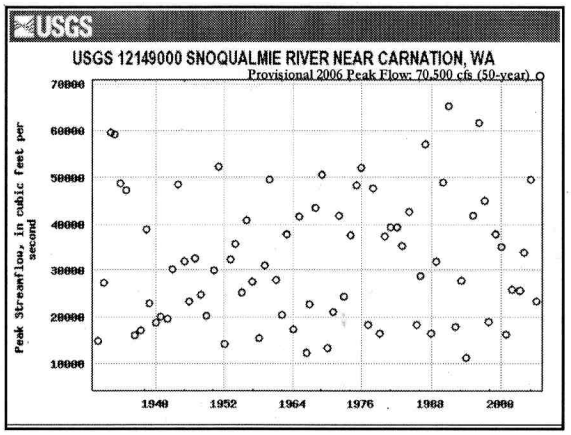
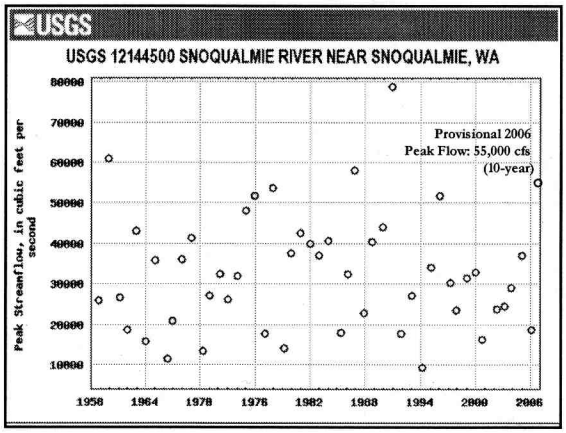
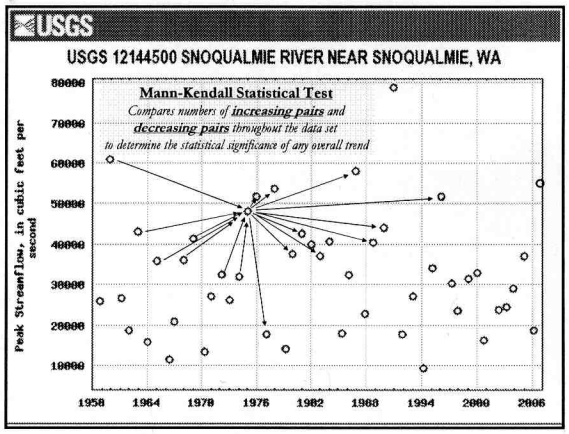
Hydrologic Trends
in the
Snoqualmie River Basin







Mann-Kendall Statistics
Snoqualmie River at Snoqualmie

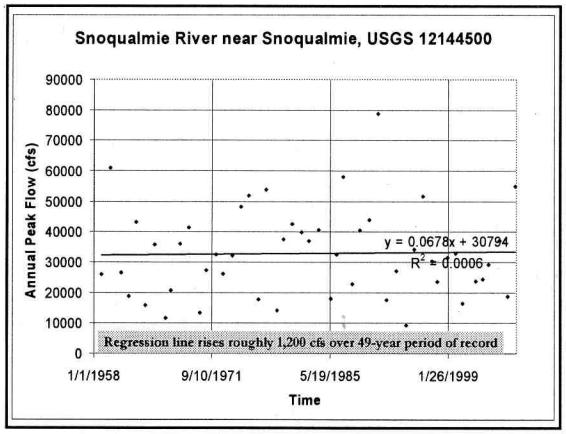
Metric	Q = Discharge
Start Year	1958
End Year	2006
Annual Peaks	49
Increasing Pairs	597
Decreasing Pairs	578
Tied Pairs	1
Apparent Trend	Rise?
Significance	0.56

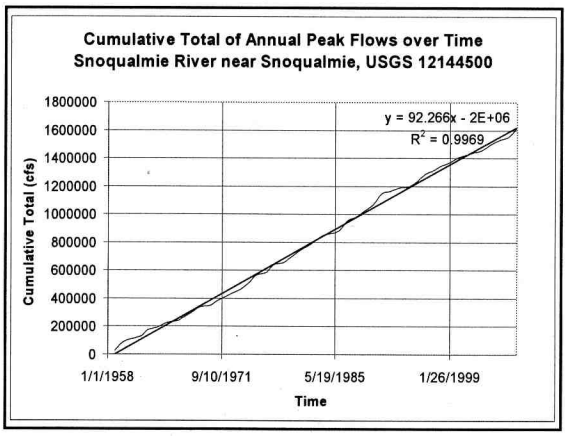
Mann-Kendall Statistics
Snoqualmie River at Snoqualmie

