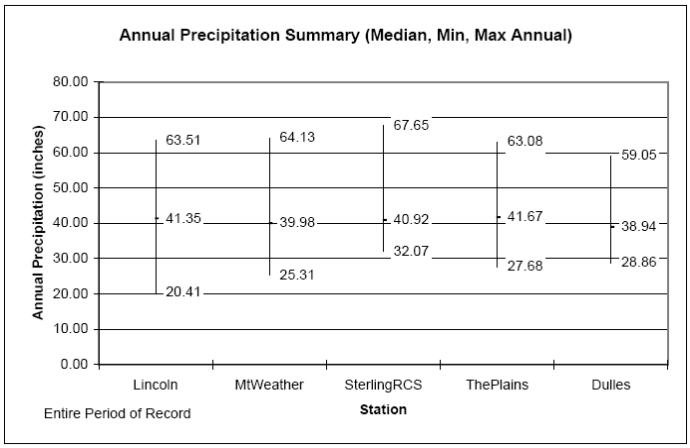
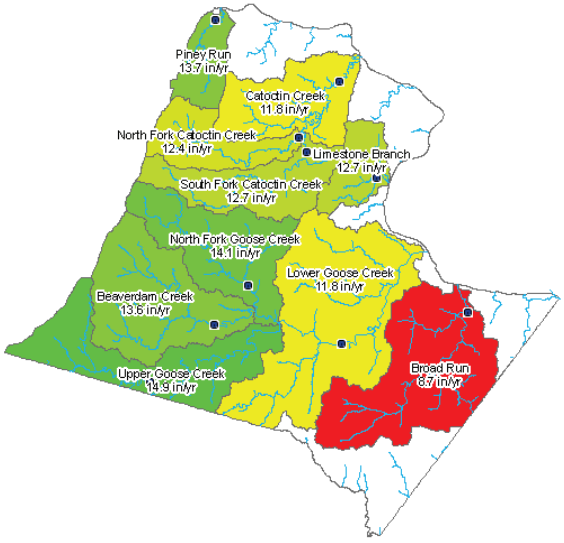
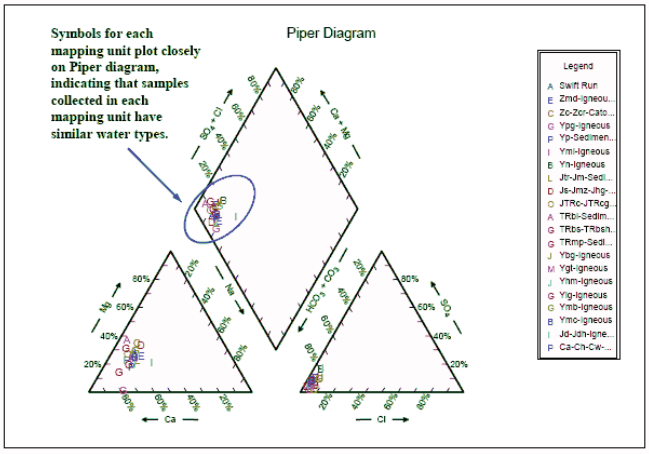
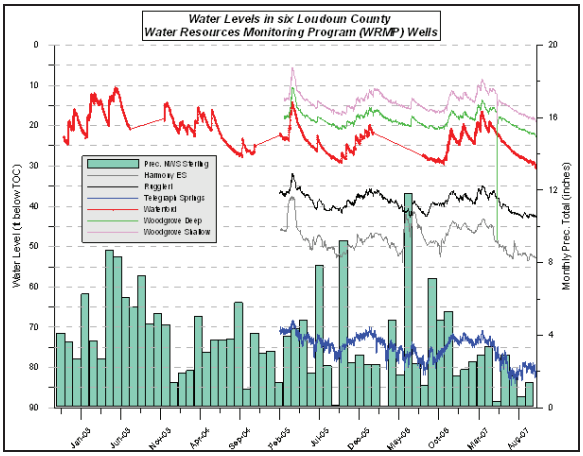
Initial Results of Statistical Analyses of Hydrologic, Water Quality, and Hydrogeologic Data Loudoun County, VA









September 4, 2007

Department of Building and Development, Engineering Division, Water Resources Team

Contents

1. Introduction

2. Precipitation (Task B.3.2)

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8. Preliminary Notes and Information for Upcoming Task B.3.8 – *Summary of Analyses and Assessment of Conditions*

Acknowledgments

The primary authors of this data analysis report were:

Dennis Cumbie, Hydrogeologist
David Ward, Water Resources Engineer

The following staff contributed technical, administrative, and review assistance:

Edward Irwin, GIS Administrator
Glen Rubis, Water Resources Team Leader
Scott Sandberg, Water Resources Data Manager
Trent Small, GIS Administrator

All personnel are staff of the Loudoun County Department of Building and Development.

Introduction

The information contained in this document is a working/draft set of primarily statistical analyses and represents the initial phase of a comprehensive evaluation of water resources in Loudoun County, Virginia. The approach taken for this initial effort was to identify and compile all pertinent and available hydrologic, water quality, and hydrogeologic data for the county and conduct basic statistical analyses on those data sets that were considered to be the most complete and representative. These results, along with additional data and analyses, will be evaluated in upcoming months to help develop a baseline of water resource conditions in the county. These data and analyses will also be used to help guide the development of a proposed county-wide watershed management plan.

Tasks identified in the chapter cover sheets (e.g., Task B.3.2) refer to tasks in a contract scope of work that is being conducted for the County by the engineering and environmental consulting firm CH2M Hill, Inc. The primary goals of that contract are to assess the conditions of water resources in the county and to develop a county-wide watershed management plan. The information in this document will be evaluated and incorporated into that scope of work.

Data sets referenced near the beginning of each data group chapter (e.g., "data set 2.2" listed on the third and fourth pages of the Precipitation data chapter) refer to the outline numbers in which the data sets are organized in the accompanying document *Summary of Water Resource and Related Data in Loudoun County, VA*.

Unless otherwise indicated, the data in this document were compiled and analyzed by staff of the Water Resources Team in the Engineering Division of the Department of Building and Development. This work was funded by the County of Loudoun and a grant from the U.S. Environmental Protection Agency.

Task B.3.2 Precipitation Data

B.3.2 Precipitation (using data set 2.2)

Period of Record, Missing Days

Annual Average Daily

Median, Max, Min of Annual Average

Annual Maximum Daily

Std Deviation and Skewness

Annual Summary of Deviation from Median Annual

Percent Exceedence on Annual Basis

Monthly Summary of Average Daily

Monthly Summary of Max Daily

Percent Exceedence on Monthly Basis

Percent Days with No Precipitation

Precipitation Gaps

Precipitation Intensity and Frequency

USGS Precipitation

Data Set 2.2

Precipitation Data – National Weather Service / National Climatic Data Center

Daily precipitation (rain and frozen) collected as part of the National Weather Service Cooperative Station Network and purchased from NCDC. (These data sets are for distribution only by NCDC.) Five stations with relatively long and complete data sets in Loudoun County and vicinity currently purchased by B&D: Lincoln (1/30-7/06), Mt. Weather (8/48-7/06), Sterling RCS (9/77-7/06), Dulles Airport (3/63-7/06), and The Plains in Fauquier County (4/54-7/06). Data sets have been converted from text files into Excel spreadsheets, missing records identified, and have monthly and annual totals calculated. **{Commercial data - restricted distribution}**

Compilation of all NCDC Preciptation Data

Flags created when value reported is either "9999" or "T". In these cases, field for values (precipiation or snow) is left blank and a value entered in Flag field.

Codes:

T = Trace
A = Accumulated amount since last measurement.

Station_Name:
Name of station assigned by Loudoun County for easy identification and labelling.

COOPID: (COOPERATIVE STATION NUMBER)
This 6-character alphanumeric station identifier is assigned by the National Climatic Data Center. The first two digits refer to a state code (value range is 01-91; reference Table "A"). The next four digits refer to the Cooperative Network Index number (value range is 0001-9999).

DATE_Prcp: Date of preciptation reading. This value was calculated by loudoun County from year-Month-Date provided by NCDC.

PRCP: Daily precipitation. Precipitation reading for 24 hours ending at time of observation. Trace is less than 0.005 inch. Unit Measurement, Inches to Hundredths.

SNOW: Daily Snowfall (Snowfall includes sleet). Amount is for 24-hour period ending at observation time. Hail was included with snowfall from July 1948 through December 1955. Hail occurring alone was not included with either snowfall or snow depth before and after that period. Trace is less than 0.05 inch. Unit Measurement, Inches to Tenths

SNWD: Snow depth at observation time. (Snow depth is depth of snow on the ground at time of observation. Trace is depth less than 0.5 inch.) Unit Measurement, Whole Inches.

David Ward 8/15/2007

Revised 9/28/07

Processing steps:

1 Load .txt files
2 Add columns for Prcp, Snow and Snrd flags
3 Move all text and 999 (any permutation) into "Flag" fields for all 3 entries
4 Expand to identify "Missing" records
5 Summarize the "Period or Record"
6 Construct aligned composite to develop statistics
7 Modify compilation in preparation for Stagraphics in which all "Missing" data is shown as "NA" and all "T" (trace) and "Nulls" are entered as zero.
8 Calculate statistical average, mean and deviations for monthly and annual for all stations
9 Percent exceedance analysis (Tools>Data Analysis>Rank and Percent) for annual and monthly
10 Apply station averaging to fill in data gaps.

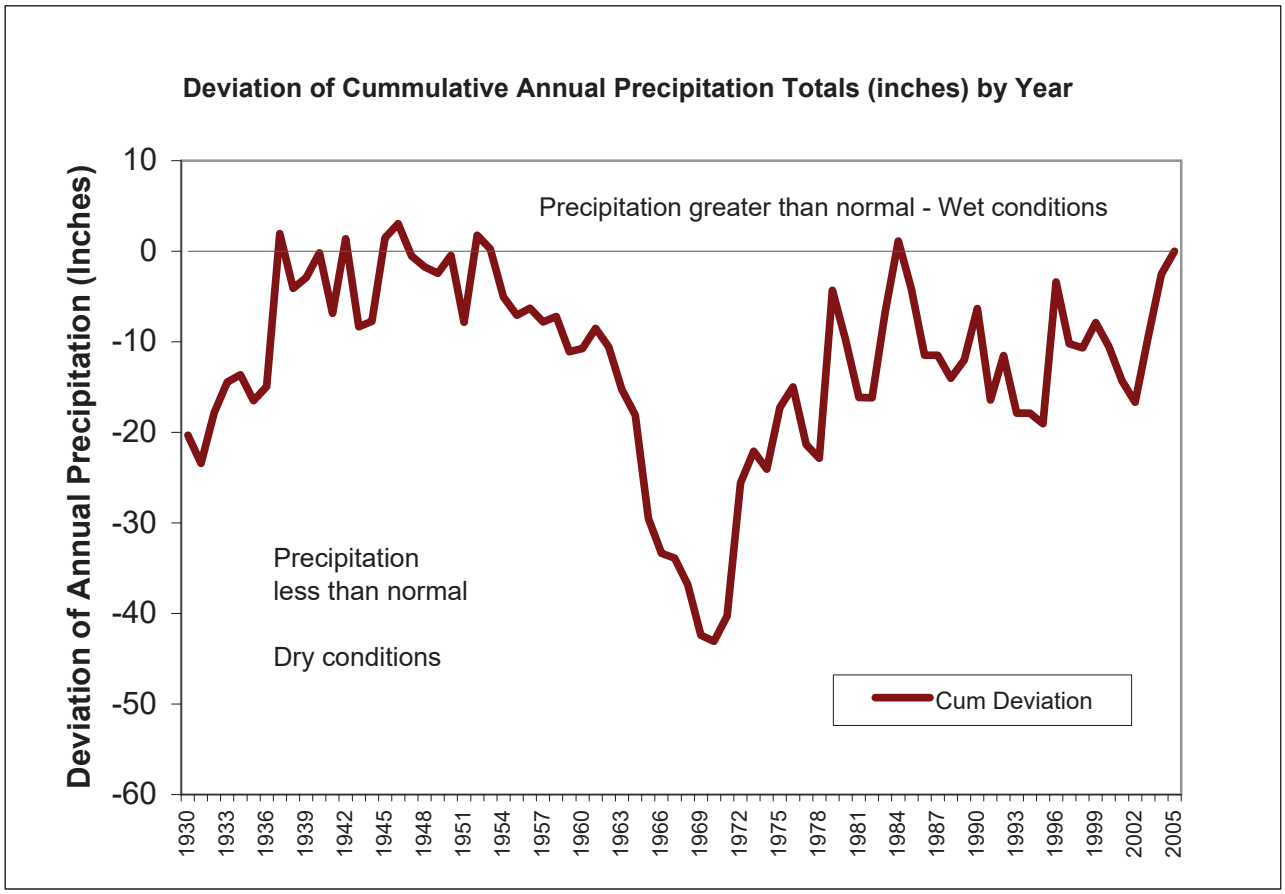
Station_Name	COOPID	Start	End	Number of days	Number of records	Number of missing days	Missing periods
Station: Lincoln	444909	01/01/30	07/31/06	27971	27787	184	10/1/50 to 10/31/50, 1/1/94 to 1/31/94, 7/1/94 to 7/31/94, 11/1/96 to 11/30/96, 1/1/05 to 1/31/05, 6/1/06 to 6/30/06
Station: Mt. Weather	445851	08/01/48	07/31/06	21184	21124	60	11/1/03 to 11/30/03, 6/1/06 to 6/30/06
Station: Sterling Rcs	448084	09/01/77	07/31/06	10561	10469	92	1/1/82 to 1/31/82, 5/1/90 to 5/31/90, 6/1/06 to 6/30/06
Station: The Plains	448396	04/01/54	07/31/06	19115	18596	519	5/1/54 to 5/31/54, 1/1/66 to 1/31/66, 12/1/74 to 1/31/75, 5/1/75 to 5/31/75, 12/1/78 to 12/31/78, 2/1/03 to 11/30/03, 6/1/06 to 6/30/06
Station: Dulles	448903	11/01/62	10/31/01	14245	14245	0	None

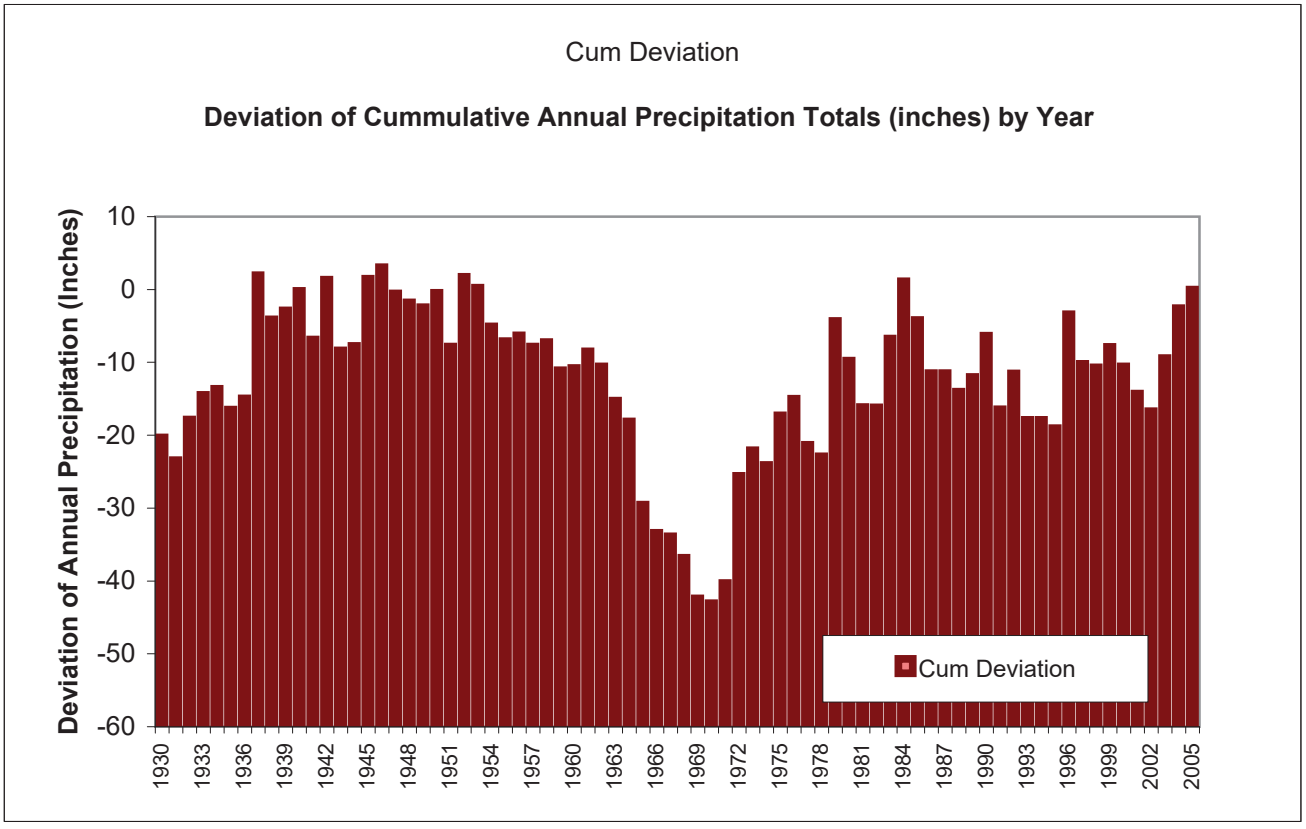
Period of Record

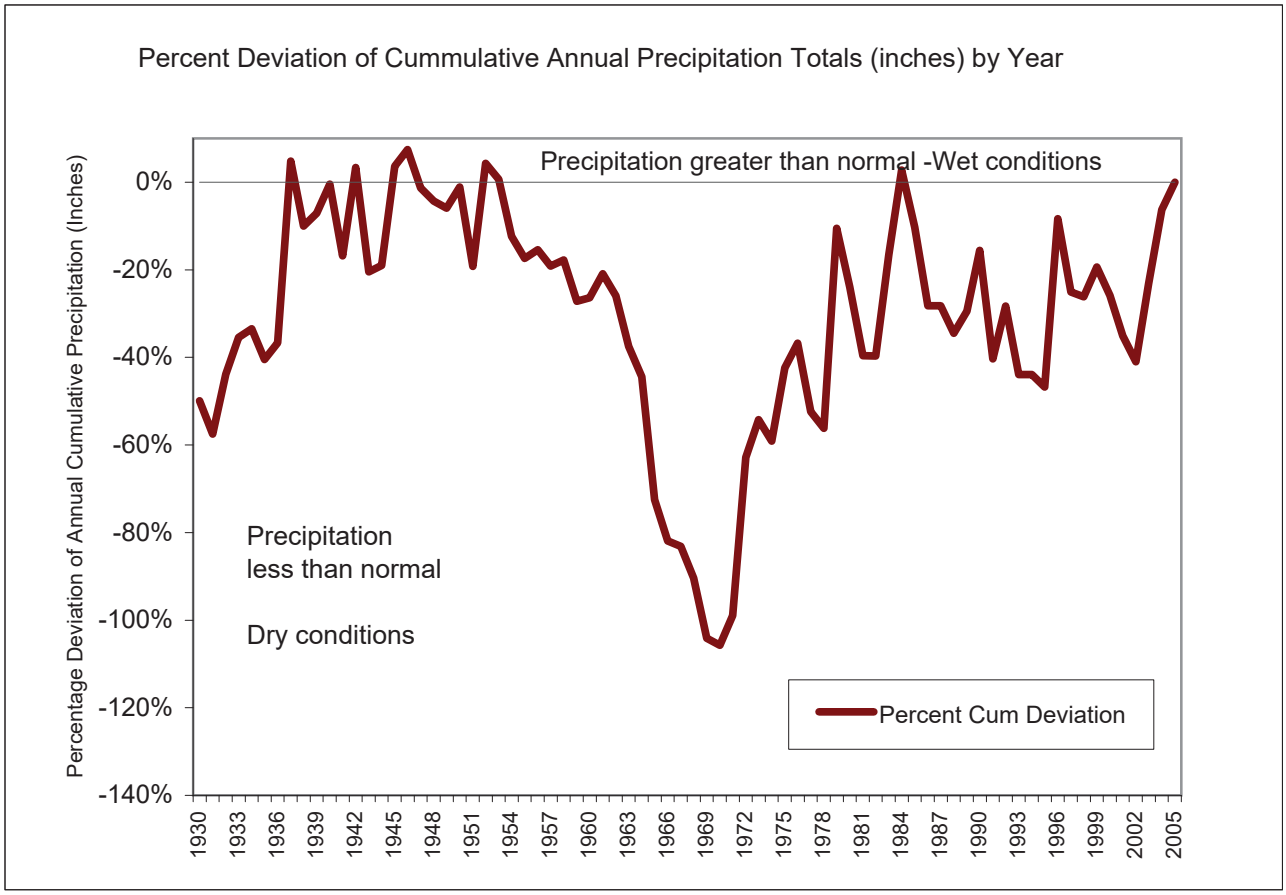
Deviation of Cummulative Annual Precipitation Totals (inches) by Year

Year	Lincoln	MtWeather	SterlingRCS	ThePlains	Dulles	Average	Cum	Norm	Cum Deviation	Percent of Norm Cum Deviation
1930	20.41					20.41	20.41	40.73	-20.32	-49.9%
1931	37.61					37.61	58.02	81.46	-23.44	-57.5%
1932	46.31					46.31	104.33	122.19	-17.86	-43.8%
1933	44.14					44.14	148.47	162.92	-14.45	-35.5%
1934	41.53					41.53	190.00	203.65	-13.65	-33.5%
1935	37.88					37.88	227.88	244.38	-16.50	-40.5%
1936	42.29					42.29	270.17	285.11	-14.94	-36.7%
1937	57.61					57.61	327.78	325.83	1.95	4.8%
1938	34.69					34.69	362.47	366.56	-4.09	-10.1%
1939	41.94					41.94	404.41	407.29	-2.88	-7.1%
1940	43.44					43.44	447.85	448.02	-0.17	-0.4%
1941	34.04					34.04	481.89	488.75	-6.86	-16.8%
1942	48.96					48.96	530.85	529.48	1.37	3.4%
1943	31.01					31.01	561.86	570.21	-8.35	-20.5%
1944	41.34					41.34	603.20	610.94	-7.74	-19.0%
1945	49.95					49.95	653.15	651.67	1.48	3.6%
1946	42.29					42.29	695.44	692.40	3.04	7.5%
1947	37.15					37.15	732.59	733.13	-0.54	-1.3%
1948	52.26	26.78				39.52	772.11	773.86	-1.75	-4.3%
1949	42.86	37.24				40.05	812.16	814.59	-2.43	-6.0%
1950	42.59	42.80				42.70	854.86	855.32	-0.46	-1.1%
1951	36.84	29.88				33.36	888.22	896.05	-7.83	-19.2%
1952	51.93	48.69				50.31	938.53	936.77	1.75	4.3%
1953	43.00	35.47				39.24	977.76	977.50	0.26	0.6%
1954	37.40	43.53		25.36		35.43	1013.19	1018.23	-5.04	-12.4%
1955	43.28	24.82		47.98		38.69	1051.88	1058.96	-7.08	-17.4%
1956	49.05	26.83		48.72		41.53	1093.42	1099.69	-6.28	-15.4%
1957	38.32	41.46		37.79		39.19	1132.61	1140.42	-7.81	-19.2%
1958	41.56	40.42		41.98		41.32	1173.93	1181.15	-7.22	-17.7%
1959	38.39	40.09		32.13		36.87	1210.80	1221.88	-11.08	-27.2%
1960	42.65	39.79		40.74		41.06	1251.86	1262.61	-10.75	-26.4%
1961	40.64	44.33		43.97		42.98	1294.84	1303.34	-8.50	-20.9%
1962	37.38	37.28		41.36		38.67	1333.51	1344.07	-10.56	-25.9%
1963	34.57	38.66		35.88	34.96	36.02	1369.53	1384.80	-15.27	-37.5%
1964	39.96	34.91		40.77	35.97	37.90	1407.43	1425.53	-18.10	-44.4%
1965	31.01	25.31		32.08	28.86	29.32	1436.75	1466.26	-29.51	-72.5%
1966	38.52	32.40		36.52	40.05	36.87	1473.62	1506.99	-33.37	-81.9%
1967	41.41	38.25		42.30	38.93	40.22	1513.84	1547.71	-33.87	-83.2%
1968	40.06	34.64		37.94	38.48	37.78	1551.62	1588.44	-36.82	-90.4%
1969	34.77	34.68		32.92	38.24	35.15	1586.77	1629.17	-42.40	-104.1%
1970	41.32	39.00		41.01	38.94	40.07	1626.84	1669.90	-43.06	-105.7%
1971	46.08	39.87		41.41	46.61	43.49	1670.33	1710.63	-40.30	-98.9%
1972	54.44	50.74		57.53	59.05	55.44	1725.77	1751.36	-25.59	-62.8%
1973	40.12	48.66		46.71	41.49	44.25	1770.02	1792.09	-22.07	-54.2%

