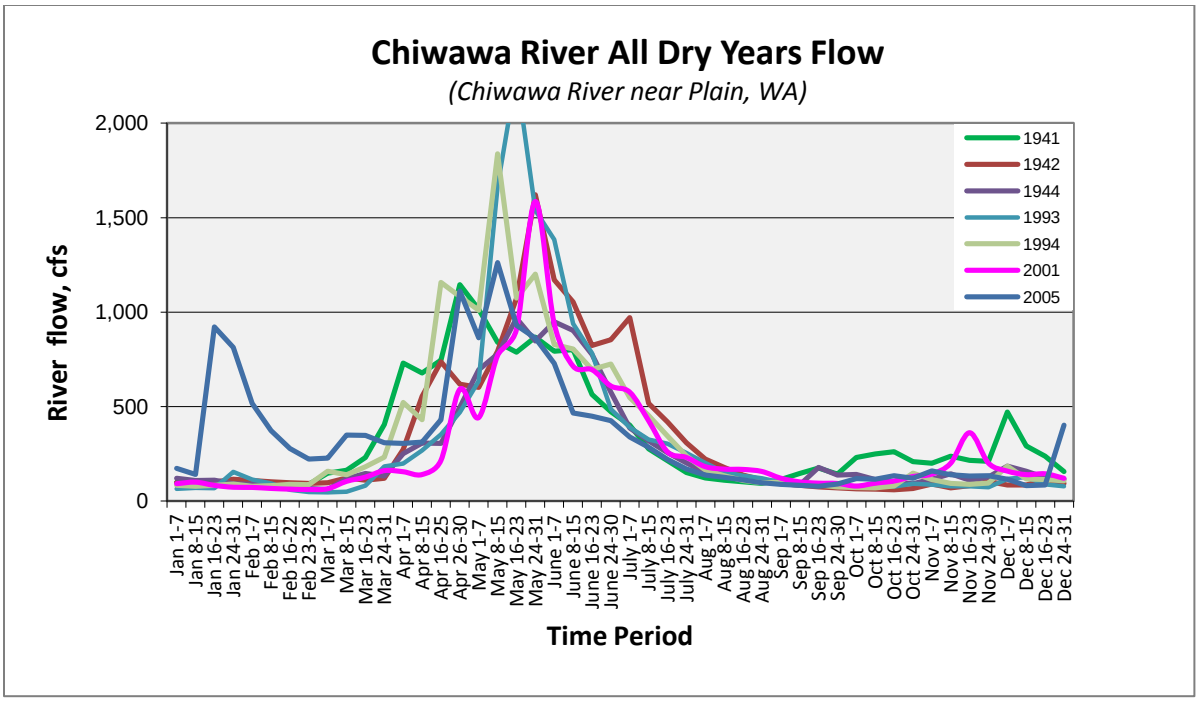

Chiwaukum Creek Dry, Average and Wet Year Flows
(Chiwaukum Creek near mouth)
River flow, cfs
500
400
300
200
100
0
Wet year (2006)
Avg.year (2003)
Dry year (2005)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

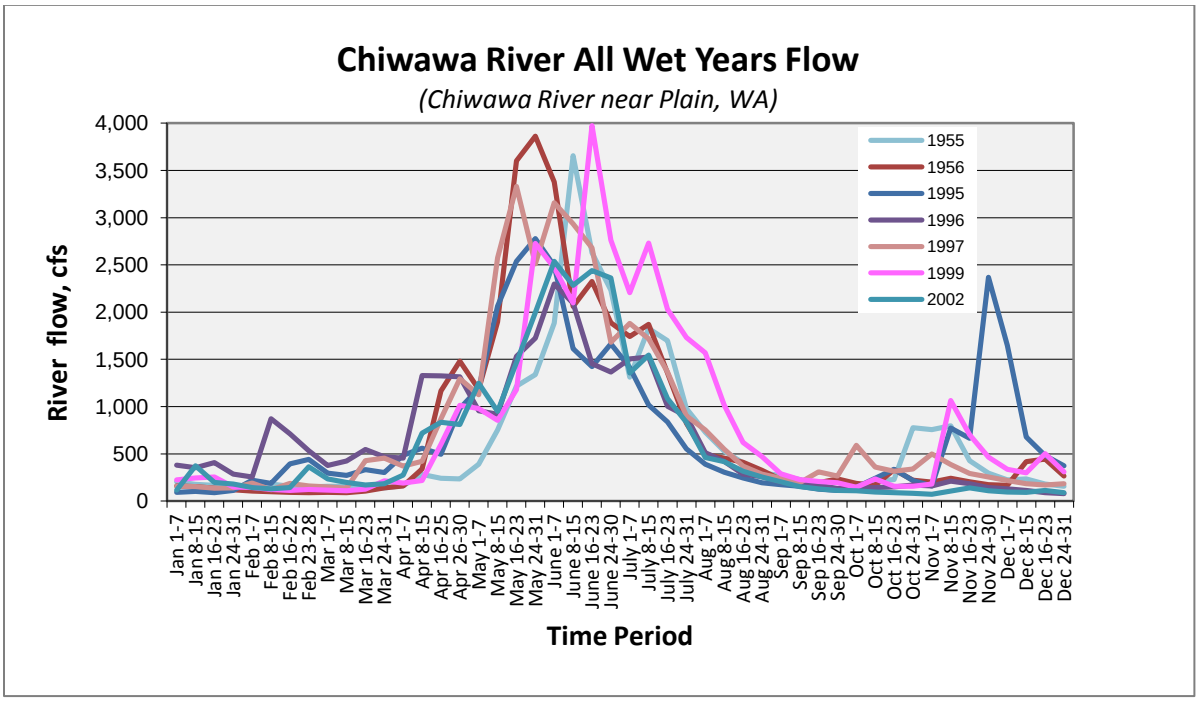

Chiwawa River Historic Flows
(USGS 12456500–Chiwawa River near Plain, WA)
Annual river flow, Kac-ft
600
500
400
300
200
100
0
1937 1939 1941 1943 1945 1947 1949 1951 1953 1955 1957 1959 1961 1963 1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009
Years
*No data available for 38 years

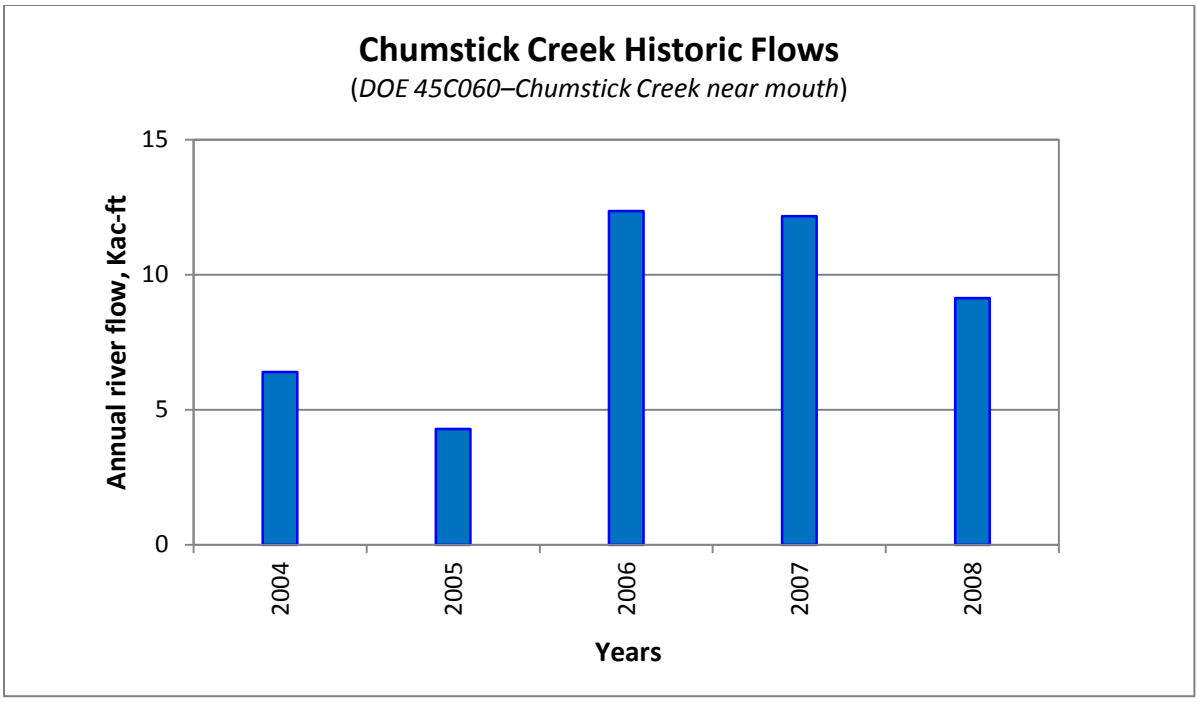

Chiwawa River Flow Exceedance Curve
(Chiwawa River near Plain, WA)
Annual river flow, Kac-ft
600
500
400
300
200
100
0
dry years (20% driest years)
avg.years
wet years (20% wettest years)
1944 2001 1993 1942 1941 2005 1994 1939 1945 1940 1992 2009 1937 1991 2004 1957 2003 2008 1938 1998 1943 2000 1946 1949 1947 1948 2007 2006 2002 1955 1996 1995 1956 1997 1999
Years

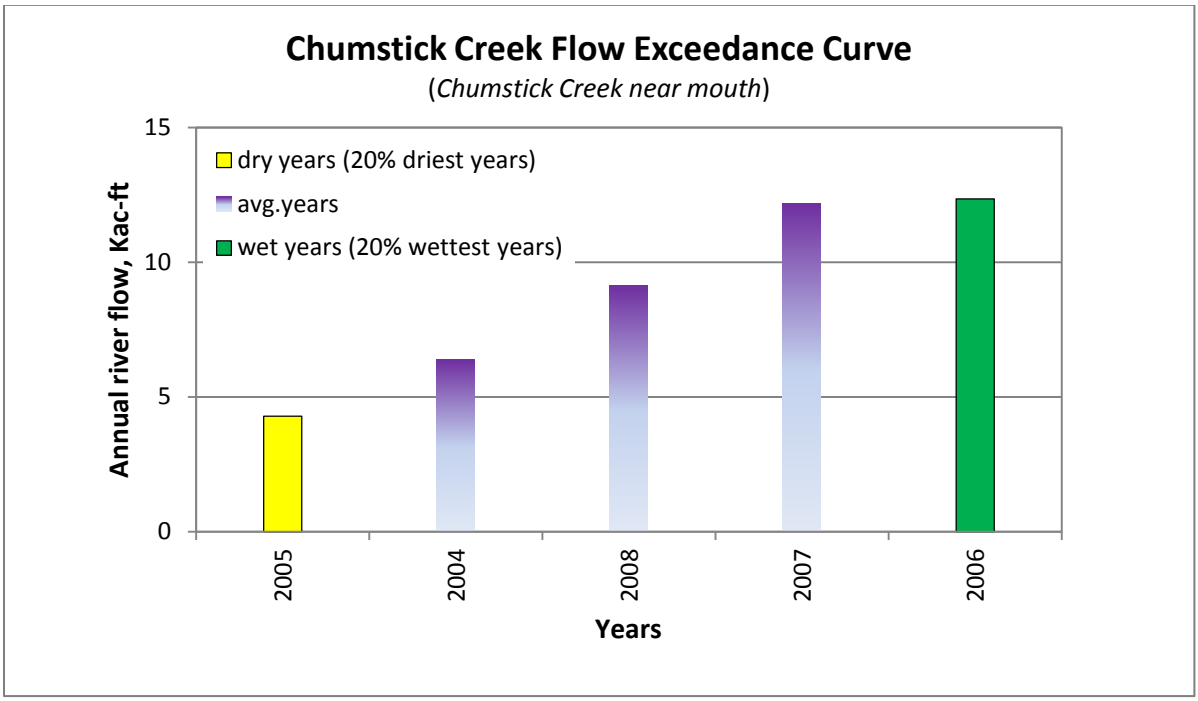

Dry Years Trend for Chiwawa River Flow
(Chiwawa River near Plain, WA)
Linear Trend
y = -0.2417x + 618.44
Annual river flow, Kac-ft
300
250
200
150
100
50
0
1941
1942
1944
1993
1994
2001
2005
Years

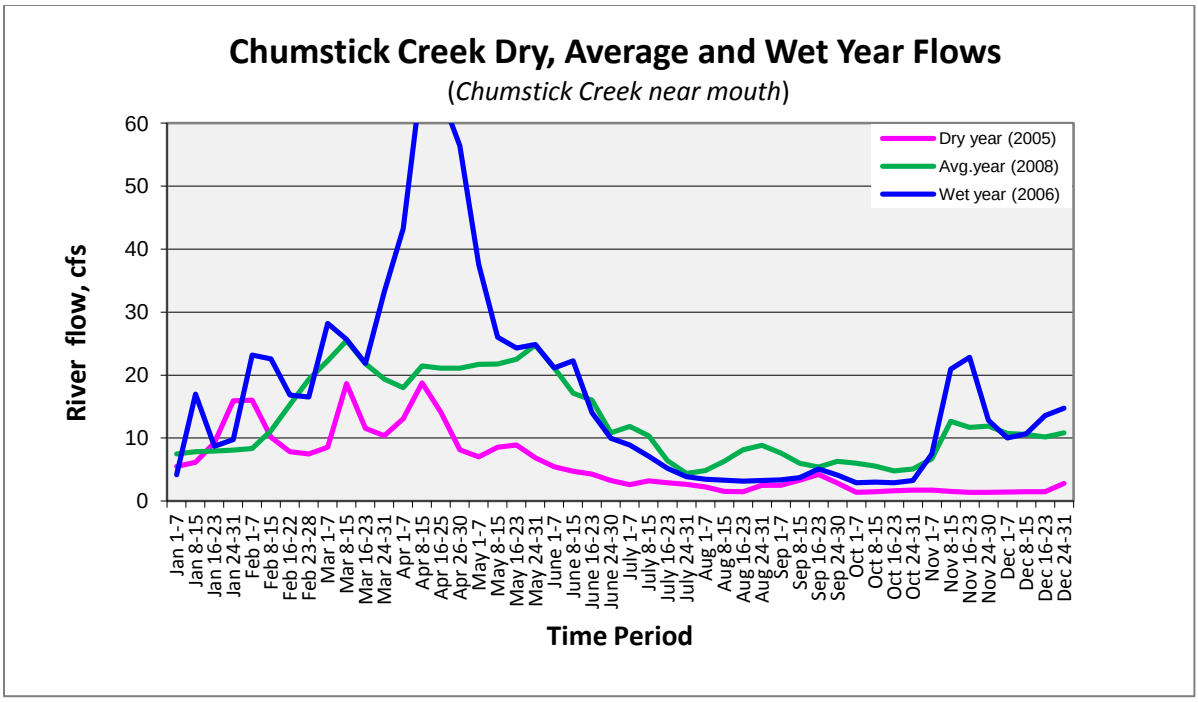

Chiwawa River Dry, Average and Wet Year Flows
(Chiwawa River near Plain, WA)
Dry year (1944)
Avg.year (2008)
Wet year (1999)
River flow, cfs
4,000
3,000
2,000
1,000
0
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

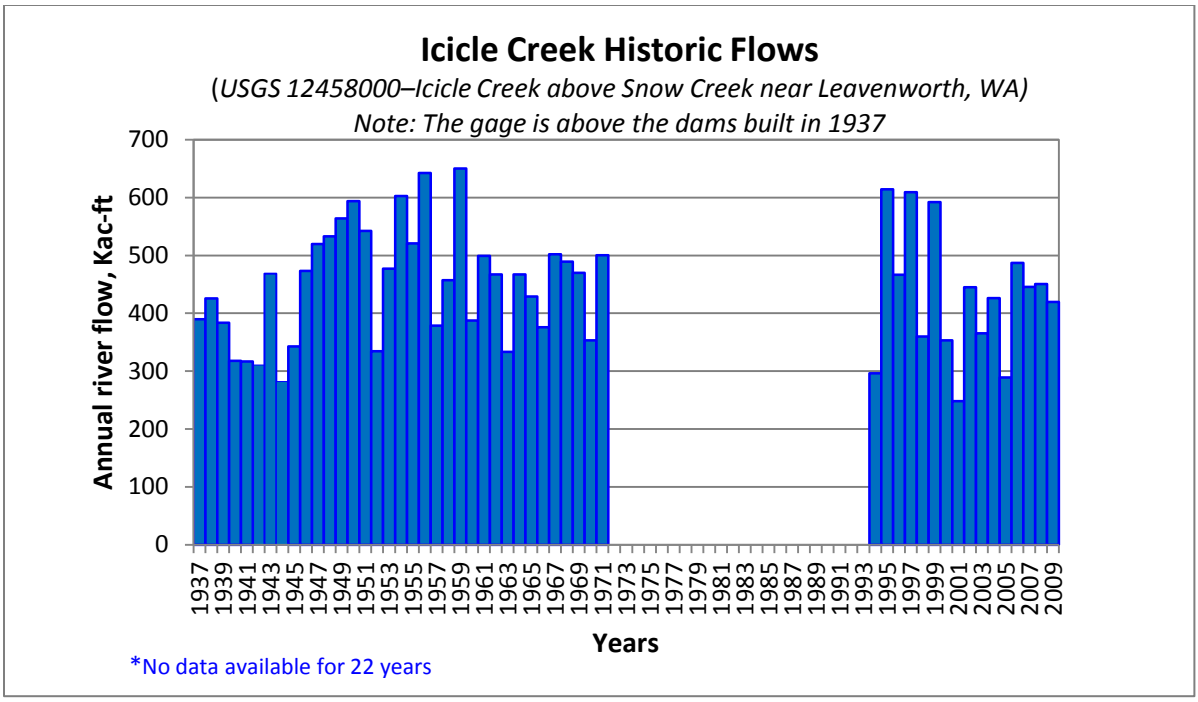

Chiwawa River All Dry Years Flow
(Chiwawa River near Plain, WA)
River flow, cfs
2,000
1,500
1,000
500
0
1941
1942
1944
1993
1994
2001
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

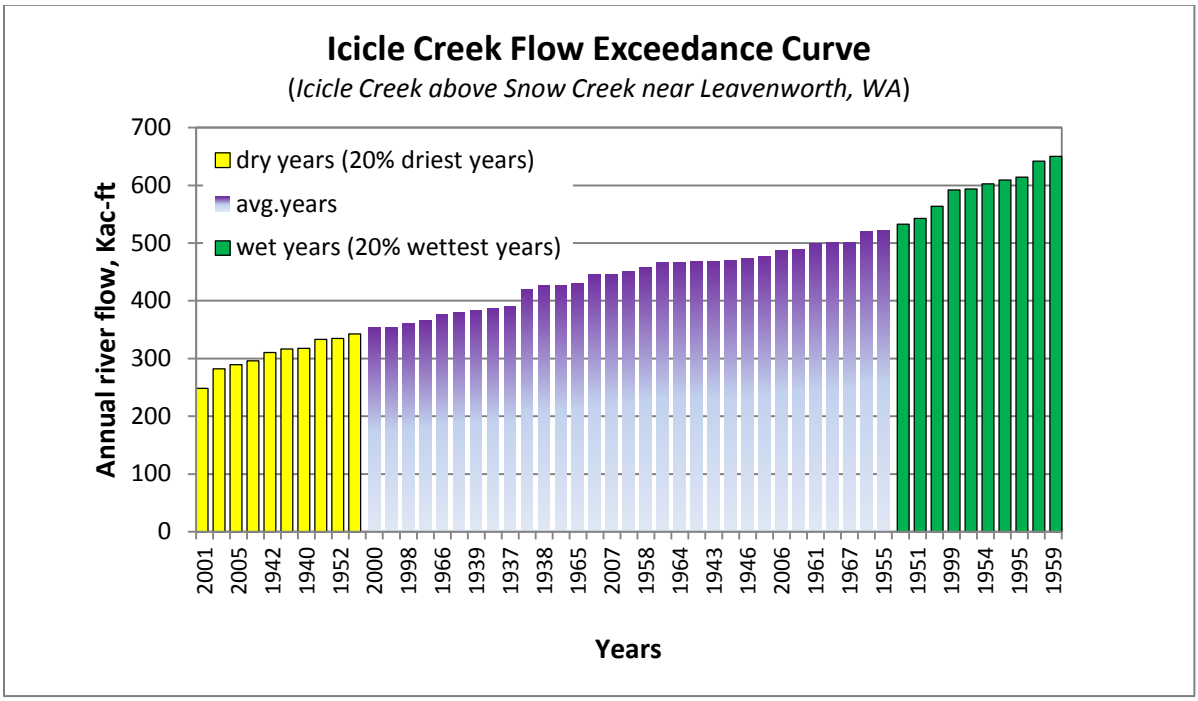

Chiwawa River All Wet Years Flow
(Chiwawa River near Plain, WA)
River flow, cfs
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1955
1956
1995
1996
1997
1999
2002
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

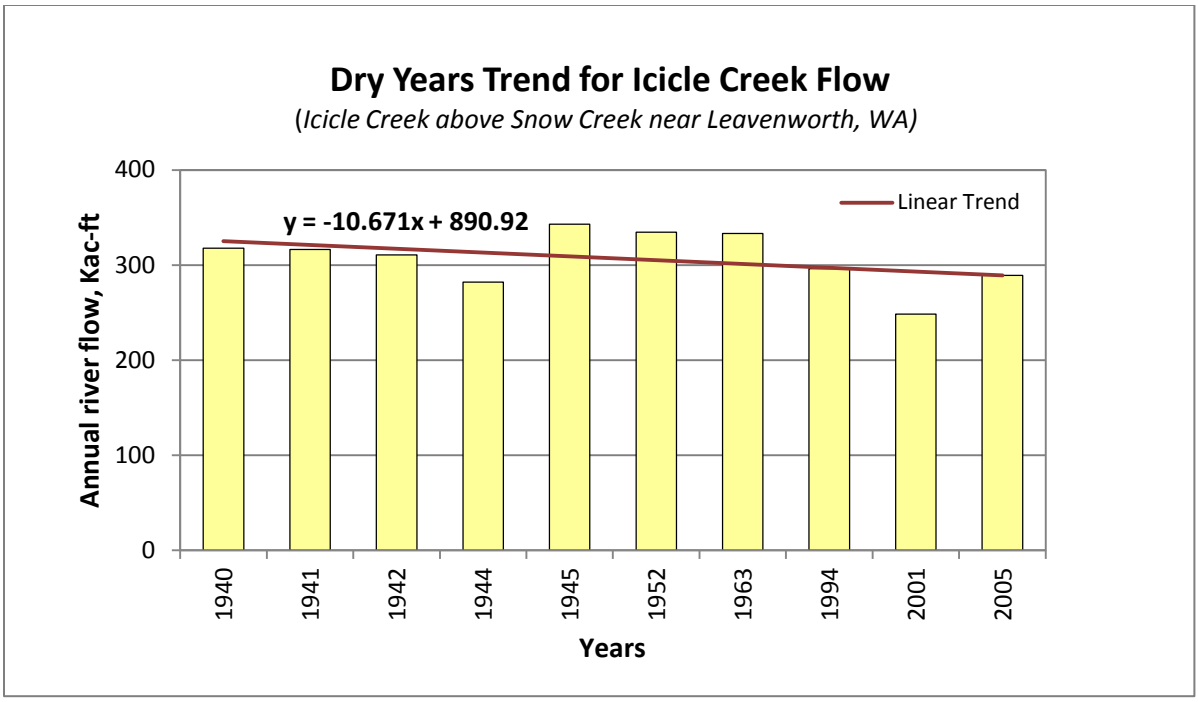

Chumstick Creek Historic Flows
(DOE 45C060–Chumstick Creek near mouth)
Annual river flow, Kac-ft
15
10
5
0
2004
2005
2006
2007
2008
Years

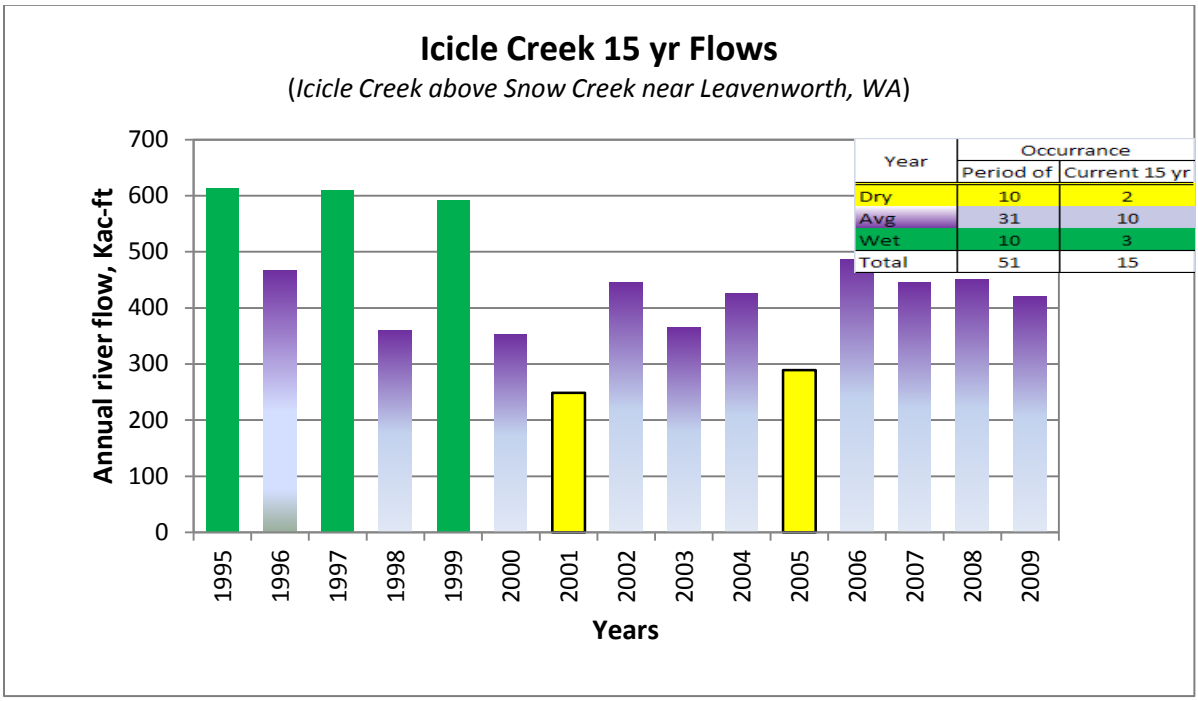

Chumstick Creek Flow Exceedance Curve
(Chumstick Creek near mouth)
Annual river flow, Kac-ft
15
10
5
0
dry years (20% driest years)
avg.years
wet years (20% wettest years)
2005
2004
2008
2007
2006
Years

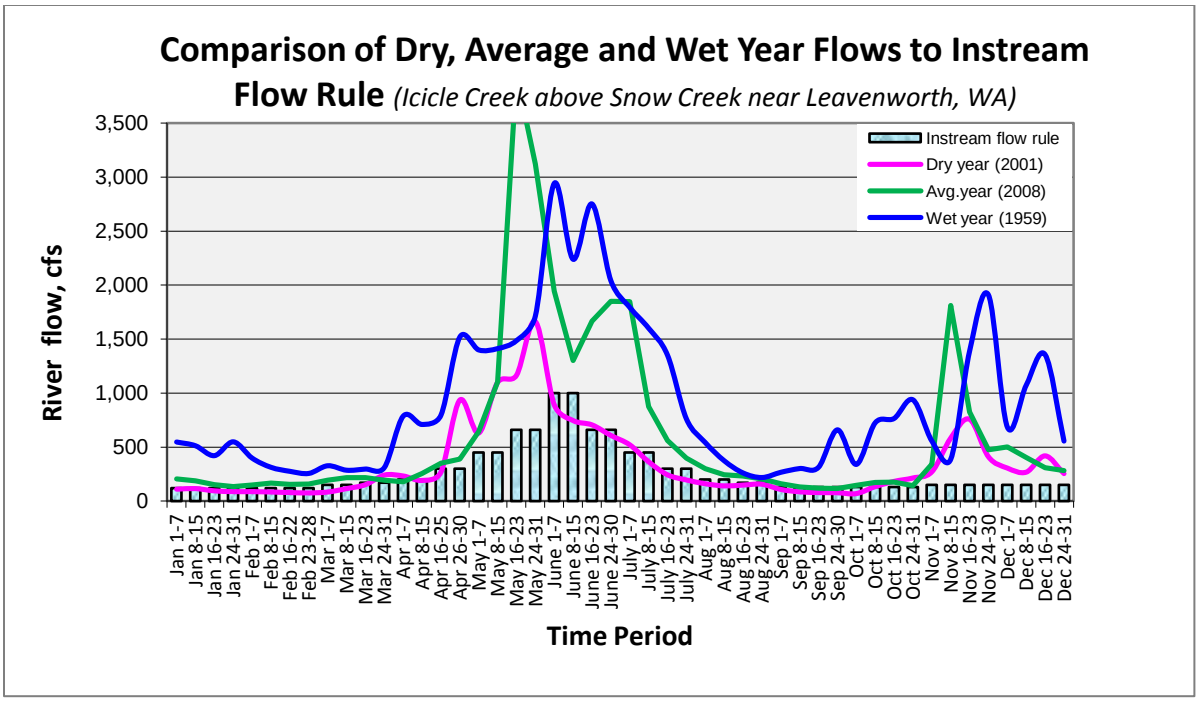

Chumstick Creek Dry, Average and Wet Year Flows
(Chumstick Creek near mouth)
River flow, cfs
60
50
40
30
20
10
0
Dry year (2005)
Avg.year (2008)
Wet year (2006)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

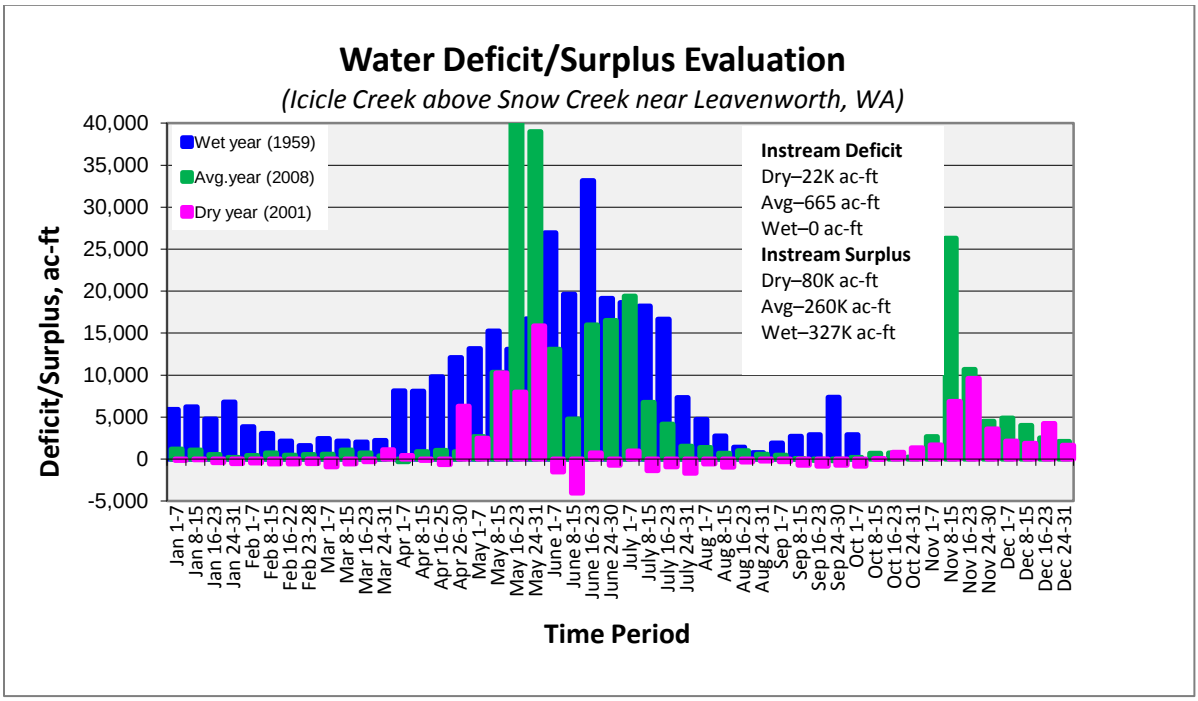

Icicle Creek Historic Flows
(USGS 12458000–Icicle Creek above Snow Creek near Leavenworth, WA)
Note: The gage is above the dams built in 1937
Annual river flow, Kac-ft
700
600
500
400
300
200
100
0
1937 1939 1941 1943 1945 1947 1949 1951 1953 1955 1957 1959 1961 1963 1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009
Years
*No data available for 22 years

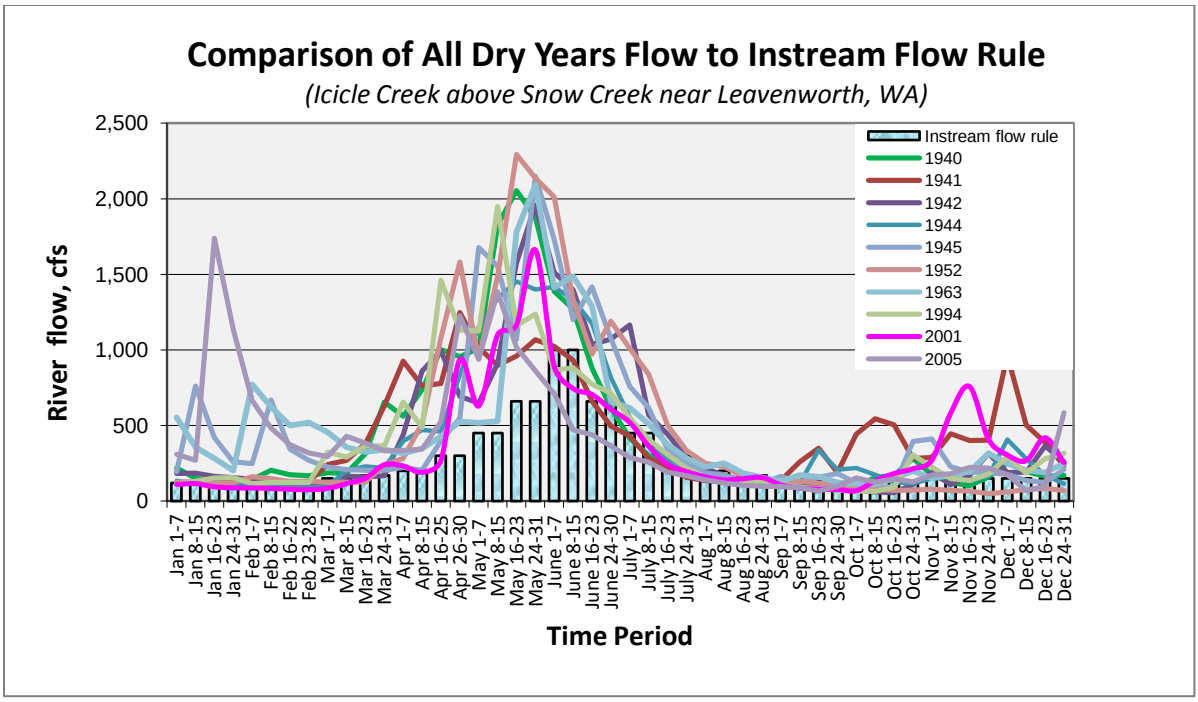

Icicle Creek Flow Exceedance Curve
(Icicle Creek above Snow Creek near Leavenworth, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, Kac-ft
700
600
500
400
300
200
100
0
2001 2005 1942 1940 1952 2000 1998 1966 1939 1937 1938 1965 2007 1958 1964 1943 1946 2006 1961 1967 1955 1951 1999 1954 1995 1959
Years

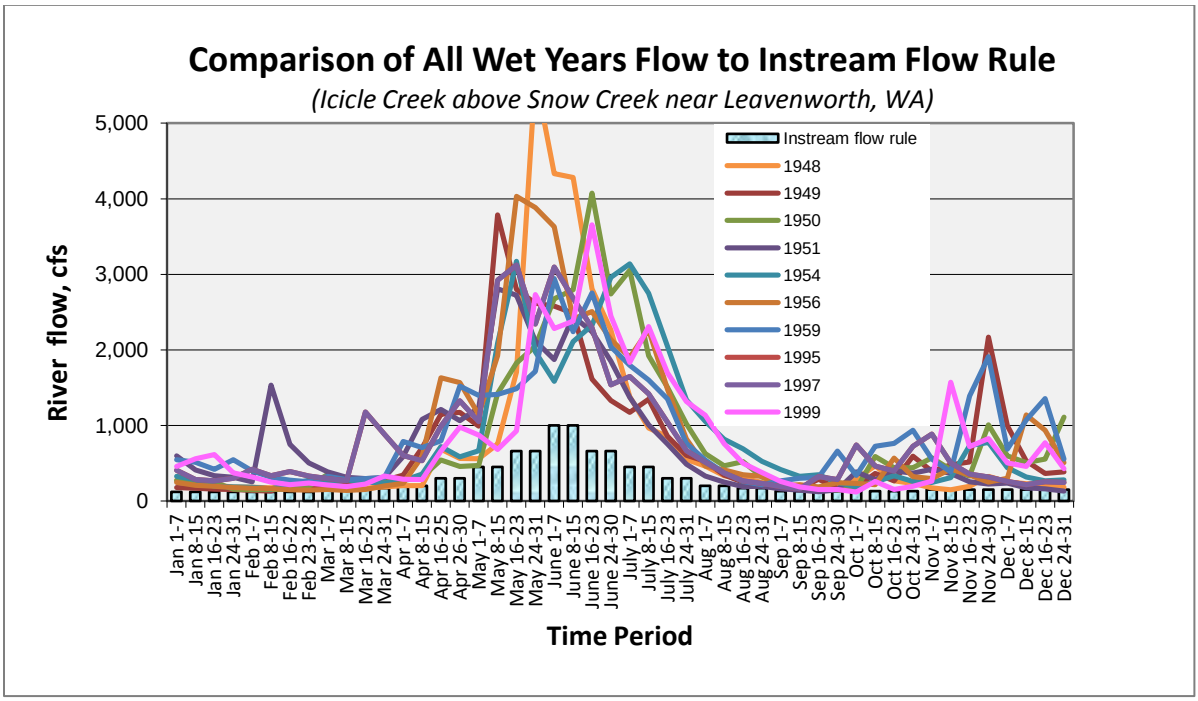

Dry Years Trend for Icicle Creek Flow
(Icicle Creek above Snow Creek near Leavenworth, WA)
y = -10.671x + 890.92
Linear Trend
Annual river flow, Kac-ft
400
300
200
100
0
1940
1941
1942
1944
1945
1952
1963
1994
2001
2005
Years

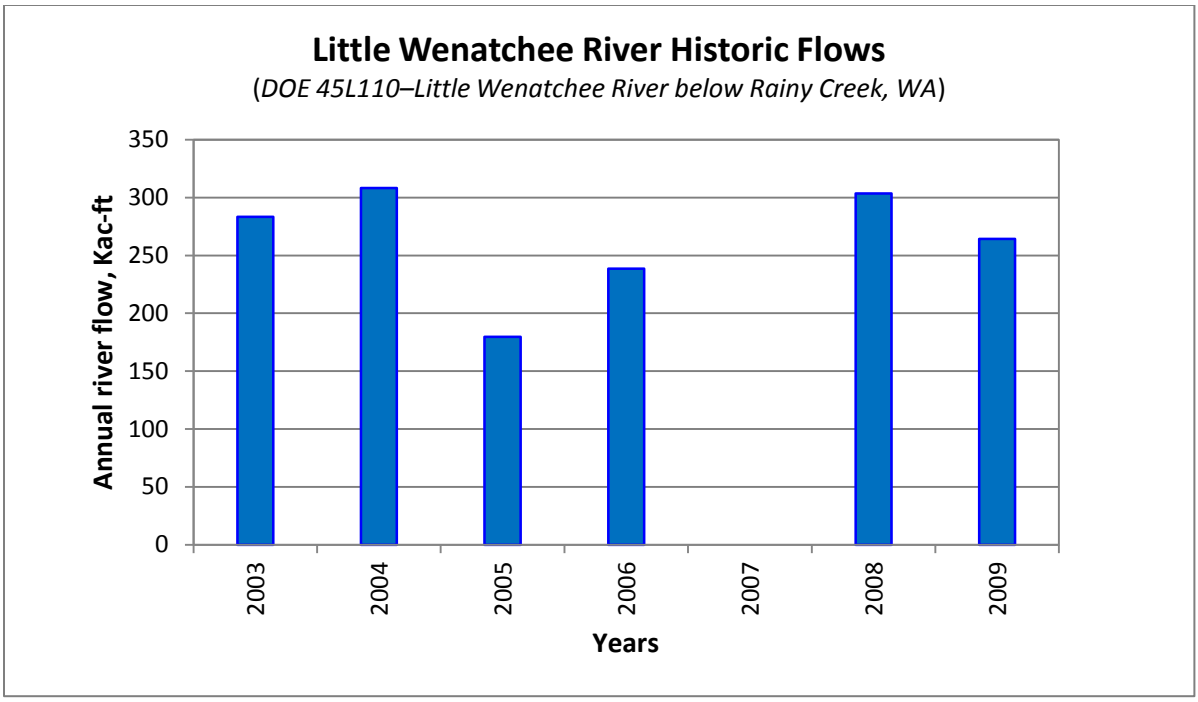

Icicle Creek 15 yr Flows
(Icicle Creek above Snow Creek near Leavenworth, WA)
Annual river flow, Kac-ft
700
600
500
400
300
200
100
0
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 15 yr
Dry 10 2
Avg 31 10
Wet 10 3
Total 51 15

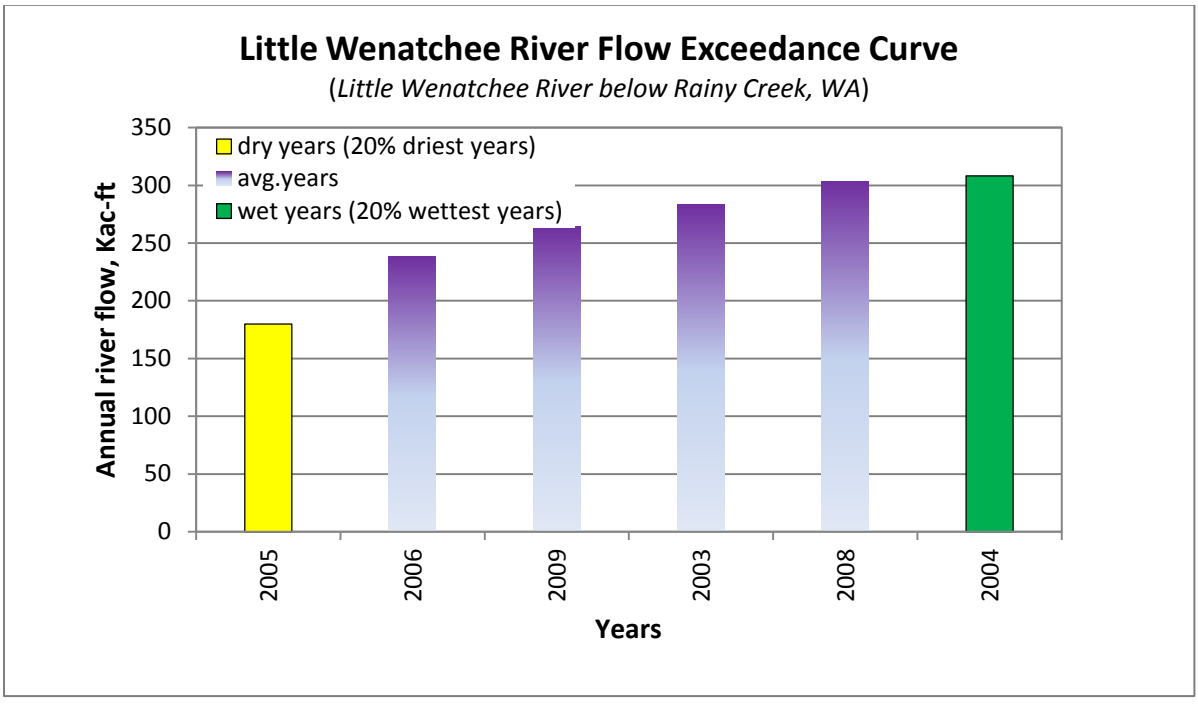

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Icicle Creek above Snow Creek near Leavenworth, WA)
River flow, cfs
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Instream flow rule
Dry year (2001)
Avg.year (2008)
Wet year (1959)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

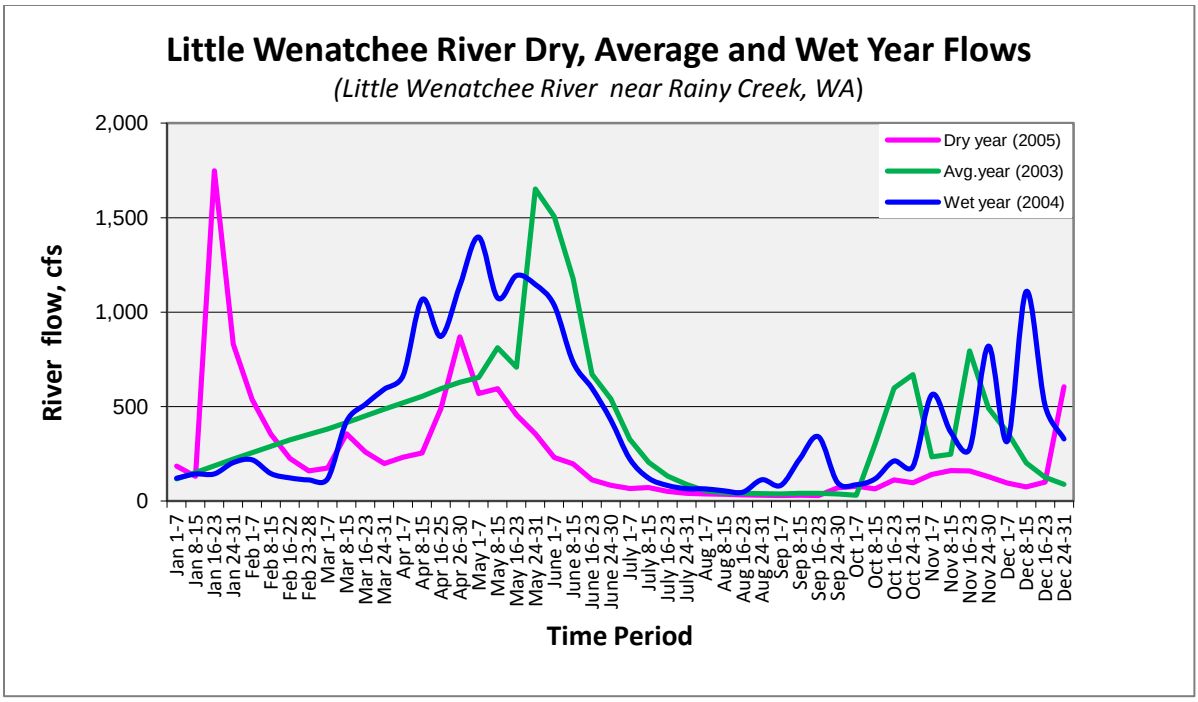

Water Deficit/Surplus Evaluation
(Icicle Creek above Snow Creek near Leavenworth, WA)
Deficit/Surplus, ac-ft
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
-5,000
Wet year (1959)
Avg.year (2008)
Dry year (2001)
Instream Deficit
Dry–22K ac-ft
Avg–665 ac-ft
Wet–0 ac-ft
Instream Surplus
Dry–80K ac-ft
Avg–260K ac-ft
Wet–327K ac-ft
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

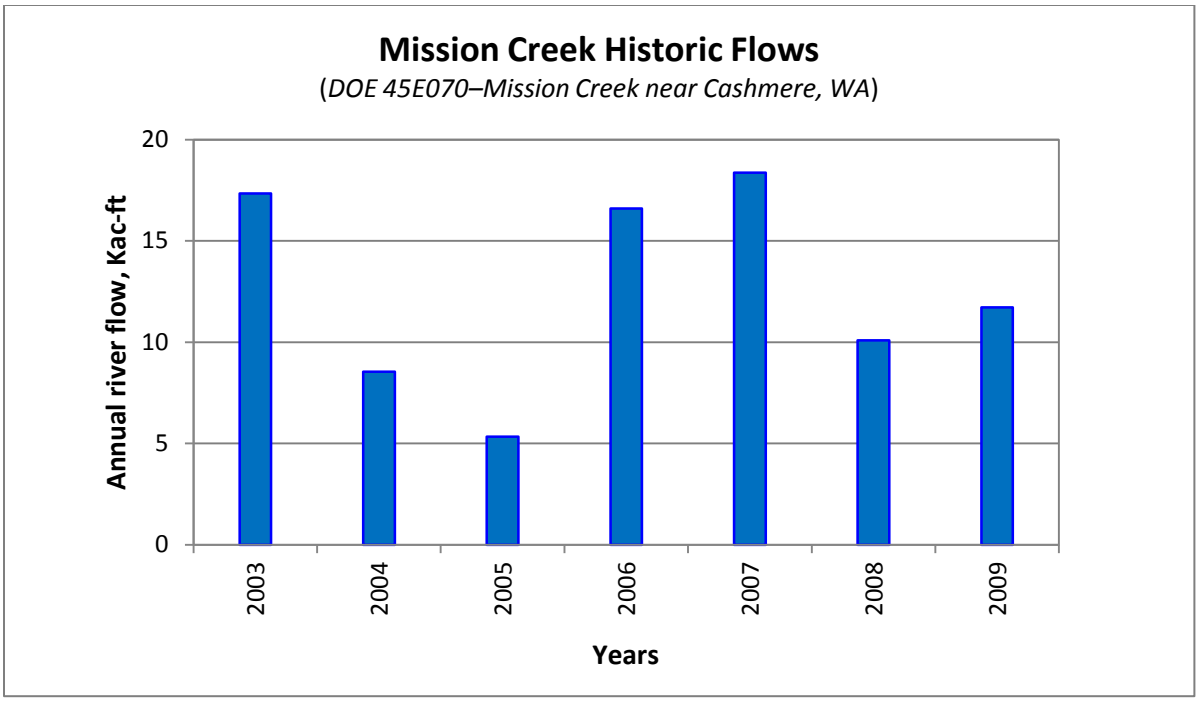

Comparison of All Dry Years Flow to Instream Flow Rule
(Icicle Creek above Snow Creek near Leavenworth, WA)
River flow, cfs
2,500
2,000
1,500
1,000
500
0
Instream flow rule
1940
1941
1942
1944
1945
1952
1963
1994
2001
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

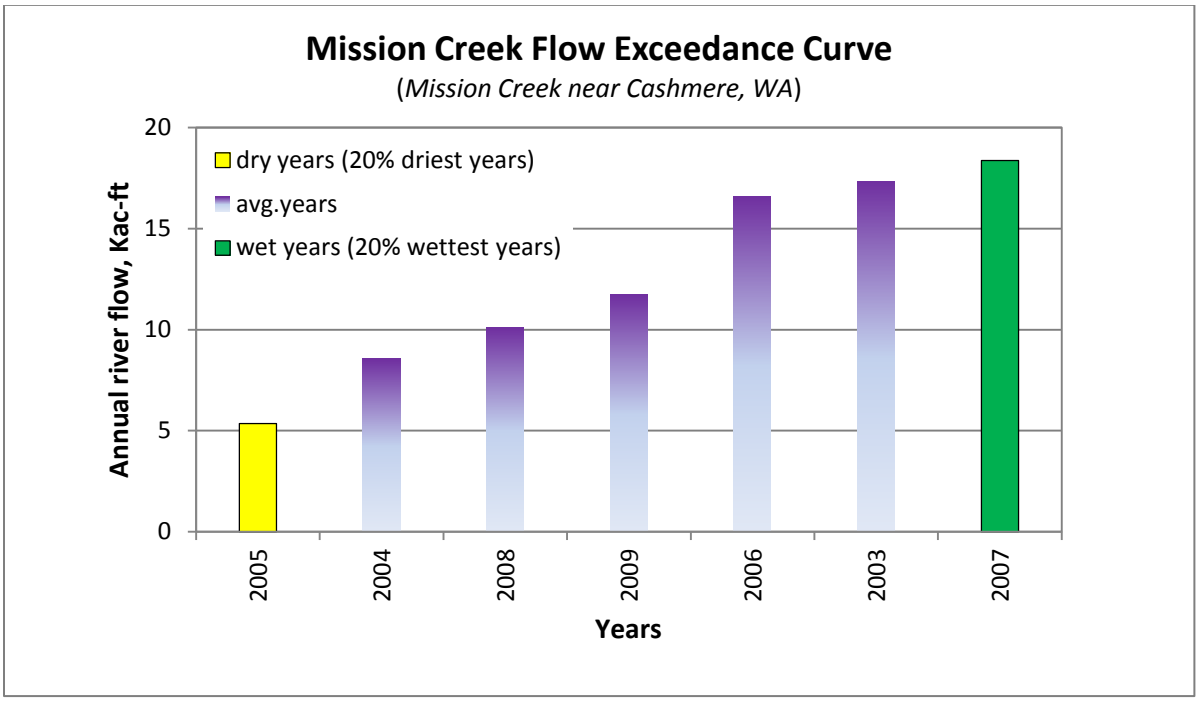

Comparison of All Wet Years Flow to Instream Flow Rule
(Icicle Creek above Snow Creek near Leavenworth, WA)
River flow, cfs
5,000
4,000
3,000
2,000
1,000
0
Instream flow rule
1948
1949
1950
1951
1954
1956
1959
1995
1997
1999
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

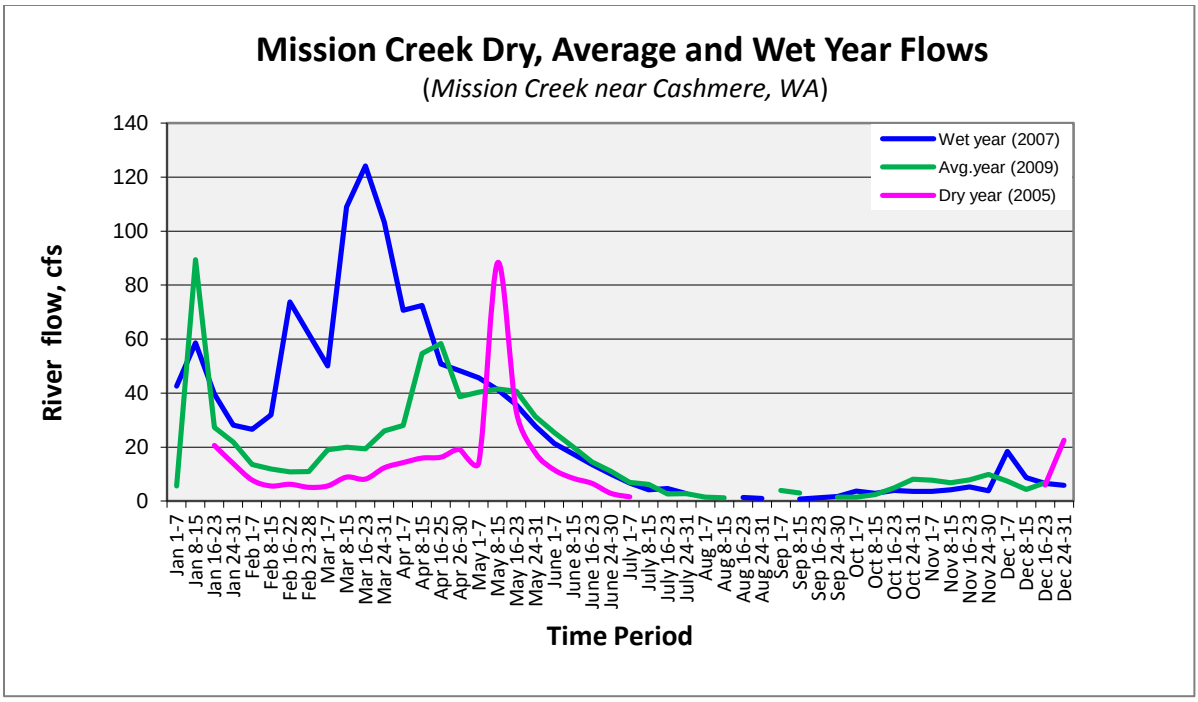

Little Wenatchee River Historic Flows
(DOE 45L110–Little Wenatchee River below Rainy Creek, WA)
Annual river flow, Kac-ft
350
300
250
200
150
100
50
0
2003
2004
2005
2006
2007
2008
2009
Years

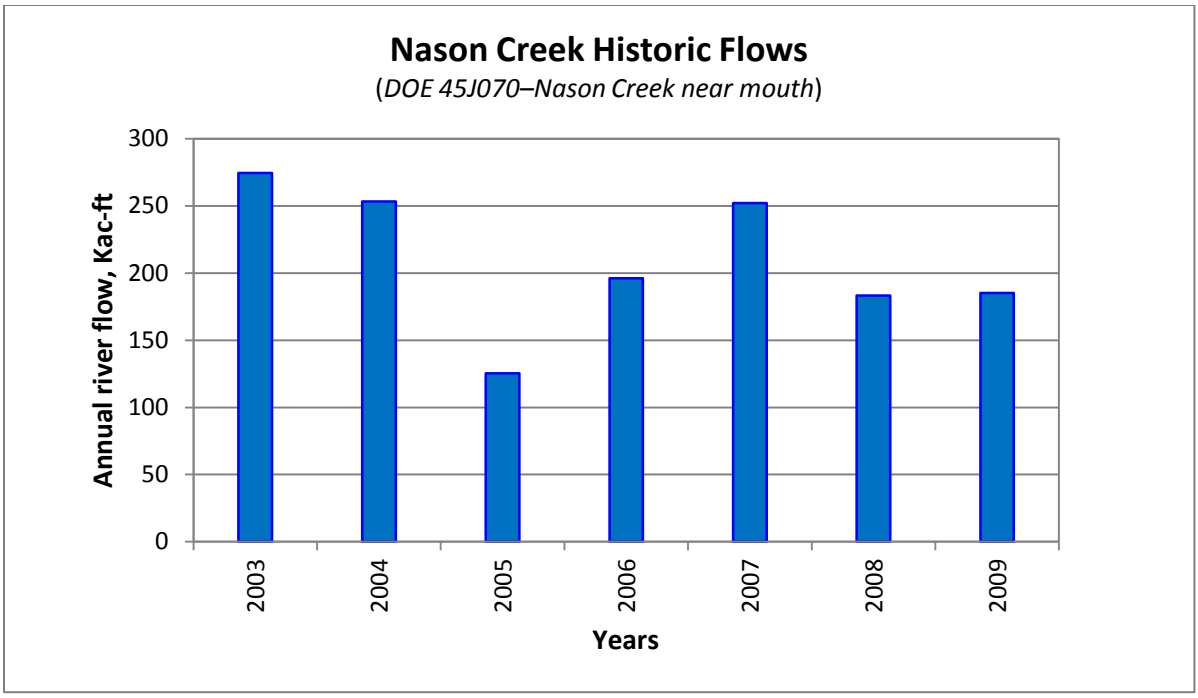

Little Wenatchee River Flow Exceedance Curve
(Little Wenatchee River below Rainy Creek, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, Kac-ft
350
300
250
200
150
100
50
0
2005
2006
2009
2003
2008
2004
Years

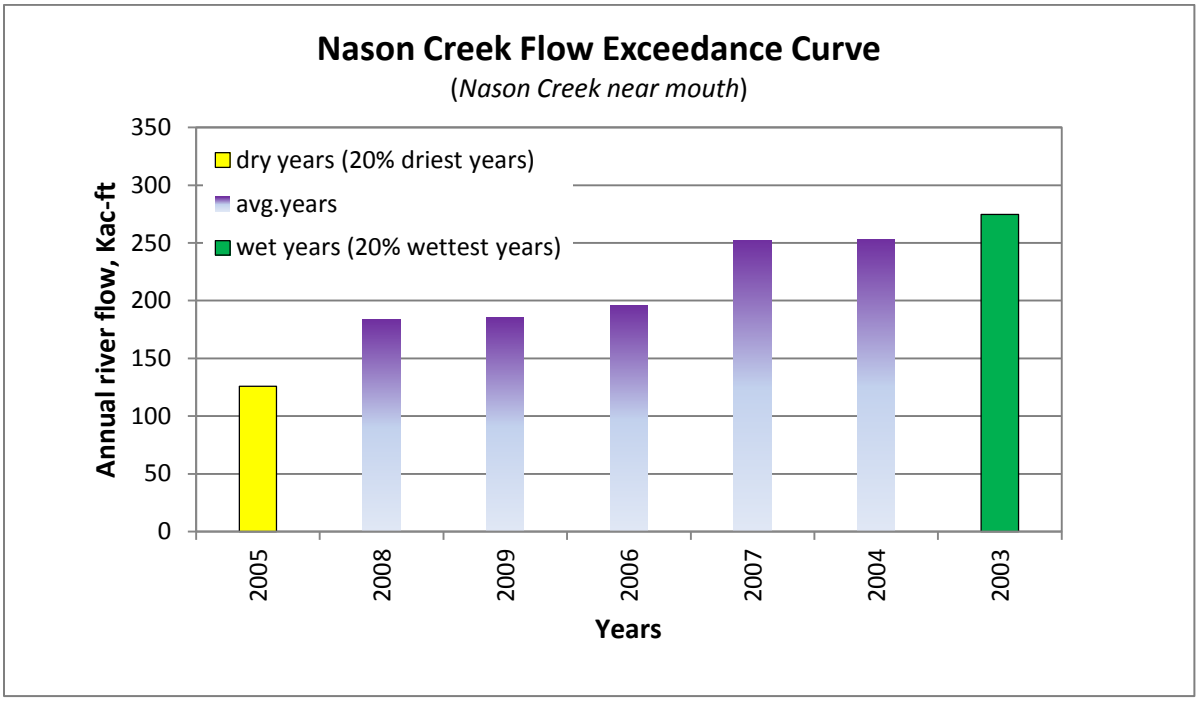

Little Wenatchee River Dry, Average and Wet Year Flows
(Little Wenatchee River near Rainy Creek, WA)
River flow, cfs
2,000
1,500
1,000
500
0
Dry year (2005)
Avg.year (2003)
Wet year (2004)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

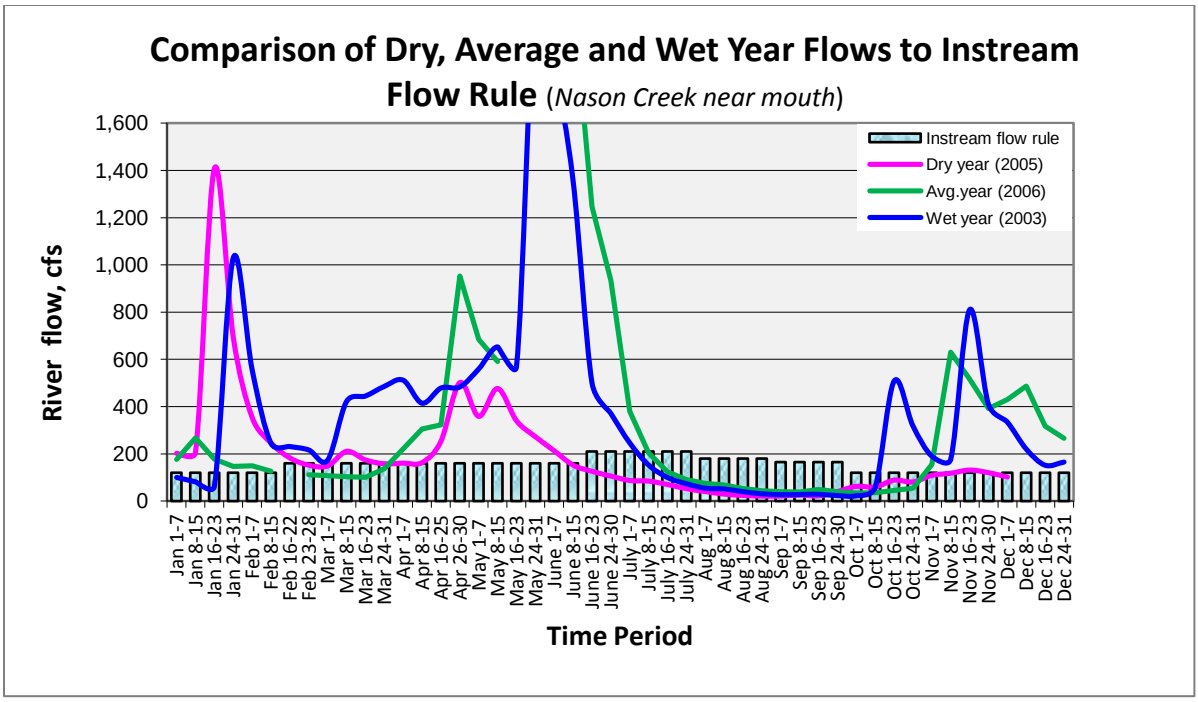

Mission Creek Historic Flows
(DOE 45E070–Mission Creek near Cashmere, WA)
Annual river flow, Kac-ft
20
15
10
5
0
2003
2004
2005
2006
2007
2008
2009
Years

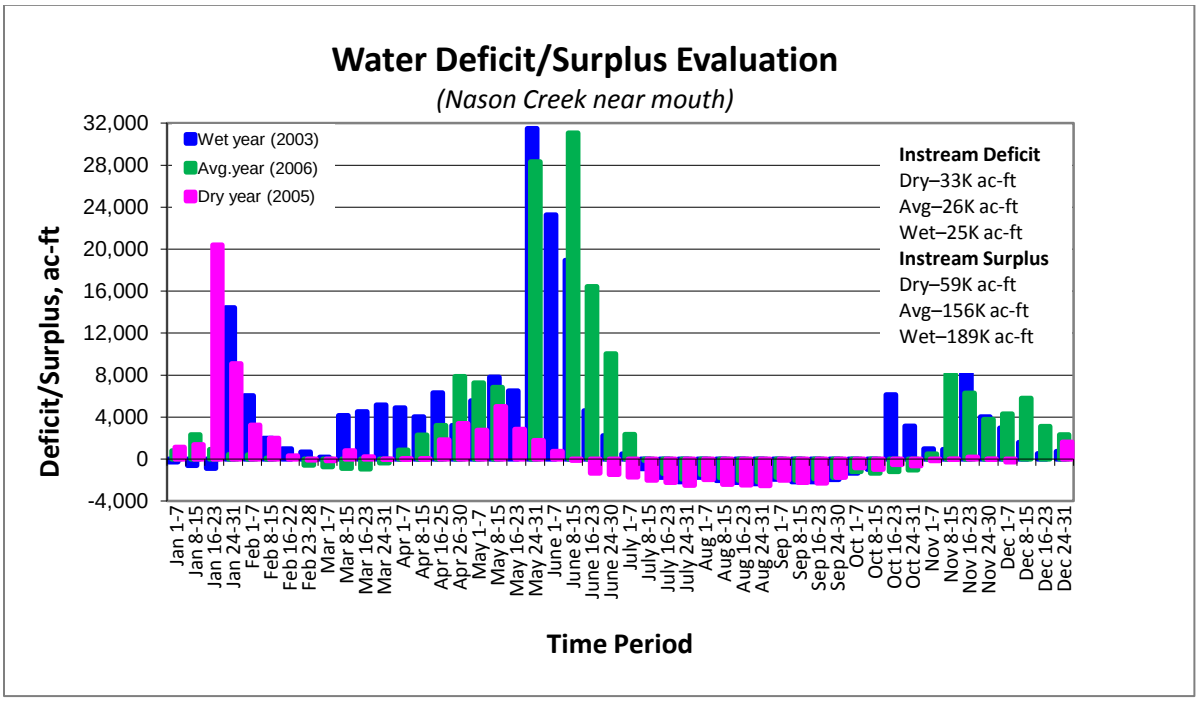

Mission Creek Flow Exceedance Curve
(Mission Creek near Cashmere, WA)
Annual river flow, Kac-ft
20
15
10
5
0
dry years (20% driest years)
avg.years
wet years (20% wettest years)
2005
2004
2008
2009
2006
2003
2007
Years

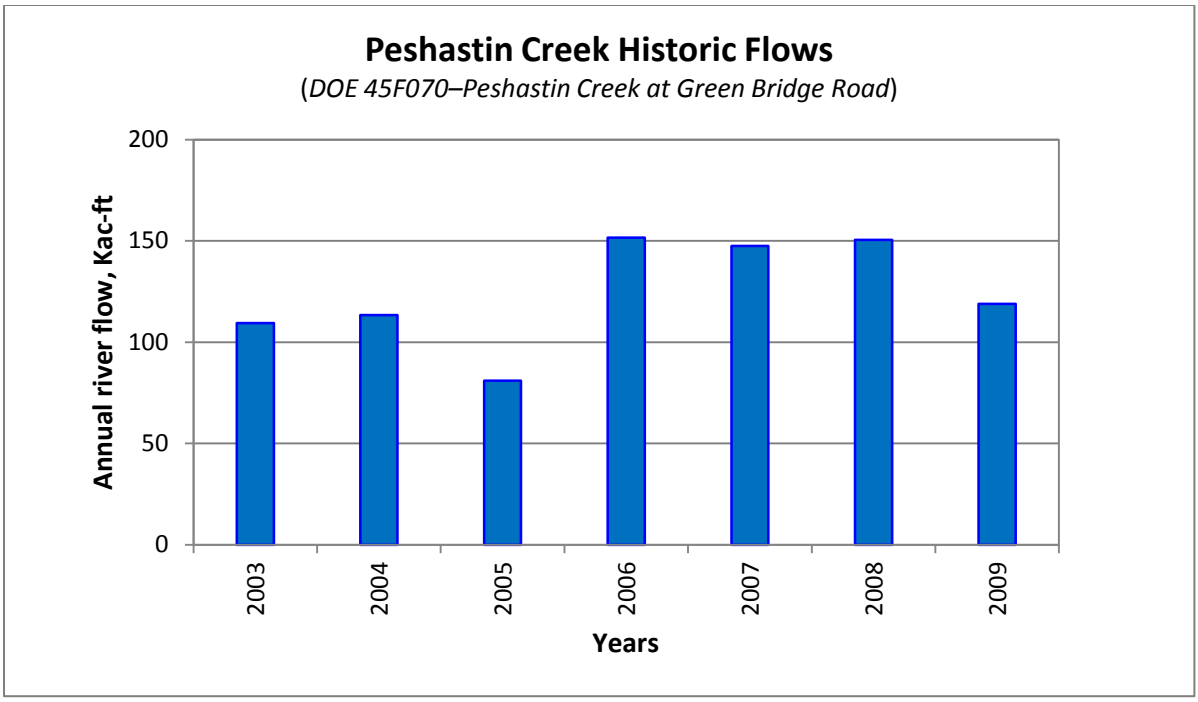

Mission Creek Dry, Average and Wet Year Flows
(Mission Creek near Cashmere, WA)
River flow, cfs
140
120
100
80
60
40
20
0
Wet year (2007)
Avg.year (2009)
Dry year (2005)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

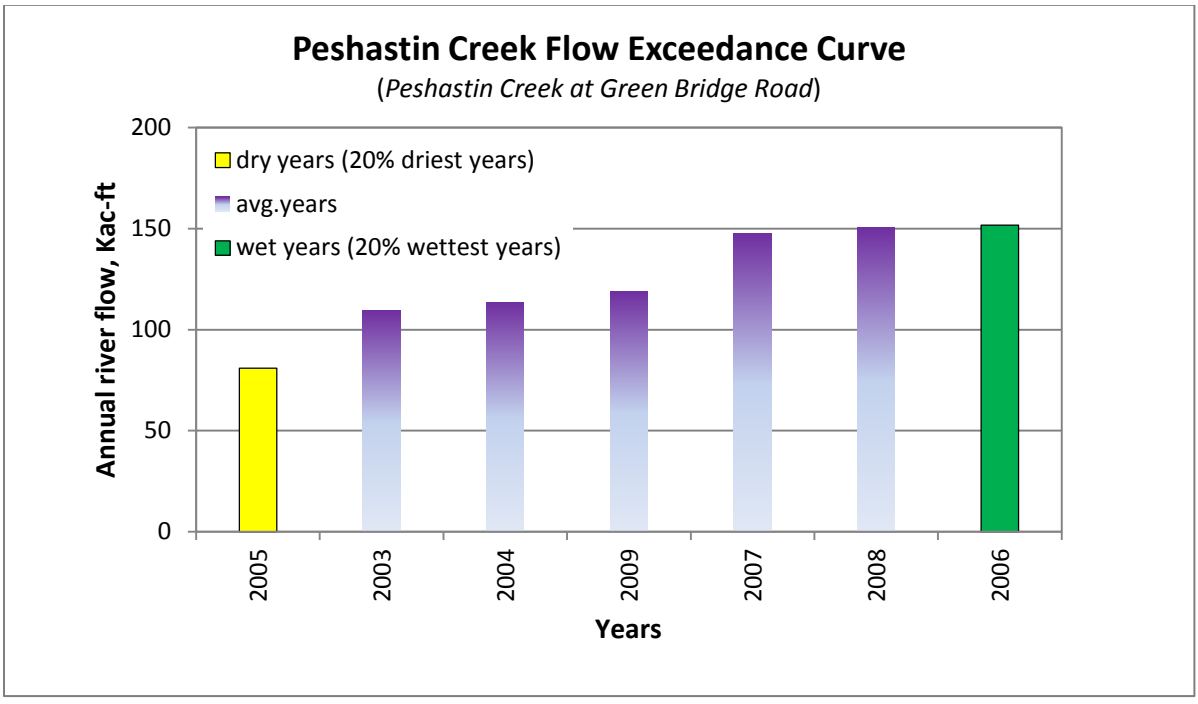

Nason Creek Historic Flows
(DOE 45J070–Nason Creek near mouth)
Annual river flow, Kac-ft
300
250
200
150
100
50
0
2003
2004
2005
2006
2007
2008
2009
Years

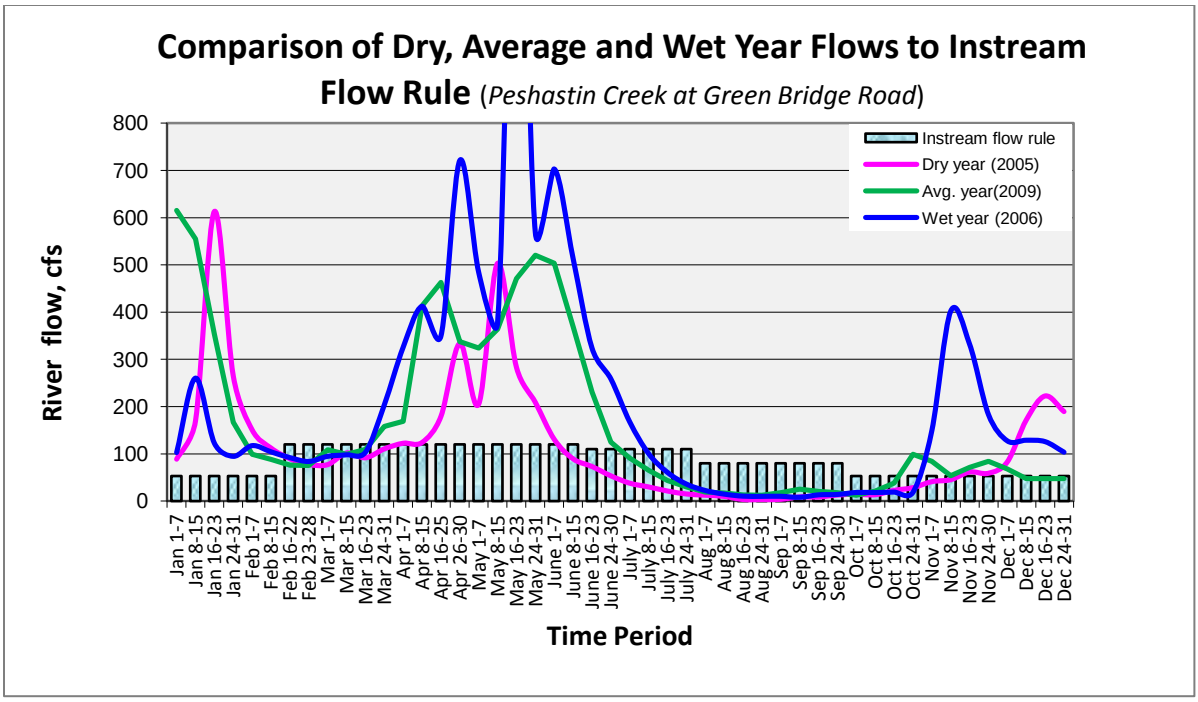

Nason Creek Flow Exceedance Curve
(Nason Creek near mouth)
Annual river flow, Kac-ft
350
300
250
200
150
100
50
0
dry years (20% driest years)
avg.years
wet years (20% wettest years)
2005
2008
2009
2006
2007
2004
2003
Years

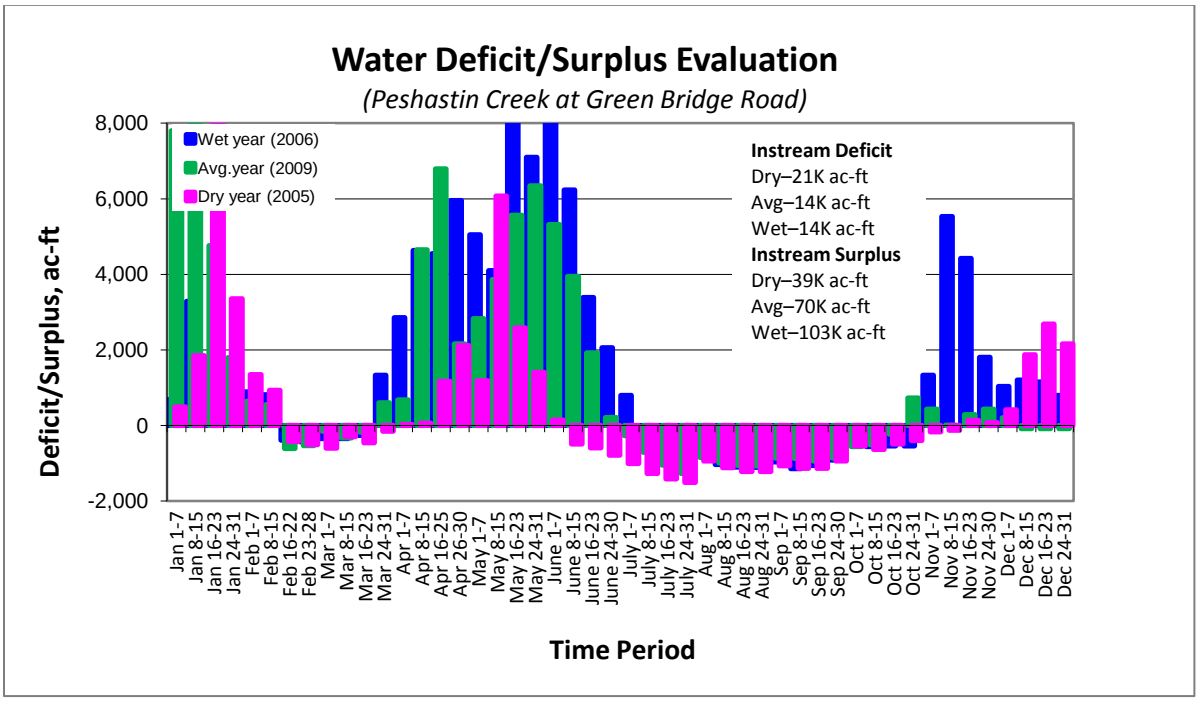

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Nason Creek near mouth)
River flow, cfs
1,600
1,400
1,200
1,000
800
600
400
200
0
Instream flow rule
Dry year (2005)
Avg.year (2006)
Wet year (2003)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

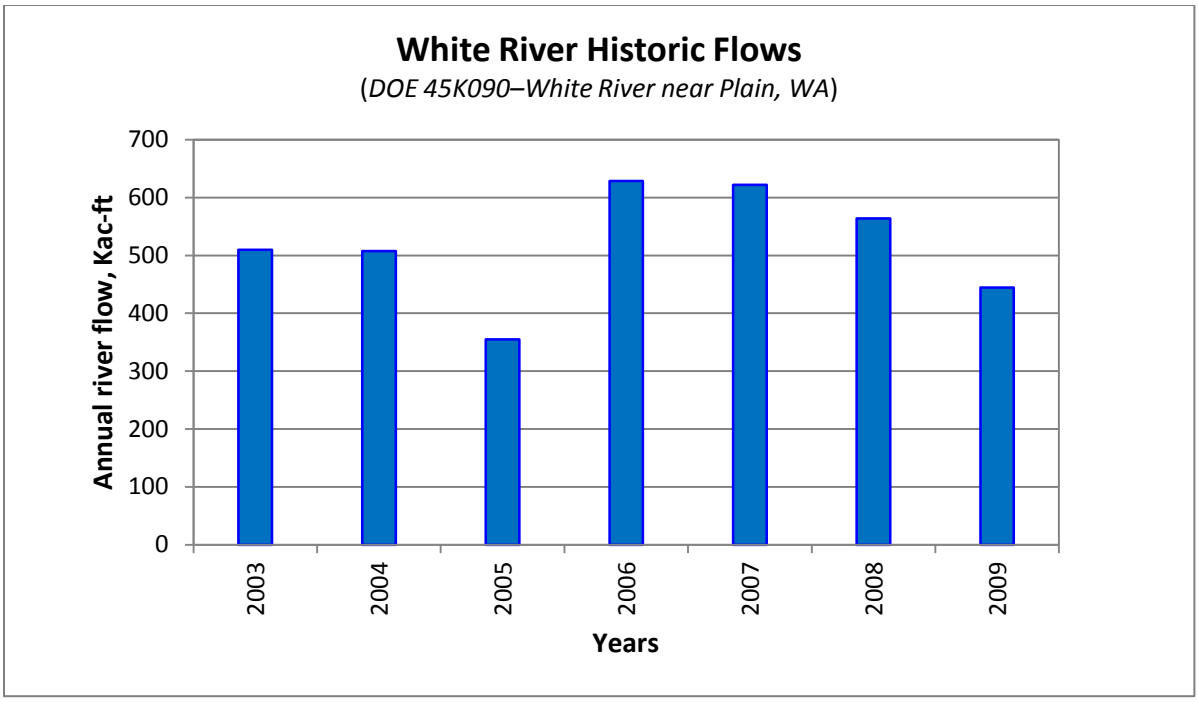

Water Deficit/Surplus Evaluation
(Nason Creek near mouth)
Deficit/Surplus, ac-ft
32,000
28,000
24,000
20,000
16,000
12,000
8,000
4,000
0
-4,000
Wet year (2003)
Avg.year (2006)
Dry year (2005)
Instream Deficit
Dry–33K ac-ft
Avg–26K ac-ft
Wet–25K ac-ft
Instream Surplus
Dry–59K ac-ft
Avg–156K ac-ft
Wet–189K ac-ft
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

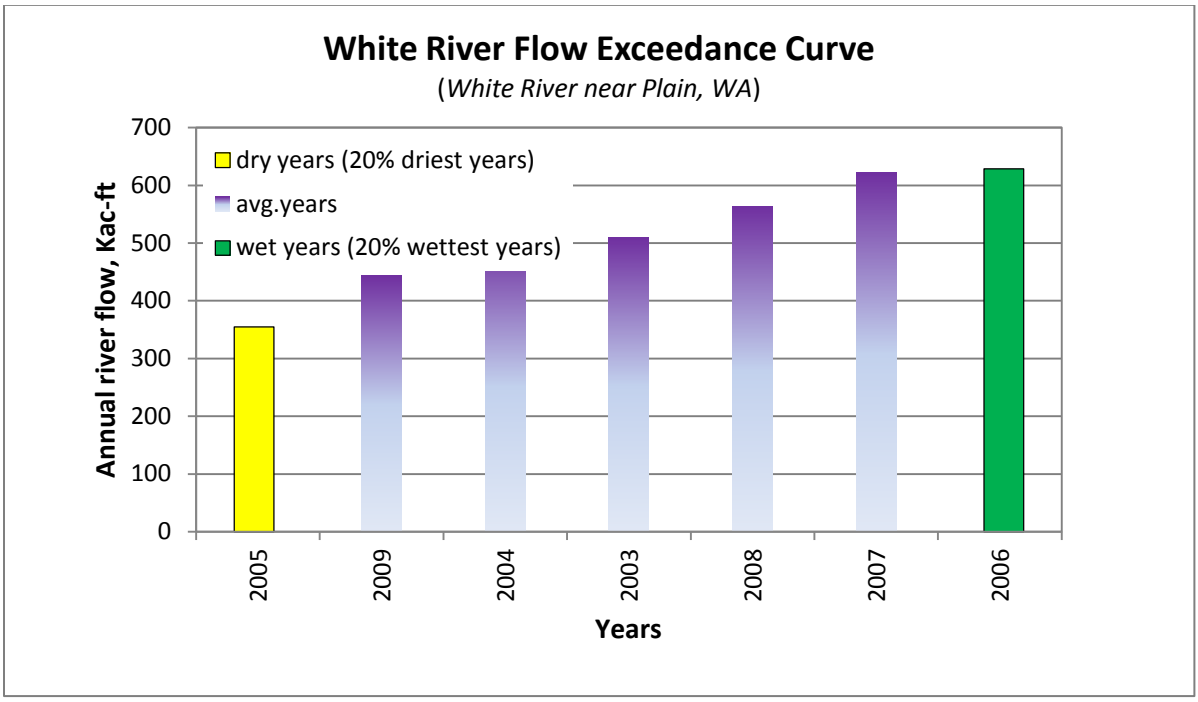

Peshastin Creek Historic Flows
(DOE 45F070–Peshastin Creek at Green Bridge Road)
Annual river flow, Kac-ft
200
150
100
50
0
2003
2004
2005
2006
2007
2008
2009
Years