Metric	Q = Discharge	
Start Year	1958	1987
End Year	2006	2006
Annual Peaks	49	20
Increasing Pairs	597	93
Decreasing Pairs	578	97
Tied Pairs	1	0
Apparent Trend	Rise?	Fall?
Significance	0.56	0.54

Mann-Kendall Statistics
Snoqualmie River at Snoqualmie

Metric	Q = Discharge		
Start Year	1958	1987	1997
End Year	2006	2006	2006
Annual Peaks	49	20	11
Increasing Pairs	597	93	33
Decreasing Pairs	578	97	22
Tied Pairs	1	0	0
Apparent Trend	Rise?	Fall?	Rise?
Significance	0.56	0.54	0.78





Mann-Kendall Statistics
Snoqualmie River at Carnation

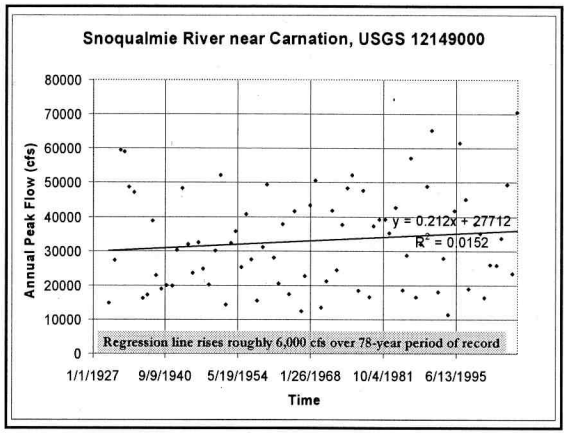
Metric	Q = Discharge
Start Year	1929
End Year	2006
Annual Peaks	78
Increasing Pairs	1,621
Decreasing Pairs	1,377
Tied Pairs	5
Apparent Trend	Rise
Significance	0.85

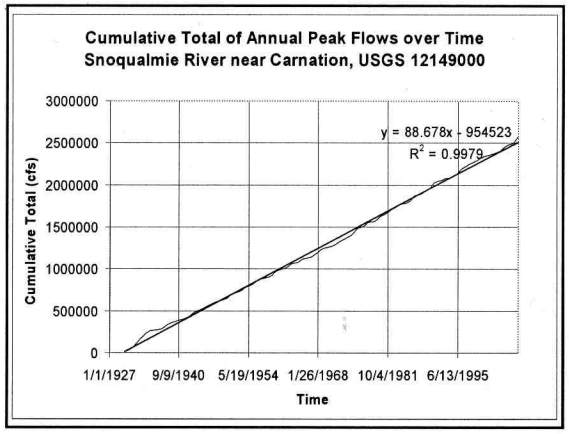
Mann-Kendall Statistics
Snoqualmie River at Carnation

Metric	Q = Discharge	
Start Year	1929	1987
End Year	2006	2006
Annual Peaks	78	31
Increasing Pairs	1,621	238
Decreasing Pairs	1,377	226
Tied Pairs	5	1
Apparent Trend	Rise	Rise?
Significance	0.85	0.57

Mann-Kendall Statistics
Snoqualmie River at Carnation

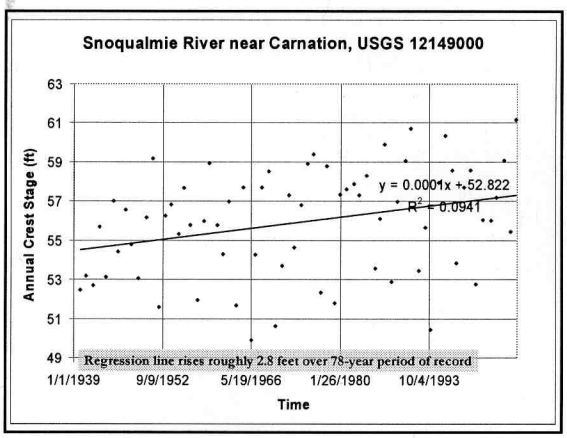
Metric	Q = Discharge		
Start Year	1929	1987	1997
End Year	2006	2006	2006
Annual Peaks	78	31	11
Increasing Pairs	1,621	238	30
Decreasing Pairs	1,377	226	25
Tied Pairs	5	1	0
Apparent Trend	Rise	Rise?	Rise?
Significance	0.85	0.57	0.62