1974	42.89	41.81		32.13	38.12	38.74	1808.76	1832.82	-24.07	-59.1%
1975	44.04	49.12		44.38	52.64	47.55	1856.30	1873.55	-17.25	-42.4%
1976	48.49	43.73		43.62	36.19	43.01	1899.31	1914.28	-14.97	-36.8%
1977	42.16	37.68	16.35	39.73	35.92	34.37	1933.68	1955.01	-21.33	-52.4%
1978	37.57	40.92	40.40	39.37	37.66	39.18	1972.86	1995.74	-22.88	-56.2%
1979	53.85	64.13	60.05	63.08	55.43	59.31	2032.17	2036.47	-4.30	-10.6%
1980	38.45	36.81	34.48	32.77	33.81	35.26	2067.43	2077.20	-9.76	-24.0%
1981	34.73	35.21	32.27	37.45	32.13	34.36	2101.79	2117.93	-16.14	-39.6%
1982	44.90	38.08	37.76	44.15	38.56	40.69	2142.48	2158.65	-16.18	-39.7%
1983	56.55	46.89	48.58	52.73	46.18	50.19	2192.67	2199.38	-6.72	-16.5%
1984	51.38	48.04	46.12	53.22	44.07	48.57	2241.23	2240.11	1.12	2.7%
1985	39.76	36.62	32.52	35.21	32.94	35.41	2276.64	2280.84	-4.20	-10.3%
1986	36.01	33.29	32.07	35.47	30.38	33.44	2310.09	2321.57	-11.49	-28.2%
1987	42.18	37.87	40.92	41.92	40.77	40.73	2350.82	2362.30	-11.48	-28.2%
1988	39.04	37.82	40.38	33.82	39.81	38.17	2388.99	2403.03	-14.04	-34.5%
1989	40.45	45.50	44.23	39.32	44.34	42.77	2431.76	2443.76	-12.00	-29.5%
1990	44.26	49.82	43.11	49.49	45.33	46.40	2478.16	2484.49	-6.33	-15.5%
1991	29.90	26.34	35.19	27.68	34.02	30.63	2508.79	2525.22	-16.43	-40.3%
1992	46.02	45.88	44.91	47.10	44.36	45.65	2554.44	2565.95	-11.51	-28.3%
1993	33.55	30.67	35.65	33.55	38.36	34.36	2588.80	2606.68	-17.88	-43.9%
1994	27.54	44.26	41.75	45.85	44.26	40.73	2629.53	2647.41	-17.88	-43.9%
1995	29.77	44.53	39.24	44.12	40.20	39.57	2669.10	2688.14	-19.03	-46.7%
1996	46.14	59.32	62.17	60.98	53.22	56.37	2725.47	2728.87	-3.40	-8.3%
1997	28.17	31.30	33.74	39.87	36.52	33.92	2759.39	2769.59	-10.21	-25.1%
1998	39.07	43.66	38.10	43.13	37.41	40.27	2799.66	2810.32	-10.66	-26.2%
1999	37.72	47.37	45.04	43.78	43.60	43.50	2843.16	2851.05	-7.89	-19.4%
2000	35.20	39.15	37.16	42.12	36.79	38.08	2881.25	2891.78	-10.54	-25.9%
2001	41.35	34.72	40.52	35.43	32.79	36.96	2918.21	2932.51	-14.30	-35.1%
2002	42.78	36.00	39.03	35.58		38.35	2956.56	2973.24	-16.68	-41.0%
2003	63.51	53.56	67.65	7.26		48.00	3004.55	3013.97	-9.42	-23.1%
2004	45.22	48.58	45.51	51.07		47.60	3052.15	3054.70	-2.55	-6.3%
2005	35.85	42.37	48.88	46.03		43.28	3095.43	3095.43	0.00	0.0%
					Average	**40.73**				


Deviation of Cummulative Annual Precipitation Totals (inches) by Year
Deviation of Annual Precipitation (Inches)
10
0
-10
-20
-30
-40
-50
-60
Precipitation greater than normal - Wet conditions
Precipitation
less than normal
Dry conditions
Cum Deviation
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


Cum Deviation
Deviation of Cummulative Annual Precipitation Totals (inches) by Year
Deviation of Annual Precipitation (Inches)
10
0
-10
-20
-30
-40
-50
-60
Cum Deviation
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


Percent Deviation of Cummulative Annual Precipitation Totals (inches) by Year
Percentage Deviation of Annual Cumulative Precipitation (Inches)
Precipitation greater than normal -Wet conditions
Precipitation
less than normal
Dry conditions
Percent Cum Deviation
0%
-20%
-40%
-60%
-80%
-100%
-120%
-140%
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

Daily Precipitation Totals (inches) by Year

Year	Lincoln	MtWeather	SterlingRCS	ThePlains	Dulles	Average
1930	20.41					20.41
1931	37.61					37.61
1932	46.31					46.31
1933	44.14					44.14
1934	41.53					41.53
1935	37.88					37.88
1936	42.29					42.29
1937	57.61					57.61
1938	34.69					34.69
1939	41.94					41.94
1940	43.44					43.44
1941	34.04					34.04
1942	48.96					48.96
1943	31.01					31.01
1944	41.34					41.34
1945	49.95					49.95
1946	42.29					42.29
1947	37.15					37.15
1948	52.26	64.06				58.16
1949	42.86	37.24				40.05
1950	46.54	42.80				44.67
1951	36.84	32.65				34.75
1952	51.93	48.69				50.31
1953	43.00	35.47				39.24
1954	37.40	43.53		37.94		39.62
1955	43.28	27.12		47.98		39.46
1956	49.05	35.71		48.72		44.49
1957	38.32	41.46		37.79		39.19
1958	41.56	40.42		41.98		41.32
1959	38.39	40.09		32.13		36.87
1960	42.65	39.79		40.74		41.06
1961	40.64	44.33		43.97		42.98
1962	37.38	40.62		41.36		39.79
1963	34.57	38.66		35.88	34.96	36.02
1964	39.96	34.91		40.77	35.97	37.90
1965	31.01	25.31		32.08	28.86	29.32
1966	38.52	35.09		39.91	40.05	38.39
1967	41.41	38.25		42.30	38.93	40.22
1968	40.06	34.64		37.94	38.48	37.78
1969	34.77	34.68		32.92	38.24	35.15
1970	41.32	39.00		41.01	38.94	40.07
1971	46.08	39.87		41.41	46.61	43.49
1972	54.44	50.74		57.53	59.05	55.44
1973	40.12	48.66		46.71	41.49	44.25
1974	42.89	41.81		35.11	38.12	39.48

1975	48.13	49.12		53.46	52.64	50.84
1976	52.66	43.73		43.62	36.19	44.05
1977	42.16	37.68	48.92	39.73	35.92	40.88
1978	37.57	40.92	40.40	43.02	37.66	39.91
1979	53.85	64.13	60.05	63.08	55.43	59.31
1980	38.45	36.81	34.48	32.77	33.81	35.26
1981	34.73	35.21	32.27	37.45	32.13	34.36
1982	44.90	38.08	41.26	44.15	38.56	41.39
1983	56.55	46.89	48.58	52.73	46.18	50.19
1984	51.38	48.04	46.12	53.22	44.07	48.57
1985	39.76	36.62	32.52	35.21	32.94	35.41
1986	36.01	33.29	32.07	35.47	30.38	33.44
1987	42.18	37.87	40.92	41.92	40.77	40.73
1988	39.04	37.82	40.38	33.82	39.81	38.17
1989	40.45	45.50	44.23	39.32	44.34	42.77
1990	44.26	49.82	47.11	49.49	45.33	47.20
1991	29.90	26.34	35.19	27.68	34.02	30.63
1992	46.02	45.88	44.91	47.10	44.36	45.65
1993	37.68	37.95	40.04	37.68	43.08	39.29
1994	36.55	44.26	41.75	45.85	44.26	42.53
1995	35.51	44.53	39.24	44.12	40.20	40.72
1996	55.19	59.32	62.17	60.98	53.22	58.18
1997	30.78	34.10	33.74	39.87	36.52	35.00
1998	39.07	43.66	38.10	43.13	37.41	40.27
1999	37.72	47.37	45.04	43.78	43.60	43.50
2000	35.20	39.15	37.16	42.12	36.79	38.08
2001	41.35	34.72	40.52	35.43	39.37	38.28
2002	42.78	36.00	39.03	38.88		39.17
2003	63.51	58.36	67.65	42.74		58.06
2004	45.22	48.58	45.51	51.07		47.60
2005	39.30	42.37	48.88	46.03		44.14
						41.65

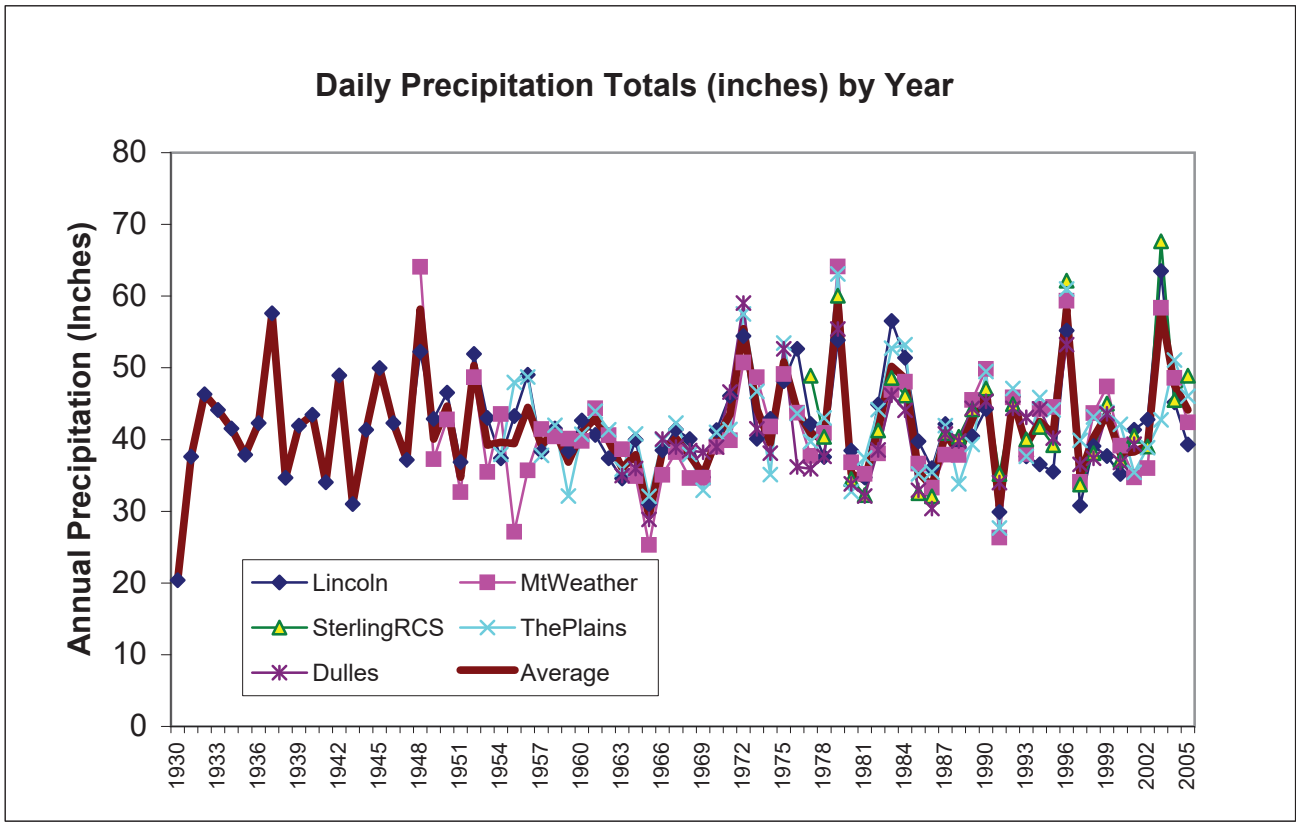
Daily Precipitation Totals (inches) by Year

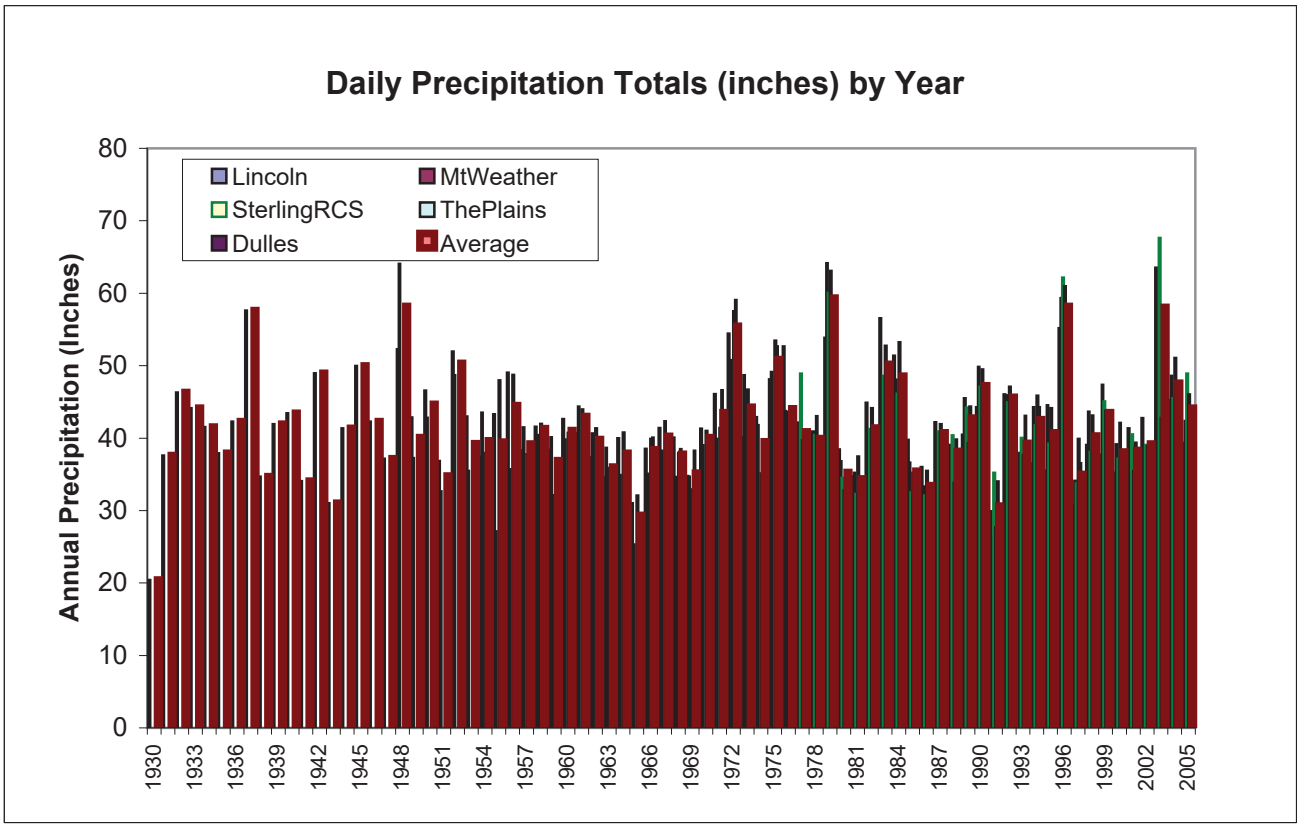
Entire Period of Record

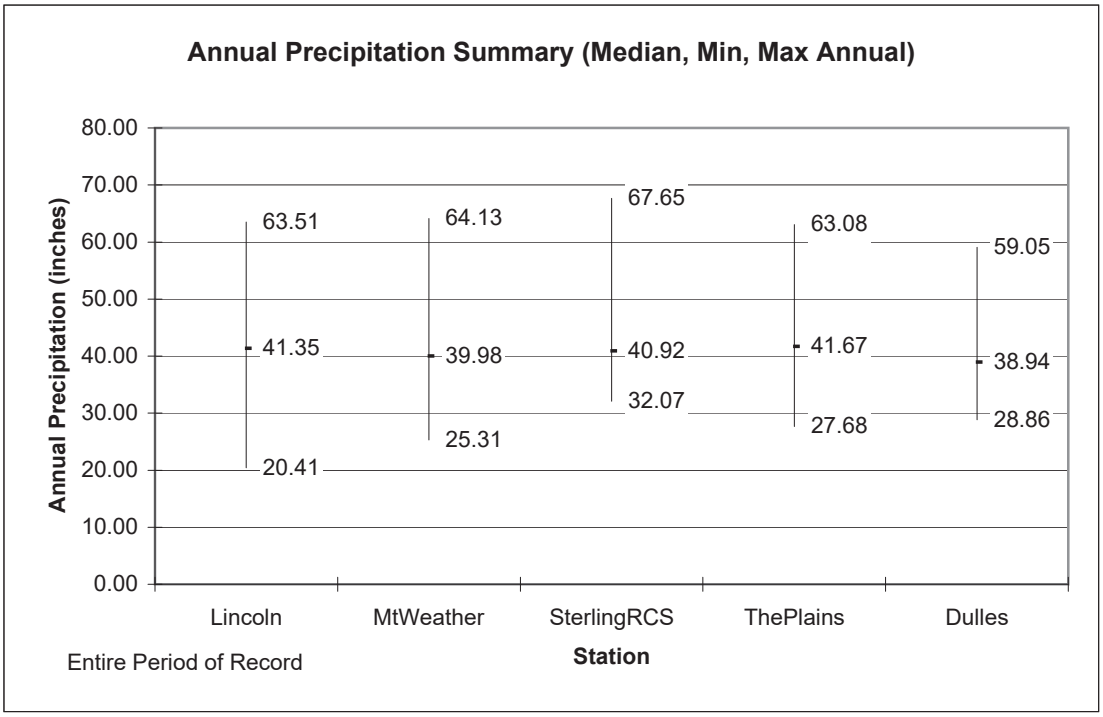
	Lincoln	MtWeather	SterlingRCS	ThePlains	Dulles
Median	41.35	39.98	40.92	41.67	38.94
Max	63.51	64.13	67.65	63.08	59.05
Min	20.41	25.31	32.07	27.68	28.86
Std Dev	7.11	7.95	8.66	7.29	6.61
Skewness	0.41	0.84	1.26	0.77	0.92

Selected Common Period 1977-2001

	Lincoln	MtWeather	SterlingRCS	ThePlains	Dulles
Median	39.07	39.15	40.52	42.12	39.81
Max	56.55	64.13	62.17	63.08	55.43
Min	29.90	26.34	32.07	27.68	30.38
Std Dev	7.06	8.20	7.65	8.39	6.13
Skewness	0.84	0.95	1.13	0.79	0.65


Daily Precipitation Totals (inches) by Year
Annual Precipitation (Inches)
0
10
20
30
40
50
60
70
80
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
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
Average


Daily Precipitation Totals (inches) by Year
Annual Precipitation (Inches)
0
10
20
30
40
50
60
70
80
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
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
Average


Annual Precipitation Summary (Median, Min, Max Annual)
Annual Precipitation (inches)
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
63.51
41.35
20.41
64.13
39.98
25.31
67.65
40.92
32.07
63.08
41.67
27.68
59.05
38.94
28.86
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
Station
Entire Period of Record

Maximum Individual Daily Precipitation (inches) by Year

Year	Lincoln	MtWeather	SterlingRCS	ThePlains	Dulles	Maximum
1930	2.00					2.00
1931	1.87					1.87
1932	2.34					2.34
1933	4.08					4.08
1934	2.10					2.10
1935	2.73					2.73
1936	2.03					2.03
1937	3.23					3.23
1938	2.00					2.00
1939	2.05					2.05
1940	1.79					1.79
1941	4.15					4.15
1942	3.18					3.18
1943	2.19					2.19
1944	1.70					1.70
1945	3.50					3.50
1946	2.54					2.54
1947	2.32					2.32
1948	1.79	2.75				2.75
1949	2.78	1.60				2.78
1950	3.26	2.83				3.26
1951	1.85	2.40				2.40
1952	2.36	2.59				2.59
1953	2.61	1.90				2.61
1954	1.55	3.96		3.57		3.96
1955	3.77	2.00		6.04		6.04
1956	2.77	7.90		5.71		7.90
1957	1.90	2.60		3.65		3.65
1958	1.91	1.87		1.88		1.91
1959	3.90	3.43		2.22		3.90
1960	2.47	3.00		2.23		3.00
1961	2.41	2.02		1.64		2.41
1962	2.23	2.13		2.93		2.93
1963	2.72	4.73		4.42	2.42	4.73
1964	4.55	2.54		3.76	1.79	4.55
1965	2.63	1.53		2.32	1.55	2.63
1966	4.22	4.34		3.63	5.52	5.52
1967	2.27	2.00		4.47	3.88	4.47
1968	2.30	1.90		3.03	2.36	3.03
1969	1.46	1.69		1.48	2.93	2.93
1970	2.70	3.06		2.68	2.28	3.06
1971	2.82	2.01		2.91	3.39	3.39
1972	8.26	7.67		10.48	10.67	10.67
1973	2.73	2.60		2.10	2.34	2.73
1974	2.07	4.73		1.60	2.02	4.73

1975	2.98	2.56		3.80	3.21	3.80
1976	4.80	4.12		2.75	2.53	4.80
1977	1.97	1.90	1.95	2.28	2.92	2.92
1978	2.08	2.20	1.67	2.32	1.91	2.32
1979	2.24	5.55	4.00	4.03	4.06	5.55
1980	2.01	2.12	1.80	1.55	2.22	2.22
1981	1.76	1.46	1.77	2.94	1.42	2.94
1982	2.42	1.33	2.00	3.73	2.16	3.73
1983	2.43	1.96	1.96	2.67	2.59	2.67
1984	5.11	3.27	5.79	3.88	4.68	5.79
1985	1.78	2.05	1.98	1.66	1.77	2.05
1986	1.73	1.60	2.03	2.37	2.49	2.49
1987	2.61	1.75	3.62	3.05	3.56	3.62
1988	2.86	2.58	2.44	2.34	3.13	3.13
1989	1.92	3.20	2.90	2.89	2.34	3.20
1990	2.73	2.34	2.87	3.07	2.63	3.07
1991	1.84	1.42	3.69	1.50	4.34	4.34
1992	4.27	4.55	2.90	4.07	2.26	4.55
1993	2.45	3.36	1.80	2.11	2.43	3.36
1994	3.12	2.91	3.21	3.94	3.50	3.94
1995	2.02	3.20	3.07	2.55	2.45	3.20
1996	2.20	2.80	3.20	3.03	3.62	3.62
1997	2.15	2.21	2.30	2.09	3.32	3.32
1998	1.95	3.71	2.26	2.30	2.17	3.71
1999	1.88	3.80	2.93	2.40	3.03	3.80
2000	2.48	3.00	2.52	2.27	2.33	3.00
2001	3.95	5.13	3.70	4.05	2.17	5.13
2002	3.06	2.20	1.95	1.80		3.06
2003	4.40	3.95	2.85	2.06		4.40
2004	4.67	5.50	2.10	5.67		5.67
2005	3.63	3.65	4.72	4.10		4.72