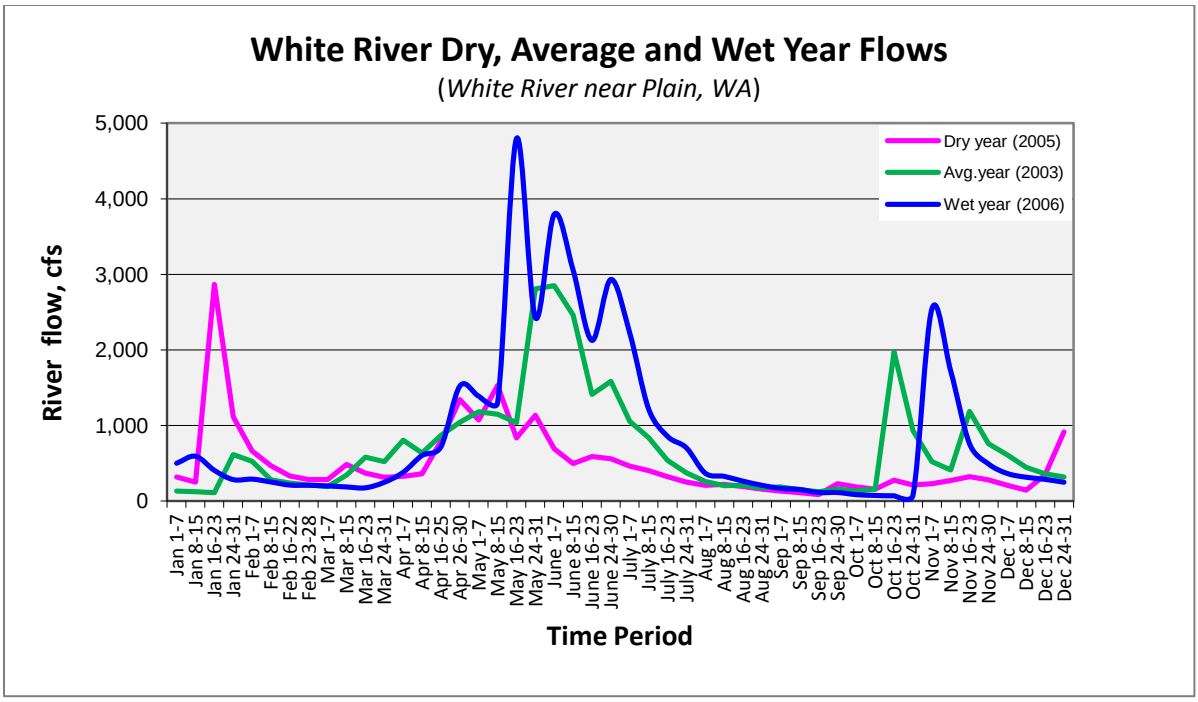

Peshastin Creek Flow Exceedance Curve
(Peshastin Creek at Green Bridge Road)
Annual river flow, Kac-ft
200
150
100
50
0
dry years (20% driest years)
avg.years
wet years (20% wettest years)
2005
2003
2004
2009
2007
2008
2006
Years

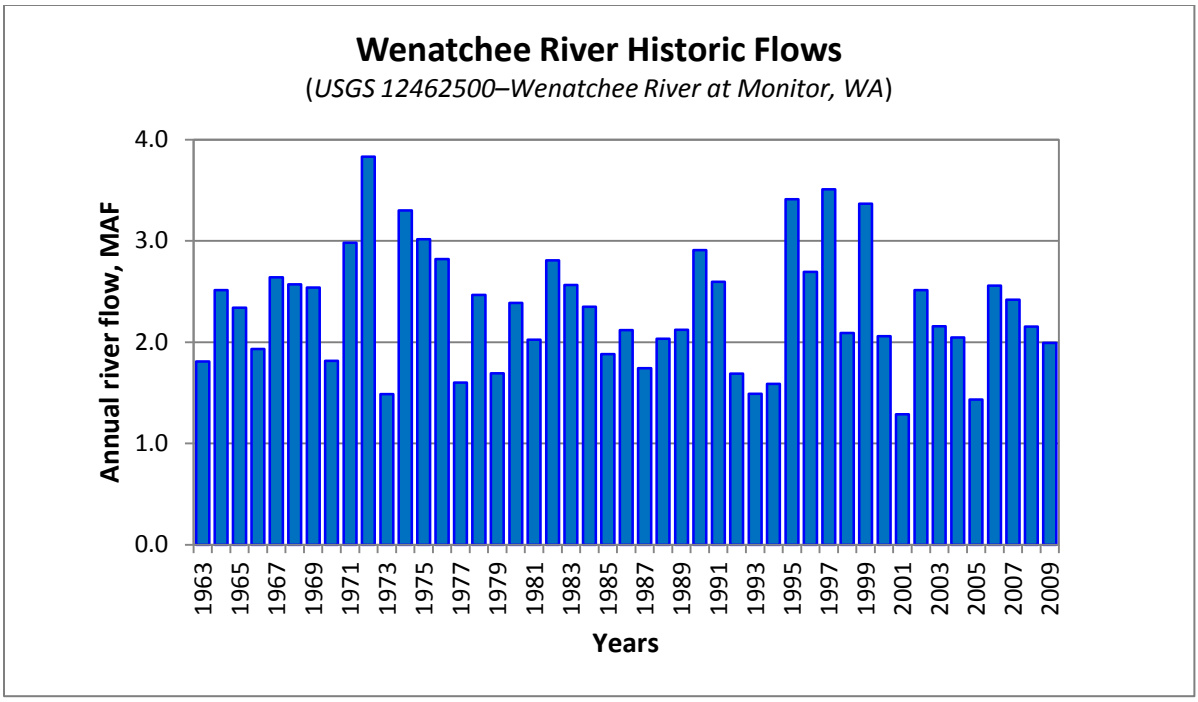

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Peshastin Creek at Green Bridge Road)
River flow, cfs
800
700
600
500
400
300
200
100
0
Instream flow rule
Dry year (2005)
Avg. year(2009)
Wet year (2006)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

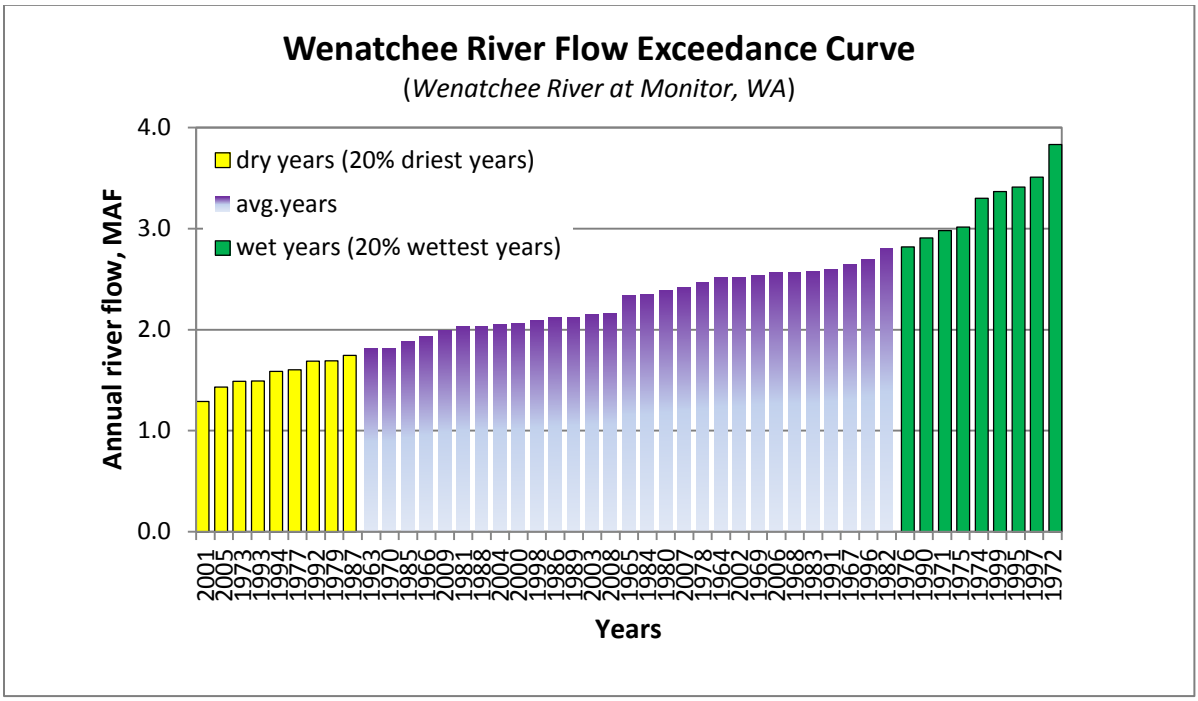

Water Deficit/Surplus Evaluation
(Peshastin Creek at Green Bridge Road)
Deficit/Surplus, ac-ft
8,000
6,000
4,000
2,000
0
-2,000
Wet year (2006)
Avg.year (2009)
Dry year (2005)
Instream Deficit
Dry–21K ac-ft
Avg–14K ac-ft
Wet–14K ac-ft
Instream Surplus
Dry–39K ac-ft
Avg–70K ac-ft
Wet–103K ac-ft
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

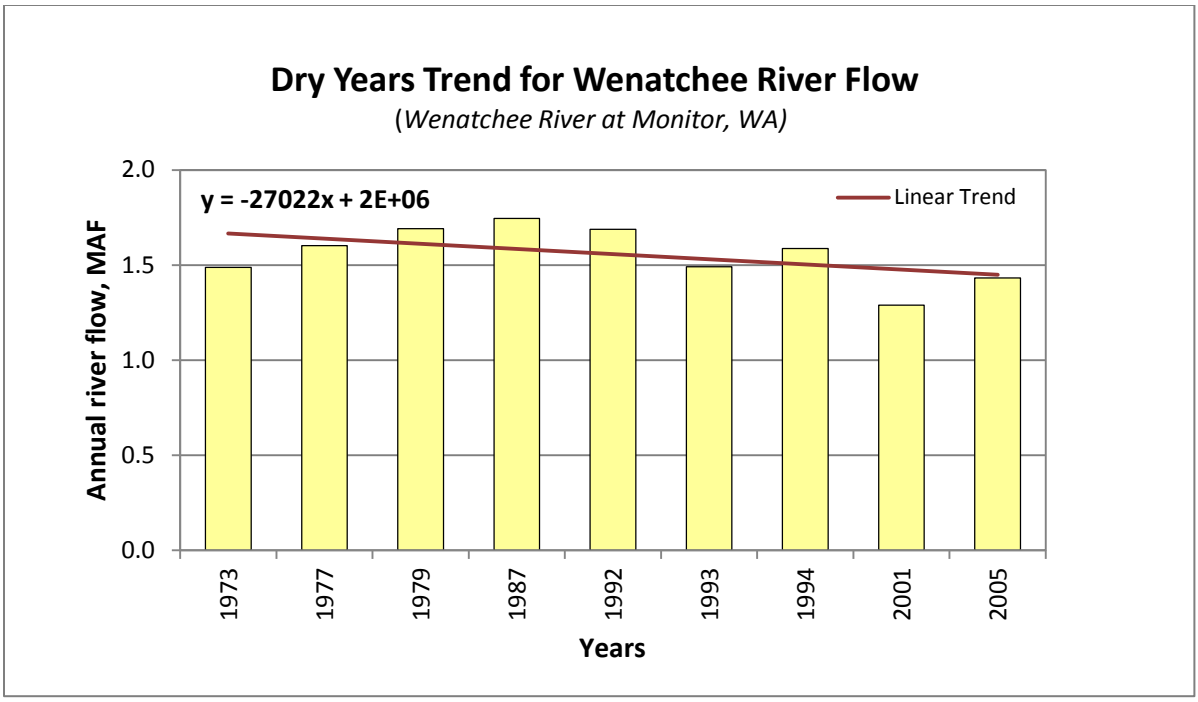

White River Historic Flows
(DOE 45K090–White River near Plain, WA)
Annual river flow, Kac-ft
700
600
500
400
300
200
100
0
2003
2004
2005
2006
2007
2008
2009
Years

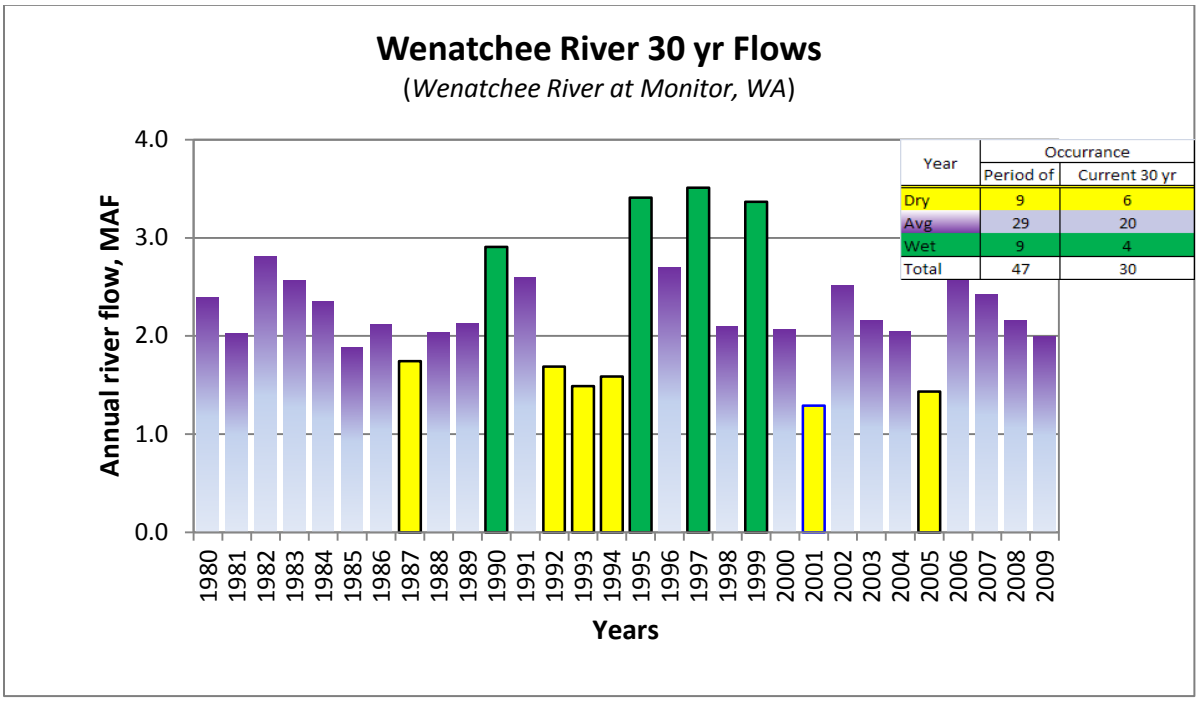

White River Flow Exceedance Curve
(White River near Plain, WA)
Annual river flow, Kac-ft
700
600
500
400
300
200
100
0
dry years (20% driest years)
avg.years
wet years (20% wettest years)
2005
2009
2004
2003
2008
2007
2006
Years

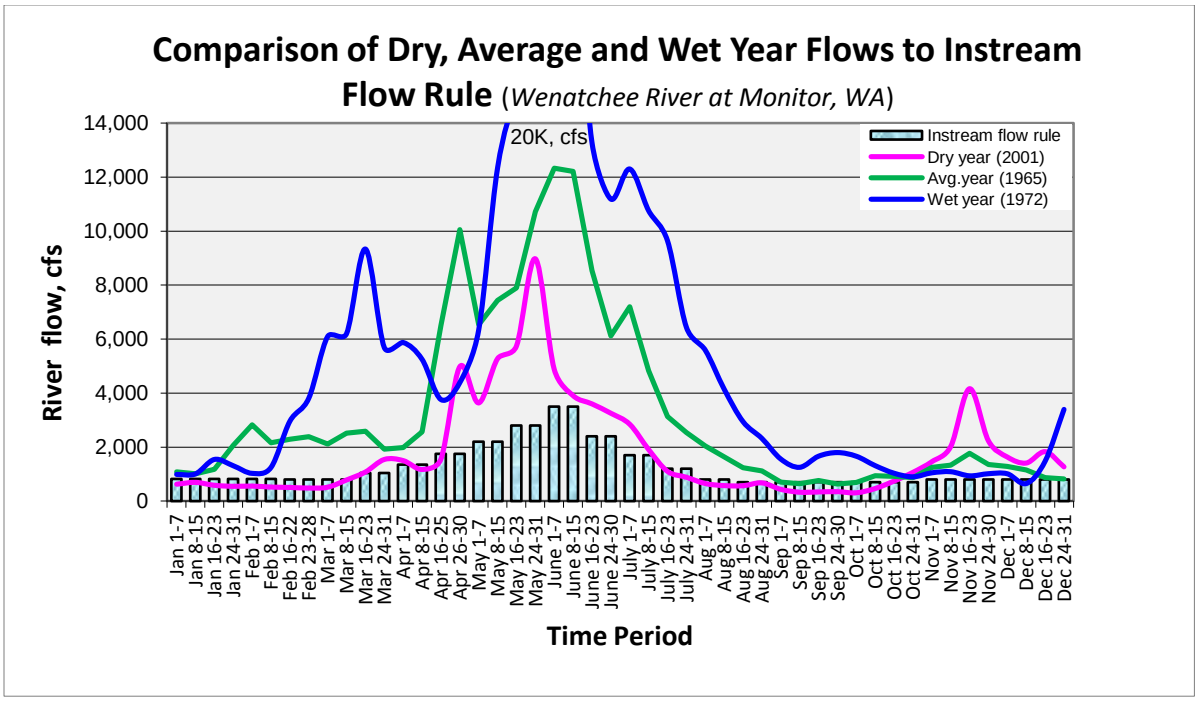

White River Dry, Average and Wet Year Flows
(White River near Plain, WA)
River flow, cfs
5,000
4,000
3,000
2,000
1,000
0
Dry year (2005)
Avg.year (2003)
Wet year (2006)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

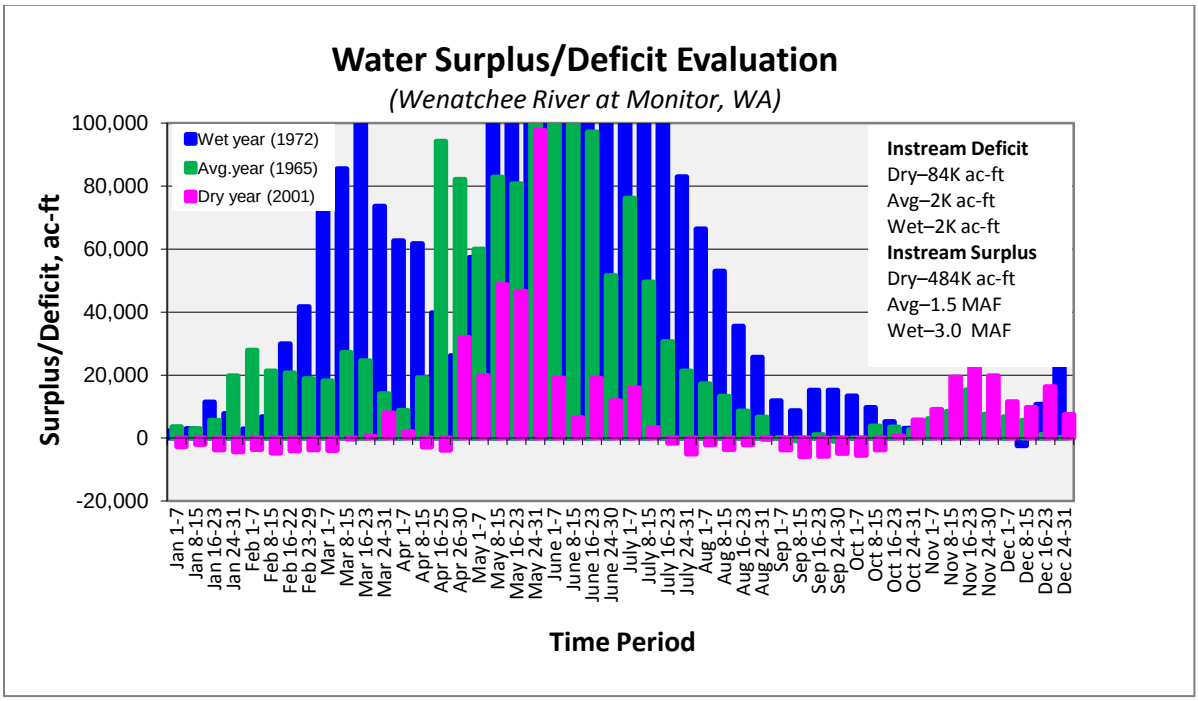

Wenatchee River Historic Flows
(USGS 12462500–Wenatchee River at Monitor, WA)
Annual river flow, MAF
4.0
3.0
2.0
1.0
0.0
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Years

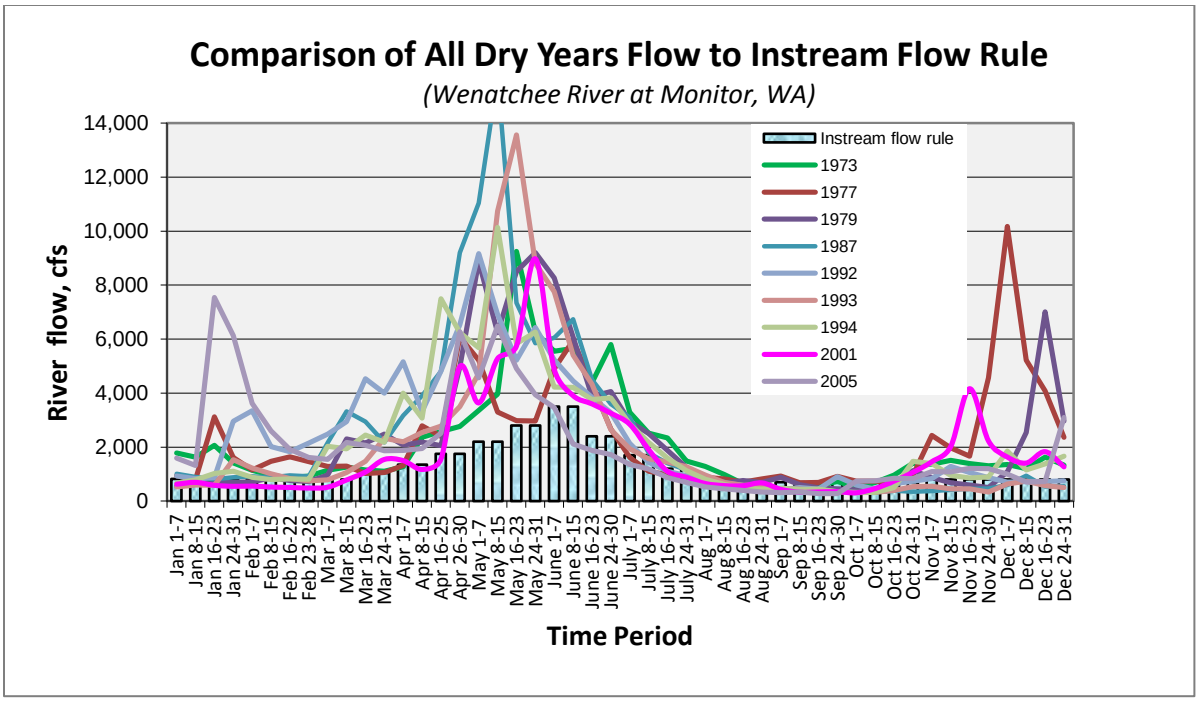

Wenatchee River Flow Exceedance Curve
(Wenatchee River at Monitor, WA)
Annual river flow, MAF
4.0
3.0
2.0
1.0
0.0
dry years (20% driest years)
avg.years
wet years (20% wettest years)
2001 2005 1973 1993 1994 1977 1992 1979 1987 1963 1970 1985 1966 2009 1981 1988 2004 2000 1998 1986 1989 1983 2003 2008 1965 1984 1980 2007 1978 1964 2002 1969 2006 1968 1983 1991 1967 1996 1982 1976 1990 1971 1975 1974 1999 1995 1997 1972
Years

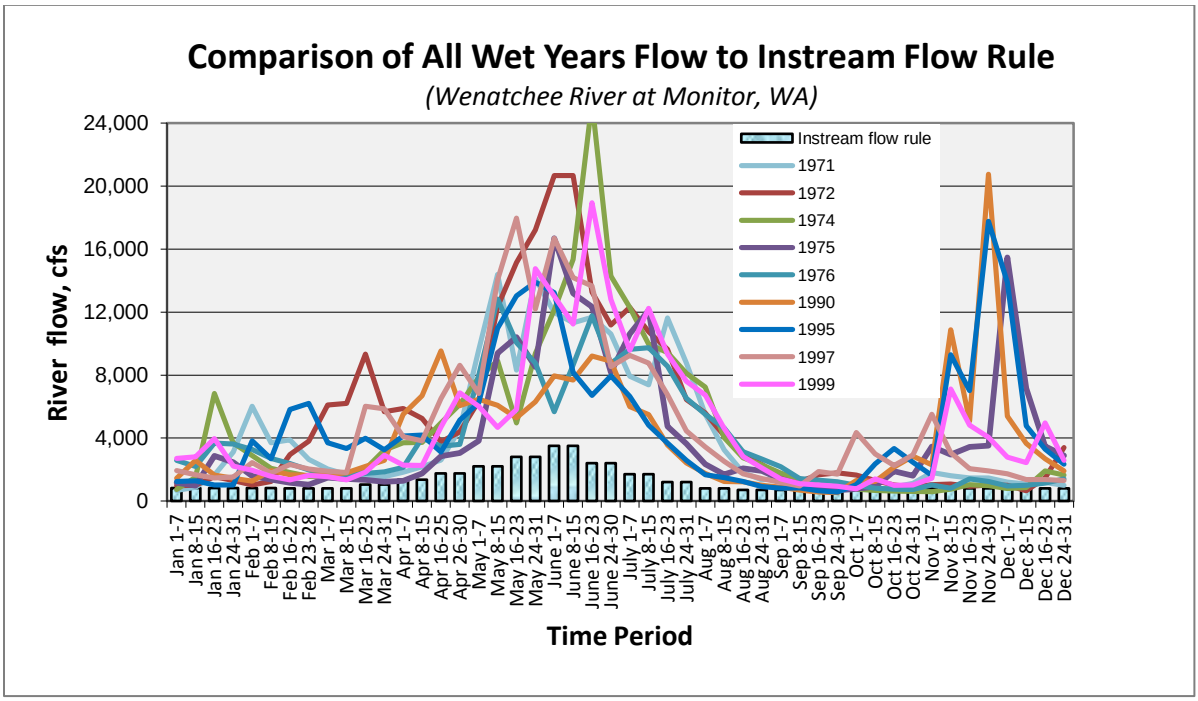

Dry Years Trend for Wenatchee River Flow
(Wenatchee River at Monitor, WA)
y = -27022x + 2E+06
Linear Trend
Annual river flow, MAF
2.0
1.5
1.0
0.5
0.0
1973
1977
1979
1987
1992
1993
1994
2001
2005
Years

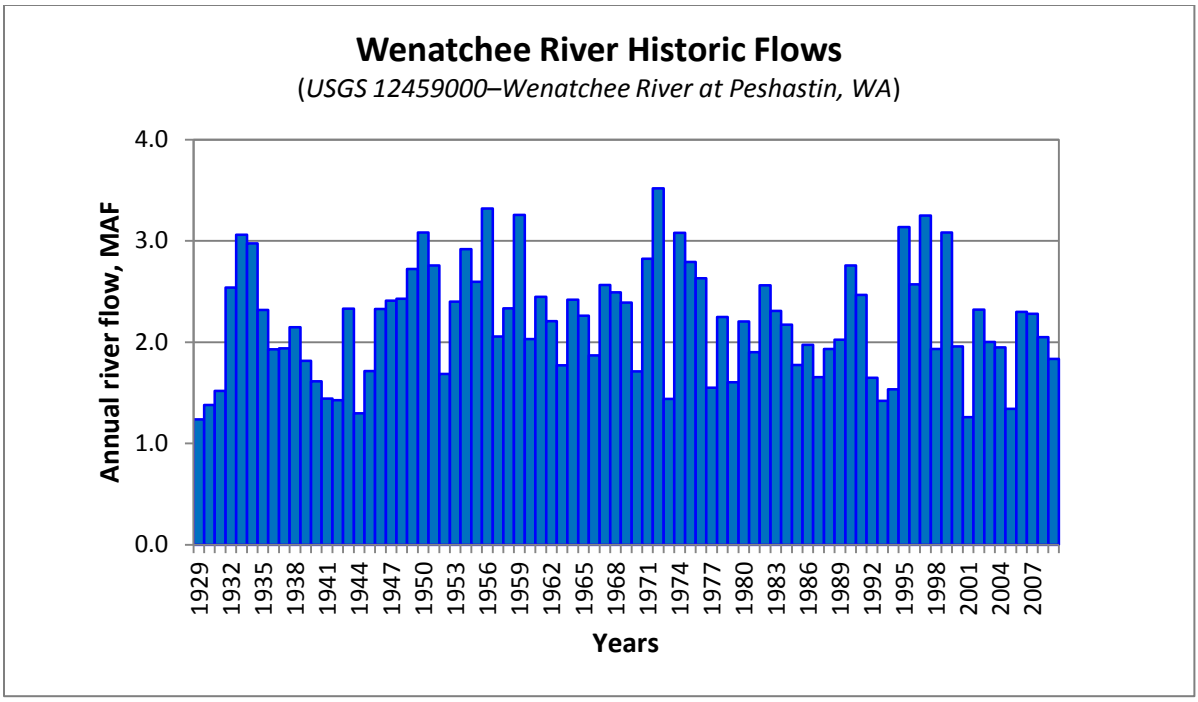

Wenatchee River 30 yr Flows
(Wenatchee River at Monitor, WA)
Annual river flow, MAF
4.0
3.0
2.0
1.0
0.0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 9 6
Avg 29 20
Wet 9 4
Total 47 30

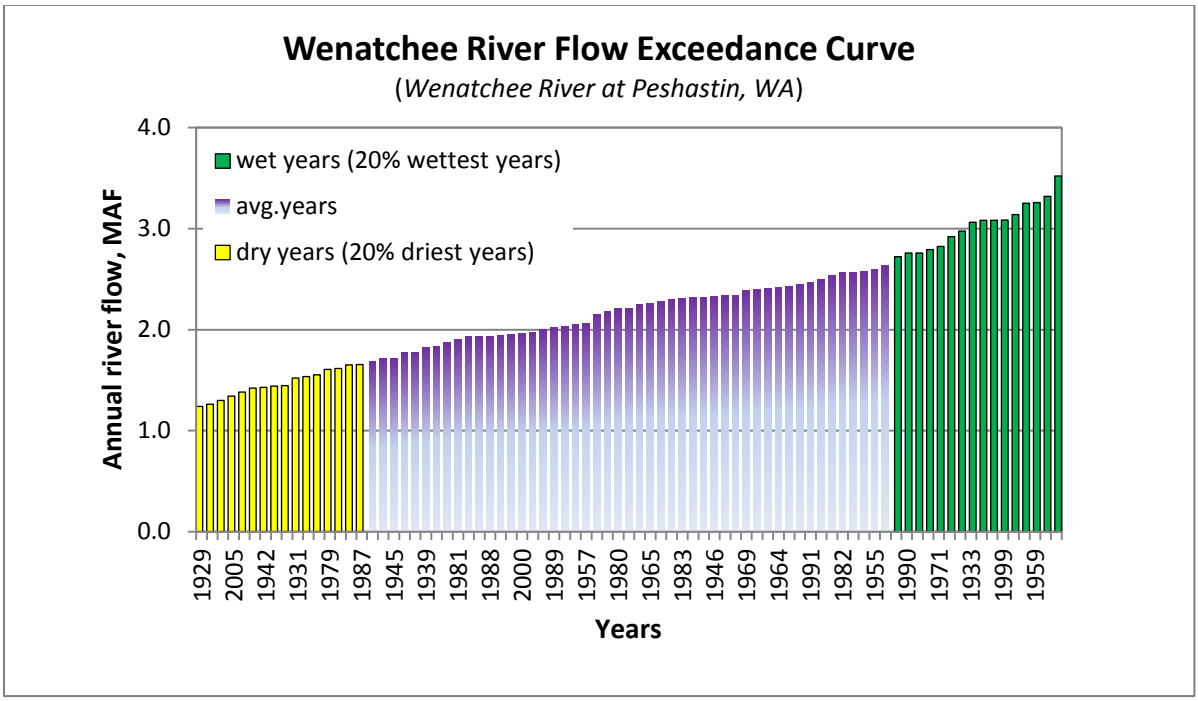

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Wenatchee River at Monitor, WA)
20K, cfs
Instream flow rule
Dry year (2001)
Avg.year (1965)
Wet year (1972)
River flow, cfs
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

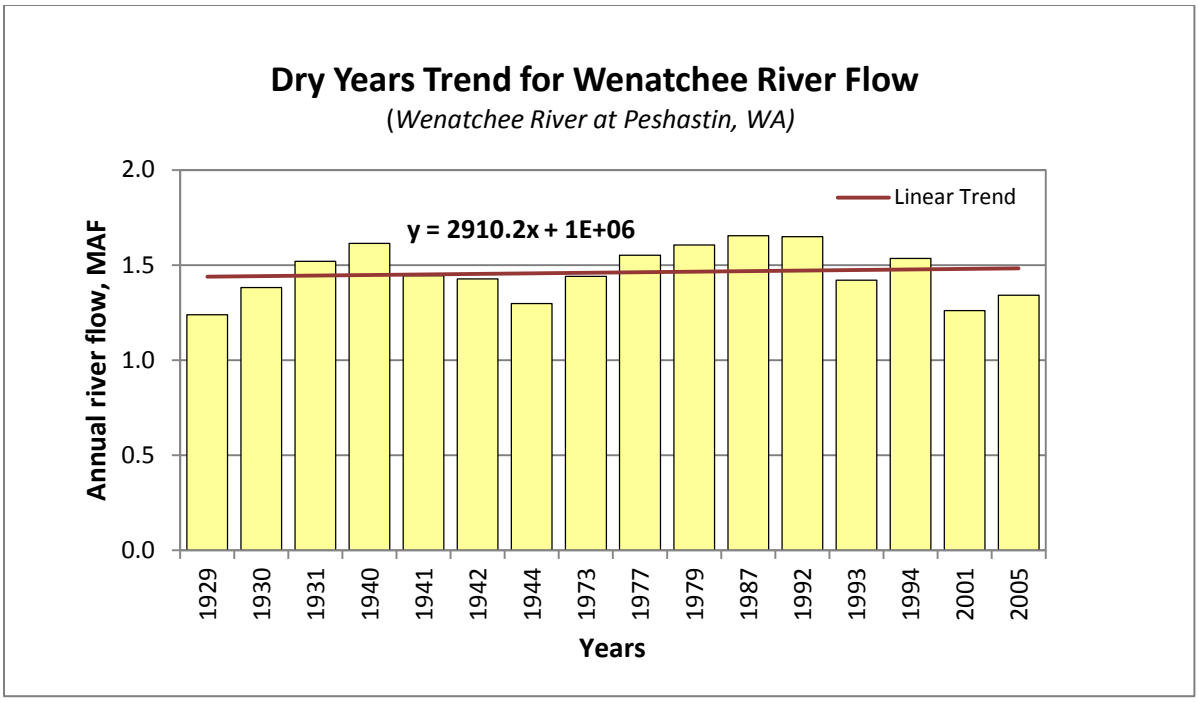

Water Surplus/Deficit Evaluation
(Wenatchee River at Monitor, WA)
Wet year (1972)
Avg.year (1965)
Dry year (2001)
Instream Deficit
Dry–84K ac-ft
Avg–2K ac-ft
Wet–2K ac-ft
Instream Surplus
Dry–484K ac-ft
Avg–1.5 MAF
Wet–3.0 MAF
Surplus/Deficit, ac-ft
100,000
80,000
60,000
40,000
20,000
0
-20,000
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

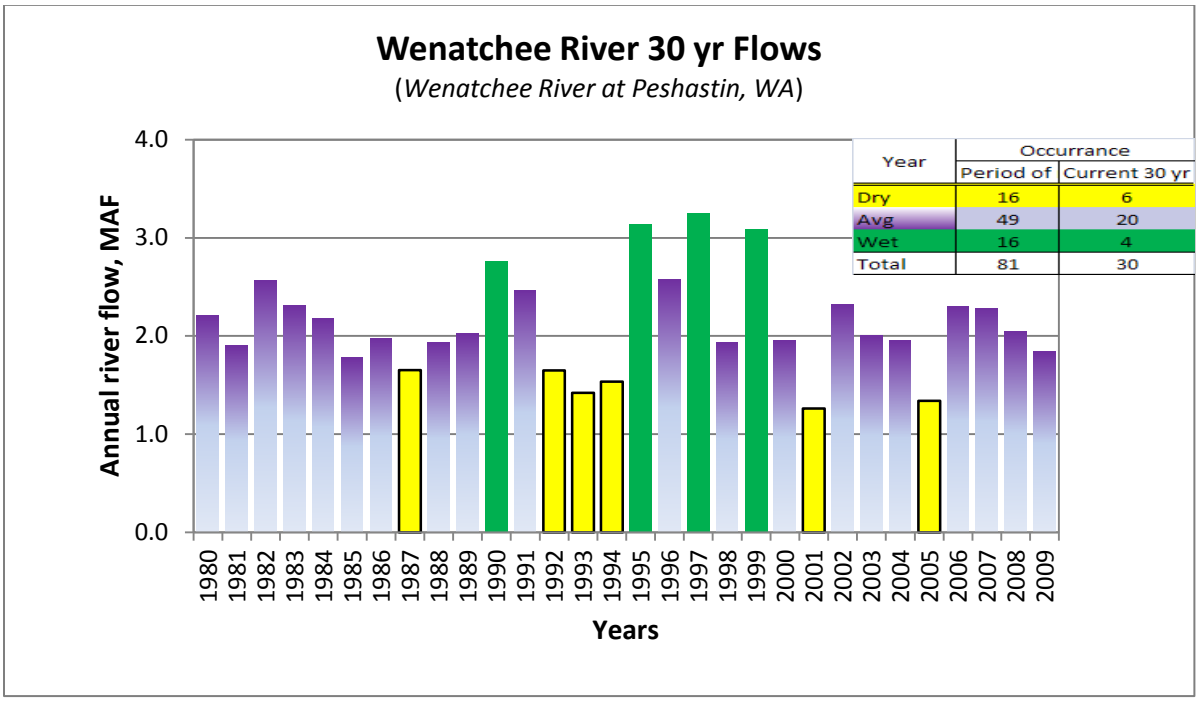

Comparison of All Dry Years Flow to Instream Flow Rule
(Wenatchee River at Monitor, WA)
River flow, cfs
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Instream flow rule
1973
1977
1979
1987
1992
1993
1994
2001
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

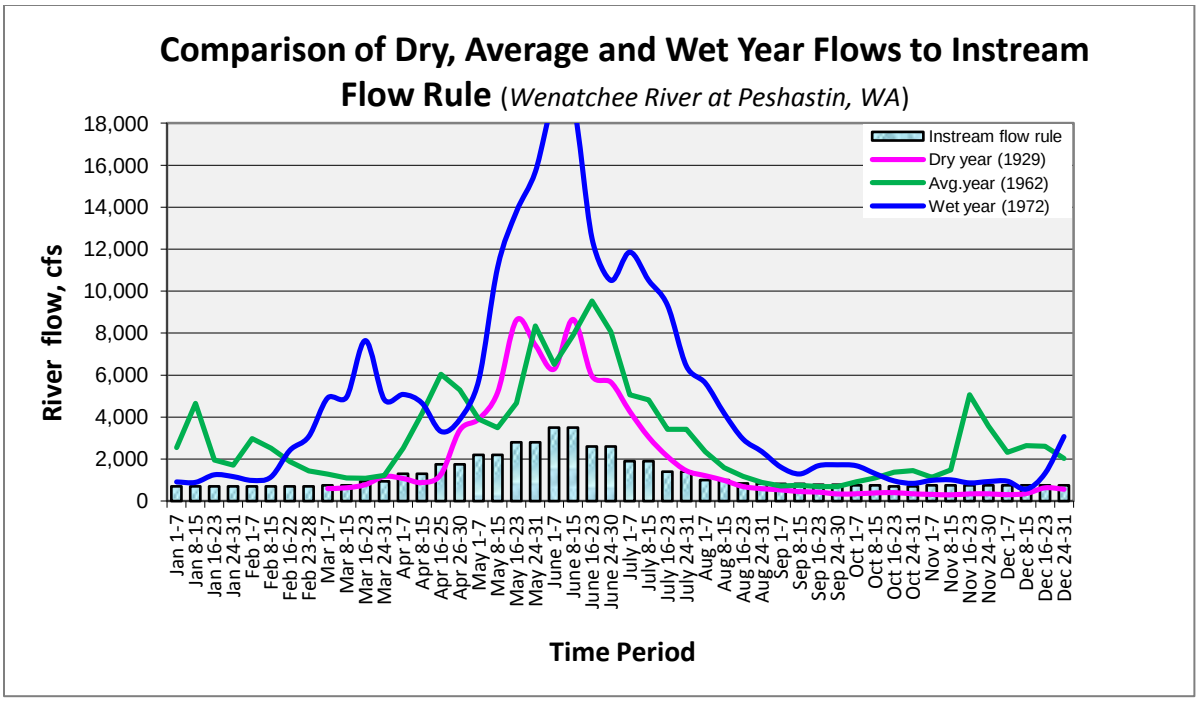

Comparison of All Wet Years Flow to Instream Flow Rule
(Wenatchee River at Monitor, WA)
River flow, cfs
24,000
20,000
16,000
12,000
8,000
4,000
0
Instream flow rule
1971
1972
1974
1975
1976
1990
1995
1997
1999
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

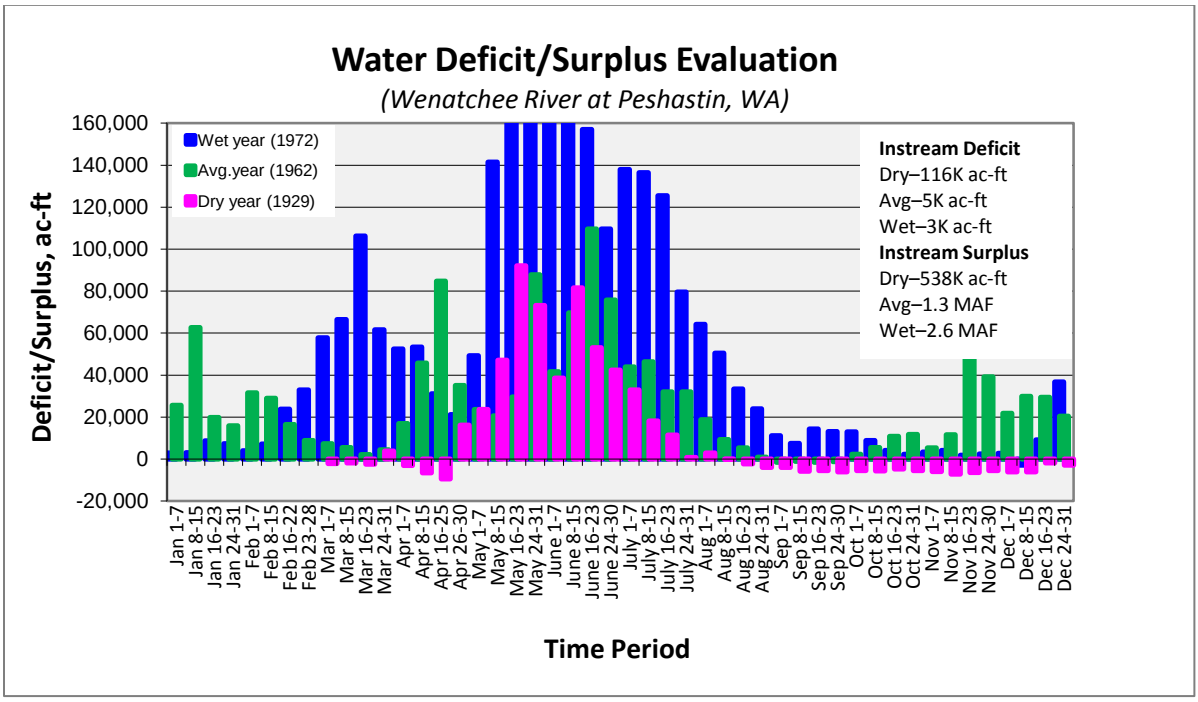

Wenatchee River Historic Flows
(USGS 12459000–Wenatchee River at Peshastin, WA)
Annual river flow, MAF
4.0
3.0
2.0
1.0
0.0
1929
1932
1935
1938
1941
1944
1947
1950
1953
1956
1959
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
Years

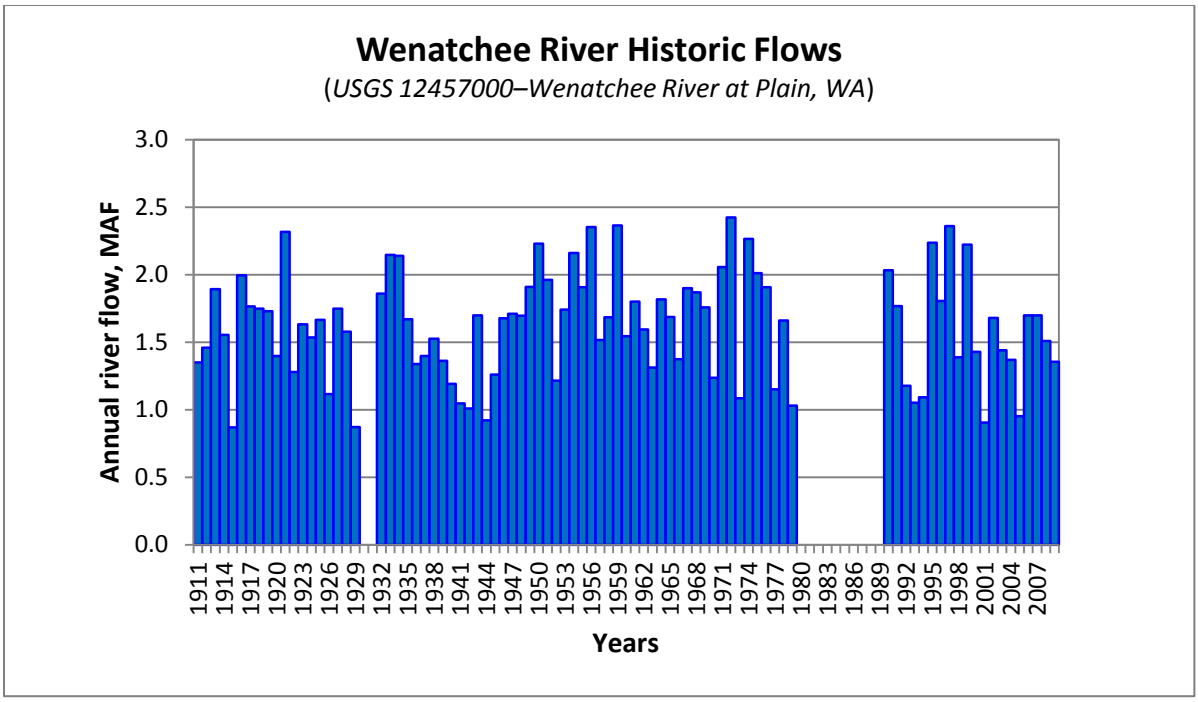

Wenatchee River Flow Exceedance Curve
(Wenatchee River at Peshastin, WA)
wet years (20% wettest years)
avg.years
dry years (20% driest years)
Annual river flow, MAF
4.0
3.0
2.0
1.0
0.0
1929
2005
1942
1931
1979
1987
1945
1939
1981
1988
2000
1989
1957
1980
1965
1983
1946
1969
1964
1991
1982
1955
1990
1971
1933
1999
1959
Years

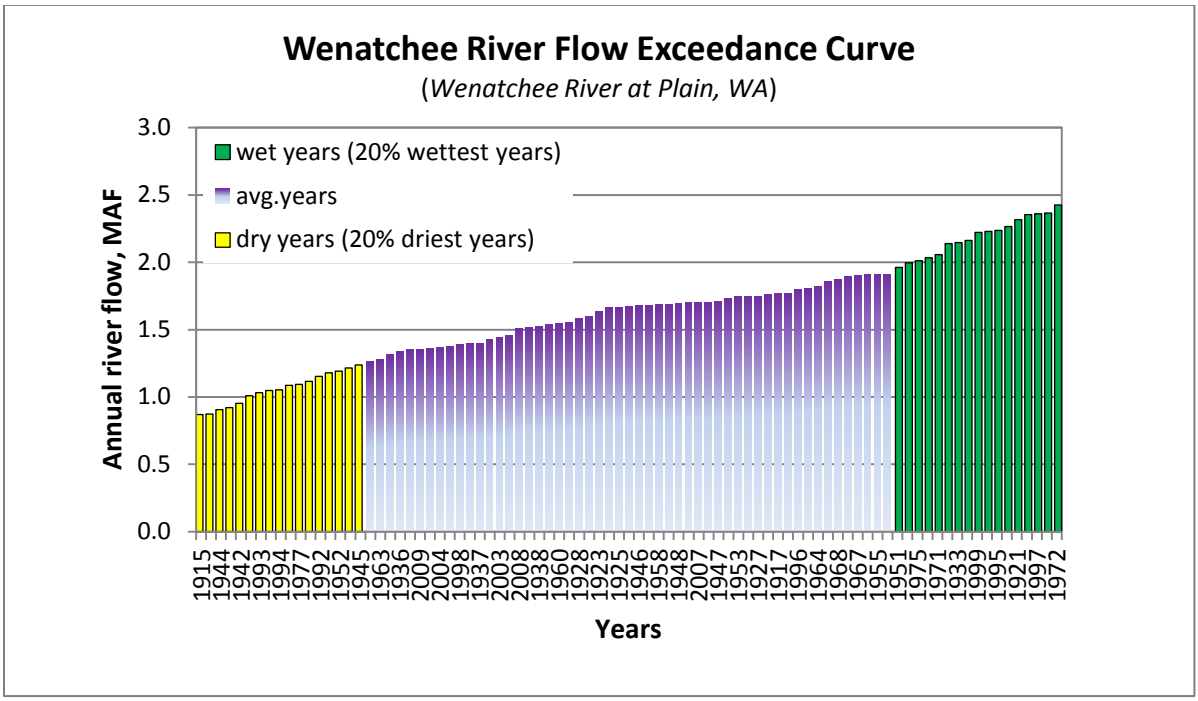

Dry Years Trend for Wenatchee River Flow
(Wenatchee River at Peshastin, WA)
Linear Trend
y = 2910.2x + 1E+06
Annual river flow, MAF
2.0
1.5
1.0
0.5
0.0
1929
1930
1931
1940
1941
1942
1944
1973
1977
1979
1987
1992
1993
1994
2001
2005
Years

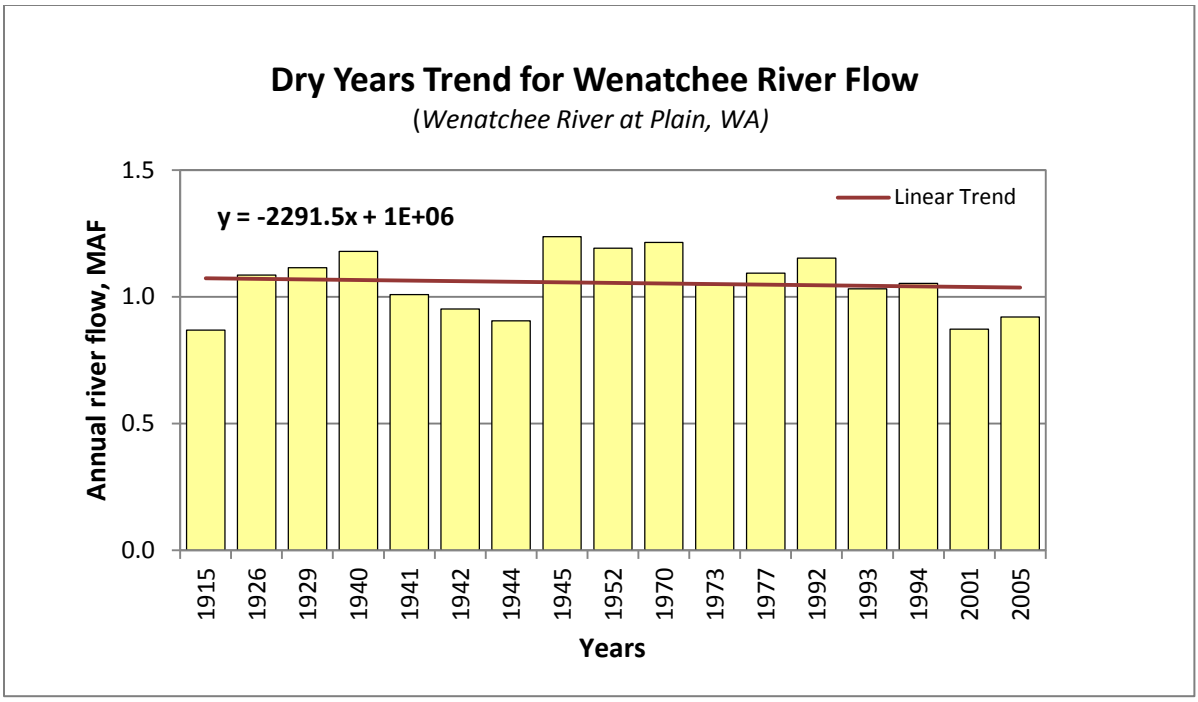

Wenatchee River 30 yr Flows
(Wenatchee River at Peshastin, WA)
Annual river flow, MAF
4.0
3.0
2.0
1.0
0.0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 16 6
Avg 49 20
Wet 16 4
Total 81 30

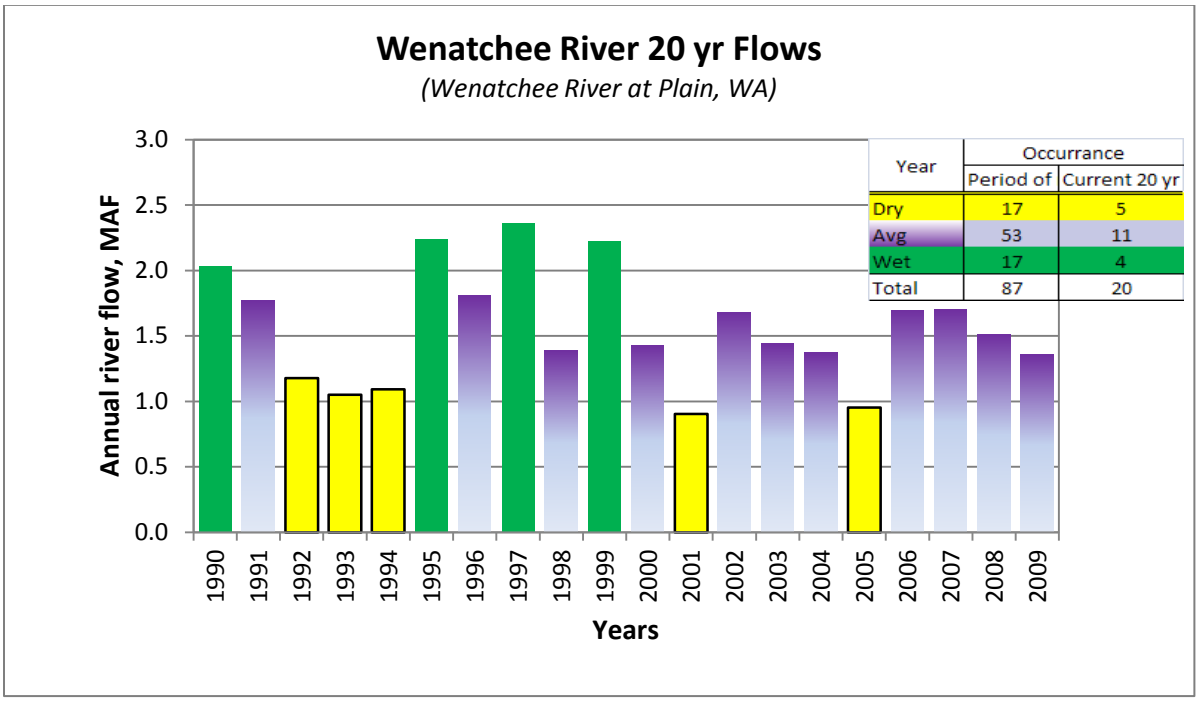

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Wenatchee River at Peshastin, WA)
River flow, cfs
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Instream flow rule
Dry year (1929)
Avg.year (1962)
Wet year (1972)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

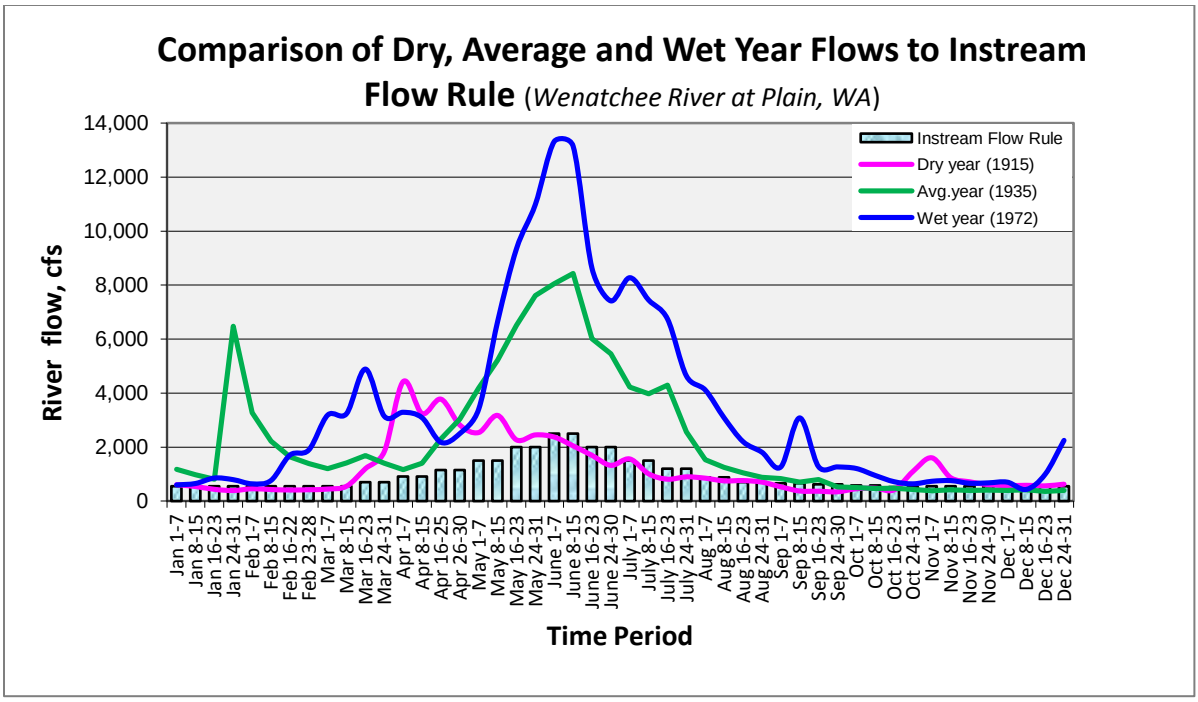

Water Deficit/Surplus Evaluation
(Wenatchee River at Peshastin, WA)
Deficit/Surplus, ac-ft
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
-20,000
Wet year (1972)
Avg.year (1962)
Dry year (1929)
Instream Deficit
Dry–116K ac-ft
Avg–5K ac-ft
Wet–3K ac-ft
Instream Surplus
Dry–538K ac-ft
Avg–1.3 MAF
Wet–2.6 MAF
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

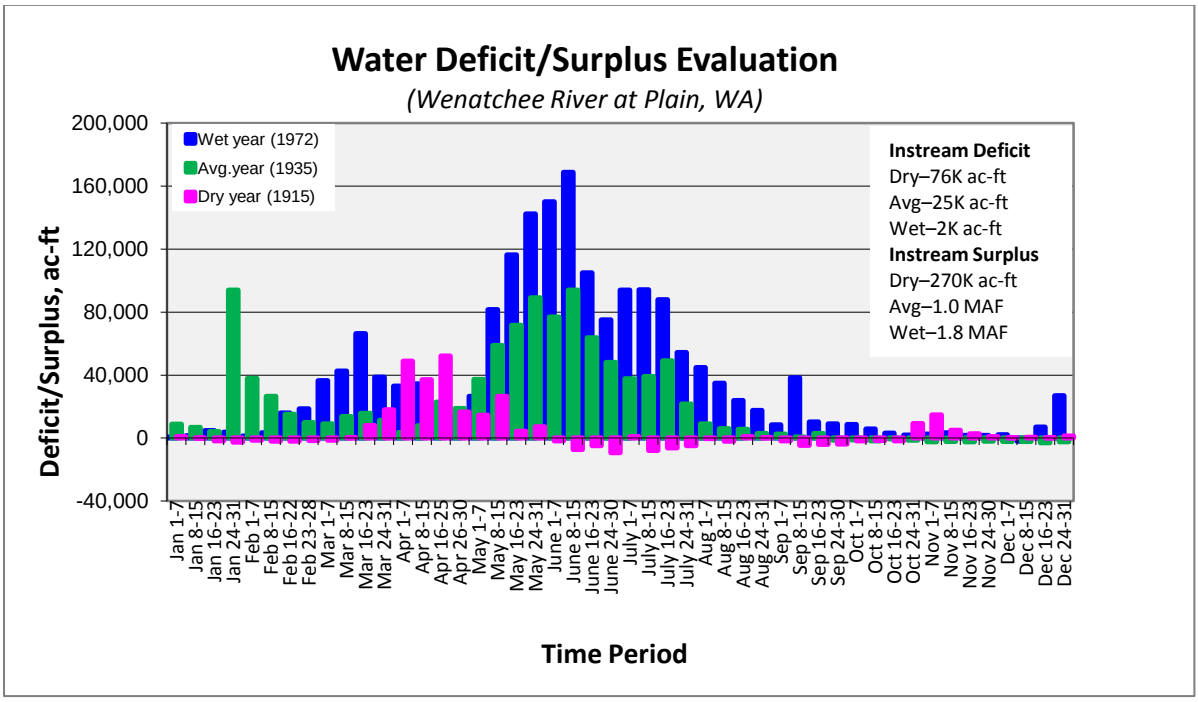

Wenatchee River Historic Flows
(USGS 12457000–Wenatchee River at Plain, WA)
Annual river flow, MAF
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1911 1914 1917 1920 1923 1926 1929 1932 1935 1938 1941 1944 1947 1950 1953 1956 1959 1962 1965 1968 1971 1974 1977 1980 1983 1986 1989 1992 1995 1998 2001 2004 2007
Years


Wenatchee River Flow Exceedance Curve
(Wenatchee River at Plain, WA)
wet years (20% wettest years)
avg.years
dry years (20% driest years)
Annual river flow, MAF
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1915 1944 1942 1993 1994 1977 1992 1952 1945 1963 1936 2009 2004 1998 1937 2003 2008 1938 1960 1928 1923 1925 1946 1958 1948 2007 1947 1953 1927 1917 1996 1964 1968 1967 1955 1951 1975 1971 1933 1999 1995 1921 1997 1972
Years


Dry Years Trend for Wenatchee River Flow
(Wenatchee River at Plain, WA)
y = -2291.5x + 1E+06
Linear Trend
Annual river flow, MAF
1.5
1.0
0.5
0.0
1915
1926
1929
1940
1941
1942
1944
1945
1952
1970
1973
1977
1992
1993
1994
2001
2005
Years


Wenatchee River 20 yr Flows
(Wenatchee River at Plain, WA)
Annual river flow, MAF
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 20 yr
Dry 17 5
Avg 53 11
Wet 17 4
Total 87 20


Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Wenatchee River at Plain, WA)
River flow, cfs
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Instream Flow Rule
Dry year (1915)
Avg.year (1935)
Wet year (1972)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

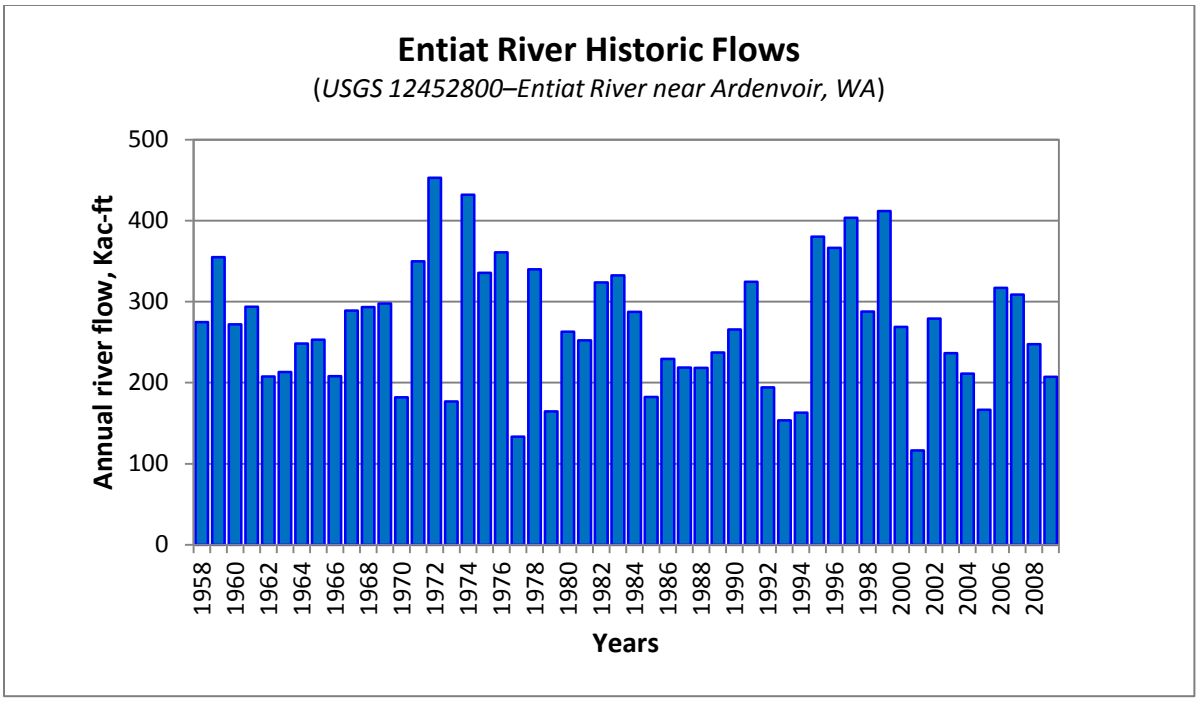

Water Deficit/Surplus Evaluation
(Wenatchee River at Plain, WA)
Deficit/Surplus, ac-ft
200,000
160,000
120,000
80,000
40,000
0
-40,000
Wet year (1972)
Avg.year (1935)
Dry year (1915)
Instream Deficit
Dry–76K ac-ft
Avg–25K ac-ft
Wet–2K ac-ft
Instream Surplus
Dry–270K ac-ft
Avg–1.0 MAF
Wet–1.8 MAF
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

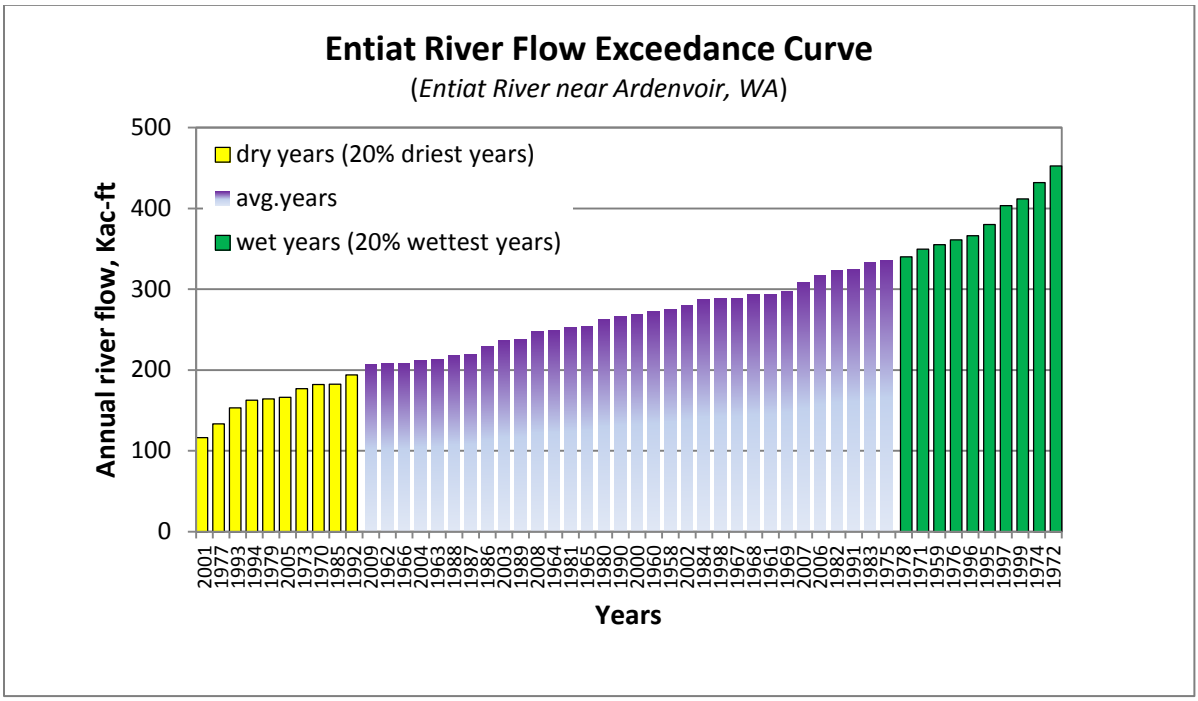
WRIA 46 (Entiat)

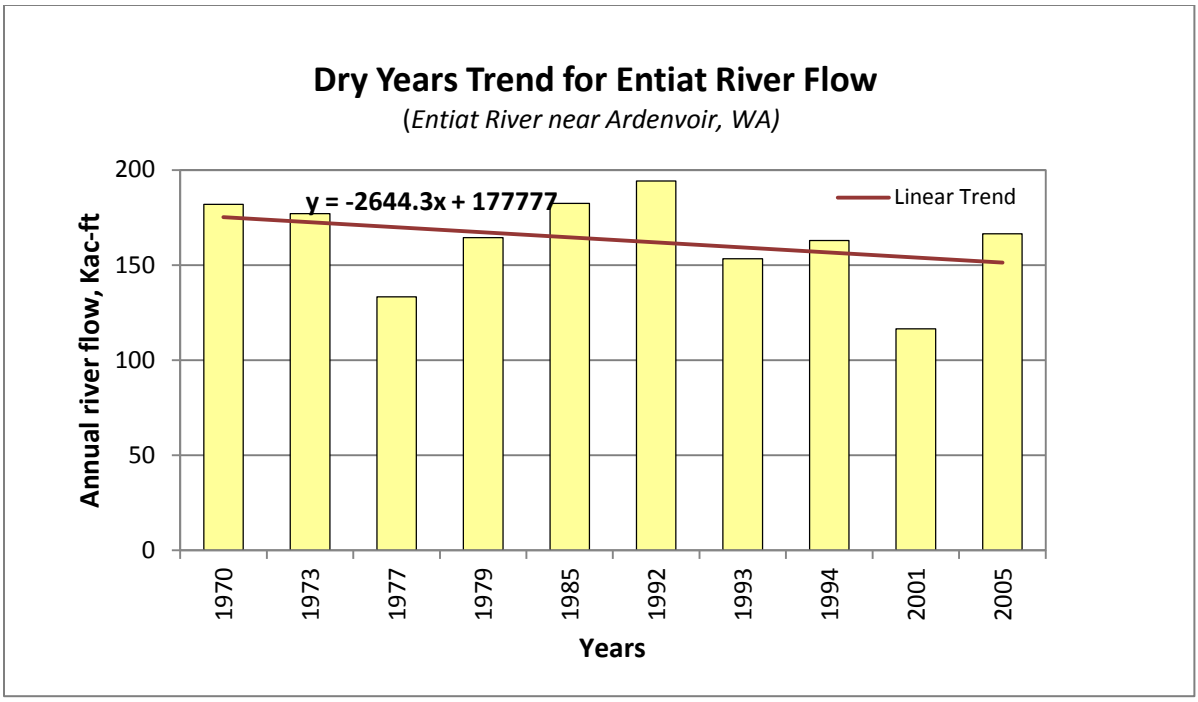
For WRIA 46, OCR graphed the flows of 3 rivers and streams. For most rivers and streams, a series of six to eight graphs were created. The results provide information on historic flow levels, drought occurrences and when instream flow rules are or are not met. These data contribute to OCR's understanding of historic trends, drought patterns and hydrograph variability. For example, by graphing the 14 year (1996–2009) flows of the Entiat River near Entiat, gauge number, 12452990 it is shown that:

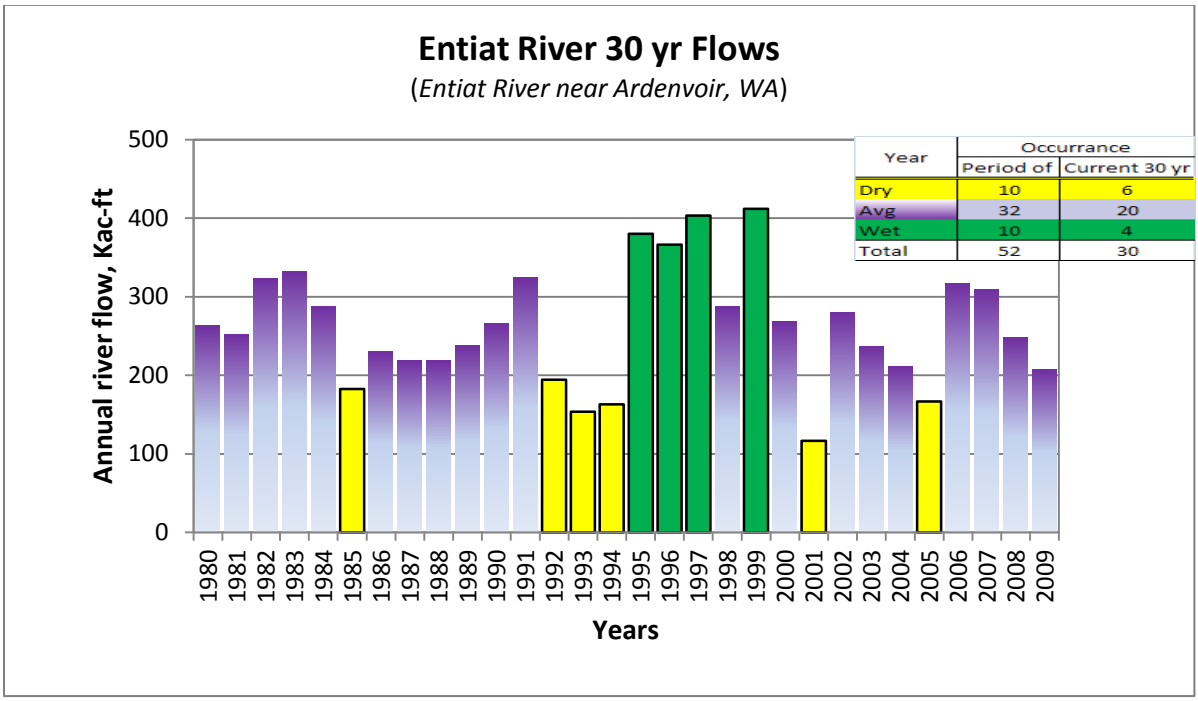
- Historic mean annual flows generally varied between 0.1 and 0.5 million acre-feet (MAF).
- Ecology defined "dry" years as the 80% exceedance value (80% of the time more water was available). Over the 14 years, dry years occurred 3 times. During this same time period, the availability of water during dry years improved by 83 %.
- Ecology compared different water years (dry, average, wet) to the instream flow rule. The instream flow rule is almost always met in average years except in late summer. In dry years, the instream flow is not met in early spring, through summer and in the winter.
- The magnitude of unmet instream flows is small. For example, in average years, the instream flow deficit for the entire year totals 10,000 acre-feet, which grows to 69,000 acre-feet in dry years.
- Water is available in-basin to address instream shortages through OCR-funded projects (e.g. storage, conservation, pump exchanges). For example, the average water year surplus is 149,000 acre-feet.

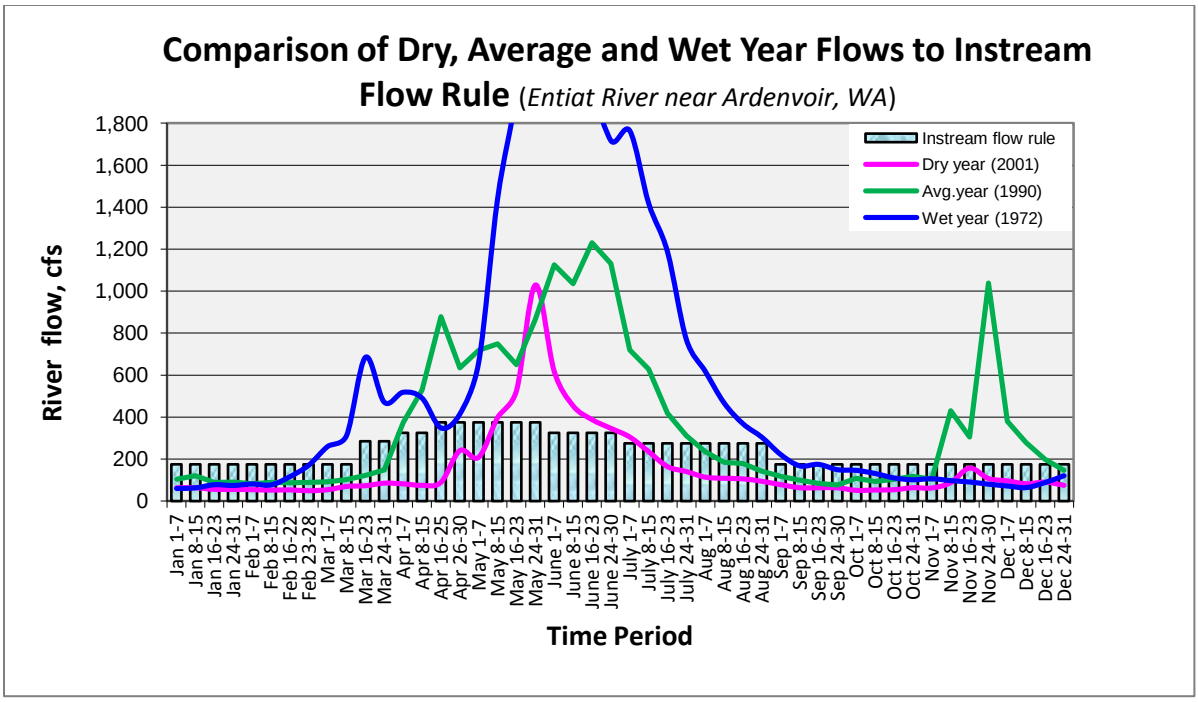
OCR can use this information to recognize where water is needed, when water is available and whether or not the in-basin or out-of-basin water supply development can help meet the WRIA's water demands.