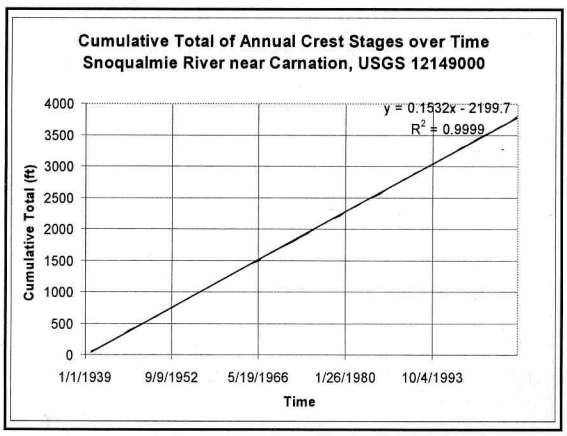


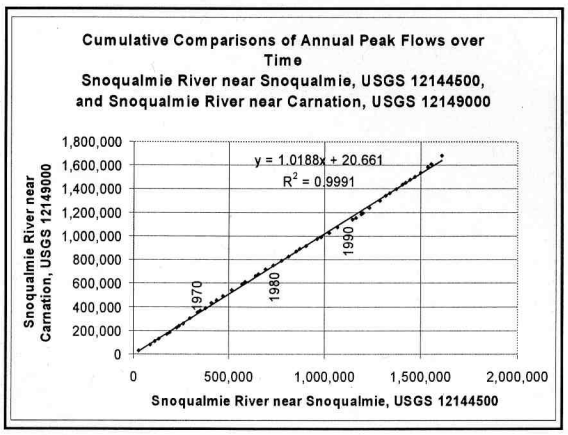


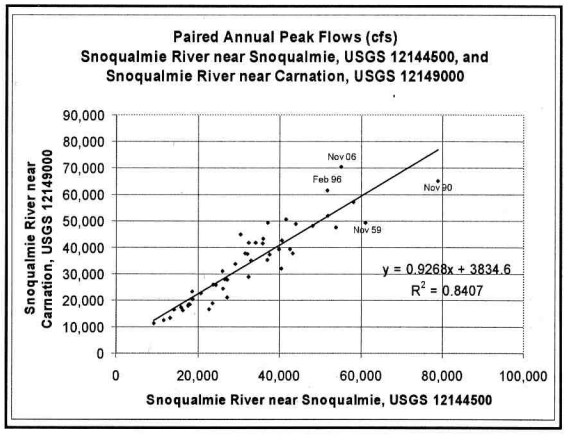
Mann-Kendall Statistics
Snoqualmie River at Carnation

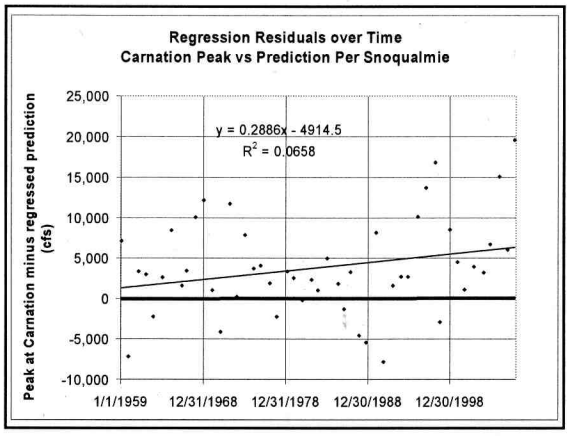
Metric	Q = Discharge			Z = Stage
Start Year	1929	1987	1997	1939
End Year	2006	2006	2006	2006
Annual Peaks	78	31	11	68
Increasing Pairs	1,621	238	30	1,390
Decreasing Pairs	1,377	226	25	885
Tied Pairs	5	1	0	3
Apparent Trend	Rise	Rise?	Rise?	Rise
Significance	0.85	0.57	0.62	0.996