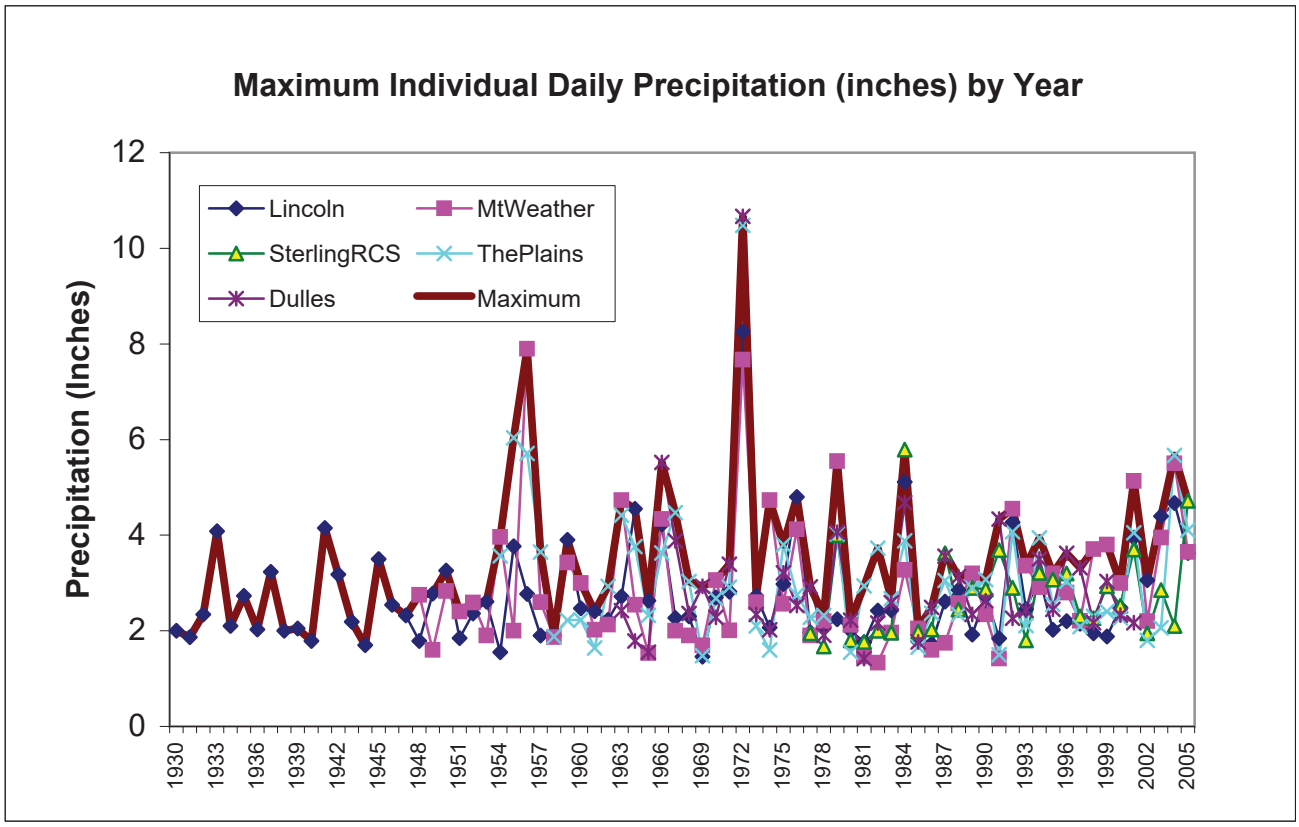
Maximum Individual Daily Precipitation (inches) by Year

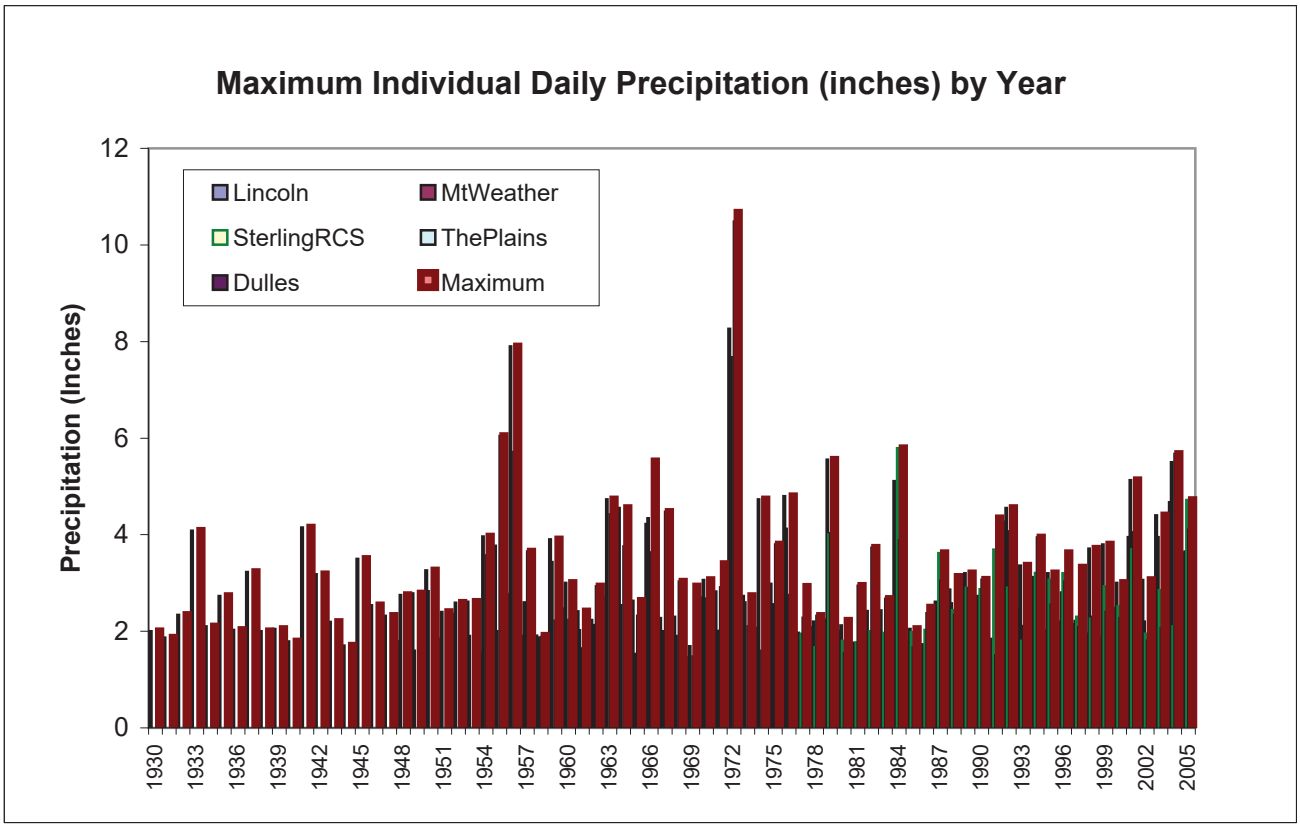
Entire Period of Record

	Lincoln	MtWeather	SterlingRCS	ThePlains	Dulles
Median	2.43	2.59	2.52	2.82	2.49
Max	8.26	7.90	5.79	10.48	10.67
Min	1.46	1.33	1.67	1.48	1.42
Std Dev	1.08	1.40	0.97	1.51	1.54
Skewness	2.28	1.64	1.36	2.57	3.53

Selected Common Period 1977-2001

	Lincoln	MtWeather	SterlingRCS	ThePlains	Dulles
Median	2.20	2.58	2.52	2.55	2.49
Max	5.11	5.55	5.79	4.07	4.68
Min	1.73	1.33	1.67	1.50	1.42
Std Dev	0.84	1.13	0.94	0.80	0.82
Skewness	1.92	0.92	1.46	0.36	0.73

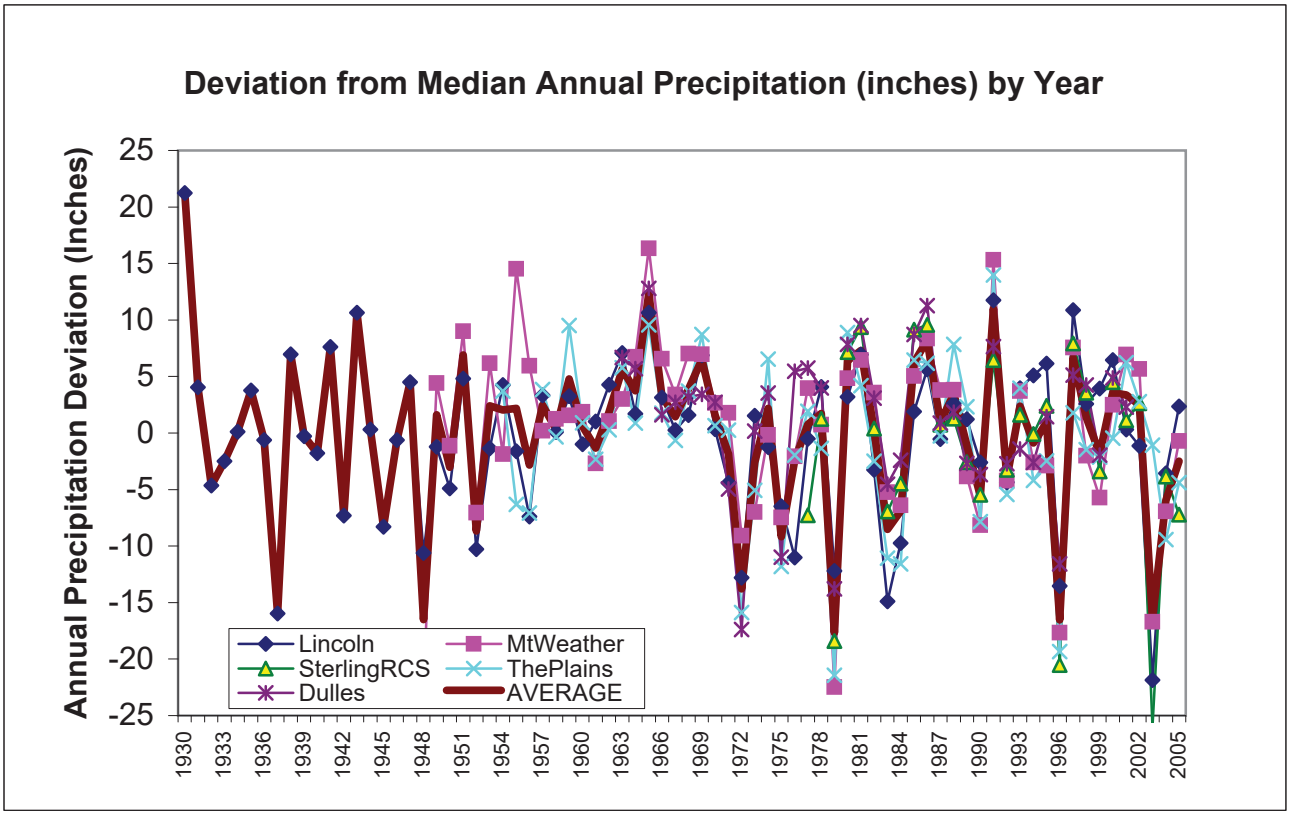

Maximum Individual Daily Precipitation (inches) by Year
Precipitation (Inches)
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
Maximum
0
2
4
6
8
10
12
1930
1933
1936
1939
1942
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
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1978
1981
1984
1987
1990
1993
1996
1999
2002
2005

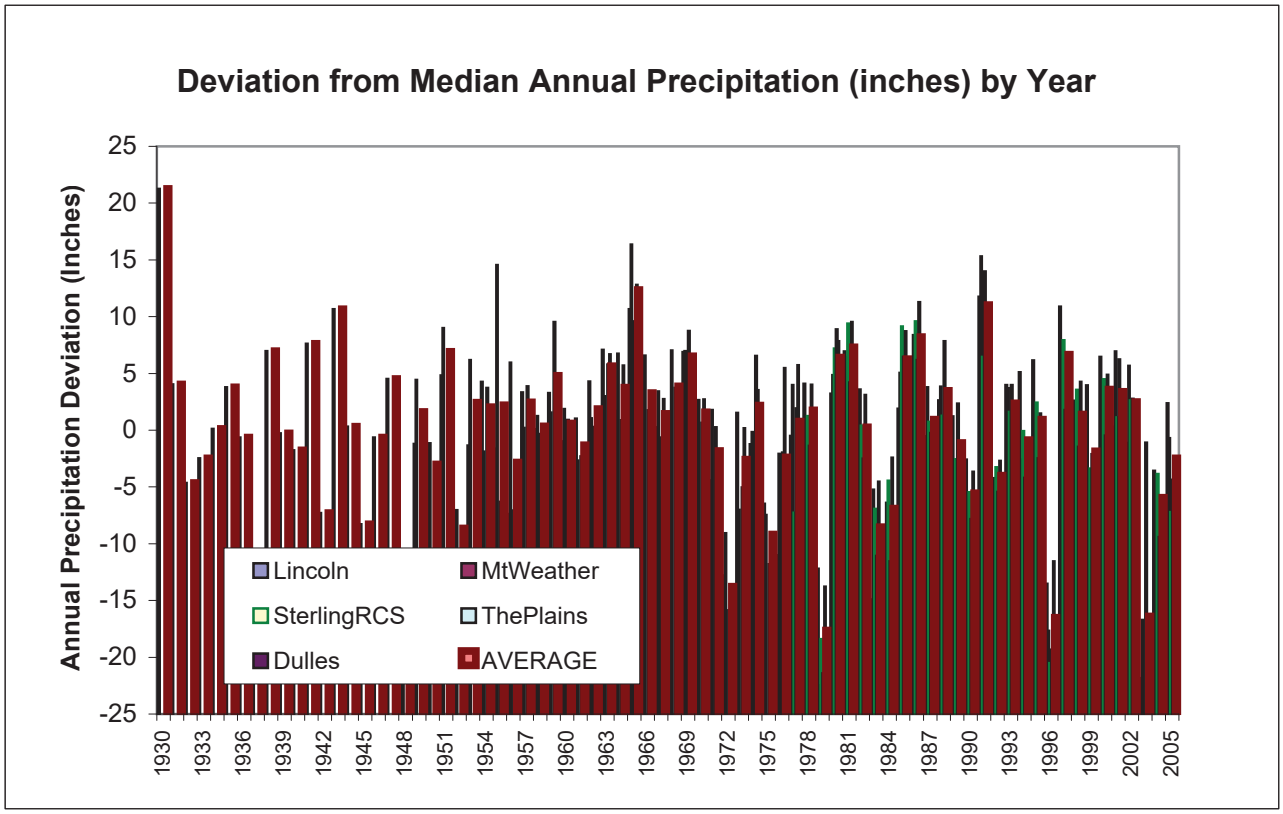

Maximum Individual Daily Precipitation (inches) by Year
Precipitation (Inches)
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
Maximum
0
2
4
6
8
10
12
1930
1933
1936
1939
1942
1945
1948
1951
1954
1957
1960
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1966
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1993
1996
1999
2002
2005

Deviation from Median Annual Precipitation (inches) by Year

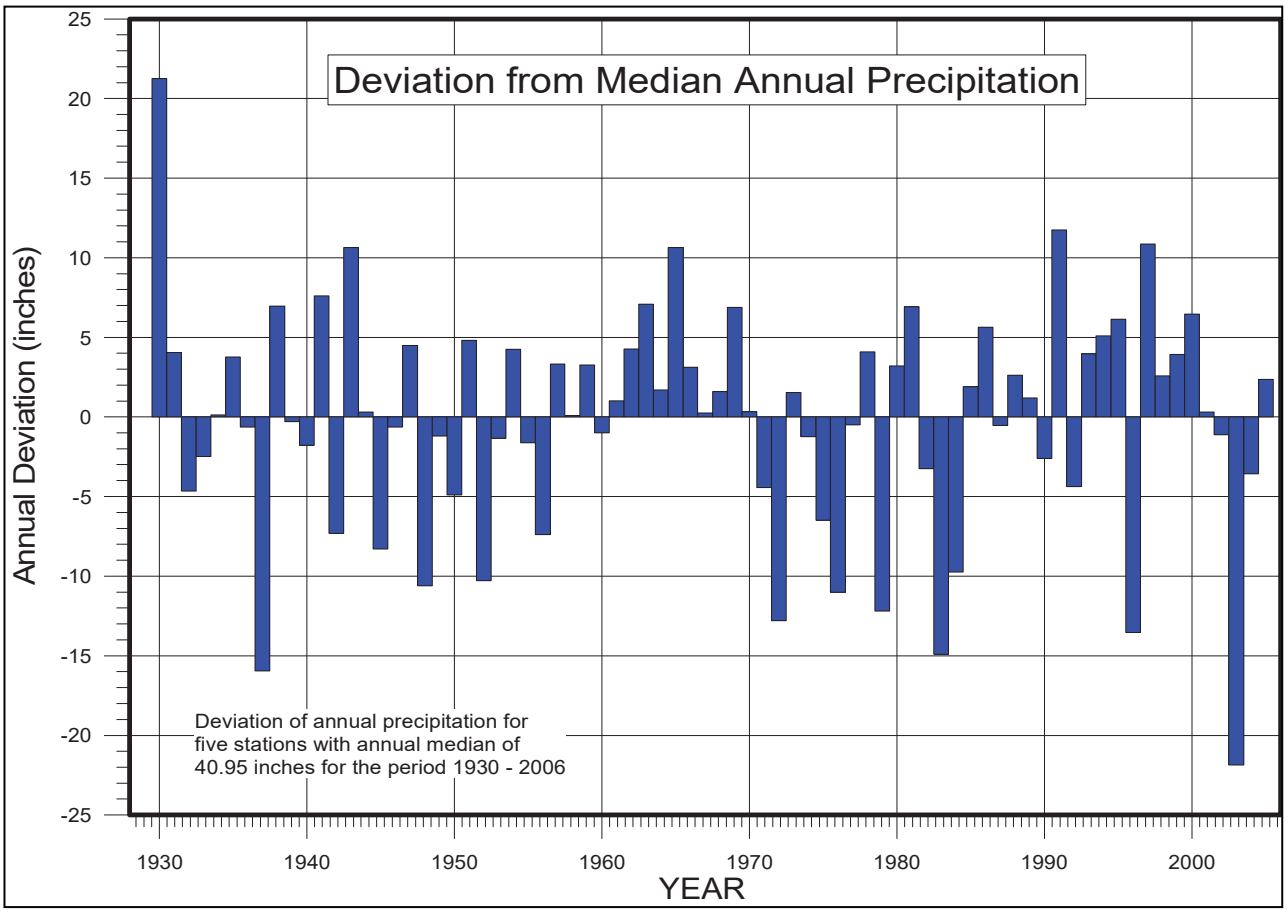
Year	Lincoln	MtWeather	SterlingRCS	ThePlains	Dulles	AVERAGE
1930	21.24					21.24
1931	4.04					4.04
1932	-4.66					-4.66
1933	-2.49					-2.49
1934	0.12					0.12
1935	3.77					3.77
1936	-0.64					-0.64
1937	-15.96					-15.96
1938	6.96					6.96
1939	-0.29					-0.29
1940	-1.79					-1.79
1941	7.61					7.61
1942	-7.31					-7.31
1943	10.64					10.64
1944	0.31					0.31
1945	-8.30					-8.30
1946	-0.64					-0.64
1947	4.50					4.50
1948	-10.61	-22.41				-16.51
1949	-1.21	4.41				1.60
1950	-4.89	-1.15				-3.02
1951	4.81	9.00				6.91
1952	-10.28	-7.04				-8.66
1953	-1.35	6.18				2.42
1954	4.25	-1.88		3.72		2.03
1955	-1.63	14.53		-6.33		2.19
1956	-7.40	5.95		-7.07		-2.84
1957	3.33	0.19		3.86		2.46
1958	0.09	1.23		-0.33		0.33
1959	3.26	1.56		9.52		4.78
1960	-1.00	1.86		0.91		0.59
1961	1.01	-2.68		-2.32		-1.33
1962	4.27	1.03		0.29		1.87
1963	7.08	2.99		5.77	6.69	5.64
1964	1.69	6.74		0.88	5.68	3.75
1965	10.64	16.34		9.57	12.79	12.34
1966	3.13	6.56		1.74	1.60	3.26
1967	0.24	3.40		-0.65	2.72	1.43
1968	1.59	7.01		3.71	3.17	3.87
1969	6.88	6.97		8.73	3.41	6.50
1970	0.33	2.65		0.64	2.71	1.59
1971	-4.43	1.78		0.24	-4.96	-1.84
1972	-12.79	-9.09		-15.88	-17.40	-13.79
1973	1.53	-7.01		-5.06	0.16	-2.59
1974	-1.24	-0.16		6.54	3.53	2.17

1975	-6.47	-7.47		-11.81	-10.99	-9.18
1976	-11.01	-2.08		-1.97	5.46	-2.40
1977	-0.51	3.97	-7.26	1.92	5.73	0.77
1978	4.08	0.73	1.25	-1.37	3.99	1.74
1979	-12.20	-22.48	-18.40	-21.43	-13.78	-17.65
1980	3.20	4.84	7.17	8.88	7.84	6.39
1981	6.92	6.44	9.38	4.20	9.52	7.30
1982	-3.25	3.57	0.39	-2.50	3.09	0.26
1983	-14.90	-5.24	-6.93	-11.08	-4.53	-8.53
1984	-9.73	-6.39	-4.47	-11.57	-2.42	-6.91
1985	1.89	5.03	9.13	6.44	8.71	6.24
1986	5.64	8.36	9.58	6.18	11.27	8.21
1987	-0.53	3.78	0.73	-0.27	0.88	0.92
1988	2.61	3.83	1.27	7.83	1.84	3.48
1989	1.20	-3.85	-2.58	2.33	-2.69	-1.11
1990	-2.61	-8.17	-5.46	-7.84	-3.68	-5.55
1991	11.75	15.31	6.46	13.97	7.63	11.03
1992	-4.37	-4.23	-3.26	-5.45	-2.71	-4.00
1993	3.97	3.71	1.62	3.97	-1.43	2.37
1994	5.10	-2.61	-0.10	-4.20	-2.61	-0.88
1995	6.14	-2.88	2.41	-2.47	1.45	0.93
1996	-13.53	-17.67	-20.52	-19.33	-11.57	-16.52
1997	10.87	7.55	7.91	1.78	5.13	6.65
1998	2.58	-2.01	3.55	-1.48	4.24	1.38
1999	3.93	-5.72	-3.39	-2.13	-1.95	-1.85
2000	6.45	2.50	4.49	-0.47	4.86	3.57
2001	0.30	6.93	1.13	6.22	2.28	3.38
2002	-1.13	5.65	2.62	2.77		2.48
2003	-21.86	-16.70	-26.00	-1.09		-16.41
2004	-3.57	-6.93	-3.86	-9.42		-5.94
2005	2.36	-0.72	-7.23	-4.38		-2.49


Deviation from Median Annual Precipitation (inches) by Year
Annual Precipitation Deviation (Inches)
25
20
15
10
5
0
-5
-10
-15
-20
-25
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
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
AVERAGE


Deviation from Median Annual Precipitation (inches) by Year
Annual Precipitation Deviation (Inches)
25
20
15
10
5
0
-5
-10
-15
-20
-25
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
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
AVERAGE

Below bar chart is originally in Grapher



Deviation_Annual

Lincoln

Point	Column1	Rank	Percent
67	60.22	1	100.00%
74	60.16	2	98.60%
8	56.86	3	97.30%
43	55.42	4	96.00%
54	55.05	5	94.60%
23	53.28	6	93.30%
55	52.44	7	92.00%
19	51.12	8	90.60%
16	49.80	9	89.30%
50	48.80	10	88.00%
46	48.78	11	86.60%
47	48.60	12	85.30%
27	48.42	13	84.00%
13	48.40	14	82.60%
48	48.10	15	81.30%
73	48.04	16	80.00%
21	46.37	17	78.60%
75	46.25	18	77.30%
63	45.93	19	76.00%
42	45.80	20	74.60%
26	44.82	21	73.30%
61	44.56	22	72.00%
3	44.23	23	70.60%
4	44.02	24	69.30%
11	43.55	25	68.00%
45	43.02	26	66.60%
64	42.93	27	65.30%
31	42.89	28	64.00%
41	42.82	29	62.60%
38	42.53	30	61.30%
53	42.42	31	60.00%
17	42.38	32	58.60%
20	42.22	33	57.30%
5	41.97	34	56.00%
10	41.85	35	54.60%
24	41.29	36	53.30%
58	41.16	37	52.00%
7	41.09	38	50.60%
60	40.67	39	49.30%
29	40.43	40	48.00%
32	40.38	41	46.60%
44	40.22	42	45.30%
76	40.03	43	44.00%
15	39.86	44	42.60%
72	39.63	45	41.30%
2	39.58	46	40.00%
56	39.43	47	38.60%