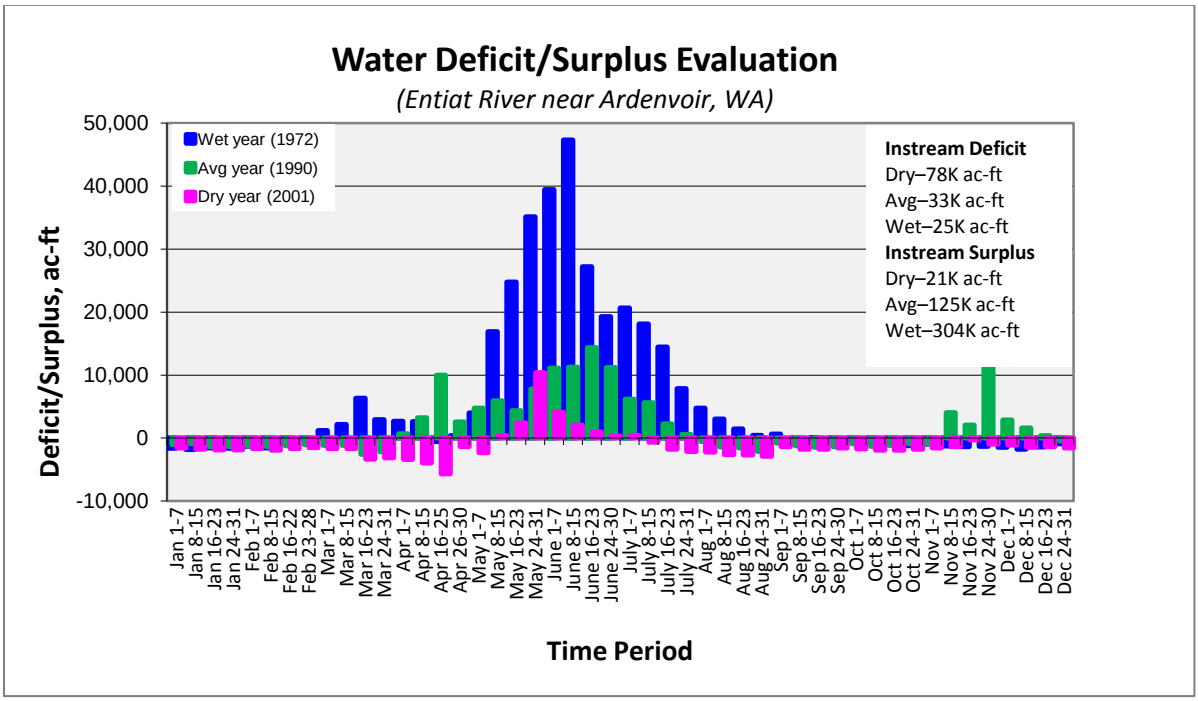

Entiat River Historic Flows
(USGS 12452800–Entiat River near Ardenvoir, WA)
Annual river flow, Kac-ft
500
400
300
200
100
0
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
Years

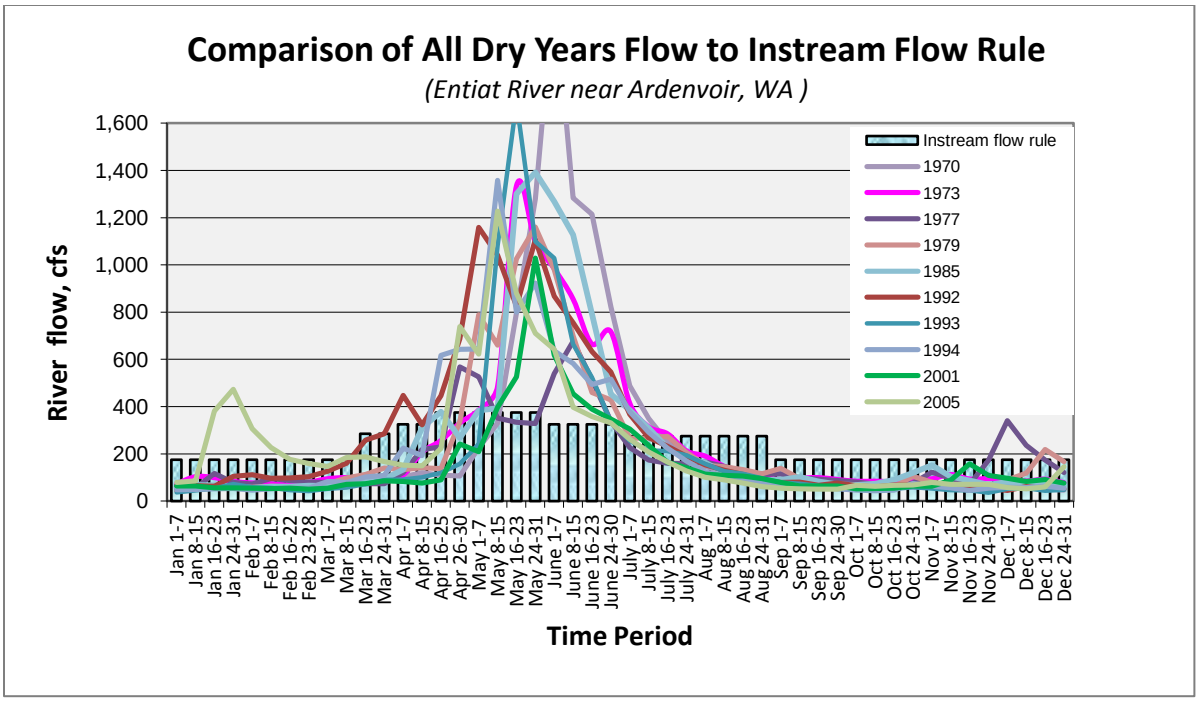

Entiat River Flow Exceedance Curve
(Entiat River near Ardenvoir, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, Kac-ft
500
400
300
200
100
0
2001 1977 1993 1994 1979 2005 1973 1970 1985 1992 2009 1962 1966 2004 1963 1988 1987 1986 2003 1989 2008 1964 1981 1965 1980 1990 2000 1960 1958 2002 1984 1998 1967 1968 1961 1969 2007 2006 1982 1991 1983 1975 1978 1971 1959 1976 1996 1995 1997 1999 1974 1972
Years

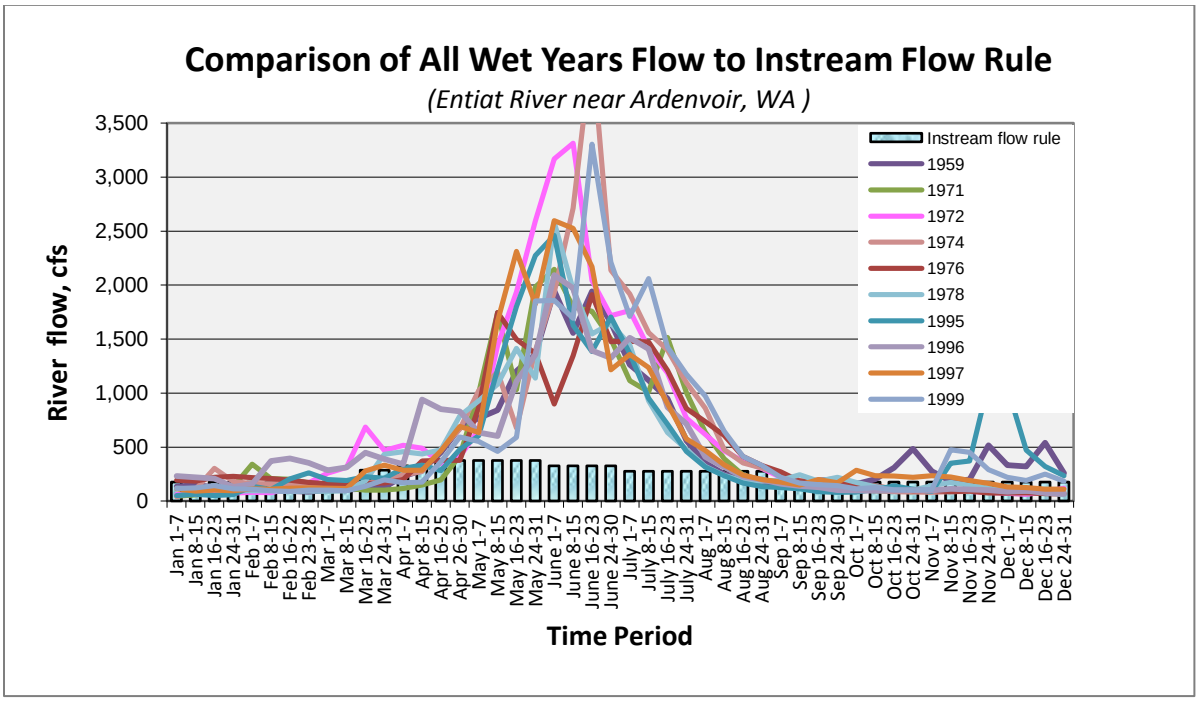

Dry Years Trend for Entiat River Flow
(Entiat River near Ardenvoir, WA)
y = -2644.3x + 177777
Linear Trend
Annual river flow, Kac-ft
200
150
100
50
0
1970
1973
1977
1979
1985
1992
1993
1994
2001
2005
Years

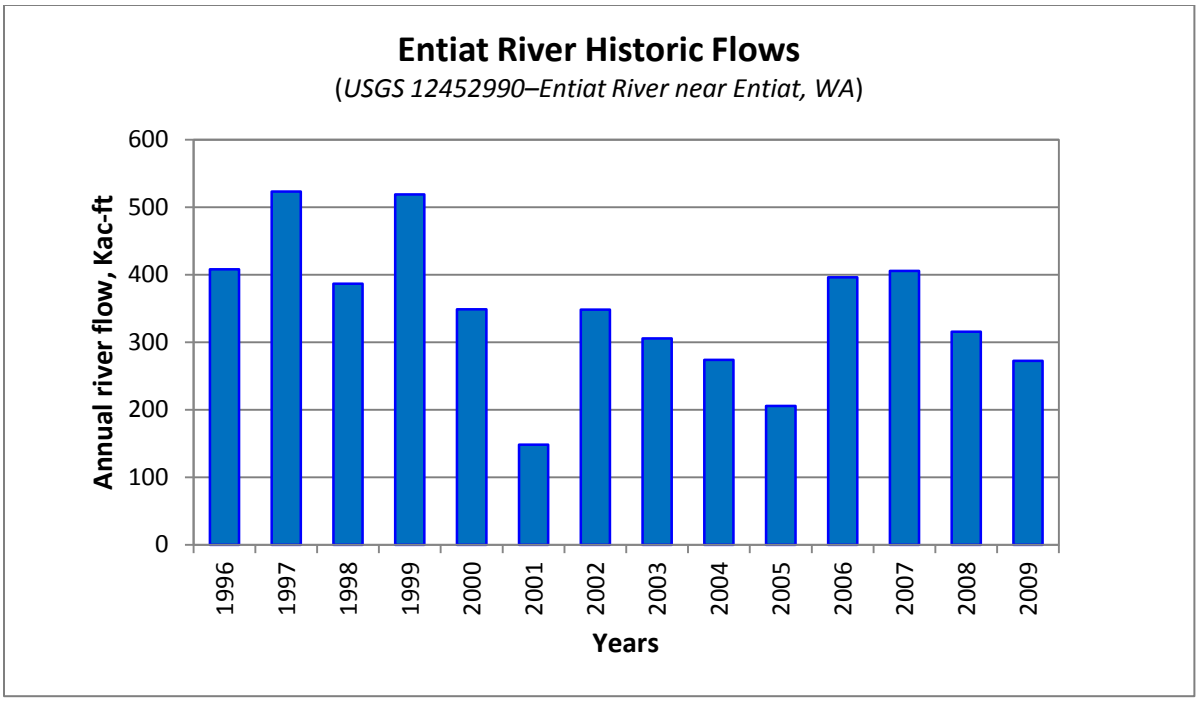

Entiat River 30 yr Flows
(Entiat River near Ardenvoir, WA)
Annual river flow, Kac-ft
500
400
300
200
100
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 10 6
Avg 32 20
Wet 10 4
Total 52 30

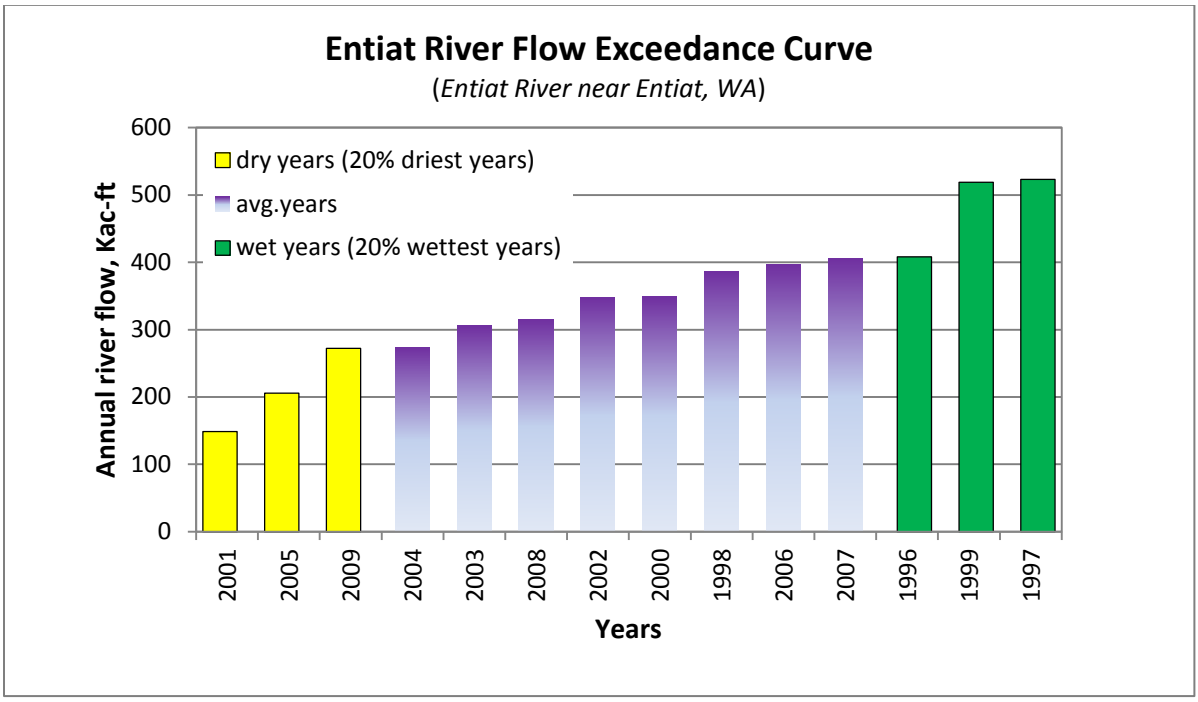

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Entiat River near Ardenvoir, WA)
River flow, cfs
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Instream flow rule
Dry year (2001)
Avg.year (1990)
Wet year (1972)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

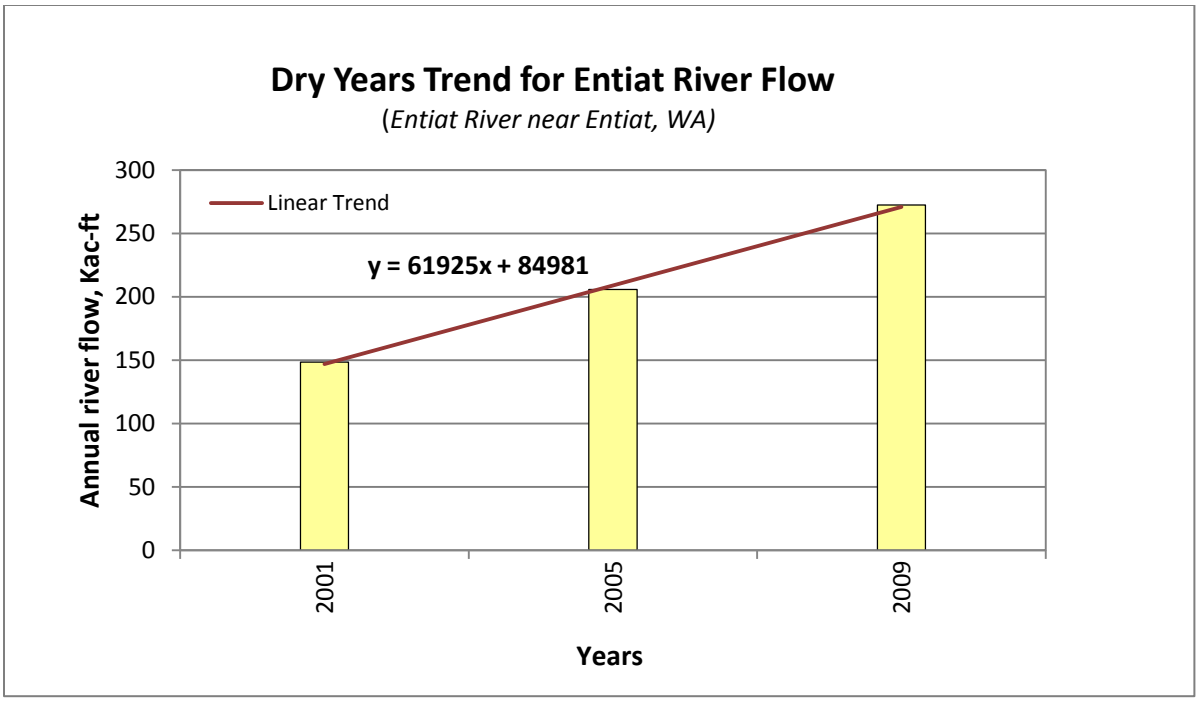

Water Deficit/Surplus Evaluation
(Entiat River near Ardenvoir, WA)
Deficit/Surplus, ac-ft
50,000
40,000
30,000
20,000
10,000
0
-10,000
Wet year (1972)
Avg year (1990)
Dry year (2001)
Instream Deficit
Dry–78K ac-ft
Avg–33K ac-ft
Wet–25K ac-ft
Instream Surplus
Dry–21K ac-ft
Avg–125K ac-ft
Wet–304K ac-ft
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

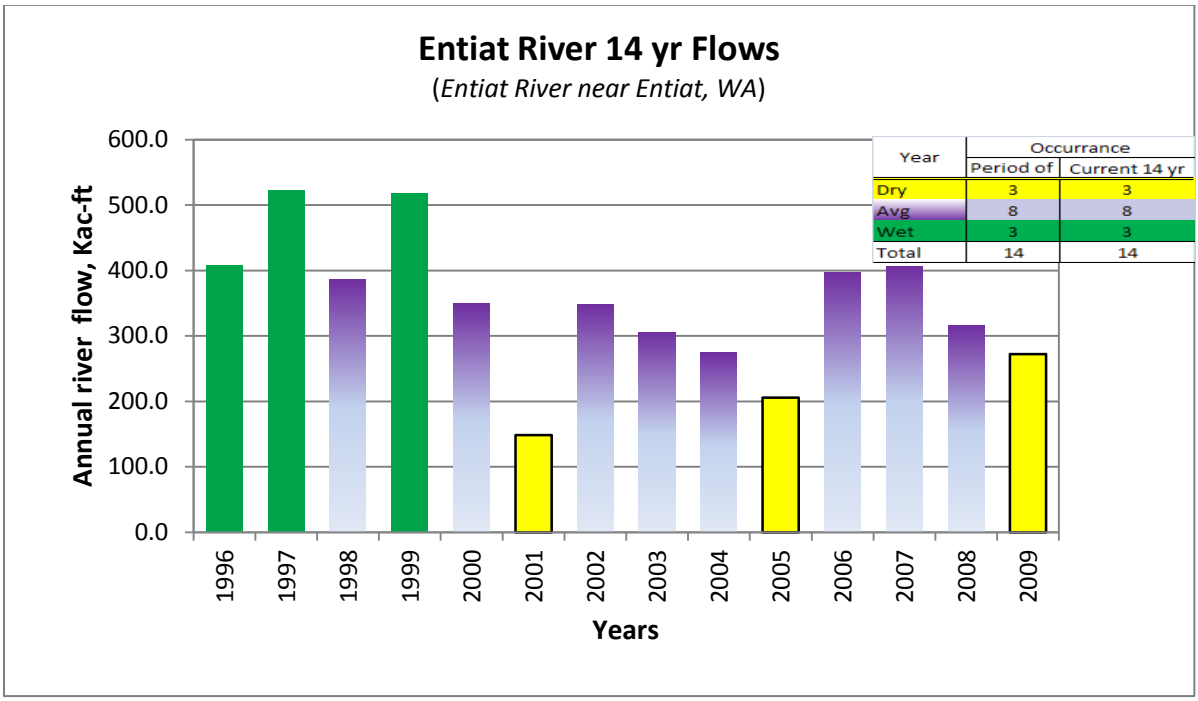

Comparison of All Dry Years Flow to Instream Flow Rule
(Entiat River near Ardenvoir, WA)
River flow, cfs
1,600
1,400
1,200
1,000
800
600
400
200
0
Instream flow rule
1970
1973
1977
1979
1985
1992
1993
1994
2001
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

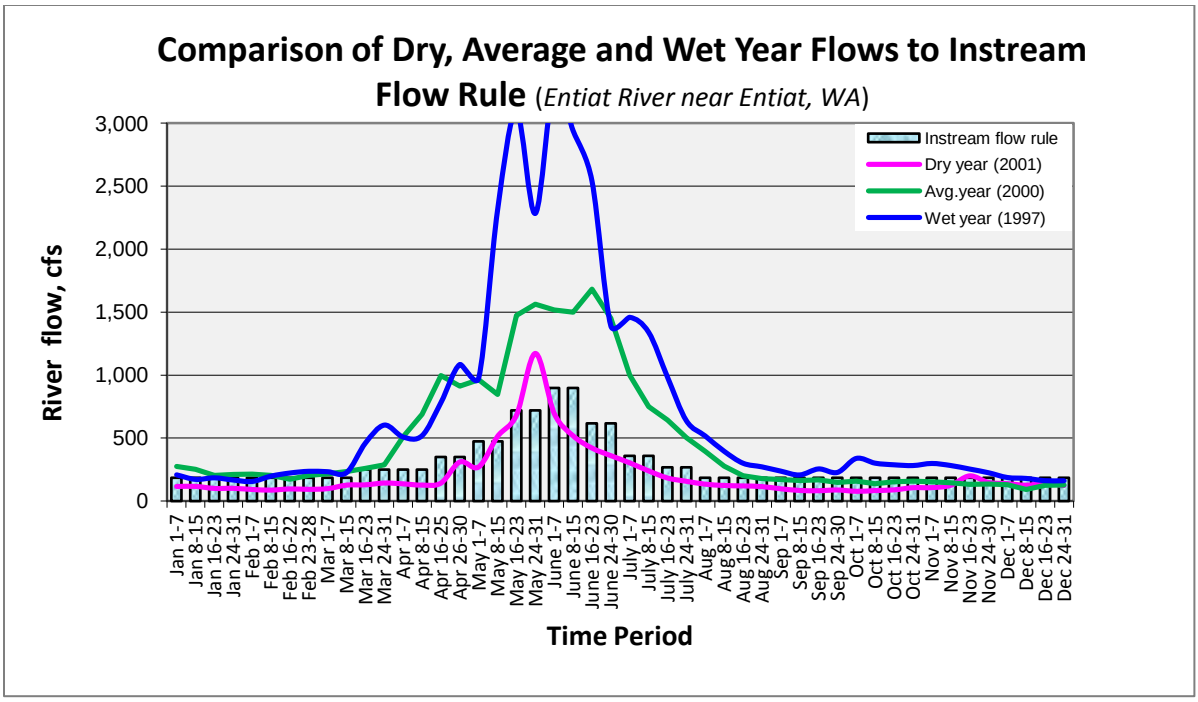

Comparison of All Wet Years Flow to Instream Flow Rule
(Entiat River near Ardenvoir, WA)
River flow, cfs
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Instream flow rule
1959
1971
1972
1974
1976
1978
1995
1996
1997
1999
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

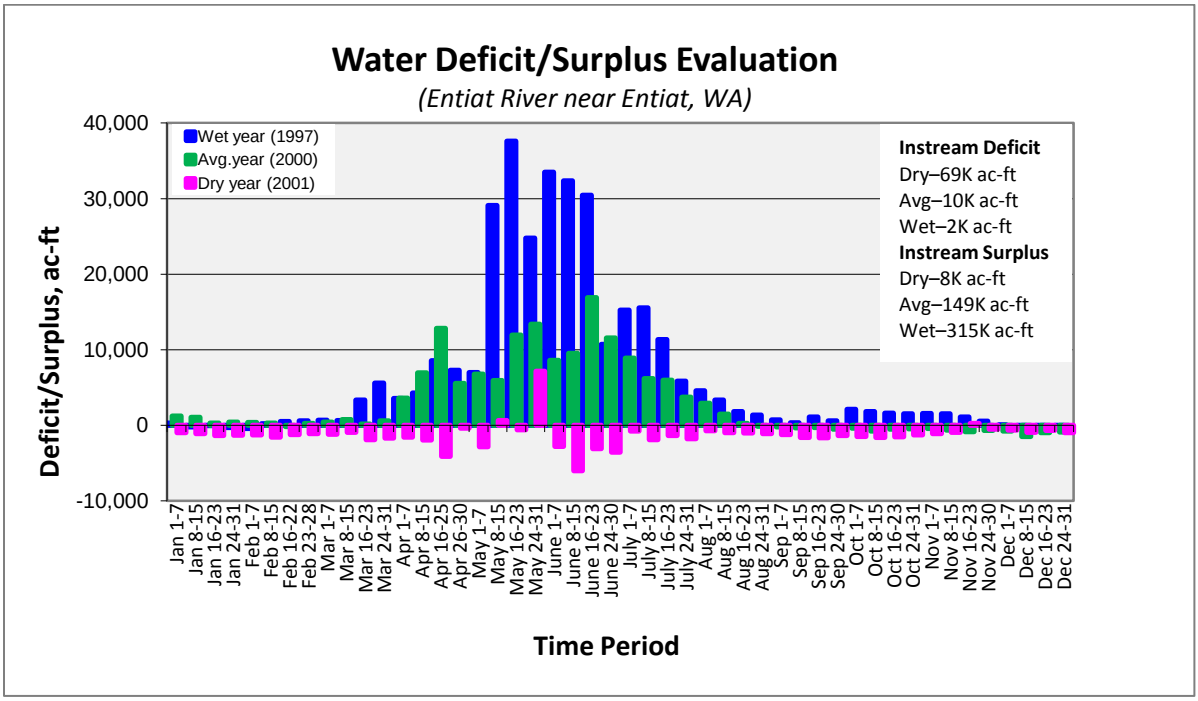

Entiat River Historic Flows
(USGS 12452990–Entiat River near Entiat, WA)
Annual river flow, Kac-ft
600
500
400
300
200
100
0
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years

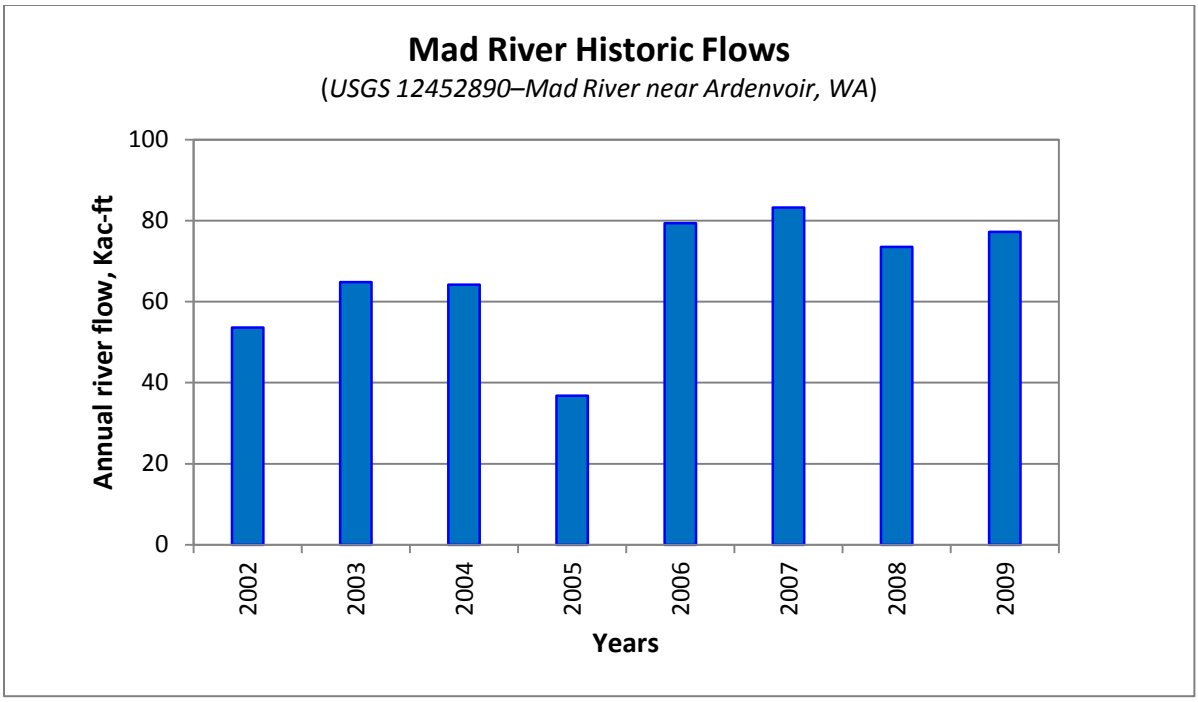

Entiat River Flow Exceedance Curve
(Entiat River near Entiat, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, Kac-ft
600
500
400
300
200
100
0
2001
2005
2009
2004
2003
2008
2002
2000
1998
2006
2007
1996
1999
1997
Years

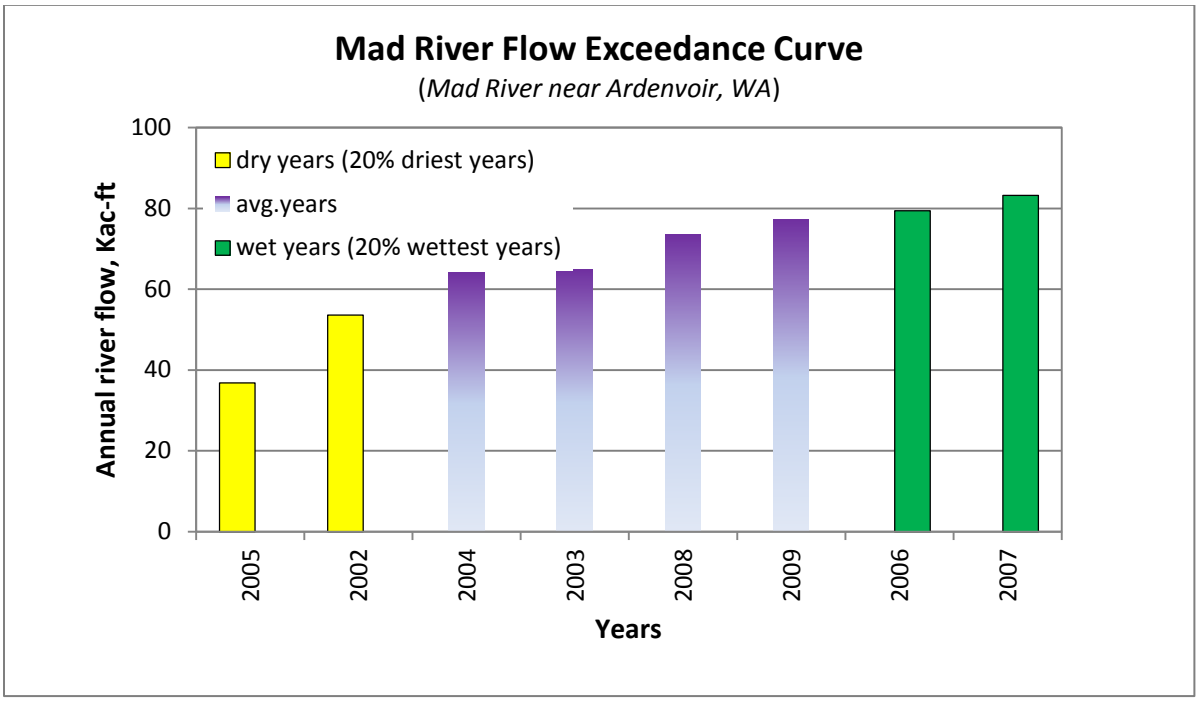

Dry Years Trend for Entiat River Flow
(Entiat River near Entiat, WA)
Linear Trend
y = 61925x + 84981
Annual river flow, Kac-ft
300
250
200
150
100
50
0
2001
2005
2009
Years

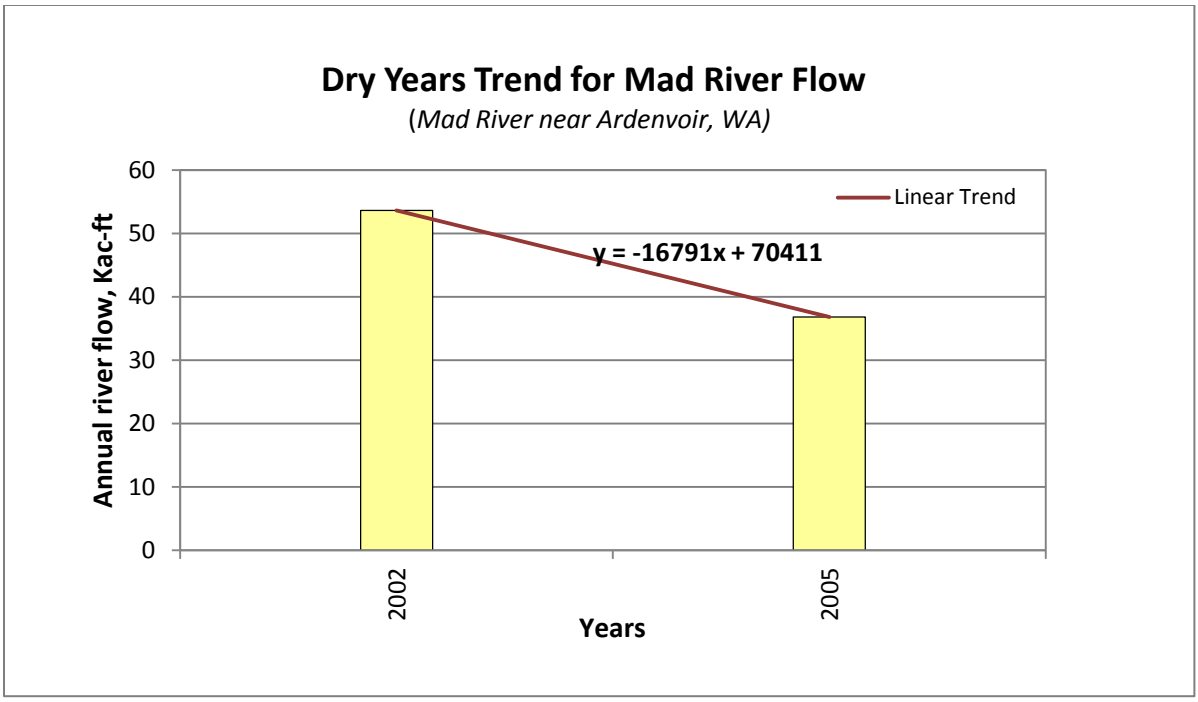

Entiat River 14 yr Flows
(Entiat River near Entiat, WA)
Annual river flow, Kac-ft
600.0
500.0
400.0
300.0
200.0
100.0
0.0
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 14 yr
Dry 3 3
Avg 8 8
Wet 3 3
Total 14 14

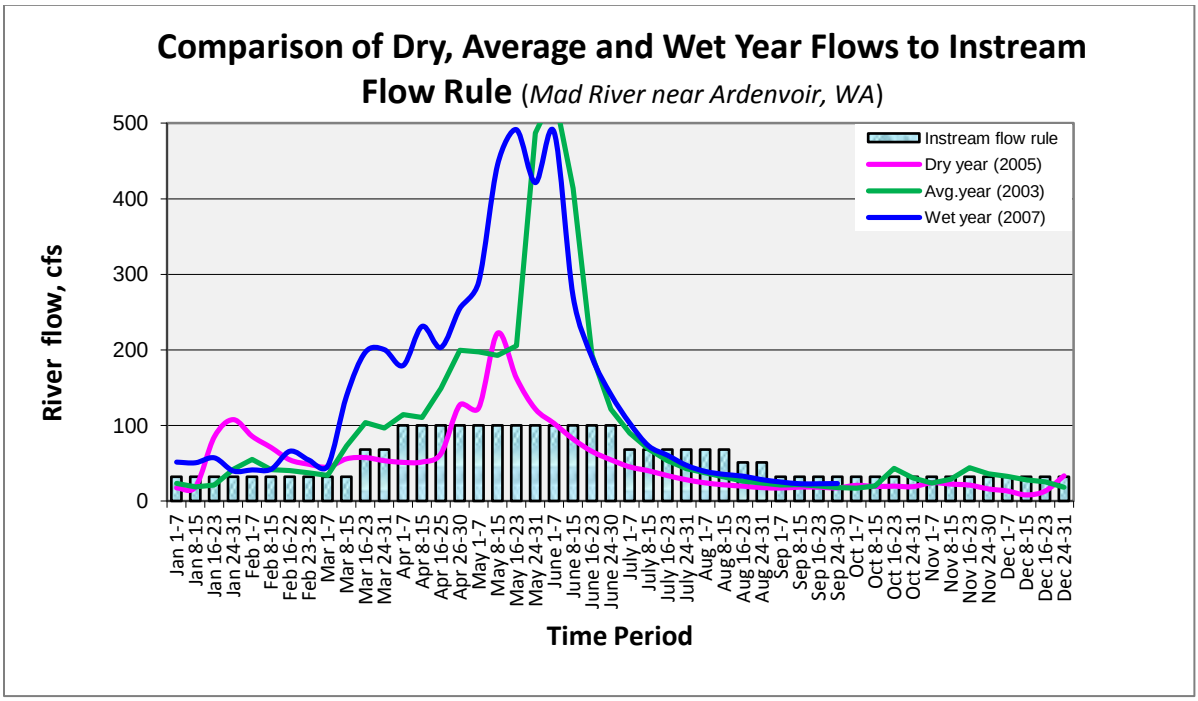

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Entiat River near Entiat, WA)
River flow, cfs
3,000
2,500
2,000
1,500
1,000
500
0
Instream flow rule
Dry year (2001)
Avg.year (2000)
Wet year (1997)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

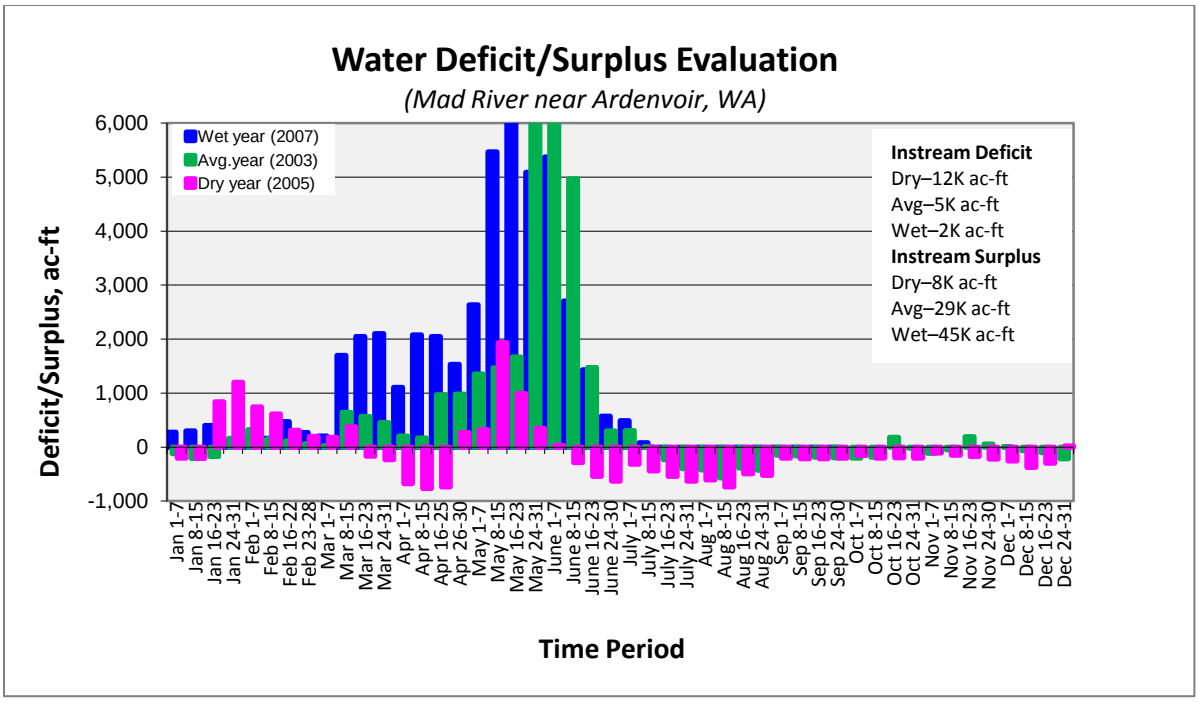

Water Deficit/Surplus Evaluation
(Entiat River near Entiat, WA)
Deficit/Surplus, ac-ft
40,000
30,000
20,000
10,000
0
-10,000
Wet year (1997)
Avg.year (2000)
Dry year (2001)
Instream Deficit
Dry–69K ac-ft
Avg–10K ac-ft
Wet–2K ac-ft
Instream Surplus
Dry–8K ac-ft
Avg–149K ac-ft
Wet–315K ac-ft
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

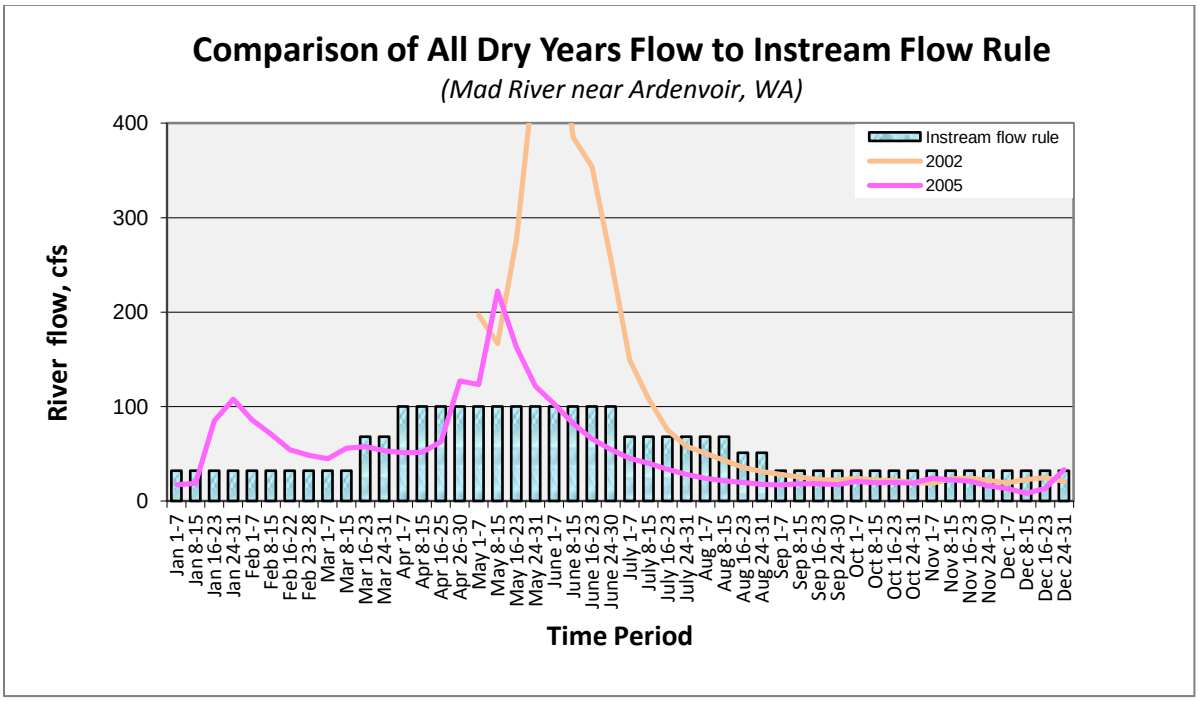

Mad River Historic Flows
(USGS 12452890–Mad River near Ardenvoir, WA)
Annual river flow, Kac-ft
100
80
60
40
20
0
2002
2003
2004
2005
2006
2007
2008
2009
Years

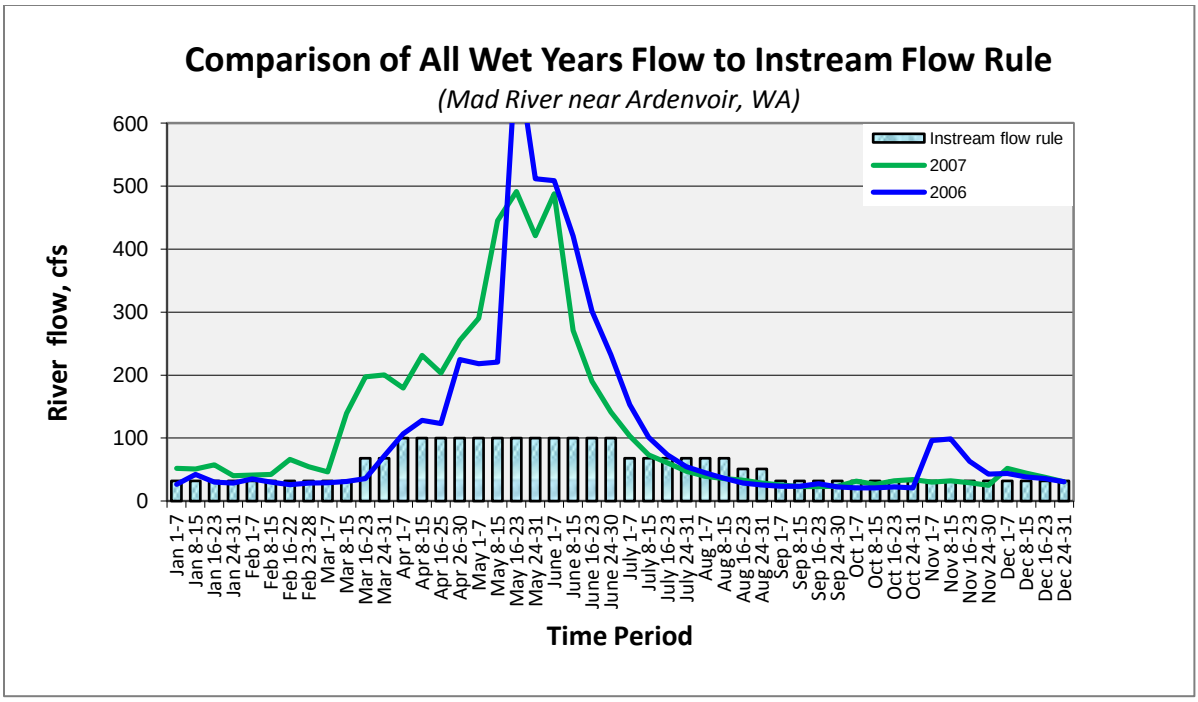

Mad River Flow Exceedance Curve
(Mad River near Ardenvoir, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, Kac-ft
100
80
60
40
20
0
2005
2002
2004
2003
2008
2009
2006
2007
Years


Dry Years Trend for Mad River Flow
(Mad River near Ardenvoir, WA)
Annual river flow, Kac-ft
60
50
40
30
20
10
0
Linear Trend
y = -16791x + 70411
2002
2005
Years


Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Mad River near Ardenvoir, WA)
River flow, cfs
500
400
300
200
100
0
Instream flow rule
Dry year (2005)
Avg.year (2003)
Wet year (2007)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Water Deficit/Surplus Evaluation
(Mad River near Ardenvoir, WA)
Deficit/Surplus, ac-ft
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
Wet year (2007)
Avg.year (2003)
Dry year (2005)
Instream Deficit
Dry–12K ac-ft
Avg–5K ac-ft
Wet–2K ac-ft
Instream Surplus
Dry–8K ac-ft
Avg–29K ac-ft
Wet–45K ac-ft
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Comparison of All Dry Years Flow to Instream Flow Rule
(Mad River near Ardenvoir, WA)
River flow, cfs
400
300
200
100
0
Instream flow rule
2002
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Comparison of All Wet Years Flow to Instream Flow Rule
(Mad River near Ardenvoir, WA)
River flow, cfs
600
500
400
300
200
100
0
Instream flow rule
2007
2006
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

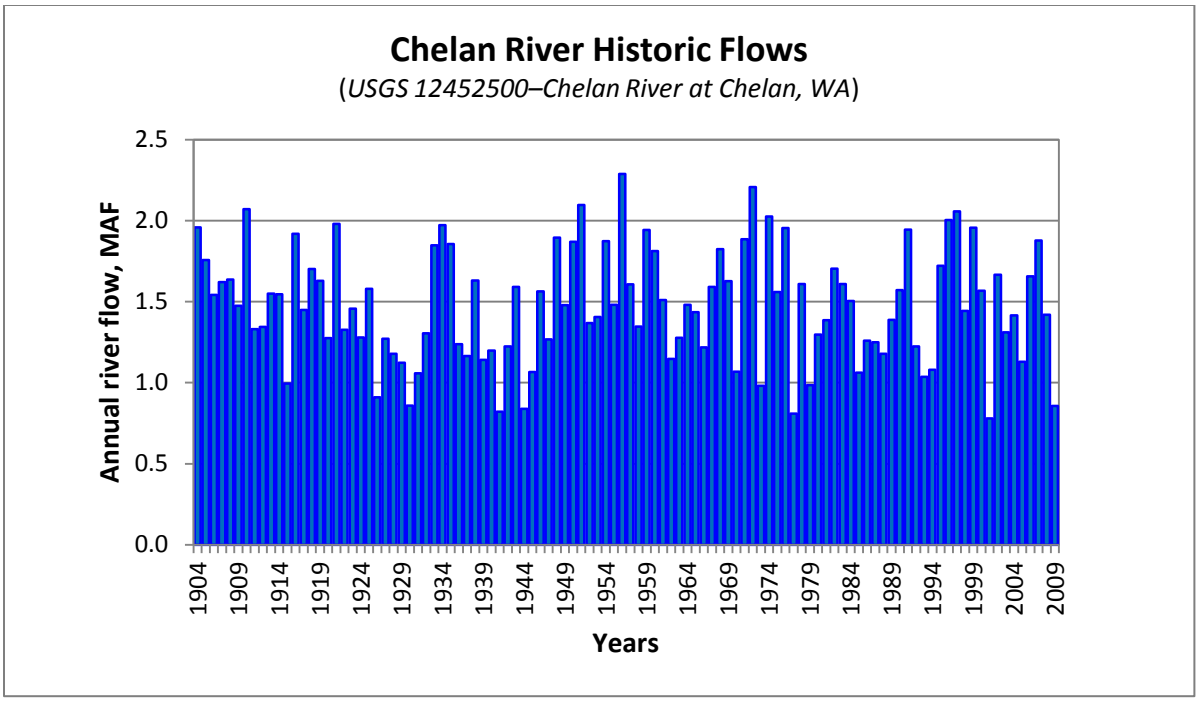
WRIA 47 (Chelan)

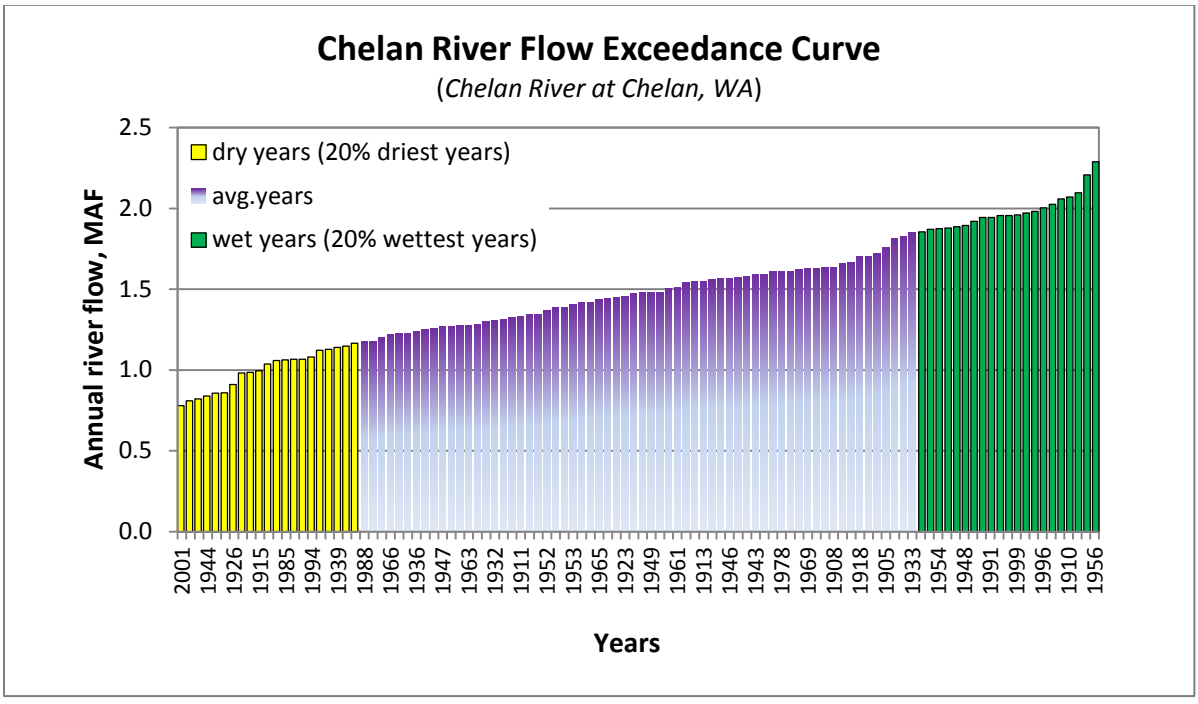
For WRIA 47, OCR graphed the flows of 2 rivers and streams. For most rivers and streams, a series of six to eight graphs were created. The results provide information on historic flow levels, drought occurrences and when instream flow rules are or are not met. These data contribute to OCR's understanding of historic trends, drought patterns and hydrograph variability. For example, by graphing the 106 year (1904–2009) flows of the Chelan River at Chelan, gauge number 12452500, it is shown that:

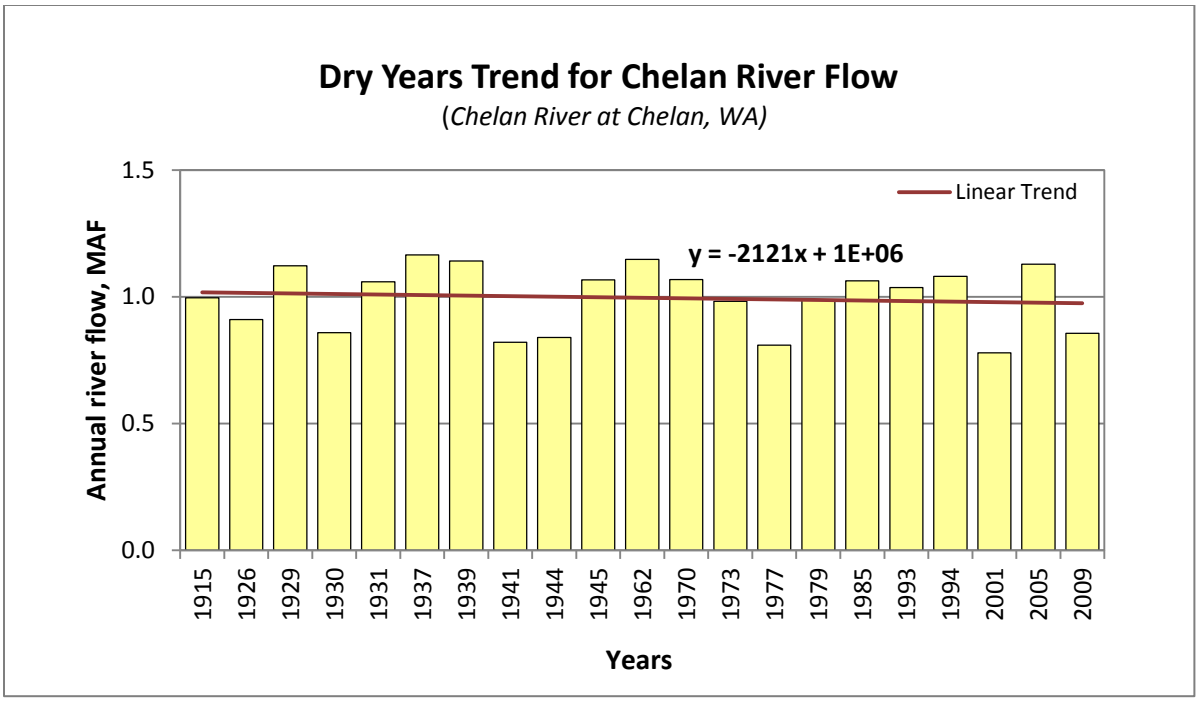
- Historic mean annual flows generally varied between 0.8 and 2.3 million acre-feet (MAF).
- Ecology defined "dry" years as the 80% exceedance value (80% of the time more water was available). Over the last 30 years, dry years occurred 6 times, with the worst stretch being 2 consecutive dry years in 1993-1994. During this same time period, the availability of water during dry years worsened by 19%.
- The Chelan River has Federal Energy Regulatory Commission (FERC) requirements below Lake Chelan Dam. The instream flow requirements are set up differently from the WAC flow requirements and have been graphed differently.

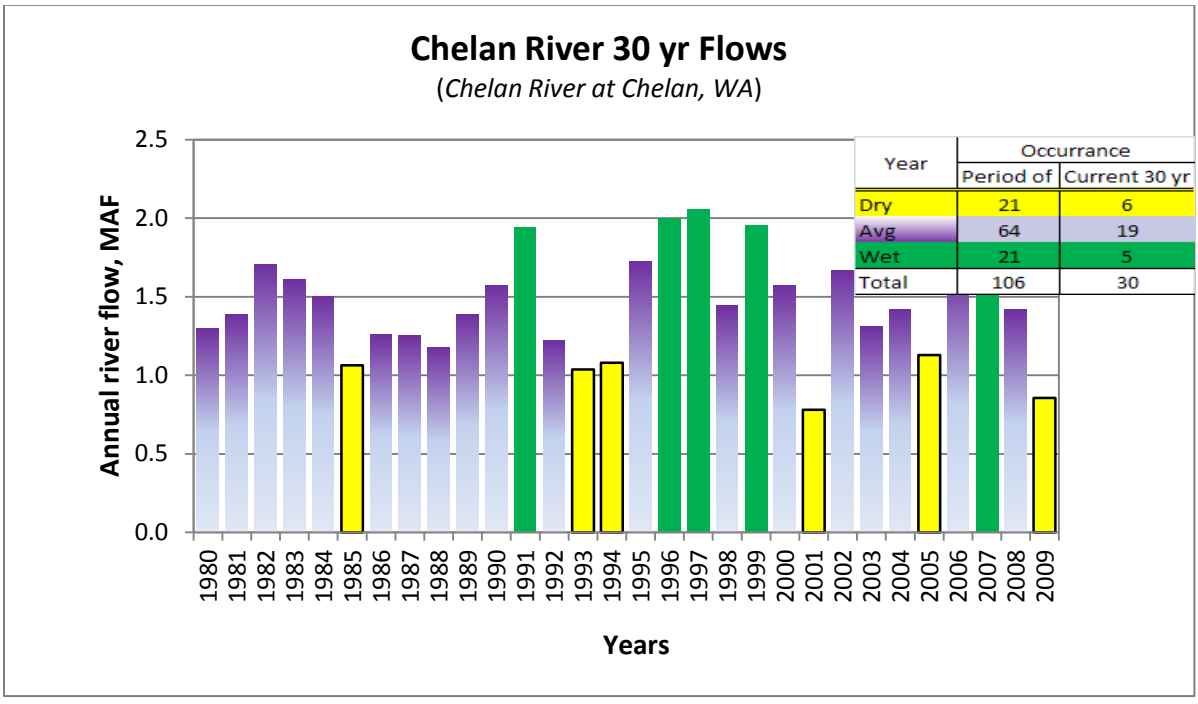
OCR graphed minimum instream and fish spawning flow requirements for the Chelan River as described in the Chelan River Biological Evaluation and Implementation Plan (CRBEIP), then compared different water years (dry, average, wet) to these requirements. The instream and fish spawning flow requirements are always met in average years. In dry years, these flows are not met in early spring and in late fall.

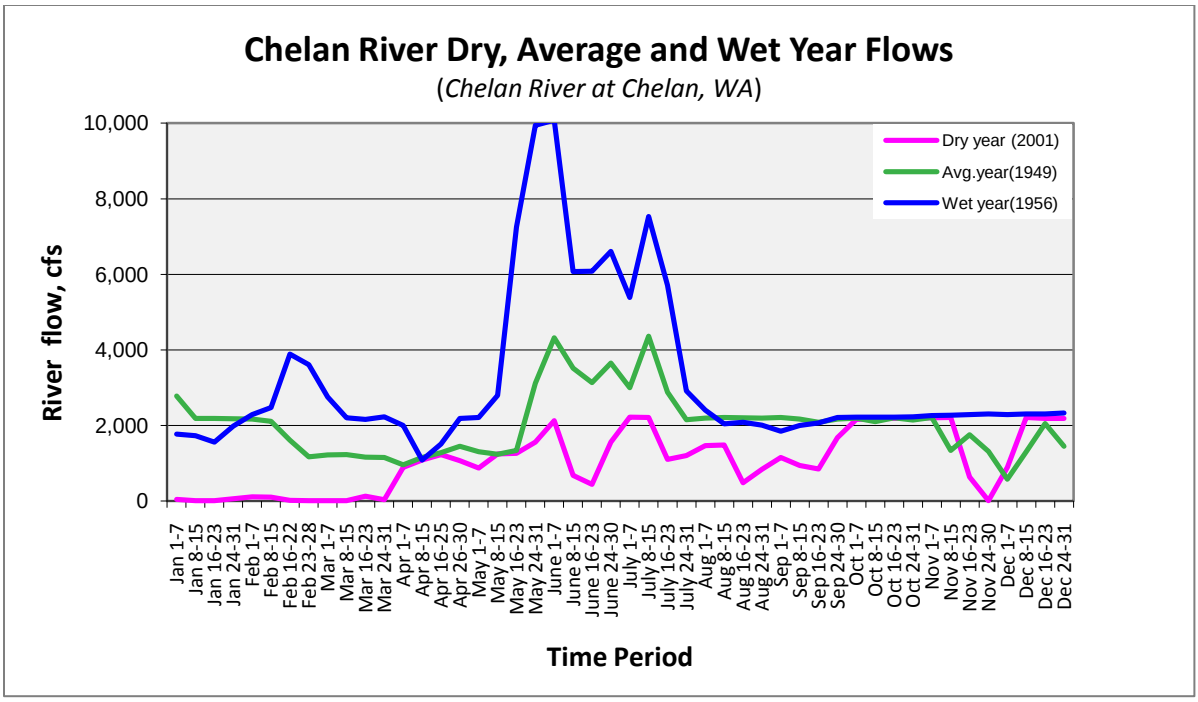
OCR can use this information to recognize where water is needed, when water is available and whether or not the in-basin or out-of-basin water supply development can help meet the WRIA's water demands.

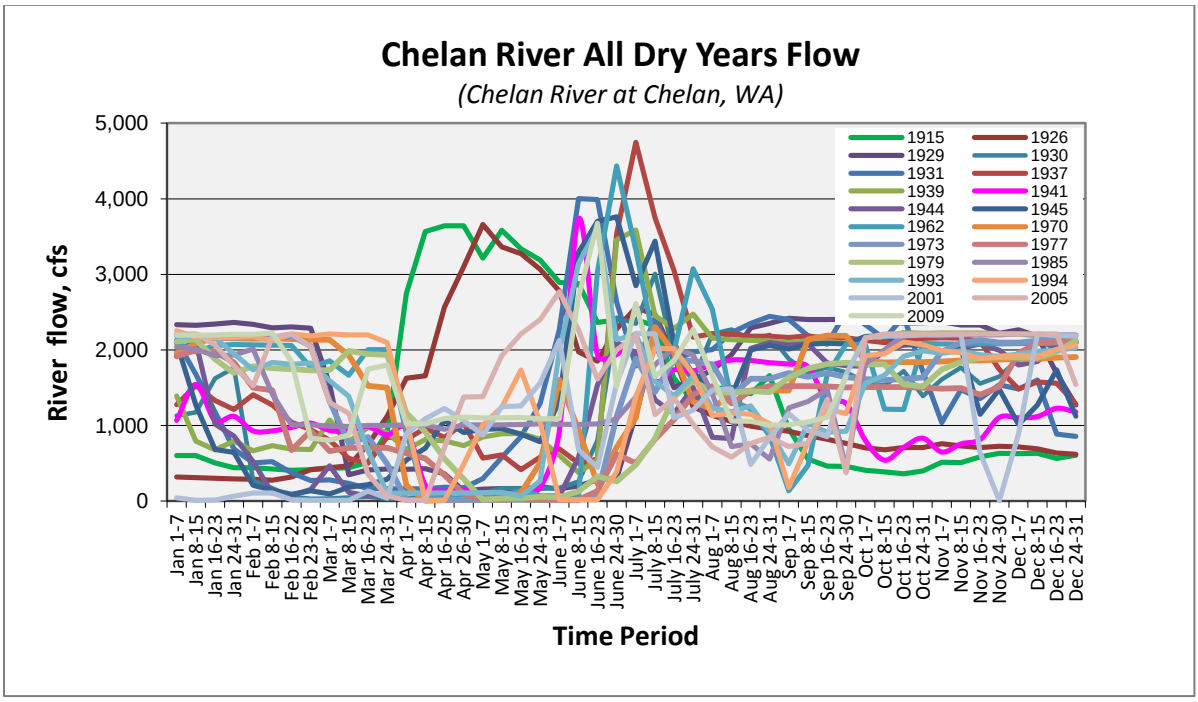

Chelan River Historic Flows
(USGS 12452500–Chelan River at Chelan, WA)
Annual river flow, MAF
2.5
2.0
1.5
1.0
0.5
0.0
1904
1909
1914
1919
1924
1929
1934
1939
1944
1949
1954
1959
1964
1969
1974
1979
1984
1989
1994
1999
2004
2009
Years

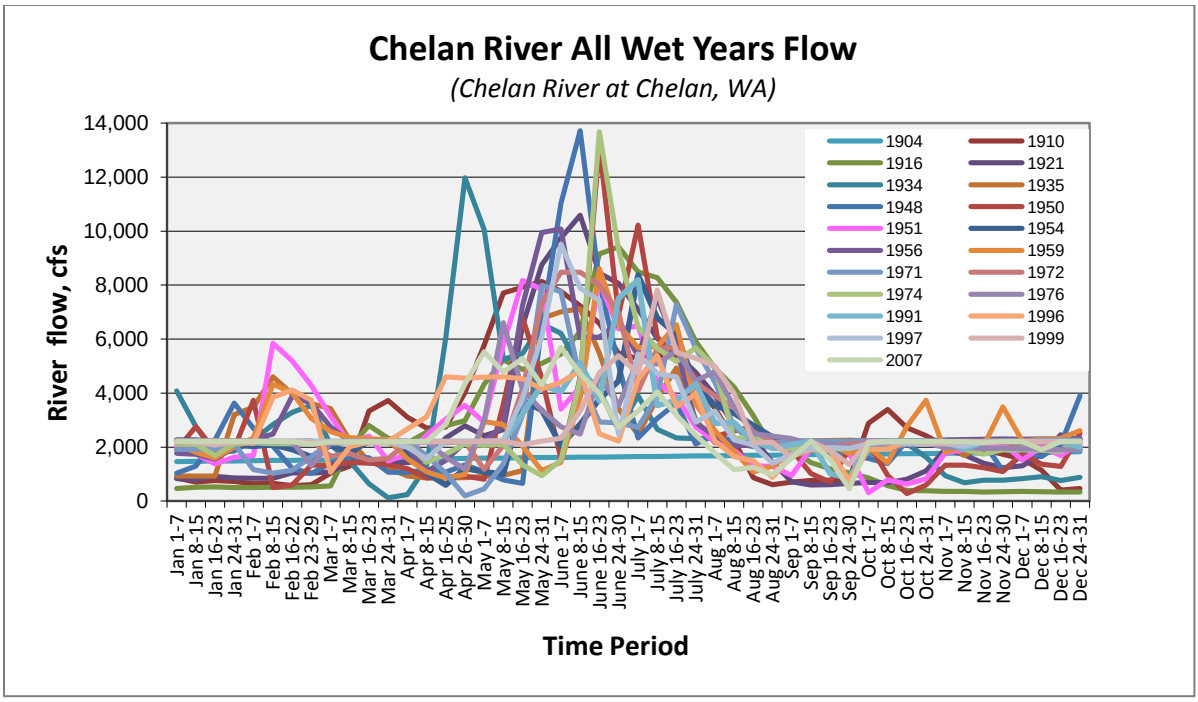

Chelan River Flow Exceedance Curve
(Chelan River at Chelan, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, MAF
2.5
2.0
1.5
1.0
0.5
0.0
2001
1944
1926
1915
1985
1994
1939
1988
1966
1936
1947
1963
1932
1911
1952
1953
1965
1923
1949
1961
1913
1946
1943
1978
1969
1908
1918
1905
1933
1954
1948
1991
1999
1996
1910
1956
Years

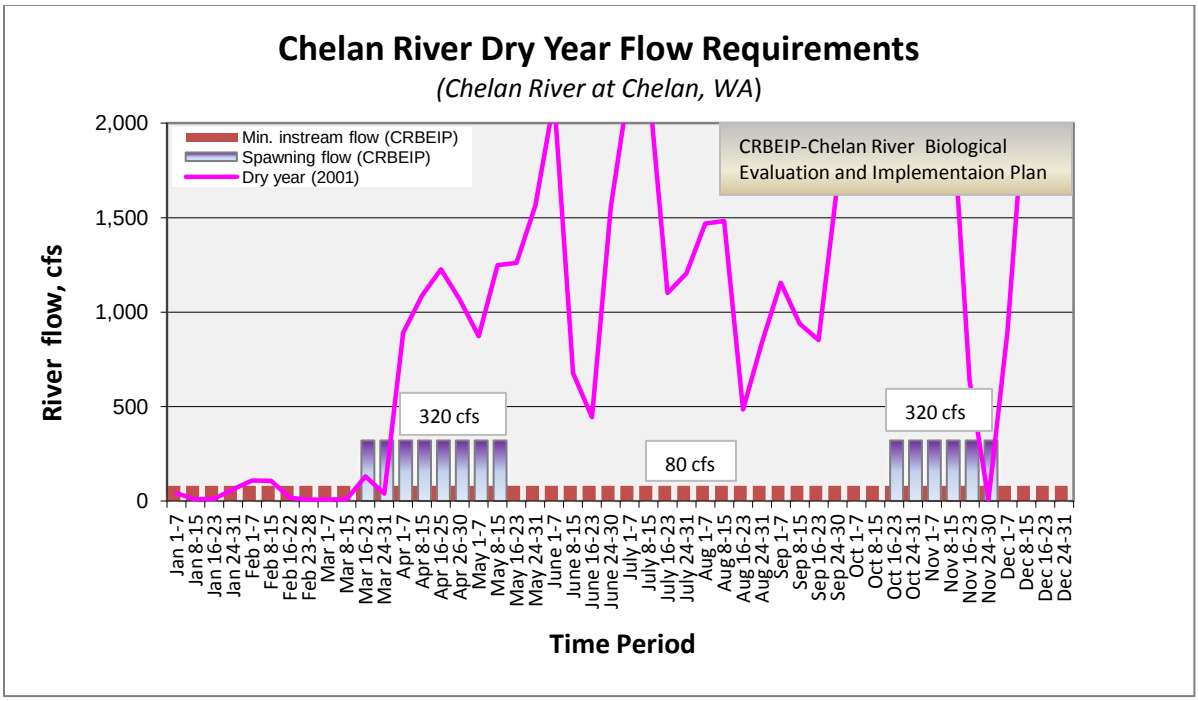

Dry Years Trend for Chelan River Flow
(Chelan River at Chelan, WA)
Linear Trend
y = -2121x + 1E+06
Annual river flow, MAF
1.5
1.0
0.5
0.0
1915
1926
1929
1930
1931
1937
1939
1941
1944
1945
1962
1970
1973
1977
1979
1985
1993
1994
2001
2005
2009
Years

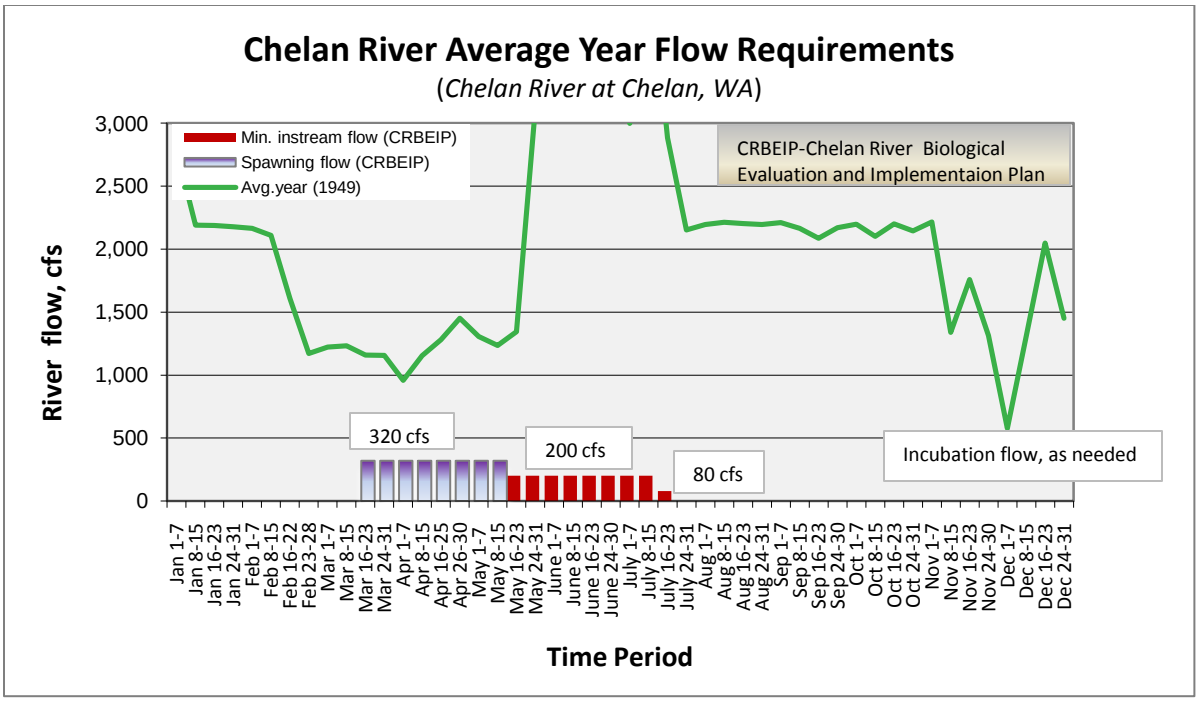

Chelan River 30 yr Flows
(Chelan River at Chelan, WA)
Annual river flow, MAF
2.5
2.0
1.5
1.0
0.5
0.0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry
21
6
Avg
64
19
Wet
21
5
Total
106
30

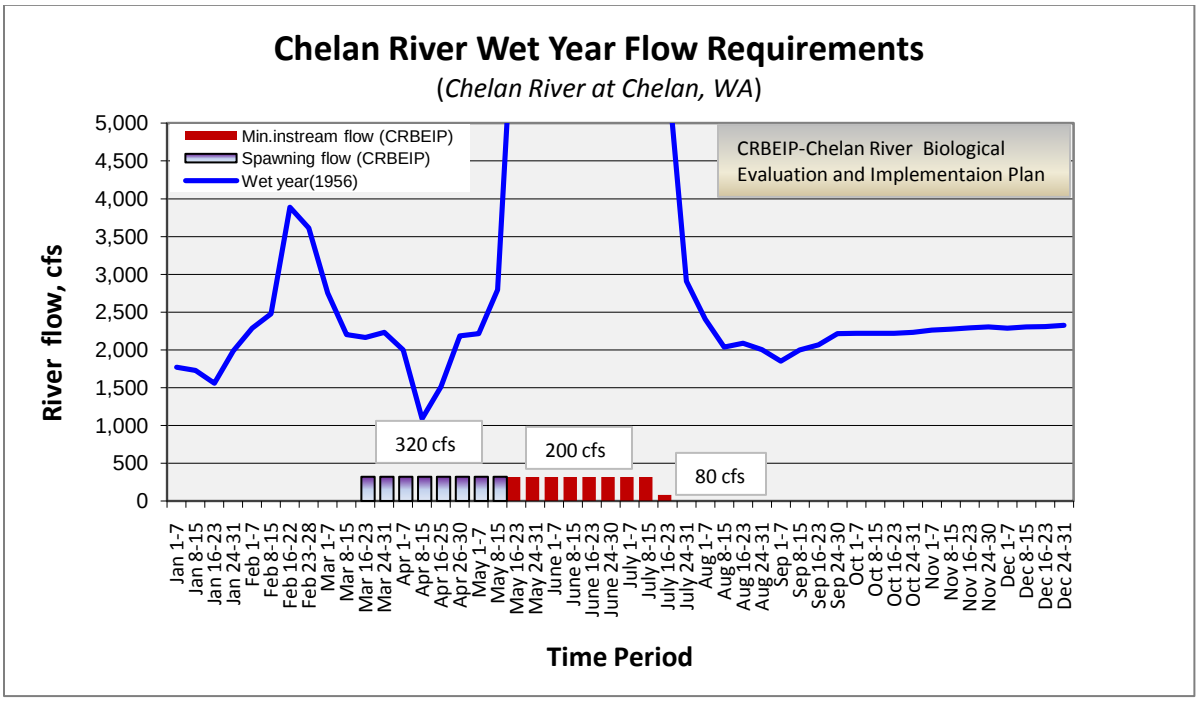

Chelan River Dry, Average and Wet Year Flows
(Chelan River at Chelan, WA)
River flow, cfs
10,000
8,000
6,000
4,000
2,000
0
Dry year (2001)
Avg.year(1949)
Wet year(1956)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

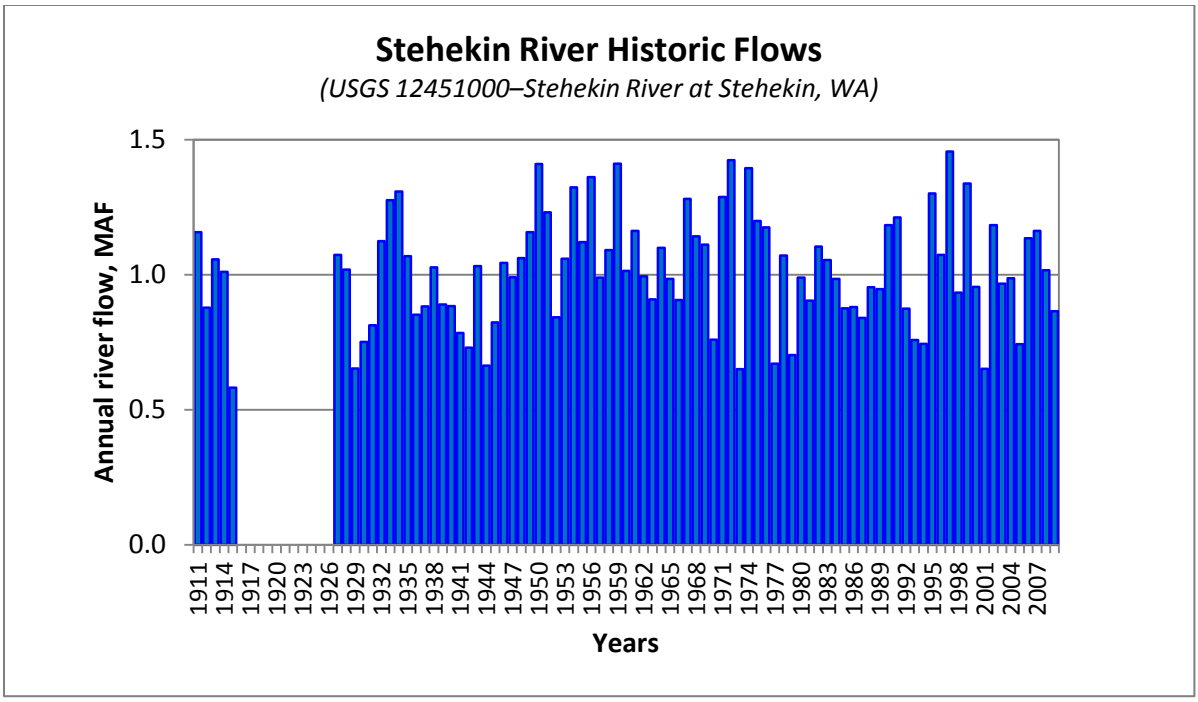

Chelan River All Dry Years Flow
(Chelan River at Chelan, WA)
River flow, cfs
5,000
4,000
3,000
2,000
1,000
0
1915
1926
1929
1930
1931
1937
1939
1941
1944
1945
1962
1970
1973
1977
1979
1985
1993
1994
2001
2005
2009
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

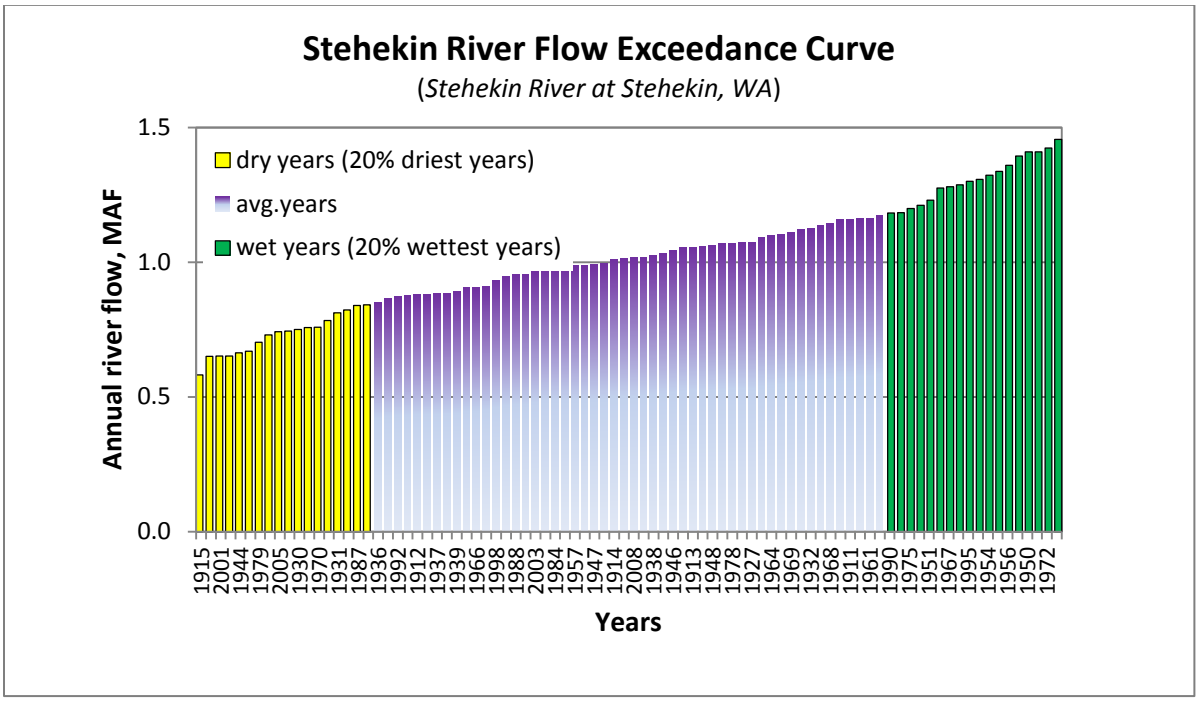

Chelan River All Wet Years Flow
(Chelan River at Chelan, WA)
River flow, cfs
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1904
1910
1916
1921
1934
1935
1948
1950
1951
1954
1956
1959
1971
1972
1974
1976
1991
1996
1997
1999
2007
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

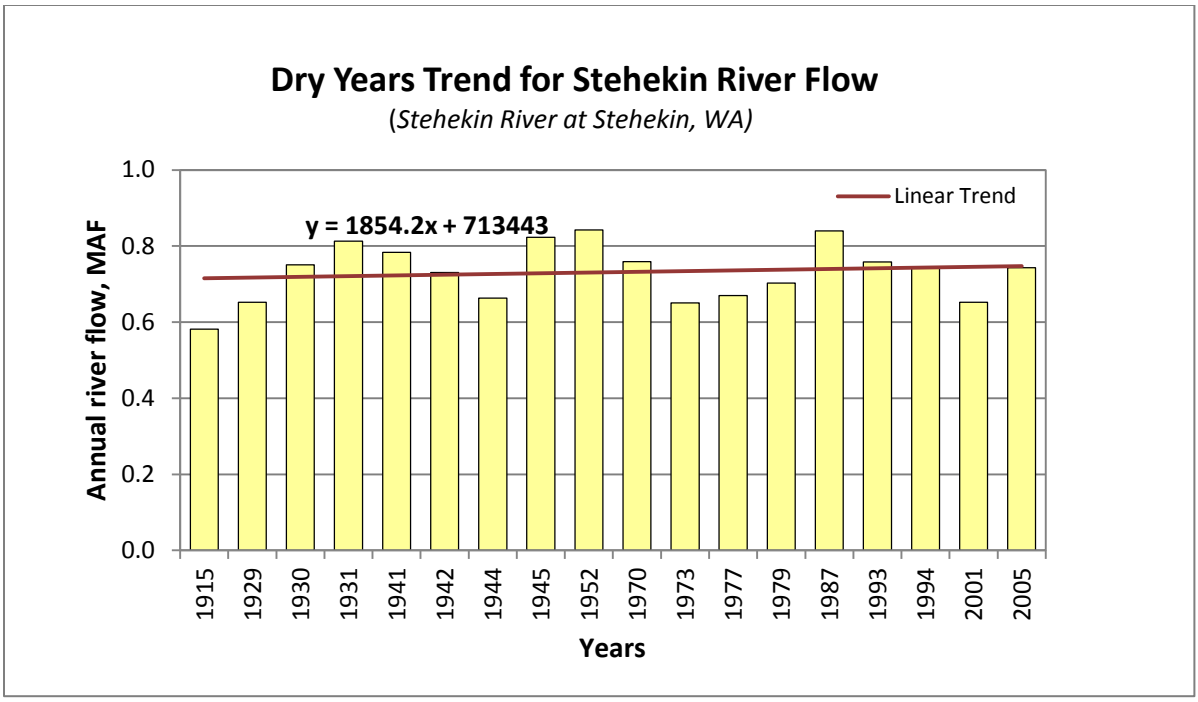

Chelan River Dry Year Flow Requirements
(Chelan River at Chelan, WA)
River flow, cfs
2,000
1,500
1,000
500
0
Min. instream flow (CRBEIP)
Spawning flow (CRBEIP)
Dry year (2001)
CRBEIP-Chelan River Biological Evaluation and Implementaion Plan
320 cfs
80 cfs
320 cfs
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

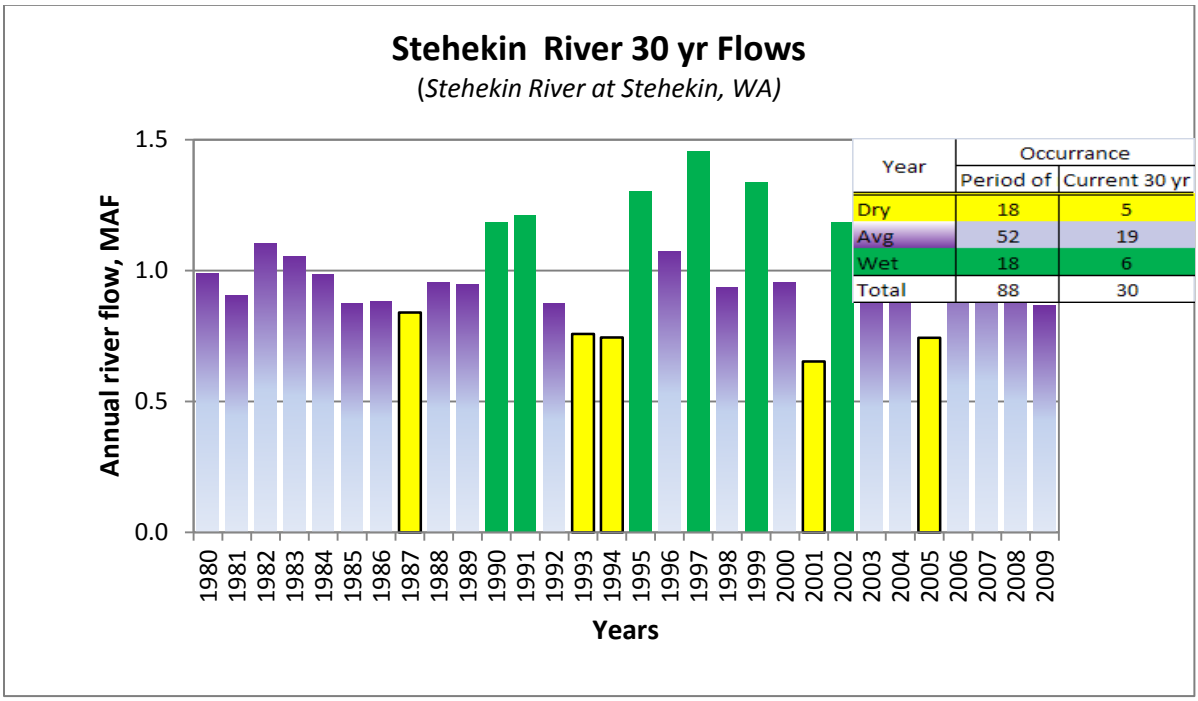

Chelan River Average Year Flow Requirements
(Chelan River at Chelan, WA)
Min. instream flow (CRBEIP)
Spawning flow (CRBEIP)
Avg.year (1949)
CRBEIP-Chelan River Biological Evaluation and Implementaion Plan
320 cfs
200 cfs
80 cfs
Incubation flow, as needed
River flow, cfs
Time Period

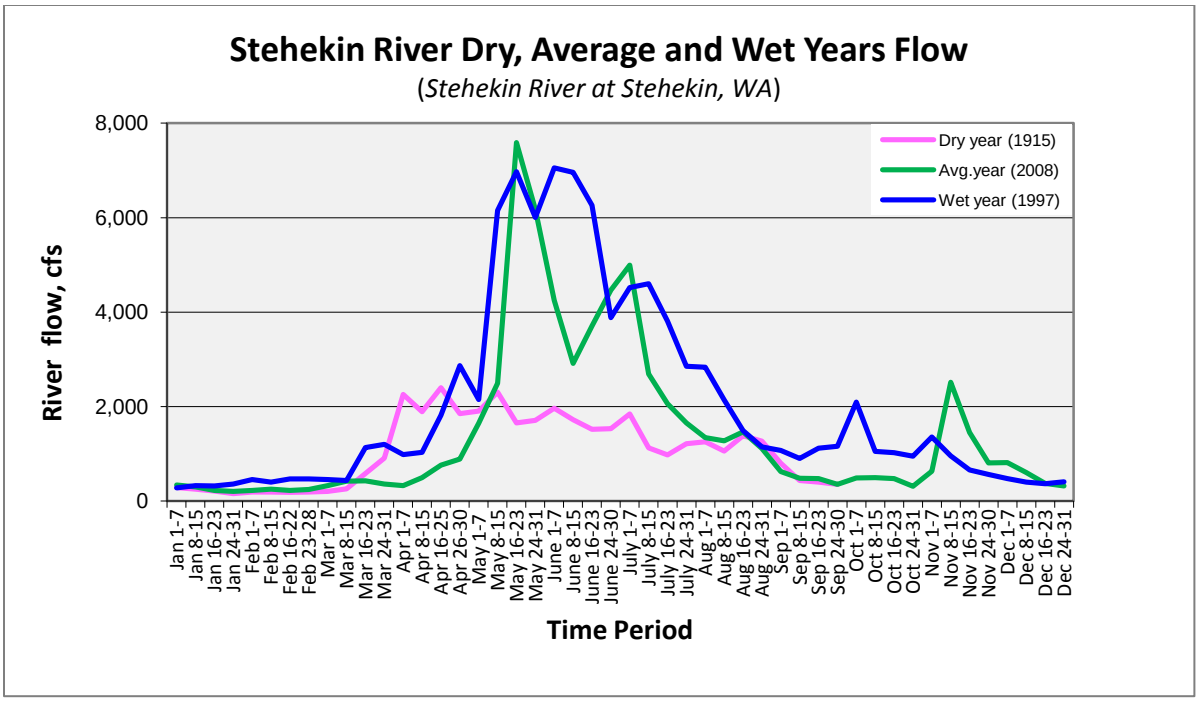

Chelan River Wet Year Flow Requirements
(Chelan River at Chelan, WA)
Min.instream flow (CRBEIP)
Spawning flow (CRBEIP)
Wet year(1956)
CRBEIP-Chelan River Biological Evaluation and Implementaion Plan
320 cfs
200 cfs
80 cfs
River flow, cfs
Time Period