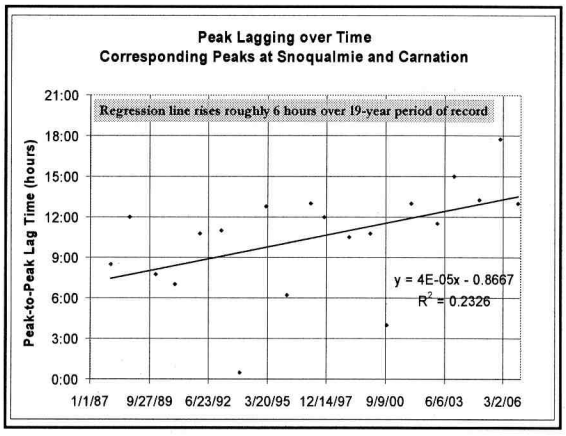


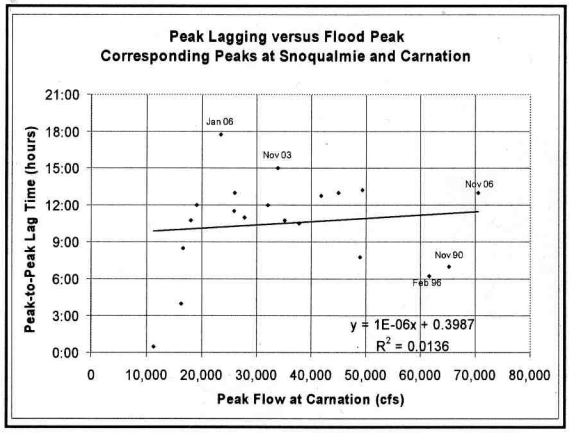


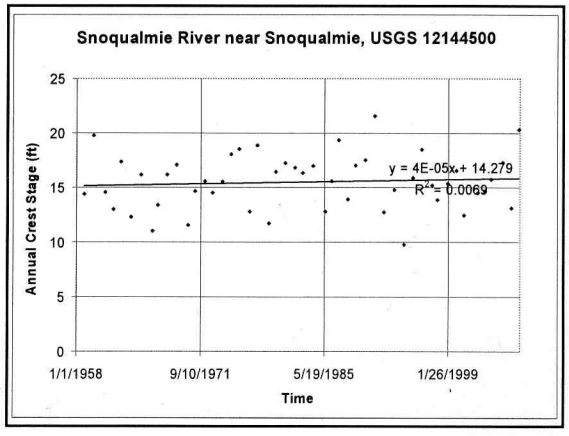


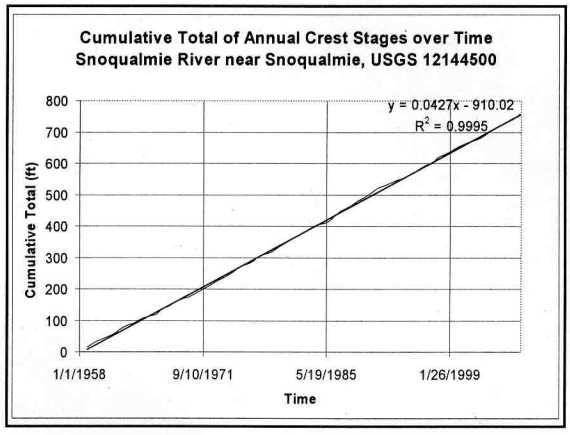

Paired Annual Peak Flows (cfs)
Snoqualmie River near Snoqualmie, USGS 12144500, and
Snoqualmie River near Carnation, USGS 12149000
Snoqualmie River near Carnation, USGS 12149000
Snoqualmie River near Snoqualmie, USGS 12144500
Nov 06
Feb 96
Nov 90
Nov 59
y = 0.9268x + 3834.6
R2 = 0.8407
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
0
20,000
40,000
60,000
80,000
100,000


Regression Residuals over Time
Carnation Peak vs Prediction Per Snoqualmie
Peak at Carnation minus regressed prediction (cfs)
y = 0.2886x - 4914.5
R2 = 0.0658
25,000
20,000
15,000
10,000
5,000
0
-5,000
-10,000
1/1/1959
12/31/1968
12/31/1978
12/30/1988
12/30/1998


Peak Lagging over Time
Corresponding Peaks at Snoqualmie and Carnation
Regression line rises roughly 6 hours over 19-year period of record
Peak-to-Peak Lag Time (hours)
y = 4E-05x - 0.8667
R2 = 0.2326
21:00
18:00
15:00
12:00
9:00
6:00
3:00
0:00
1/1/87
9/27/89
6/23/92
3/20/95
12/14/97
9/9/00
6/6/03
3/2/06


Peak Lagging versus Flood Peak
Corresponding Peaks at Snoqualmie and Carnation
Peak-to-Peak Lag Time (hours)
Jan 06
Nov 03
Nov 06
Nov 90
Feb 96
y = 1E-06x + 0.3987
R2 = 0.0136
21:00
18:00
15:00
12:00
9:00
6:00
3:00
0:00
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
Peak Flow at Carnation (cfs)


Snoqualmie River near Snoqualmie, USGS 12144500
Annual Crest Stage (ft)
y = 4E-05x + 14.279
R2 = 0.0069
25
20
15
10
5
0
1/1/1958
9/10/1971
5/19/1985
1/26/1999
Time


Cumulative Total of Annual Crest Stages over Time
Snoqualmie River near Snoqualmie, USGS 12144500
Cumulative Total (ft)
y = 0.0427x - 910.02
R2 = 0.9995
800
700
600
500
400
300
200
100
0
1/1/1958
9/10/1971
5/19/1985
1/26/1999
Time

Snoqualmie Hydrologic Trends

- Estimates from least-squares regression
  - Carnation stage trend is up 2.8 ft in 78 years
  - Carnation flow trend is up 6,000 cfs in 78 years
  - Snoqualmie flow trend is up 1,200 cfs in 49 years
  - Falls to Carnation lag trend is up 6 hours in 19 years
- River gage accuracy (USGS 2006)
  - Records from both Snoqualmie River stations (at Snoqualmie and at Carnation) are considered "good"
  - "Good" is defined such that 95% of reported measurements are within 10% of actual values