MtWeather

Point	Column1	Rank	Percent
1	62.53	1	100.00%
32	59.70	2	98.20%
49	54.47	3	96.40%
56	54.35	4	94.70%
25	52.72	5	92.90%
28	51.29	6	91.20%
57	48.72	7	89.40%
26	48.69	8	87.70%
43	48.57	9	85.90%
5	48.36	10	84.20%
37	47.68	11	82.40%
42	47.52	12	80.70%
48	46.78	13	78.90%
36	46.13	14	77.10%
52	45.70	15	75.40%
45	45.65	16	73.60%
46	45.46	17	71.90%
50	44.92	18	70.10%
58	44.26	19	68.40%
14	43.46	20	66.60%
47	43.17	21	64.90%
30	43.01	22	63.10%
10	42.56	23	61.40%
7	42.06	24	59.60%
3	41.89	25	57.80%
27	41.69	26	56.10%
31	41.27	27	54.30%
16	40.94	28	52.60%
11	40.59	29	50.80%
13	40.42	30	49.10%
23	39.76	31	47.30%
15	39.74	32	45.60%
29	39.60	33	43.80%
12	39.35	34	42.10%
55	39.31	35	40.30%
24	38.57	36	38.50%
53	38.38	37	36.80%
20	38.25	38	35.00%
51	37.99	39	33.30%
40	37.27	40	31.50%
35	37.24	41	29.80%
41	37.09	42	28.00%
38	36.83	43	26.30%
34	36.82	44	24.50%
2	36.29	45	22.80%
9	36.08	46	21.00%
33	35.85	47	19.20%

SterlingRCS

Point	Column1	Rank	Percent
27	62.18	1	100.00%
20	59.04	2	96.40%
1	55.28	3	92.80%
3	55.13	4	89.20%
29	49.34	5	85.70%
7	47.51	6	82.10%
26	46.77	7	78.50%
8	46.58	8	75.00%
28	46.09	9	71.40%
13	46.02	10	67.80%
16	45.88	11	64.20%
17	45.72	12	60.70%
14	45.50	13	57.10%
18	41.89	14	53.50%
23	40.97	15	50.00%
11	40.47	16	46.40%
19	40.47	17	42.80%
21	40.23	18	39.20%
2	40.15	19	35.70%
12	39.55	20	32.10%
6	38.65	21	28.50%
25	37.95	22	25.00%
24	37.75	23	21.40%
5	35.78	24	17.80%
22	35.01	25	14.20%
15	34.43	26	10.70%
4	33.21	27	7.10%
10	33.14	28	3.50%
9	32.23	29	0.00%

ThePlains

Point	Column1	Rank	Percent
19	58.71	1	100.00%
26	58.42	2	98.00%
22	54.95	3	96.00%
43	54.82	4	94.10%
31	53.40	5	92.10%
30	51.59	6	90.10%
51	50.93	7	88.20%
2	49.65	8	86.20%
42	48.77	9	84.30%
44	48.67	10	82.30%
37	48.61	11	80.30%
3	47.77	12	78.40%
20	47.22	13	76.40%
39	47.11	14	74.50%
52	46.66	15	72.50%
24	46.44	16	70.50%
40	46.19	17	68.60%
41	44.74	18	66.60%
14	43.59	19	64.70%
8	42.84	20	62.70%
49	42.84	21	60.70%
29	42.63	22	58.80%
17	42.53	23	56.80%
25	42.22	24	54.90%
47	42.20	25	52.90%
5	41.68	26	50.90%
7	41.59	27	49.00%
36	41.31	28	47.00%
34	40.79	29	45.00%
9	40.69	30	43.10%
18	40.47	31	41.10%
28	40.22	32	39.20%
10	39.26	33	37.20%
11	39.26	34	35.20%
46	39.10	35	33.30%
4	38.78	36	31.30%
45	38.42	37	29.40%
23	38.22	38	27.40%
13	38.14	39	25.40%
16	37.87	40	23.50%
50	37.46	41	21.50%
15	37.36	42	19.60%
33	36.58	43	17.60%
1	35.46	44	15.60%
32	35.11	45	13.70%
21	34.64	46	11.70%
35	33.05	47	9.80%

Dulles

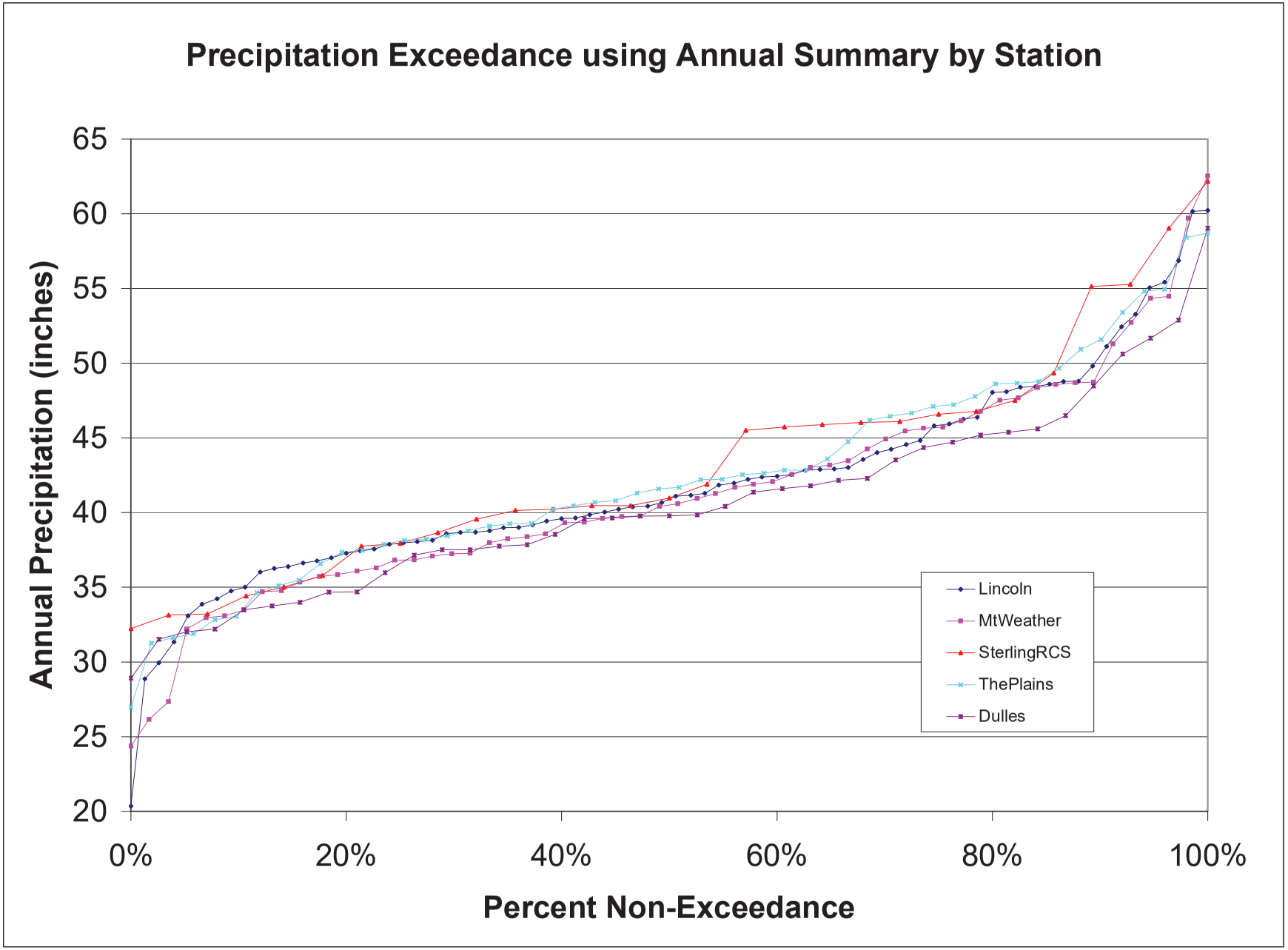
Point	Column1	Rank	Percent
10	59.04	1	100.00%
13	52.89	2	97.30%
17	51.68	3	94.70%
34	50.61	4	92.10%
31	48.47	5	89.40%
9	46.49	6	86.80%
30	45.60	7	84.20%
22	45.39	8	81.50%
21	45.19	9	78.90%
27	44.72	10	76.30%
28	44.35	11	73.60%
32	43.53	12	71.00%
11	42.28	13	68.40%
35	42.15	14	65.70%
39	41.79	15	63.10%
33	41.61	16	60.50%
15	41.37	17	57.80%
1	40.41	18	55.20%
37	39.84	19	52.60%
8	39.78	20	50.00%
25	39.77	21	47.30%
5	39.64	22	44.70%
26	39.59	23	42.10%
6	38.54	24	39.40%
4	37.85	25	36.80%
12	37.75	26	34.20%
20	37.52	27	31.50%
16	37.51	28	28.90%
38	37.15	29	26.30%
7	35.97	30	23.60%
36	34.69	31	21.00%
19	34.67	32	18.40%
14	33.99	33	15.70%
29	33.76	34	13.10%
2	33.49	35	10.50%
24	32.20	36	7.80%
18	32.03	37	5.20%
23	31.51	38	2.60%
3	28.92	39	0.00%

Exceedance_Annual

6	39.17	48	37.30%
59	39.00	49	36.00%
30	38.98	50	34.60%
28	38.77	51	33.30%
35	38.69	52	32.00%
39	38.67	53	30.60%
18	38.59	54	29.30%
65	38.15	55	28.00%
52	38.05	56	26.60%
49	37.97	57	25.30%
68	37.88	58	24.00%
22	37.56	59	22.60%
37	37.44	60	21.30%
51	37.28	61	20.00%
40	36.97	62	18.60%
34	36.77	63	17.30%
33	36.62	64	16.00%
57	36.38	65	14.60%
25	36.25	66	13.30%
69	36.02	67	12.00%
71	35.00	68	10.60%
9	34.74	69	9.30%
12	34.23	70	8.00%
70	33.87	71	6.60%
14	33.08	72	5.30%
36	31.33	73	4.00%
66	29.95	74	2.60%
62	28.86	75	1.30%
1	20.35	76	0.00%

21	35.72	48	17.50%
4	35.35	49	15.70%
6	34.77	50	14.00%
17	34.71	51	12.20%
39	33.48	52	10.50%
19	33.09	53	8.70%
22	32.97	54	7.00%
54	32.19	55	5.20%
8	27.34	56	3.50%
44	26.16	57	1.70%
18	24.36	58	0.00%

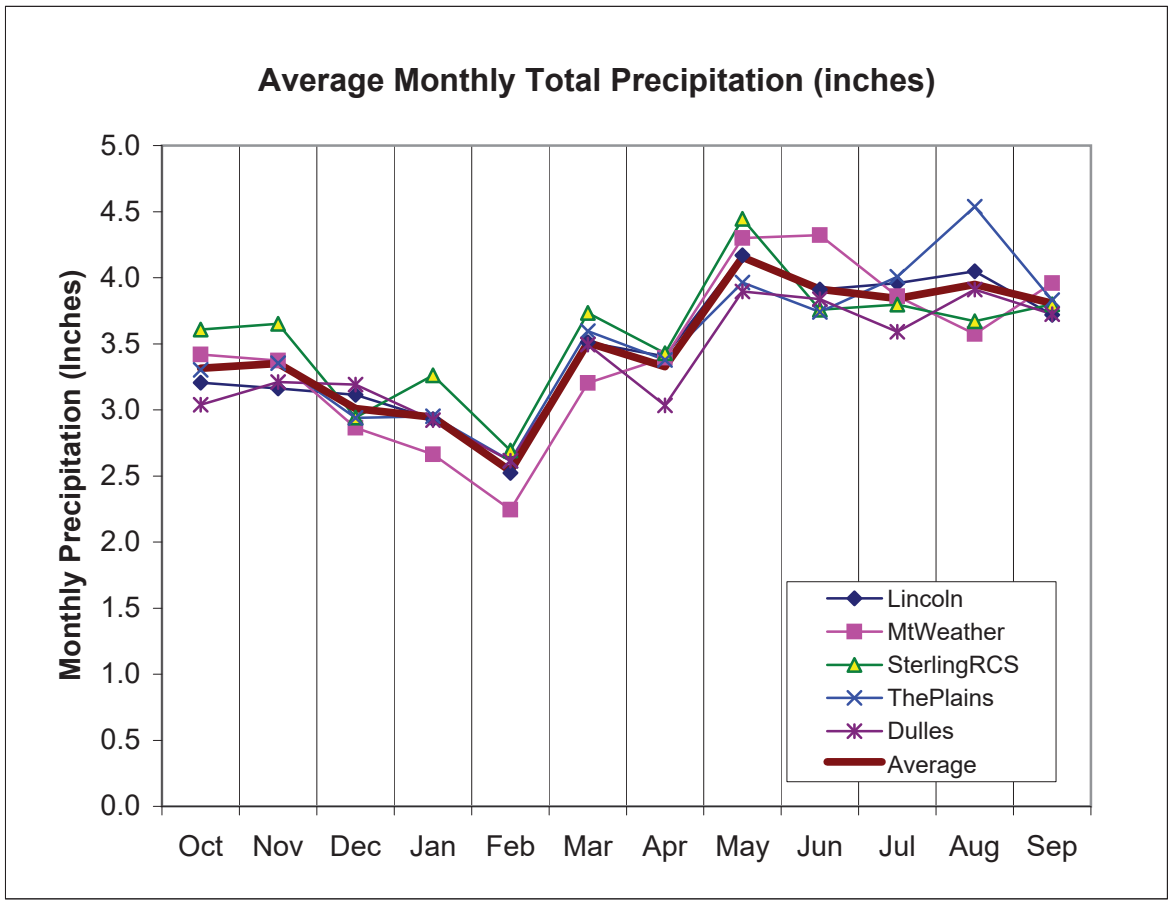
48	32.84	48	7.80%
6	31.87	49	5.80%
27	31.61	50	3.90%
12	31.26	51	1.90%
38	26.98	52	0.00%

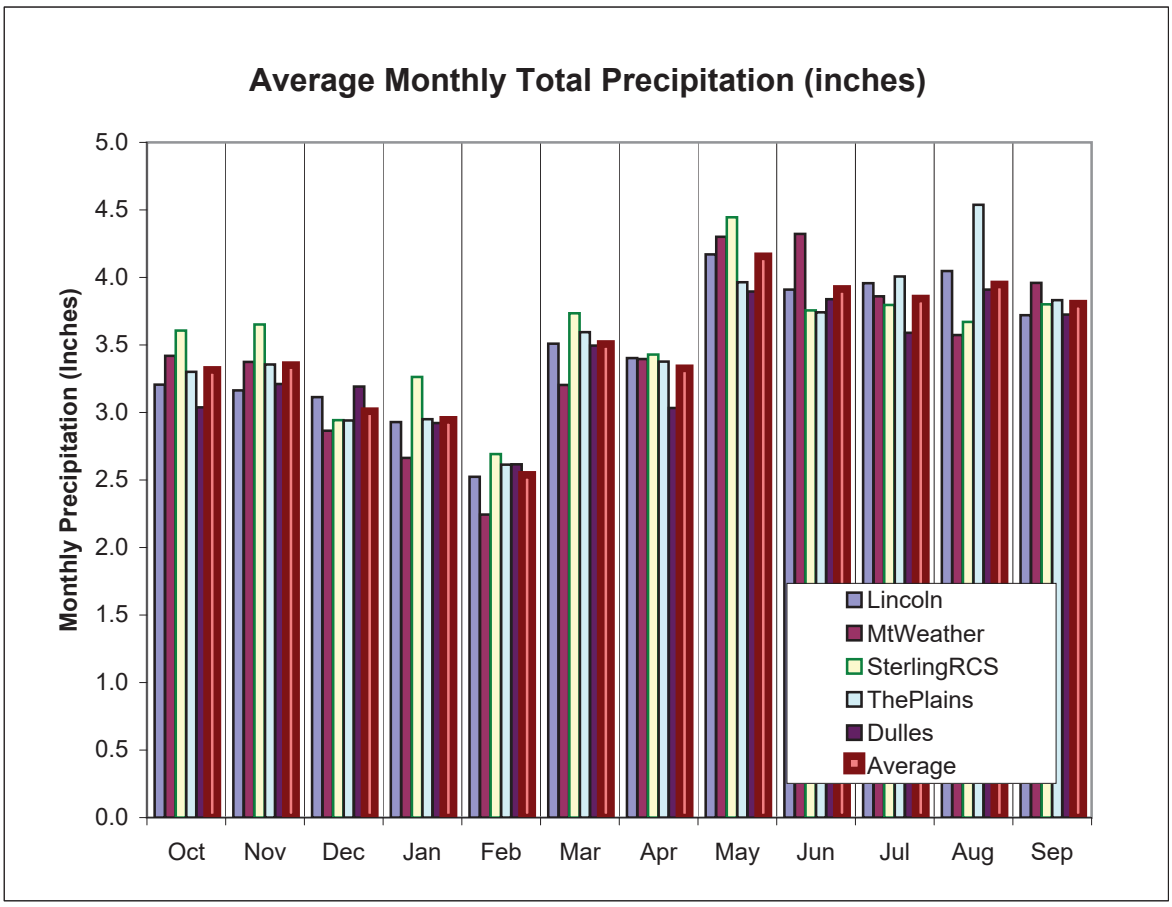


Exceedance_Annual

Average Monthly Total Precipitation (inches)

Month	Lincoln	MtWeather	SterlingRCS	ThePlains	Dulles	Average
Oct	3.21	3.42	3.61	3.30	3.04	3.31
Nov	3.16	3.37	3.65	3.35	3.21	3.35
Dec	3.11	2.87	2.94	2.94	3.19	3.01
Jan	2.93	2.66	3.26	2.95	2.92	2.95
Feb	2.52	2.24	2.69	2.61	2.62	2.54
Mar	3.51	3.20	3.73	3.60	3.49	3.51
Apr	3.40	3.40	3.43	3.38	3.03	3.33
May	4.17	4.30	4.45	3.96	3.90	4.16
Jun	3.91	4.32	3.76	3.74	3.84	3.91
Jul	3.96	3.86	3.80	4.01	3.59	3.84
Aug	4.05	3.57	3.67	4.54	3.91	3.95
Sep	3.72	3.96	3.80	3.83	3.72	3.81
Total	**41.65**	**41.18**	**42.79**	**42.22**	**40.47**	**41.66**





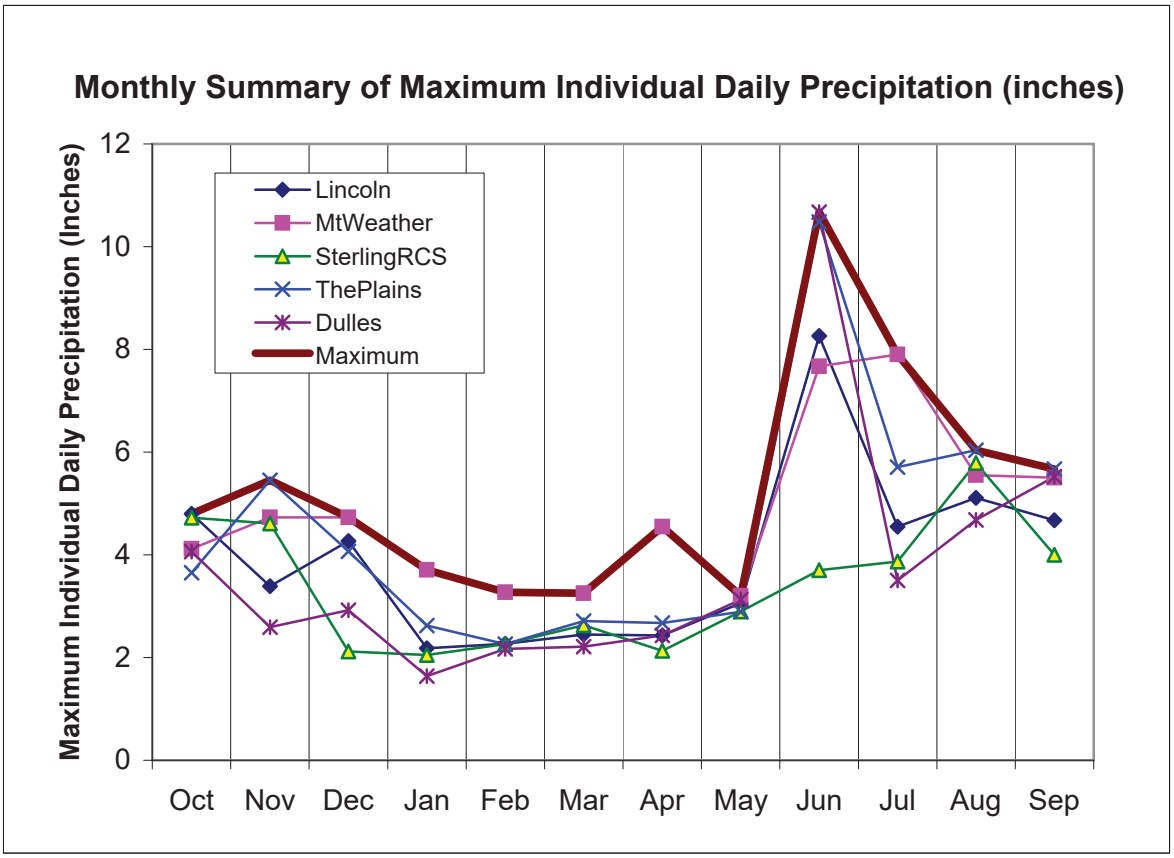
Average_Monthly

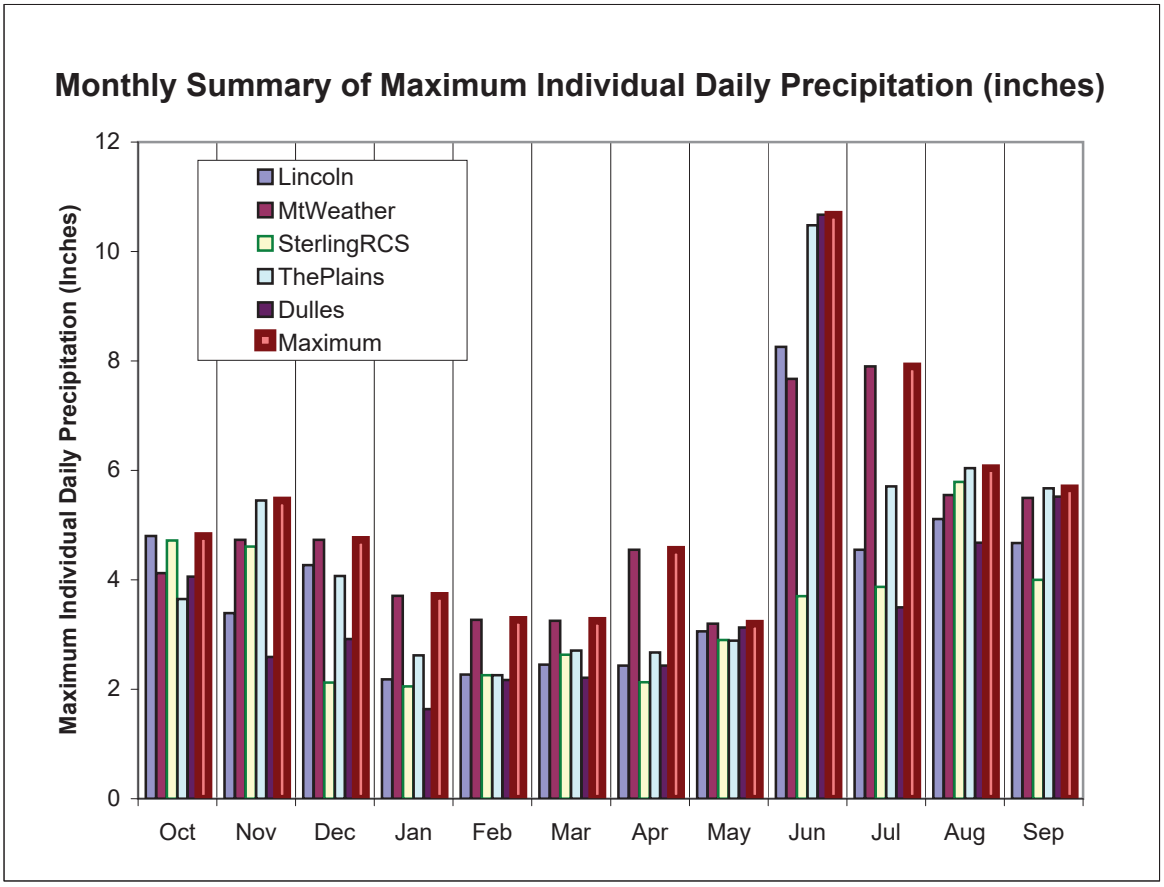
Monthly Summary of Maximum Individual Daily Precipitation (inches)