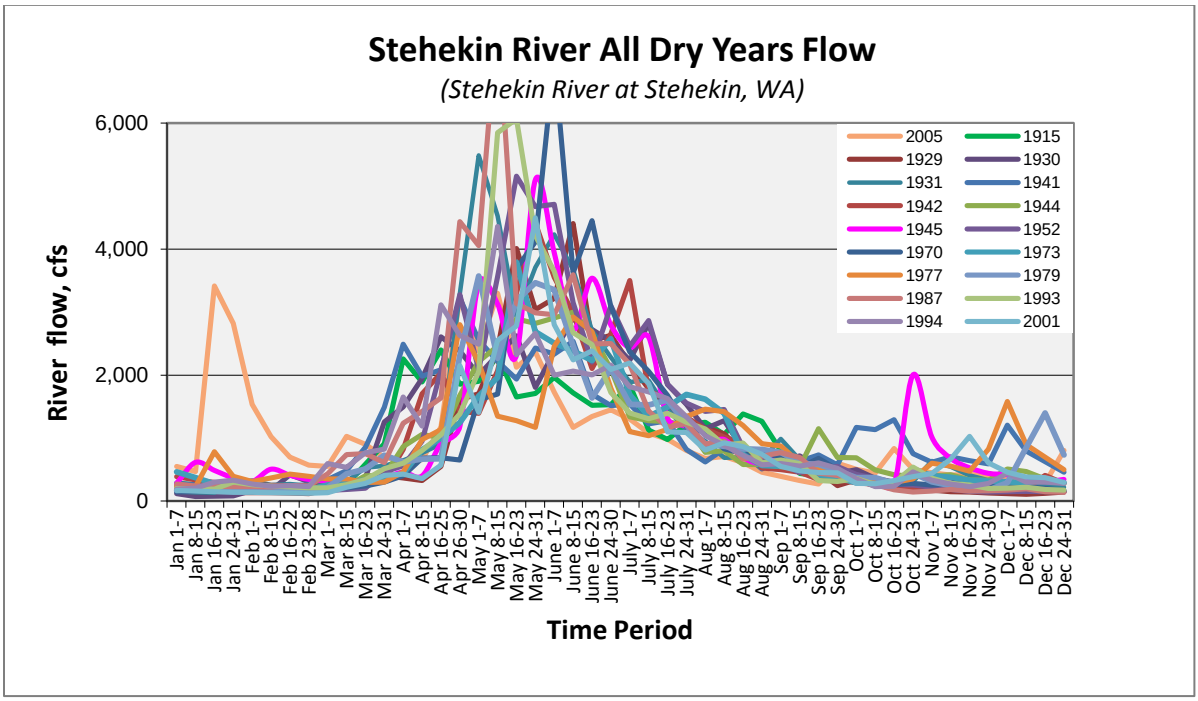

Stehekin River Historic Flows
(USGS 12451000–Stehekin River at Stehekin, WA)
Annual river flow, MAF
1.5
1.0
0.5
0.0
1911 1914 1917 1920 1923 1926 1929 1932 1935 1938 1941 1944 1947 1950 1953 1956 1959 1962 1965 1968 1971 1974 1977 1980 1983 1986 1989 1992 1995 1998 2001 2004 2007
Years

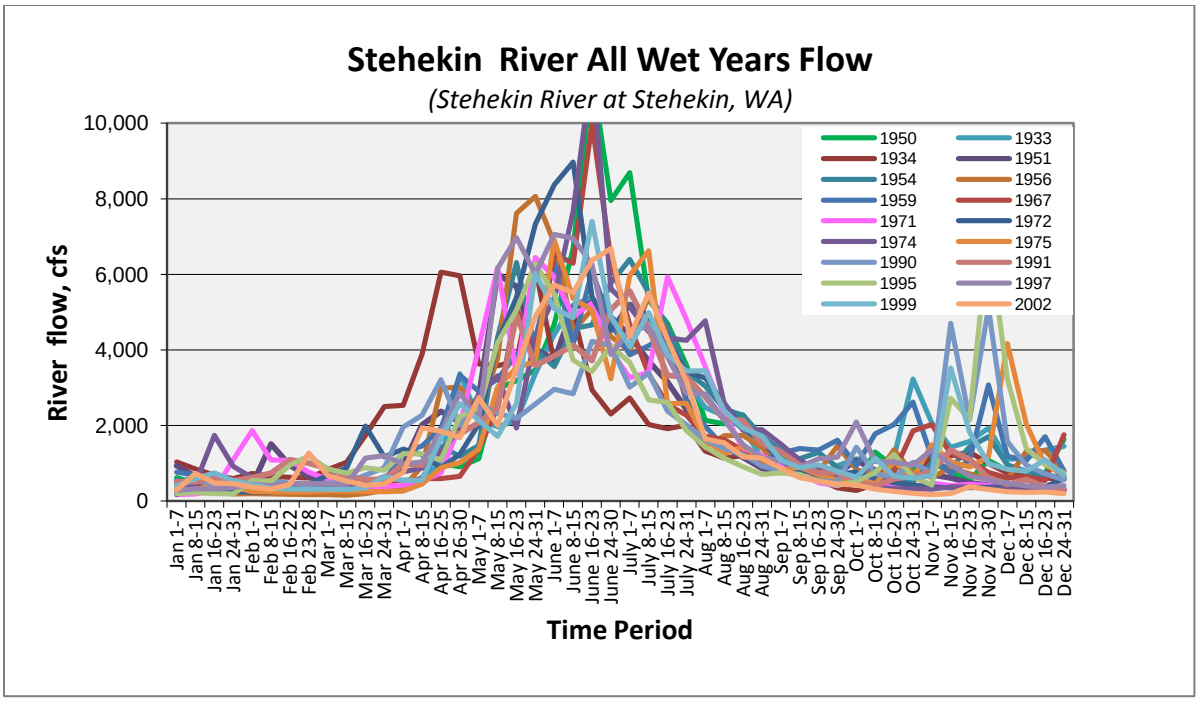

Stehekin River Flow Exceedance Curve
(Stehekin River at Stehekin, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, MAF
1.5
1.0
0.5
0.0
1915 2001 1944 1979 2005 1930 1970 1931 1987 1936 1992 1912 1937 1939 1966 1998 1988 2003 1984 1957 1947 1914 2008 1938 1946 1913 1948 1978 1927 1964 1969 1932 1968 1911 1961 1990 1975 1951 1967 1995 1954 1956 1950 1972
Years


Dry Years Trend for Stehekin River Flow
(Stehekin River at Stehekin, WA)
Linear Trend
y = 1854.2x + 713443
Annual river flow, MAF
1.0
0.8
0.6
0.4
0.2
0.0
1915
1929
1930
1931
1941
1942
1944
1945
1952
1970
1973
1977
1979
1987
1993
1994
2001
2005
Years


Stehekin River 30 yr Flows
(Stehekin River at Stehekin, WA)
Annual river flow, MAF
1.5
1.0
0.5
0.0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 18 5
Avg 52 19
Wet 18 6
Total 88 30


Stehekin River Dry, Average and Wet Years Flow
(Stehekin River at Stehekin, WA)
River flow, cfs
8,000
6,000
4,000
2,000
0
Dry year (1915)
Avg.year (2008)
Wet year (1997)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Stehekin River All Dry Years Flow
(Stehekin River at Stehekin, WA)
River flow, cfs
6,000
4,000
2,000
0
2005
1915
1929
1930
1931
1941
1942
1944
1945
1952
1970
1973
1977
1979
1987
1993
1994
2001
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

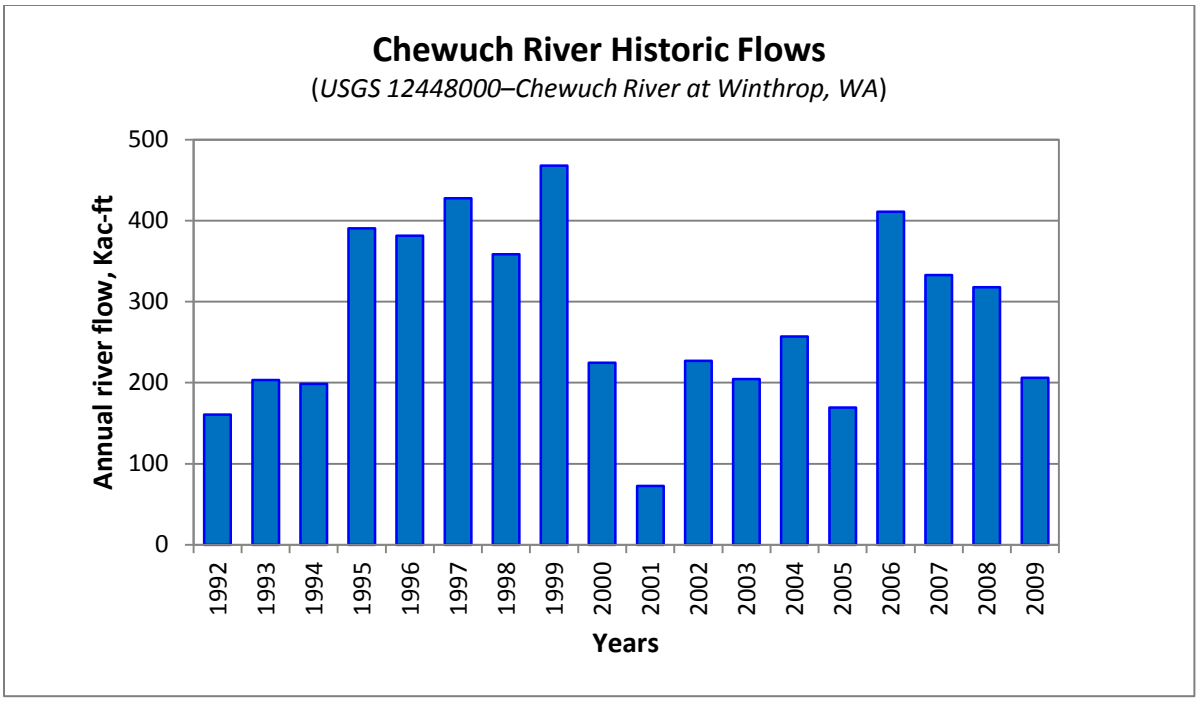

Stehekin River All Wet Years Flow
(Stehekin River at Stehekin, WA)
River flow, cfs
10,000
8,000
6,000
4,000
2,000
0
1950
1933
1934
1951
1954
1956
1959
1967
1971
1972
1974
1975
1990
1991
1995
1997
1999
2002
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

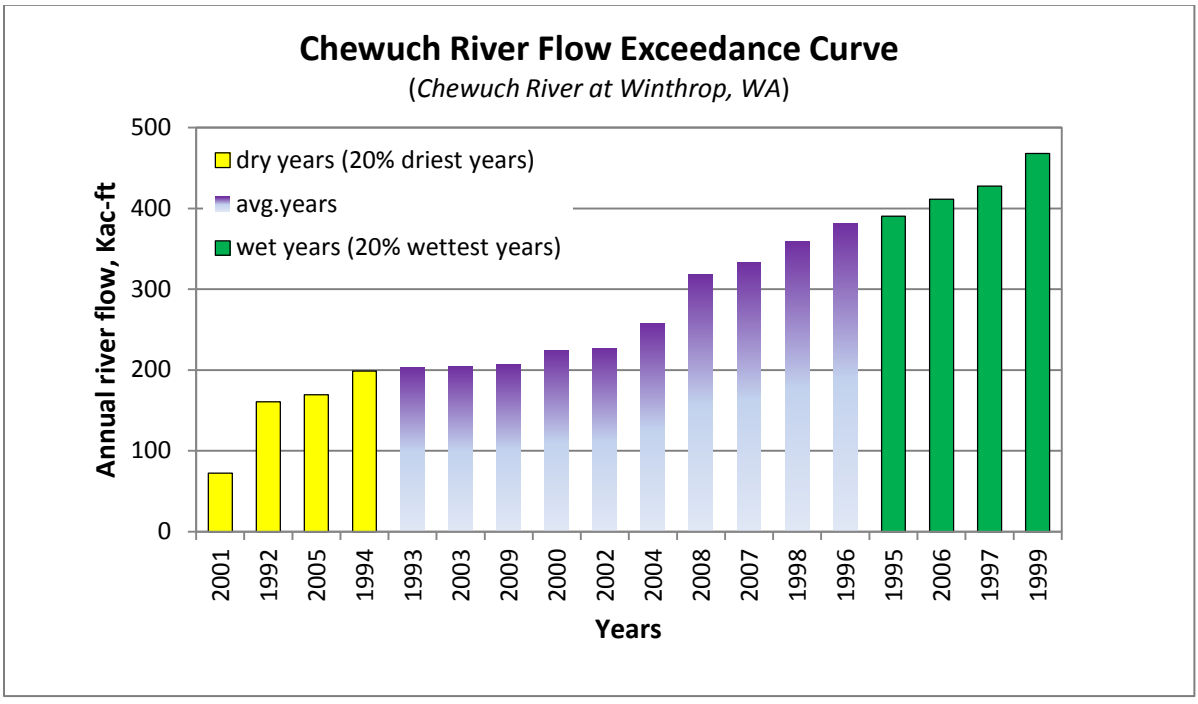
WRIA 48 (Methow)

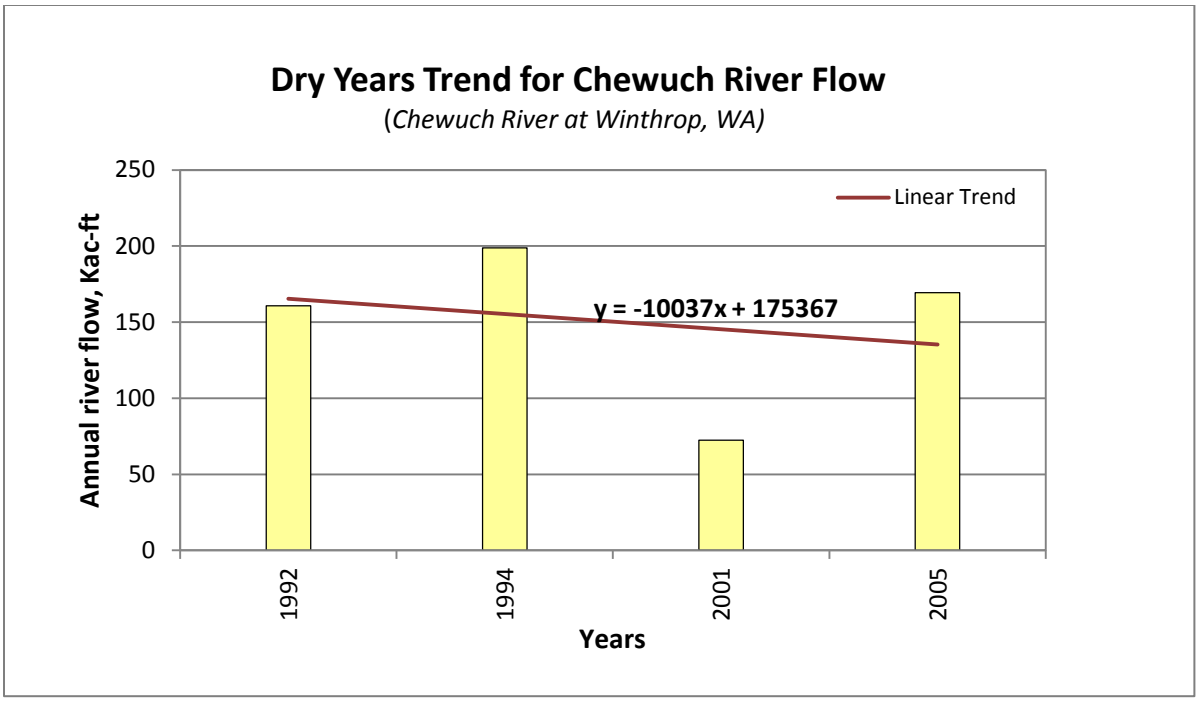
For WRIA 48, OCR graphed the flows of 5 rivers and streams. For most rivers and streams, a series of six to eight graphs were created. The results provide information on historic flow levels, drought occurrences and when instream flow rules are or are not met. These data contribute to OCR's understanding of historic trends, drought patterns and hydrograph variability. For example, by graphing the 51 year (1959–2009) flows of the Methow River near Pateros, gauge number 12449950, it is shown that:

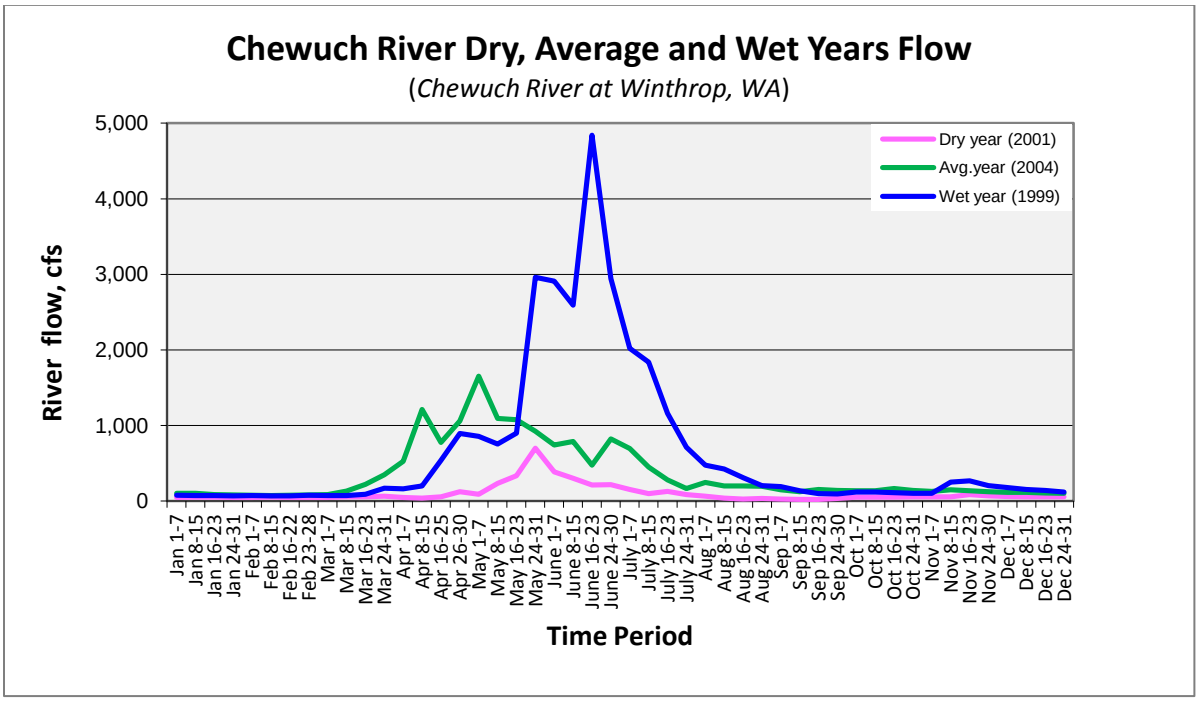
- Historic mean annual flows generally varied between 0.4 and 2.2 million acre-feet (MAF).
- Ecology defined "dry" years as the 80% exceedance value (80% of the time more water was available). Over the last 30 years, dry years occurred 6 times, with the worst stretch being 3 consecutive dry years in 1992-1994. During this same time period, the availability of water during dry years worsened by 12 %.
- Ecology compared different water years (dry, average, wet) to the instream flow rule. The instream flow rule is almost always met in average years. In dry years, the instream flow has never been met.
- The magnitude of unmet instream flows is large. For example, in average years, there is no instream flow deficit for the entire year, which grows to 170,000 acre-feet in dry years.
- Water is available in-basin to address instream shortages through OCR-funded projects (e.g. storage, conservation, pump exchanges). For example, the average water year surplus is 561,000 acre-feet.

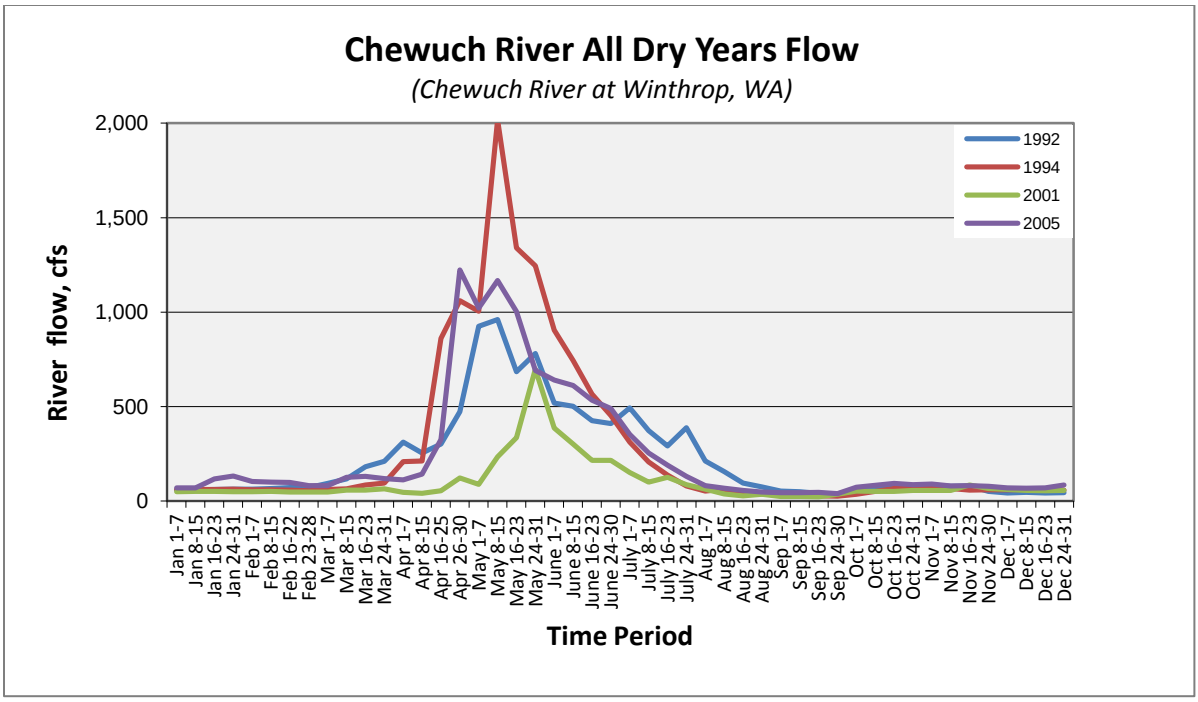
OCR can use this information to recognize where water is needed, when water is available and whether or not the in-basin or out-of-basin water supply development can help meet the WRIA's water demands.

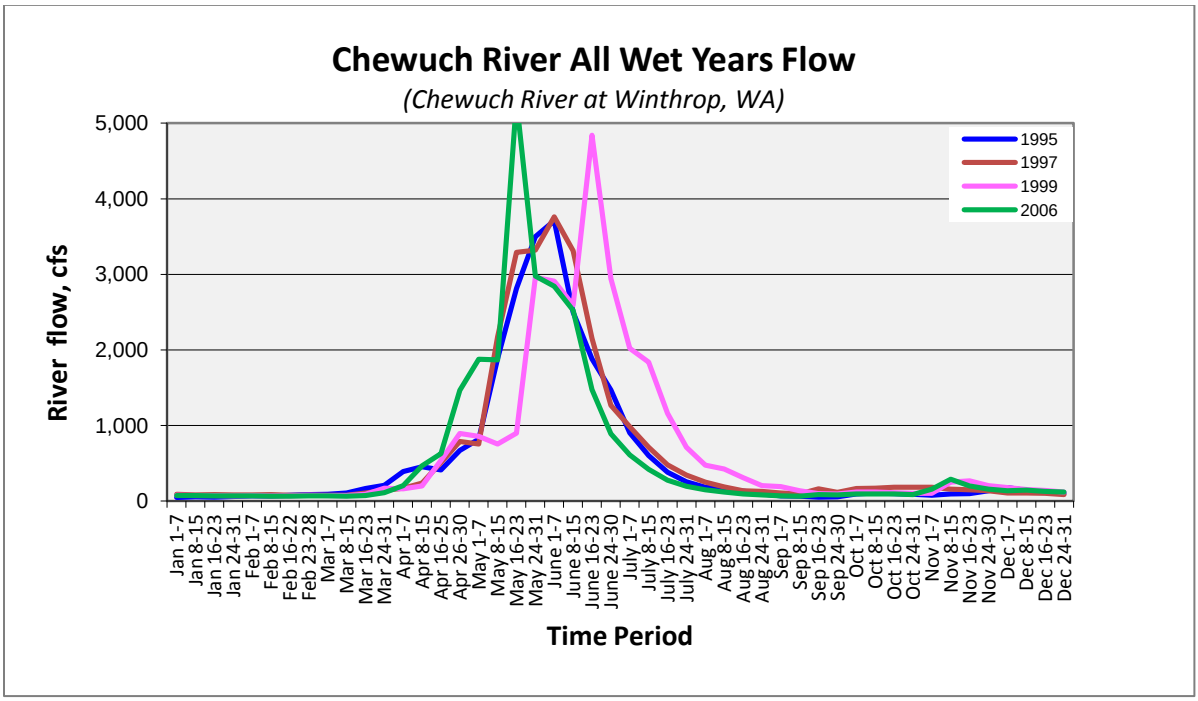

Chewuch River Historic Flows
(USGS 12448000–Chewuch River at Winthrop, WA)
Annual river flow, Kac-ft
500
400
300
200
100
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years

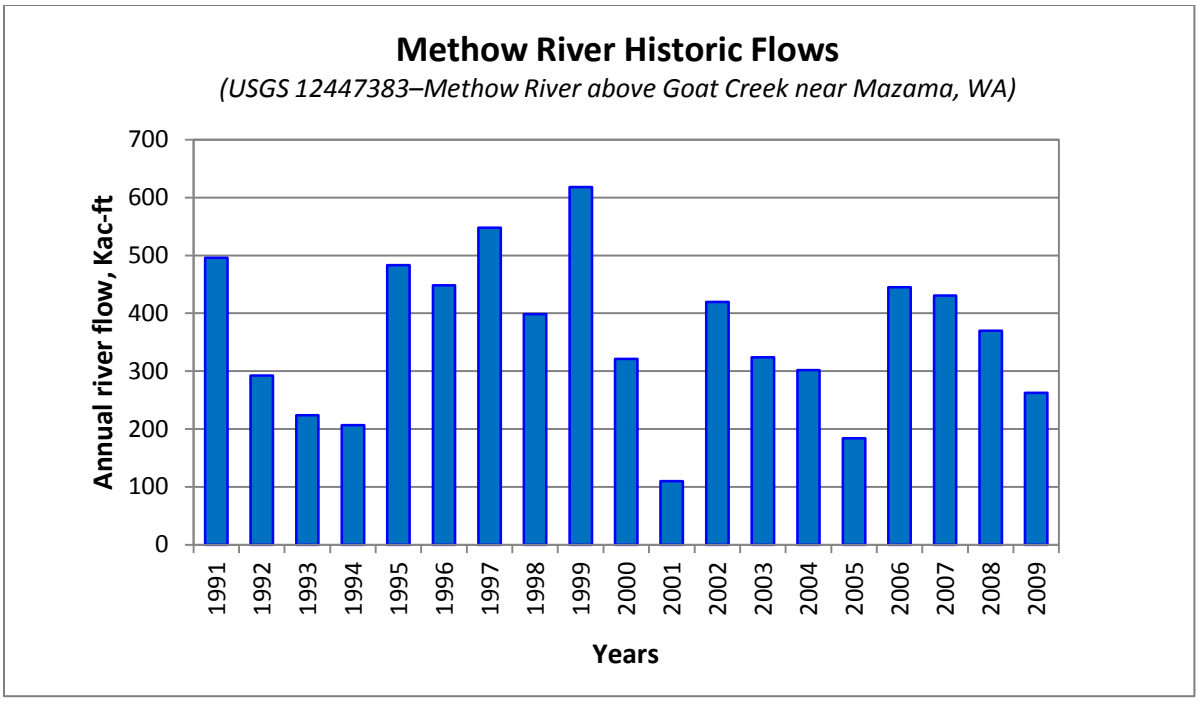

Chewuch River Flow Exceedance Curve
(Chewuch River at Winthrop, WA)
Annual river flow, Kac-ft
500
400
300
200
100
0
dry years (20% driest years)
avg.years
wet years (20% wettest years)
2001
1992
2005
1994
1993
2003
2009
2000
2002
2004
2008
2007
1998
1996
1995
2006
1997
1999
Years

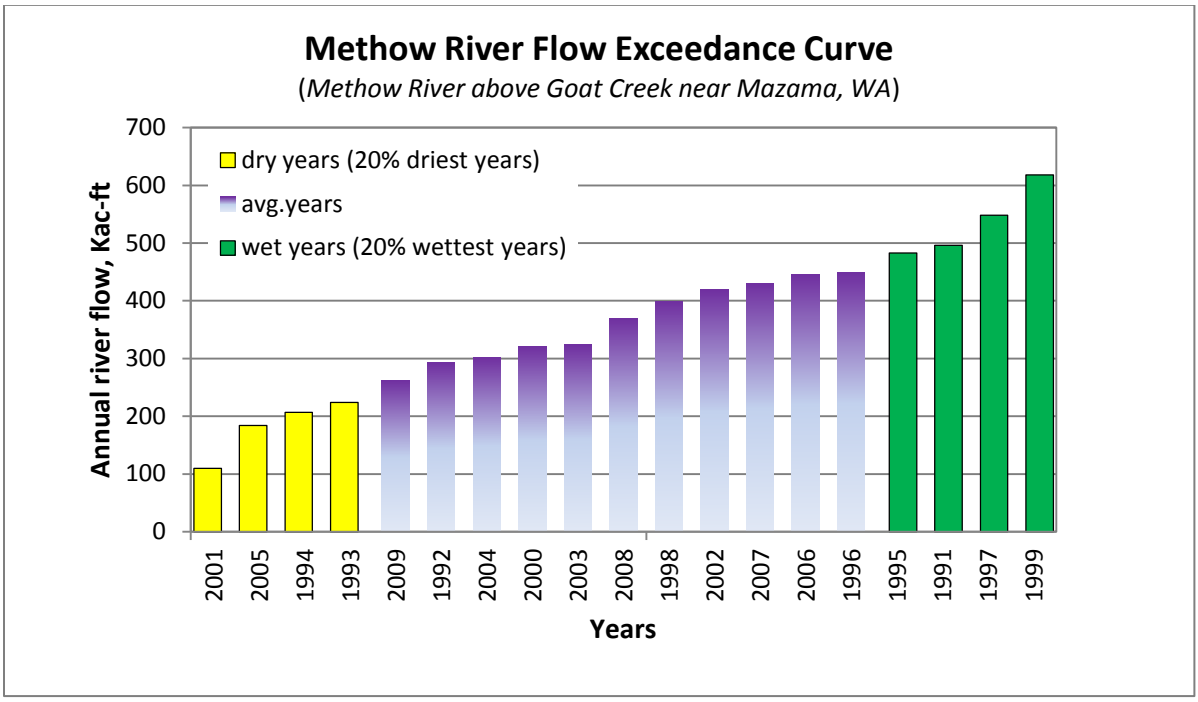

Dry Years Trend for Chewuch River Flow
(Chewuch River at Winthrop, WA)
Annual river flow, Kac-ft
250
200
150
100
50
0
Linear Trend
y = -10037x + 175367
1992
1994
2001
2005
Years

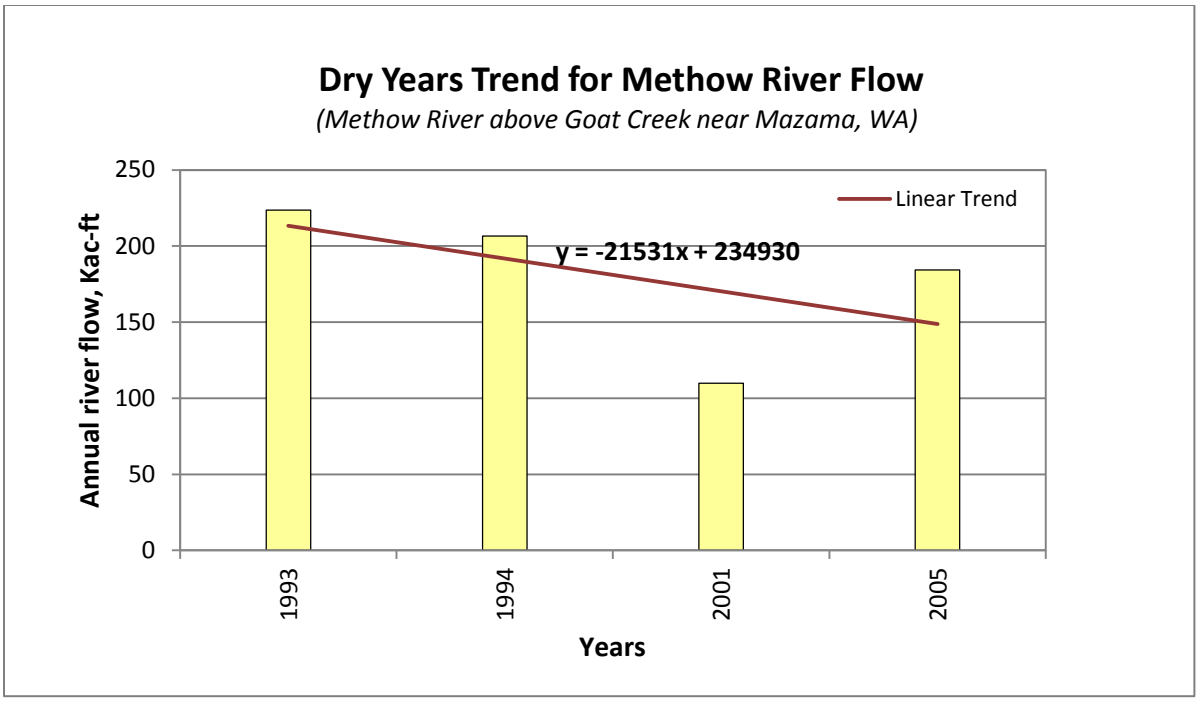

Chewuch River Dry, Average and Wet Years Flow
(Chewuch River at Winthrop, WA)
River flow, cfs
5,000
4,000
3,000
2,000
1,000
0
Dry year (2001)
Avg.year (2004)
Wet year (1999)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

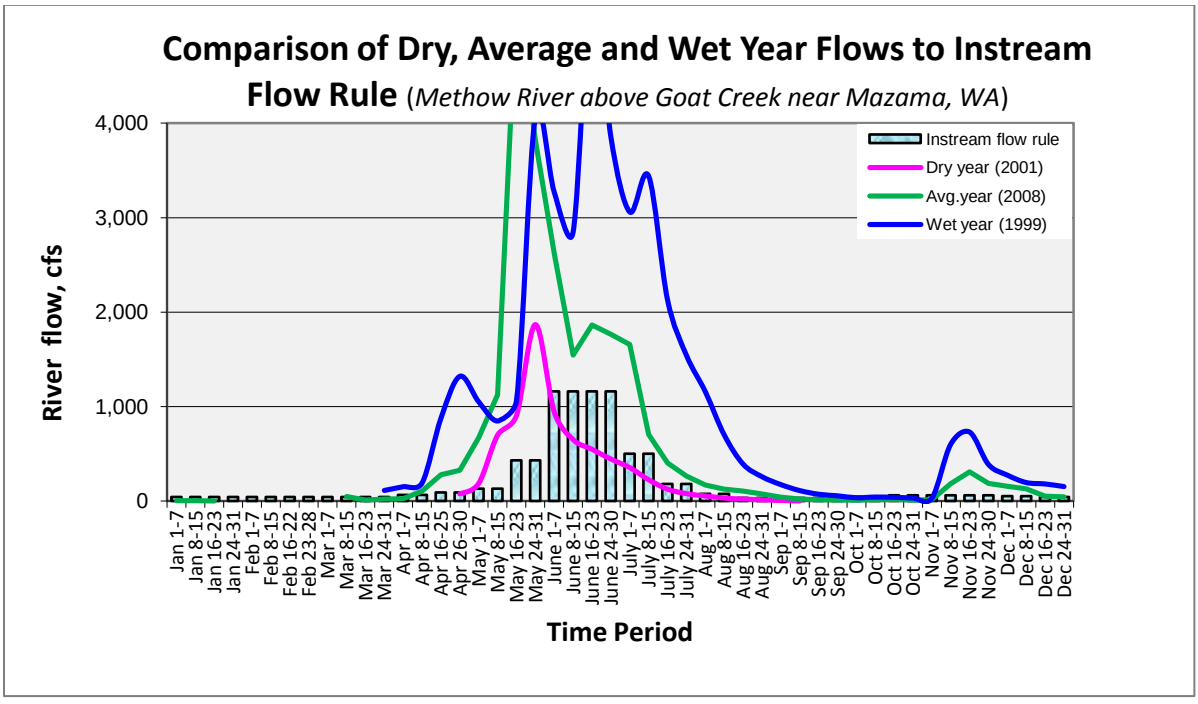

Chewuch River All Dry Years Flow
(Chewuch River at Winthrop, WA)
River flow, cfs
2,000
1,500
1,000
500
0
1992
1994
2001
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

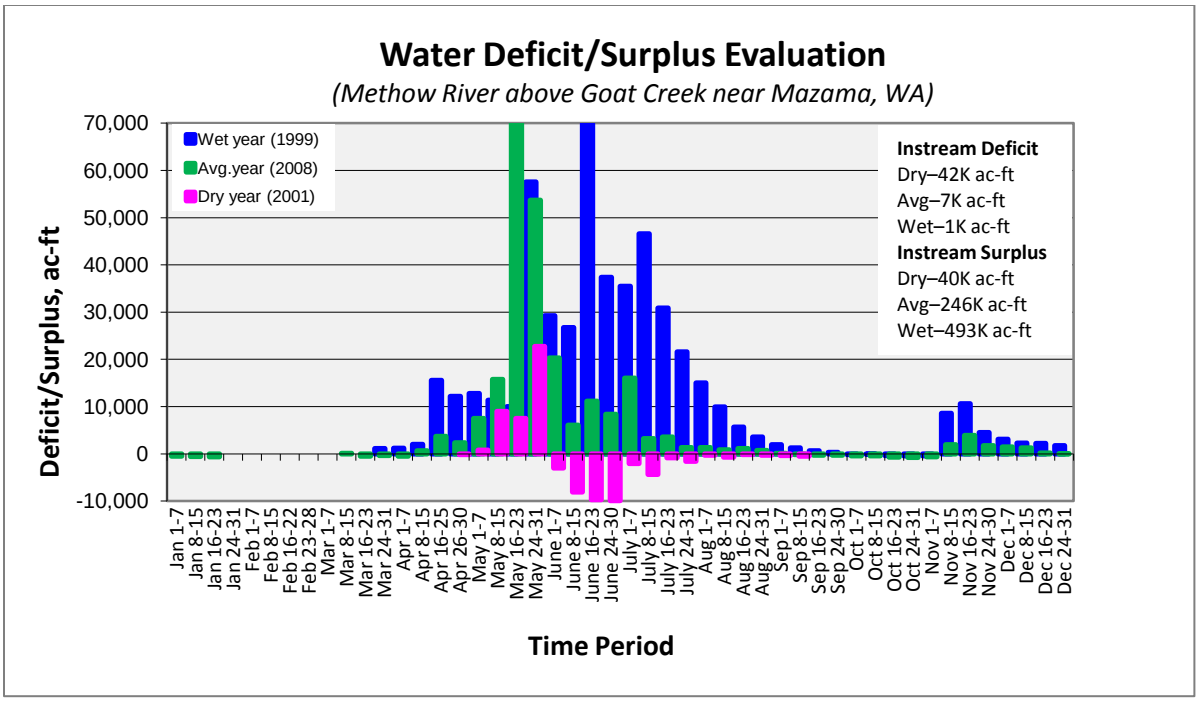

Chewuch River All Wet Years Flow
(Chewuch River at Winthrop, WA)
River flow, cfs
5,000
4,000
3,000
2,000
1,000
0
1995
1997
1999
2006
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

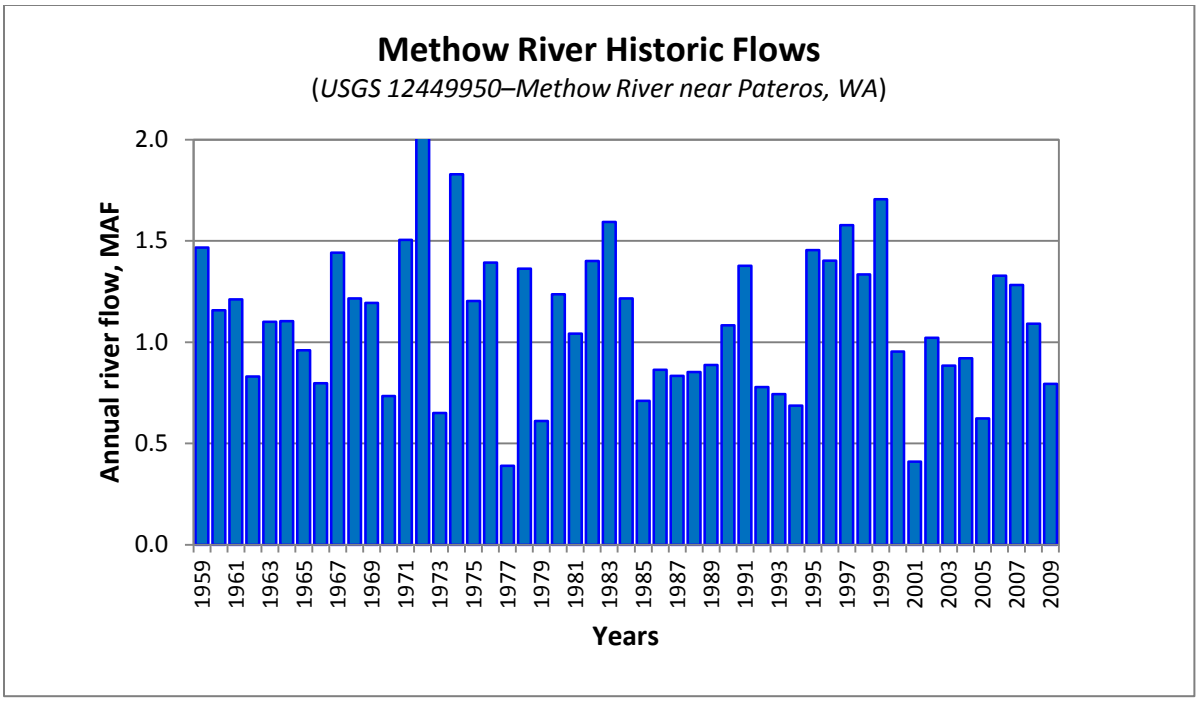

Methow River Historic Flows
(USGS 12447383–Methow River above Goat Creek near Mazama, WA)
Annual river flow, Kac-ft
0
100
200
300
400
500
600
700
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years

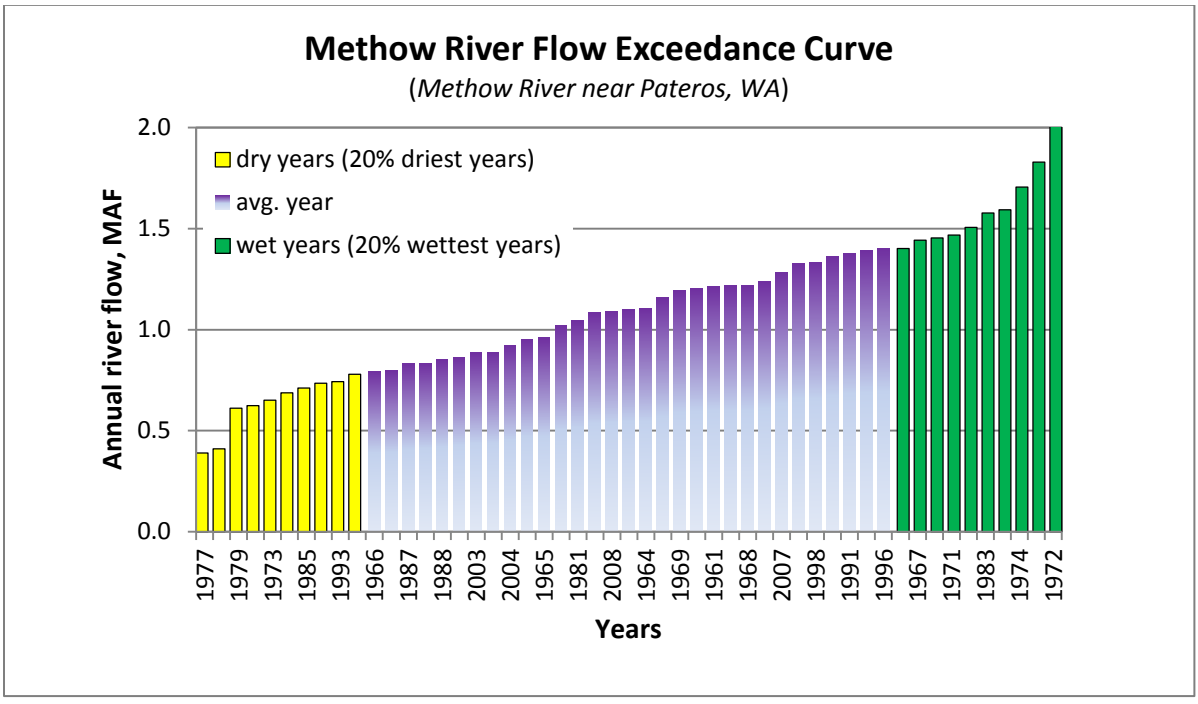

Methow River Flow Exceedance Curve
(Methow River above Goat Creek near Mazama, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, Kac-ft
0
100
200
300
400
500
600
700
2001
2005
1994
1993
2009
1992
2004
2000
2003
2008
1998
2002
2007
2006
1996
1995
1991
1997
1999
Years

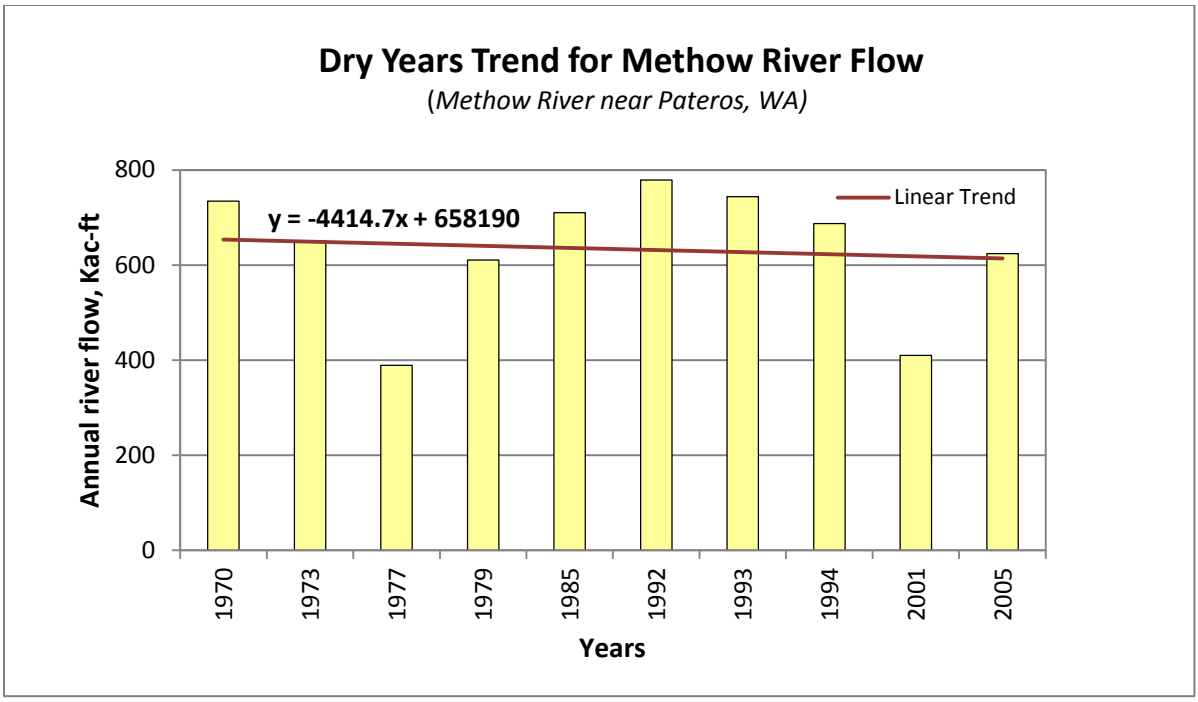

Dry Years Trend for Methow River Flow
(Methow River above Goat Creek near Mazama, WA)
Annual river flow, Kac-ft
250
200
150
100
50
0
Linear Trend
y = -21531x + 234930
1993
1994
2001
2005
Years

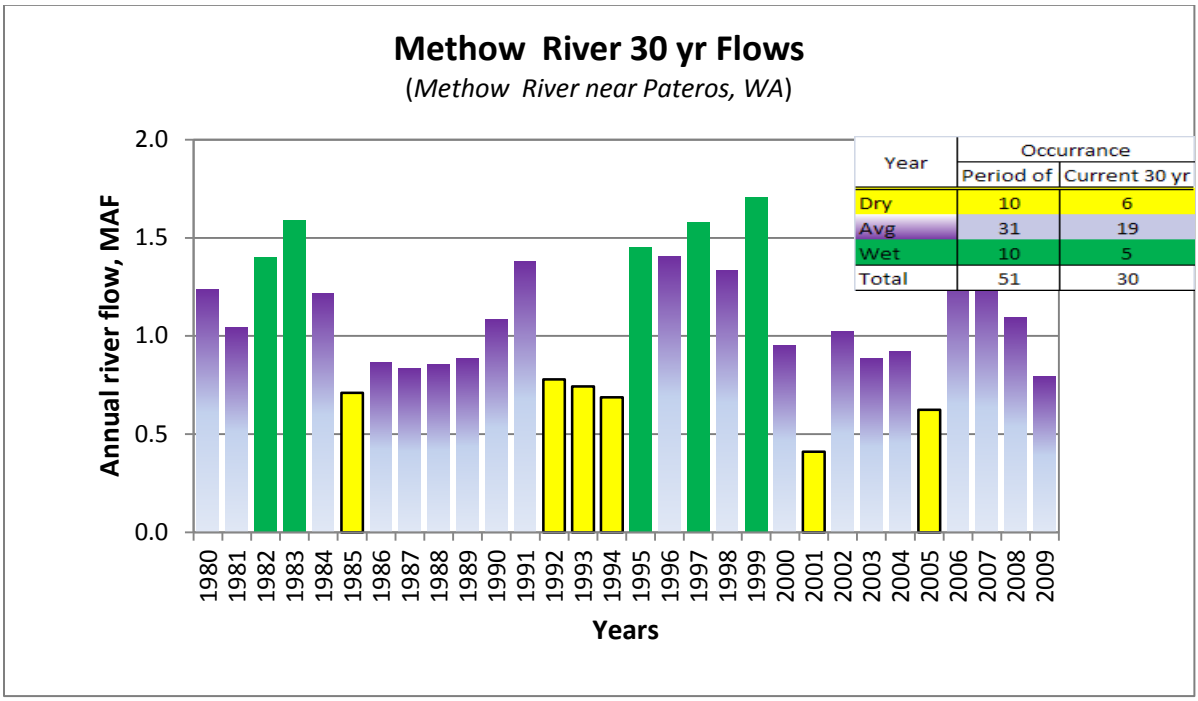

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Methow River above Goat Creek near Mazama, WA)
River flow, cfs
4,000
3,000
2,000
1,000
0
Instream flow rule
Dry year (2001)
Avg.year (2008)
Wet year (1999)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

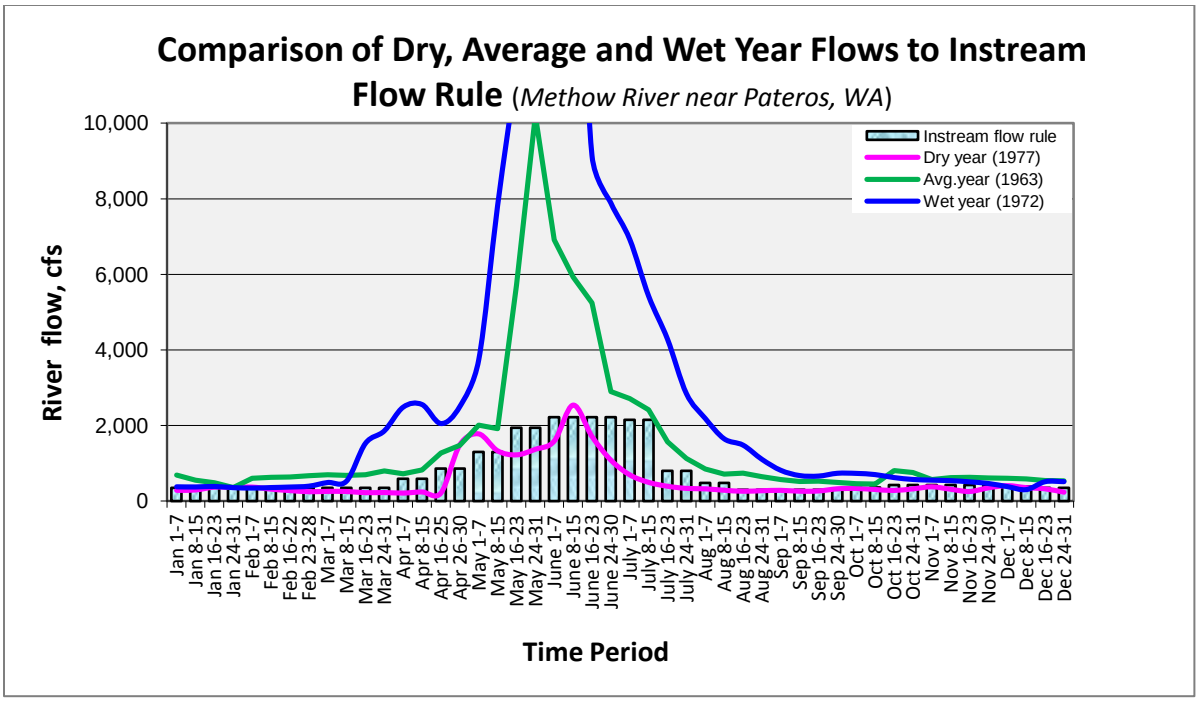

Water Deficit/Surplus Evaluation
(Methow River above Goat Creek near Mazama, WA)
Deficit/Surplus, ac-ft
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
-10,000
Wet year (1999)
Avg.year (2008)
Dry year (2001)
Instream Deficit
Dry–42K ac-ft
Avg–7K ac-ft
Wet–1K ac-ft
Instream Surplus
Dry–40K ac-ft
Avg–246K ac-ft
Wet–493K ac-ft
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

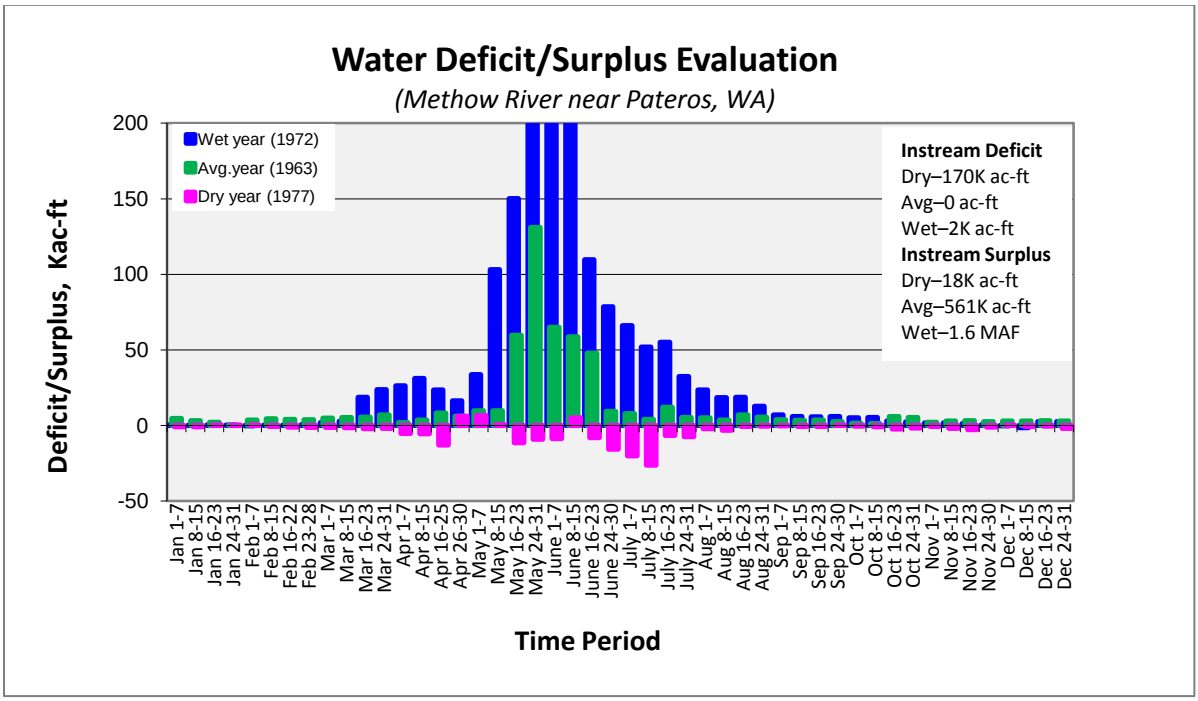

Methow River Historic Flows
(USGS 12449950–Methow River near Pateros, WA)
Annual river flow, MAF
2.0
1.5
1.0
0.5
0.0
1959
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Years

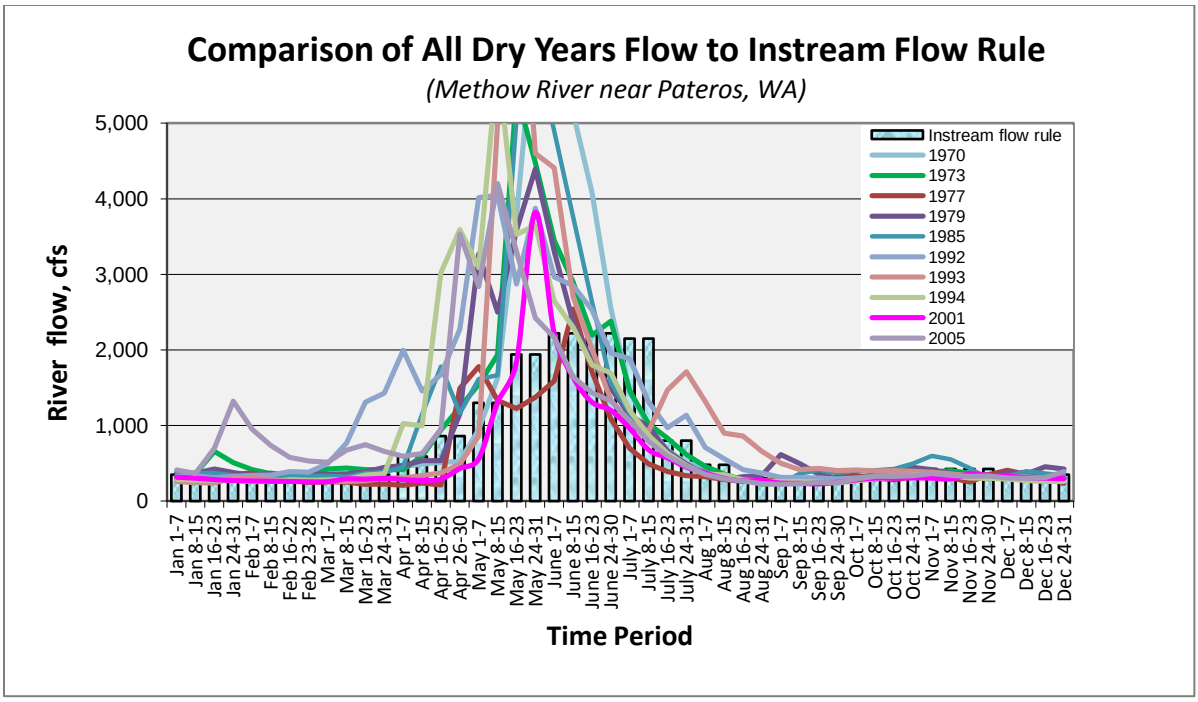

Methow River Flow Exceedance Curve
(Methow River near Pateros, WA)
Annual river flow, MAF
2.0
1.5
1.0
0.5
0.0
dry years (20% driest years)
avg. year
wet years (20% wettest years)
1977
1979
1973
1985
1993
1966
1987
1988
2003
2004
1965
1981
2008
1964
1969
1961
1968
2007
1998
1991
1996
1967
1971
1983
1974
1972
Years

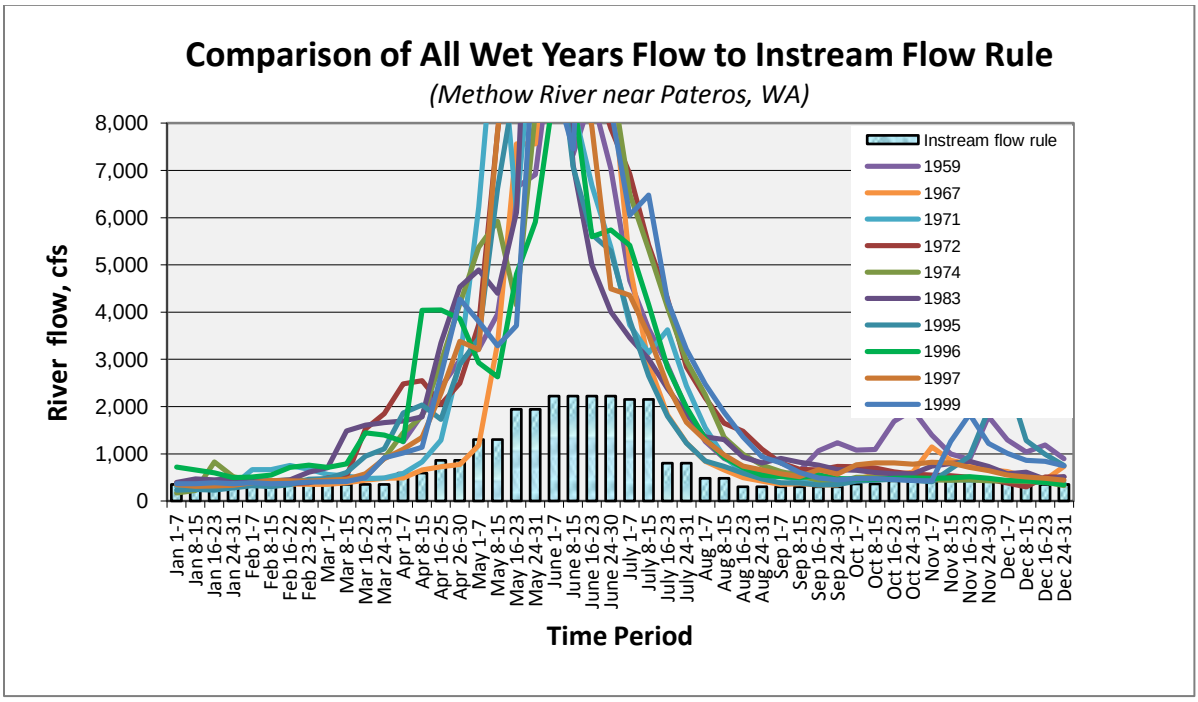

Dry Years Trend for Methow River Flow
(Methow River near Pateros, WA)
y = -4414.7x + 658190
Linear Trend
Annual river flow, Kac-ft
800
600
400
200
0
1970
1973
1977
1979
1985
1992
1993
1994
2001
2005
Years

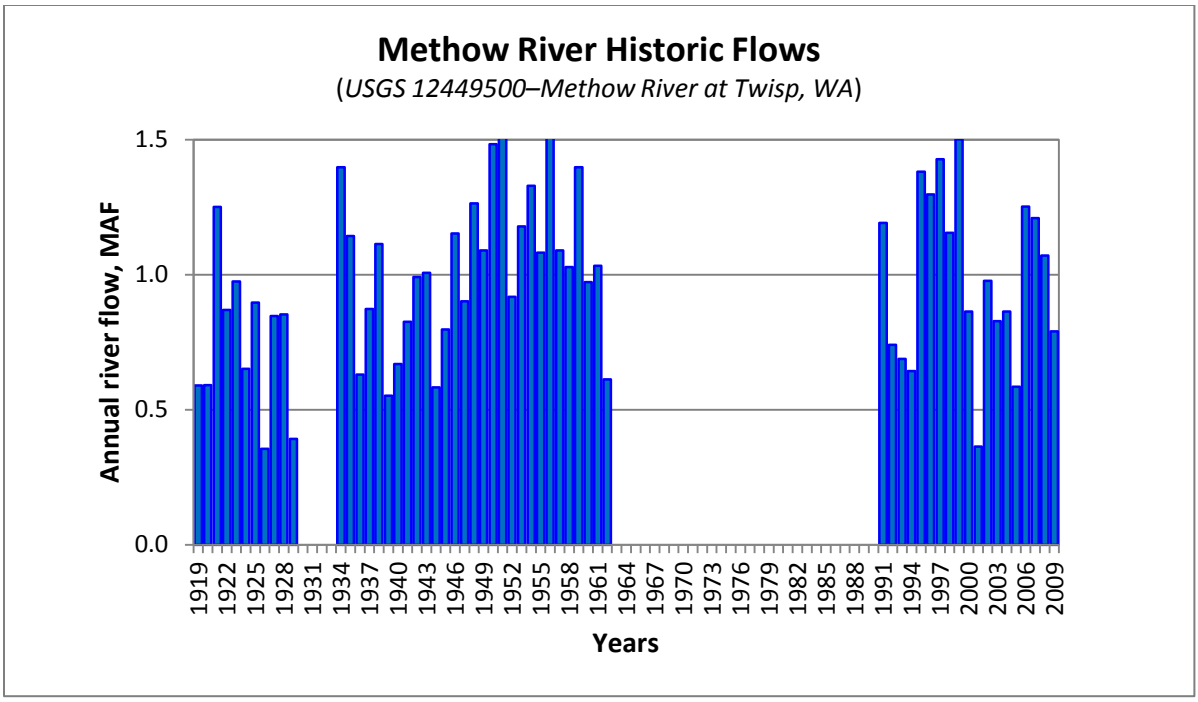

Methow River 30 yr Flows
(Methow River near Pateros, WA)
Annual river flow, MAF
2.0
1.5
1.0
0.5
0.0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 10 6
Avg 31 19
Wet 10 5
Total 51 30

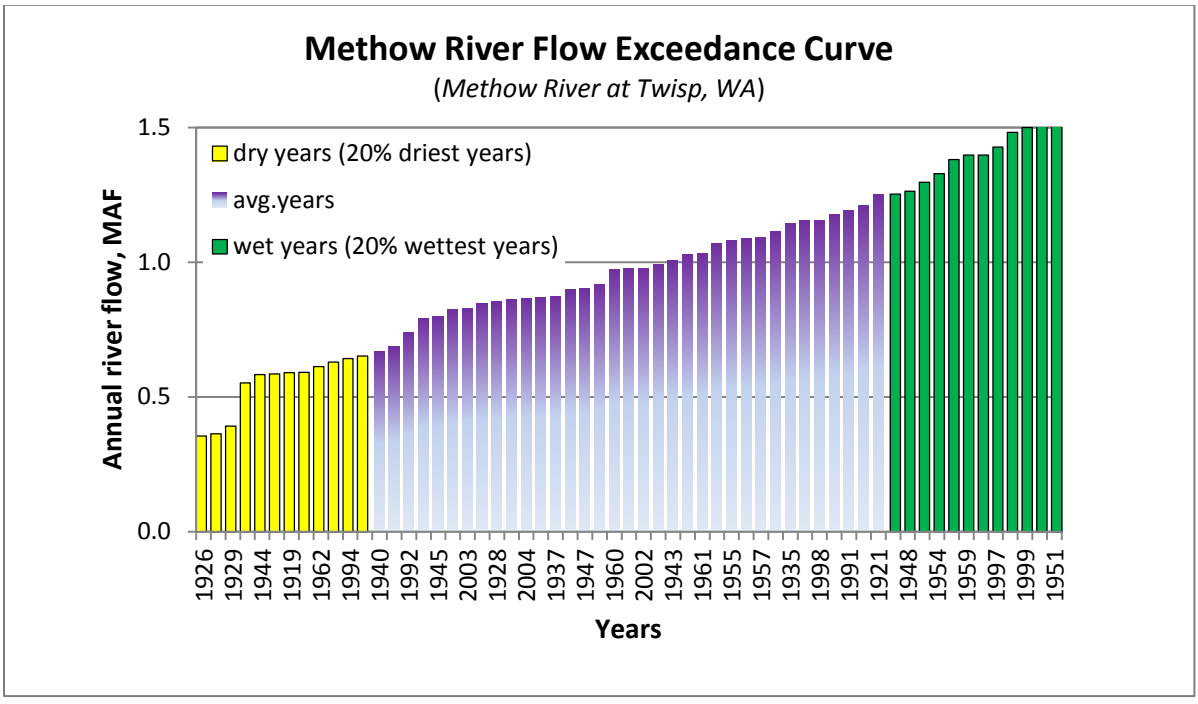

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Methow River near Pateros, WA)
River flow, cfs
10,000
8,000
6,000
4,000
2,000
0
Instream flow rule
Dry year (1977)
Avg.year (1963)
Wet year (1972)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

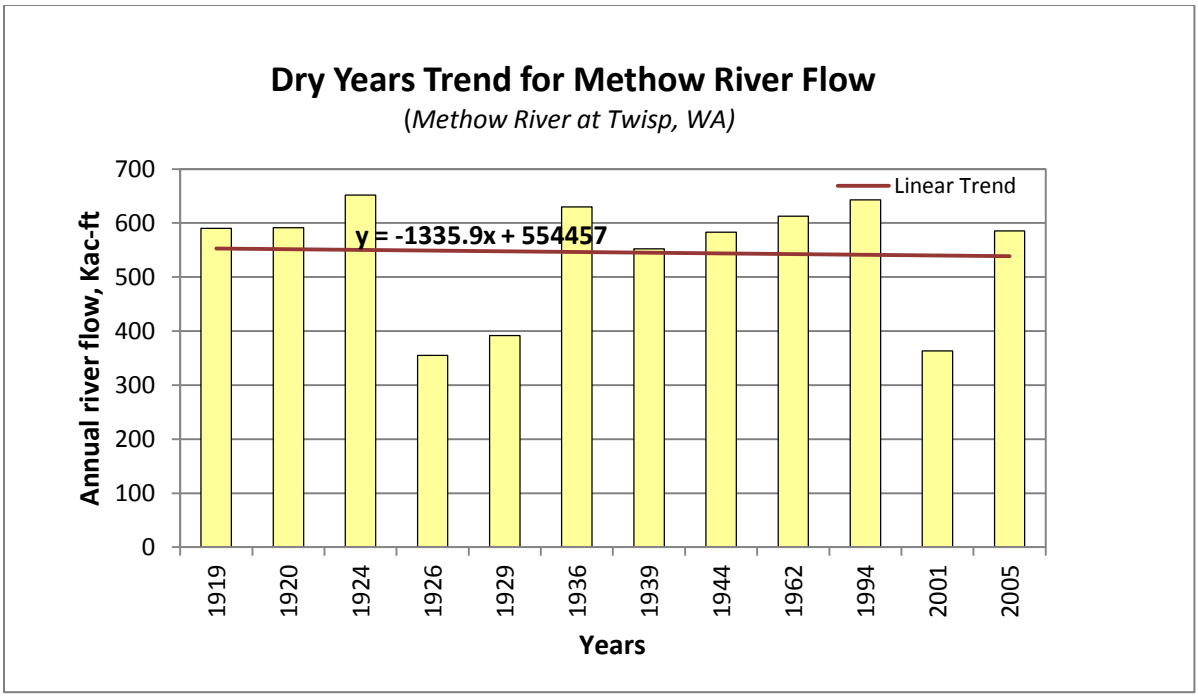

Water Deficit/Surplus Evaluation
(Methow River near Pateros, WA)
Deficit/Surplus, Kac-ft
200
150
100
50
0
-50
Wet year (1972)
Avg.year (1963)
Dry year (1977)
Instream Deficit
Dry–170K ac-ft
Avg–0 ac-ft
Wet–2K ac-ft
Instream Surplus
Dry–18K ac-ft
Avg–561K ac-ft
Wet–1.6 MAF
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

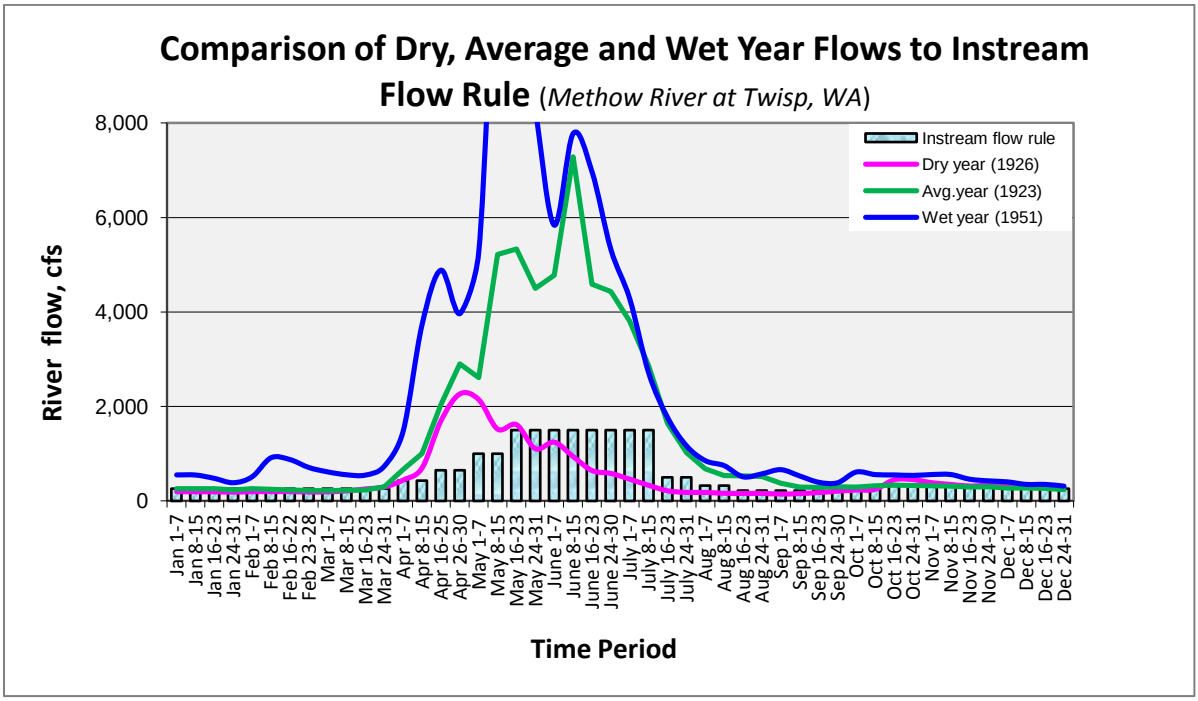

Comparison of All Dry Years Flow to Instream Flow Rule
(Methow River near Pateros, WA)
River flow, cfs
5,000
4,000
3,000
2,000
1,000
0
Instream flow rule
1970
1973
1977
1979
1985
1992
1993
1994
2001
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

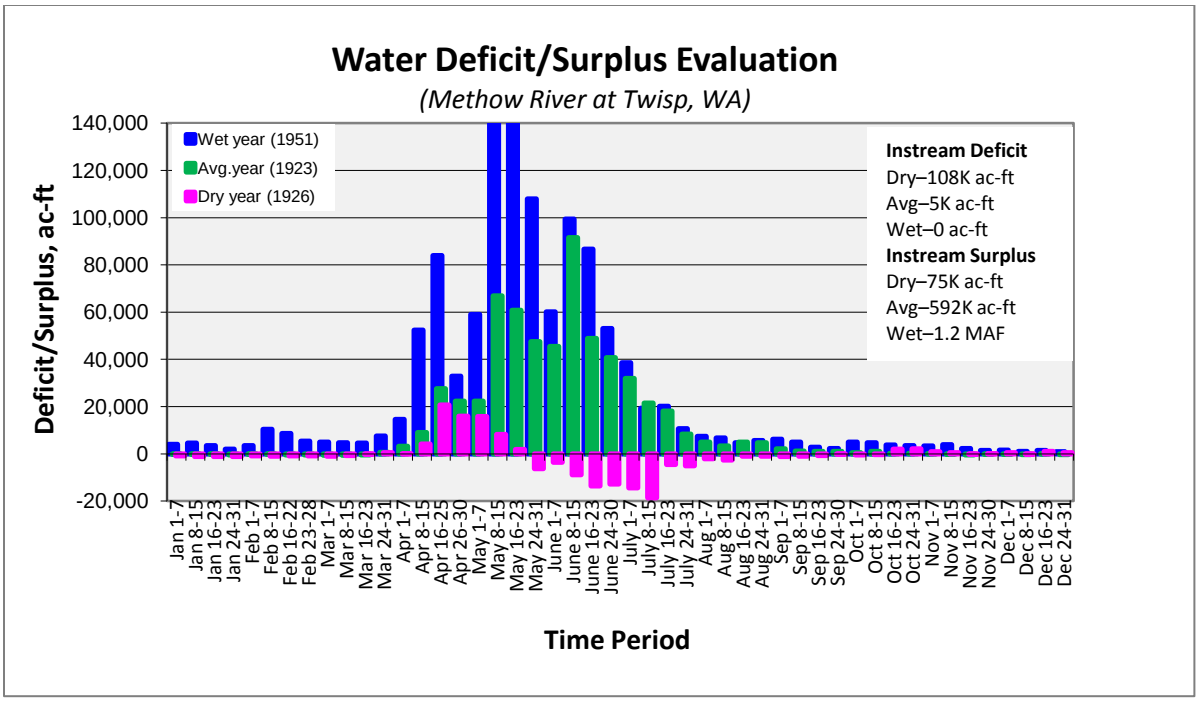

Comparison of All Wet Years Flow to Instream Flow Rule
(Methow River near Pateros, WA)
River flow, cfs
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Instream flow rule
1959
1967
1971
1972
1974
1983
1995
1996
1997
1999
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

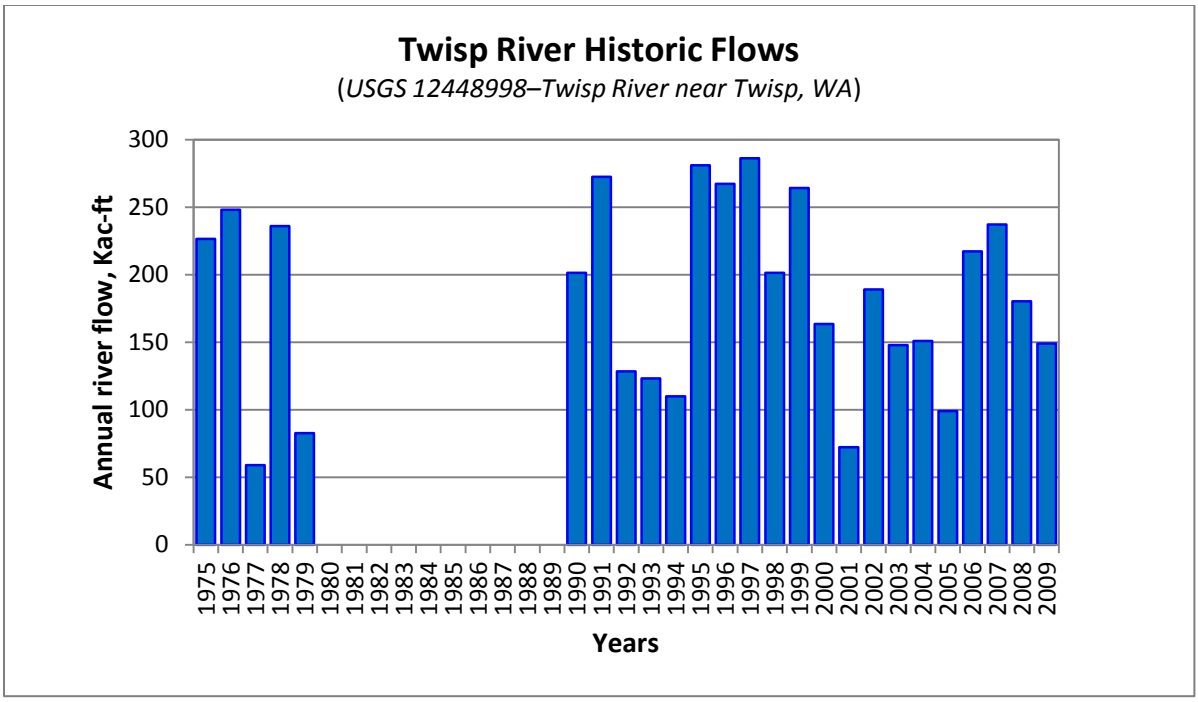

Methow River Historic Flows
(USGS 12449500–Methow River at Twisp, WA)
Annual river flow, MAF
1.5
1.0
0.5
0.0
1919
1922
1925
1928
1931
1934
1937
1940
1943
1946
1949
1952
1955
1958
1961
1964
1967
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
Years

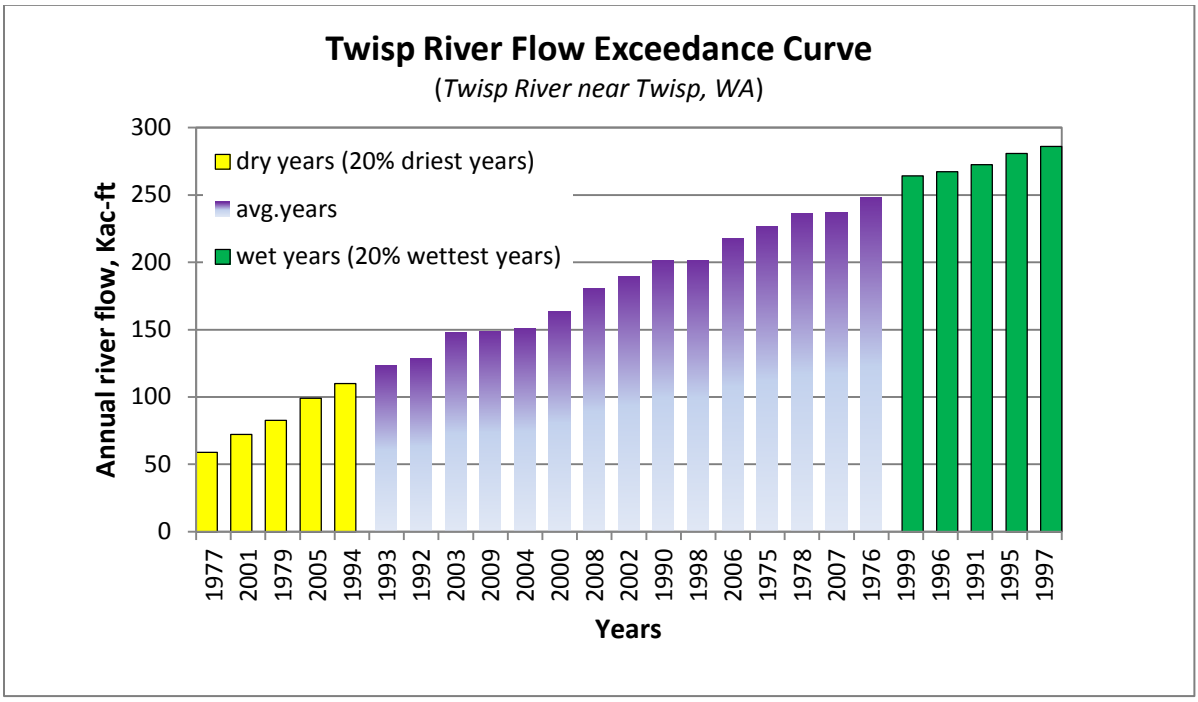

Methow River Flow Exceedance Curve
(Methow River at Twisp, WA)
Annual river flow, MAF
1.5
1.0
0.5
0.0
dry years (20% driest years)
avg.years
wet years (20% wettest years)
1926
1929
1944
1919
1962
1994
1940
1992
1945
2003
1928
2004
1937
1947
1960
2002
1943
1961
1955
1957
1935
1998
1991
1921
1948
1954
1959
1997
1999
1951
Years