Month	Lincoln	MtWeather	SterlingRCS	ThePlains	Dulles	Maximum
Oct	4.80	4.12	4.72	3.65	4.06	4.80
Nov	3.39	4.73	4.61	5.45	2.59	5.45
Dec	4.27	4.73	2.12	4.07	2.92	4.73
Jan	2.18	3.71	2.05	2.62	1.64	3.71
Feb	2.27	3.27	2.26	2.26	2.17	3.27
Mar	2.45	3.25	2.63	2.71	2.21	3.25
Apr	2.43	4.55	2.13	2.67	2.43	4.55
May	3.06	3.20	2.90	2.89	3.13	3.20
Jun	8.26	7.67	3.70	10.48	10.67	10.67
Jul	4.55	7.90	3.87	5.71	3.50	7.90
Aug	5.11	5.55	5.79	6.04	4.68	6.04
Sep	4.67	5.50	4.00	5.67	5.52	5.67
Max	**8.26**	**7.90**	**5.79**	**10.48**	**10.67**	**10.67**

Note:

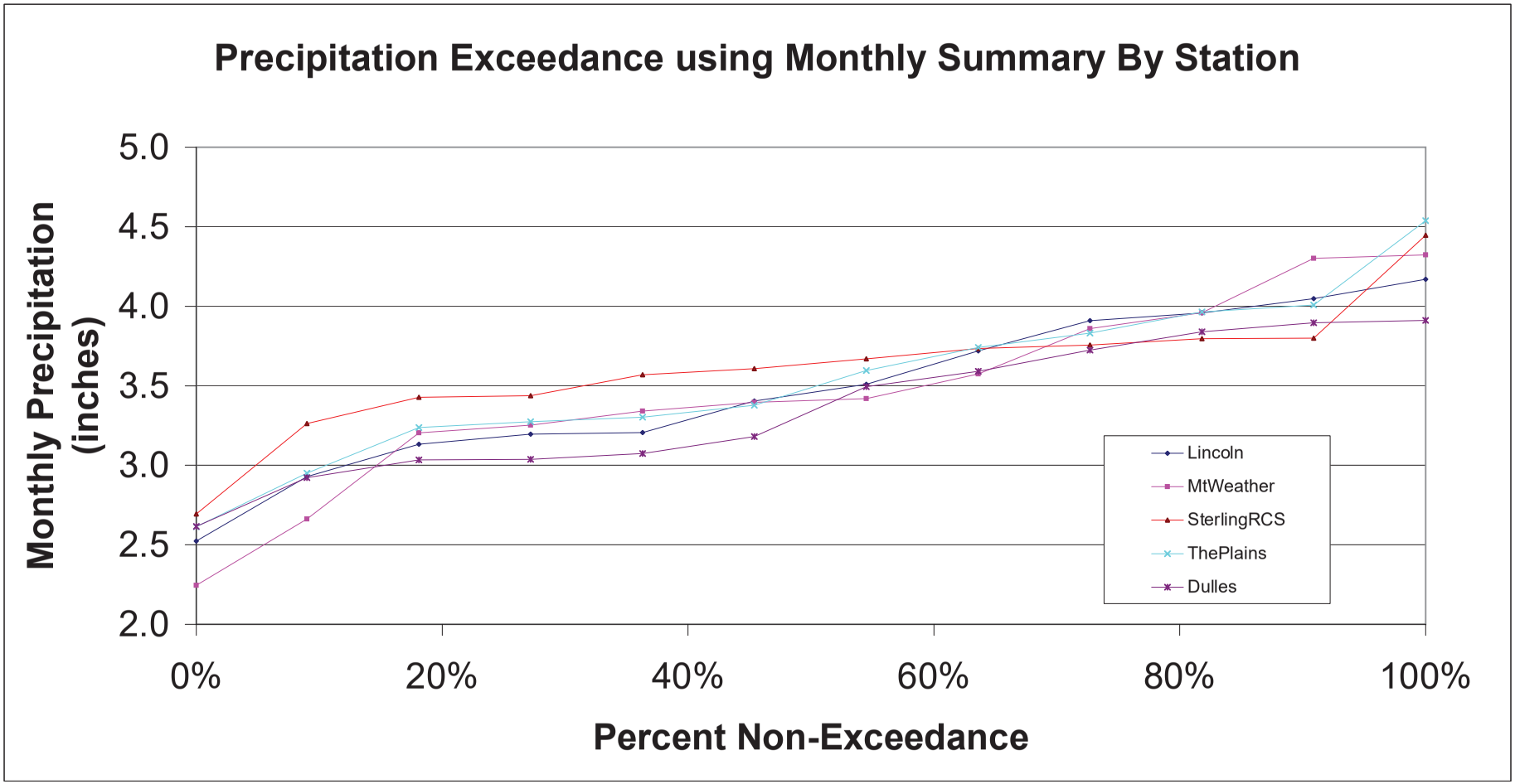
This is not a good measure of many of the storm events that span several days.


Monthly Summary of Maximum Individual Daily Precipitation (inches)
Maximum Individual Daily Precipitation (Inches)
0
2
4
6
8
10
12
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
Maximum


Monthly Summary of Maximum Individual Daily Precipitation (inches)
Maximum Individual Daily Precipitation (Inches)
0
2
4
6
8
10
12
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
Maximum

Precipitation Exceedance on Monthly Basis By Station

Lincoln				MtWeather				SterlingRCS				ThePlains				Dulles			
Point	*Lincoln*	*Rank*	*Percent*	*Point*	*MtWeather*	*Rank*	*Percent*	*Point*	*SterlingRCS*	*Rank*	*Percent*	*Point*	*ThePlains*	*Rank*	*Percent*	*Point*	*Dulles*	*Rank*	*Percent*
	4.17	1	100.00%	9	4.32	1	100.00%	8	4.45	1	100.00%	11	4.54	1	100.00%	11	3.91	1	100.00%
	4.05	2	90.90%	8	4.30	2	90.90%	12	3.80	2	90.90%	10	4.01	2	90.90%	8	3.90	2	90.90%
	3.96	3	81.80%	12	3.96	3	81.80%	10	3.80	3	81.80%	8	3.96	3	81.80%	9	3.84	3	81.80%
	3.91	4	72.70%	10	3.86	4	72.70%	9	3.76	4	72.70%	12	3.83	4	72.70%	12	3.72	4	72.70%
	3.72	5	63.60%	11	3.57	5	63.60%	6	3.73	5	63.60%	9	3.74	5	63.60%	10	3.59	5	63.60%
	3.51	6	54.50%	1	3.42	6	54.50%	11	3.67	6	54.50%	6	3.60	6	54.50%	6	3.49	6	54.50%
	3.40	7	45.40%	7	3.40	7	45.40%	1	3.61	7	45.40%	7	3.38	7	45.40%	3	3.18	7	45.40%
1	3.21	8	36.30%	2	3.34	8	36.30%	2	3.57	8	36.30%	1	3.30	8	36.30%	2	3.07	8	36.30%
	3.20	9	27.20%	3	3.25	9	27.20%	3	3.44	9	27.20%	2	3.27	9	27.20%	1	3.04	9	27.20%
	3.13	10	18.10%	6	3.20	10	18.10%	7	3.43	10	18.10%	3	3.24	10	18.10%	7	3.03	10	18.10%
	2.93	11	9.00%	4	2.66	11	9.00%	4	3.26	11	9.00%	4	2.95	11	9.00%	4	2.92	11	9.00%
	2.52	12	0.00%	5	2.24	12	0.00%	5	2.69	12	0.00%	5	2.61	12	0.00%	5	2.62	12	0.00%

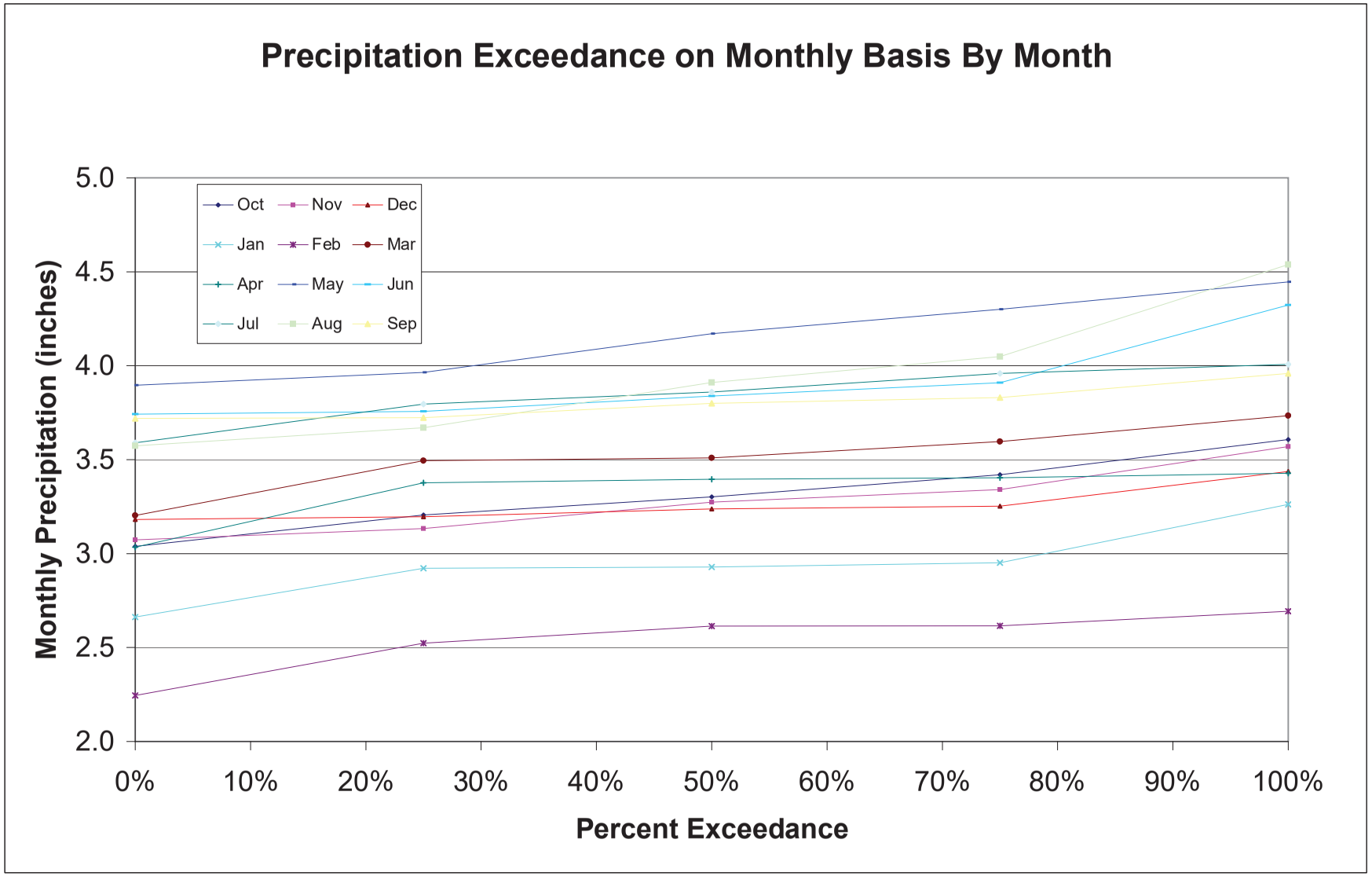


Precipitation Exceedance on Monthly Basis By Month

Point	Oct	Rank	Percent	Point	Nov	Rank	Percent	Point	Dec	Rank	Percent	Point	Jan	Rank	Percent
3	3.61	1	100.00%	3	3.57	1	100.00%	3	3.44	1	100.00%	3	3.26	1	100.00%
2	3.42	2	75.00%	2	3.34	2	75.00%	2	3.25	2	75.00%	4	2.95	2	75.00%
4	3.30	3	50.00%	4	3.27	3	50.00%	4	3.24	3	50.00%	1	2.93	3	50.00%
1	3.21	4	25.00%	1	3.13	4	25.00%	1	3.20	4	25.00%	5	2.92	4	25.00%
5	3.04	5	0.00%	5	3.07	5	0.00%	5	3.18	5	0.00%	2	2.66	5	0.00%

Point	Feb	Rank	Percent	Point	Mar	Rank	Percent	Point	Apr	Rank	Percent	Point	May	Rank	Percent
3	2.69	1	100.00%	3	3.73	1	100.00%	3	3.43	1	100.00%	3	4.45	1	100.00%
5	2.62	2	75.00%	4	3.60	2	75.00%	1	3.40	2	75.00%	2	4.30	2	75.00%
4	2.61	3	50.00%	1	3.51	3	50.00%	2	3.40	3	50.00%	1	4.17	3	50.00%
1	2.52	4	25.00%	5	3.49	4	25.00%	4	3.38	4	25.00%	4	3.96	4	25.00%
2	2.24	5	0.00%	2	3.20	5	0.00%	5	3.03	5	0.00%	5	3.90	5	0.00%

Point	Jun	Rank	Percent	Point	Jul	Rank	Percent	Point	Aug	Rank	Percent	Point	Sep	Rank	Percent
2	4.32	1	100.00%	4	4.01	1	100.00%	4	4.54	1	100.00%	2	3.96	1	100.00%
1	3.91	2	75.00%	1	3.96	2	75.00%	1	4.05	2	75.00%	4	3.83	2	75.00%
5	3.84	3	50.00%	2	3.86	3	50.00%	5	3.91	3	50.00%	3	3.80	3	50.00%
3	3.76	4	25.00%	3	3.80	4	25.00%	3	3.67	4	25.00%	5	3.72	4	25.00%
4	3.74	5	0.00%	5	3.59	5	0.00%	2	3.57	5	0.00%	1	3.72	5	0.00%

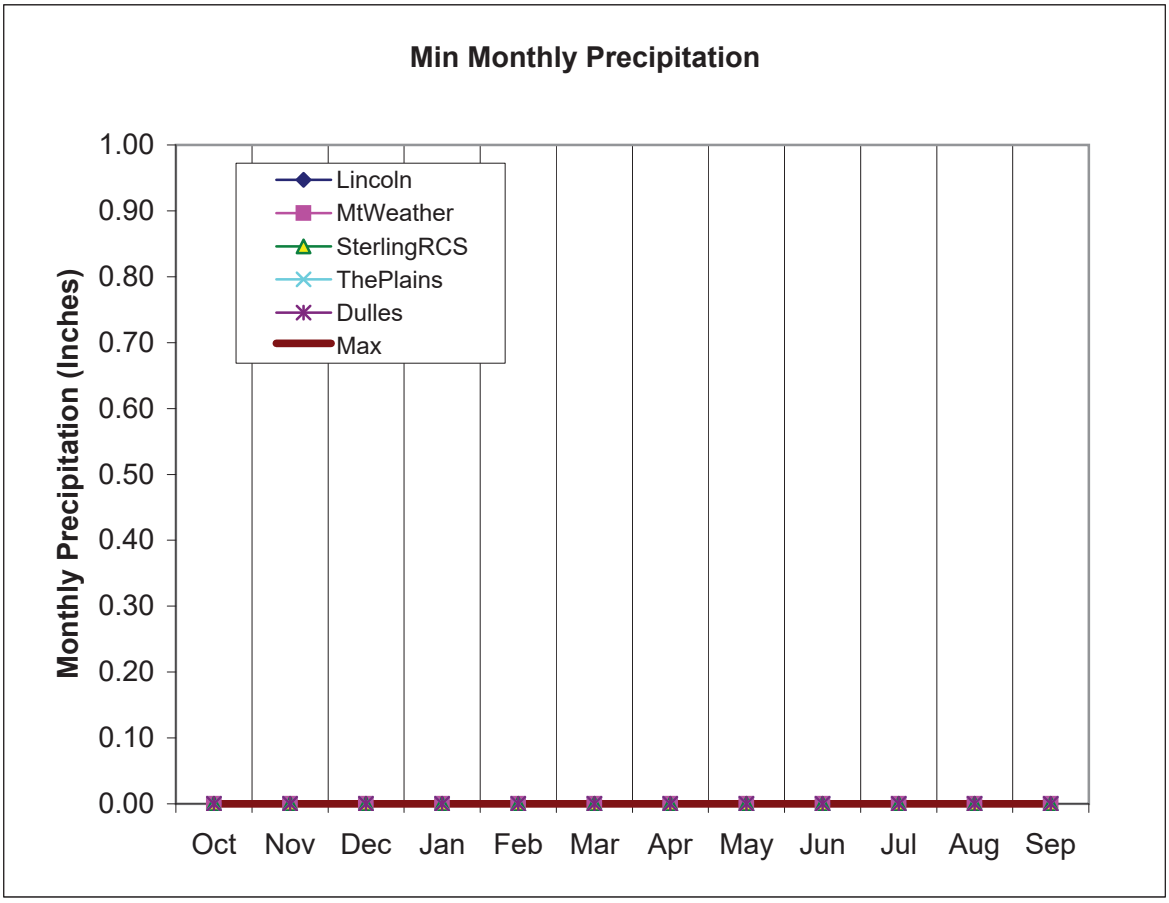


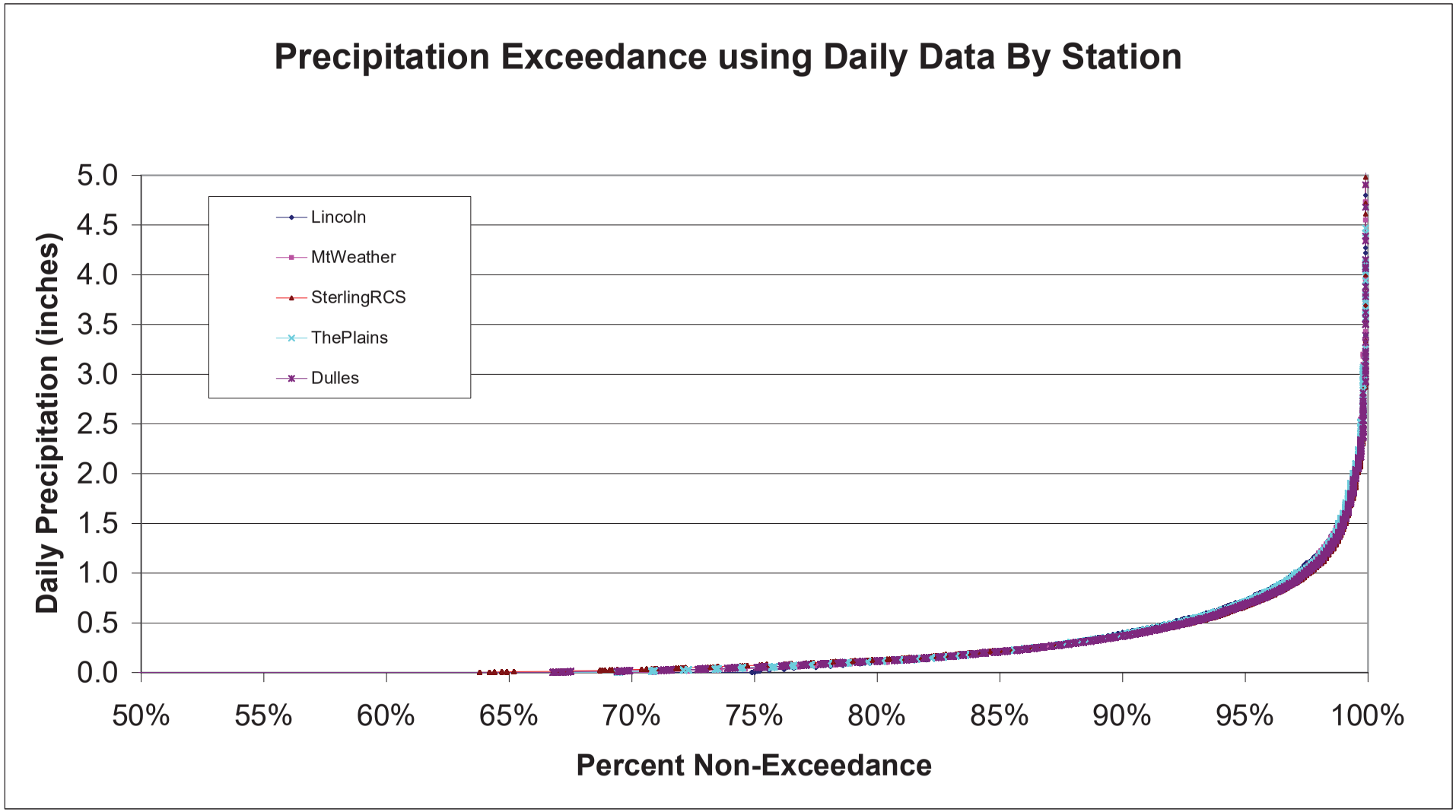
Exceedance_Monthly

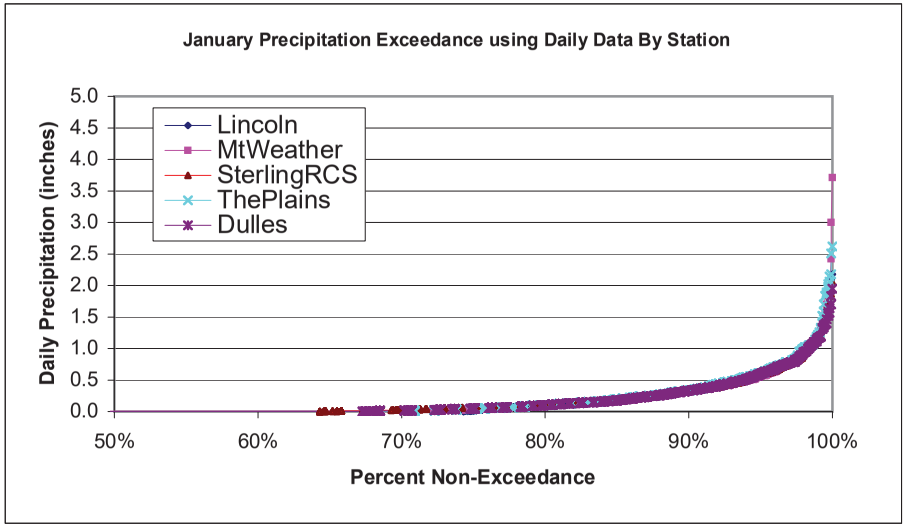
Monthly Summary of Miminum Daily Precipitation (inches)

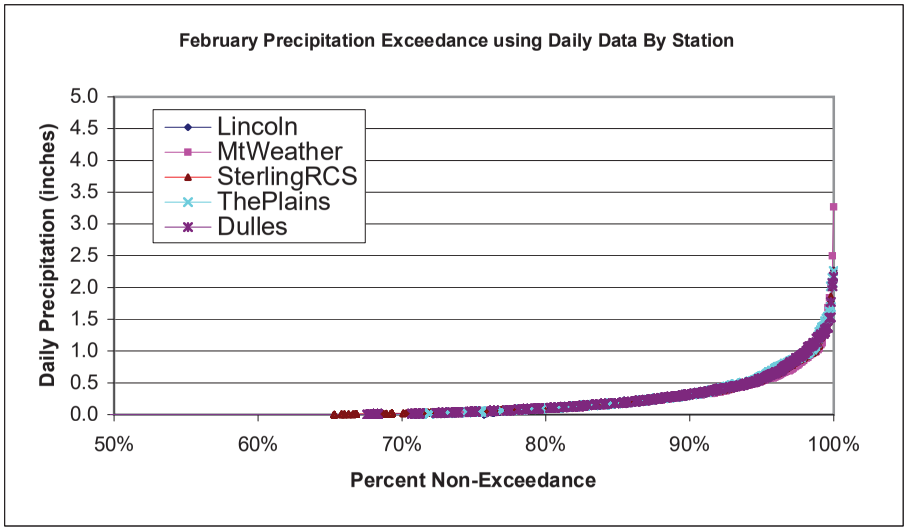
Month	Lincoln	MtWeather	SterlingRCS	ThePlains	Dulles	Max
Oct	0.00	0.00	0.00	0.00	0.00	0.00
Nov	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.00	0.00	0.00	0.00	0.00	0.00
Jan	0.0				0.00	0.00
Feb	0.0				0.00	0.00
Mar	0.0				0.00	0.00
Apr	0.00	0.00	0.00	0.00	0.00	0.00
May	0.00	0.00	0.00	0.00	0.00	0.00
Jun	0.00	0.00	0.00	0.00	0.00	0.00
Jul	0.00	0.00	0.00	0.00	0.00	0.00
Aug	0.00	0.00	0.00	0.00	0.00	0.00
Sep	0.00	0.00	0.00	0.00	0.00	0.00
Max	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

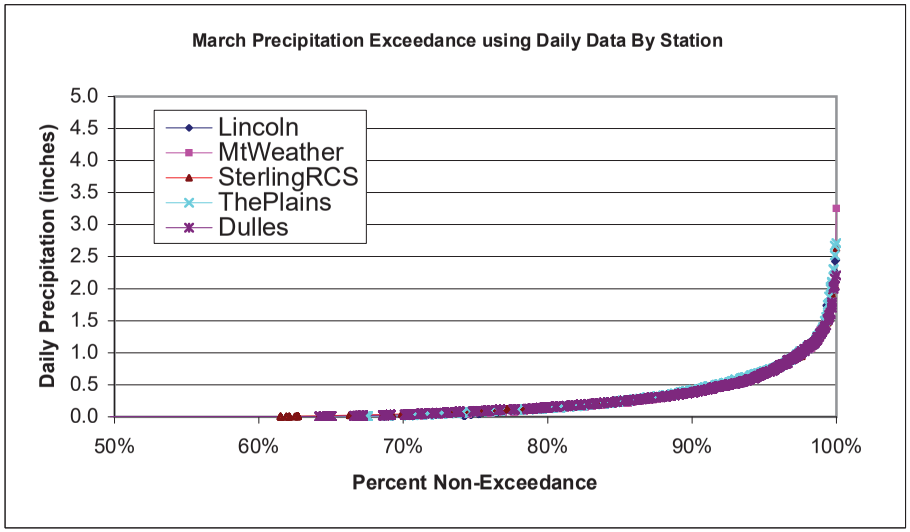
When using daily data, there will always be rain free days, therefore presenting minimums is not meanful.