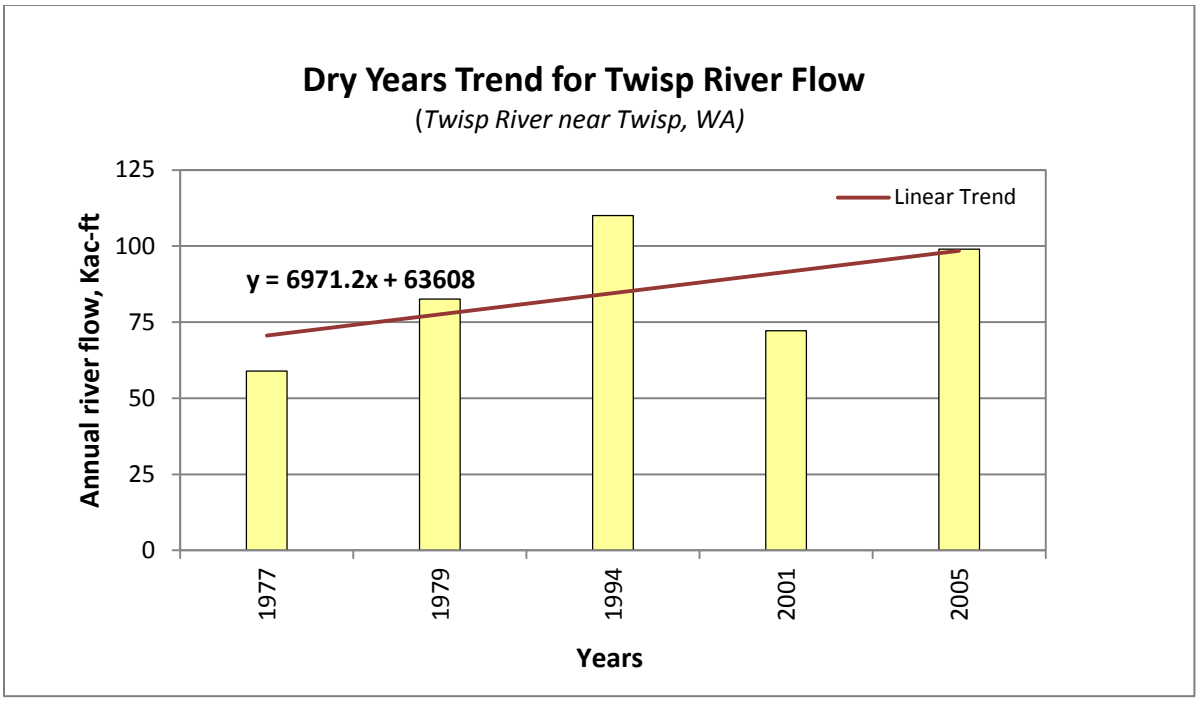

Dry Years Trend for Methow River Flow
(Methow River at Twisp, WA)
Annual river flow, Kac-ft
700
600
500
400
300
200
100
0
Linear Trend
y = -1335.9x + 554457
1919
1920
1924
1926
1929
1936
1939
1944
1962
1994
2001
2005
Years

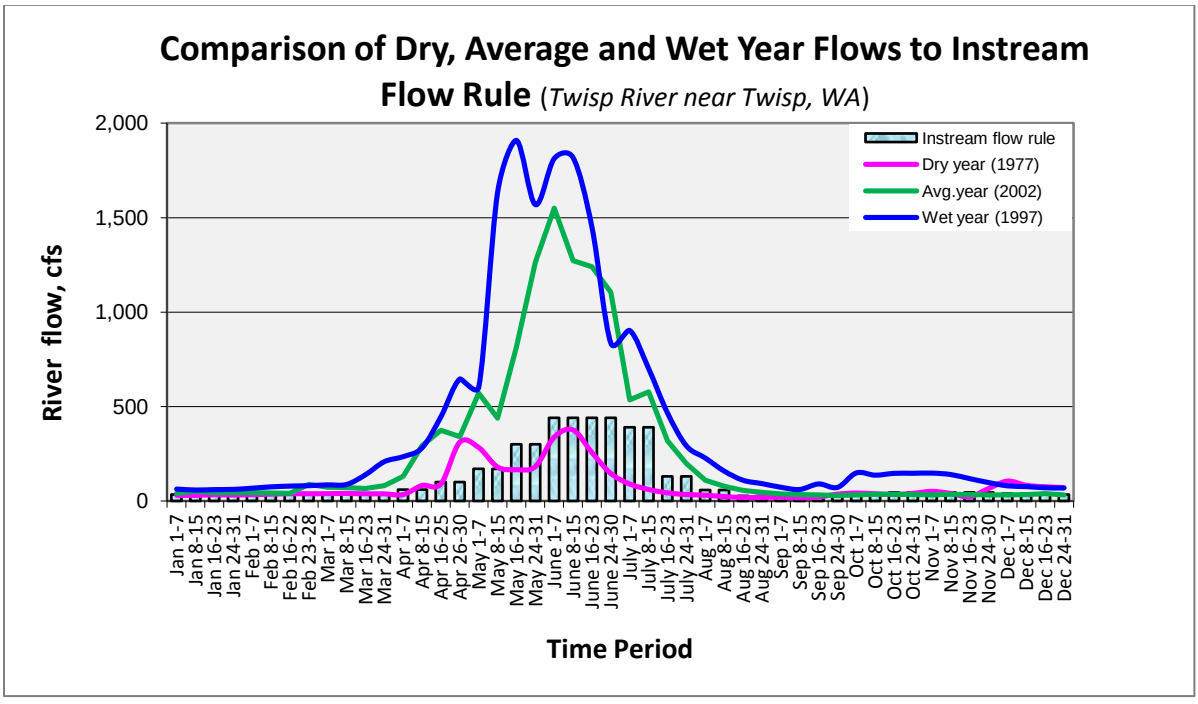

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Methow River at Twisp, WA)
River flow, cfs
8,000
6,000
4,000
2,000
0
Instream flow rule
Dry year (1926)
Avg.year (1923)
Wet year (1951)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

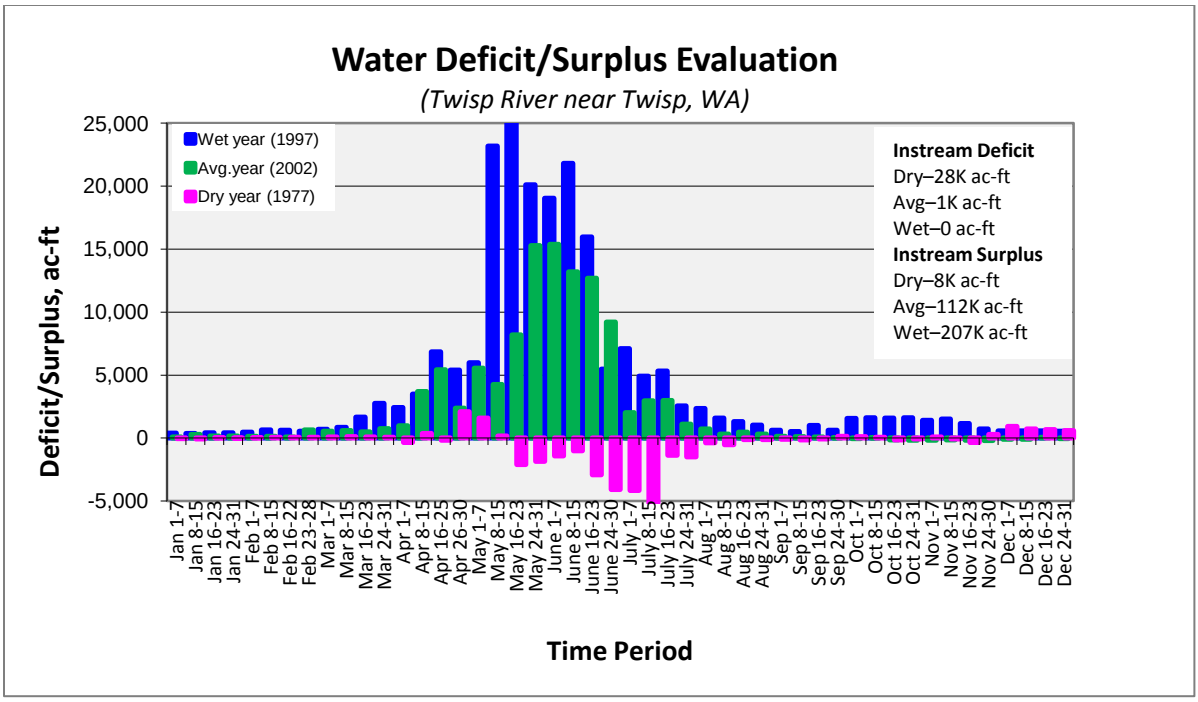

Water Deficit/Surplus Evaluation
(Methow River at Twisp, WA)
Deficit/Surplus, ac-ft
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
-20,000
Wet year (1951)
Avg.year (1923)
Dry year (1926)
Instream Deficit
Dry–108K ac-ft
Avg–5K ac-ft
Wet–0 ac-ft
Instream Surplus
Dry–75K ac-ft
Avg–592K ac-ft
Wet–1.2 MAF
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

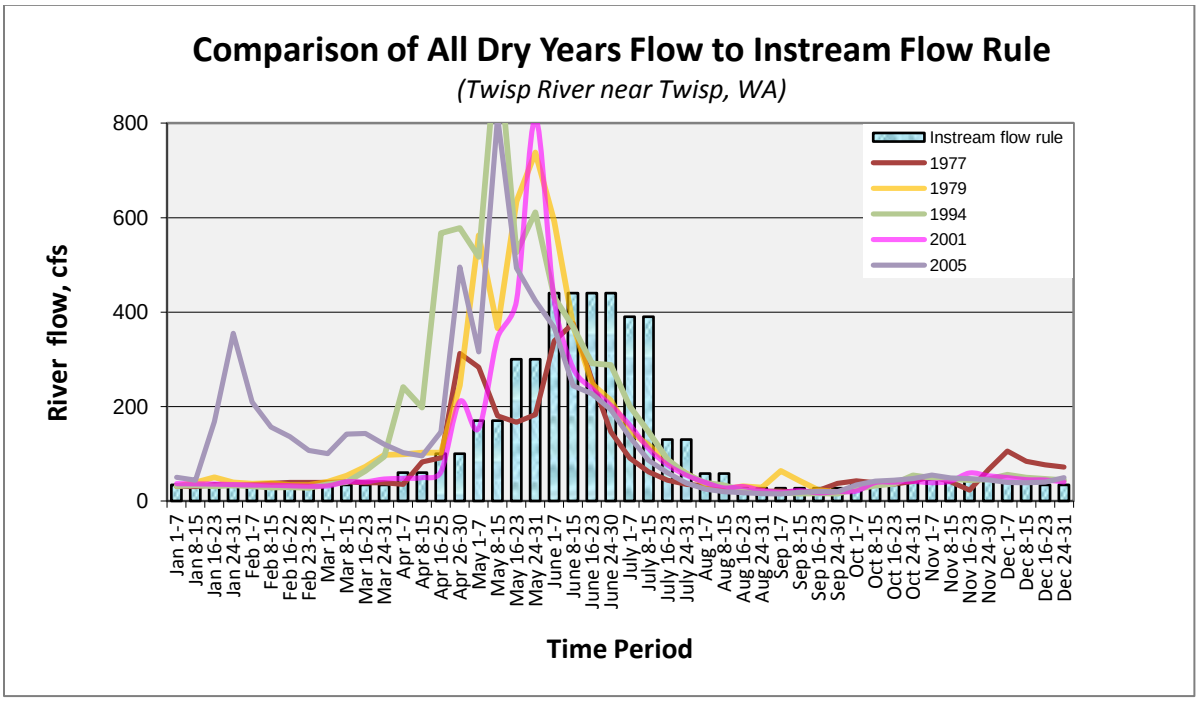

Twisp River Historic Flows
(USGS 12448998–Twisp River near Twisp, WA)
Annual river flow, Kac-ft
300
250
200
150
100
50
0
1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Years

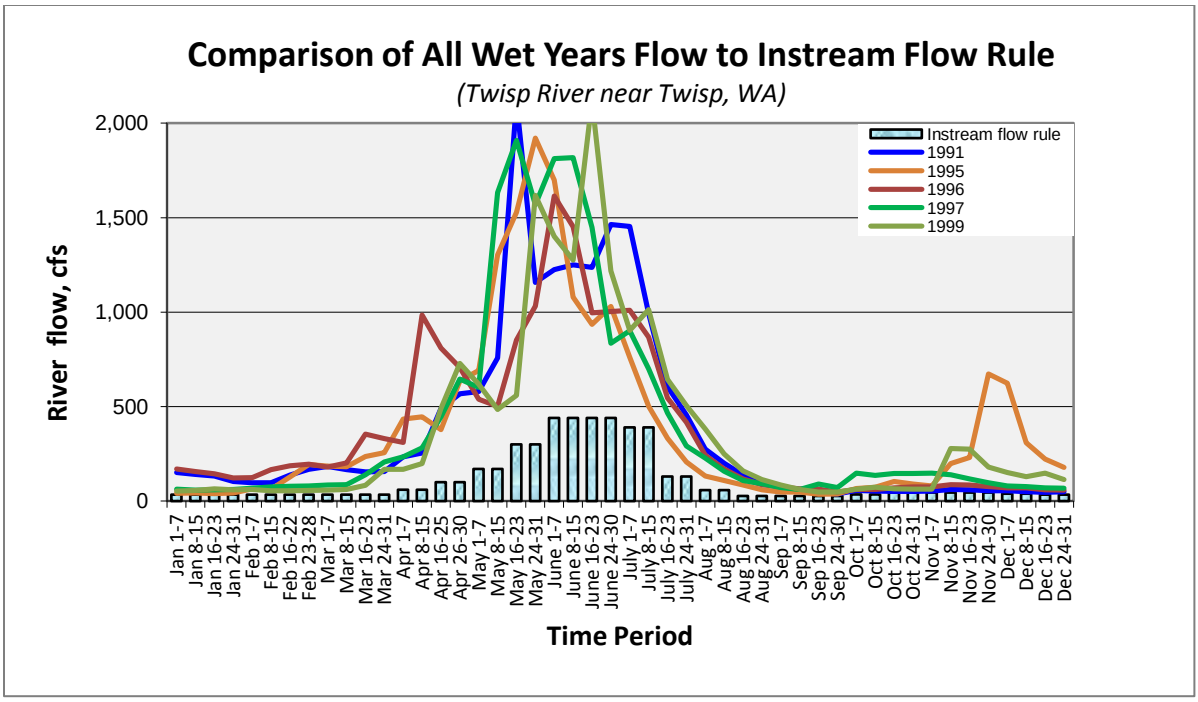

Twisp River Flow Exceedance Curve
(Twisp River near Twisp, WA)
Annual river flow, Kac-ft
300
250
200
150
100
50
0
dry years (20% driest years)
avg.years
wet years (20% wettest years)
1977 2001 1979 2005 1994 1993 1992 2003 2009 2004 2000 2008 2002 1990 1998 2006 1975 1978 2007 1976 1999 1996 1991 1995 1997
Years


Dry Years Trend for Twisp River Flow
(Twisp River near Twisp, WA)
Annual river flow, Kac-ft
125
100
75
50
25
0
Linear Trend
y = 6971.2x + 63608
1977
1979
1994
2001
2005
Years


Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Twisp River near Twisp, WA)
River flow, cfs
2,000
1,500
1,000
500
0
Instream flow rule
Dry year (1977)
Avg.year (2002)
Wet year (1997)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Water Deficit/Surplus Evaluation
(Twisp River near Twisp, WA)
Deficit/Surplus, ac-ft
25,000
20,000
15,000
10,000
5,000
0
-5,000
Wet year (1997)
Avg.year (2002)
Dry year (1977)
Instream Deficit
Dry–28K ac-ft
Avg–1K ac-ft
Wet–0 ac-ft
Instream Surplus
Dry–8K ac-ft
Avg–112K ac-ft
Wet–207K ac-ft
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Comparison of All Dry Years Flow to Instream Flow Rule
(Twisp River near Twisp, WA)
River flow, cfs
800
600
400
200
0
Instream flow rule
1977
1979
1994
2001
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

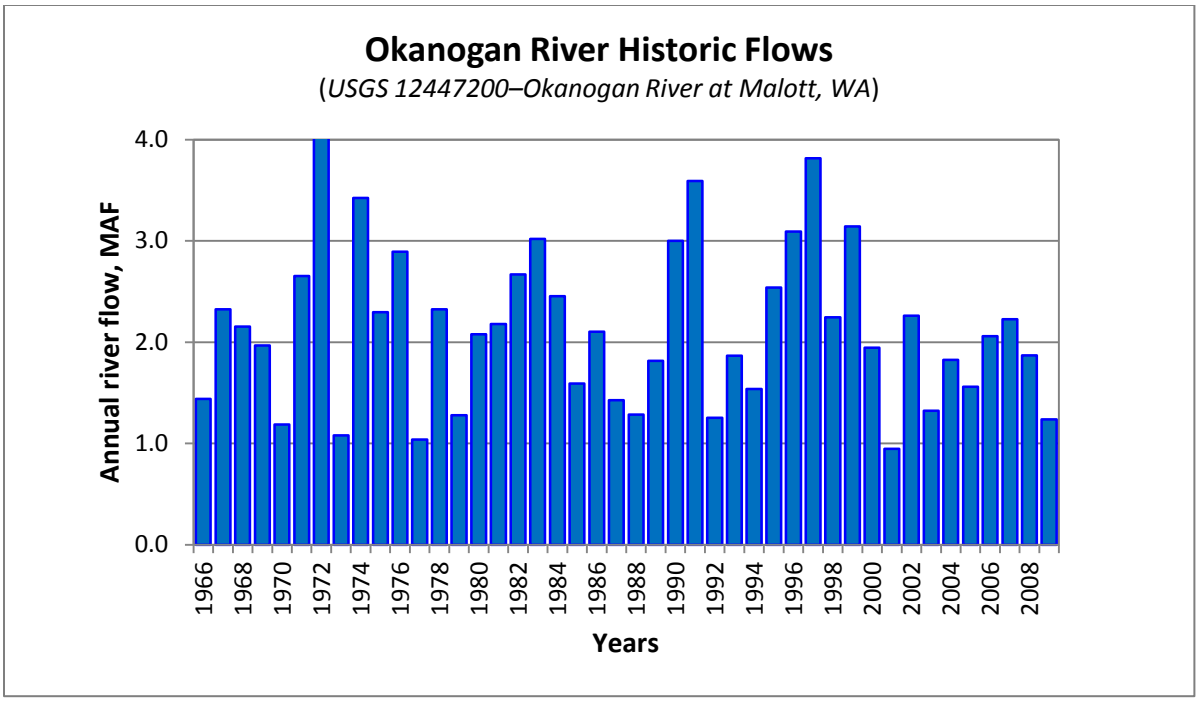

Comparison of All Wet Years Flow to Instream Flow Rule
(Twisp River near Twisp, WA)
River flow, cfs
2,000
1,500
1,000
500
0
Instream flow rule
1991
1995
1996
1997
1999
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

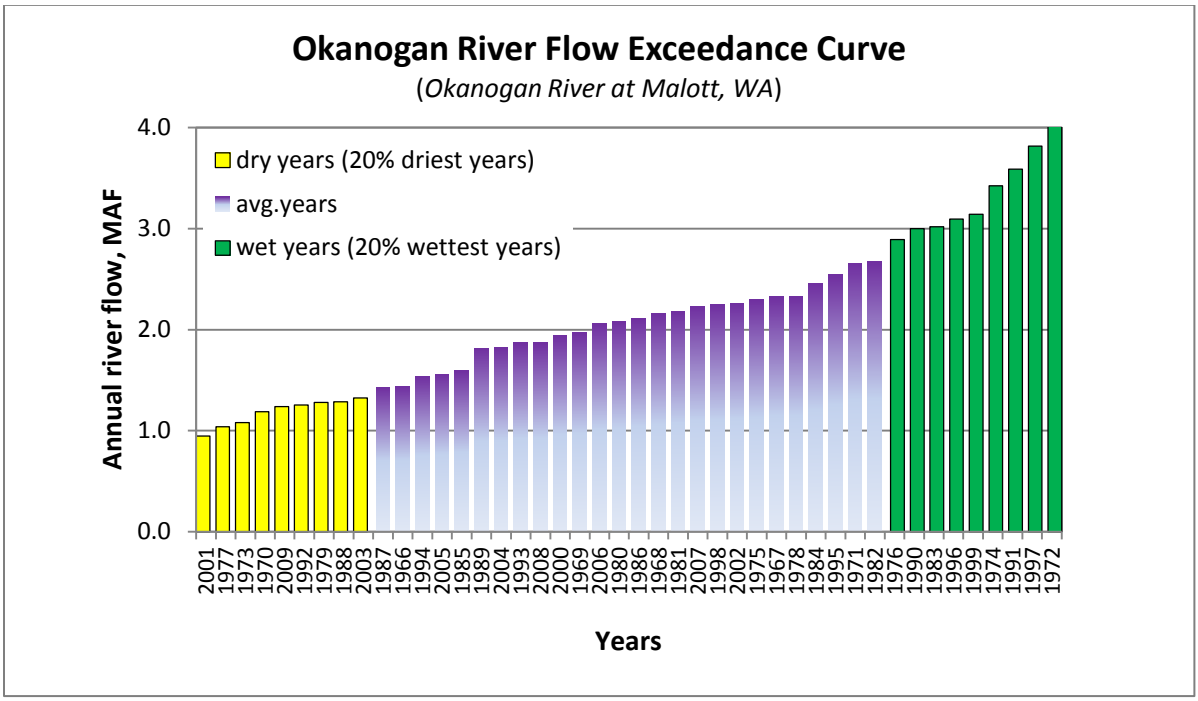
WRIA 49 (Okanogan)

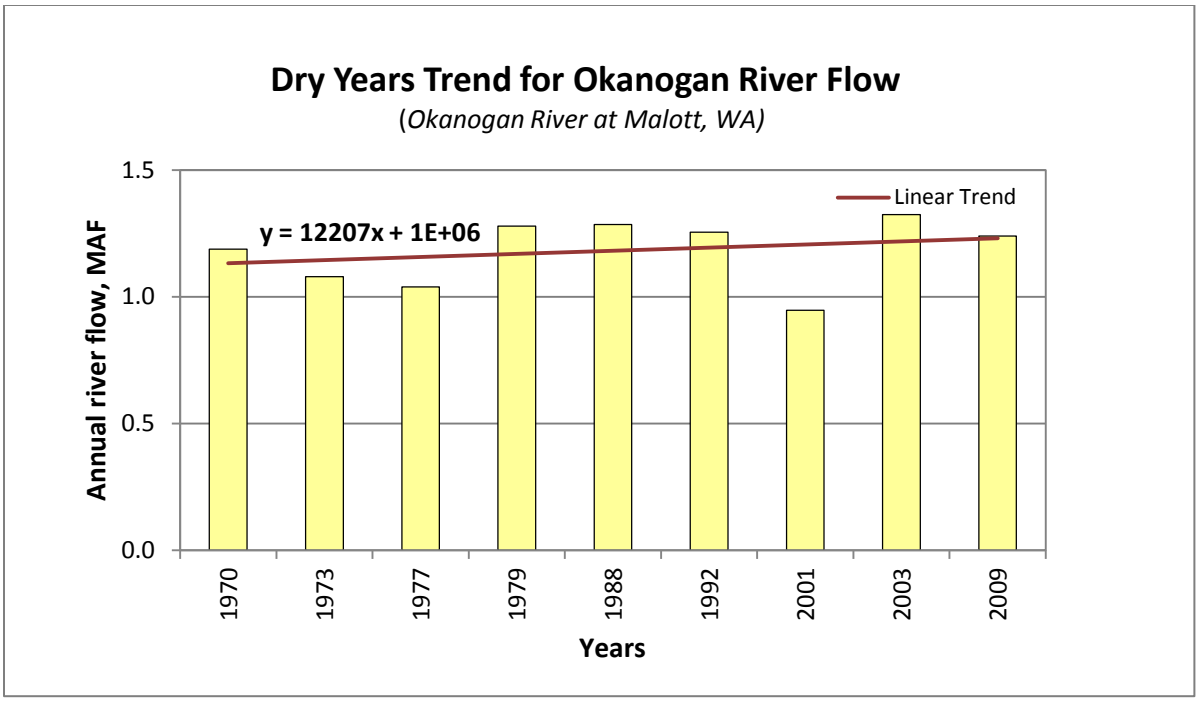
For WRIA 49, OCR graphed the flows of 4 rivers and streams. For most rivers and streams, a series of six to eight graphs were created. The results provide information on historic flow levels, drought occurrences and when instream flow rules are or are not met. These data contribute to OCR's understanding of historic trends, drought patterns and hydrograph variability. For example, by graphing the 44 year (1966–2009) flows of the Okanogan River at Malott, gauge number 12447200, it is shown that:

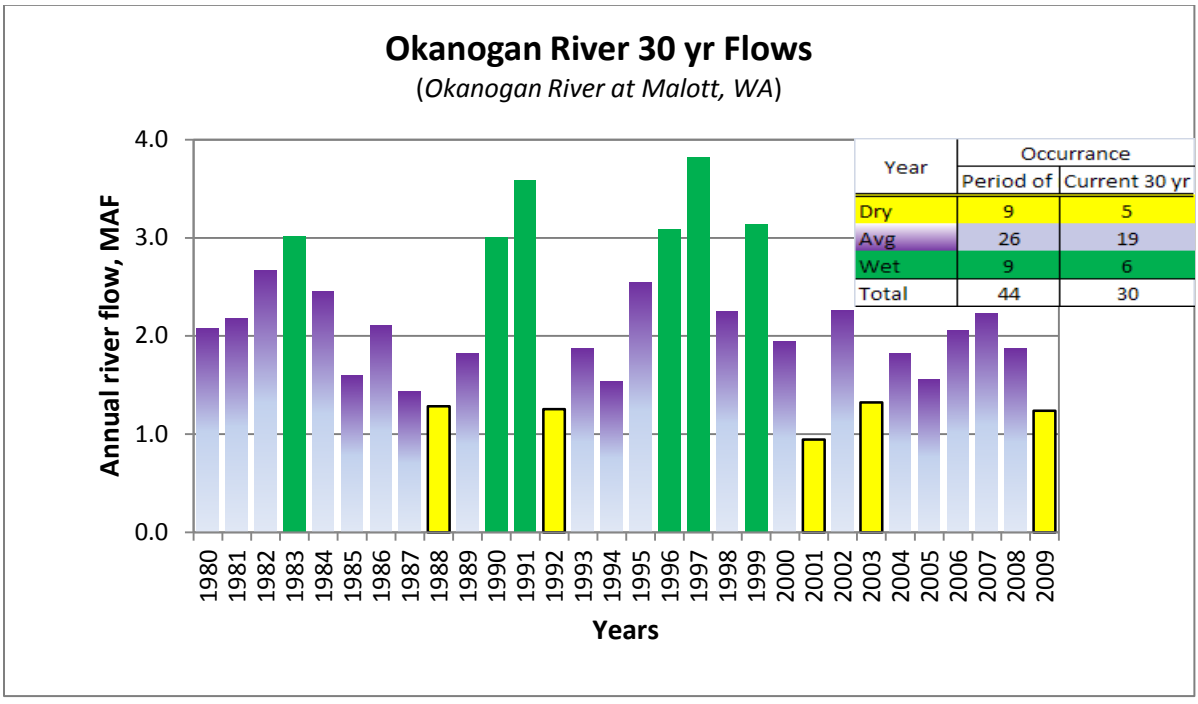
- Historic mean annual flows generally varied between 0.9 and 5.0 million acre-feet (MAF).
- Ecology defined "dry" years as the 80% exceedance value (80% of the time more water was available). Over the last 30 years, dry years occurred 5 times. During this same time period, the availability of water during dry years resulted in a slight incline.
- Ecology compared different water years (dry, average, wet) to the instream flow rule. The instream flow rule is almost always met in average years. In dry years, the instream flow is met only in late spring and early summer.
- The magnitude of unmet instream flows is large. For example, in average years, the instream flow deficit for the entire year totals 3,000 acre-feet, which grows to 136,000 acre-feet in dry years.
- Water is available in-basin to address instream shortages through OCR-funded projects (e.g. storage, conservation, pump exchanges). For example, the average water year surplus is 1.2 MAF.

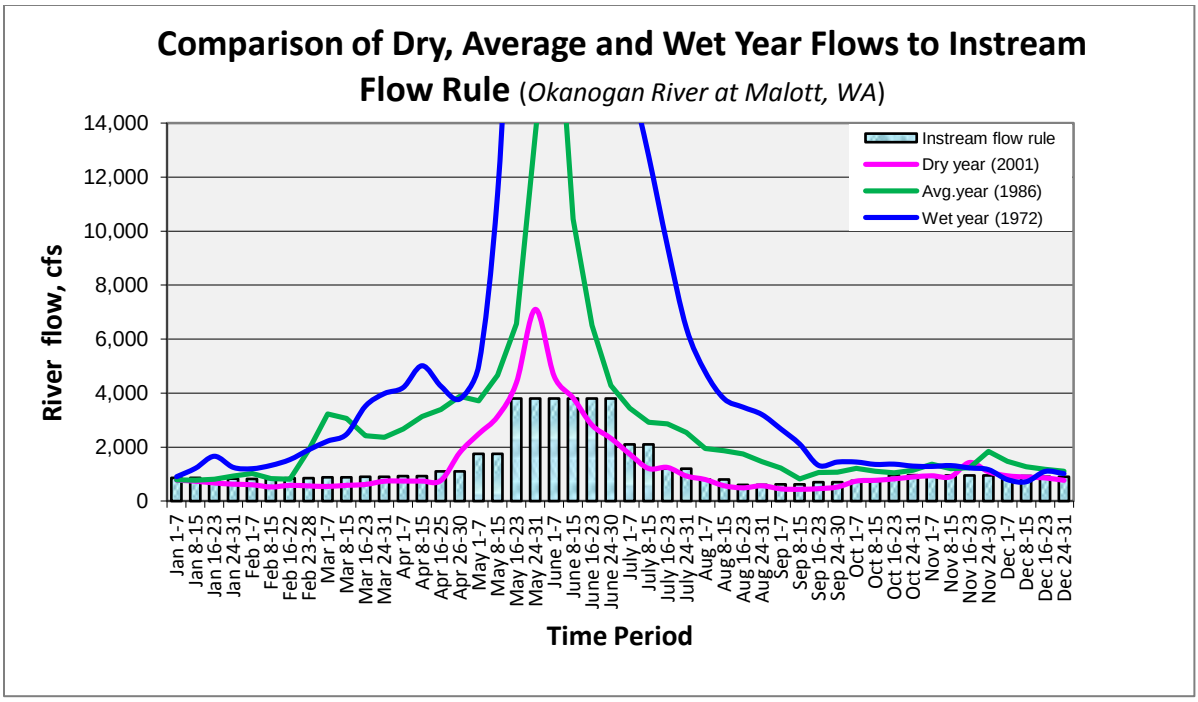
OCR can use this information to recognize where water is needed, when water is available and whether or not the in-basin or out-of-basin water supply development can help meet the WRIA's water demands.

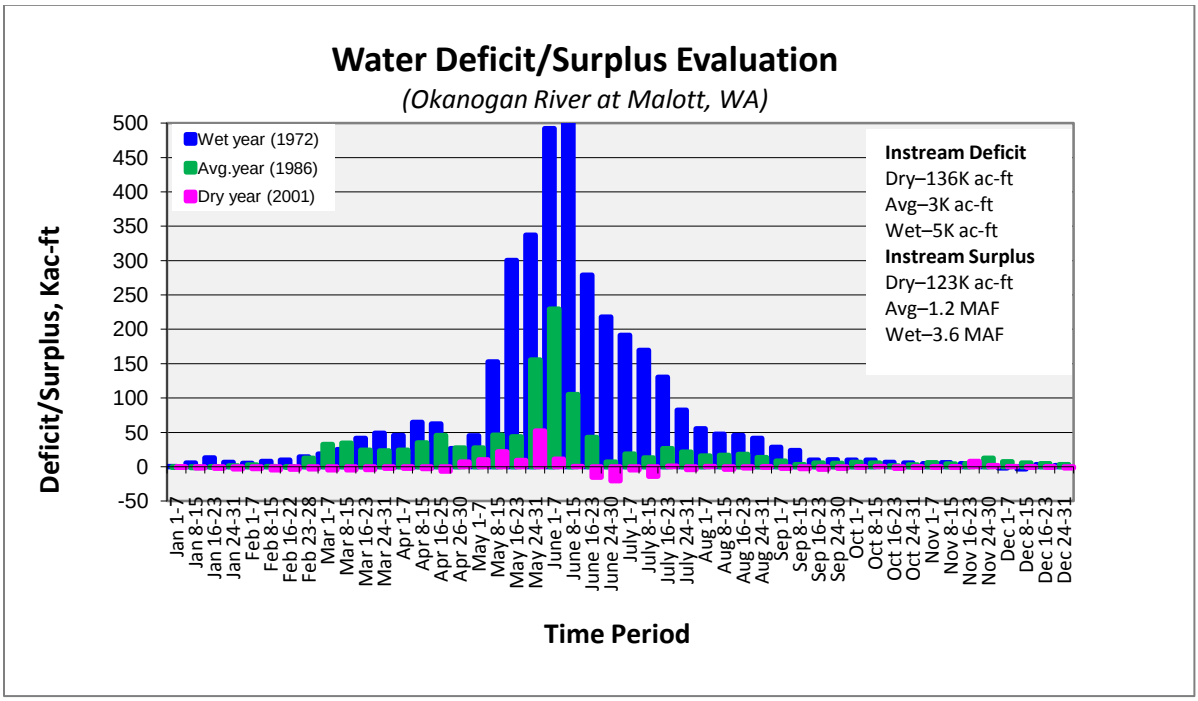

Okanogan River Historic Flows
(USGS 12447200–Okanogan River at Malott, WA)
Annual river flow, MAF
4.0
3.0
2.0
1.0
0.0
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
Years

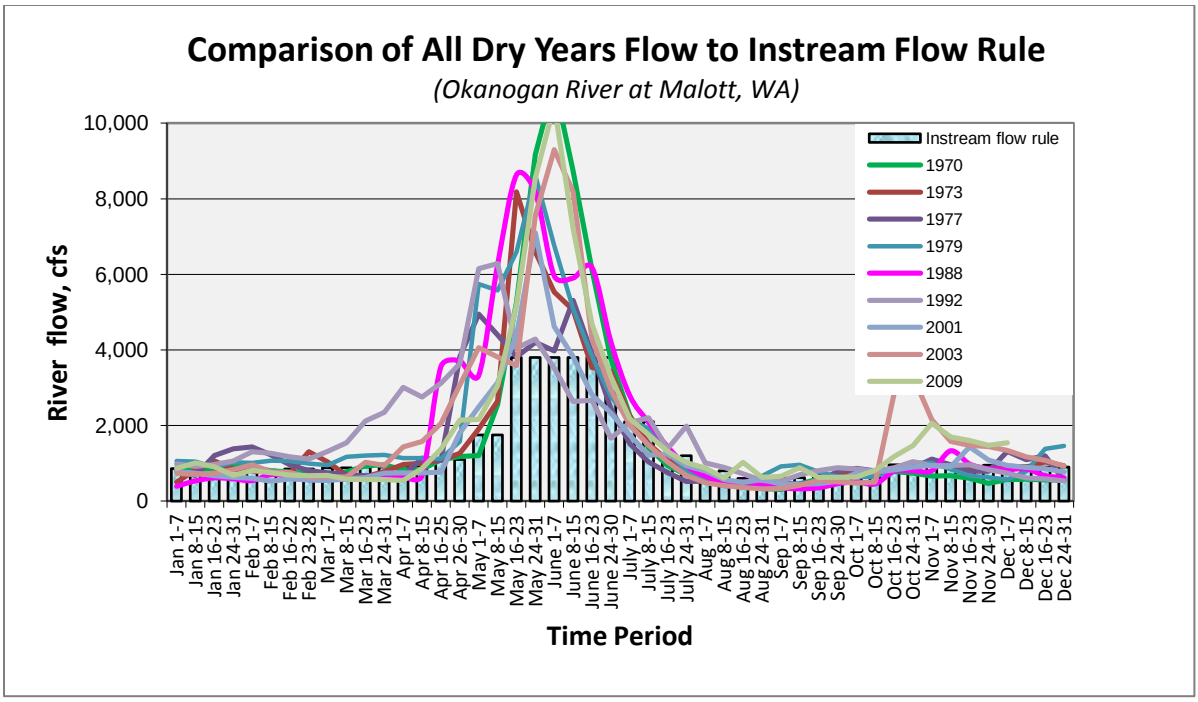

Okanogan River Flow Exceedance Curve
(Okanogan River at Malott, WA)
Annual river flow, MAF
4.0
3.0
2.0
1.0
0.0
dry years (20% driest years)
avg.years
wet years (20% wettest years)
2001
1977
1973
1970
2009
1992
1979
1988
2003
1987
1966
1994
2005
1985
1989
2004
1993
2008
2000
1969
2006
1980
1986
1968
1981
2007
1998
2002
1975
1967
1978
1984
1995
1971
1982
1976
1990
1983
1996
1999
1974
1991
1997
1972
Years

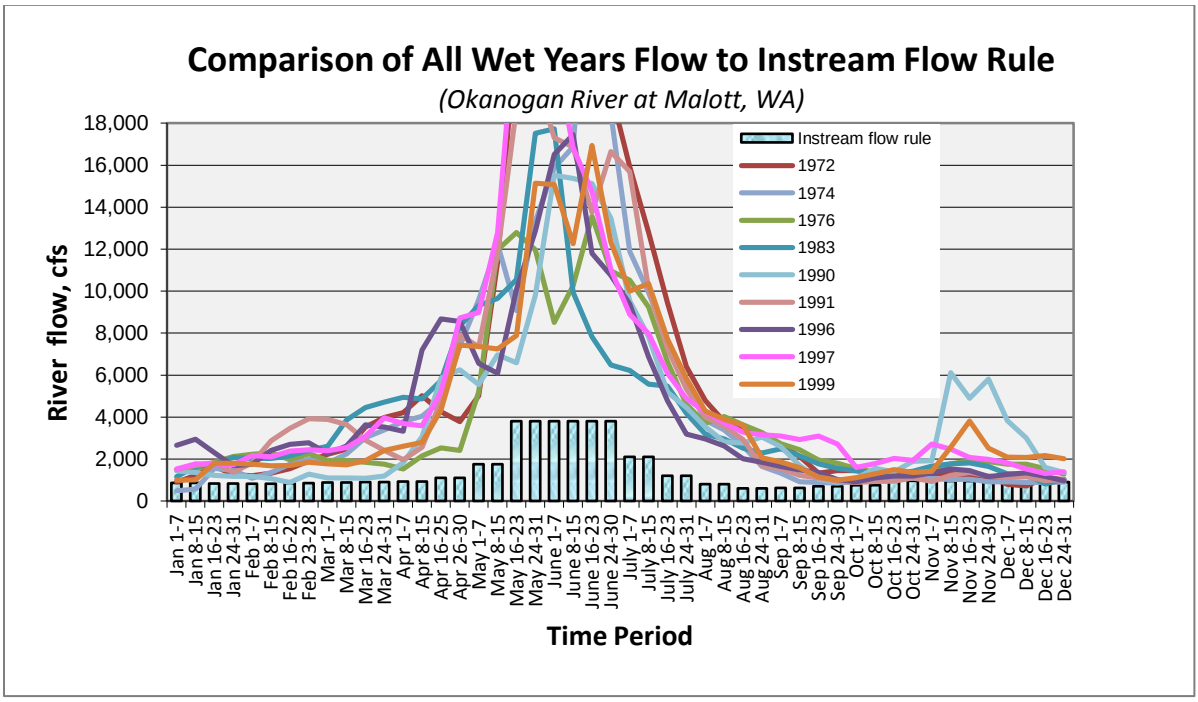

Dry Years Trend for Okanogan River Flow
(Okanogan River at Malott, WA)
Linear Trend
y = 12207x + 1E+06
Annual river flow, MAF
1.5
1.0
0.5
0.0
1970
1973
1977
1979
1988
1992
2001
2003
2009
Years

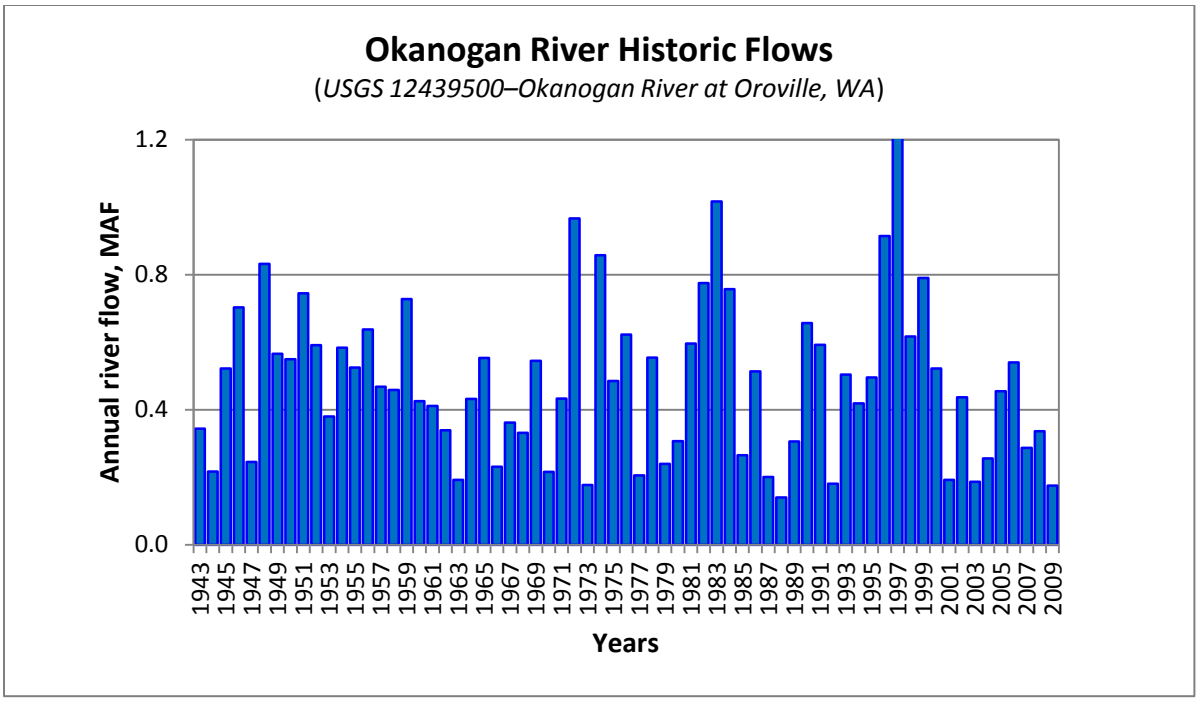

Okanogan River 30 yr Flows
(Okanogan River at Malott, WA)
Annual river flow, MAF
4.0
3.0
2.0
1.0
0.0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 9 5
Avg 26 19
Wet 9 6
Total 44 30

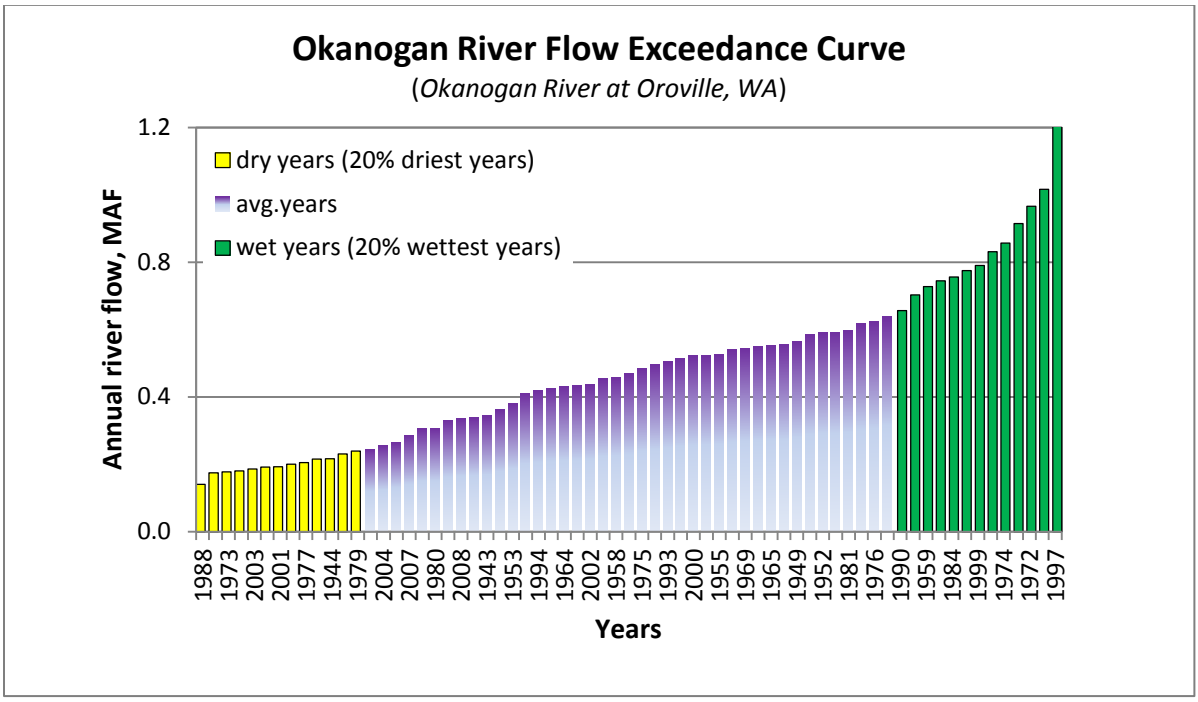

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Okanogan River at Malott, WA)
River flow, cfs
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Instream flow rule
Dry year (2001)
Avg.year (1986)
Wet year (1972)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

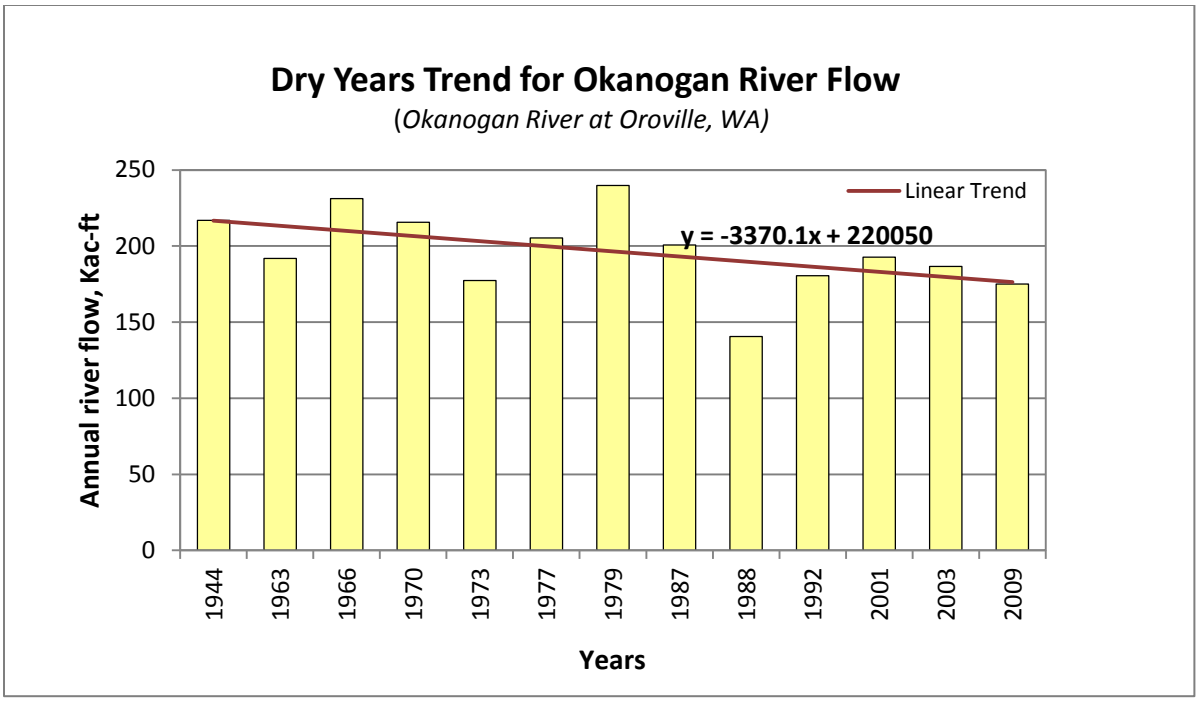

Water Deficit/Surplus Evaluation
(Okanogan River at Malott, WA)
Deficit/Surplus, Kac-ft
500
450
400
350
300
250
200
150
100
50
0
-50
Wet year (1972)
Avg.year (1986)
Dry year (2001)
Instream Deficit
Dry–136K ac-ft
Avg–3K ac-ft
Wet–5K ac-ft
Instream Surplus
Dry–123K ac-ft
Avg–1.2 MAF
Wet–3.6 MAF
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

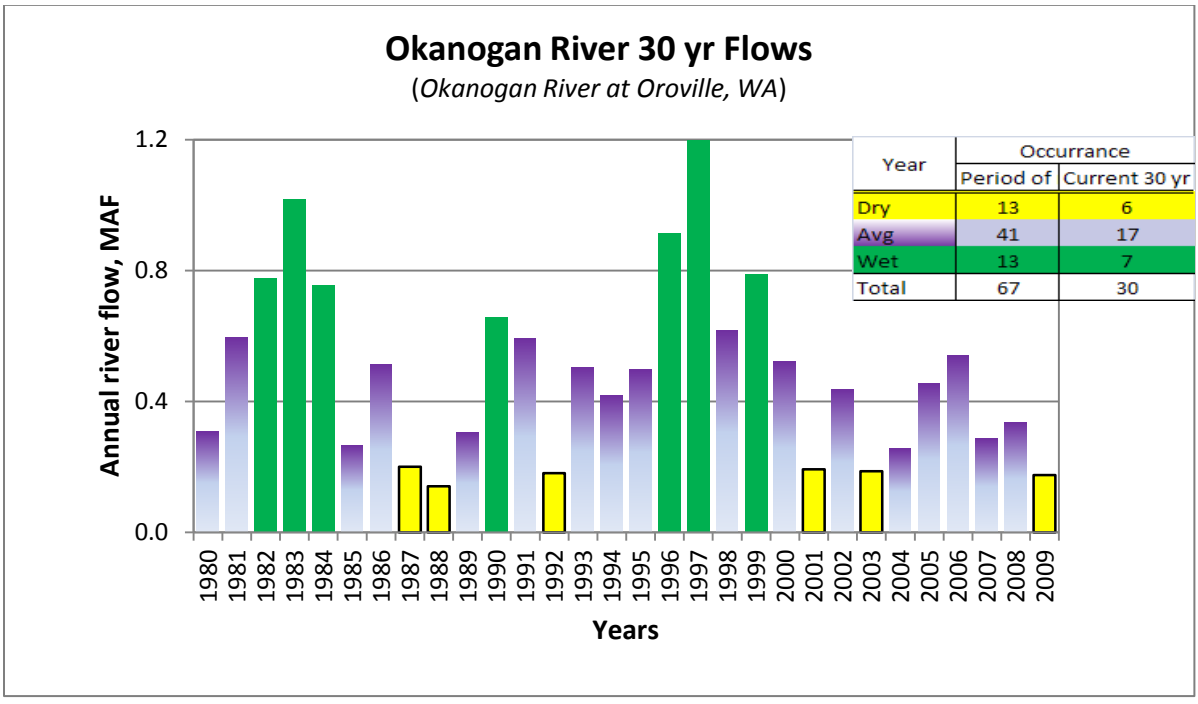

Comparison of All Dry Years Flow to Instream Flow Rule
(Okanogan River at Malott, WA)
River flow, cfs
10,000
8,000
6,000
4,000
2,000
0
Instream flow rule
1970
1973
1977
1979
1988
1992
2001
2003
2009
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

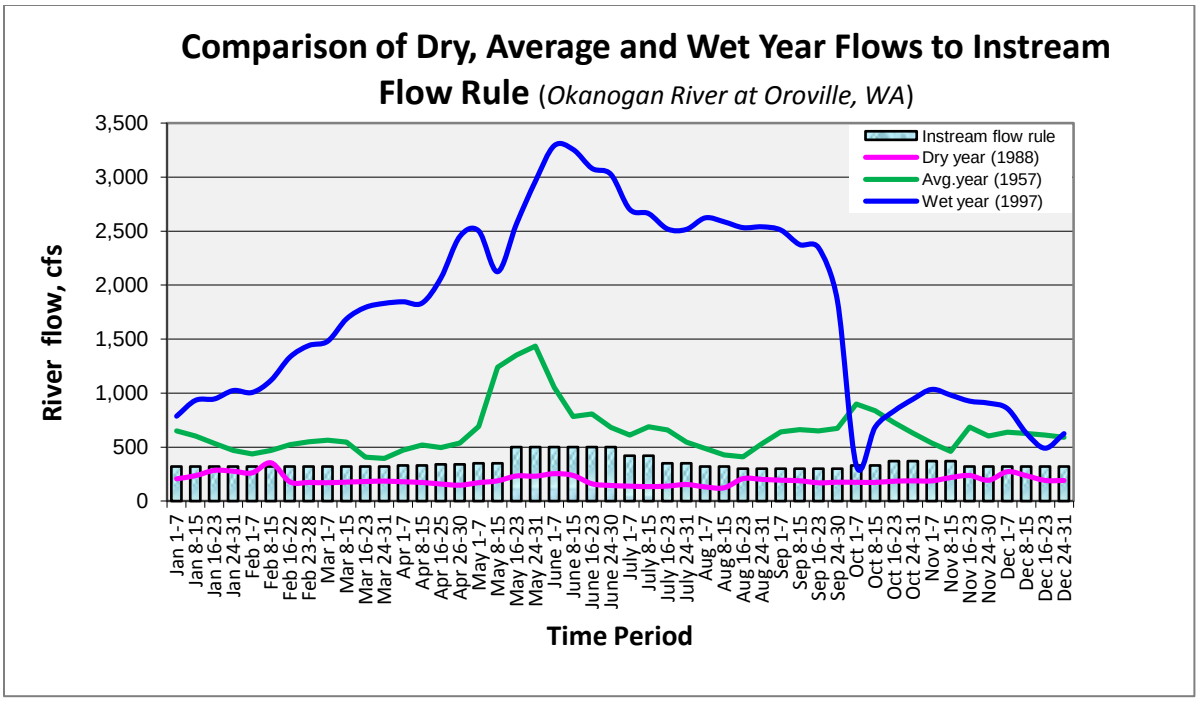

Comparison of All Wet Years Flow to Instream Flow Rule
(Okanogan River at Malott, WA)
River flow, cfs
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Instream flow rule
1972
1974
1976
1983
1990
1991
1996
1997
1999
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

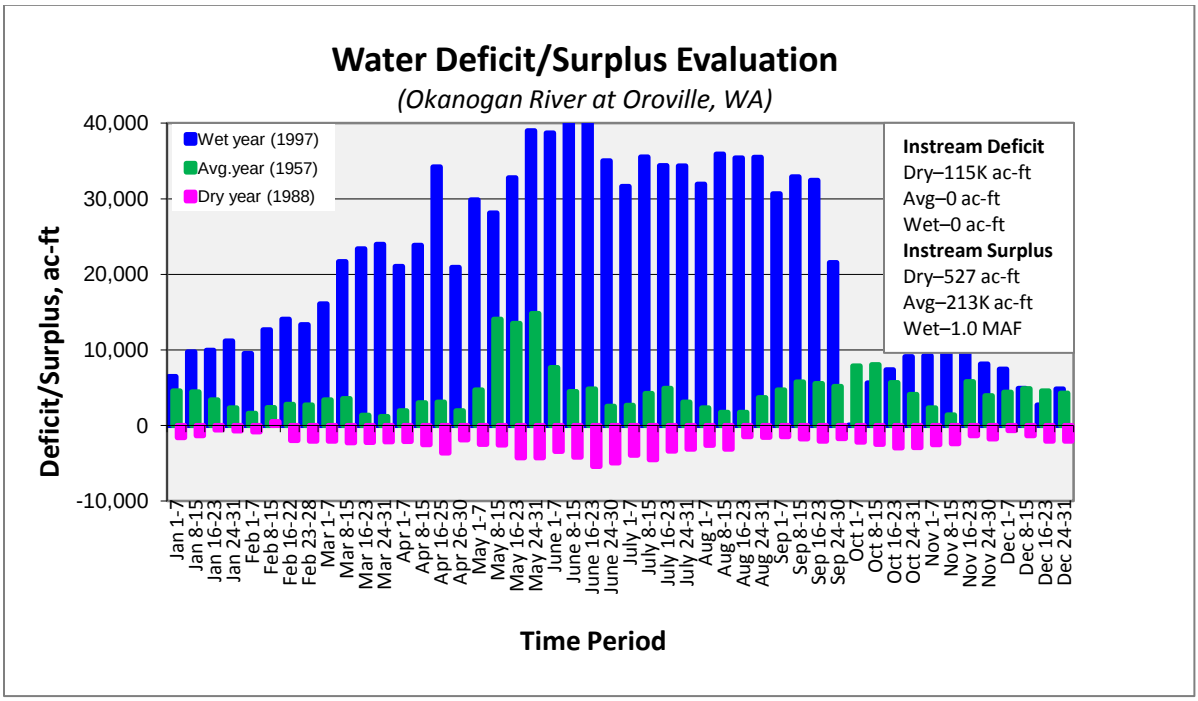

Okanogan River Historic Flows
(USGS 12439500–Okanogan River at Oroville, WA)
Annual river flow, MAF
1.2
0.8
0.4
0.0
1943 1945 1947 1949 1951 1953 1955 1957 1959 1961 1963 1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009
Years

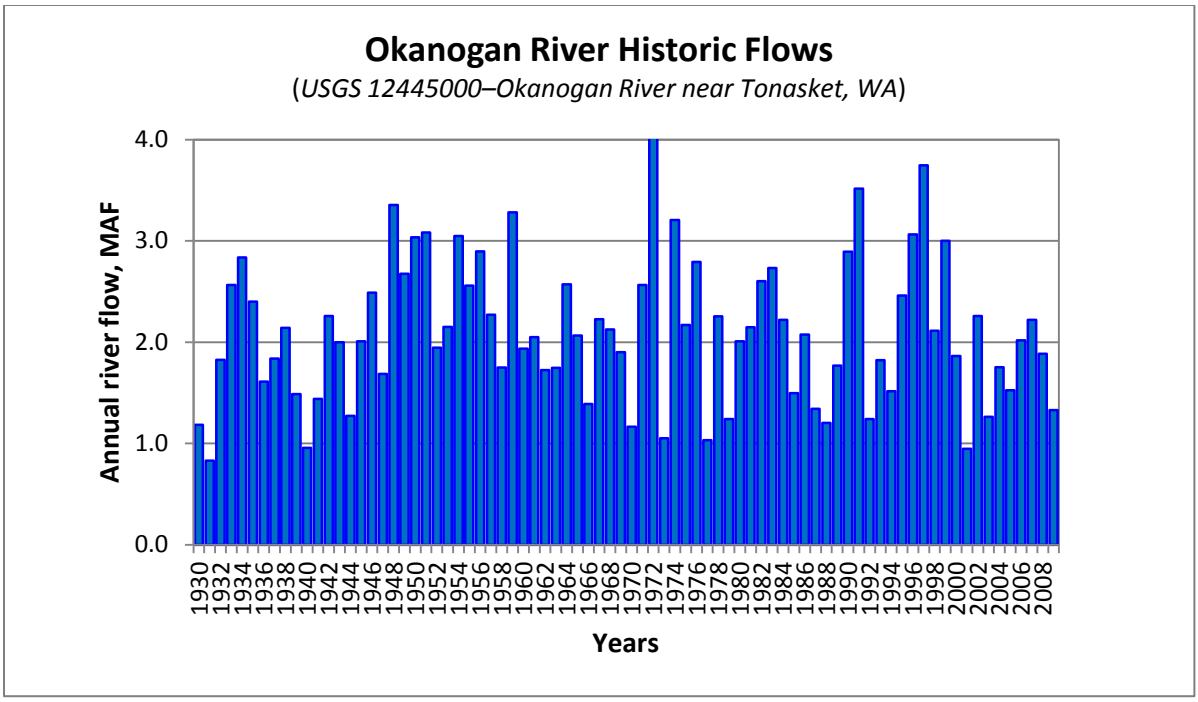

Okanogan River Flow Exceedance Curve
(Okanogan River at Oroville, WA)
Annual river flow, MAF
1.2
0.8
0.4
0.0
dry years (20% driest years)
avg.years
wet years (20% wettest years)
1988 1973 2003 2001 1977 1944 1979 2004 2007 1980 2008 1943 1953 1994 1964 2002 1958 1975 1993 2000 1955 1969 1965 1949 1952 1981 1976 1990 1959 1984 1999 1974 1972 1997
Years

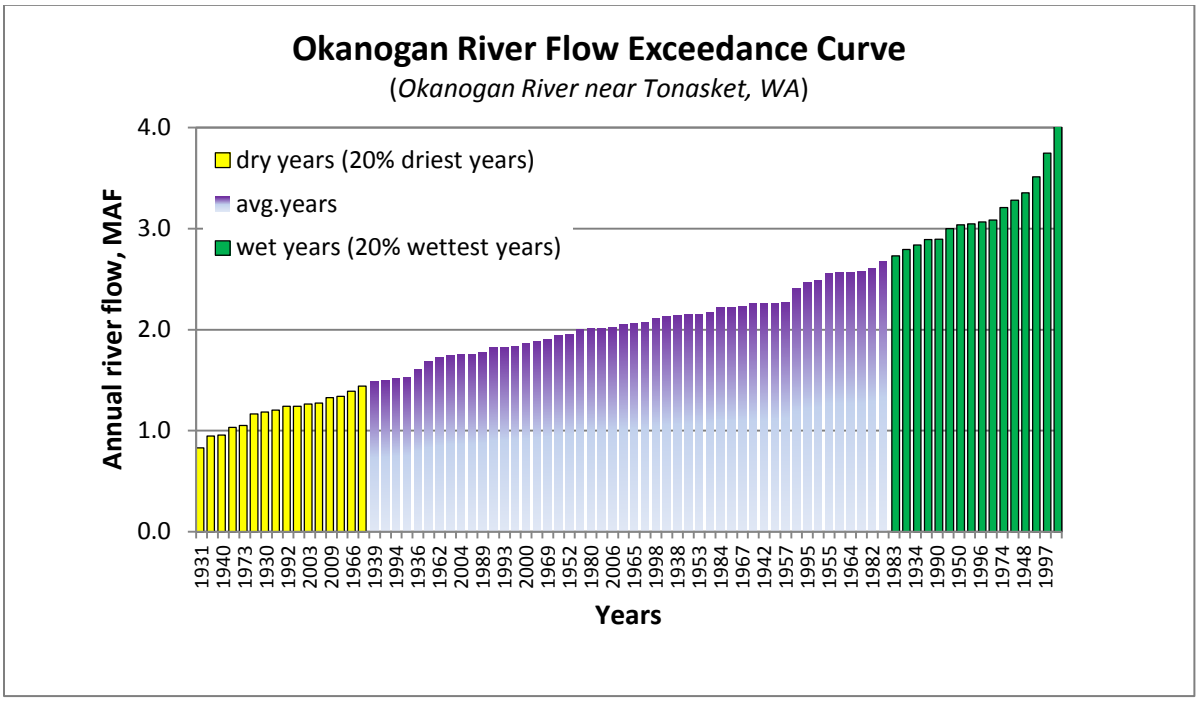

Dry Years Trend for Okanogan River Flow
(Okanogan River at Oroville, WA)
Linear Trend
y = -3370.1x + 220050
Annual river flow, Kac-ft
250
200
150
100
50
0
1944
1963
1966
1970
1973
1977
1979
1987
1988
1992
2001
2003
2009
Years

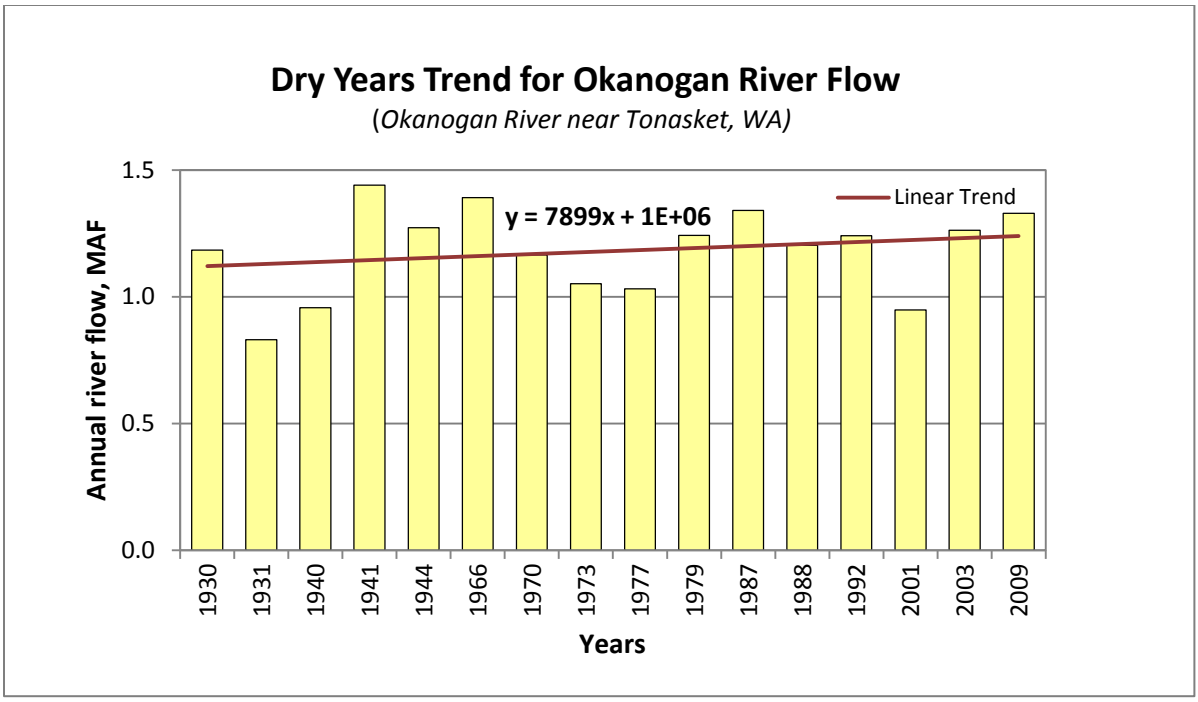

Okanogan River 30 yr Flows
(Okanogan River at Oroville, WA)
Annual river flow, MAF
1.2
0.8
0.4
0.0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 13 6
Avg 41 17
Wet 13 7
Total 67 30

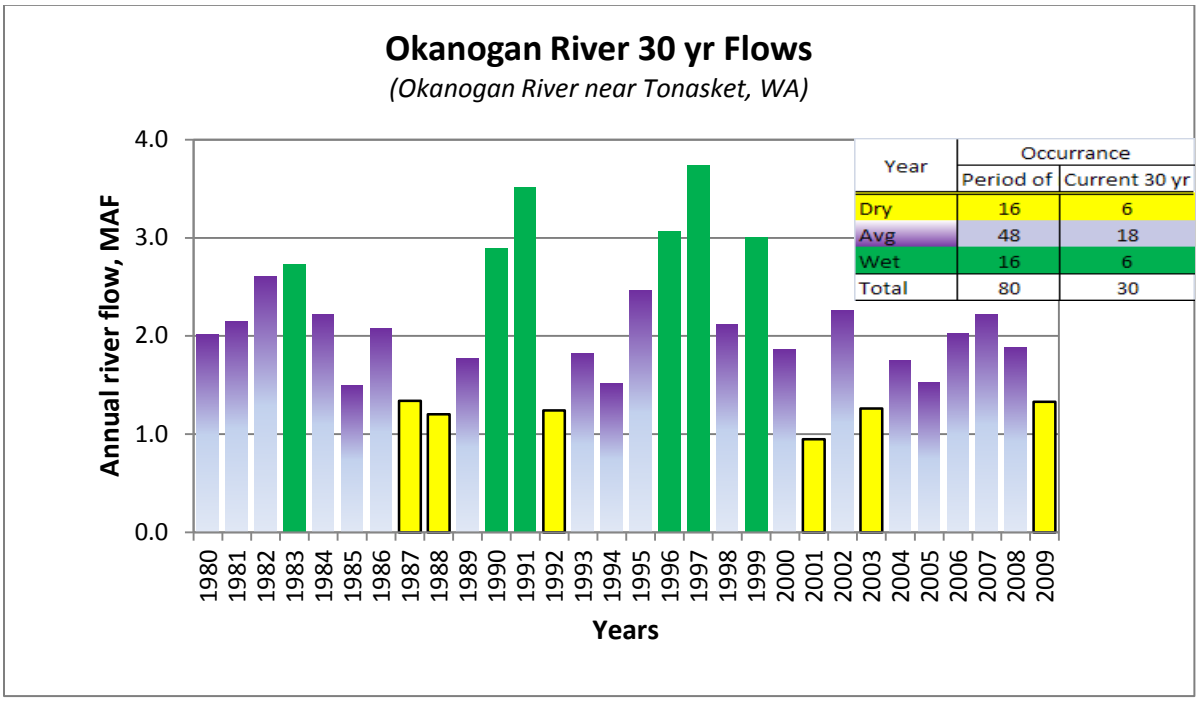

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Okanogan River at Oroville, WA)
River flow, cfs
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Instream flow rule
Dry year (1988)
Avg.year (1957)
Wet year (1997)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

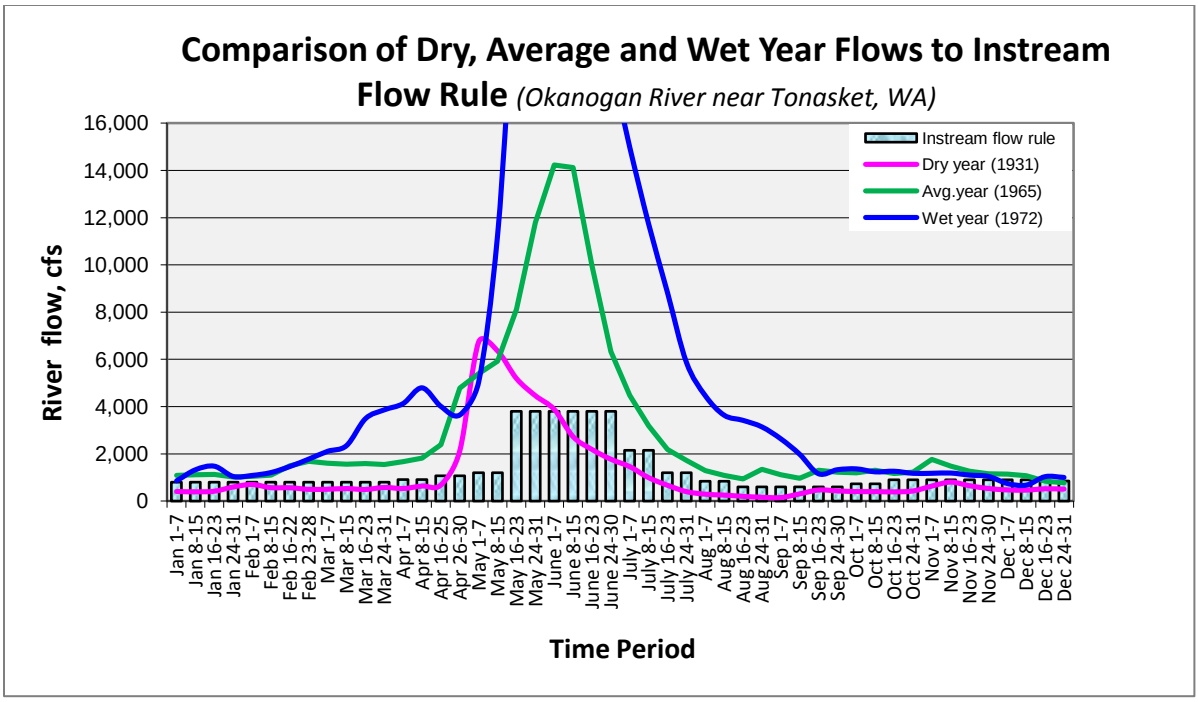

Water Deficit/Surplus Evaluation
(Okanogan River at Oroville, WA)
Deficit/Surplus, ac-ft
40,000
30,000
20,000
10,000
0
-10,000
Wet year (1997)
Avg.year (1957)
Dry year (1988)
Instream Deficit
Dry–115K ac-ft
Avg–0 ac-ft
Wet–0 ac-ft
Instream Surplus
Dry–527 ac-ft
Avg–213K ac-ft
Wet–1.0 MAF
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

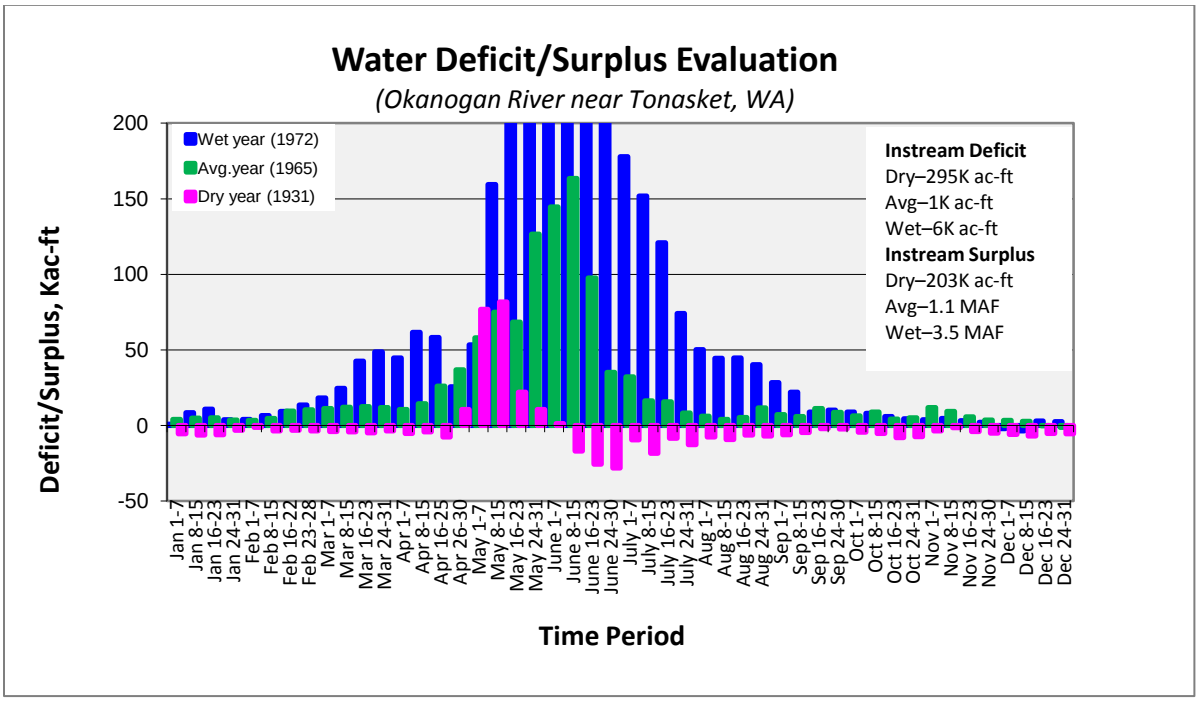

Okanogan River Historic Flows
(USGS 12445000–Okanogan River near Tonasket, WA)
Annual river flow, MAF
4.0
3.0
2.0
1.0
0.0
1930 1932 1934 1936 1938 1940 1942 1944 1946 1948 1950 1952 1954 1956 1958 1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008
Years

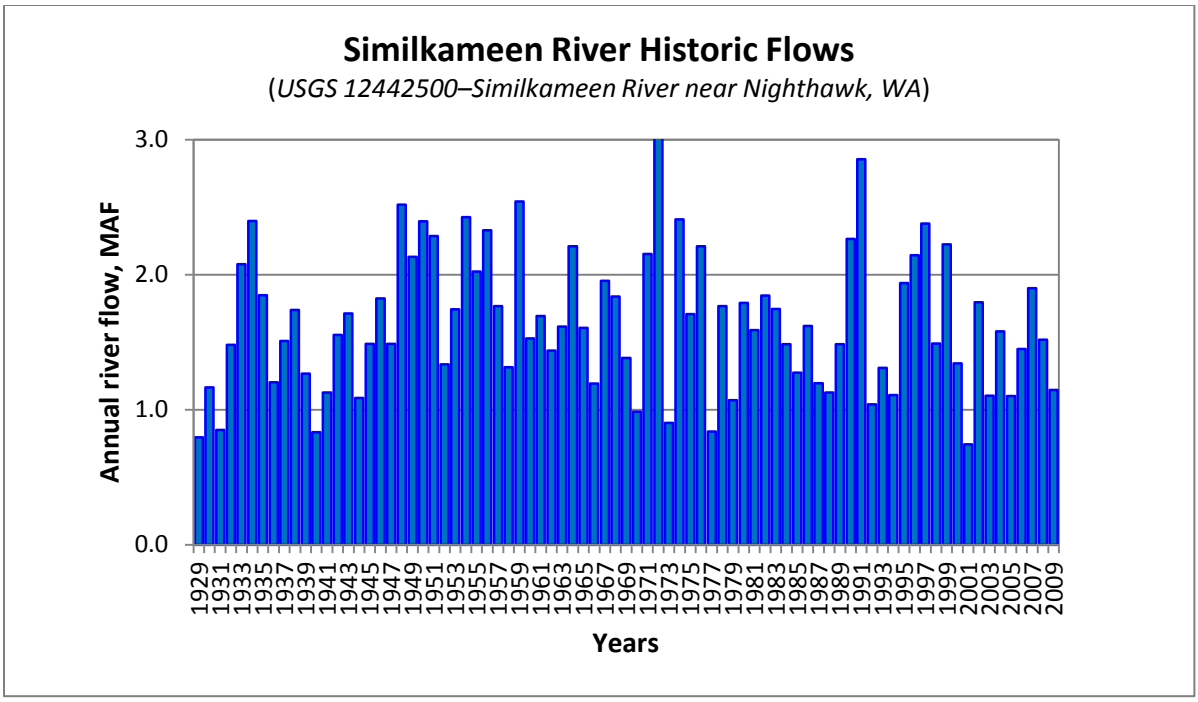

Okanogan River Flow Exceedance Curve
(Okanogan River near Tonasket, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, MAF
4.0
3.0
2.0
1.0
0.0
1931 1940 1973 1930 1992 2003 2009 1966 1939 1994 1936 1962 2004 1989 1993 2000 1969 1952 1980 2006 1965 1998 1938 1953 1984 1967 1942 1957 1995 1955 1964 1982 1983 1934 1990 1950 1996 1974 1948 1997
Years

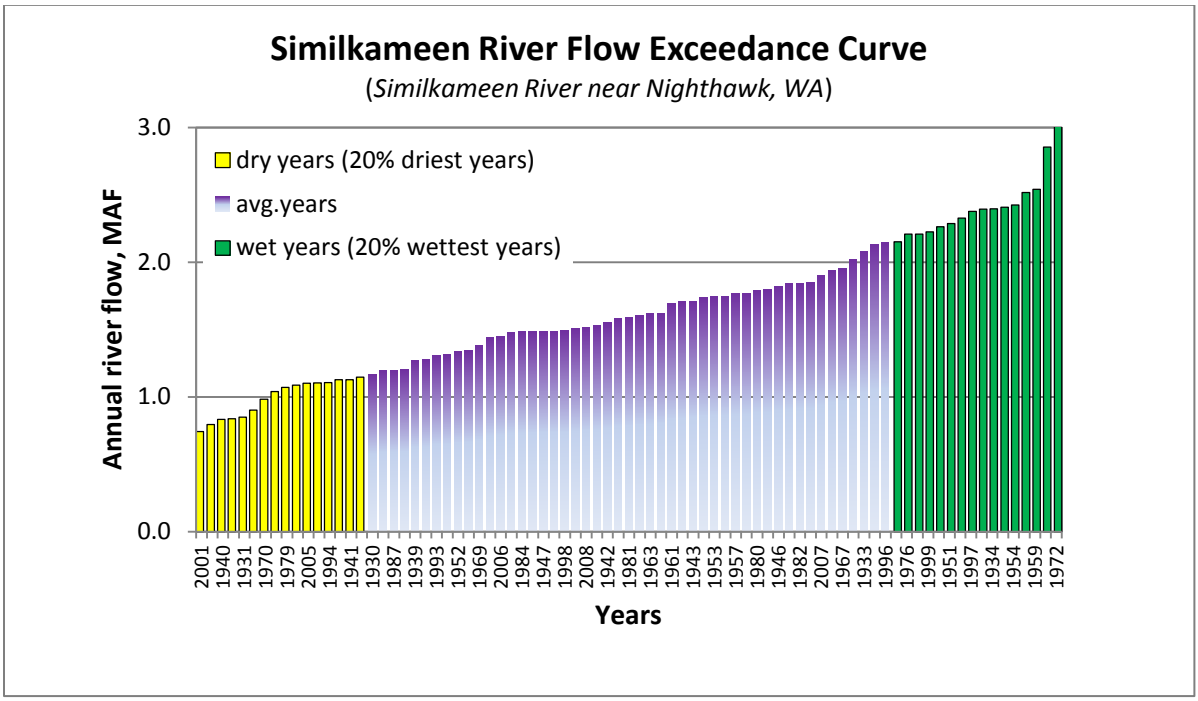

Dry Years Trend for Okanogan River Flow
(Okanogan River near Tonasket, WA)
Annual river flow, MAF
1.5
1.0
0.5
0.0
y = 7899x + 1E+06
Linear Trend
1930
1931
1940
1941
1944
1966
1970
1973
1977
1979
1987
1988
1992
2001
2003
2009
Years

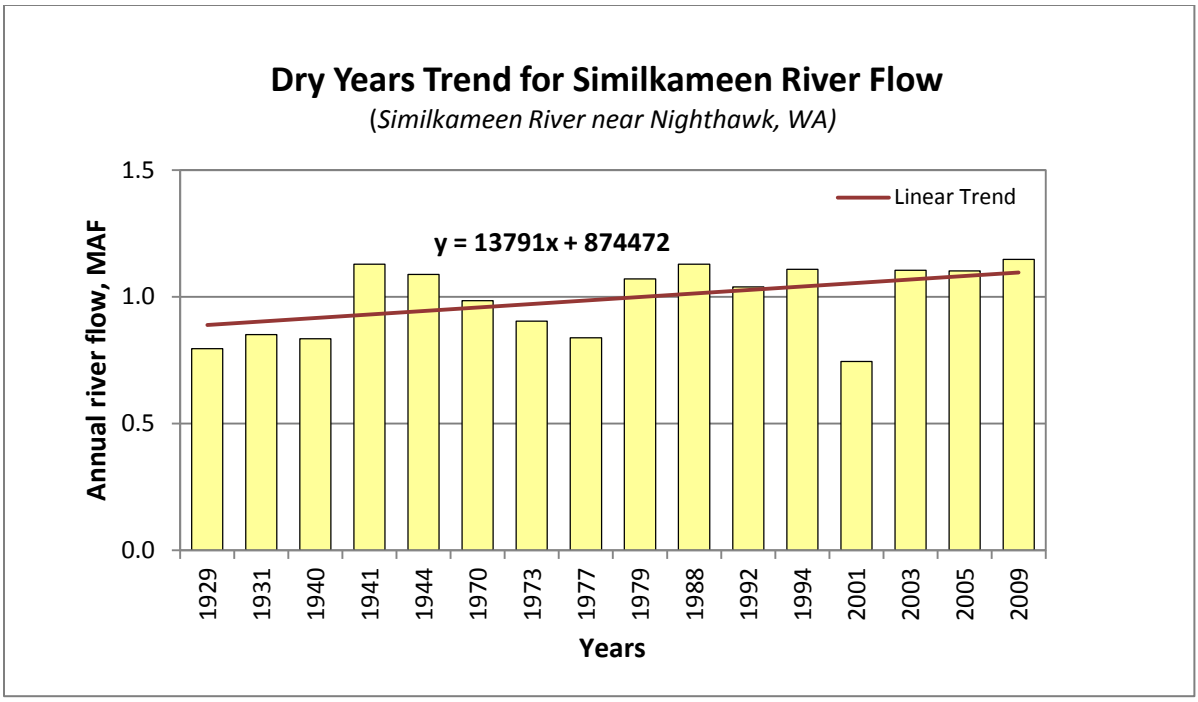

Okanogan River 30 yr Flows
(Okanogan River near Tonasket, WA)
Annual river flow, MAF
4.0
3.0
2.0
1.0
0.0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 16 6
Avg 48 18
Wet 16 6
Total 80 30

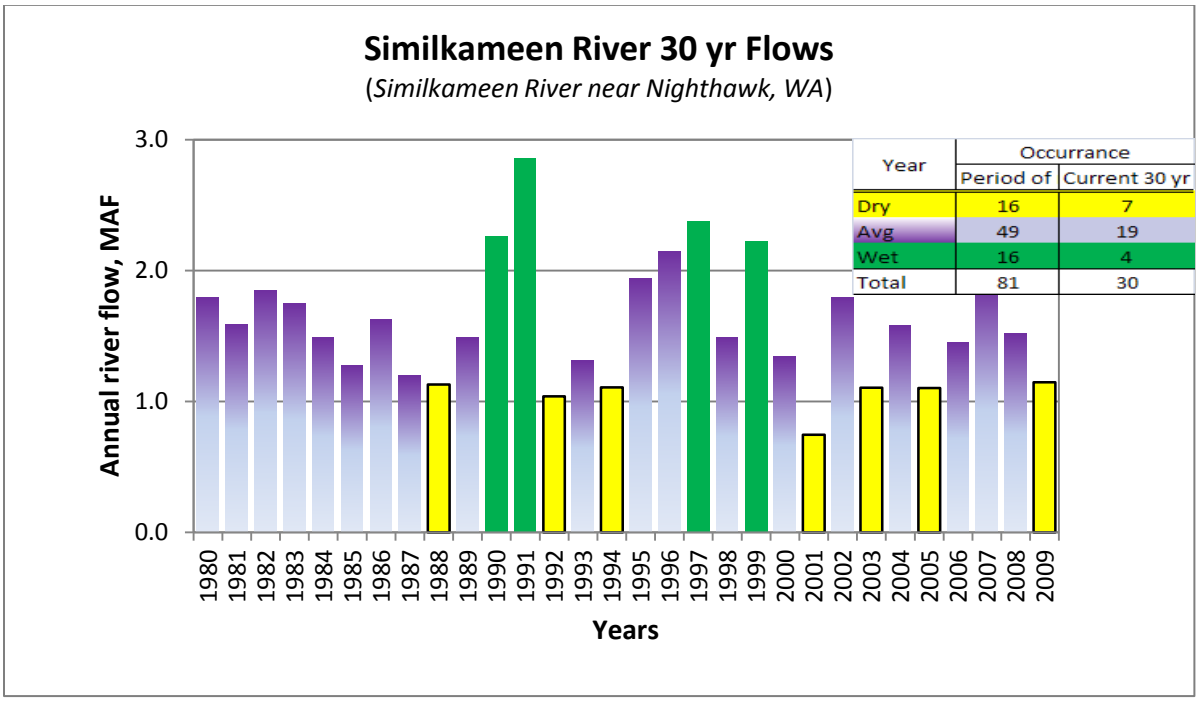

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Okanogan River near Tonasket, WA)
River flow, cfs
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Instream flow rule
Dry year (1931)
Avg.year (1965)
Wet year (1972)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