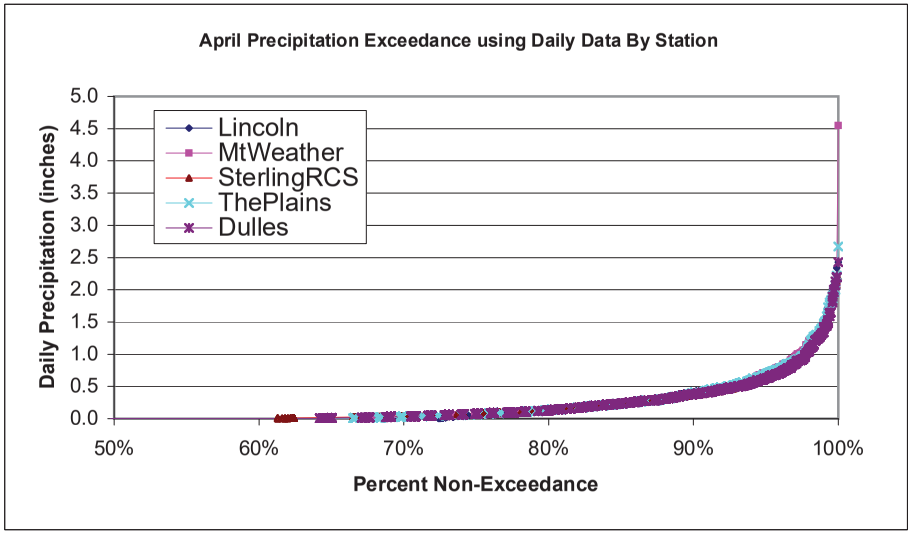

Min Monthly Precipitation
Monthly Precipitation (Inches)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
Max
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep

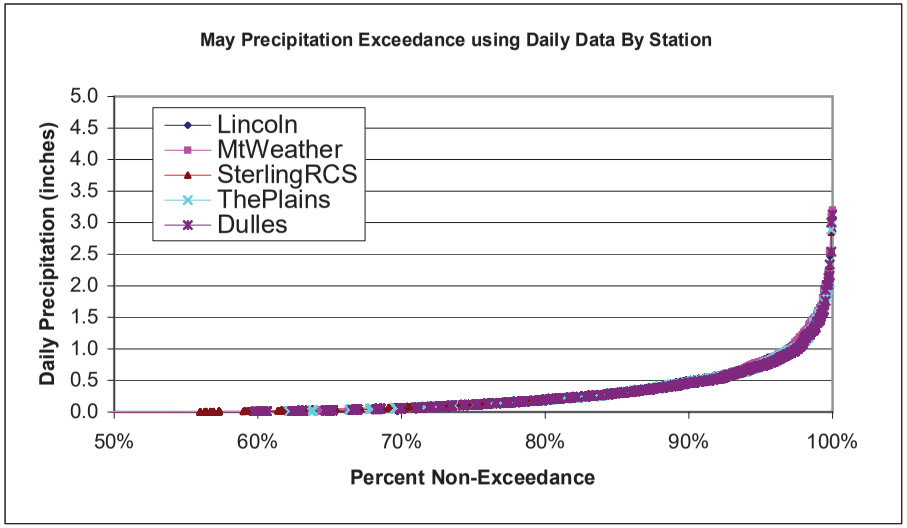

Precipitation Exceedance using Daily Data By Station
Daily Precipitation (inches)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
50%
55%
60%
65%
70%
75%
80%
85%
90%
95%
100%
Percent Non-Exceedance

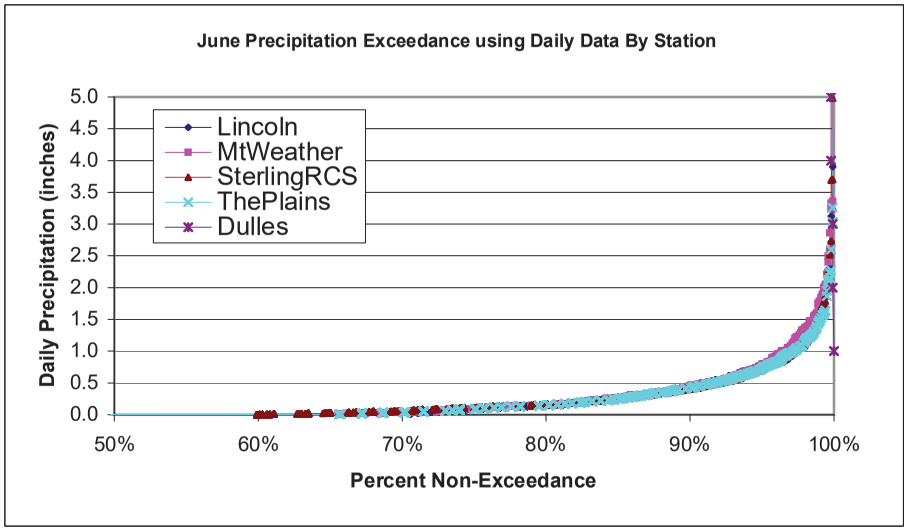

January Precipitation Exceedance using Daily Data By Station
Daily Precipitation (inches)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
50%
60%
70%
80%
90%
100%
Percent Non-Exceedance

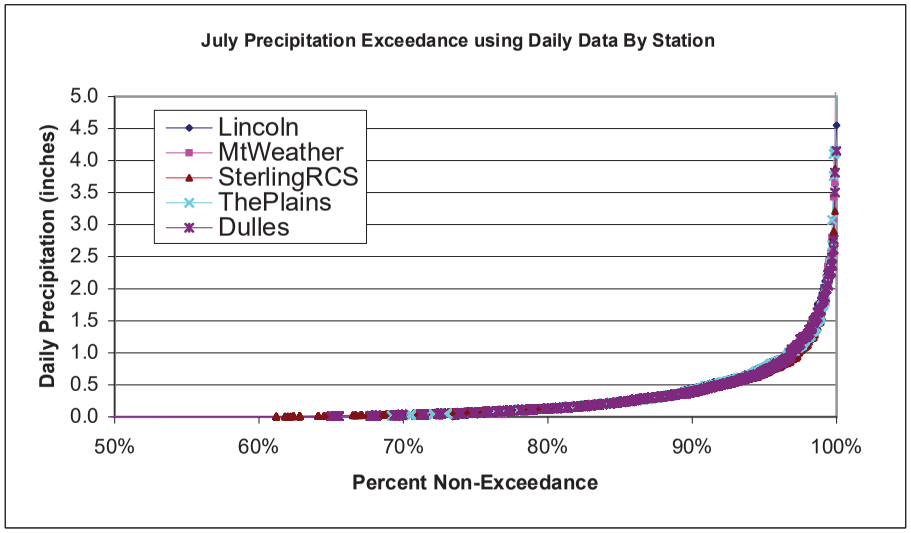

February Precipitation Exceedance using Daily Data By Station
Daily Precipitation (inches)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
50%
60%
70%
80%
90%
100%
Percent Non-Exceedance

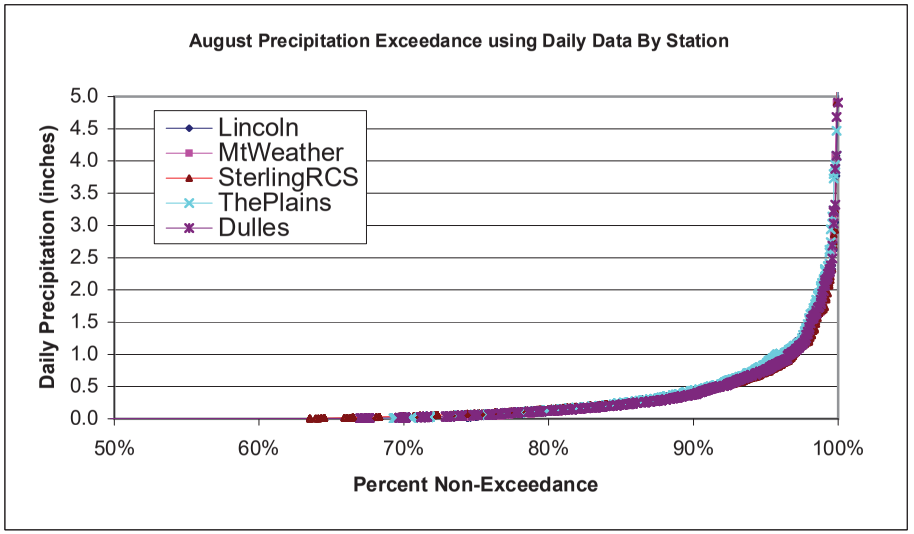

March Precipitation Exceedance using Daily Data By Station
Daily Precipitation (inches)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
50%
60%
70%
80%
90%
100%
Percent Non-Exceedance

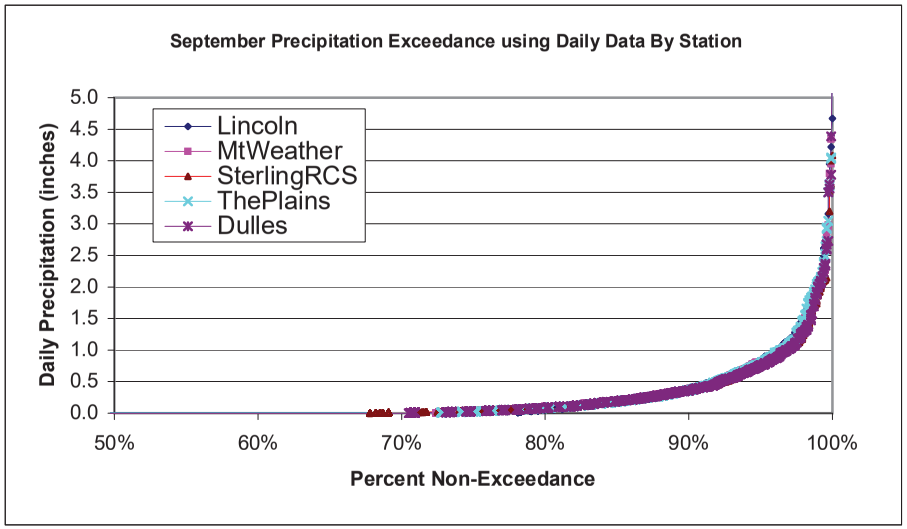

April Precipitation Exceedance using Daily Data By Station
Daily Precipitation (inches)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
50%
60%
70%
80%
90%
100%
Percent Non-Exceedance

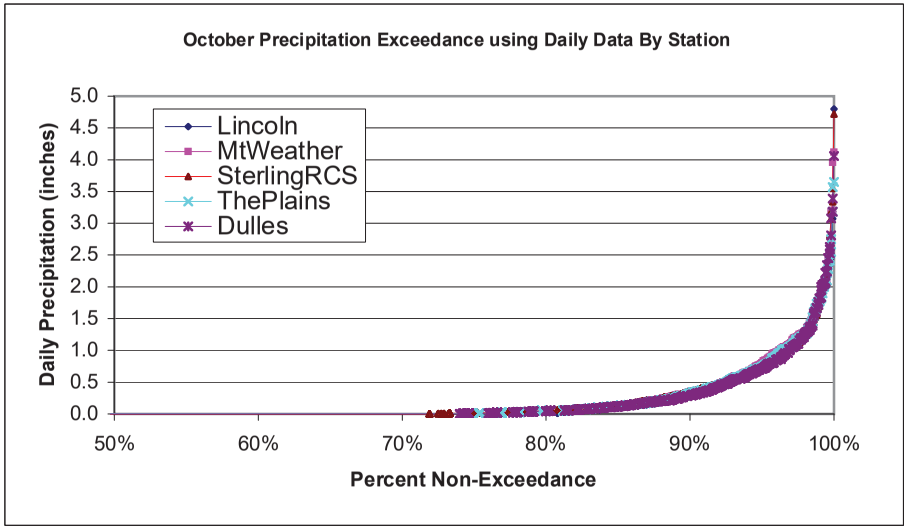

May Precipitation Exceedance using Daily Data By Station
Daily Precipitation (inches)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
50%
60%
70%
80%
90%
100%
Percent Non-Exceedance

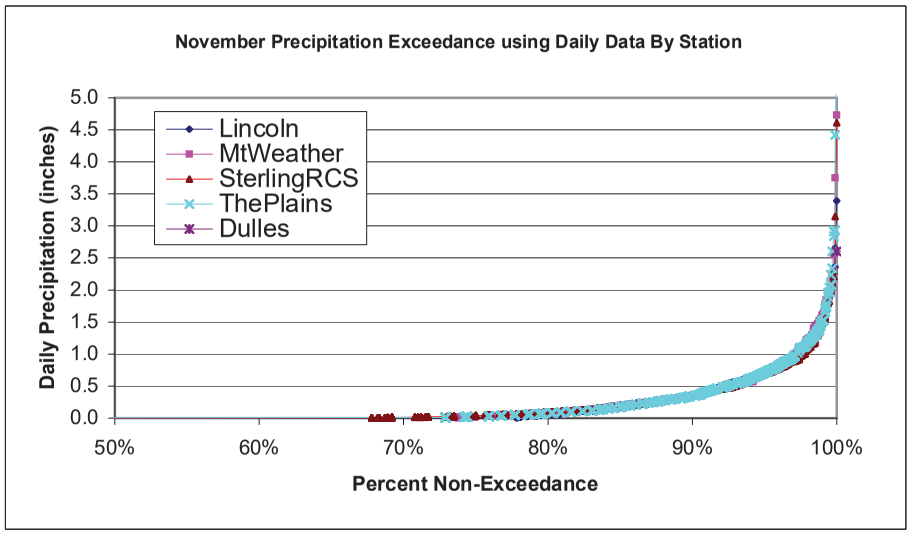

June Precipitation Exceedance using Daily Data By Station
Daily Precipitation (inches)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
50%
60%
70%
80%
90%
100%
Percent Non-Exceedance

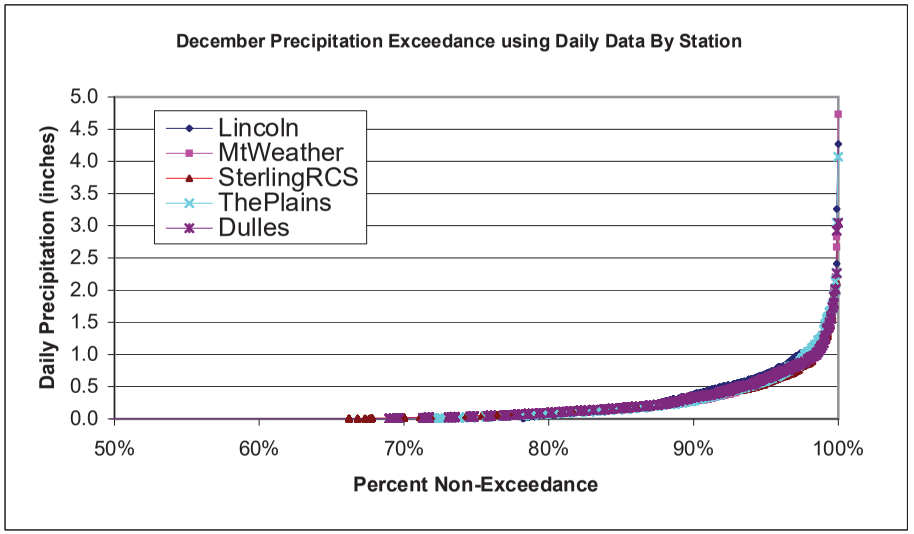

July Precipitation Exceedance using Daily Data By Station
Daily Precipitation (inches)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
50%
60%
70%
80%
90%
100%
Percent Non-Exceedance


August Precipitation Exceedance using Daily Data By Station
Daily Precipitation (inches)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
50%
60%
70%
80%
90%
100%
Percent Non-Exceedance


September Precipitation Exceedance using Daily Data By Station
Daily Precipitation (inches)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
50%
60%
70%
80%
90%
100%
Percent Non-Exceedance


October Precipitation Exceedance using Daily Data By Station
Daily Precipitation (inches)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
50%
60%
70%
80%
90%
100%
Percent Non-Exceedance


November Precipitation Exceedance using Daily Data By Station
Daily Precipitation (inches)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
50%
60%
70%
80%
90%
100%
Percent Non-Exceedance


December Precipitation Exceedance using Daily Data By Station
Daily Precipitation (inches)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Lincoln
MtWeather
SterlingRCS
ThePlains
Dulles
50%
60%
70%
80%
90%
100%
Percent Non-Exceedance

	Lincoln	MtWeather	SterlingRCS	ThePlains	Dulles
Number of Days with Precipitation Data	27,577	20,852	10,468	18,564	14,214
Number of Days with Zero Precipitation Recorded	20,770	14,663	7,032	12,909	9,708
Number of Days with Nonzero Precipitation	6,807	6,189	3,436	5,655	4,506
Percentage days with Zero Precipitation	75.3%	70.3%	67.2%	69.5%	68.3%
Percentage days with Nonzero Precipitation	24.7%	29.7%	32.8%	30.5%	31.7%

These are the counts prior to adding the missing data.

Counts

COOPID	STATION_NAME	COUNTY	ELEVATION_FT	LatitudeDD	LongitudeDD	URL
444909	LINCOLN	LOUDOUN	152.4	39.0833333	-77.7000000	http://cirrus.dnr.state.sc.us/cgi-bin/sercc/cliMAIN.pl?va4909
445851	MOUNT WEATHER	LOUDOUN	524.3	39.0666667	-77.8833333	http://cirrus.dnr.state.sc.us/cgi-bin/sercc/cliMAIN.pl?va5851
448084	STERLING RCS	LOUDOUN	85.3	38.9833333	-77.4833333	http://cirrus.dnr.state.sc.us/cgi-bin/sercc/cliMAIN.pl?va8084
448396	THE PLAINS 2 NNE	FAUQUIER	161.5	38.9000000	-77.7500000	http://cirrus.dnr.state.sc.us/cgi-bin/sercc/cliMAIN.pl?va8396
448903	WASHINGTON DULLES	LOUDOUN	290	38.9333333	-77.4833333	http://cirrus.dnr.state.sc.us/cgi-bin/sercc/cliMAIN.pl?va8903

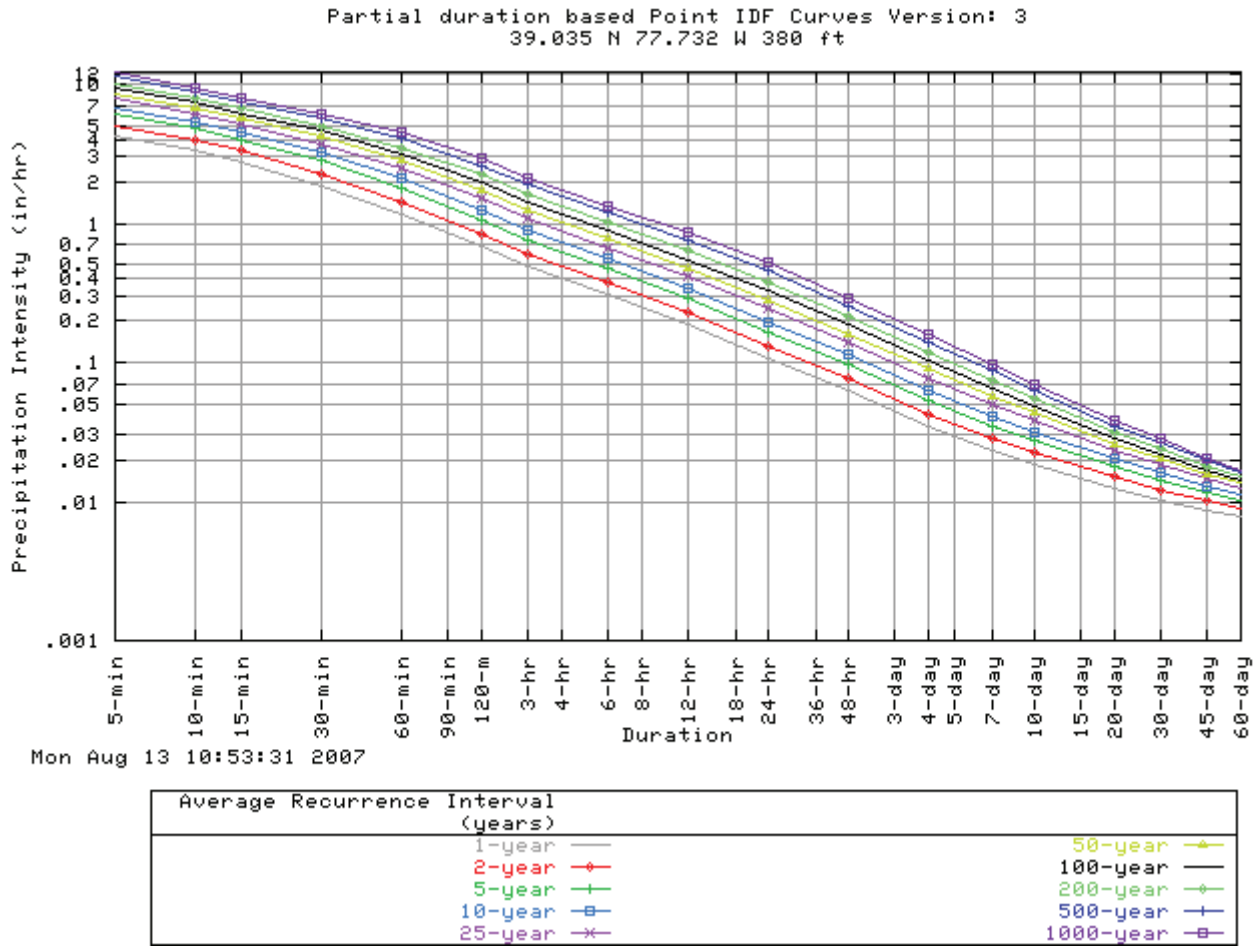
Coordinates

Precipitation Intensity Estimates for Loudoun County

The following estimates were obtained form NOAA website.