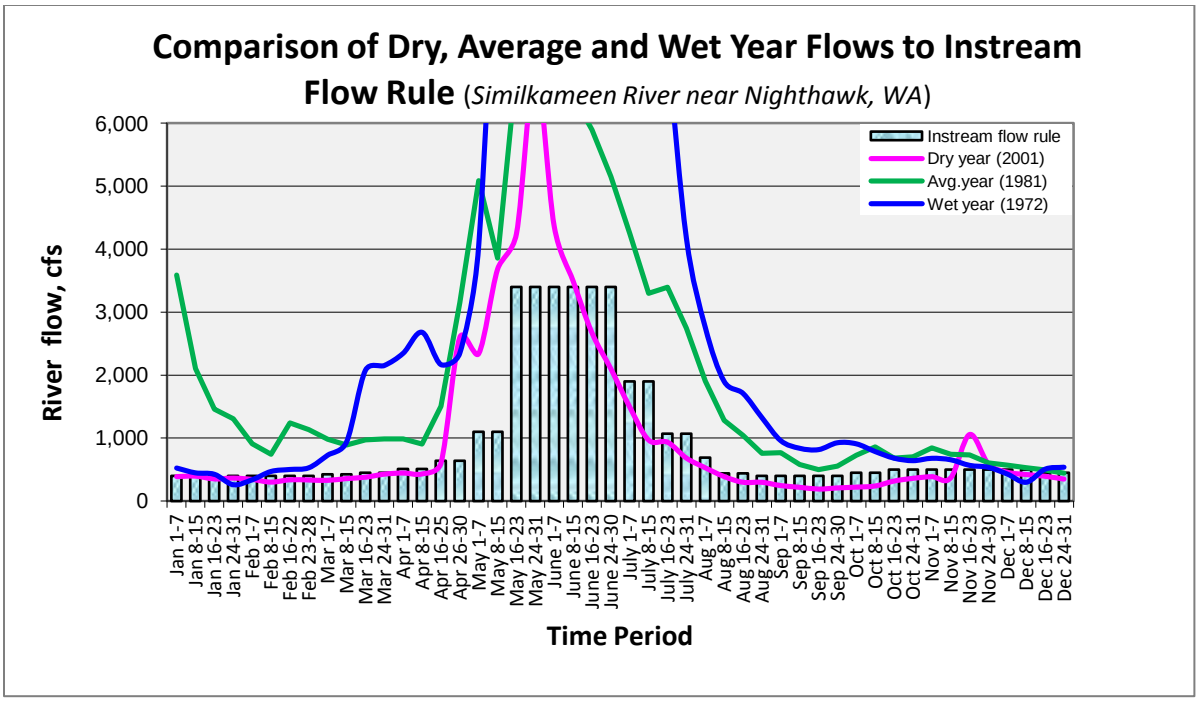

Water Deficit/Surplus Evaluation
(Okanogan River near Tonasket, WA)
Deficit/Surplus, Kac-ft
200
150
100
50
0
-50
Wet year (1972)
Avg.year (1965)
Dry year (1931)
Instream Deficit
Dry–295K ac-ft
Avg–1K ac-ft
Wet–6K ac-ft
Instream Surplus
Dry–203K ac-ft
Avg–1.1 MAF
Wet–3.5 MAF
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

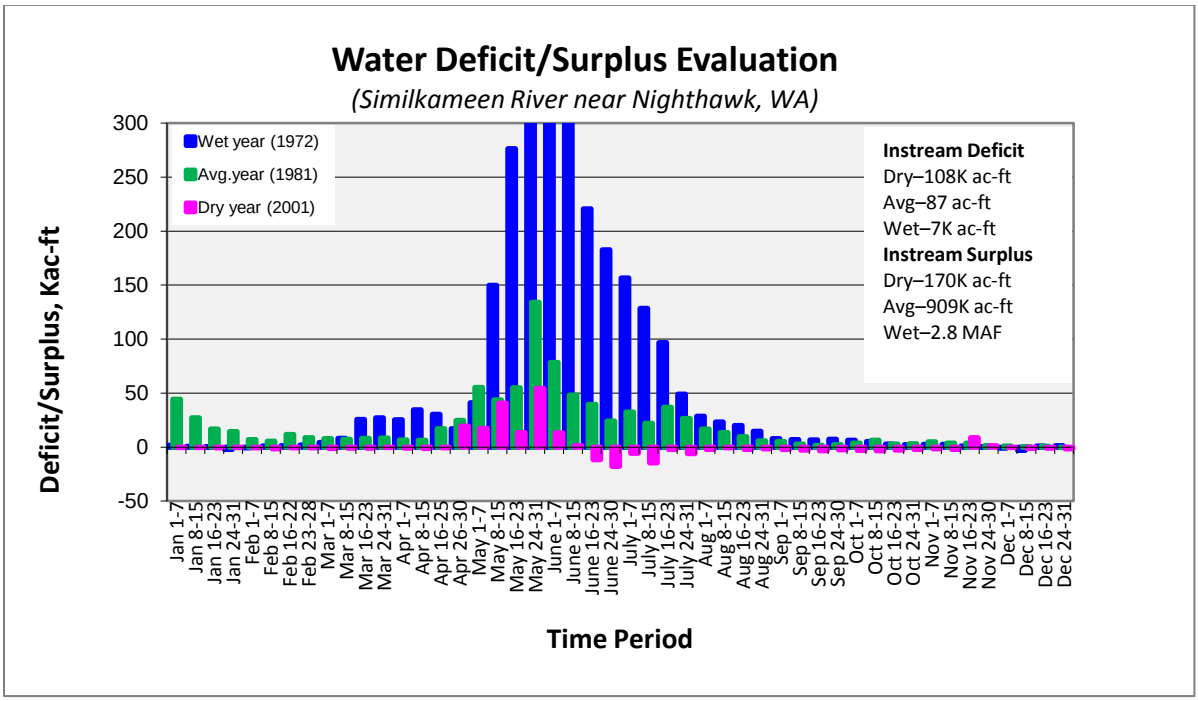

Similkameen River Historic Flows
(USGS 12442500–Similkameen River near Nighthawk, WA)
Annual river flow, MAF
3.0
2.0
1.0
0.0
1929 1931 1933 1935 1937 1939 1941 1943 1945 1947 1949 1951 1953 1955 1957 1959 1961 1963 1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009
Years

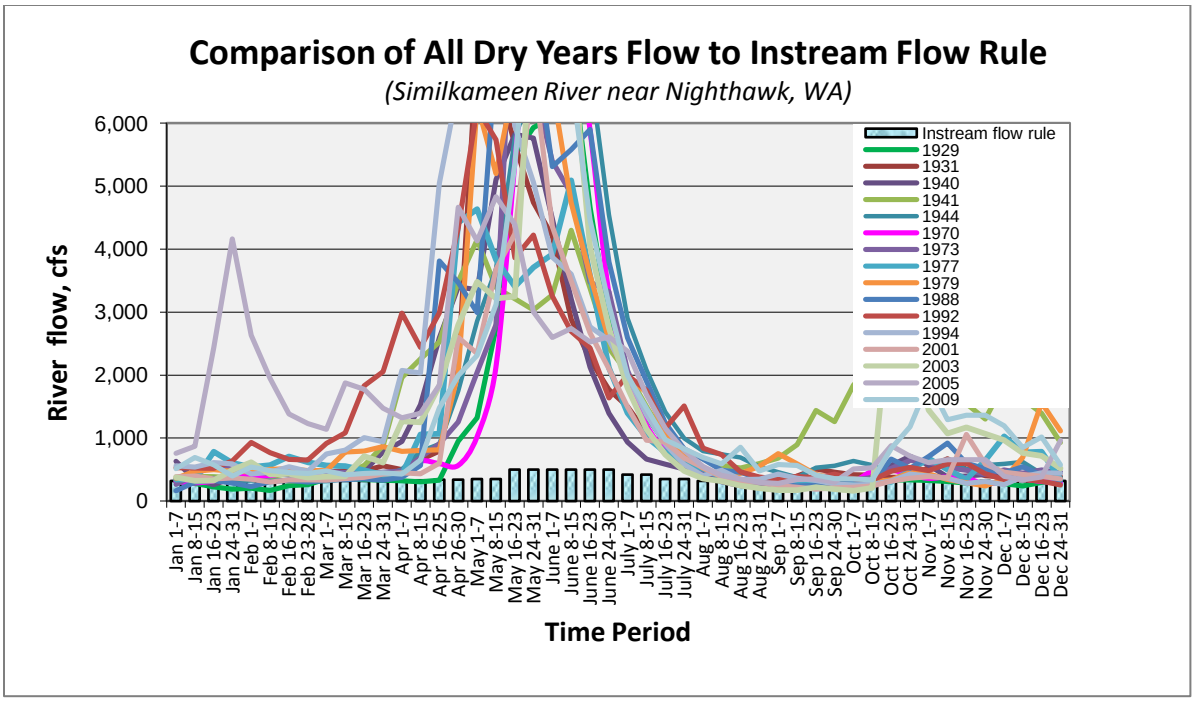

Similkameen River Flow Exceedance Curve
(Similkameen River near Nighthawk, WA)
Annual river flow, MAF
3.0
2.0
1.0
0.0
dry years (20% driest years)
avg.years
wet years (20% wettest years)
2001 1940 1931 1970 1979 2005 1994 1941 1930 1987 1939 1993 1952 1969 2006 1984 1947 1998 2008 1942 1981 1963 1961 1943 1953 1957 1980 1946 1982 2007 1967 1933 1996 1976 1999 1951 1997 1934 1954 1959 1972
Years

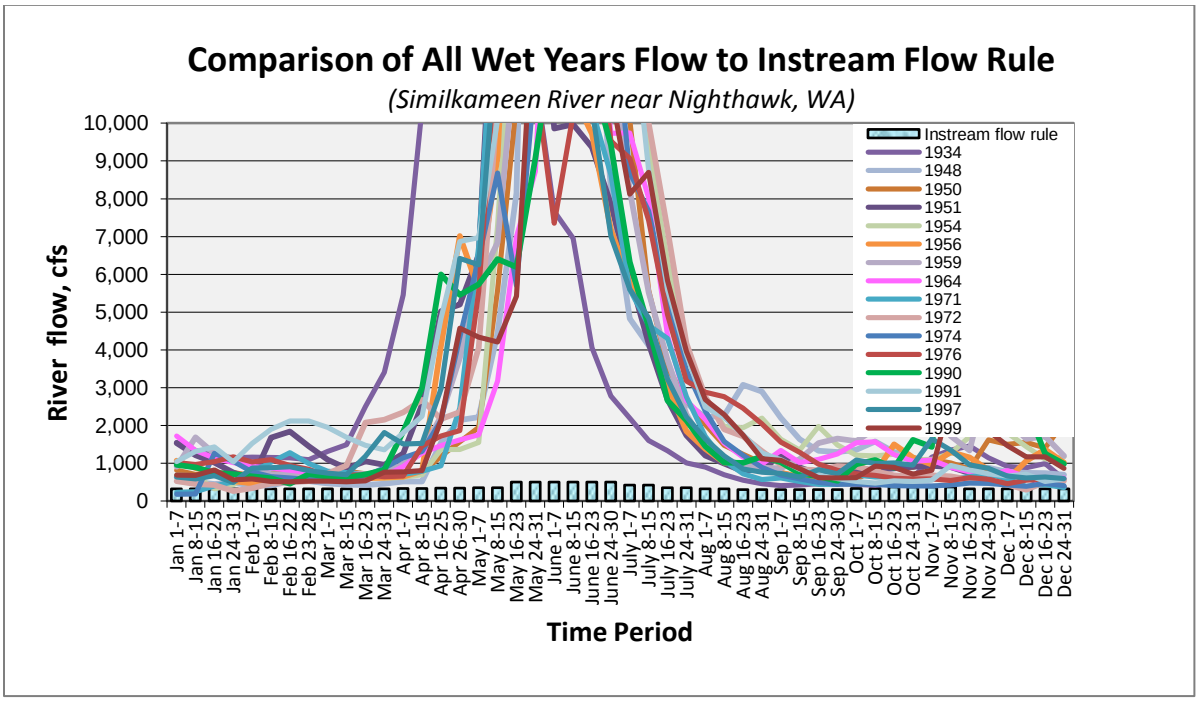

Dry Years Trend for Similkameen River Flow
(Similkameen River near Nighthawk, WA)
Linear Trend
y = 13791x + 874472
Annual river flow, MAF
1.5
1.0
0.5
0.0
1929
1931
1940
1941
1944
1970
1973
1977
1979
1988
1992
1994
2001
2003
2005
2009
Years


Similkameen River 30 yr Flows
(Similkameen River near Nighthawk, WA)
Annual river flow, MAF
3.0
2.0
1.0
0.0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 16 7
Avg 49 19
Wet 16 4
Total 81 30

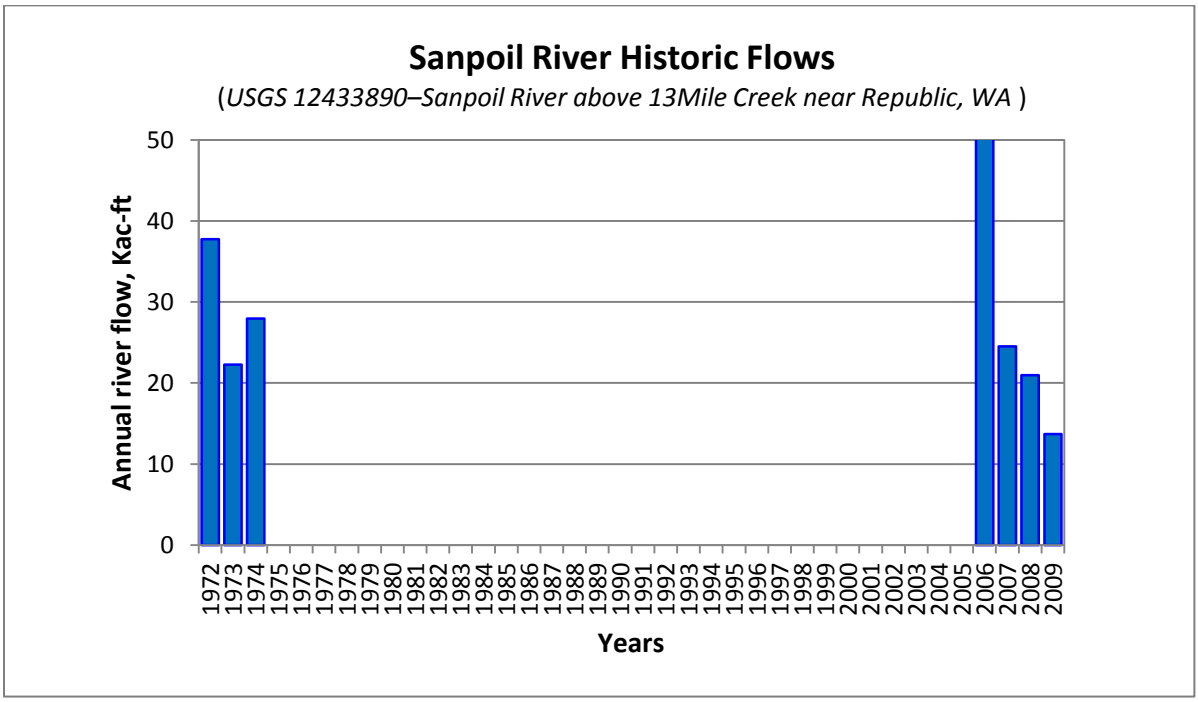

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Similkameen River near Nighthawk, WA)
River flow, cfs
6,000
5,000
4,000
3,000
2,000
1,000
0
Instream flow rule
Dry year (2001)
Avg.year (1981)
Wet year (1972)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

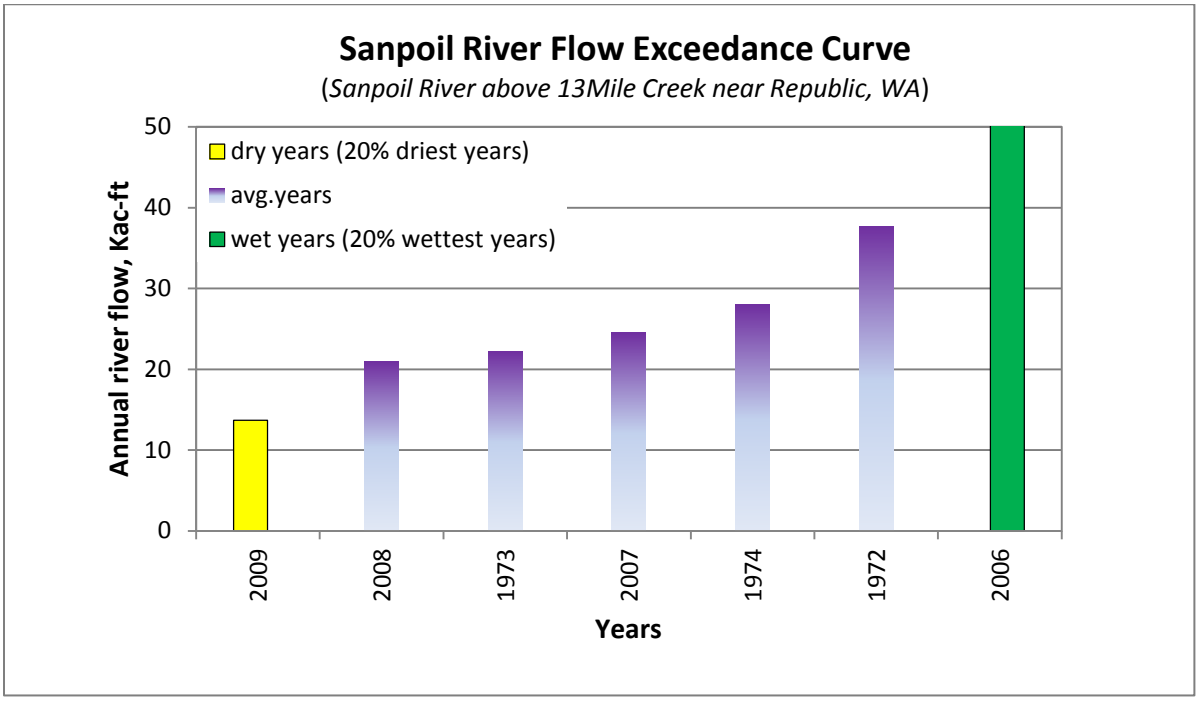

Water Deficit/Surplus Evaluation
(Similkameen River near Nighthawk, WA)
Deficit/Surplus, Kac-ft
300
250
200
150
100
50
0
-50
Wet year (1972)
Avg.year (1981)
Dry year (2001)
Instream Deficit
Dry–108K ac-ft
Avg–87 ac-ft
Wet–7K ac-ft
Instream Surplus
Dry–170K ac-ft
Avg–909K ac-ft
Wet–2.8 MAF
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

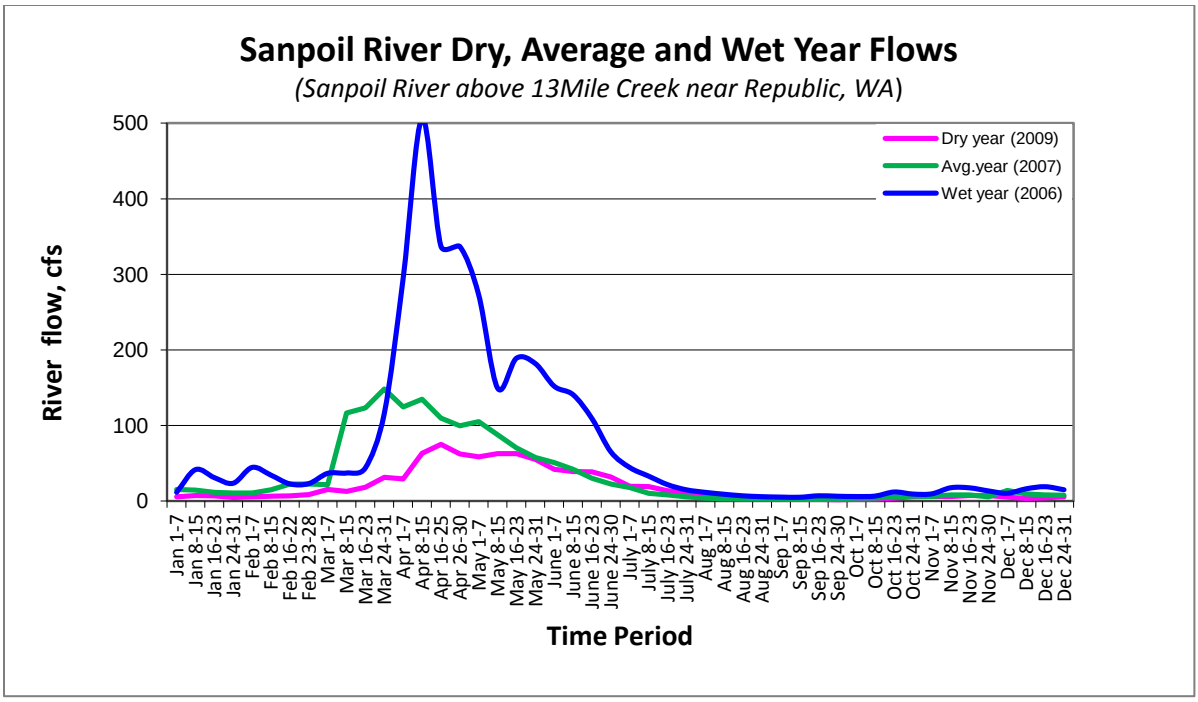

Comparison of All Dry Years Flow to Instream Flow Rule
(Similkameen River near Nighthawk, WA)
River flow, cfs
6,000
5,000
4,000
3,000
2,000
1,000
0
Instream flow rule
1929
1931
1940
1941
1944
1970
1973
1977
1979
1988
1992
1994
2001
2003
2005
2009
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Comparison of All Wet Years Flow to Instream Flow Rule
(Similkameen River near Nighthawk, WA)
River flow, cfs
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Instream flow rule
1934
1948
1950
1951
1954
1956
1959
1964
1971
1972
1974
1976
1990
1991
1997
1999
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

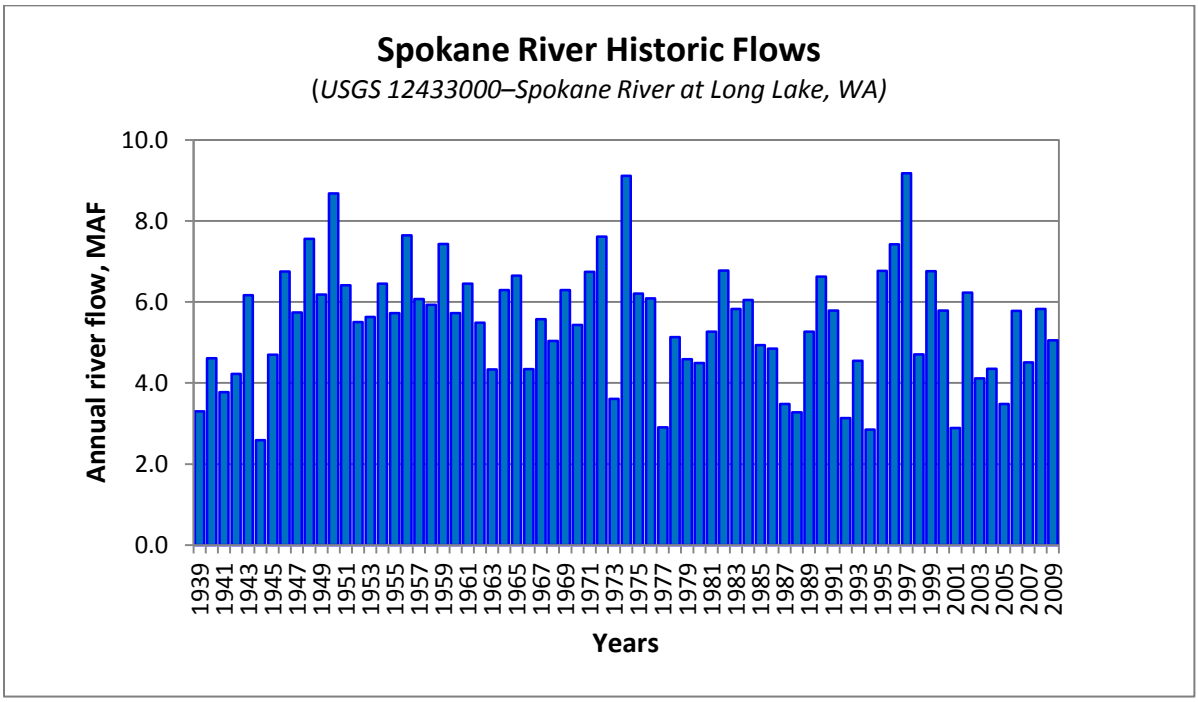
WRIA 52 (Sanpoil)

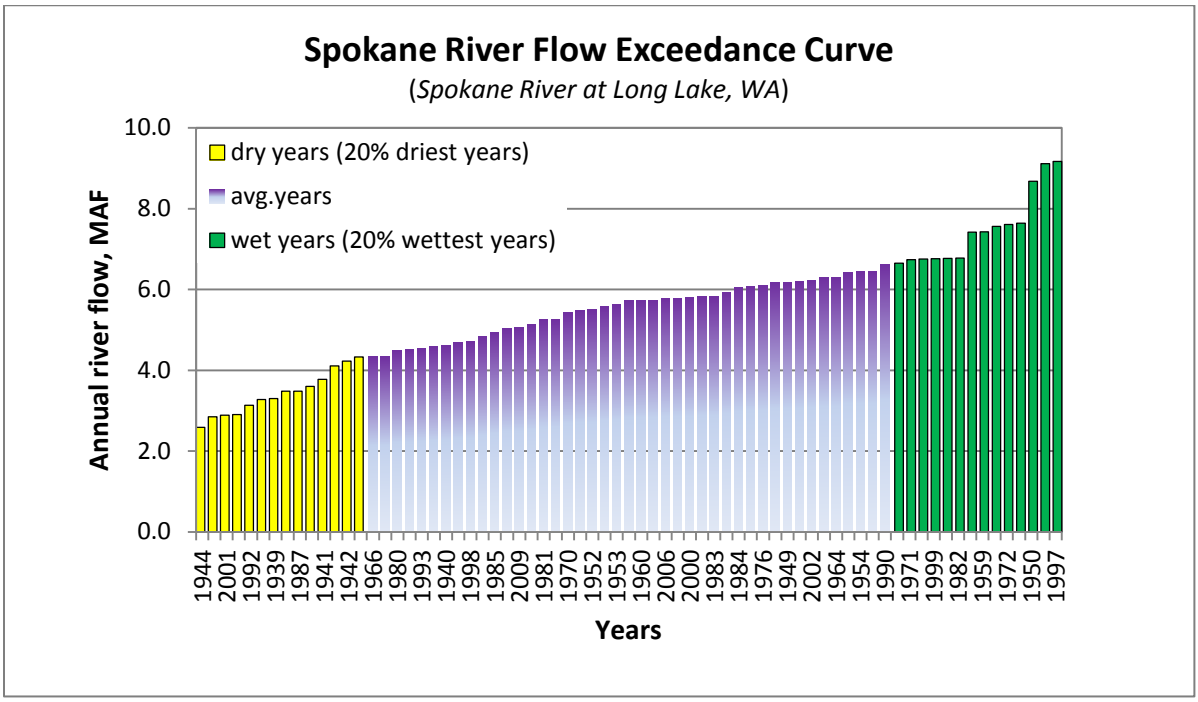


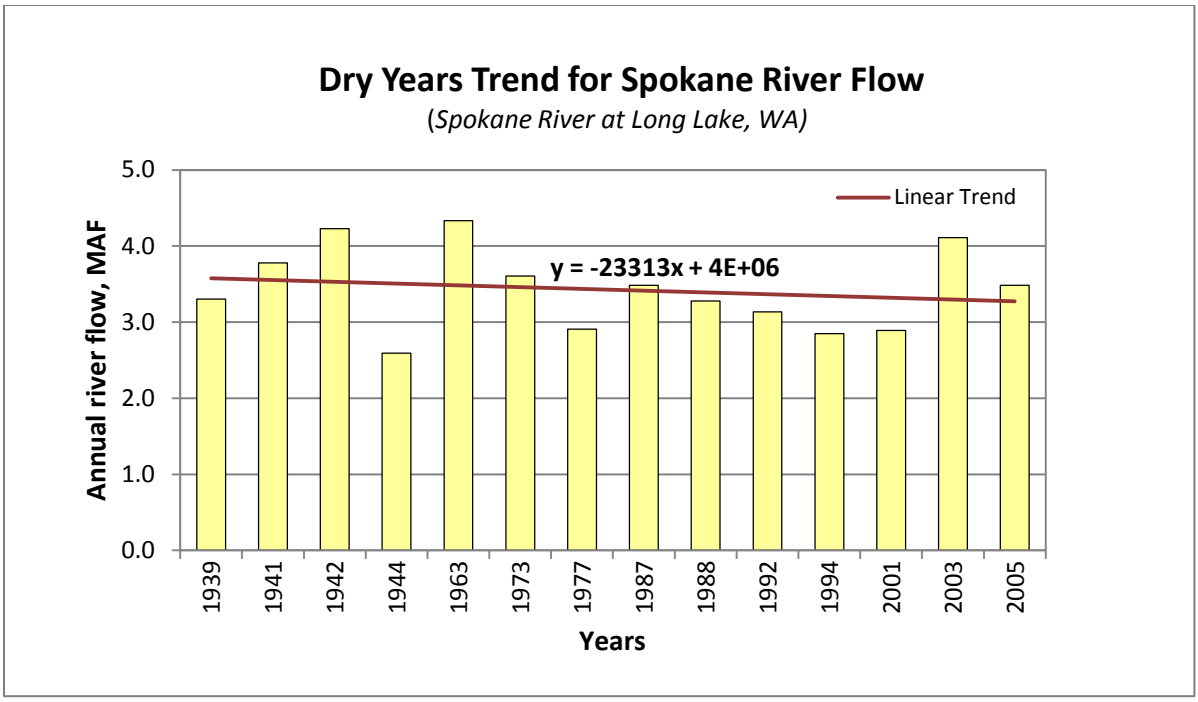


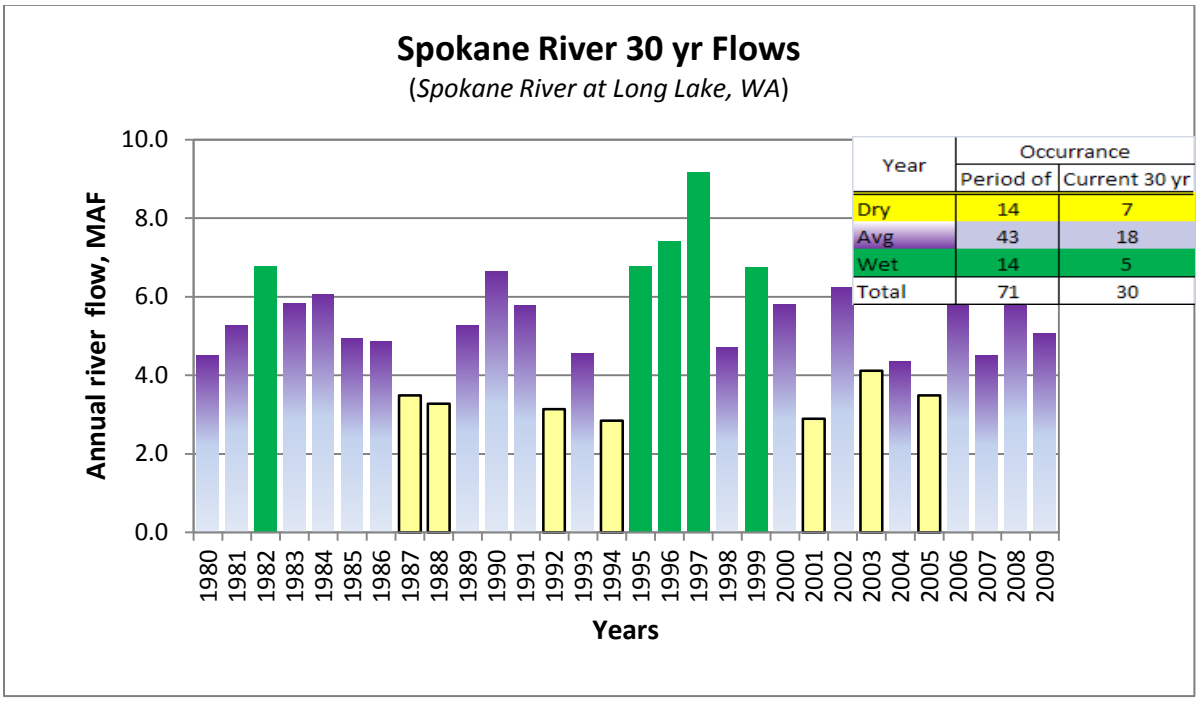

Sanpoil River Dry, Average and Wet Year Flows
(Sanpoil River above 13Mile Creek near Republic, WA)
River flow, cfs
500
400
300
200
100
0
Dry year (2009)
Avg.year (2007)
Wet year (2006)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

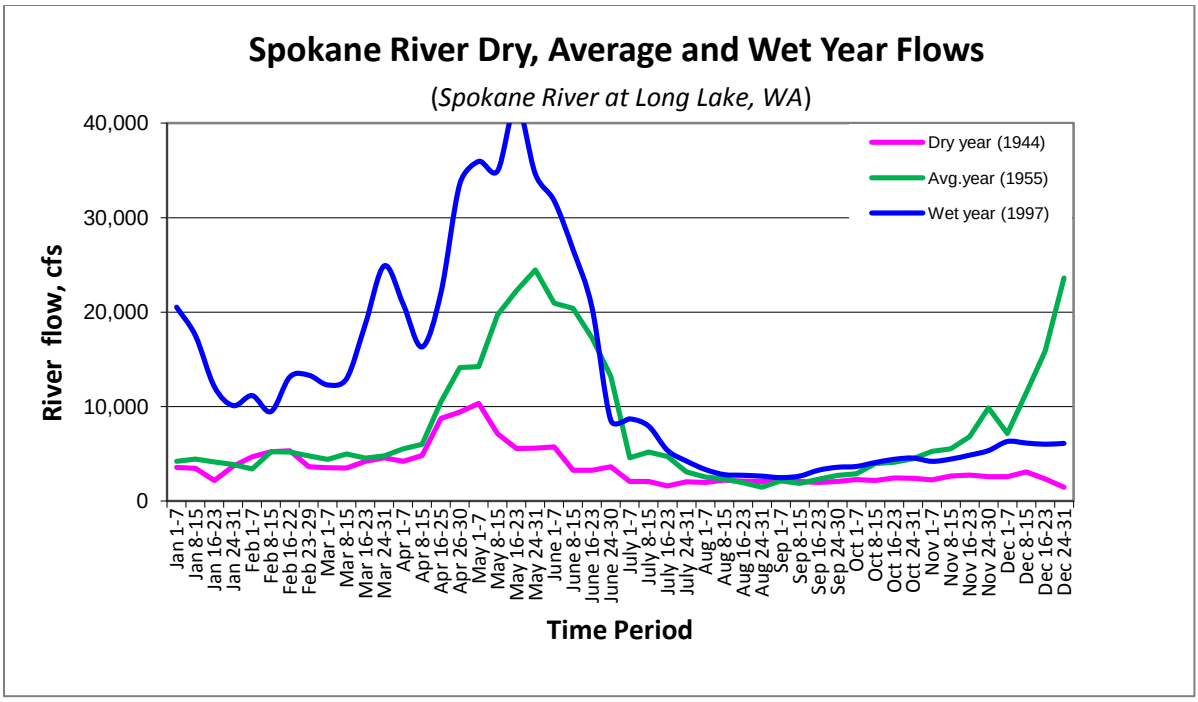
WRIA 54 (Lower Spokane)

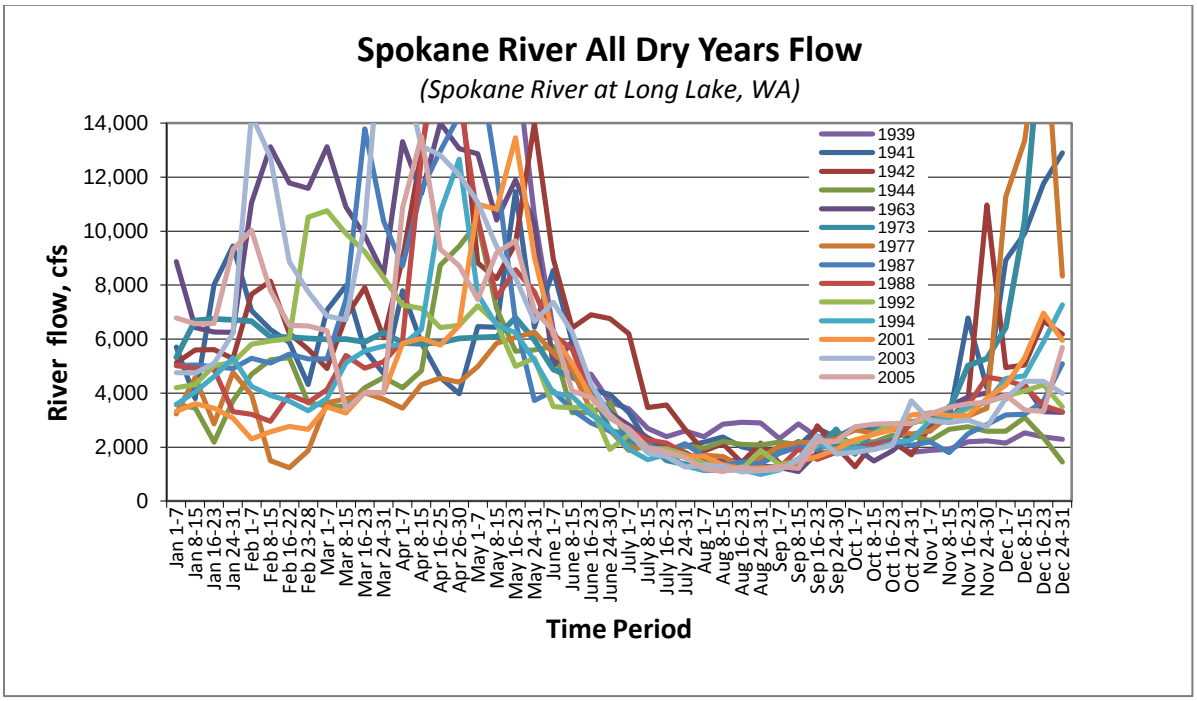


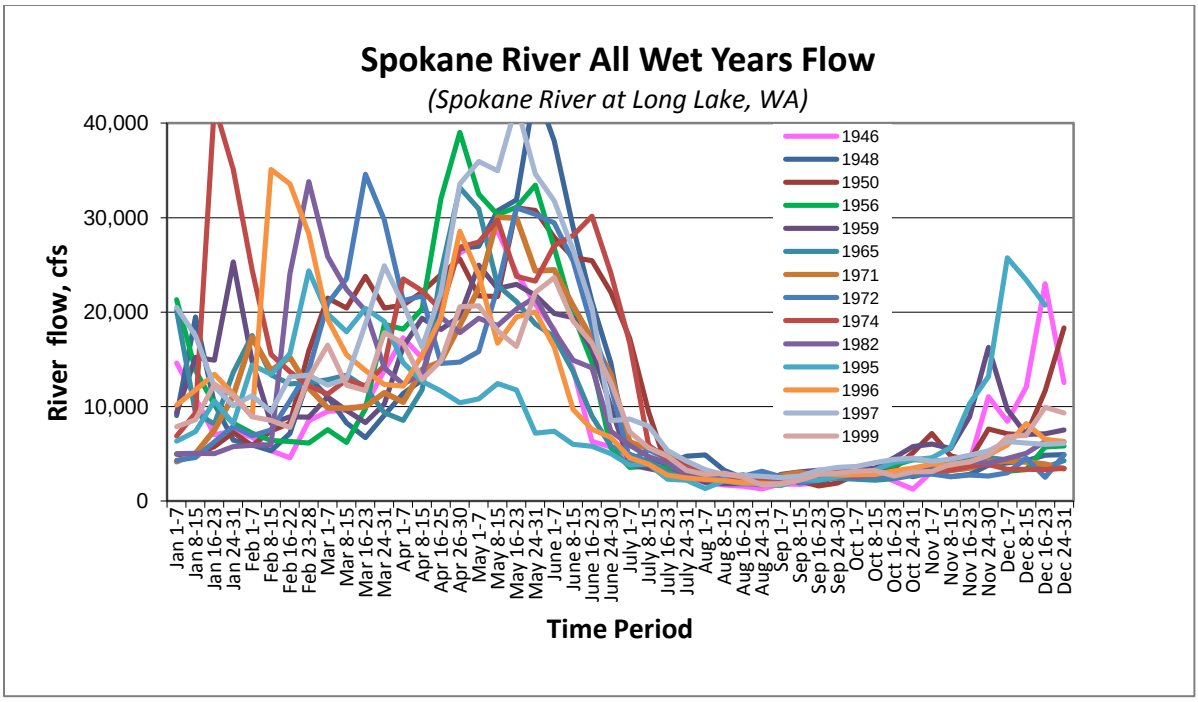


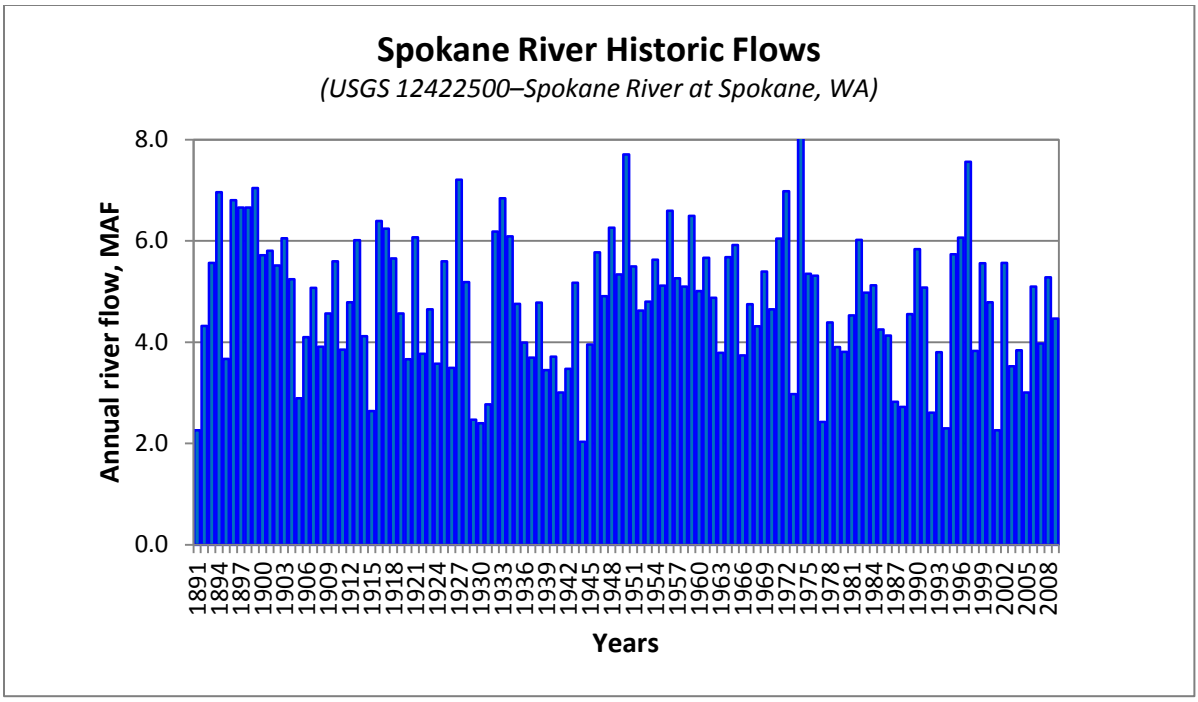

Dry Years Trend for Spokane River Flow
(Spokane River at Long Lake, WA)
Linear Trend
y = -23313x + 4E+06
Annual river flow, MAF
5.0
4.0
3.0
2.0
1.0
0.0
1939
1941
1942
1944
1963
1973
1977
1987
1988
1992
1994
2001
2003
2005
Years

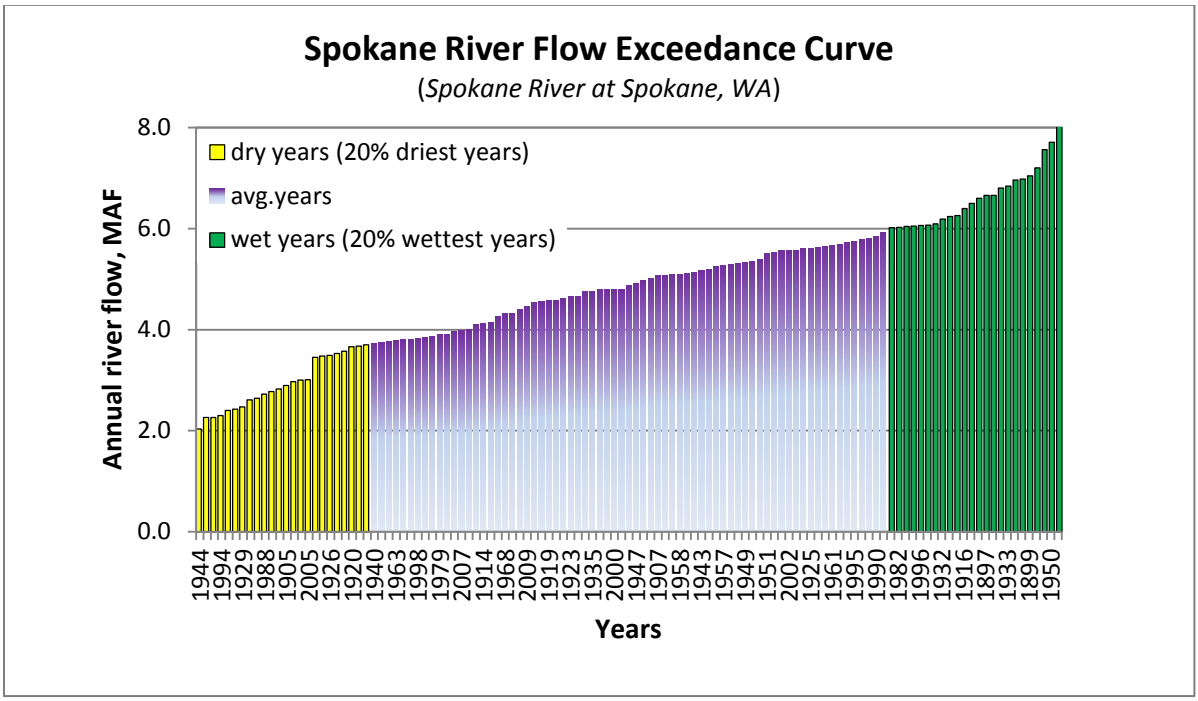

Spokane River 30 yr Flows
(Spokane River at Long Lake, WA)
Annual river flow, MAF
10.0
8.0
6.0
4.0
2.0
0.0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 14 7
Avg 43 18
Wet 14 5
Total 71 30

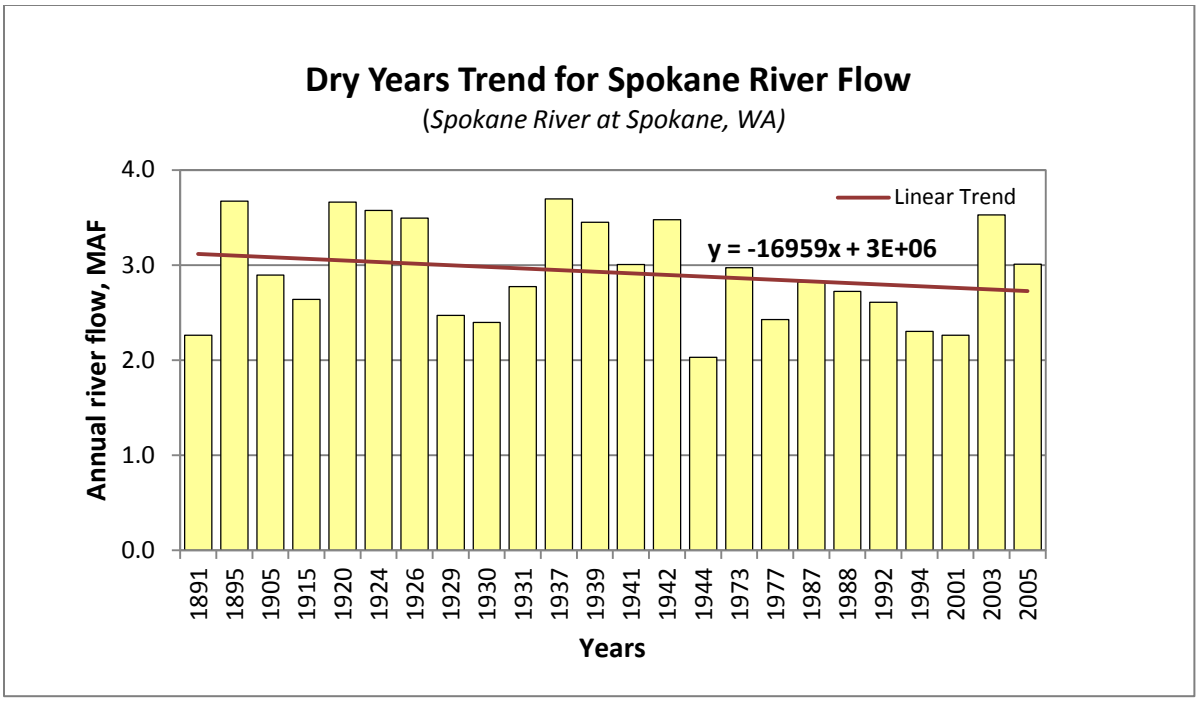

Spokane River Dry, Average and Wet Year Flows
(Spokane River at Long Lake, WA)
River flow, cfs
40,000
30,000
20,000
10,000
0
Dry year (1944)
Avg.year (1955)
Wet year (1997)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

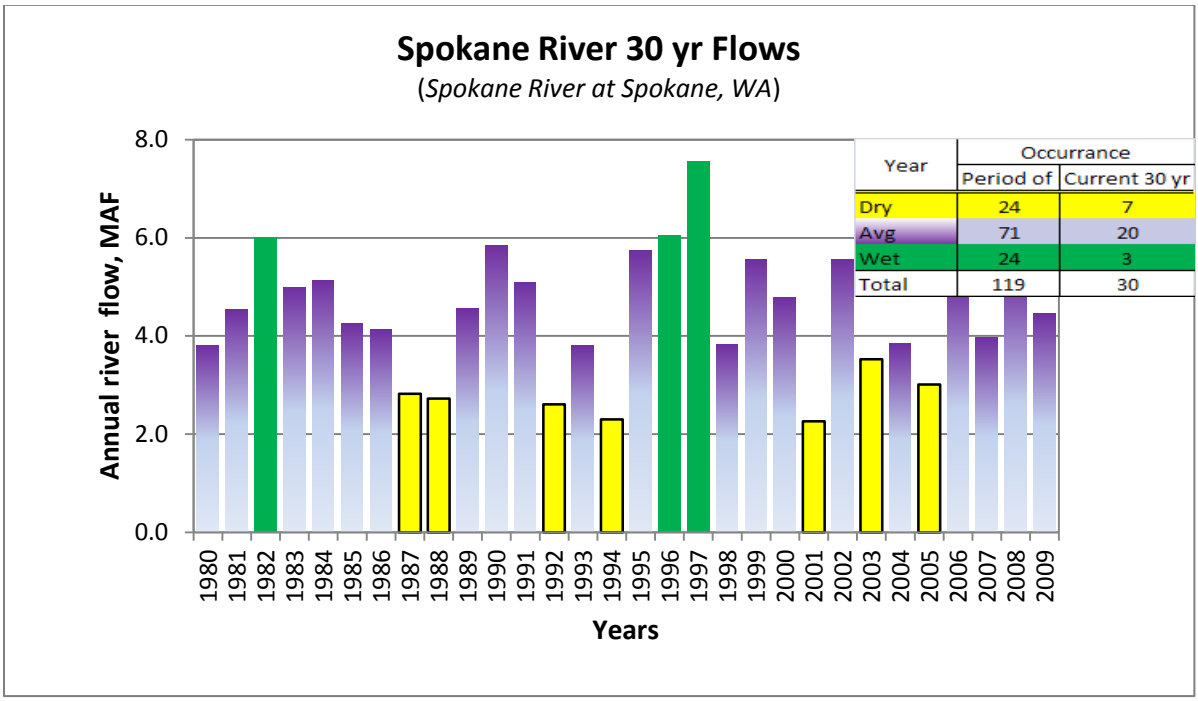

Spokane River All Dry Years Flow
(Spokane River at Long Lake, WA)
River flow, cfs
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1939
1941
1942
1944
1963
1973
1977
1987
1988
1992
1994
2001
2003
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

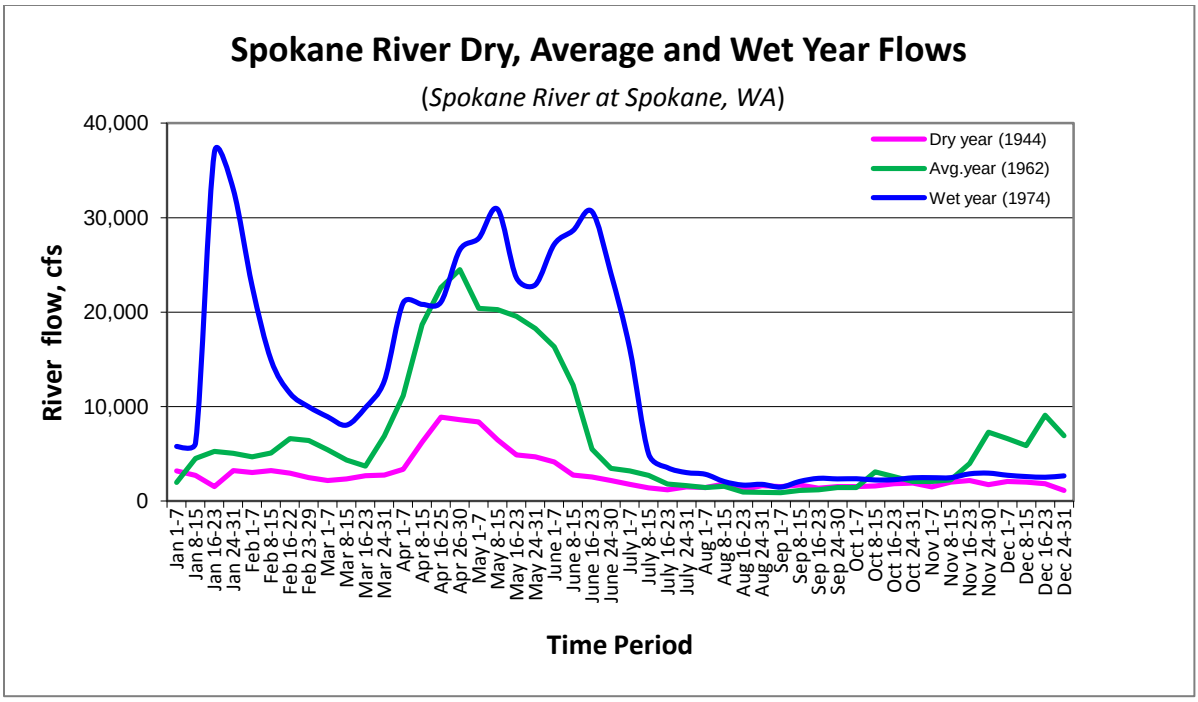

Spokane River All Wet Years Flow
(Spokane River at Long Lake, WA)
River flow, cfs
40,000
30,000
20,000
10,000
0
1946
1948
1950
1956
1959
1965
1971
1972
1974
1982
1995
1996
1997
1999
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

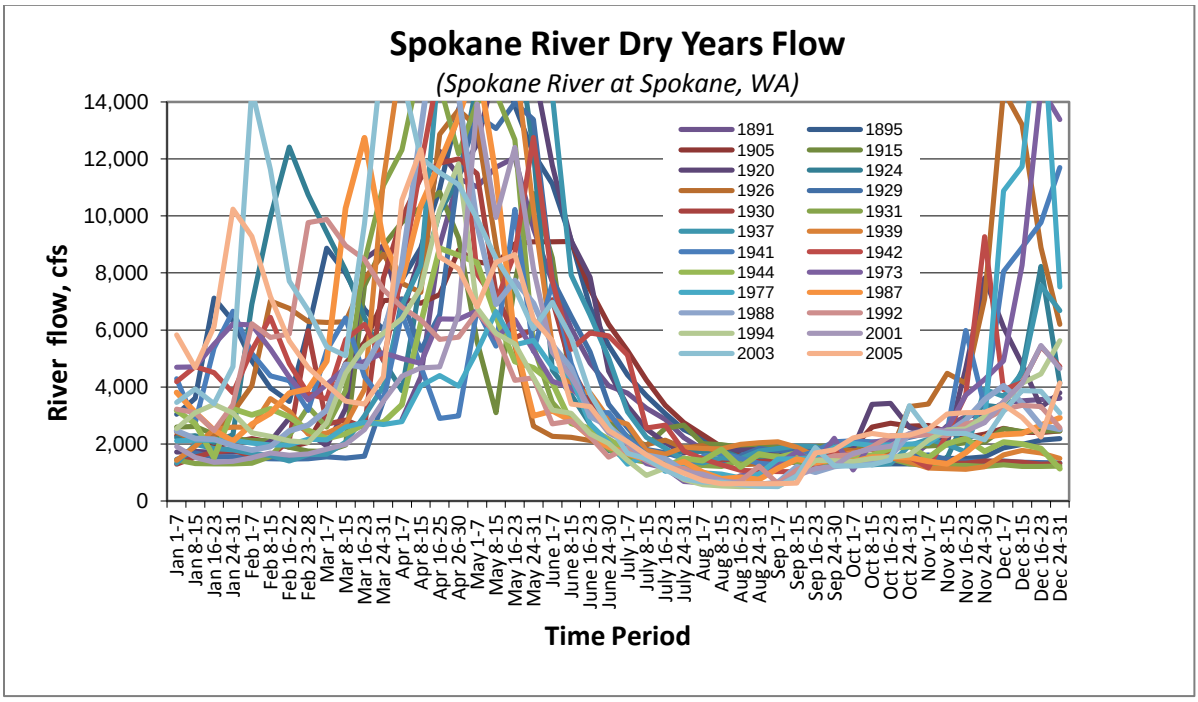

Spokane River Historic Flows
(USGS 12422500–Spokane River at Spokane, WA)
Annual river flow, MAF
8.0
6.0
4.0
2.0
0.0
1891
1894
1897
1900
1903
1906
1909
1912
1915
1918
1921
1924
1927
1930
1933
1936
1939
1942
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
Years

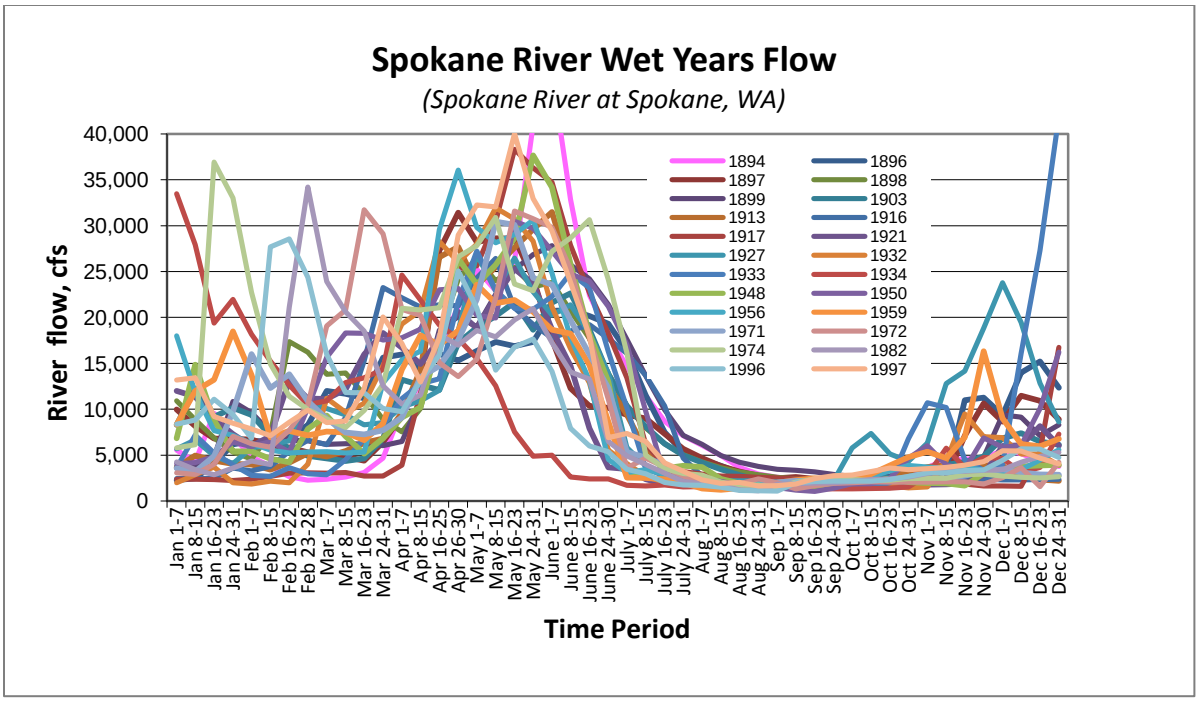

Spokane River Flow Exceedance Curve
(Spokane River at Spokane, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, MAF
8.0
6.0
4.0
2.0
0.0
1944
1994
1929
1988
1905
2005
1926
1920
1940
1963
1998
1979
2007
1914
1968
2009
1919
1923
1935
2000
1947
1907
1958
1943
1957
1949
1951
2002
1925
1961
1995
1990
1982
1996
1932
1916
1897
1933
1899
1950
Years


Dry Years Trend for Spokane River Flow
(Spokane River at Spokane, WA)
Linear Trend
y = -16959x + 3E+06
Annual river flow, MAF
4.0
3.0
2.0
1.0
0.0
1891
1895
1905
1915
1920
1924
1926
1929
1930
1931
1937
1939
1941
1942
1944
1973
1977
1987
1988
1992
1994
2001
2003
2005
Years

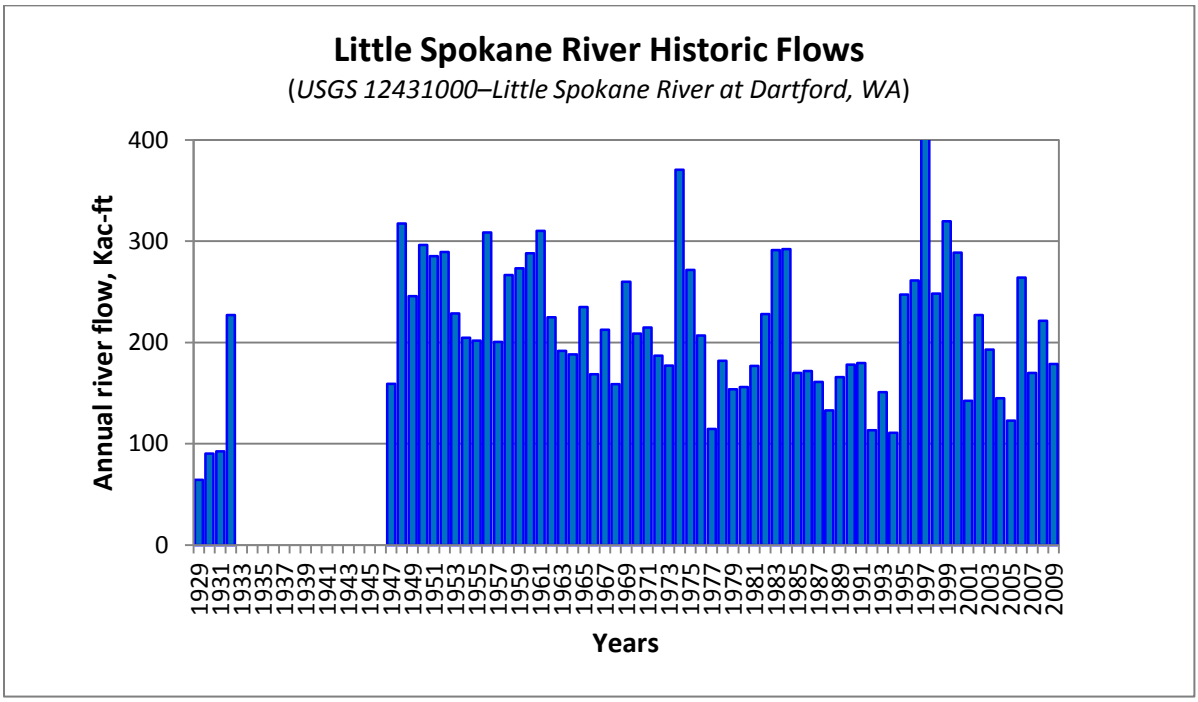

Spokane River 30 yr Flows
(Spokane River at Spokane, WA)
Annual river flow, MAF
8.0
6.0
4.0
2.0
0.0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 24 7
Avg 71 20
Wet 24 3
Total 119 30

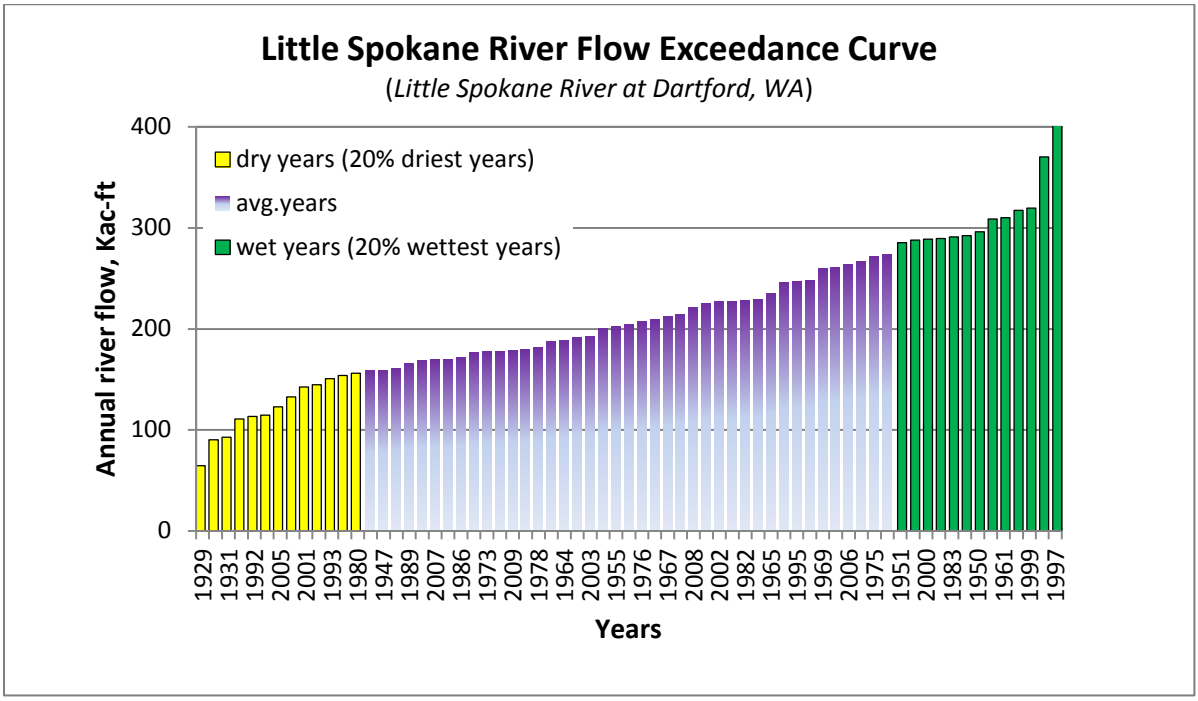

Spokane River Dry, Average and Wet Year Flows
(Spokane River at Spokane, WA)
River flow, cfs
40,000
30,000
20,000
10,000
0
Dry year (1944)
Avg.year (1962)
Wet year (1974)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

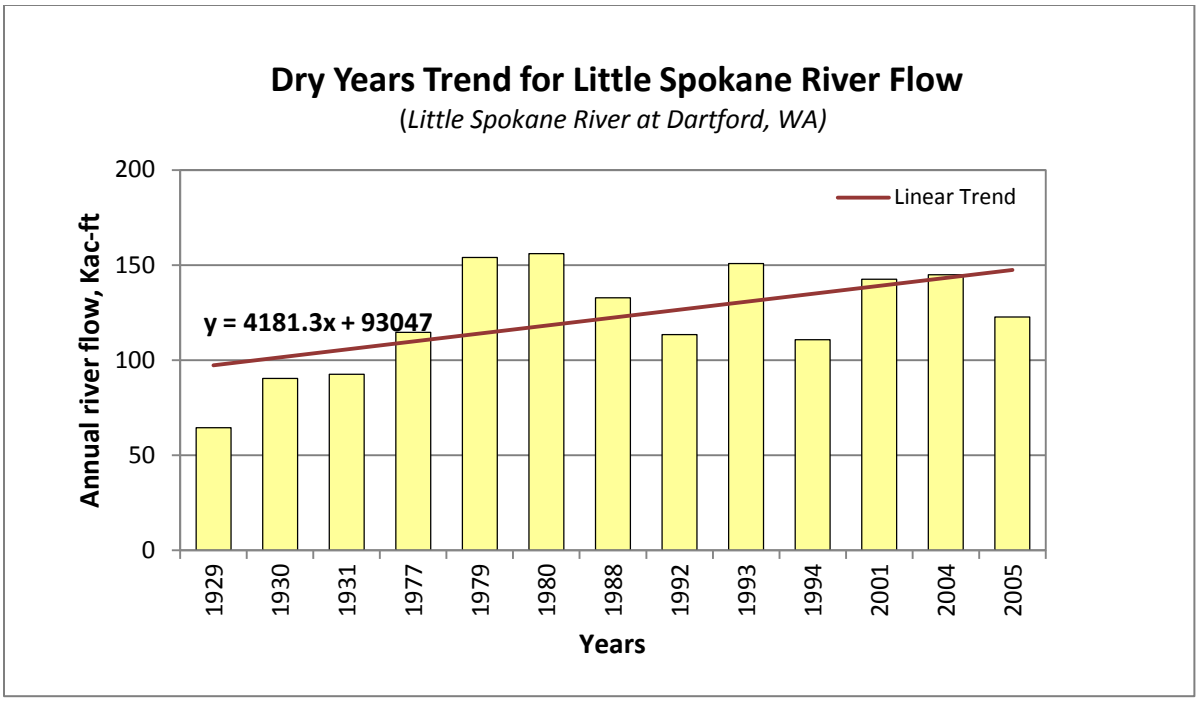

Spokane River Dry Years Flow
(Spokane River at Spokane, WA)
River flow, cfs
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1891
1895
1905
1915
1920
1924
1926
1929
1930
1931
1937
1939
1941
1942
1944
1973
1977
1987
1988
1992
1994
2001
2003
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

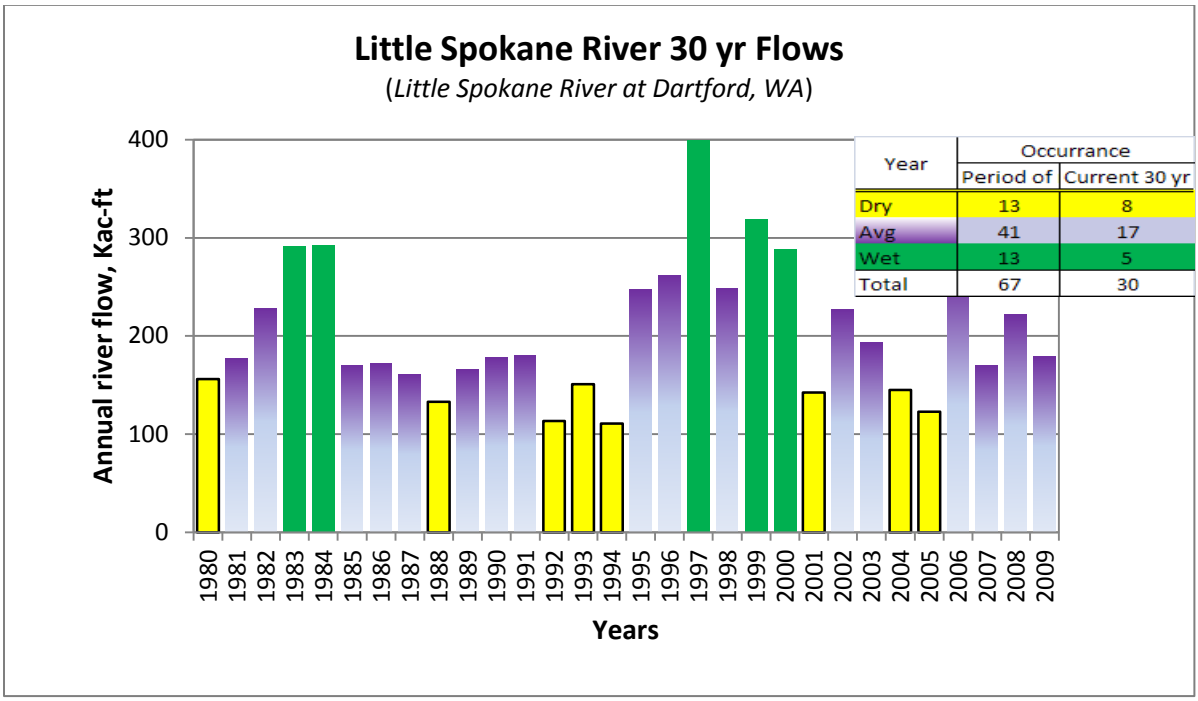

Spokane River Wet Years Flow
(Spokane River at Spokane, WA)
River flow, cfs
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
1894
1896
1897
1898
1899
1903
1913
1916
1917
1921
1927
1932
1933
1934
1948
1950
1956
1959
1971
1972
1974
1982
1996
1997
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

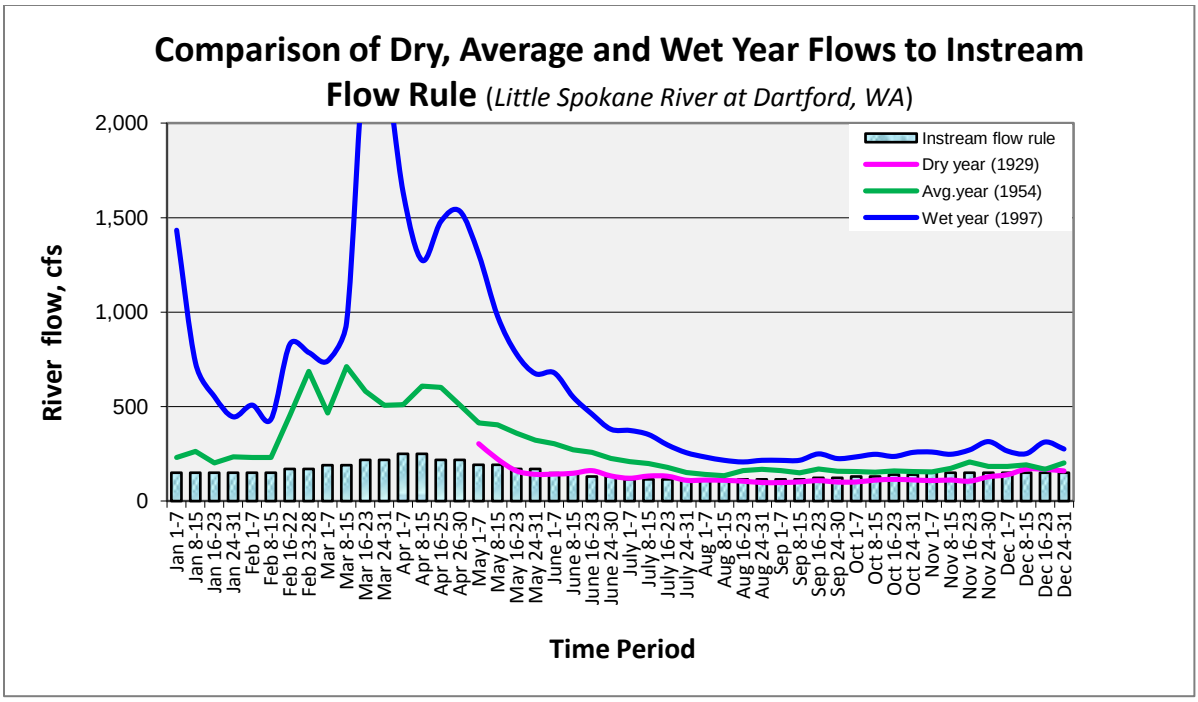
WRIA 55 (Little Spokane)






Dry Years Trend for Little Spokane River Flow
(Little Spokane River at Dartford, WA)
Linear Trend
y = 4181.3x + 93047
Annual river flow, Kac-ft
200
150
100
50
0
1929
1930
1931
1977
1979
1980
1988
1992
1993
1994
2001
2004
2005
Years


Little Spokane River 30 yr Flows
(Little Spokane River at Dartford, WA)
Annual river flow, Kac-ft
400
300
200
100
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 13 8
Avg 41 17
Wet 13 5
Total 67 30


Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Little Spokane River at Dartford, WA)
River flow, cfs
2,000
1,500
1,000
500
0
Instream flow rule
Dry year (1929)
Avg.year (1954)
Wet year (1997)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
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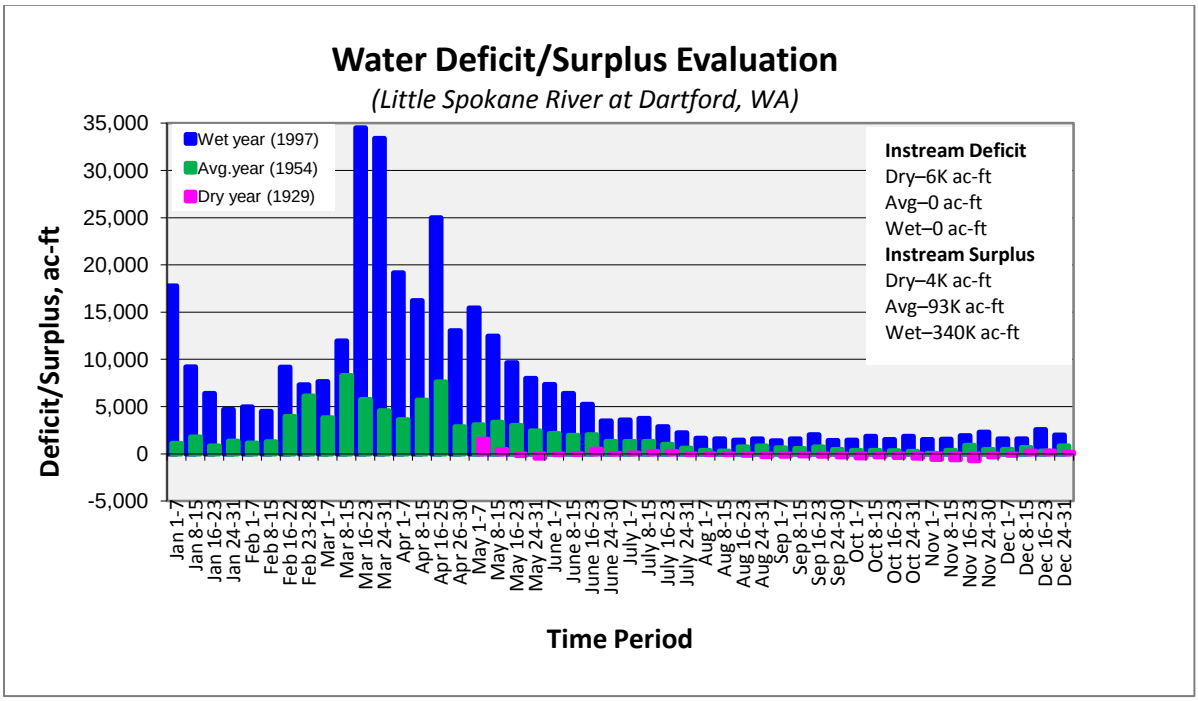
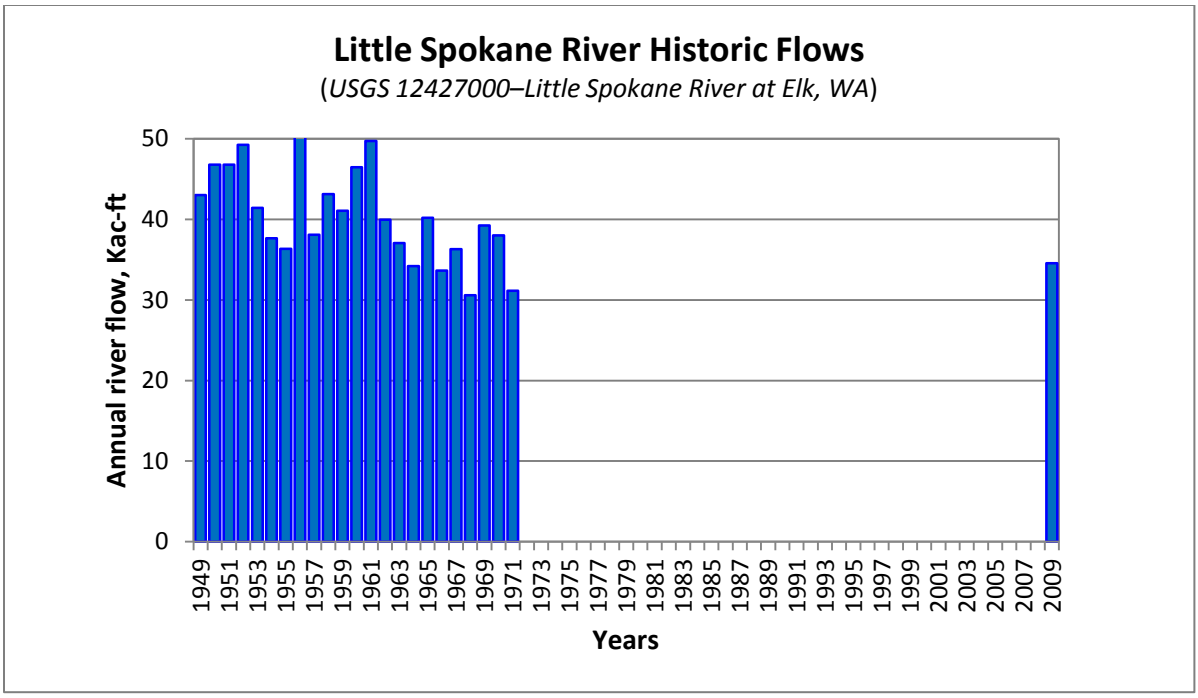
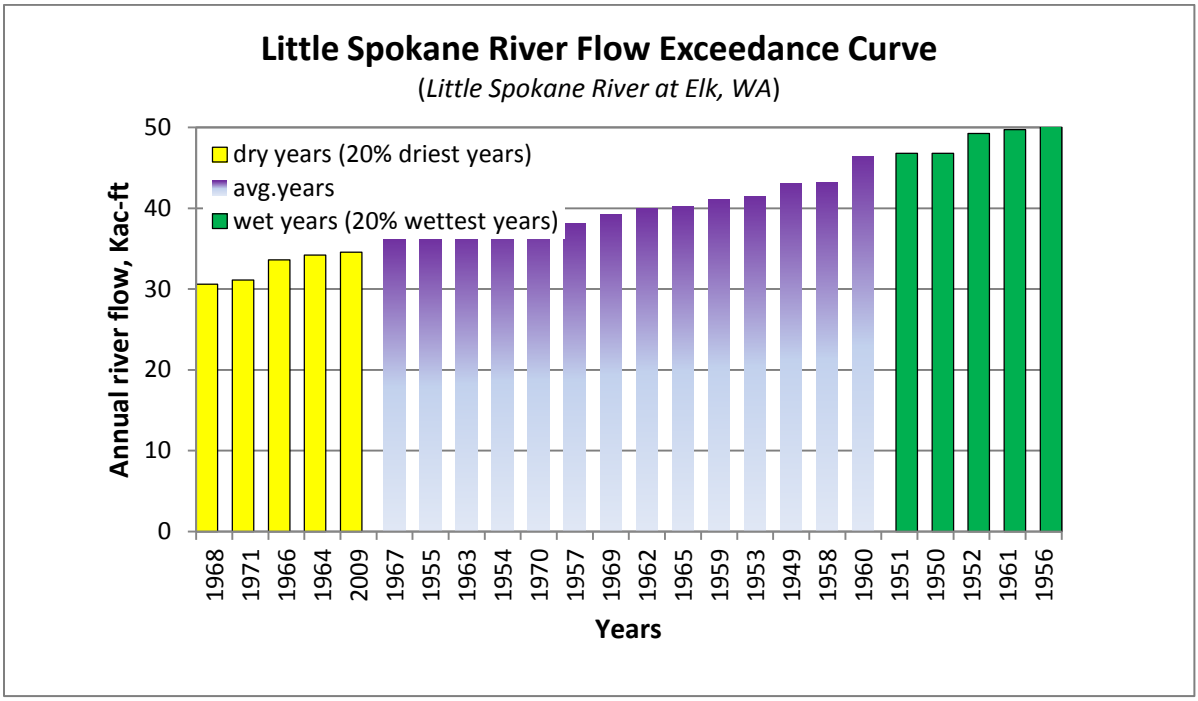
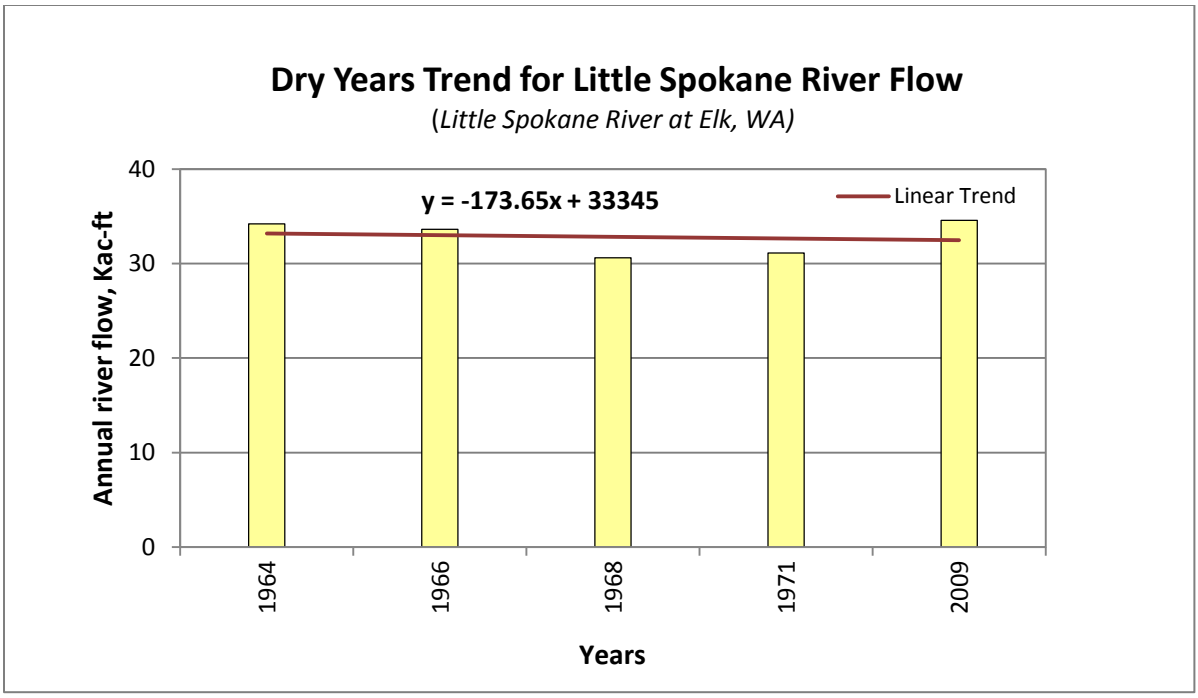
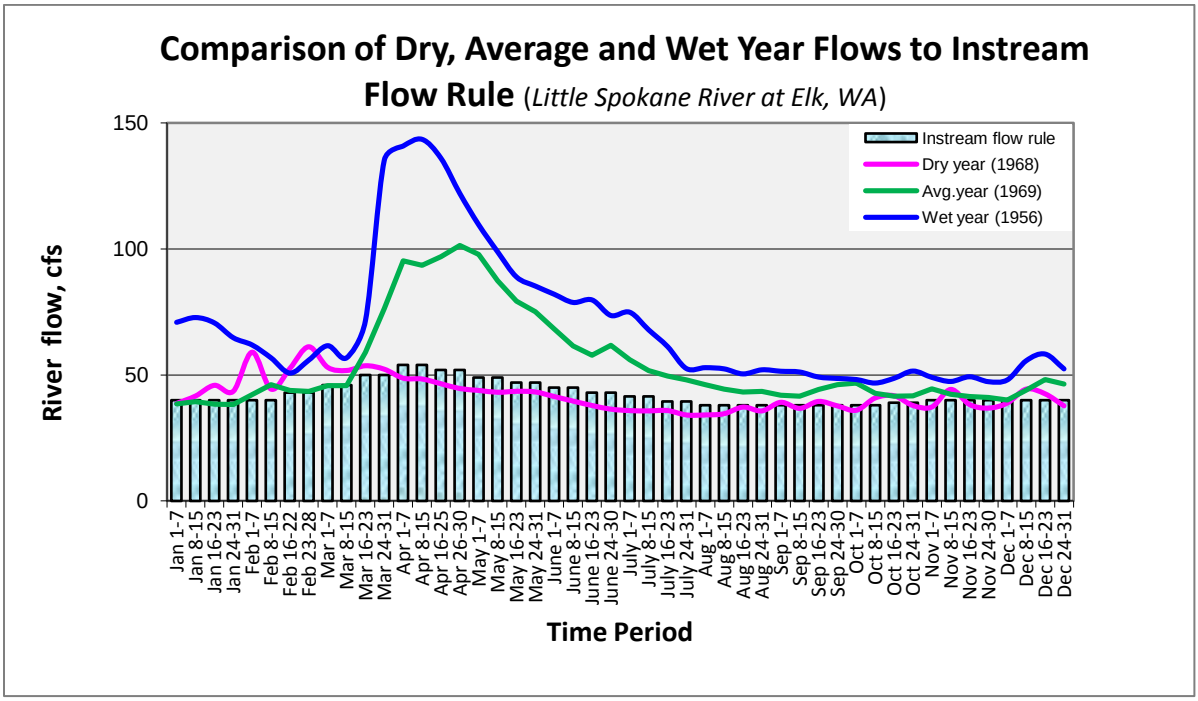
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

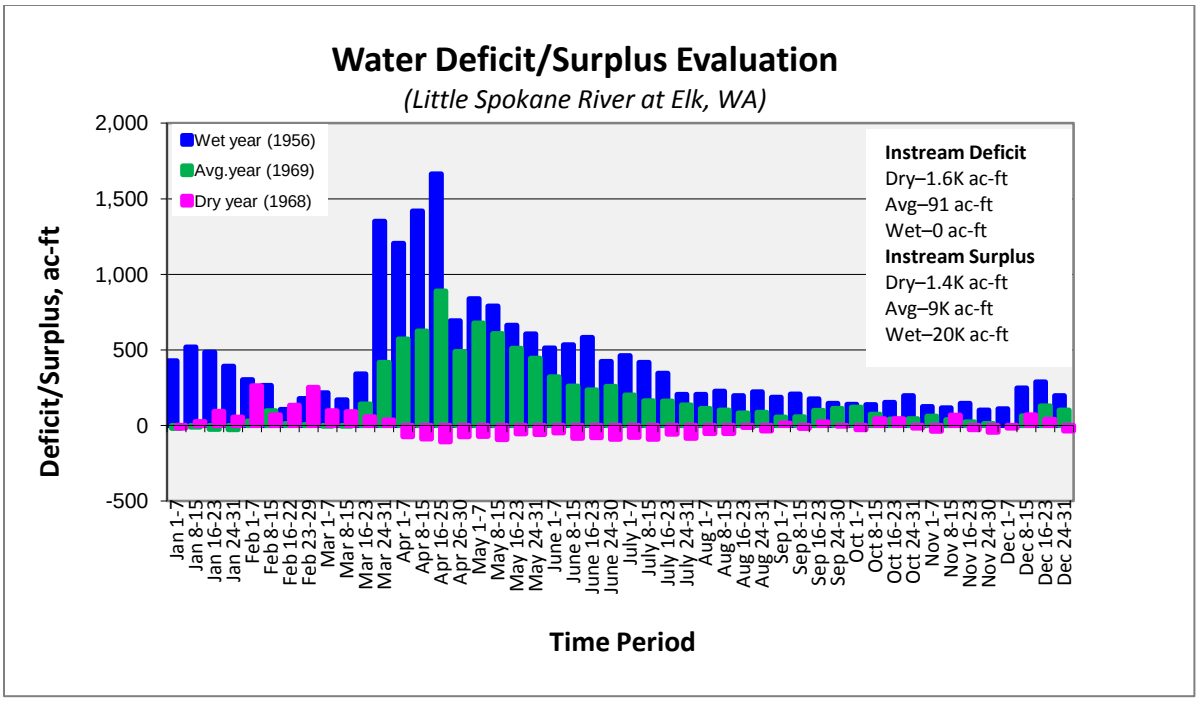

Water Deficit/Surplus Evaluation
(Little Spokane River at Dartford, WA)
Deficit/Surplus, ac-ft
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
-5,000
Wet year (1997)
Avg.year (1954)
Dry year (1929)
Instream Deficit
Dry–6K ac-ft
Avg–0 ac-ft
Wet–0 ac-ft
Instream Surplus
Dry–4K ac-ft
Avg–93K ac-ft
Wet–340K ac-ft
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

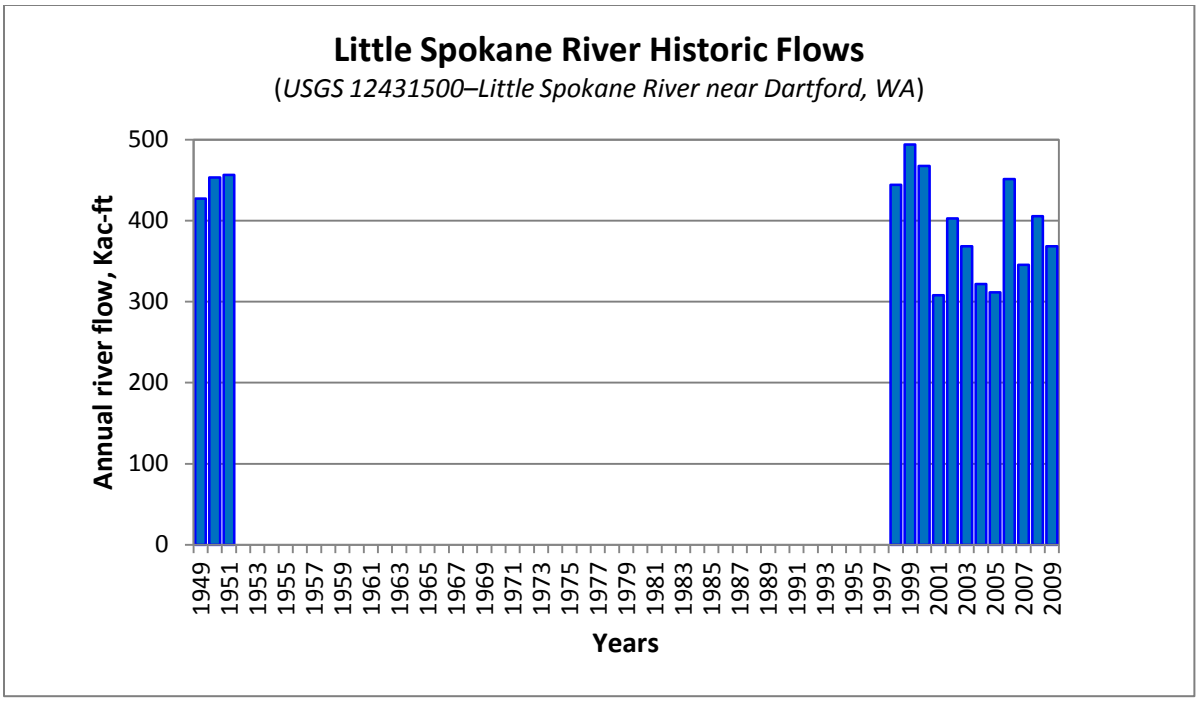

Little Spokane River Historic Flows
(USGS 12427000–Little Spokane River at Elk, WA)
Annual river flow, Kac-ft
0
10
20
30
40
50
1949
1951
1953
1955
1957
1959
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Years

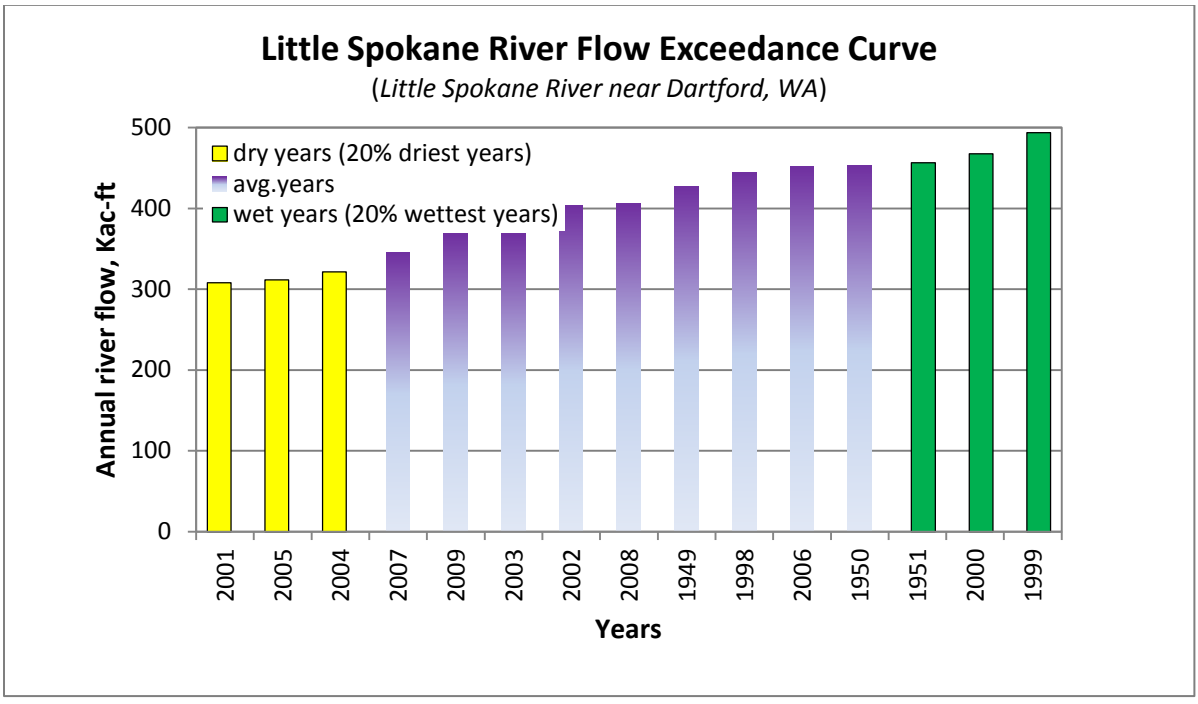

Little Spokane River Flow Exceedance Curve
(Little Spokane River at Elk, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, Kac-ft
0
10
20
30
40
50
1968
1971
1966
1964
2009
1967
1955
1963
1954
1970
1957
1969
1962
1965
1959
1953
1949
1958
1960
1951
1950
1952
1961
1956
Years

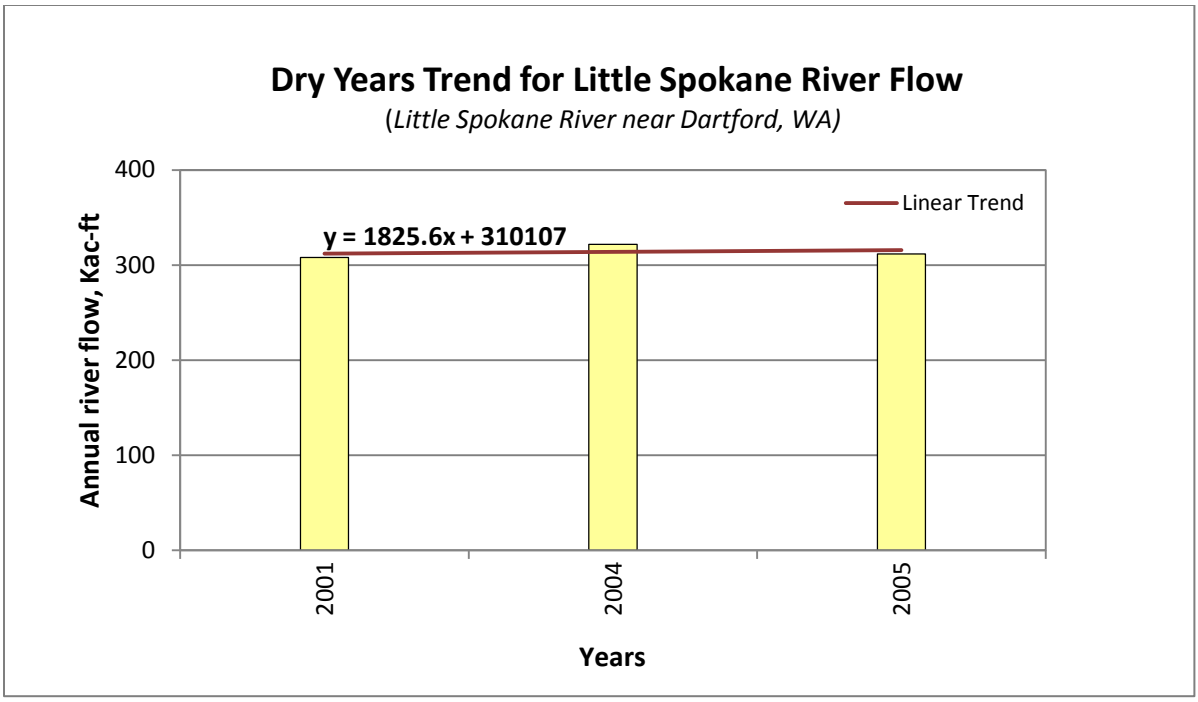

Dry Years Trend for Little Spokane River Flow
(Little Spokane River at Elk, WA)
y = -173.65x + 33345
Linear Trend
Annual river flow, Kac-ft
40
30
20
10
0
1964
1966
1968
1971
2009
Years

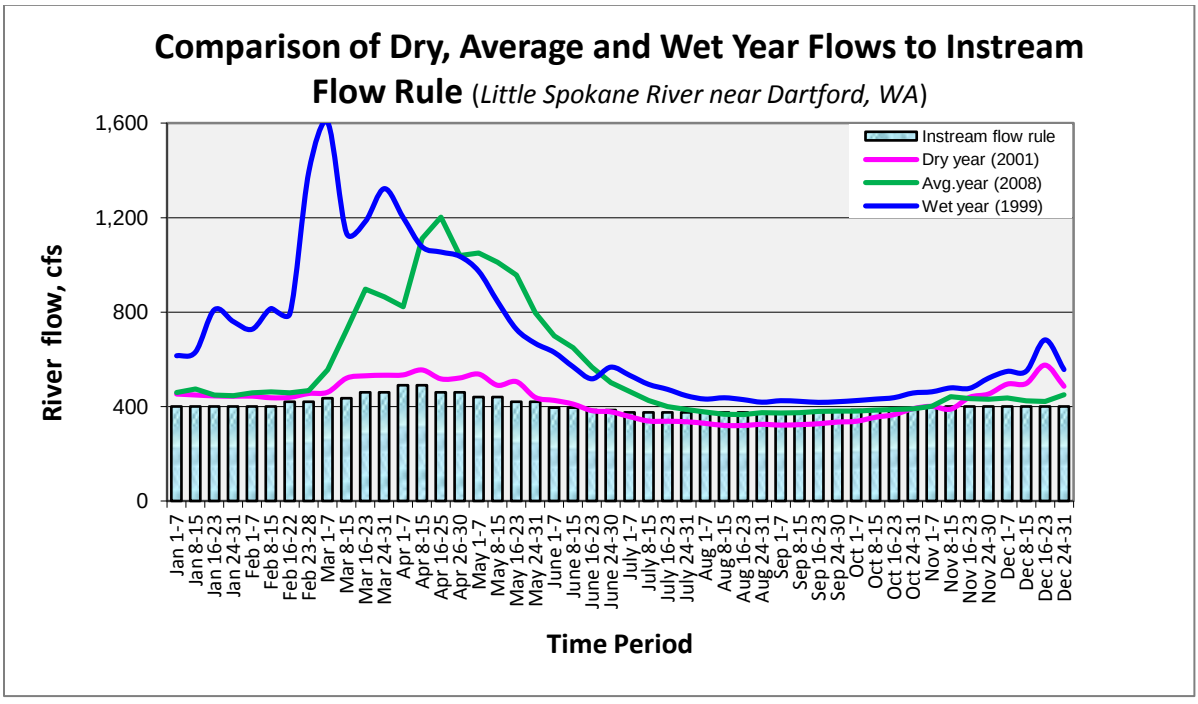

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Little Spokane River at Elk, WA)
Instream flow rule
Dry year (1968)
Avg.year (1969)
Wet year (1956)
River flow, cfs
150
100
50
0
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

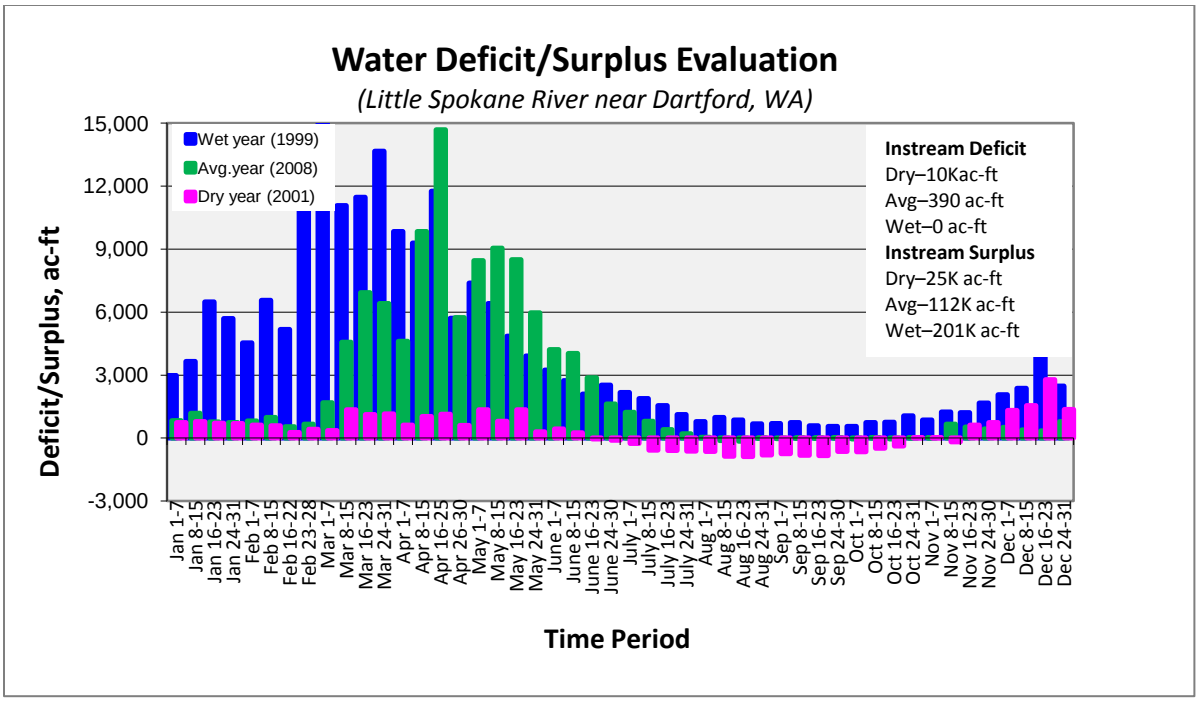

Water Deficit/Surplus Evaluation
(Little Spokane River at Elk, WA)
Deficit/Surplus, ac-ft
2,000
1,500
1,000
500
0
-500
Wet year (1956)
Avg.year (1969)
Dry year (1968)
Instream Deficit
Dry–1.6K ac-ft
Avg–91 ac-ft
Wet–0 ac-ft
Instream Surplus
Dry–1.4K ac-ft
Avg–9K ac-ft
Wet–20K ac-ft
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

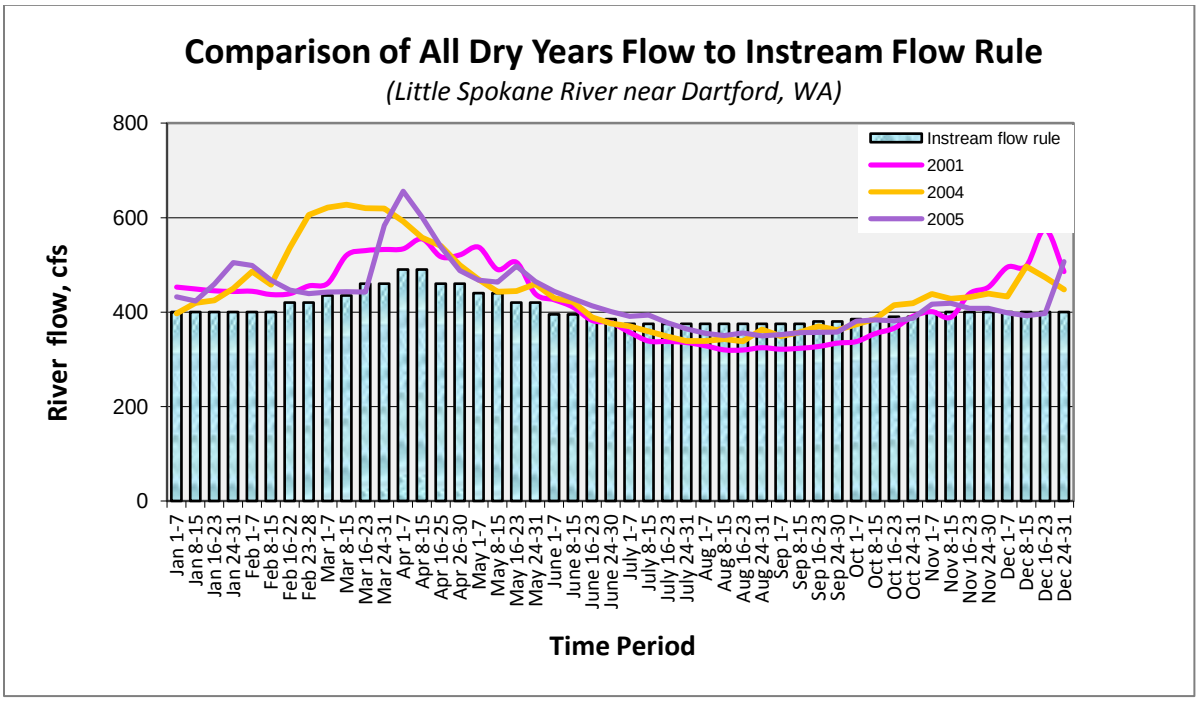

Little Spokane River Historic Flows
(USGS 12431500–Little Spokane River near Dartford, WA)
Annual river flow, Kac-ft
500
400
300
200
100
0
1949
1951
1953
1955
1957
1959
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Years

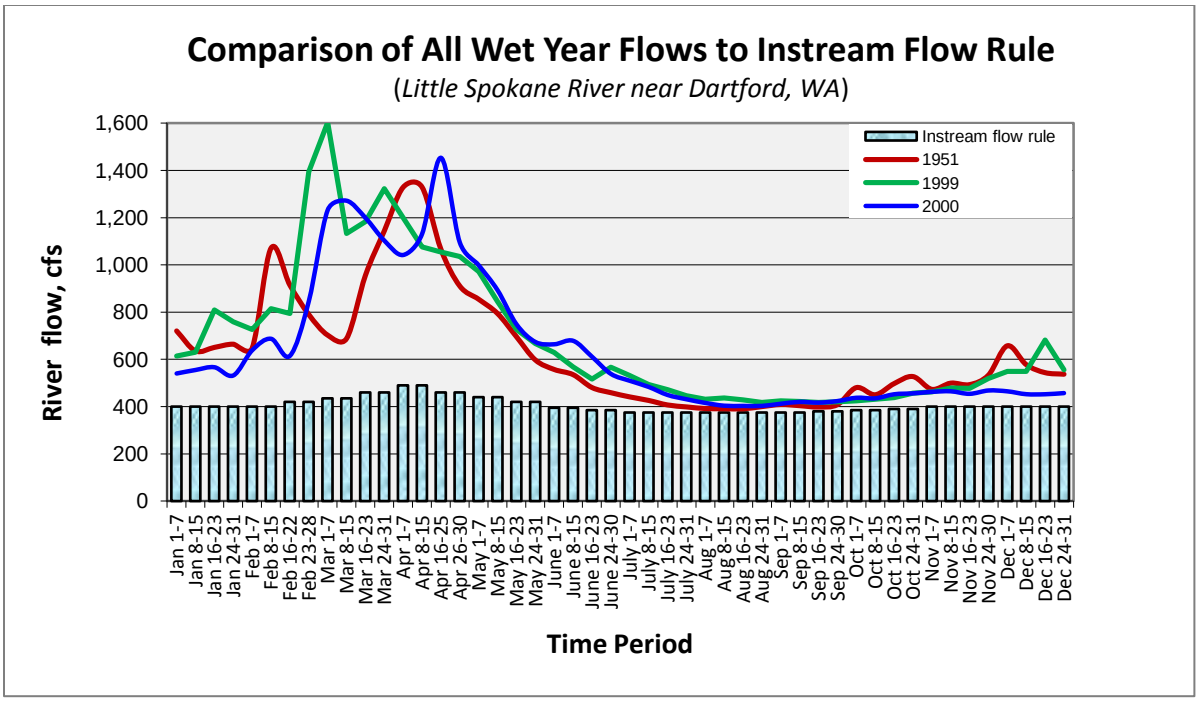

Little Spokane River Flow Exceedance Curve
(Little Spokane River near Dartford, WA)
Annual river flow, Kac-ft
500
400
300
200
100
0
dry years (20% driest years)
avg.years
wet years (20% wettest years)
2001
2005
2004
2007
2009
2003
2002
2008
1949
1998
2006
1950
1951
2000
1999
Years


Dry Years Trend for Little Spokane River Flow
(Little Spokane River near Dartford, WA)
Annual river flow, Kac-ft
400
300
200
100
0
y = 1825.6x + 310107
Linear Trend
2001
2004
2005
Years


Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Little Spokane River near Dartford, WA)
River flow, cfs
1,600
1,200
800
400
0
Instream flow rule
Dry year (2001)
Avg.year (2008)
Wet year (1999)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Water Deficit/Surplus Evaluation
(Little Spokane River near Dartford, WA)
Deficit/Surplus, ac-ft
15,000
12,000
9,000
6,000
3,000
0
-3,000
Wet year (1999)
Avg.year (2008)
Dry year (2001)
Instream Deficit
Dry–10Kac-ft
Avg–390 ac-ft
Wet–0 ac-ft
Instream Surplus
Dry–25K ac-ft
Avg–112K ac-ft
Wet–201K ac-ft
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Comparison of All Dry Years Flow to Instream Flow Rule
(Little Spokane River near Dartford, WA)
River flow, cfs
800
600
400
200
0
Instream flow rule
2001
2004
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

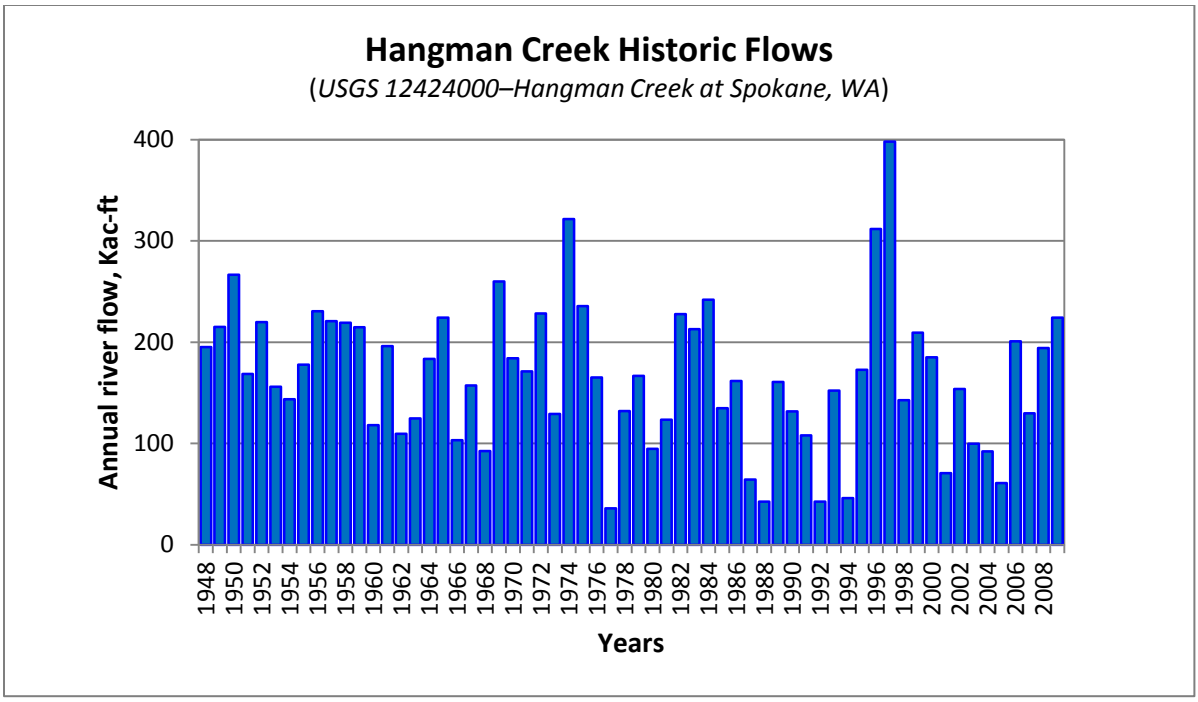

Comparison of All Wet Year Flows to Instream Flow Rule
(Little Spokane River near Dartford, WA)
River flow, cfs
1,600
1,400
1,200
1,000
800
600
400
200
0
Instream flow rule
1951
1999
2000
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

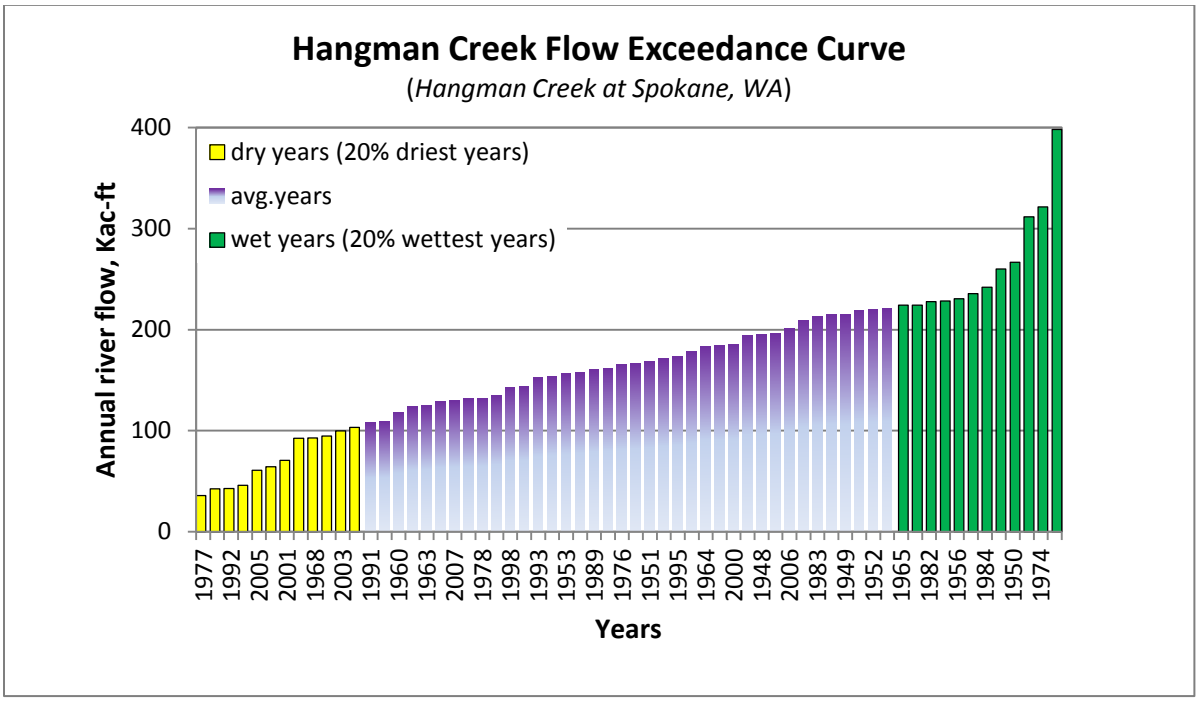
WRIA 56 (Hangman)

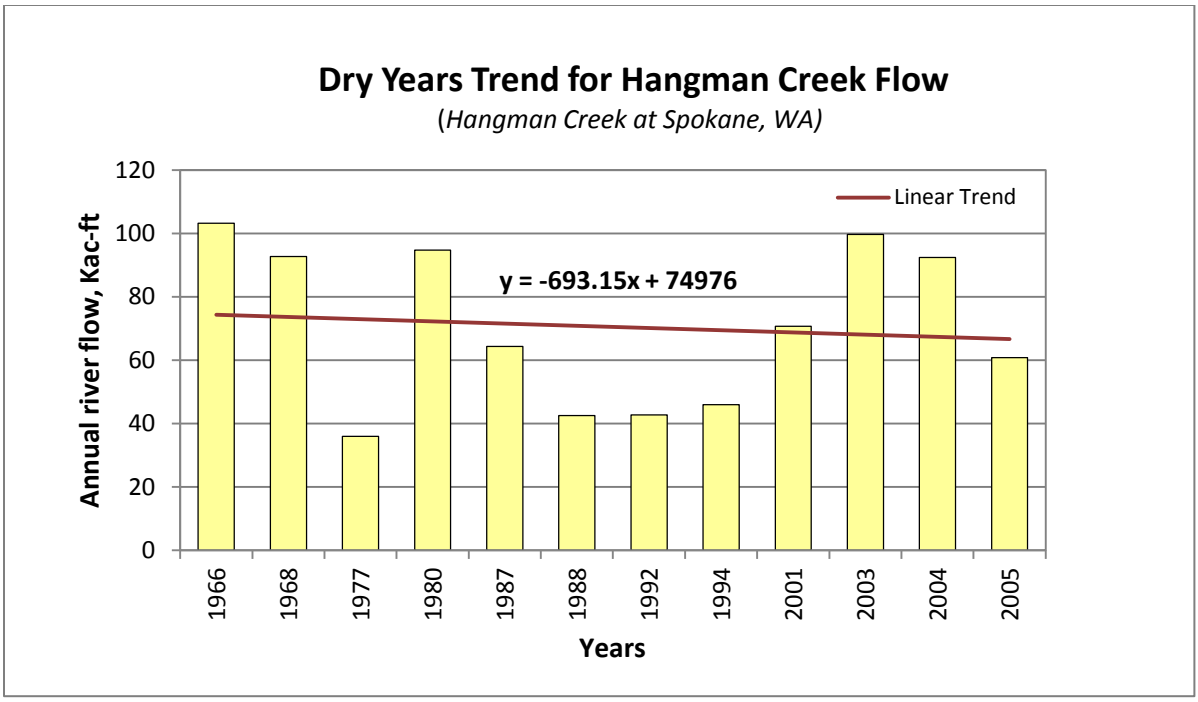
For WRIA 55 OCR graphed the flows of 3 rivers and streams. For most rivers and streams, a series of six to eight graphs were created. The results provide information on historic flow levels, drought occurrences and when instream flow rules are or are not met. These data contribute to OCR's understanding of historic trends, drought patterns and hydrograph variability. For example, by graphing the 81 (1929–2009) flows of the Little Spokane River at Dartford, gauge number 12431000, it is shown that:

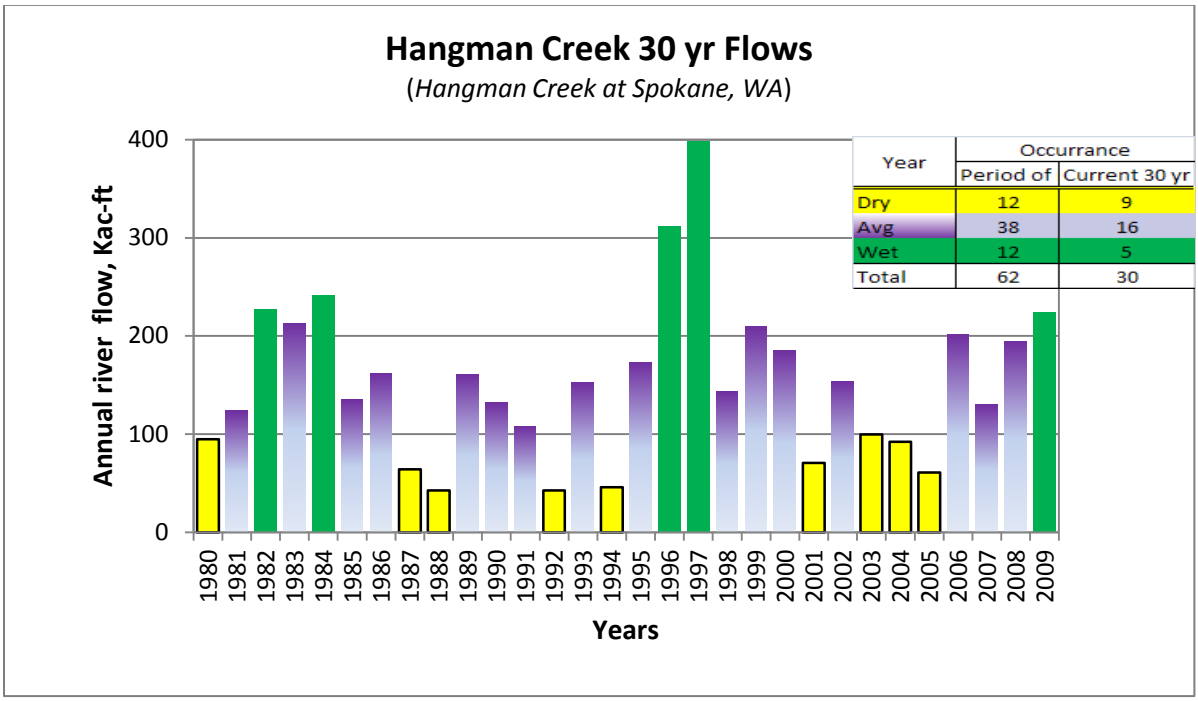
- Historic mean annual flows generally varied between 0.06 and 0.45 million acre-feet (MAF).
- Ecology defined "dry" years as the 80% exceedance value (80% of the time more water was available). Over the last 30 years, dry years occurred 8 times, with the worst stretch being 3 consecutive dry years in 1992-1994 and 2 consecutive dry years in 2004-2005. During this same time period, the availability of water during dry years worsened by 21%.
- Ecology compared different water years (dry, average, wet) to the instream flow rule. The instream flow rule is always met in average years. In dry years, the instream flow is not met in early summer and in the winter.
- The magnitude of unmet instream flows is small. For example, in average years, there is no instream flow deficit for the entire year, which grows to 6,000 acre-feet in dry years.
- Water is available in-basin to address instream shortages through OCR-funded projects (e.g. storage, conservation, pump exchanges). For example, the average water year surplus is 93,000 acre-feet.

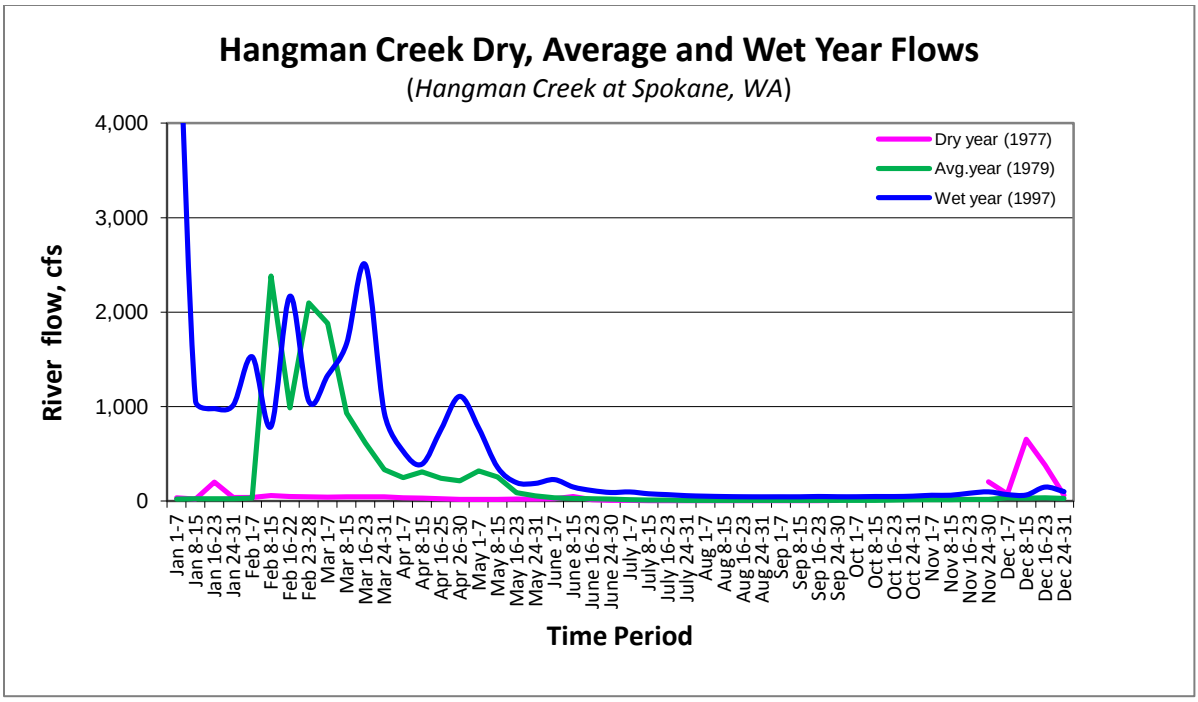
OCR can use this information to recognize where water is needed, when water is available and whether or not the in-basin or out-of-basin water supply development can help meet the WRIA's water demands.

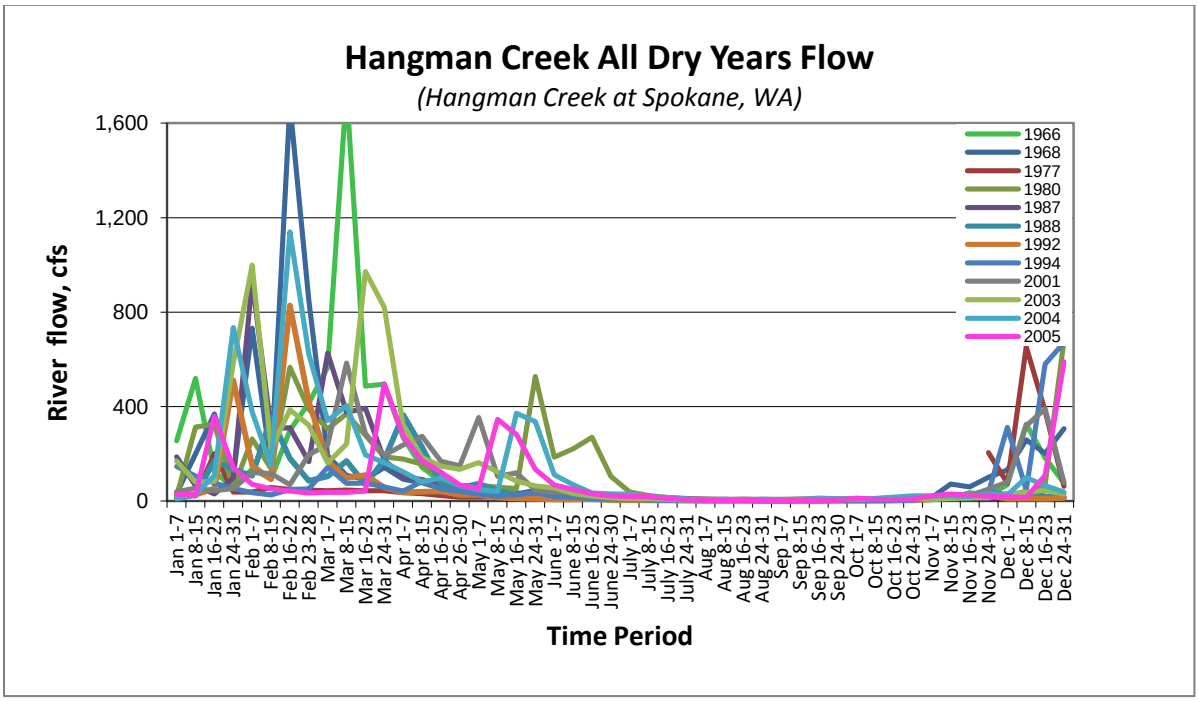

Hangman Creek Historic Flows
(USGS 12424000–Hangman Creek at Spokane, WA)
Annual river flow, Kac-ft
0
100
200
300
400
1948
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
Years

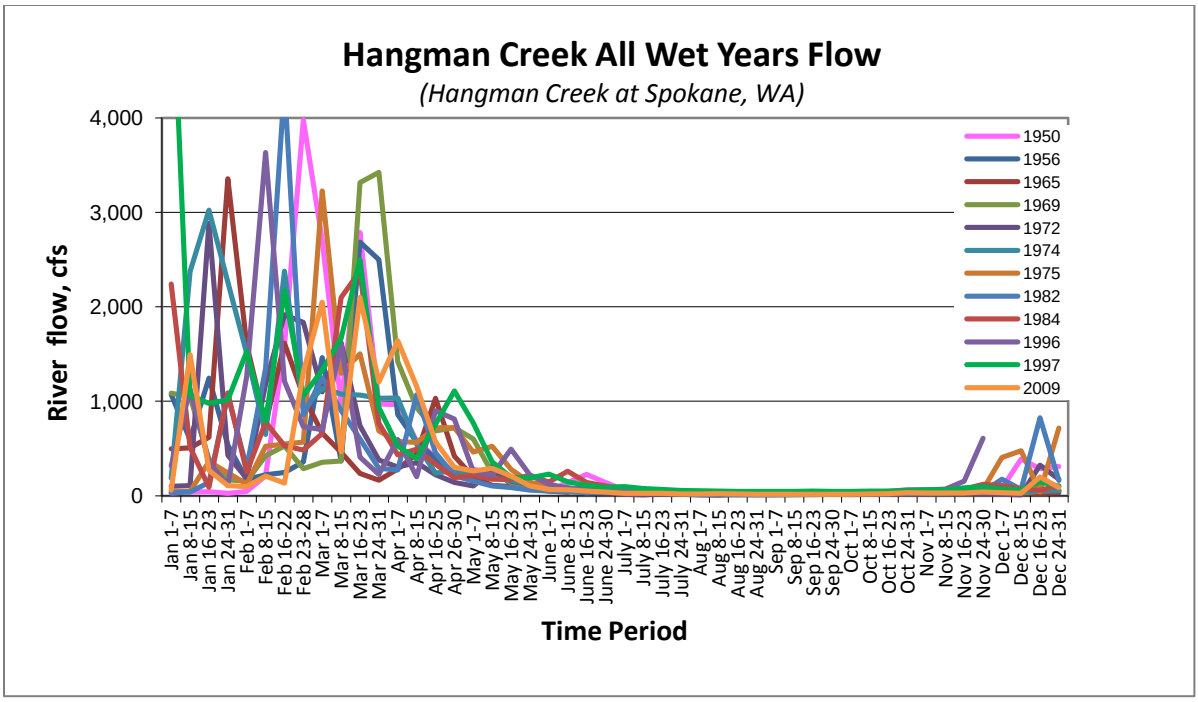

Hangman Creek Flow Exceedance Curve
(Hangman Creek at Spokane, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, Kac-ft
0
100
200
300
400
1977
1992
2005
2001
1968
2003
1991
1960
1963
2007
1978
1998
1993
1953
1989
1976
1951
1995
1964
2000
1948
2006
1983
1949
1952
1965
1982
1956
1984
1950
1974
Years


Dry Years Trend for Hangman Creek Flow
(Hangman Creek at Spokane, WA)
Linear Trend
y = -693.15x + 74976
Annual river flow, Kac-ft
120
100
80
60
40
20
0
1966
1968
1977
1980
1987
1988
1992
1994
2001
2003
2004
2005
Years

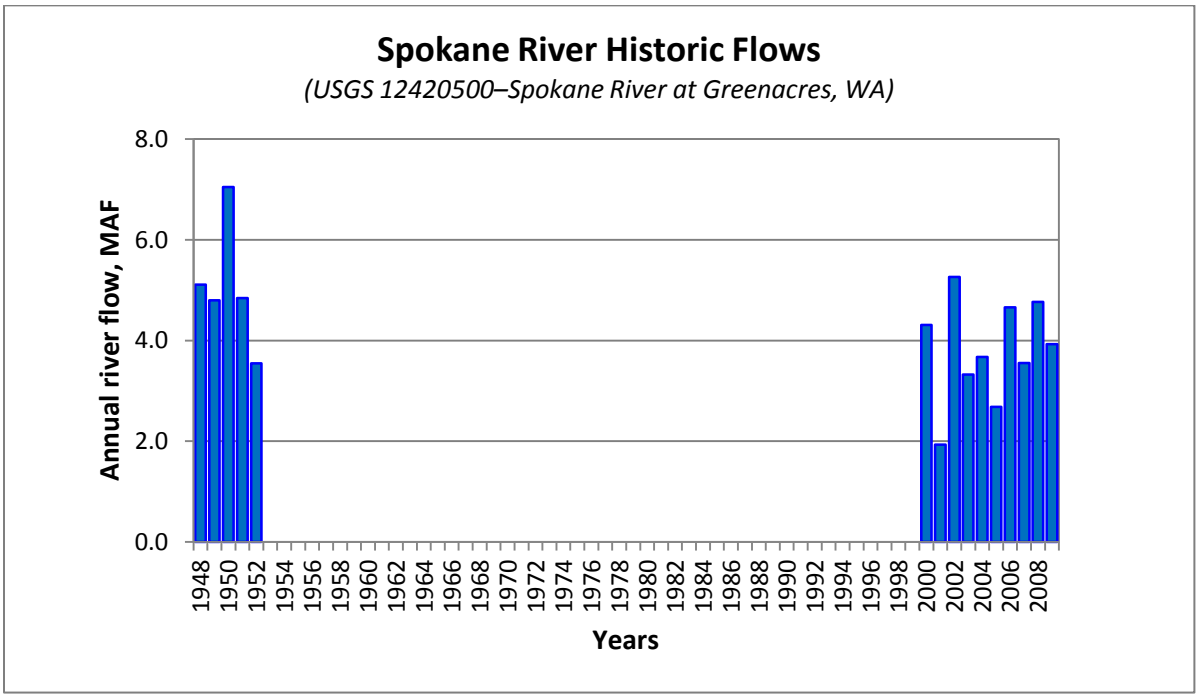

Hangman Creek 30 yr Flows
(Hangman Creek at Spokane, WA)
Year
Occurrance
Period of
Current 30 yr
Dry 12 9
Avg 38 16
Wet 12 5
Total 62 30
Annual river flow, Kac-ft
400
300
200
100
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years

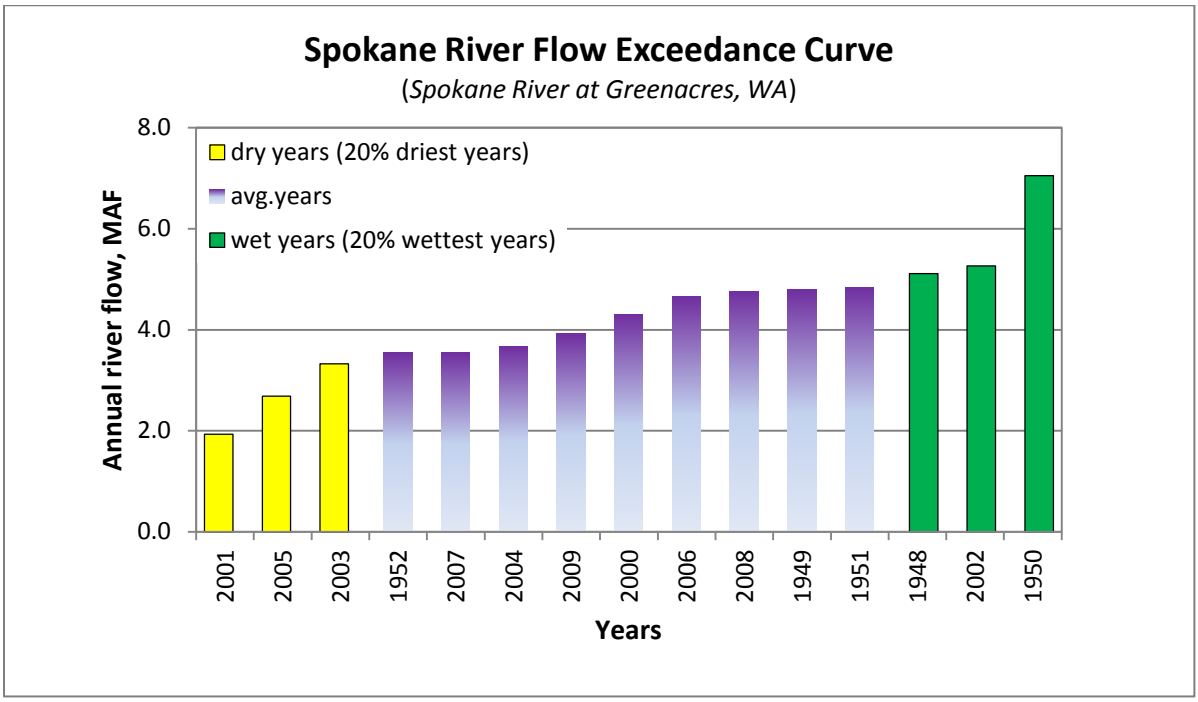

Hangman Creek Dry, Average and Wet Year Flows
(Hangman Creek at Spokane, WA)
River flow, cfs
4,000
3,000
2,000
1,000
0
Dry year (1977)
Avg.year (1979)
Wet year (1997)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

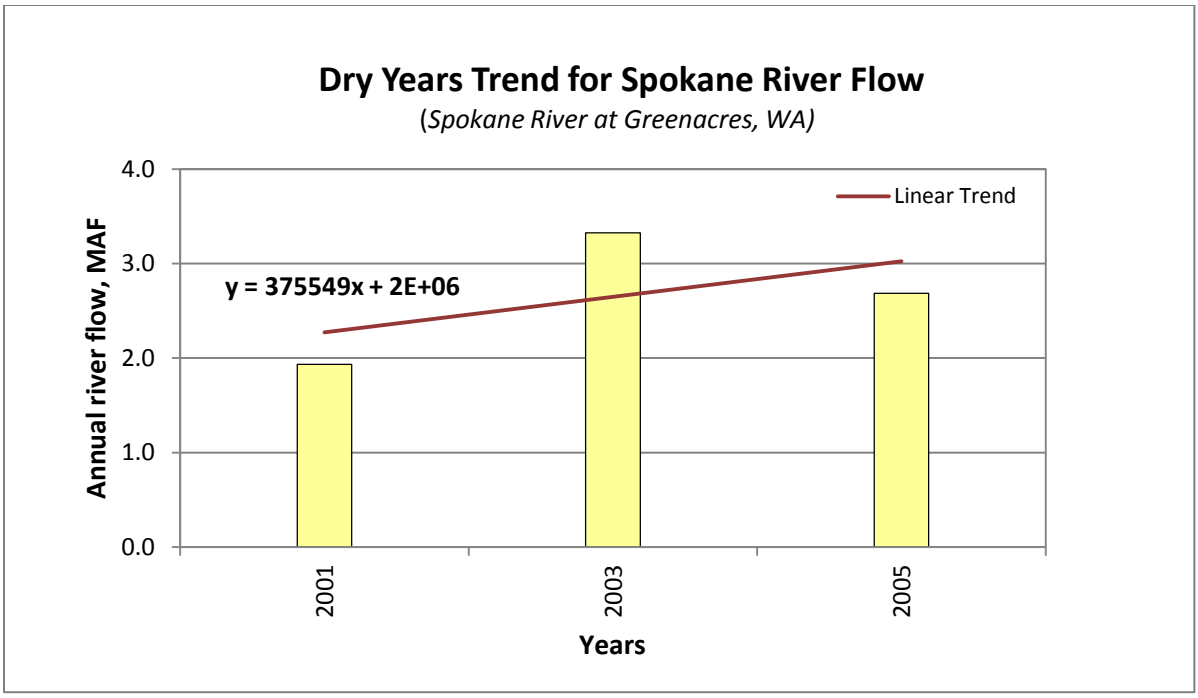

Hangman Creek All Dry Years Flow
(Hangman Creek at Spokane, WA)
River flow, cfs
1,600
1,200
800
400
0
1966
1968
1977
1980
1987
1988
1992
1994
2001
2003
2004
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

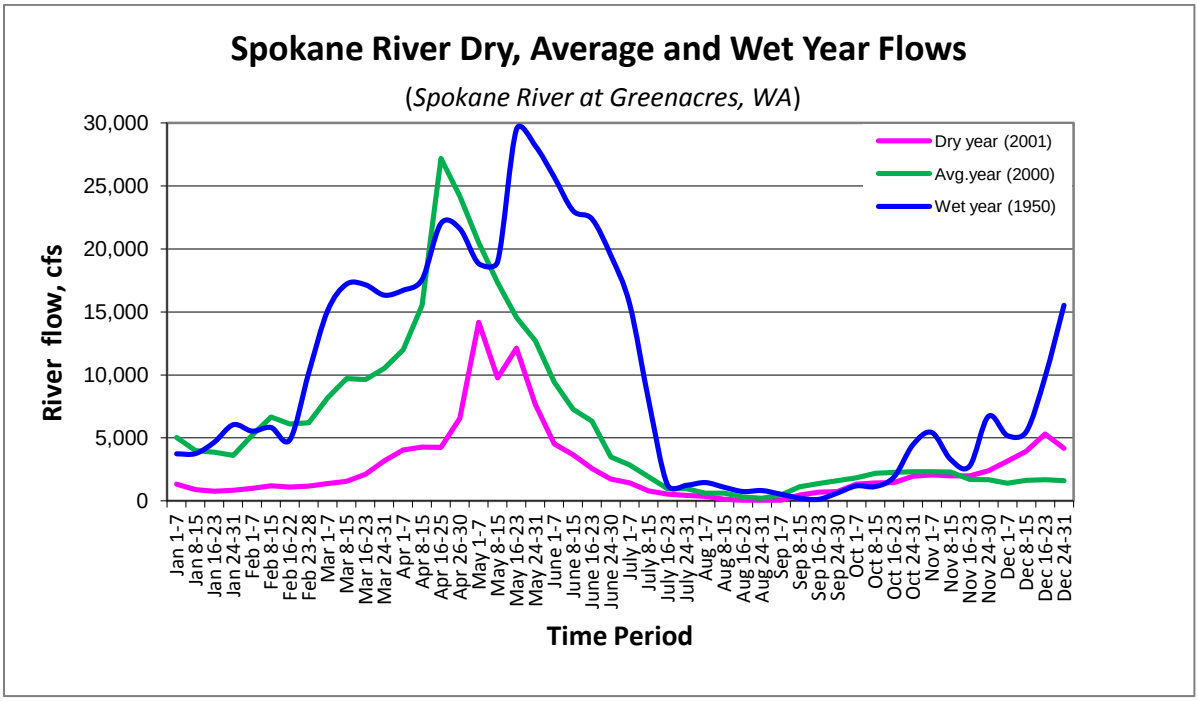

Hangman Creek All Wet Years Flow
(Hangman Creek at Spokane, WA)
River flow, cfs
4,000
3,000
2,000
1,000
0
1950
1956
1965
1969
1972
1974
1975
1982
1984
1996
1997
2009
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

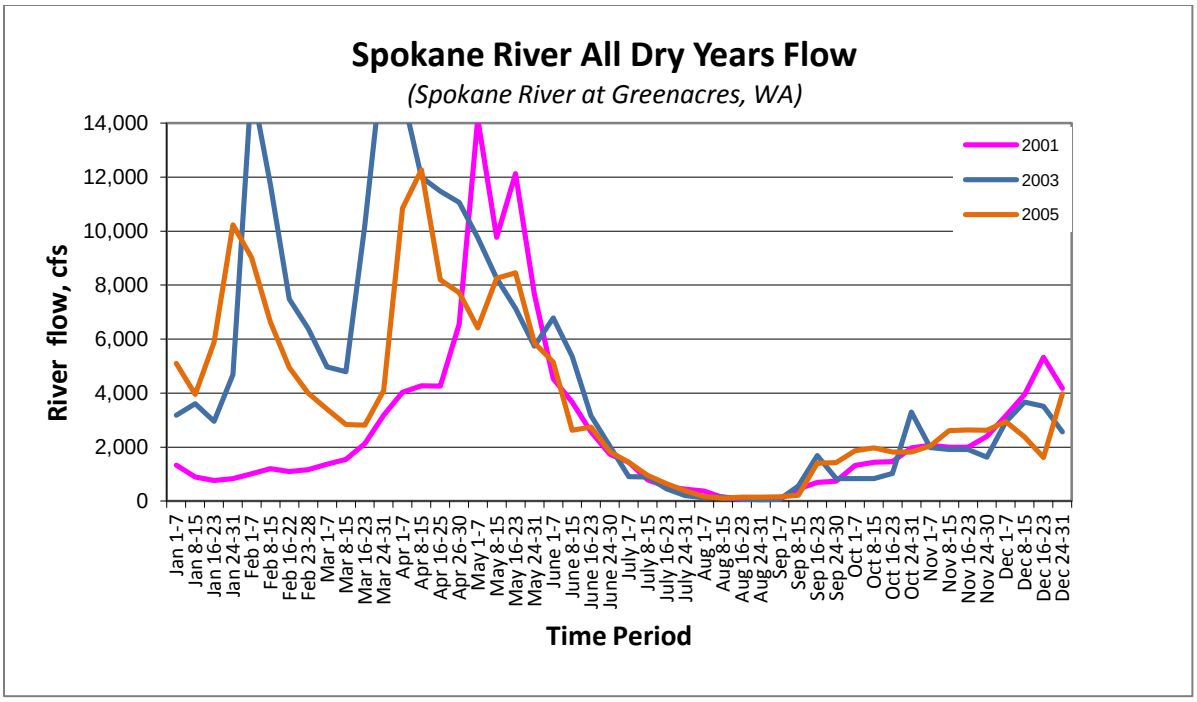
WRIA 57 (Middle Spokane)

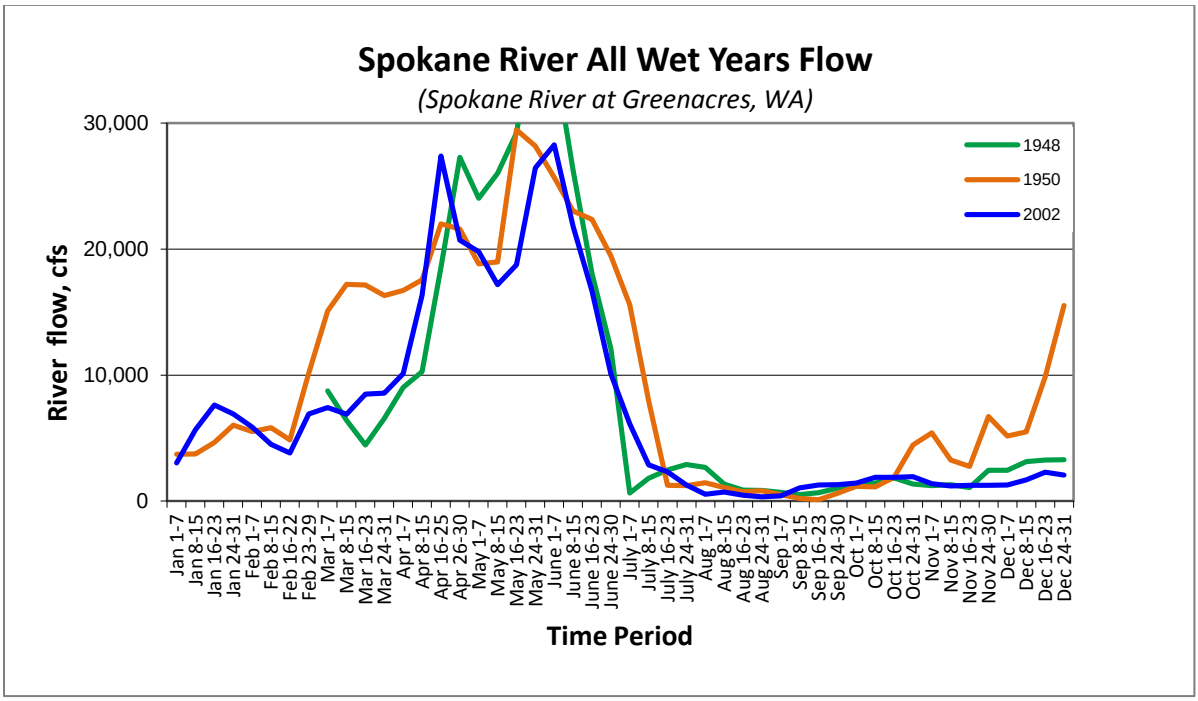


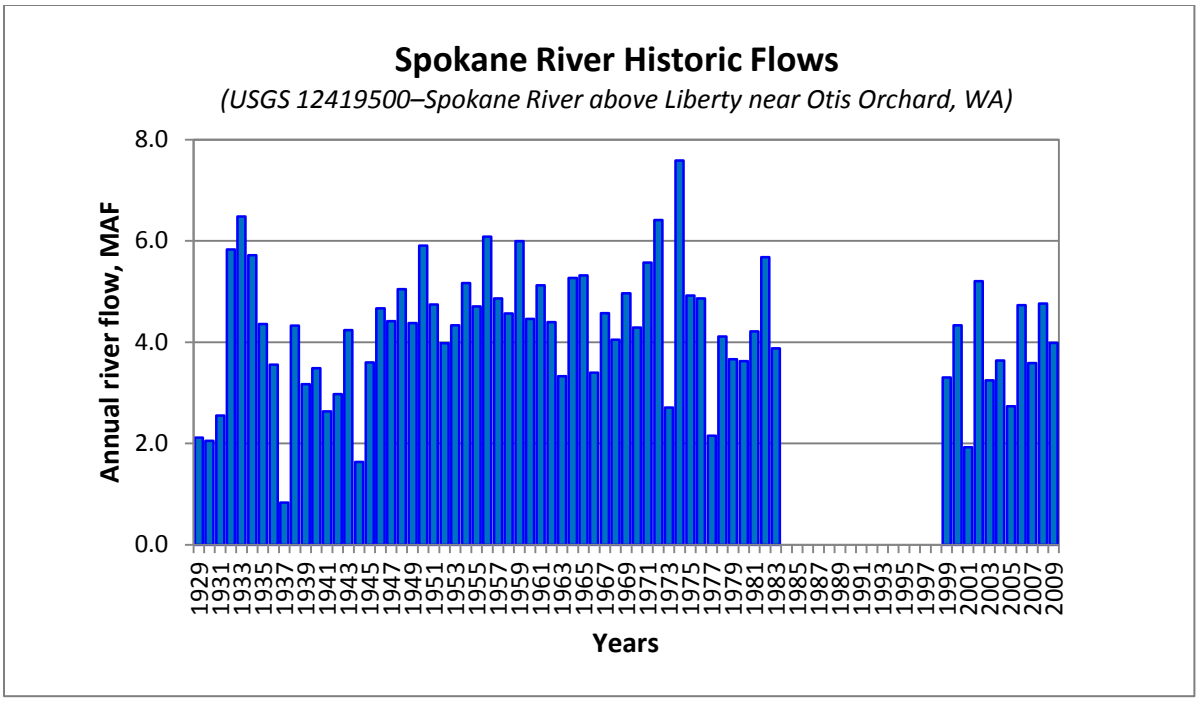


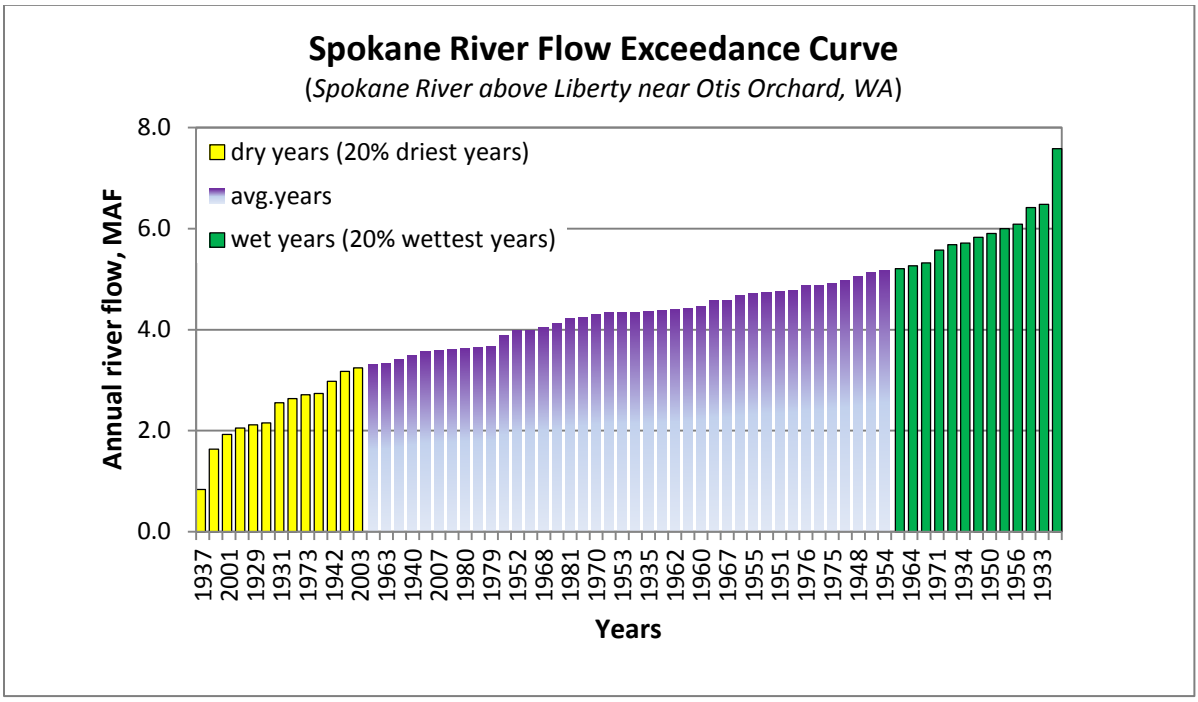

Dry Years Trend for Spokane River Flow
(Spokane River at Greenacres, WA)
Linear Trend
y = 375549x + 2E+06
Annual river flow, MAF
4.0
3.0
2.0
1.0
0.0
2001
2003
2005
Years

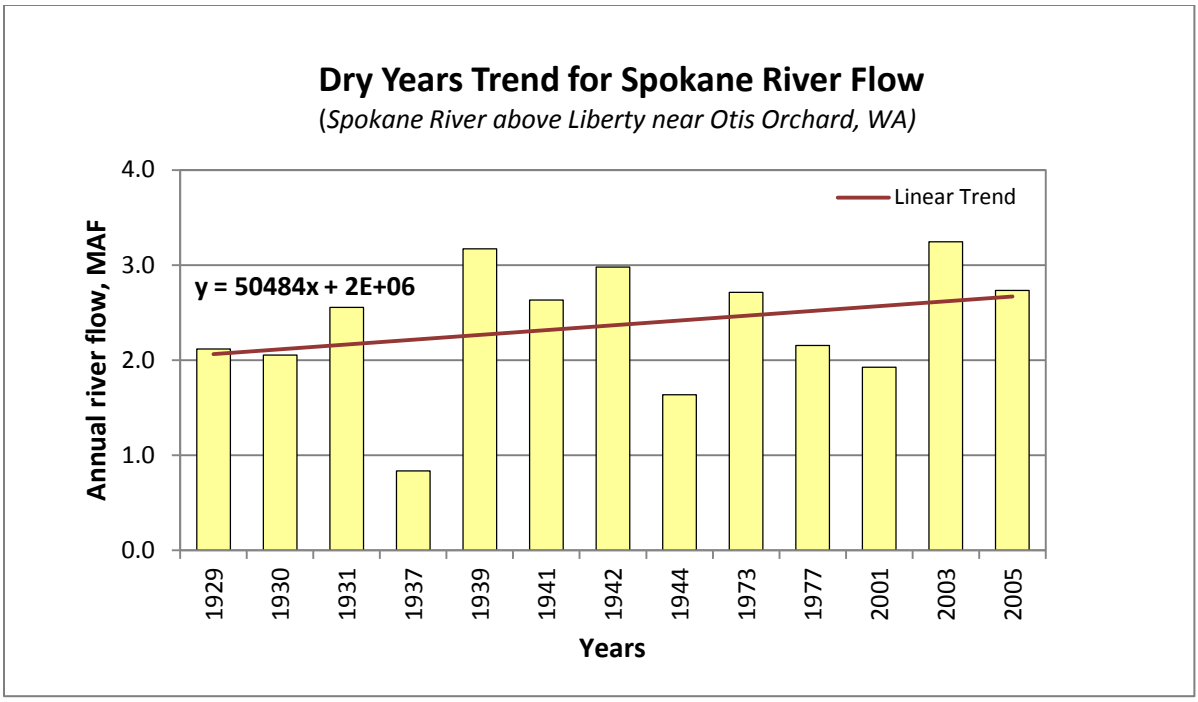

Spokane River Dry, Average and Wet Year Flows
(Spokane River at Greenacres, WA)
Dry year (2001)
Avg.year (2000)
Wet year (1950)
River flow, cfs
30,000
25,000
20,000
15,000
10,000
5,000
0
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

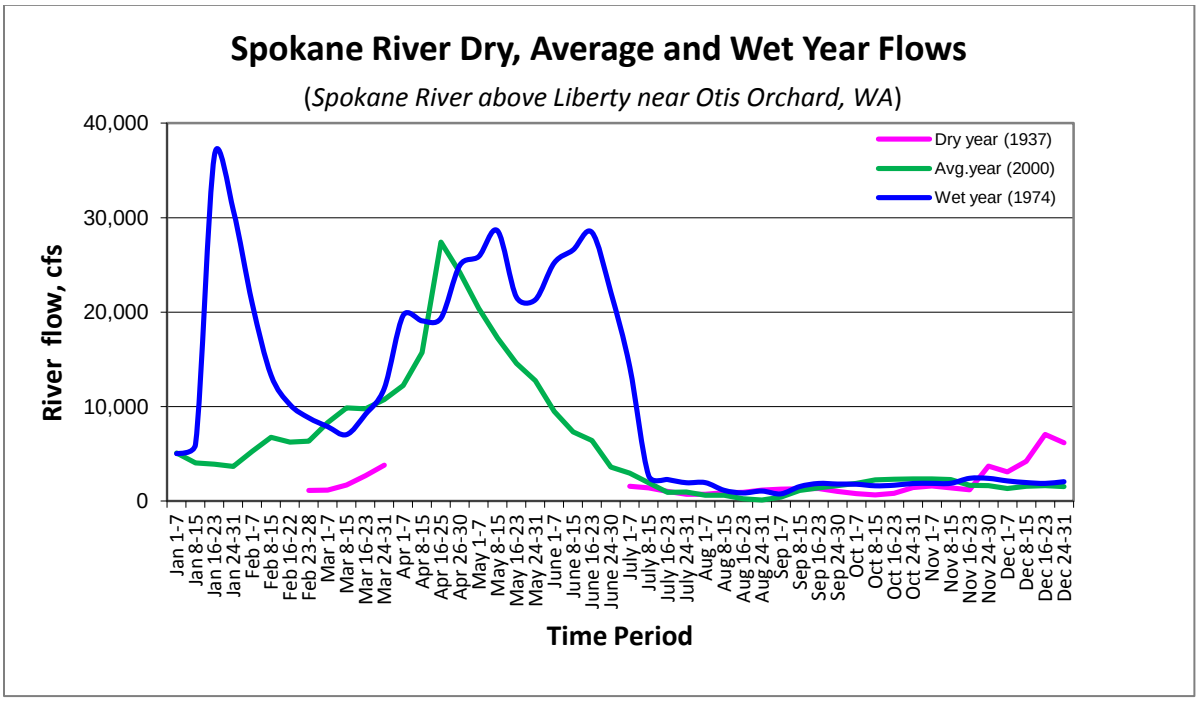

Spokane River All Dry Years Flow
(Spokane River at Greenacres, WA)
River flow, cfs
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
2001
2003
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

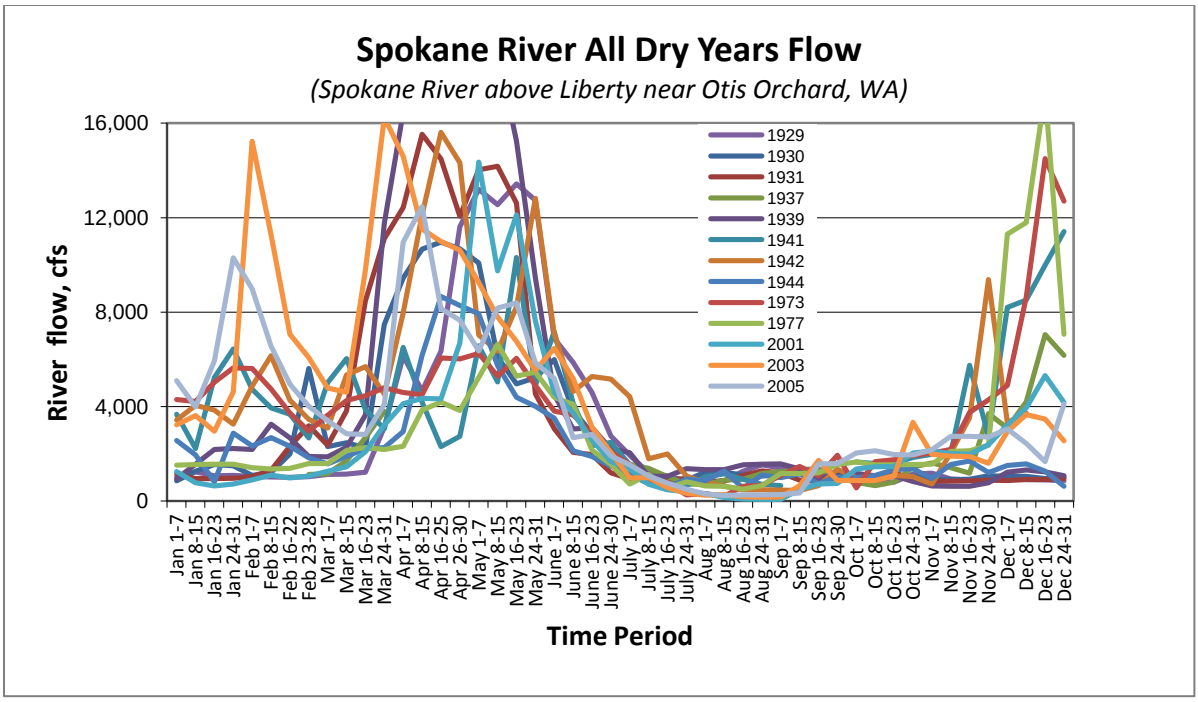

Spokane River All Wet Years Flow
(Spokane River at Greenacres, WA)
River flow, cfs
30,000
20,000
10,000
0
1948
1950
2002
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

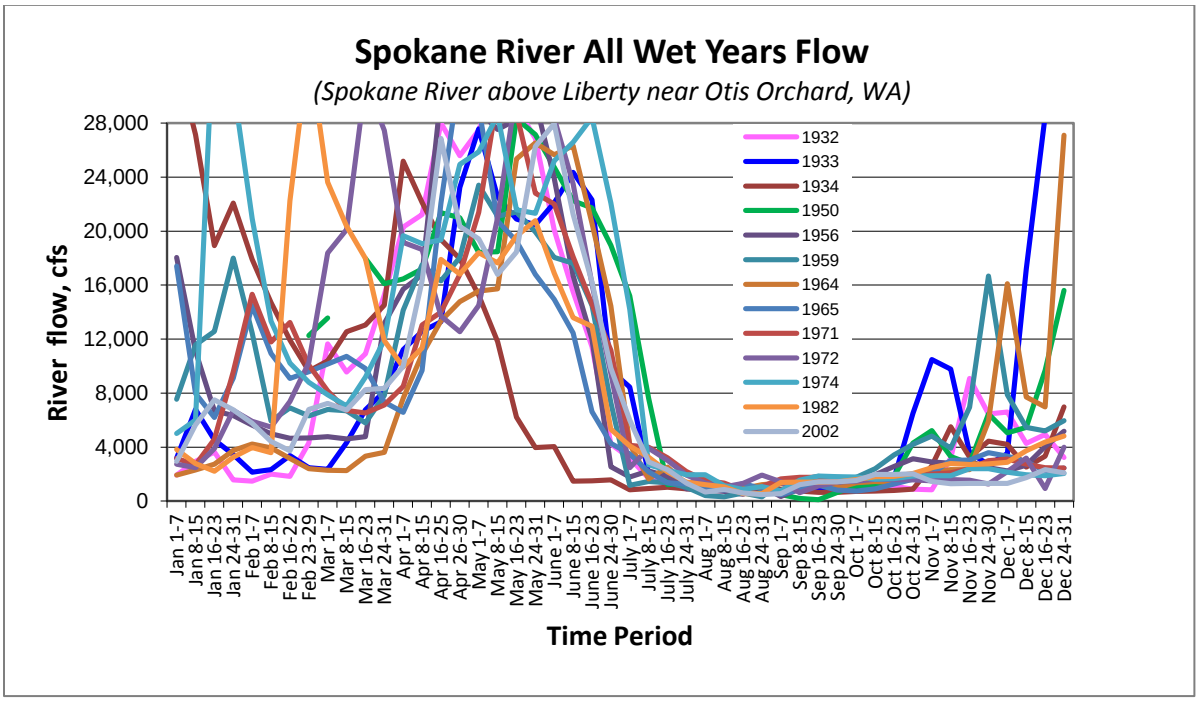

Spokane River Historic Flows
(USGS 12419500–Spokane River above Liberty near Otis Orchard, WA)
Annual river flow, MAF
8.0
6.0
4.0
2.0
0.0
1929
1931
1933
1935
1937
1939
1941
1943
1945
1947
1949
1951
1953
1955
1957
1959
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Years