Precipitation Intensity Estimates (in/hr)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	4.22	3.35	2.77	1.88	1.16	0.69	0.50	0.31	0.19	0.11	0.06	0.04	0.02	0.02	0.01	0.01	0.01	0.01
2	5.06	4.02	3.34	2.29	1.43	0.84	0.60	0.37	0.23	0.13	0.08	0.04	0.03	0.02	0.01	0.01	0.01	0.01
5	6.06	4.81	4.02	2.82	1.80	1.07	0.77	0.47	0.29	0.17	0.10	0.05	0.04	0.03	0.02	0.01	0.01	0.01
10	6.80	5.39	4.50	3.22	2.09	1.25	0.90	0.55	0.34	0.20	0.11	0.06	0.04	0.03	0.02	0.02	0.01	0.01
25	7.81	6.14	5.15	3.76	2.48	1.52	1.09	0.67	0.41	0.24	0.14	0.08	0.05	0.04	0.02	0.02	0.01	0.01
50	8.60	6.73	5.64	4.18	2.81	1.74	1.25	0.77	0.48	0.28	0.16	0.09	0.06	0.04	0.03	0.02	0.02	0.01
100	9.37	7.31	6.14	4.61	3.15	1.98	1.42	0.88	0.55	0.33	0.19	0.10	0.06	0.05	0.03	0.02	0.02	0.01
200	10.16	7.91	6.64	5.06	3.52	2.23	1.61	1.00	0.63	0.38	0.21	0.12	0.07	0.05	0.03	0.02	0.02	0.02
500	11.29	8.72	7.32	5.69	4.04	2.61	1.89	1.18	0.75	0.46	0.25	0.14	0.09	0.06	0.04	0.03	0.02	0.02
1000	12.22	9.35	7.82	6.19	4.46	2.93	2.13	1.34	0.86	0.52	0.29	0.16	0.10	0.07	0.04	0.03	0.02	0.02



Confidence Limits -

* Upper bound of the 90% confidence interval Precipitation Intensity Estimates (in/hr)																		
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	4.69	3.73	3.08	2.09	1.30	0.77	0.56	0.35	0.21	0.12	0.07	0.04	0.03	0.02	0.01	0.01	0.01	0.01
2	5.63	4.47	3.72	2.54	1.58	0.94	0.68	0.42	0.25	0.14	0.08	0.05	0.03	0.02	0.02	0.01	0.01	0.01
5	6.74	5.35	4.47	3.14	2.00	1.19	0.86	0.53	0.32	0.18	0.11	0.06	0.04	0.03	0.02	0.02	0.01	0.01
10	7.55	5.98	5.00	3.58	2.31	1.39	1.01	0.62	0.38	0.22	0.12	0.07	0.04	0.03	0.02	0.02	0.01	0.01
25	8.64	6.79	5.69	4.16	2.75	1.69	1.22	0.75	0.46	0.27	0.15	0.08	0.05	0.04	0.03	0.02	0.02	0.01
50	9.50	7.43	6.23	4.62	3.10	1.93	1.39	0.86	0.53	0.31	0.18	0.10	0.06	0.05	0.03	0.02	0.02	0.01
100	10.34	8.06	6.77	5.09	3.47	2.19	1.58	0.98	0.61	0.36	0.20	0.11	0.07	0.05	0.03	0.02	0.02	0.02
200	11.21	8.72	7.32	5.58	3.88	2.47	1.79	1.11	0.70	0.41	0.23	0.13	0.08	0.06	0.03	0.03	0.02	0.02
500	12.46	9.62	8.08	6.28	4.46	2.89	2.10	1.32	0.84	0.50	0.28	0.15	0.09	0.07	0.04	0.03	0.02	0.02
1000	13.49	10.33	8.64	6.83	4.93	3.24	2.37	1.49	0.96	0.57	0.32	0.17	0.11	0.08	0.04	0.03	0.02	0.02

* The **upper** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **greater** than.
** These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

* Lower bound of the 90% confidence interval Precipitation Intensity Estimates (in/hr)																		
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	3.79	3.01	2.49	1.69	1.05	0.62	0.44	0.28	0.17	0.10	0.06	0.03	0.02	0.02	0.01	0.01	0.01	0.01
2	4.55	3.61	3.00	2.05	1.28	0.75	0.54	0.34	0.20	0.12	0.07	0.04	0.03	0.02	0.01	0.01	0.01	0.01
5	5.44	4.31	3.61	2.53	1.61	0.96	0.69	0.42	0.26	0.15	0.09	0.05	0.03	0.03	0.02	0.01	0.01	0.01
10	6.08	4.82	4.02	2.88	1.86	1.12	0.80	0.49	0.30	0.18	0.10	0.06	0.04	0.03	0.02	0.02	0.01	0.01
25	6.94	5.45	4.57	3.34	2.21	1.35	0.96	0.59	0.36	0.22	0.13	0.07	0.05	0.04	0.02	0.02	0.01	0.01
50	7.60	5.95	4.99	3.70	2.48	1.53	1.10	0.68	0.42	0.25	0.15	0.08	0.05	0.04	0.02	0.02	0.01	0.01
100	8.24	6.43	5.40	4.05	2.77	1.73	1.24	0.77	0.48	0.29	0.17	0.09	0.06	0.04	0.03	0.02	0.02	0.01
200	8.87	6.90	5.79	4.42	3.07	1.94	1.40	0.87	0.54	0.33	0.19	0.10	0.07	0.05	0.03	0.02	0.02	0.01
500	9.76	7.54	6.32	4.92	3.49	2.25	1.62	1.01	0.64	0.39	0.22	0.12	0.08	0.06	0.03	0.02	0.02	0.02
1000	10.46	8.01	6.70	5.30	3.83	2.50	1.80	1.13	0.72	0.45	0.25	0.14	0.09	0.06	0.03	0.03	0.02	0.02

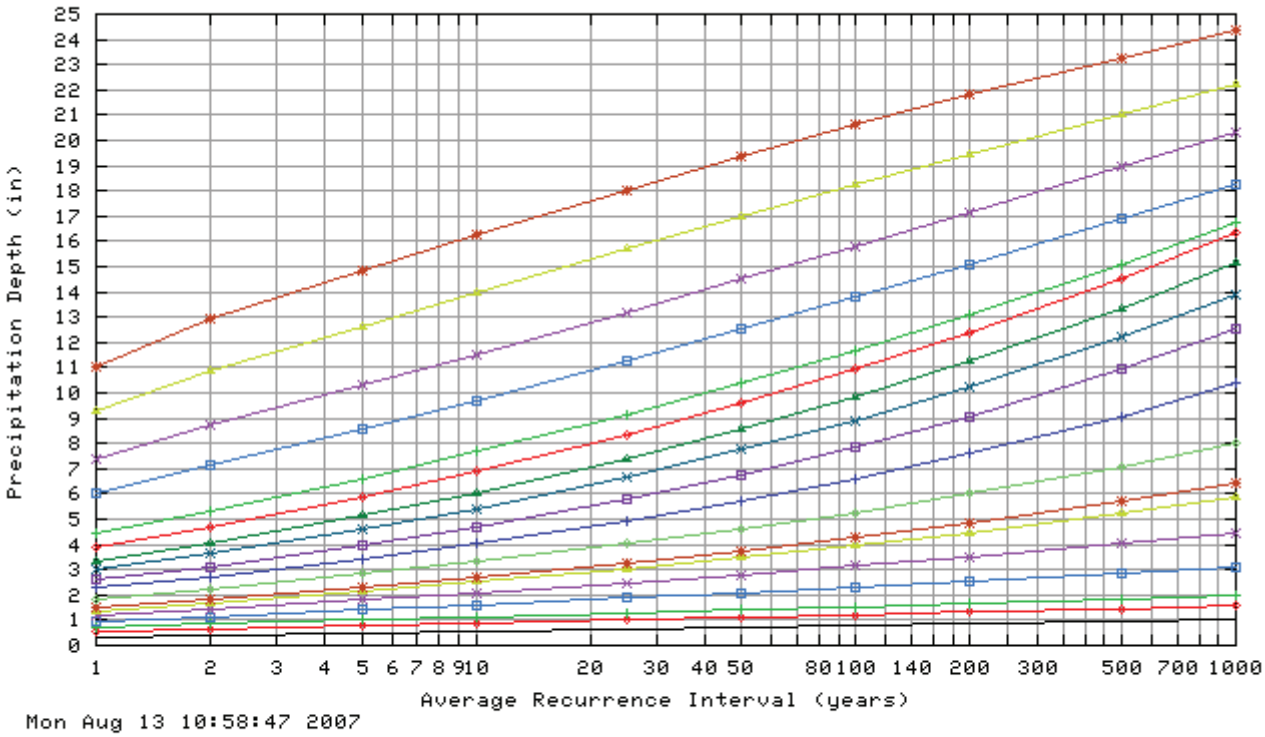
* The **lower** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **less** than.
** These precipitation frequency estimates are based on a partial duration maxima series. **ARI** is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

Data Source: Precipitation Intensity
http://hdsc.nws.noaa.gov/cgi-bin/hdsc/buildout.perl?type=idf&series=pd&units=us&statename=VIRGINIA&stateabv=va&study=orb&season=All&intype=5&plat=39.035&plon=-77.732&liststation=0&slat=lat&slon=lon&mlat=39.035&mlon=-77.732&elev=380&xy0=lat&xy1=-lon&xy2=lat&xy3=-lon&xy4=lat&xy5=-lon&xy6=lat&xy7=-lon&xy8=lat&xy9=-lon&xy10=lat&xy11=-lon&xy12=lat&xy13=-lon&xy14=lat&xy15=-lon&xy16=lat&xy17=-lon&xy18=lat&xy19=-lon&xy20=lat&xy21=-lon&xy22=lat&xy23=-lon

Precipitation Frequency Estimates for Loudoun County

Precipitation Frequency Estimates (inches)																		
ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.35	0.56	0.69	0.94	1.16	1.37	1.49	1.85	2.26	2.59	3.01	3.37	3.91	4.47	6.02	7.39	9.27	11.02
2	0.42	0.67	0.83	1.14	1.43	1.68	1.81	2.24	2.73	3.12	3.63	4.06	4.70	5.36	7.15	8.72	10.91	12.94
5	0.51	0.80	1.00	1.41	1.80	2.14	2.30	2.82	3.45	3.98	4.60	5.14	5.89	6.62	8.57	10.29	12.66	14.84
10	0.57	0.90	1.13	1.61	2.09	2.51	2.70	3.30	4.05	4.71	5.43	6.06	6.88	7.66	9.71	11.52	13.99	16.25
25	0.65	1.02	1.29	1.88	2.48	3.04	3.27	4.01	4.96	5.82	6.67	7.41	8.34	9.15	11.27	13.19	15.71	18.05
50	0.72	1.12	1.41	2.09	2.81	3.48	3.76	4.62	5.74	6.78	7.74	8.57	9.57	10.37	12.51	14.50	17.00	19.38
100	0.78	1.22	1.53	2.31	3.15	3.95	4.28	5.28	6.62	7.86	8.92	9.85	10.91	11.68	13.78	15.82	18.25	20.62
200	0.85	1.32	1.66	2.53	3.52	4.47	4.84	6.00	7.60	9.08	10.23	11.26	12.38	13.08	15.09	17.15	19.47	21.81
500	0.94	1.45	1.83	2.85	4.04	5.22	5.68	7.08	9.08	10.93	12.19	13.37	14.54	15.08	16.88	18.94	21.04	23.29
1000	1.02	1.56	1.96	3.09	4.46	5.86	6.39	8.00	10.37	12.54	13.88	15.16	16.37	16.76	18.28	20.32	22.19	24.36

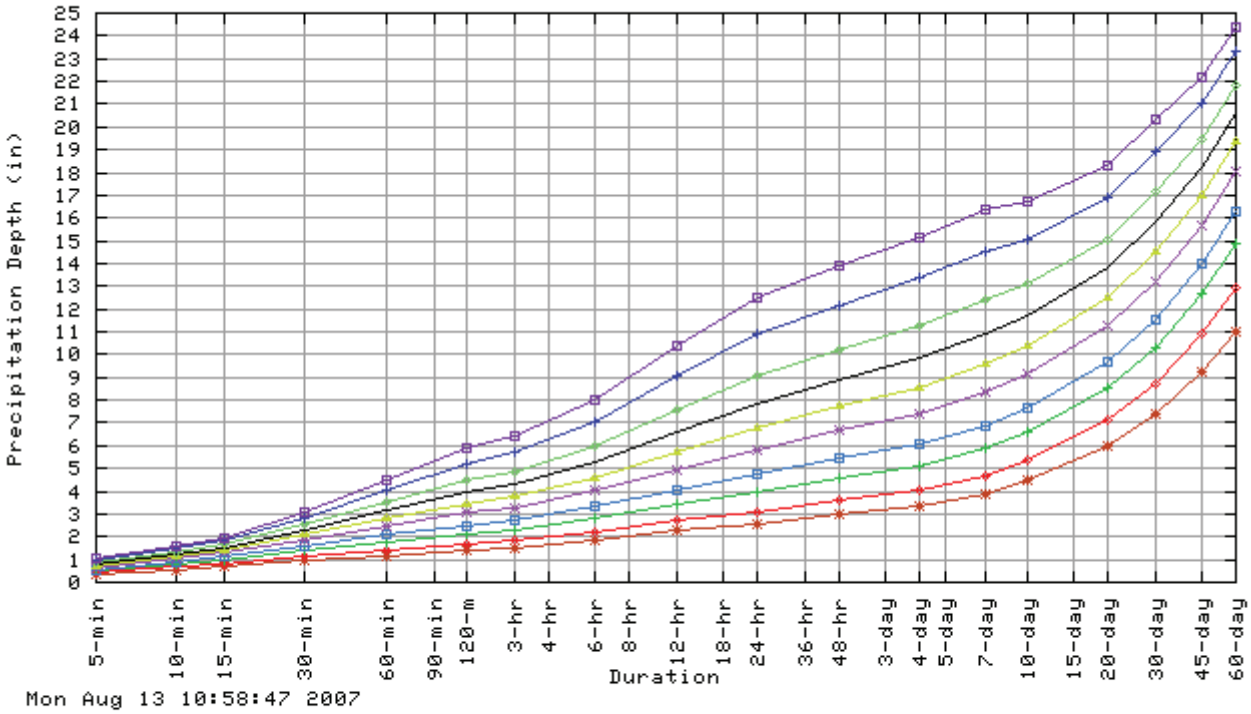
Partial duration based Point Precipitation Frequency Estimates Version: 3
39.035 N 77.732 W 380 ft



Mon Aug 13 10:58:47 2007

Duration			
5-min	120-m	48-hr	30-day
10-min	3-hr	4-day	45-day
15-min	6-hr	7-day	60-day
30-min	12-hr	10-day	
60-min	24-hr	20-day	

Partial duration based Point Precipitation Frequency Estimates Version: 3
39.035 N 77.732 W 380 ft



Mon Aug 13 10:58:47 2007

Average Recurrence Interval (years)	
1	50
2	100
5	200
10	500
25	1000

Confidence Limits -

* Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches)																		
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.39	0.62	0.77	1.05	1.30	1.53	1.67	2.08	2.55	2.86	3.30	3.67	4.24	4.82	6.44	7.85	9.76	11.59
2	0.47	0.74	0.93	1.27	1.58	1.87	2.04	2.52	3.07	3.46	3.98	4.43	5.09	5.78	7.65	9.28	11.49	13.59
5	0.56	0.89	1.12	1.57	2.00	2.38	2.58	3.17	3.87	4.40	5.05	5.61	6.38	7.15	9.18	10.94	13.33	15.60
10	0.63	1.00	1.25	1.79	2.31	2.79	3.02	3.70	4.53	5.20	5.95	6.60	7.46	8.26	10.39	12.24	14.73	17.09
25	0.72	1.13	1.42	2.08	2.75	3.37	3.65	4.49	5.53	6.40	7.29	8.05	9.02	9.85	12.05	14.02	16.54	18.98
50	0.79	1.24	1.56	2.31	3.10	3.86	4.18	5.15	6.40	7.44	8.44	9.30	10.34	11.16	13.38	15.41	17.91	20.38
100	0.86	1.34	1.69	2.54	3.47	4.38	4.75	5.87	7.37	8.61	9.71	10.67	11.78	12.57	14.75	16.84	19.25	21.72
200	0.93	1.45	1.83	2.79	3.88	4.94	5.38	6.68	8.44	9.92	11.14	12.21	13.38	14.07	16.16	18.27	20.57	23.00
500	1.04	1.60	2.02	3.14	4.46	5.78	6.32	7.88	10.10	11.92	13.28	14.52	15.74	16.26	18.12	20.23	22.27	24.62
1000	1.12	1.72	2.16	3.42	4.93	6.48	7.12	8.90	11.54	13.67	15.14	16.50	17.76	18.11	19.67	21.76	23.55	25.79

* The **upper** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **greater** than.
** These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

* Lower bound of the 90% confidence interval Precipitation Frequency Estimates (inches)																		
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.32	0.50	0.62	0.84	1.05	1.23	1.34	1.66	2.03	2.37	2.77	3.10	3.61	4.14	5.65	6.98	8.80	10.50
2	0.38	0.60	0.75	1.03	1.28	1.51	1.63	2.01	2.44	2.86	3.34	3.74	4.34	4.97	6.71	8.24	10.35	12.32
5	0.45	0.72	0.90	1.27	1.61	1.92	2.06	2.53	3.08	3.63	4.22	4.73	5.43	6.14	8.03	9.70	12.00	14.12
10	0.51	0.80	1.01	1.44	1.86	2.24	2.40	2.95	3.60	4.29	4.97	5.55	6.33	7.08	9.08	10.85	13.25	15.45
25	0.58	0.91	1.14	1.67	2.21	2.70	2.90	3.56	4.37	5.26	6.05	6.75	7.63	8.42	10.50	12.39	14.86	17.12
50	0.63	0.99	1.25	1.85	2.48	3.07	3.30	4.07	5.02	6.09	6.97	7.77	8.71	9.50	11.62	13.58	16.06	18.34
100	0.69	1.07	1.35	2.03	2.77	3.47	3.73	4.61	5.73	7.00	7.97	8.85	9.86	10.63	12.73	14.75	17.20	19.48
200	0.74	1.15	1.45	2.21	3.07	3.89	4.19	5.19	6.51	8.00	9.05	10.03	11.09	11.82	13.87	15.92	18.30	20.55
500	0.81	1.26	1.58	2.46	3.49	4.49	4.86	6.05	7.66	9.47	10.62	11.73	12.86	13.49	15.40	17.46	19.67	21.86
1000	0.87	1.33	1.68	2.65	3.83	4.99	5.40	6.75	8.63	10.71	11.93	13.14	14.32	14.86	16.57	18.62	20.66	22.79

* The **lower** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **less** than.
** These precipitation frequency estimates are based on a partial duration maxima series. **ARI** is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

Data Source: Precipitation Depth
http://hdsc.nws.noaa.gov/cgi-bin/hdsc/buildout.perl?type=pf&series=pd&units=us&statename=VIRGINIA&stateabv=va&study=orb&season=All&intype=5&plat=39.035&plon=-77.732&liststation=0&slat=lat&slon=lon&mlat=39.035&mlon=-77.732&elev=380&xy0=lat&xy1=-lon&xy2=lat&xy3=-lon&xy4=lat&xy5=-lon&xy6=lat&xy7=-lon&xy8=lat&xy9=-lon&xy10=lat&xy11=-lon&xy12=lat&xy13=-lon&xy14=lat&xy15=-lon&xy16=lat&xy17=-lon&xy18=lat&xy19=-lon&xy20=lat&xy21=-lon&xy22=lat&xy23=-lon

Rainfall Intensity Duration

For storm planning purposes, the 24-hour rainfall data for Loudoun in the Blue Book, page 70 of 115 http://www.dcr.virginia.gov/soil_&_water/documents/Chapter_4.pdf and the rainfall-duration-intensity curve (use Fauquier County on page 103).

USGS Precipitation Web Download

This spreadsheet contains hyperlink to execute web queries from USGS NWIS web sites for the precipitation gages in Loudoun. The process includes a complete download of all **daily** data, approved and provisional.

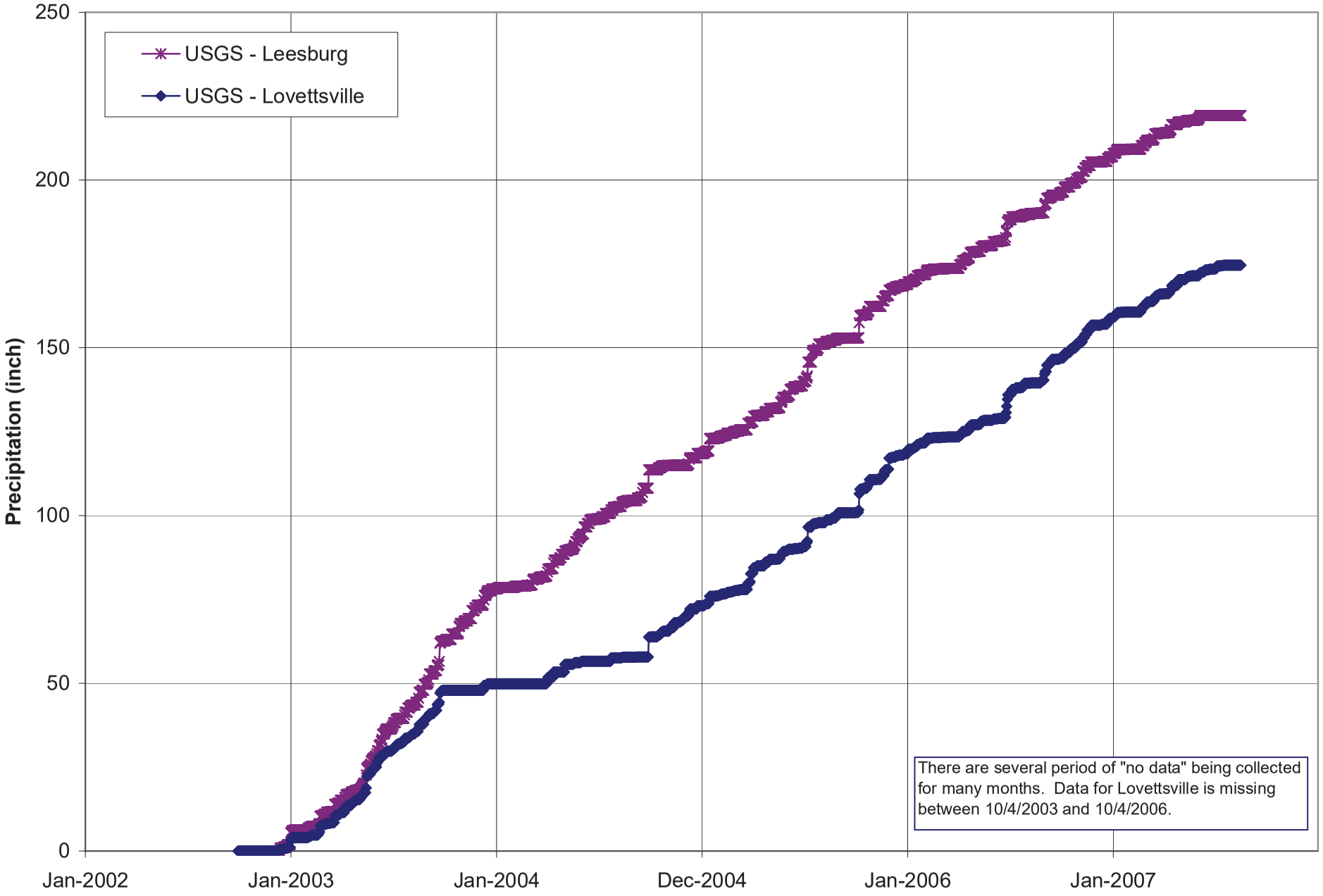
The spreadsheet offers the option to uses data "as is" from last update or update all stations. The update process will takes several minutes to process.

NOTE: There are many, many periods of incomplete records! Use this data with caution. Suggest using NCDC data files instead.