Spokane River Flow Exceedance Curve
(Spokane River above Liberty near Otis Orchard, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, MAF
8.0
6.0
4.0
2.0
0.0
1937
2001
1929
1931
1973
1942
2003
1963
1940
2007
1980
1979
1952
1968
1981
1970
1953
1935
1962
1960
1967
1955
1951
1976
1975
1948
1954
1964
1971
1934
1950
1956
1933
Years

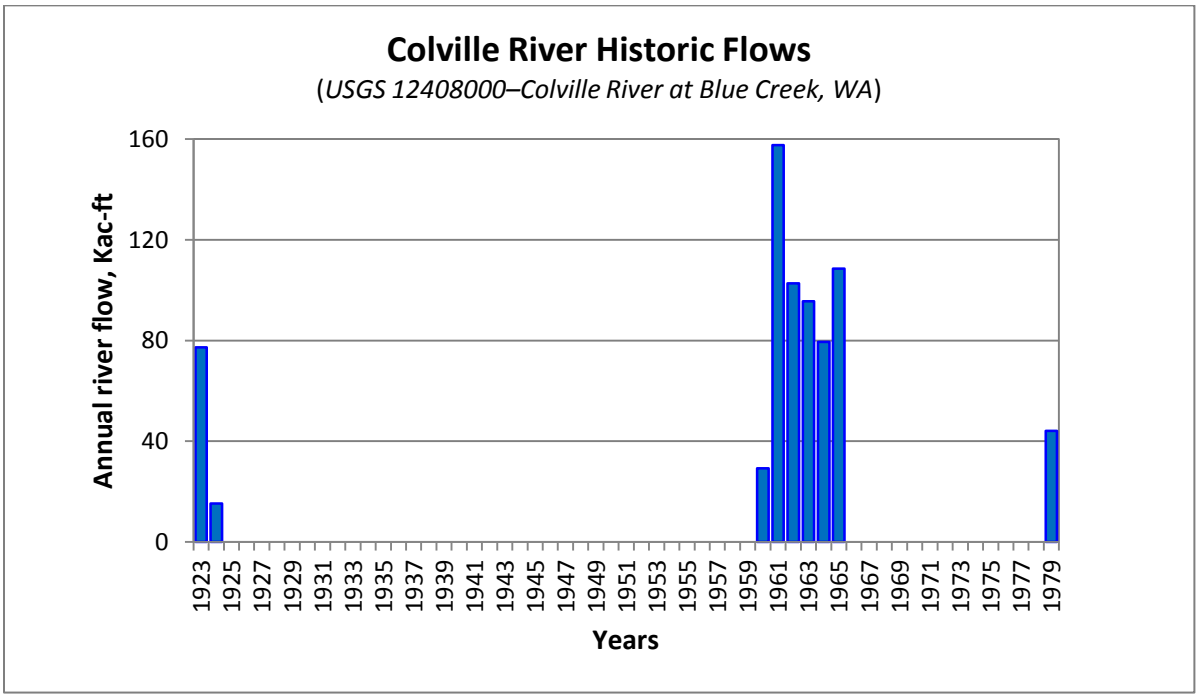

Dry Years Trend for Spokane River Flow
(Spokane River above Liberty near Otis Orchard, WA)
Linear Trend
y = 50484x + 2E+06
Annual river flow, MAF
4.0
3.0
2.0
1.0
0.0
1929
1930
1931
1937
1939
1941
1942
1944
1973
1977
2001
2003
2005
Years

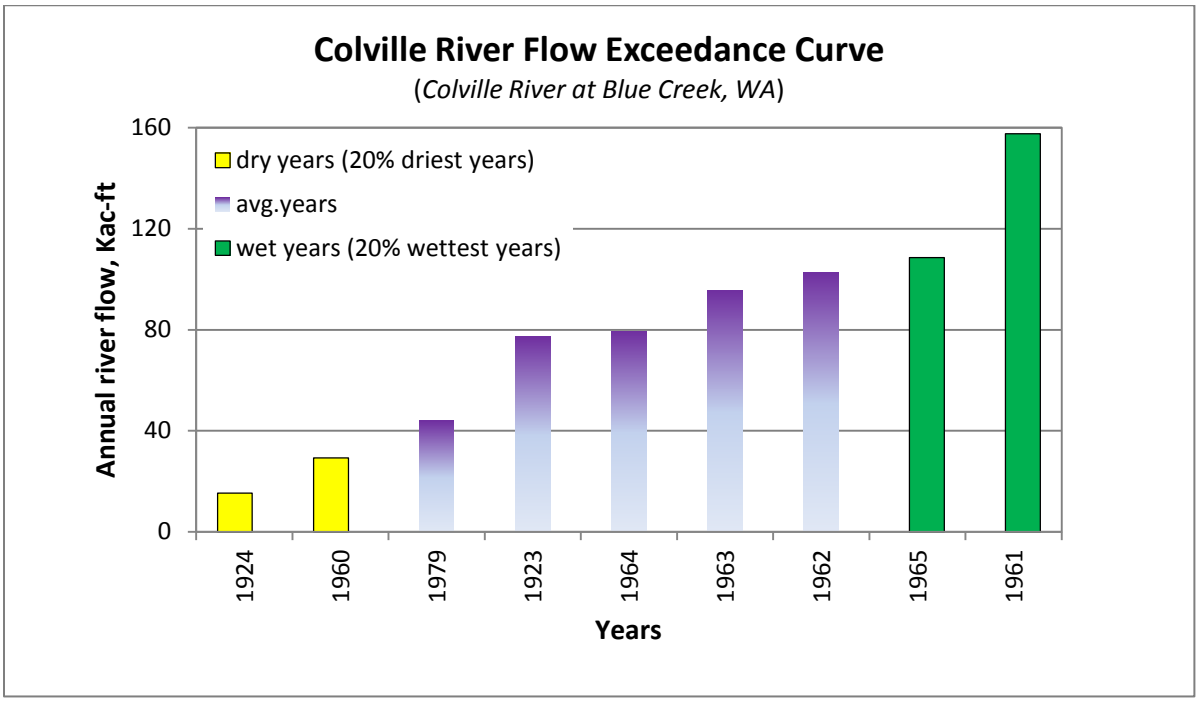

Spokane River Dry, Average and Wet Year Flows
(Spokane River above Liberty near Otis Orchard, WA)
Dry year (1937)
Avg.year (2000)
Wet year (1974)
River flow, cfs
40,000
30,000
20,000
10,000
0
Time Period

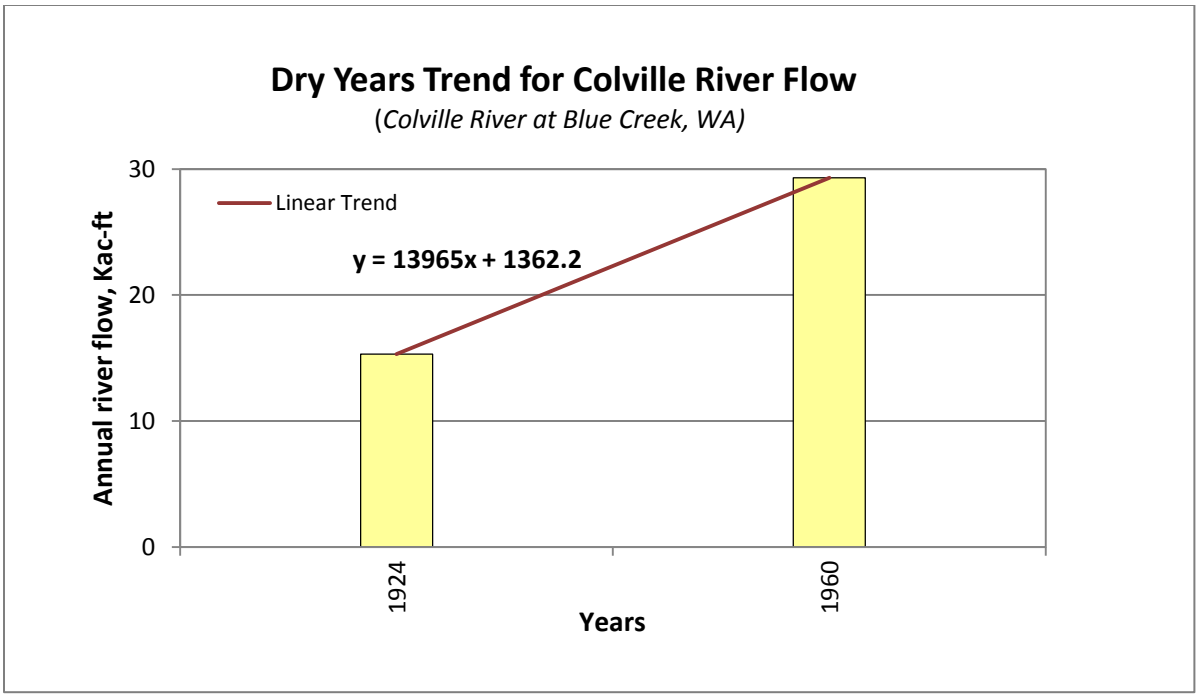

Spokane River All Dry Years Flow
(Spokane River above Liberty near Otis Orchard, WA)
River flow, cfs
16,000
12,000
8,000
4,000
0
1929
1930
1931
1937
1939
1941
1942
1944
1973
1977
2001
2003
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

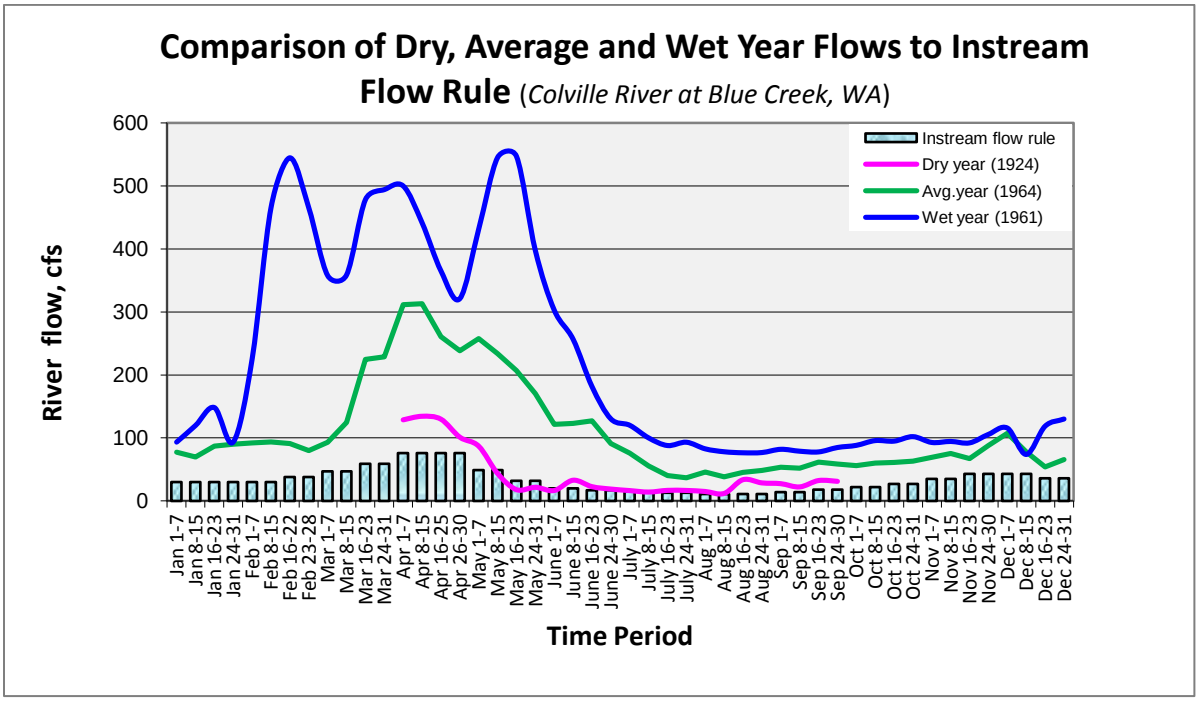

Spokane River All Wet Years Flow
(Spokane River above Liberty near Otis Orchard, WA)
River flow, cfs
28,000
24,000
20,000
16,000
12,000
8,000
4,000
0
1932
1933
1934
1950
1956
1959
1964
1965
1971
1972
1974
1982
2002
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

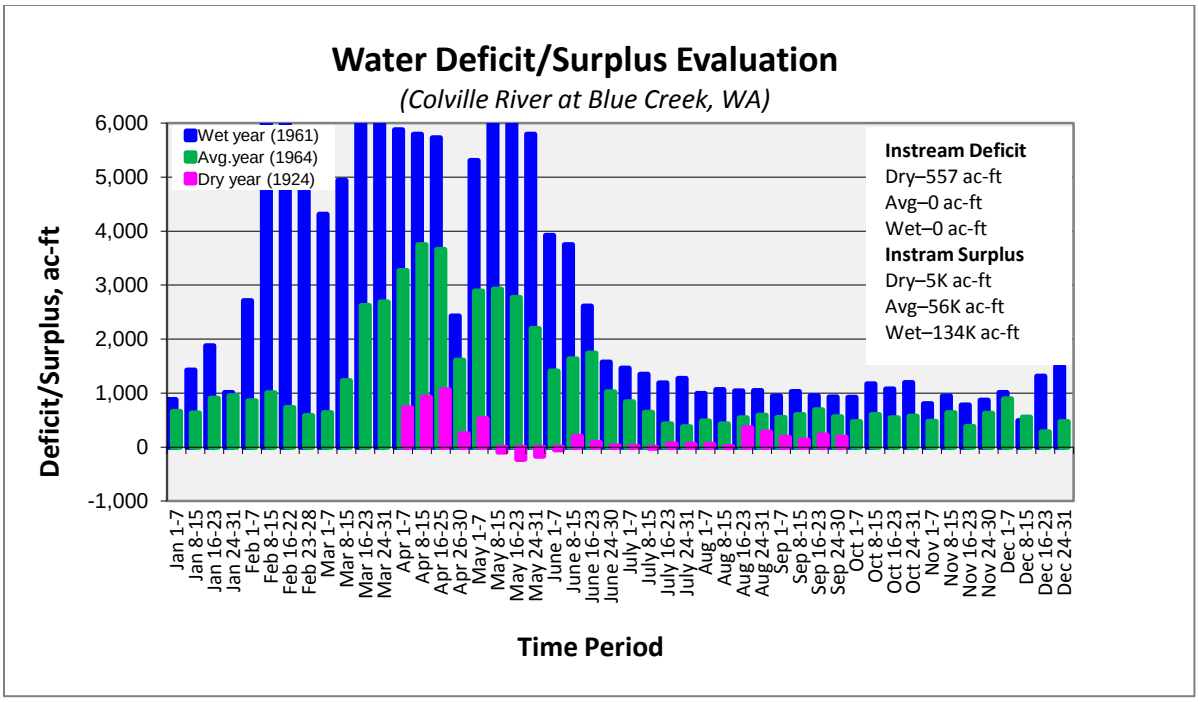
WRIA 59 (Colville)

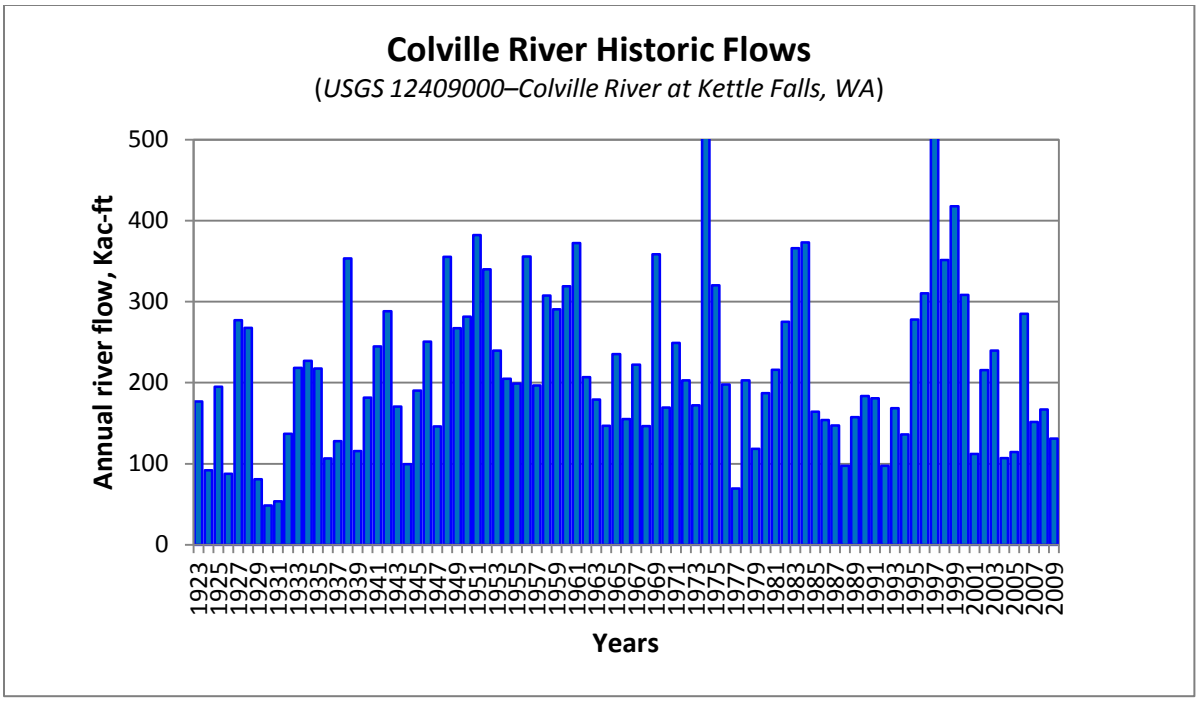


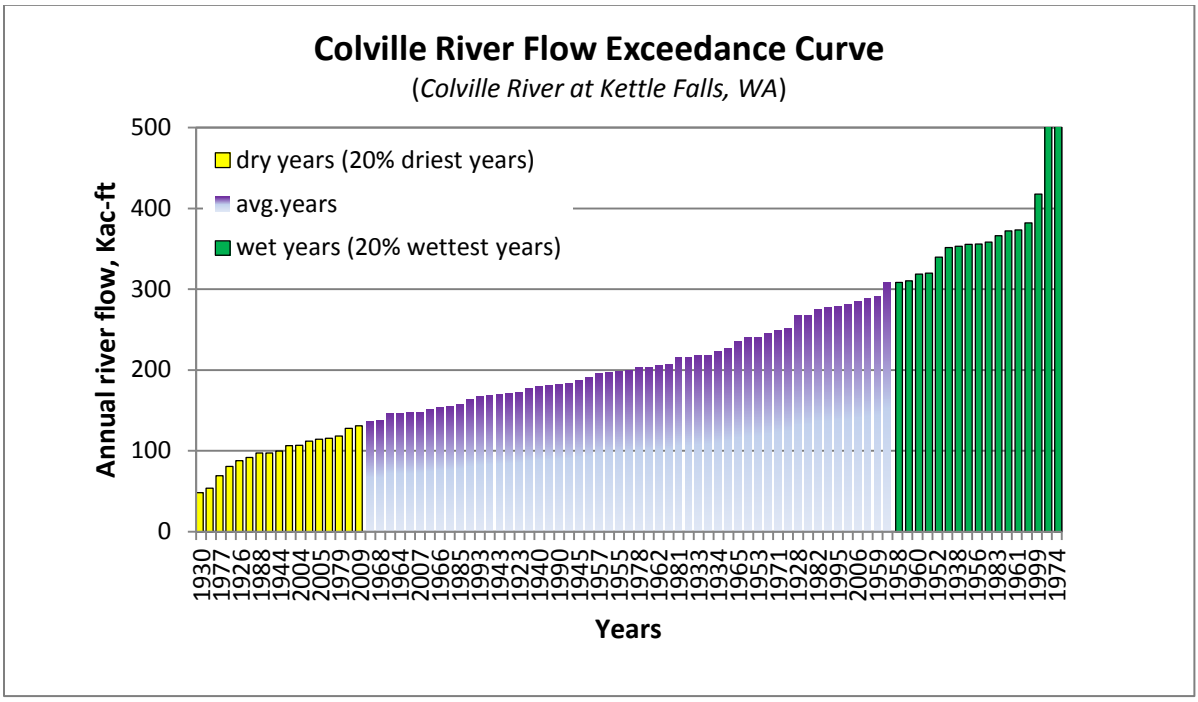


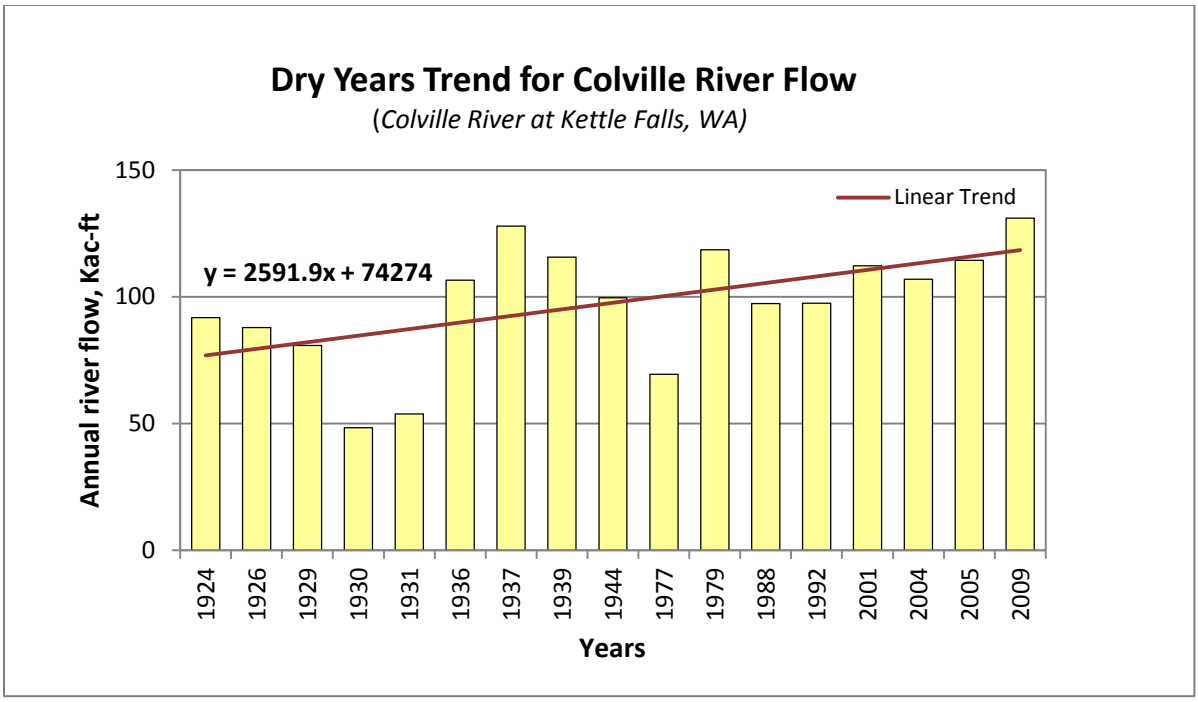

Dry Years Trend for Colville River Flow
(Colville River at Blue Creek, WA)
Linear Trend
y = 13965x + 1362.2
Annual river flow, Kac-ft
30
20
10
0
1924
1960
Years

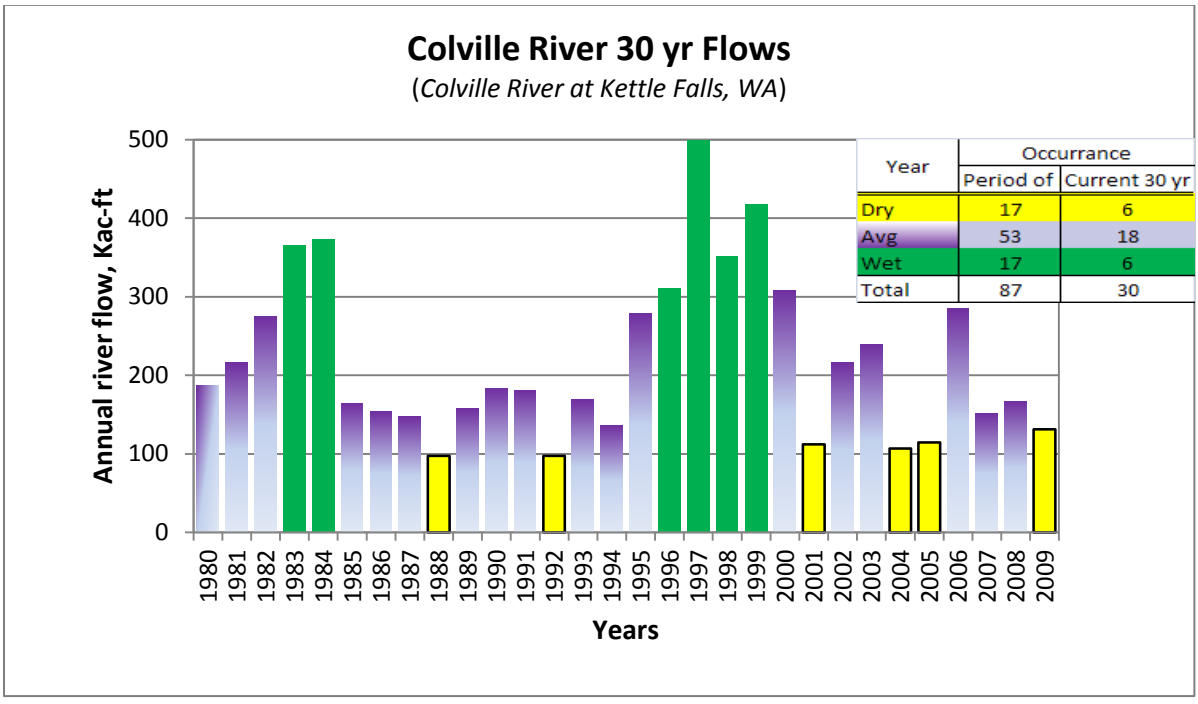

Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Colville River at Blue Creek, WA)
Instream flow rule
Dry year (1924)
Avg.year (1964)
Wet year (1961)
River flow, cfs
600
500
400
300
200
100
0
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

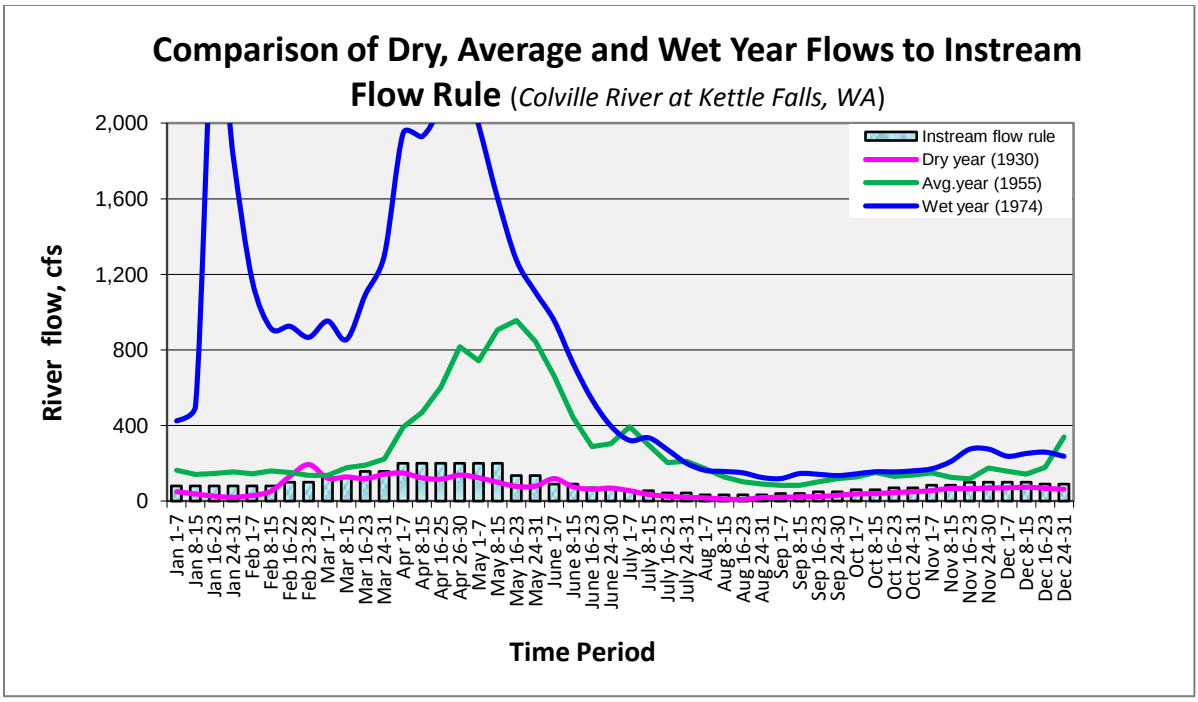

Water Deficit/Surplus Evaluation
(Colville River at Blue Creek, WA)
Deficit/Surplus, ac-ft
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
Wet year (1961)
Avg.year (1964)
Dry year (1924)
Instream Deficit
Dry–557 ac-ft
Avg–0 ac-ft
Wet–0 ac-ft
Instram Surplus
Dry–5K ac-ft
Avg–56K ac-ft
Wet–134K ac-ft
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

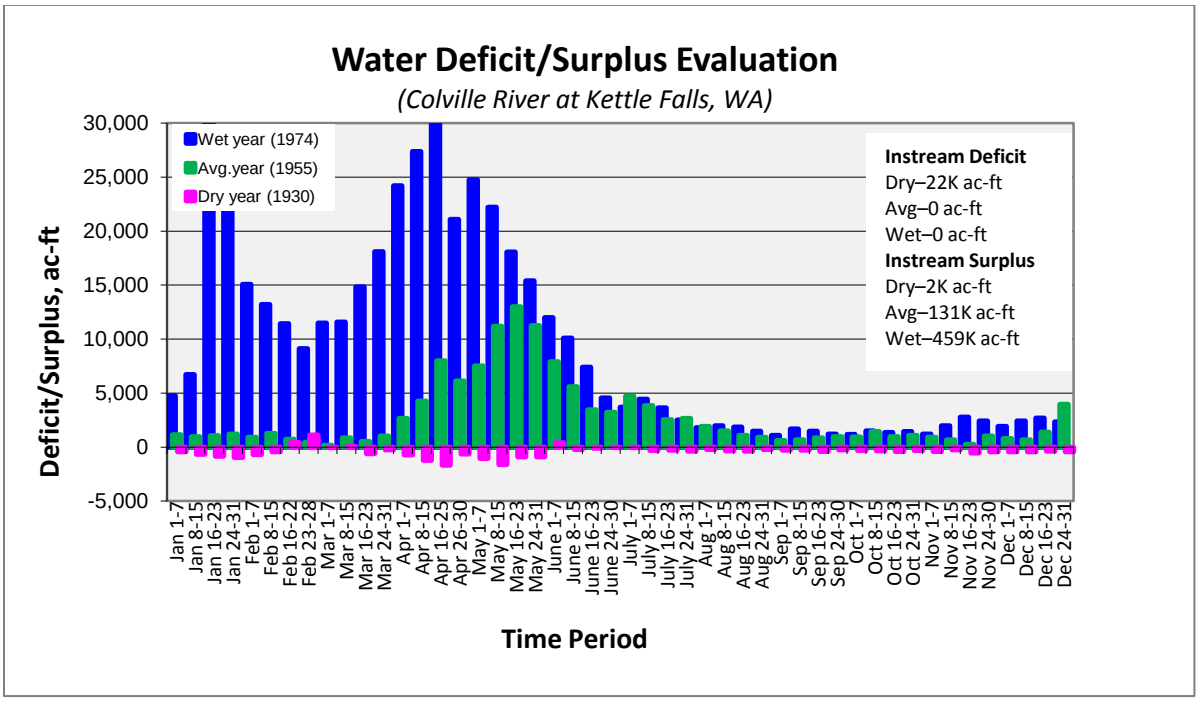

Colville River Historic Flows
(USGS 12409000–Colville River at Kettle Falls, WA)
Annual river flow, Kac-ft
500
400
300
200
100
0
1923 1925 1927 1929 1931 1933 1935 1937 1939 1941 1943 1945 1947 1949 1951 1953 1955 1957 1959 1961 1963 1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009
Years

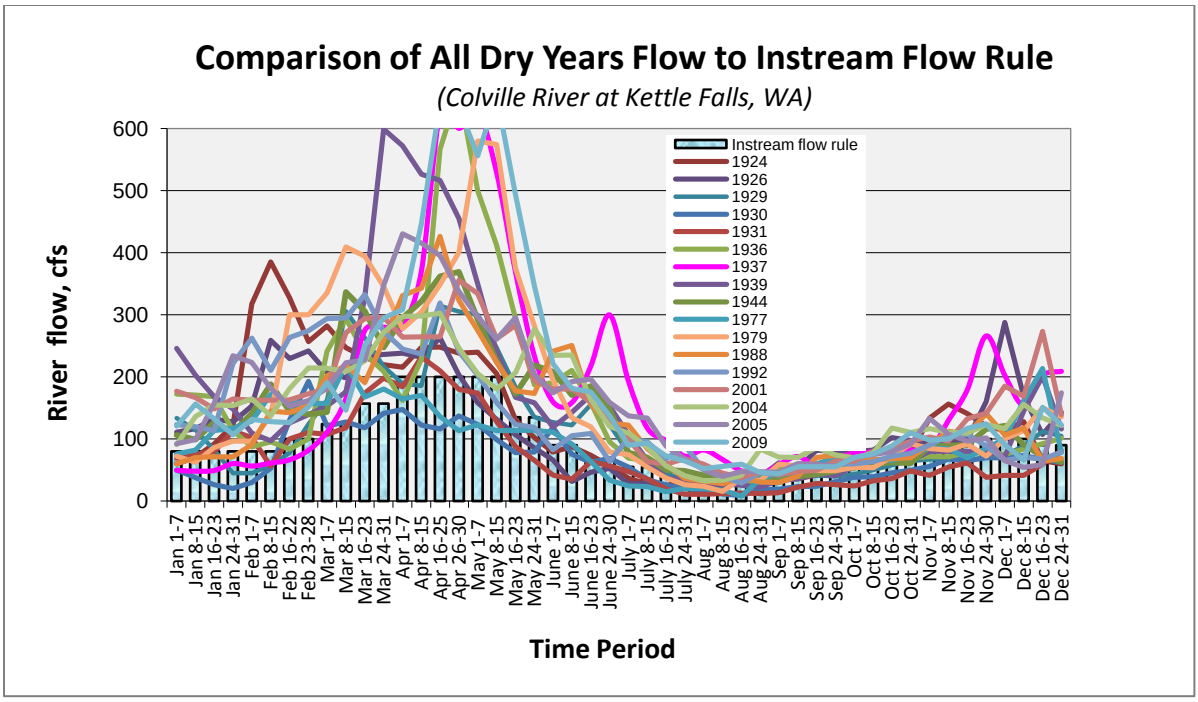

Colville River Flow Exceedance Curve
(Colville River at Kettle Falls, WA)
Annual river flow, Kac-ft
500
400
300
200
100
0
dry years (20% driest years)
avg.years
wet years (20% wettest years)
1930 1977 1926 1988 1944 2004 2005 1979 2009 1968 1964 2007 1966 1985 1993 1943 1923 1940 1990 1945 1957 1955 1978 1962 1981 1933 1934 1965 1953 1971 1928 1982 1995 2006 1959 1958 1960 1952 1938 1956 1983 1961 1999 1974
Years

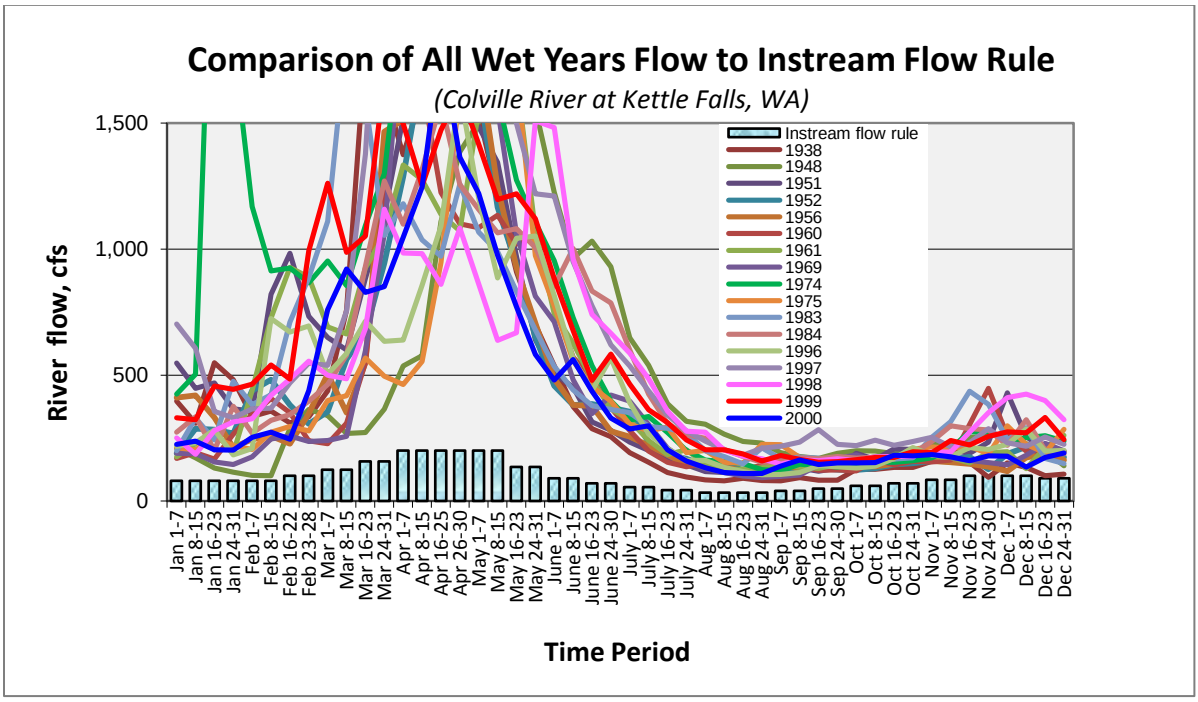

Dry Years Trend for Colville River Flow
(Colville River at Kettle Falls, WA)
Linear Trend
y = 2591.9x + 74274
Annual river flow, Kac-ft
150
100
50
0
1924
1926
1929
1930
1931
1936
1937
1939
1944
1977
1979
1988
1992
2001
2004
2005
2009
Years


Colville River 30 yr Flows
(Colville River at Kettle Falls, WA)
Annual river flow, Kac-ft
500
400
300
200
100
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 17 6
Avg 53 18
Wet 17 6
Total 87 30


Comparison of Dry, Average and Wet Year Flows to Instream Flow Rule (Colville River at Kettle Falls, WA)
River flow, cfs
2,000
1,600
1,200
800
400
0
Instream flow rule
Dry year (1930)
Avg.year (1955)
Wet year (1974)
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Water Deficit/Surplus Evaluation
(Colville River at Kettle Falls, WA)
Deficit/Surplus, ac-ft
30,000
25,000
20,000
15,000
10,000
5,000
0
-5,000
Wet year (1974)
Avg.year (1955)
Dry year (1930)
Instream Deficit
Dry–22K ac-ft
Avg–0 ac-ft
Wet–0 ac-ft
Instream Surplus
Dry–2K ac-ft
Avg–131K ac-ft
Wet–459K ac-ft
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Comparison of All Dry Years Flow to Instream Flow Rule
(Colville River at Kettle Falls, WA)
River flow, cfs
600
500
400
300
200
100
0
Instream flow rule
1924
1926
1929
1930
1931
1936
1937
1939
1944
1977
1979
1988
1992
2001
2004
2005
2009
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

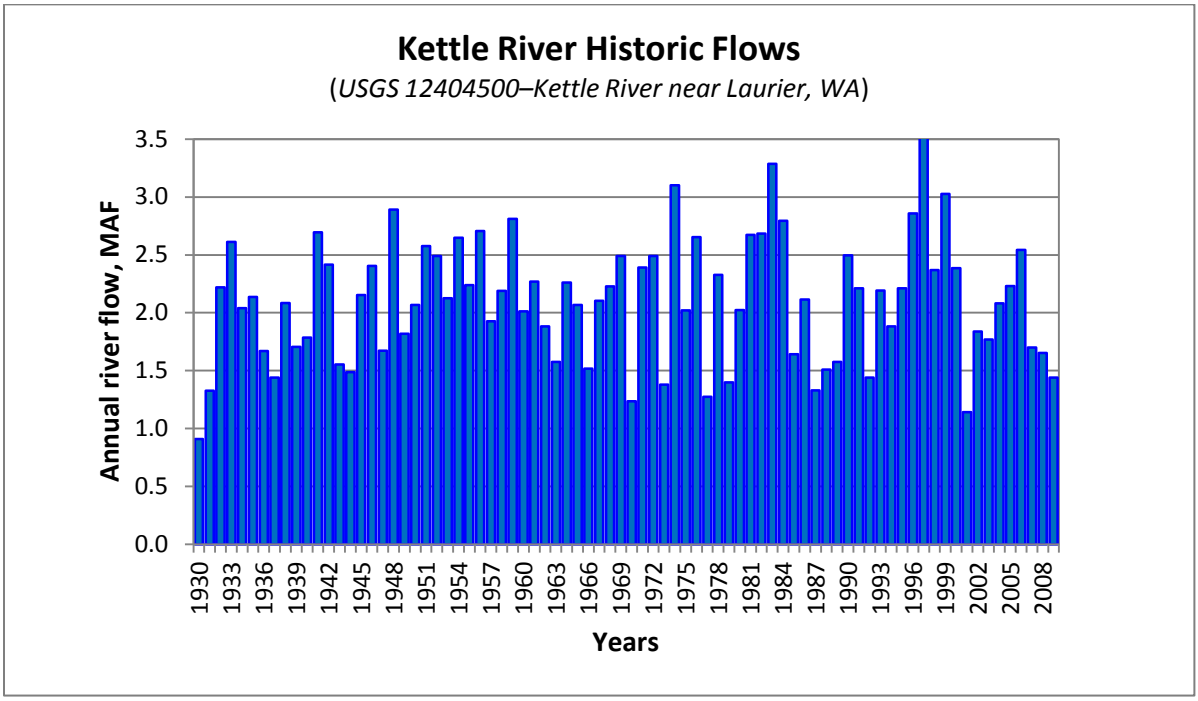

Comparison of All Wet Years Flow to Instream Flow Rule
(Colville River at Kettle Falls, WA)
River flow, cfs
1,500
1,000
500
0
Instream flow rule
1938
1948
1951
1952
1956
1960
1961
1969
1974
1975
1983
1984
1996
1997
1998
1999
2000
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

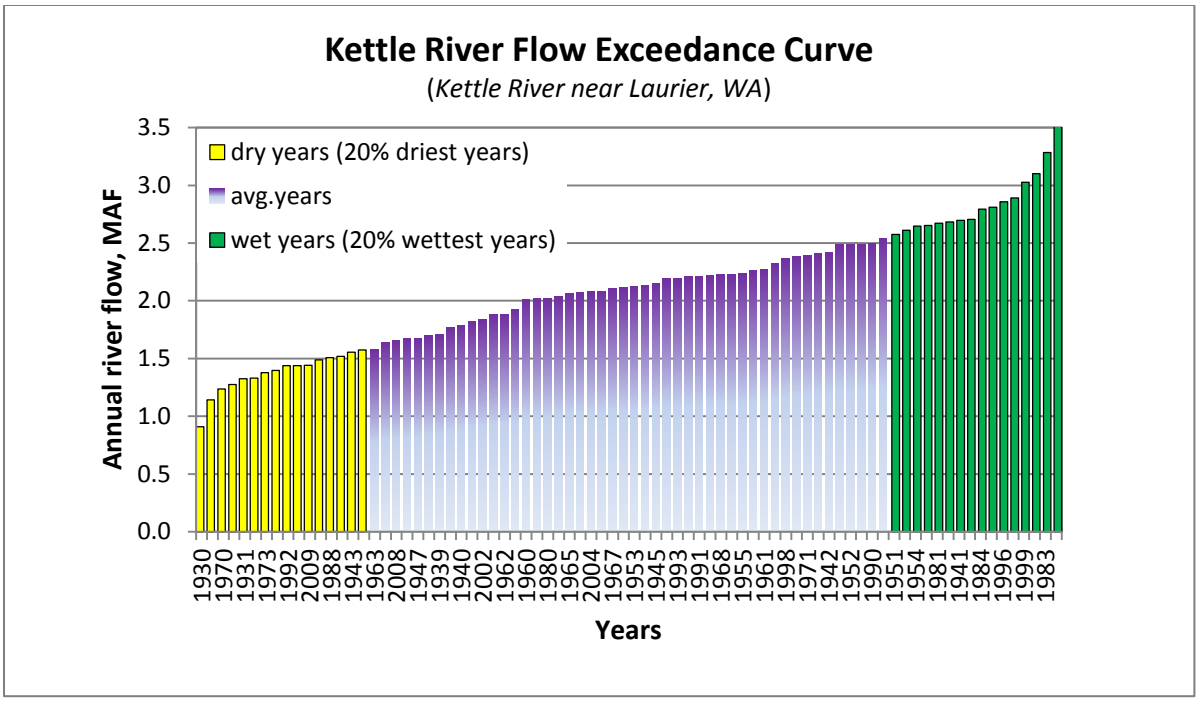
WRIA 60 (Kettle)

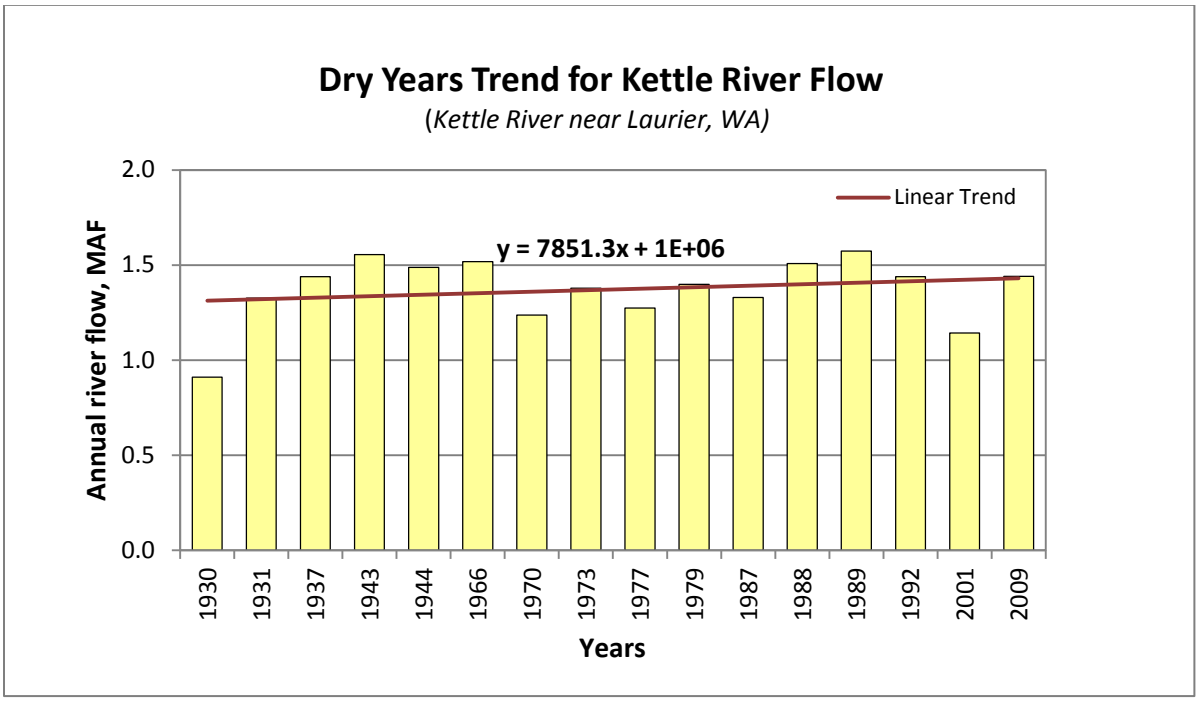
For WRIA 60, OCR graphed the flows of the Kettle River. A series of seven graphs were created. The results provide information on historic flow levels and drought occurrences. These data contribute to OCR's understanding of historic trends, drought patterns and hydrograph variability. For example, by graphing the 80 (1930–2009) flows of the Kettle River near Laurier, gauge number 124045000, it is shown that:

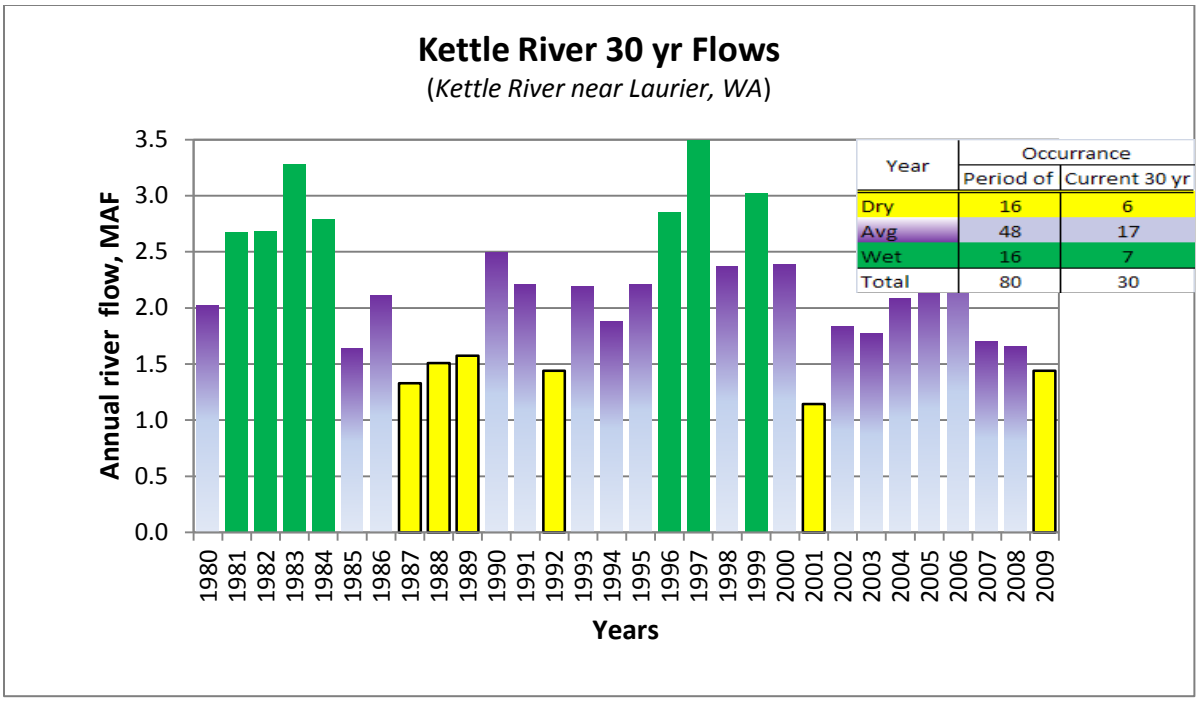
- Historic mean annual flows generally varied between 0.9 and 3.5 million acre-feet (MAF).
- Ecology defined "dry" years as the 80% exceedance value (80% of the time more water was available). Over the last 30 years, dry years occurred 6 times, with the worst stretch being 3 consecutive dry years in 1987-1989. During this same time period, the availability of water during dry years improved by 8 %.

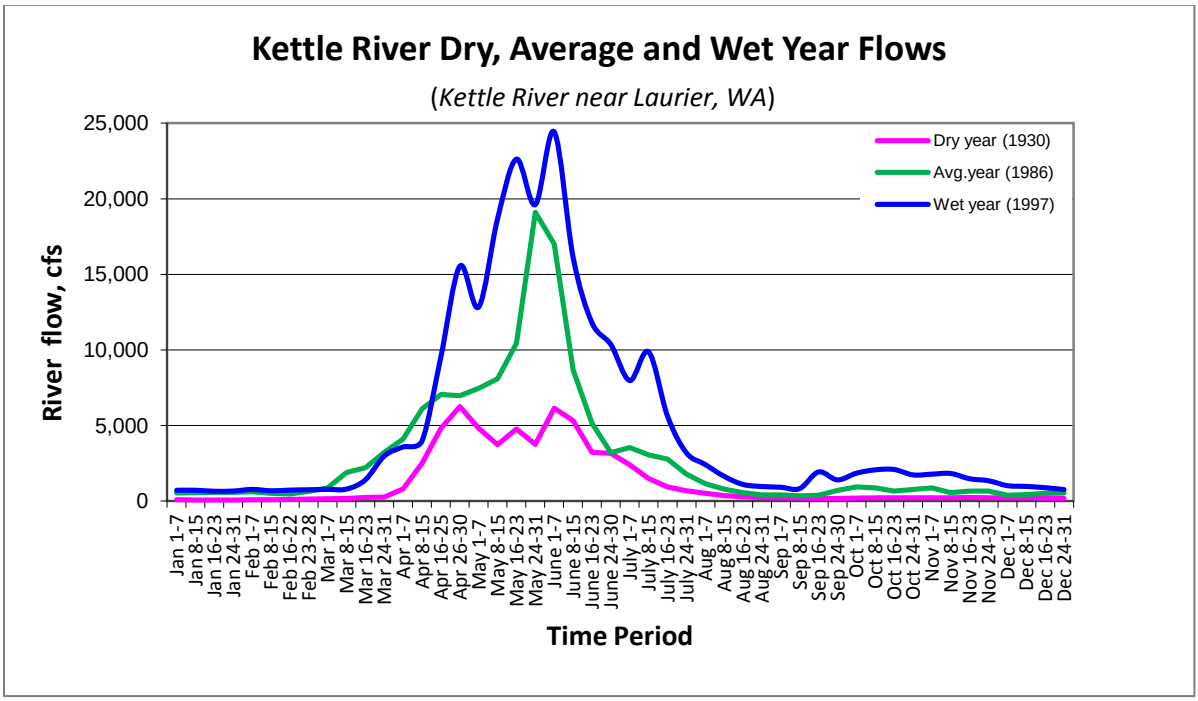
OCR can use this information to recognize where water is needed, when water is available and whether or not the in-basin or out-of-basin water supply development can help meet the WRIA's water demands.

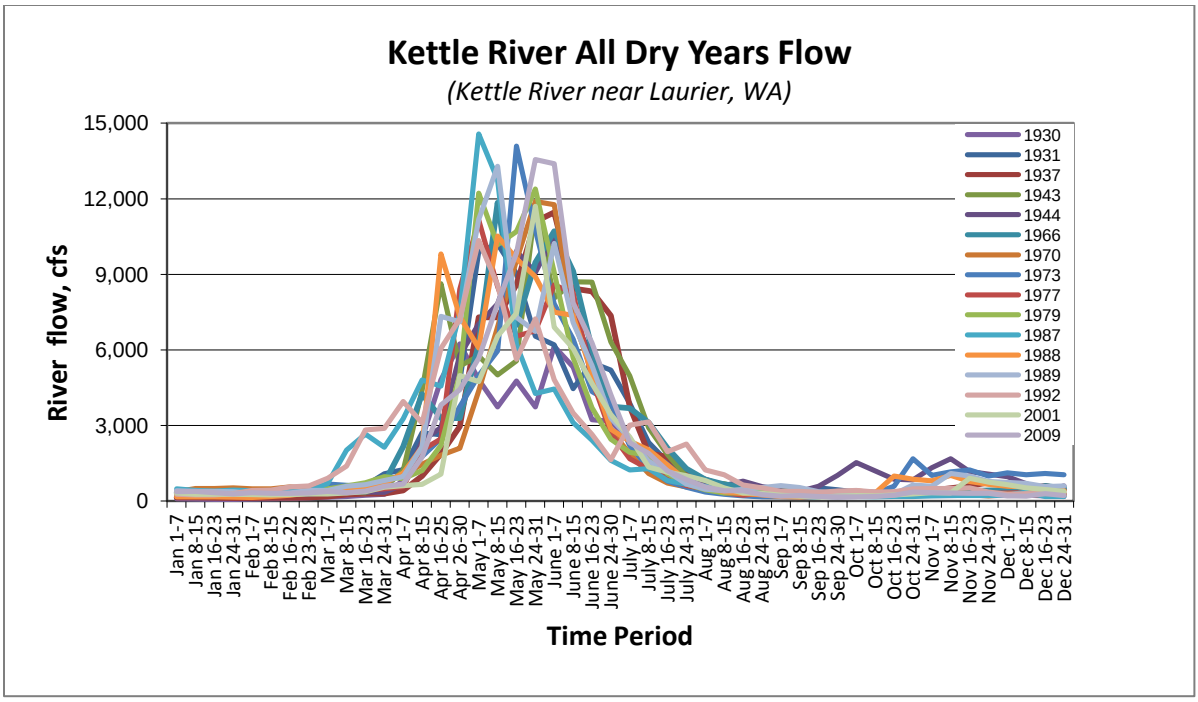


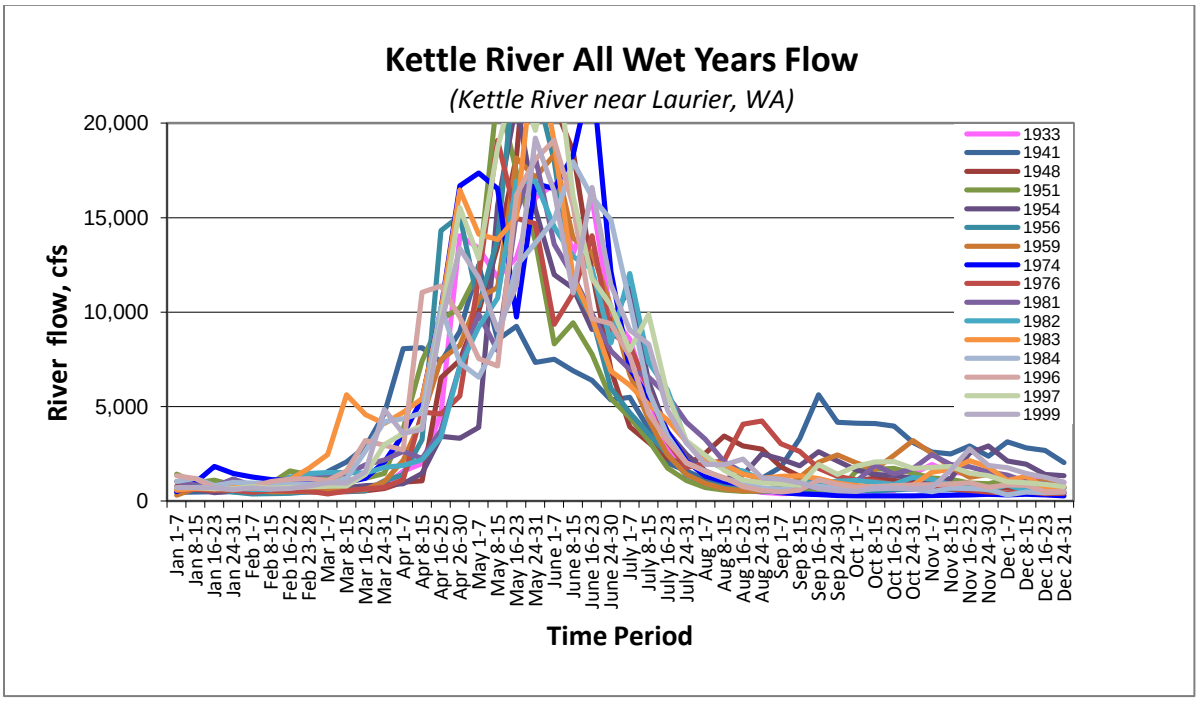

Kettle River Flow Exceedance Curve
(Kettle River near Laurier, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, MAF
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1930 1970 1931 1973 1992 2009 1988 1943 1963 2008 1947 1939 1940 2002 1962 1960 1980 1965 2004 1967 1953 1945 1993 1991 1968 1955 1961 1998 1971 1942 1952 1990 1951 1954 1981 1941 1984 1996 1999 1983
Years


Dry Years Trend for Kettle River Flow
(Kettle River near Laurier, WA)
Linear Trend
y = 7851.3x + 1E+06
Annual river flow, MAF
2.0
1.5
1.0
0.5
0.0
1930 1931 1937 1943 1944 1966 1970 1973 1977 1979 1987 1988 1989 1992 2001 2009
Years


Kettle River 30 yr Flows
(Kettle River near Laurier, WA)
Annual river flow, MAF
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 16 6
Avg 48 17
Wet 16 7
Total 80 30


Kettle River Dry, Average and Wet Year Flows
(Kettle River near Laurier, WA)
River flow, cfs
25,000
20,000
15,000
10,000
5,000
0
Dry year (1930)
Avg.year (1986)
Wet year (1997)
Jan 1-7 Jan 8-15 Jan 16-23 Jan 24-31 Feb 1-7 Feb 8-15 Feb 16-22 Feb 23-28 Mar 1-7 Mar 8-15 Mar 16-23 Mar 24-31 Apr 1-7 Apr 8-15 Apr 16-25 Apr 26-30 May 1-7 May 8-15 May 16-23 May 24-31 June 1-7 June 8-15 June 16-23 June 24-30 July 1-7 July 8-15 July 16-23 July 24-31 Aug 1-7 Aug 8-15 Aug 16-23 Aug 24-31 Sep 1-7 Sep 8-15 Sep 16-23 Sep 24-30 Oct 1-7 Oct 8-15 Oct 16-23 Oct 24-31 Nov 1-7 Nov 8-15 Nov 16-23 Nov 24-30 Dec 1-7 Dec 8-15 Dec 16-23 Dec 24-31
Time Period


Kettle River All Dry Years Flow
(Kettle River near Laurier, WA)
River flow, cfs
15,000
12,000
9,000
6,000
3,000
0
1930
1931
1937
1943
1944
1966
1970
1973
1977
1979
1987
1988
1989
1992
2001
2009
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

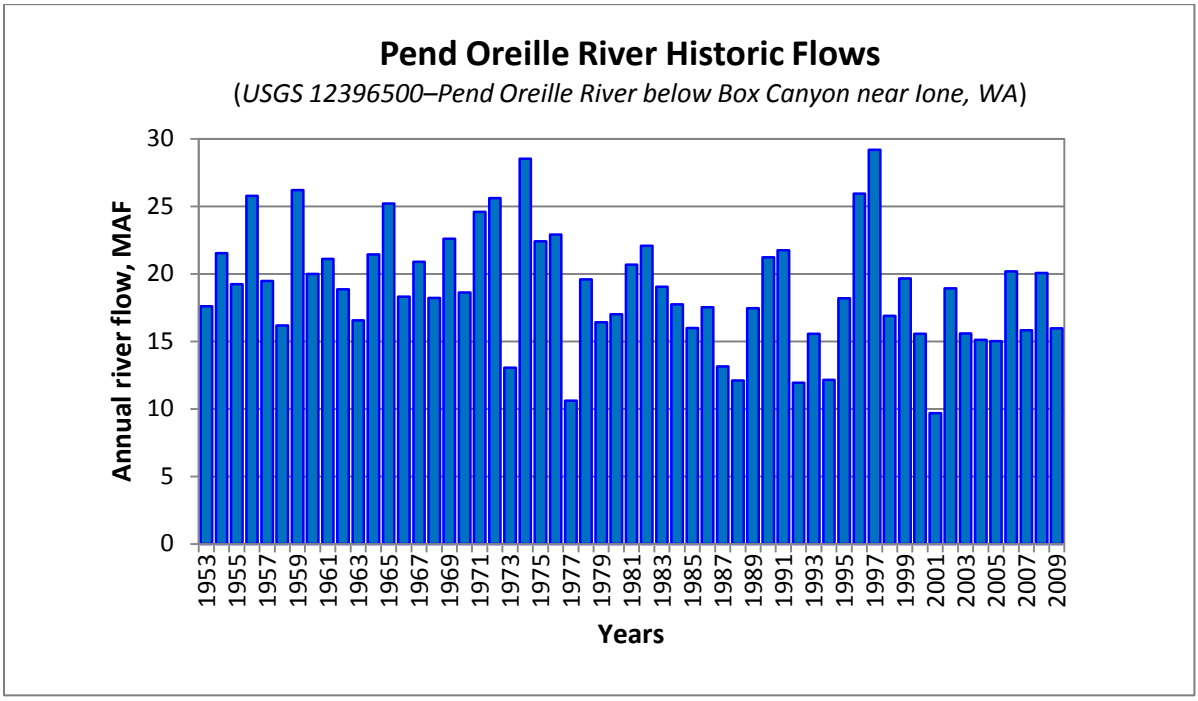

Kettle River All Wet Years Flow
(Kettle River near Laurier, WA)
River flow, cfs
20,000
15,000
10,000
5,000
0
1933
1941
1948
1951
1954
1956
1959
1974
1976
1981
1982
1983
1984
1996
1997
1999
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period

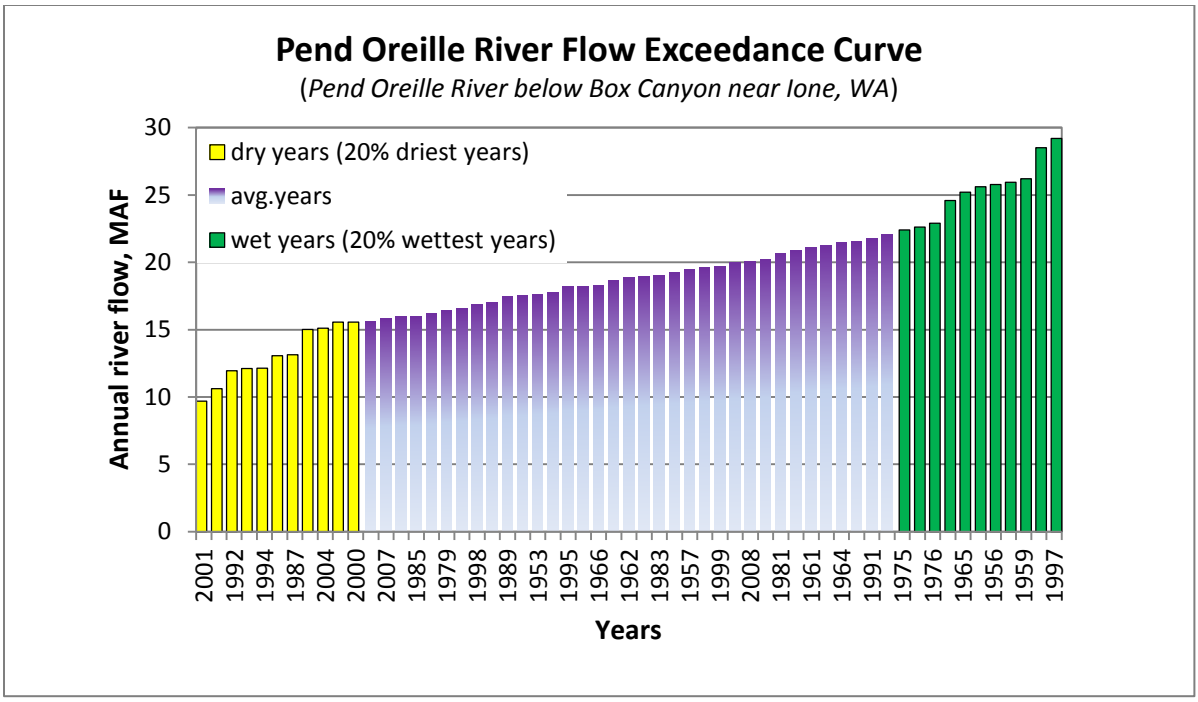
WRIA 62 (Pend Oreille)

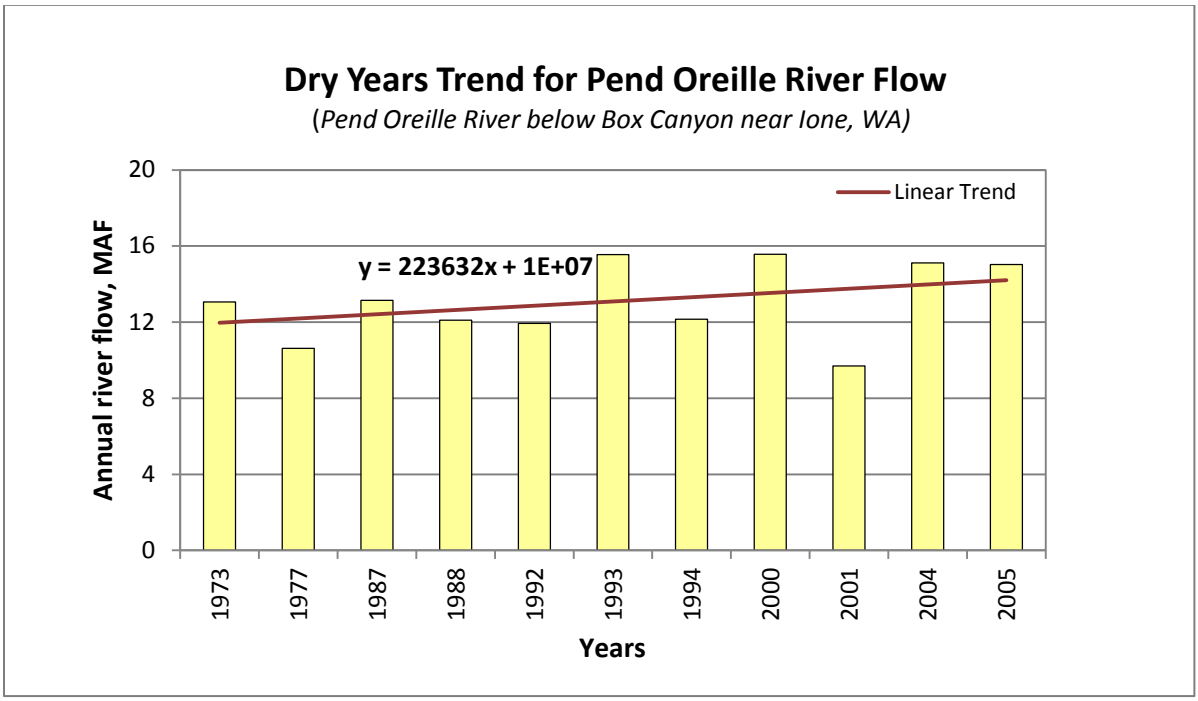
For WRIA 62, OCR graphed the flows of the Pend Oreille River. A series of seven graphs were created. The results provide information on historic flow levels and drought occurrences. These data contribute to OCR's understanding of historic trends, drought patterns and hydrograph variability. For example, by graphing the 53 (1953–2009) flows of the Pend Oreille River below Box Canyon near Ione, gauge number 123965000, it is shown that:

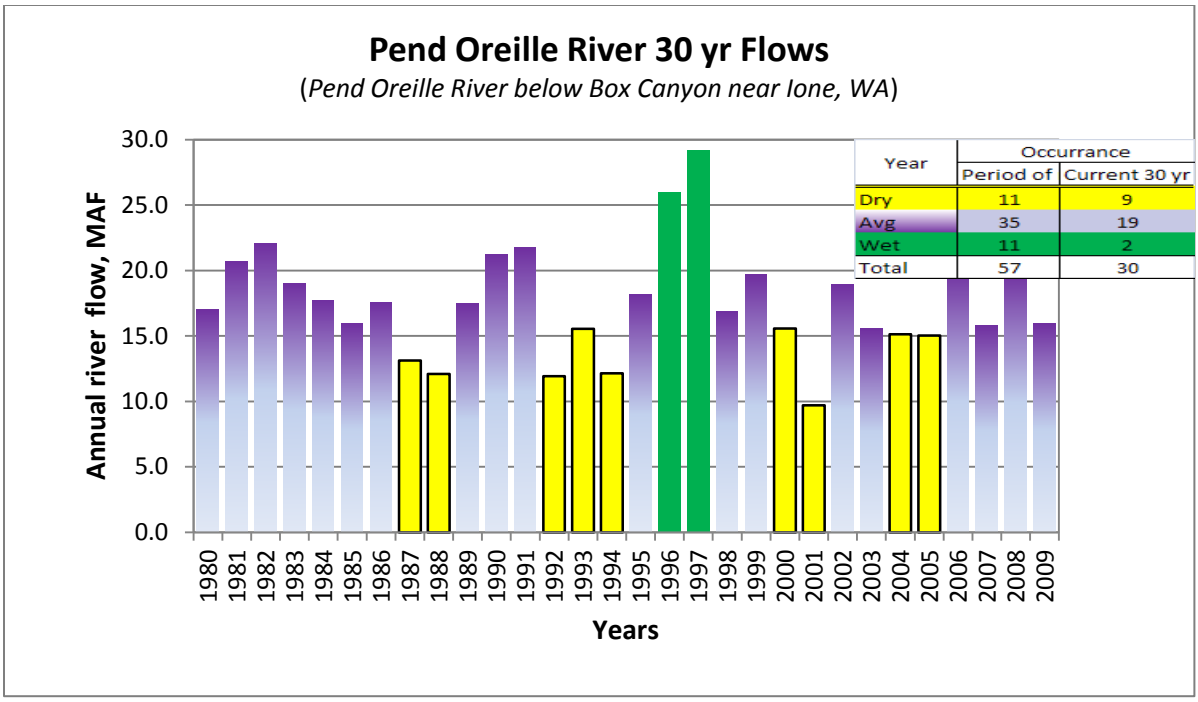
- Historic mean annual flows generally varied between 9.7 and 29.2 million acre-feet (MAF).
- Ecology defined "dry" years as the 80% exceedance value (80% of the time more water was available). Over the last 30 years, dry years occurred 9 times, with the worst stretch being 2 consecutive dry years in 1987-1988, 3 consecutive dry years in 1992-1994, 2 consecutive dry years in 2000-2001 and again 2 consecutive dry years in 2004-2005. During this same time period, the availability of water during dry years improved by 14%.

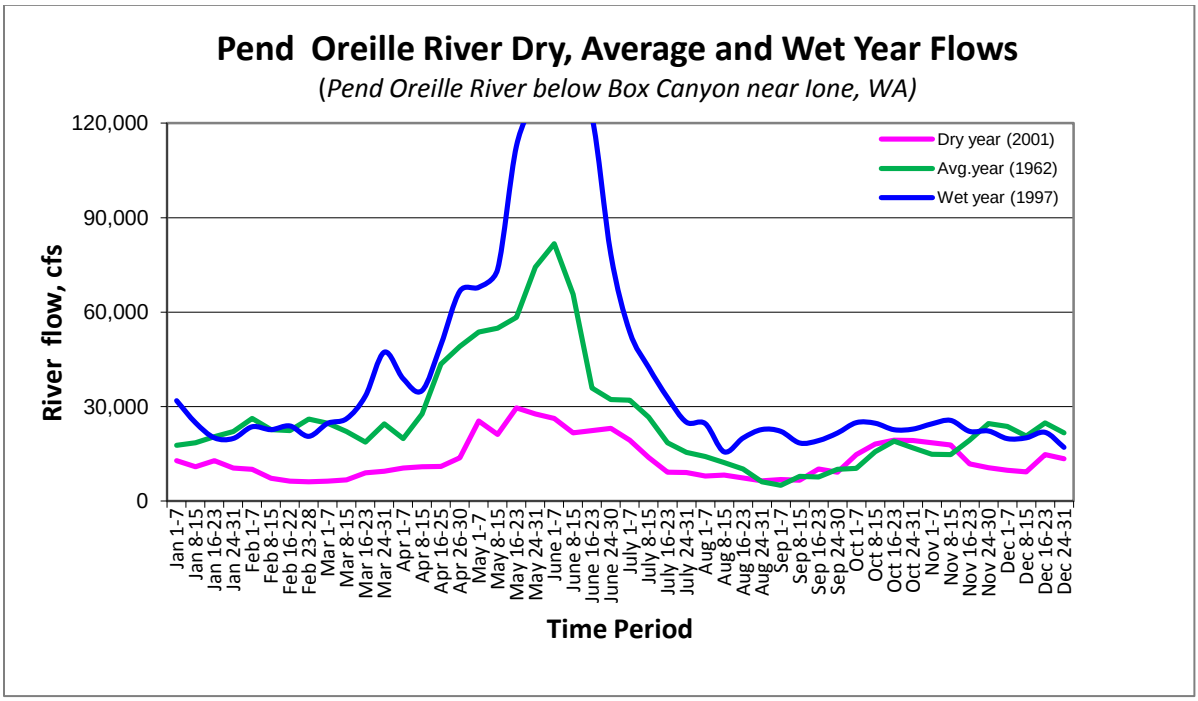
OCR can use this information to recognize where water is needed, when water is available and whether or not the in-basin or out-of-basin water supply development can help meet the WRIA's water demands.

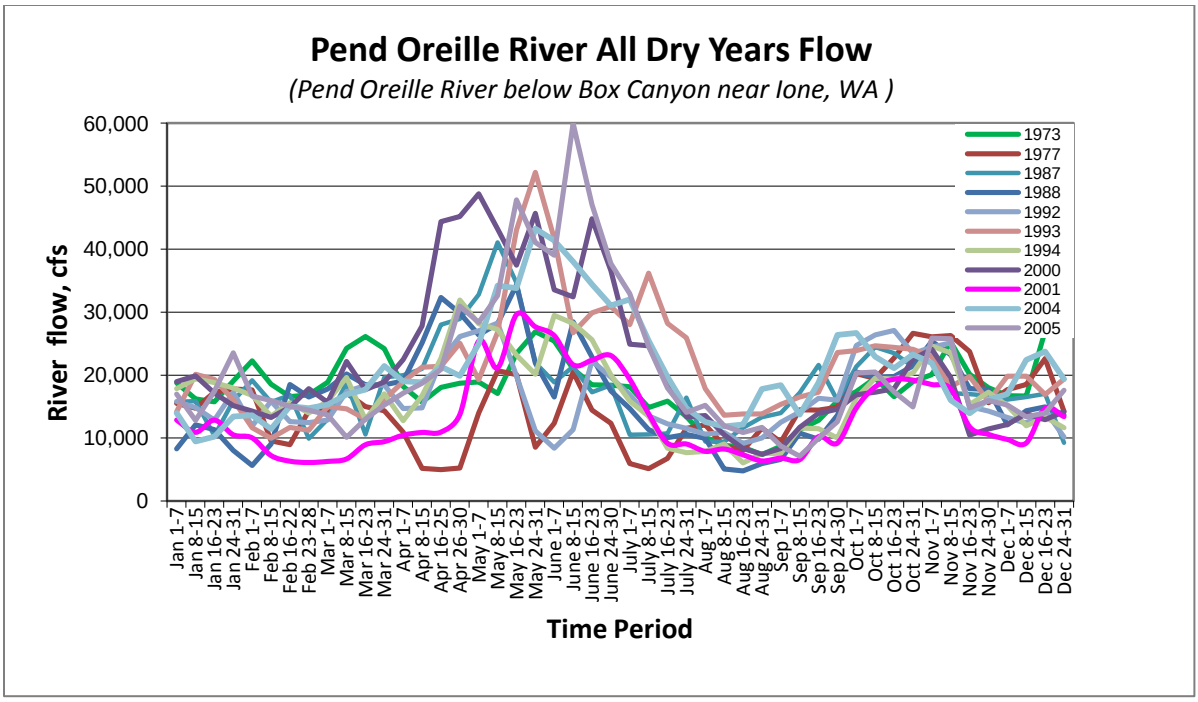


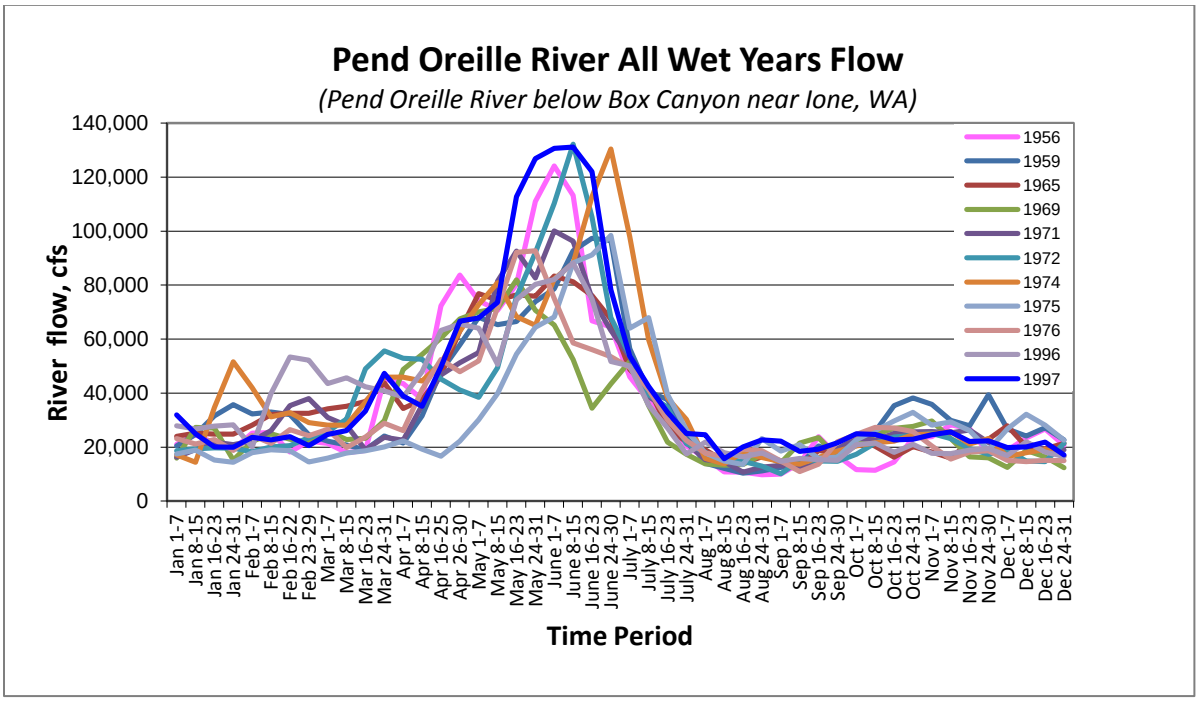

Pend Oreille River Flow Exceedance Curve
(Pend Oreille River below Box Canyon near Ione, WA)
dry years (20% driest years)
avg.years
wet years (20% wettest years)
Annual river flow, MAF
0
5
10
15
20
25
30
2001 1992 1994 1987 2004 2000 2007 1985 1979 1998 1989 1953 1995 1966 1962 1983 1957 1999 2008 1981 1961 1964 1991 1975 1976 1965 1956 1959 1997
Years


Dry Years Trend for Pend Oreille River Flow
(Pend Oreille River below Box Canyon near Ione, WA)
Linear Trend
y = 223632x + 1E+07
Annual river flow, MAF
0
4
8
12
16
20
1973 1977 1987 1988 1992 1993 1994 2000 2001 2004 2005
Years


Pend Oreille River 30 yr Flows
(Pend Oreille River below Box Canyon near Ione, WA)
Annual river flow, MAF
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Years
Year
Occurrance
Period of
Current 30 yr
Dry 11 9
Avg 35 19
Wet 11 2
Total 57 30


Pend Oreille River Dry, Average and Wet Year Flows
(Pend Oreille River below Box Canyon near Ione, WA)
River flow, cfs
120,000
90,000
60,000
30,000
0
Dry year (2001)
Avg.year (1962)
Wet year (1997)
Jan 1-7 Jan 8-15 Jan 16-23 Jan 24-31 Feb 1-7 Feb 8-15 Feb 16-22 Feb 23-28 Mar 1-7 Mar 8-15 Mar 16-23 Mar 24-31 Apr 1-7 Apr 8-15 Apr 16-25 Apr 26-30 May 1-7 May 8-15 May 16-23 May 24-31 June 1-7 June 8-15 June 16-23 June 24-30 July 1-7 July 8-15 July 16-23 July 24-31 Aug 1-7 Aug 8-15 Aug 16-23 Aug 24-31 Sep 1-7 Sep 8-15 Sep 16-23 Sep 24-30 Oct 1-7 Oct 8-15 Oct 16-23 Oct 24-31 Nov 1-7 Nov 8-15 Nov 16-23 Nov 24-30 Dec 1-7 Dec 8-15 Dec 16-23 Dec 24-31
Time Period


Pend Oreille River All Dry Years Flow
(Pend Oreille River below Box Canyon near Ione, WA)
River flow, cfs
60,000
50,000
40,000
30,000
20,000
10,000
0
1973
1977
1987
1988
1992
1993
1994
2000
2001
2004
2005
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-28
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period


Pend Oreille River All Wet Years Flow
(Pend Oreille River below Box Canyon near Ione, WA)
River flow, cfs
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1956
1959
1965
1969
1971
1972
1974
1975
1976
1996
1997
Jan 1-7
Jan 8-15
Jan 16-23
Jan 24-31
Feb 1-7
Feb 8-15
Feb 16-22
Feb 23-29
Mar 1-7
Mar 8-15
Mar 16-23
Mar 24-31
Apr 1-7
Apr 8-15
Apr 16-25
Apr 26-30
May 1-7
May 8-15
May 16-23
May 24-31
June 1-7
June 8-15
June 16-23
June 24-30
July 1-7
July 8-15
July 16-23
July 24-31
Aug 1-7
Aug 8-15
Aug 16-23
Aug 24-31
Sep 1-7
Sep 8-15
Sep 16-23
Sep 24-30
Oct 1-7
Oct 8-15
Oct 16-23
Oct 24-31
Nov 1-7
Nov 8-15
Nov 16-23
Nov 24-30
Dec 1-7
Dec 8-15
Dec 16-23
Dec 24-31
Time Period