D Ward 12/27/2006
Last revised 8/15/07

31-Aug-07

Cummulative Daily Precipitation



Task B.3.3 Stream Discharge

B.3.3 Stream discharge (using data set 2.1)

USGS Streamflow

Annual Statistics

Mean Annual Discharge by Year

Median August Flow Rate and Rate per Sq Mile

Streamflow Duration (Plots and tabular distribution by percentile)

Relating USGS Streamflow (memo)

Real-Time (15-minute) Streamflow Snapshots (Dec 2006-August 2007)

Stream Gage Drainage Areas

Groundwater Recharge from Streamflow (memo)

Using RORA for Recharge Calculations (memo)

Baseflow Summary (Historic and Current Calculations)

Recharge Summary (Published and Current Calculations)

Streamflow Drainage Area

Low Flow and Base Flow Statistics (memo)

Base Flow using DFLOW

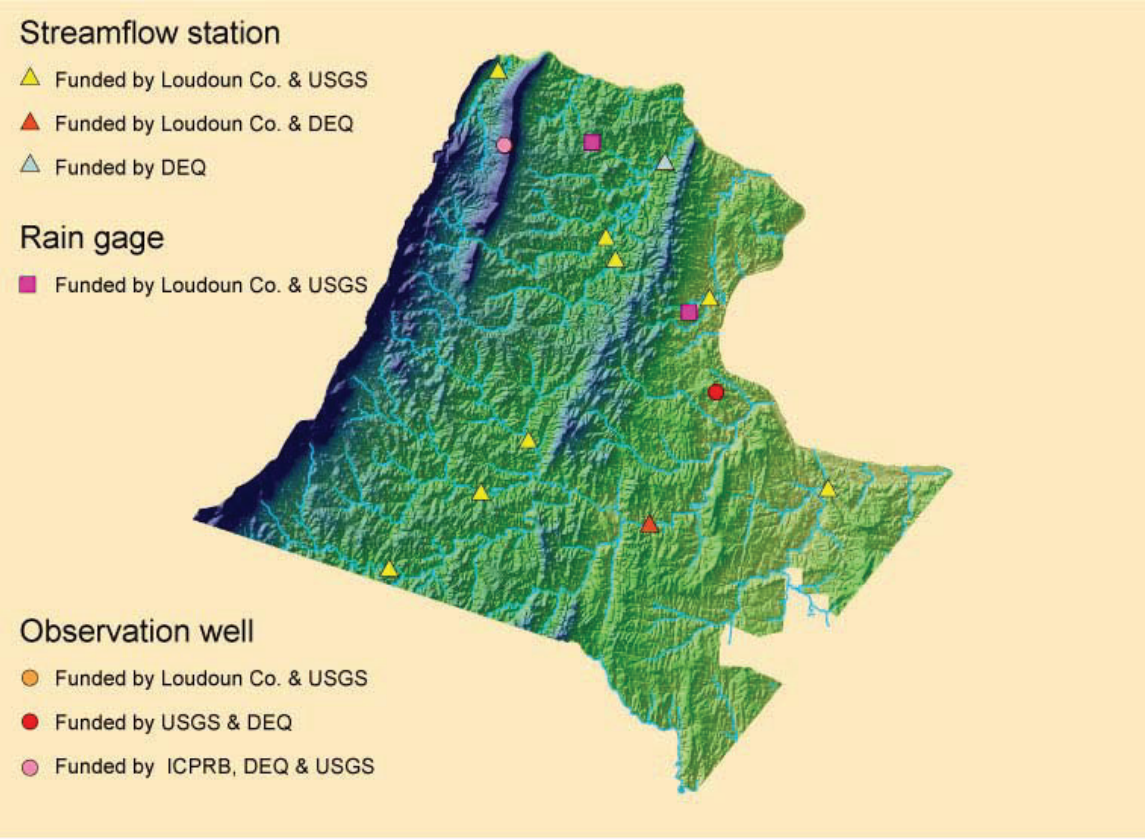
Automated Base Flow Separation and Recession using SWAT (memo)

Base Flow Calculations Summary using DFLOW

Data Set 2.1

Stream Stage & Discharge – USGS (and DEQ)

Ten stream gaging sites in Loudoun County (see map for locations) established by USGS and currently operated by USGS (8 sites) and DEQ (2 sites). Data include daily stage (ft) and discharge (cfs). Site locations and POR are: Broad Run at Rt. 7 (10/01-present), Limestone Branch at Rt 15 (9/01-present), Goose Creek nr. Rt 621 (1/30-present), Catoctin Creek at Taylorstown (11/70-present), S.F. Catoctin Creek at Rt 698 (7/01-present), N.F. Catoctin Creek at Rt 681 (8/01-present), N.F. Goose Creek at Rt 734/Lincoln (8/01-present), Beaverdam Creek at Rt 734/Mountvail (8/01-present), Goose Creek nr Middleburg (10/65-12/96 | 6/01-present), Piney Run at Rt 671 (10/01-present). POR data and some statistics for these sites available on USGS web page. Since December 2006, the 15-minute "real-time" data available for only last 30 days have been snap-shotted each month, providing stage/discharge of provisional values for more detailed hydrographs.



Locations of stream gages, wells, and rainfall monitoring sites managed by, or in cooperation with, USGS.

USGS Streamflow Web Download

This spreadsheet contains hyperlink to execute web queries from USGS NWIS web sites for the stream gages in Loudoun. The process includes a complete download of all **daily** data, approved and provisional.

The spreadsheet offers the option to uses data "as is" from last update or update all stations. The update process will takes several minutes to process.

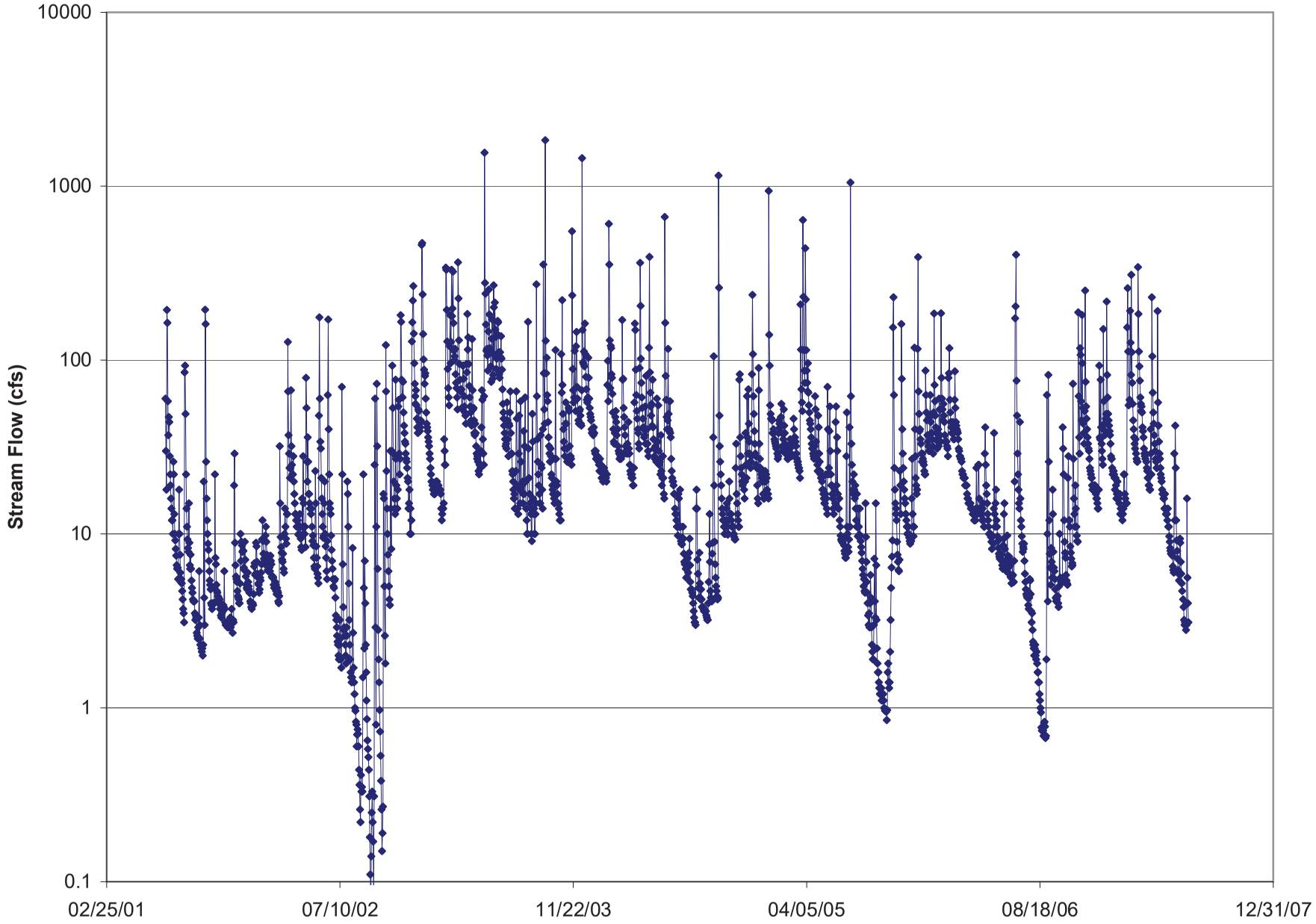
To ensure that data is updated correctly, 10 charts are linked to the data downloads.

URL's for the recent 30 day, **15-minute** data are included in "Sites" tab, but are not part of the routine web query.

D Ward 12/20/2006

31-Aug-07

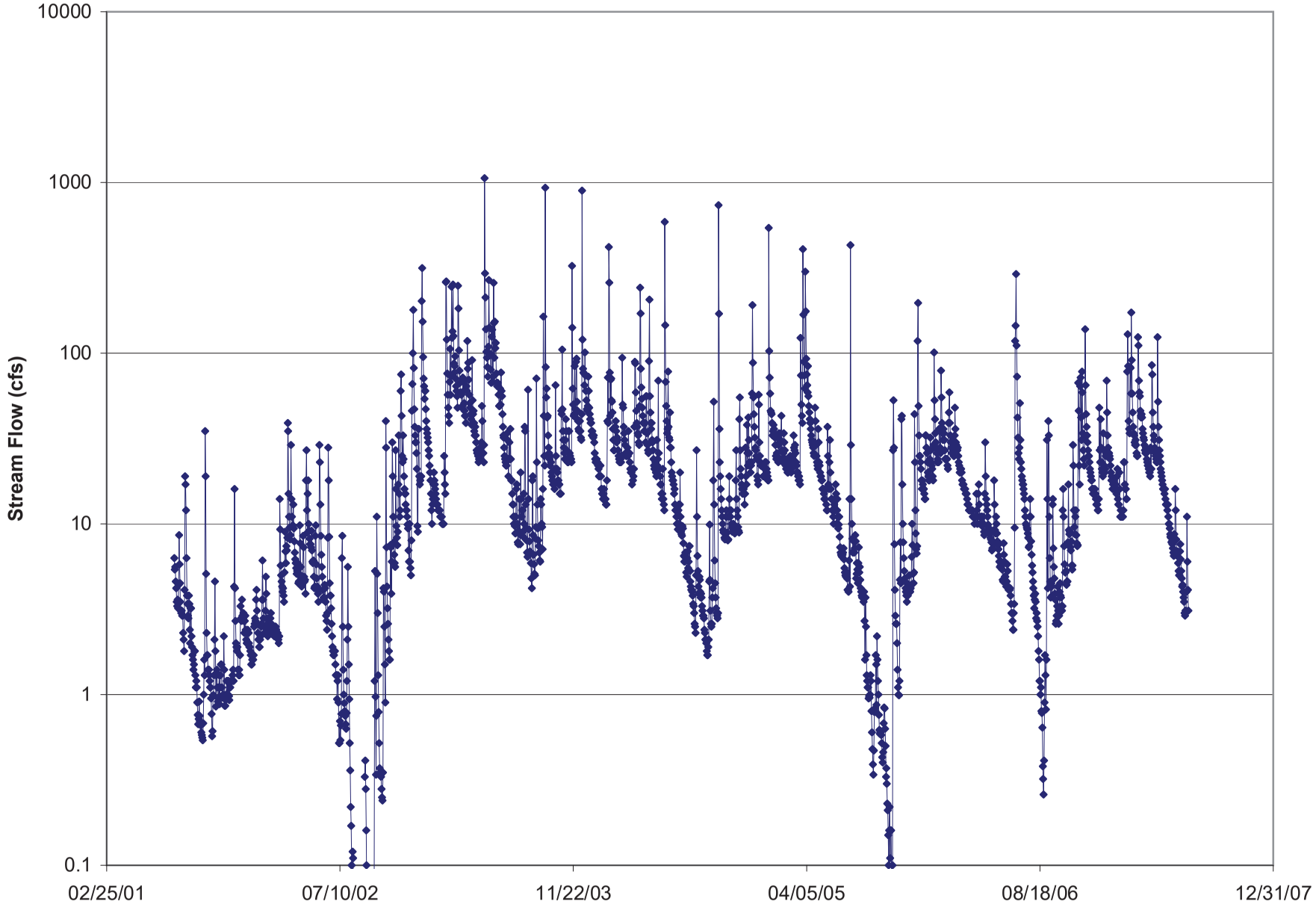
USGS Stream Flow



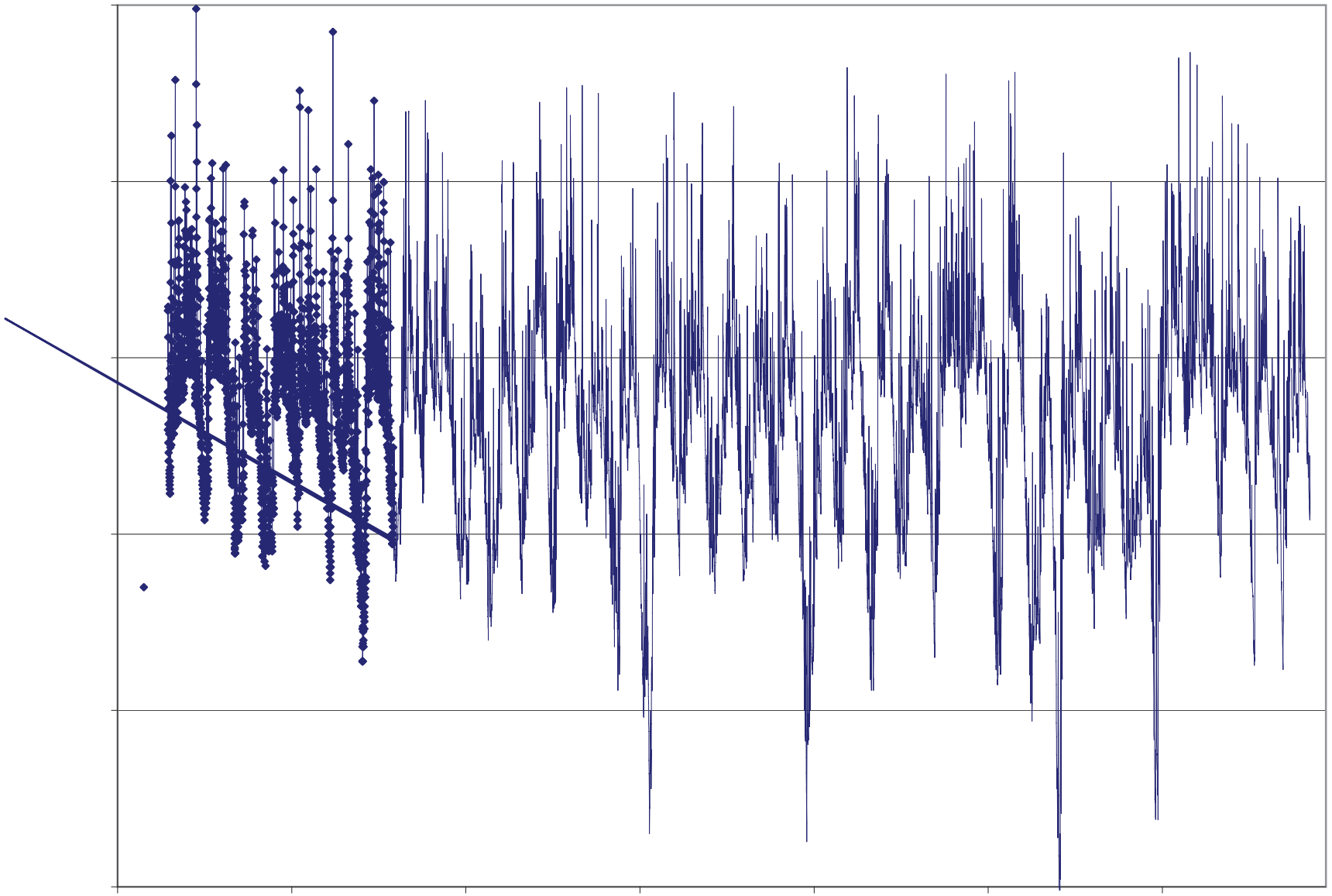
Cht_SF_Cat

31-Aug-07

USGS Stream Flow

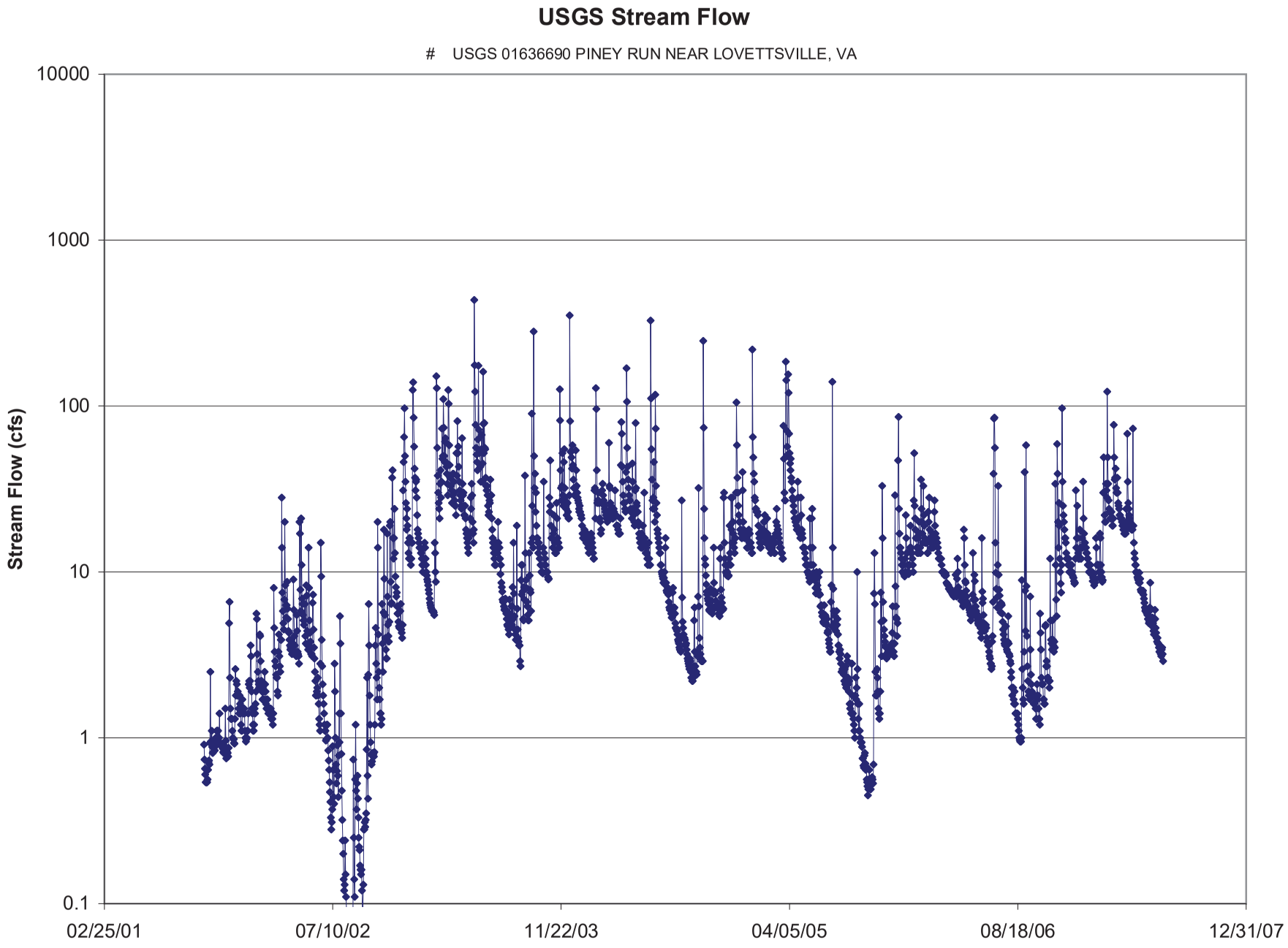


Cht_NF_Cat



Cht_Cat

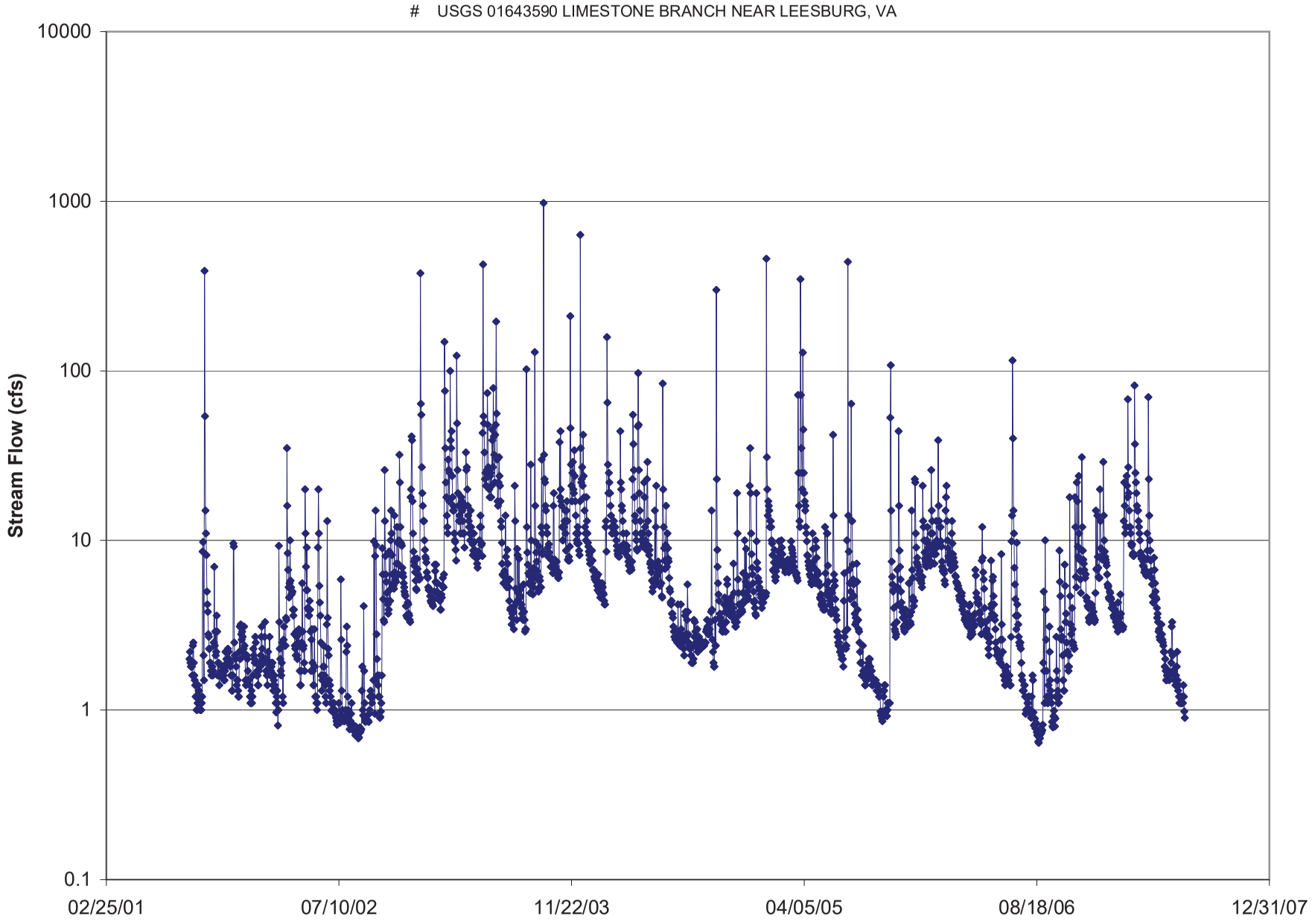
31-Aug-07



Cht_Piney

31-Aug-07

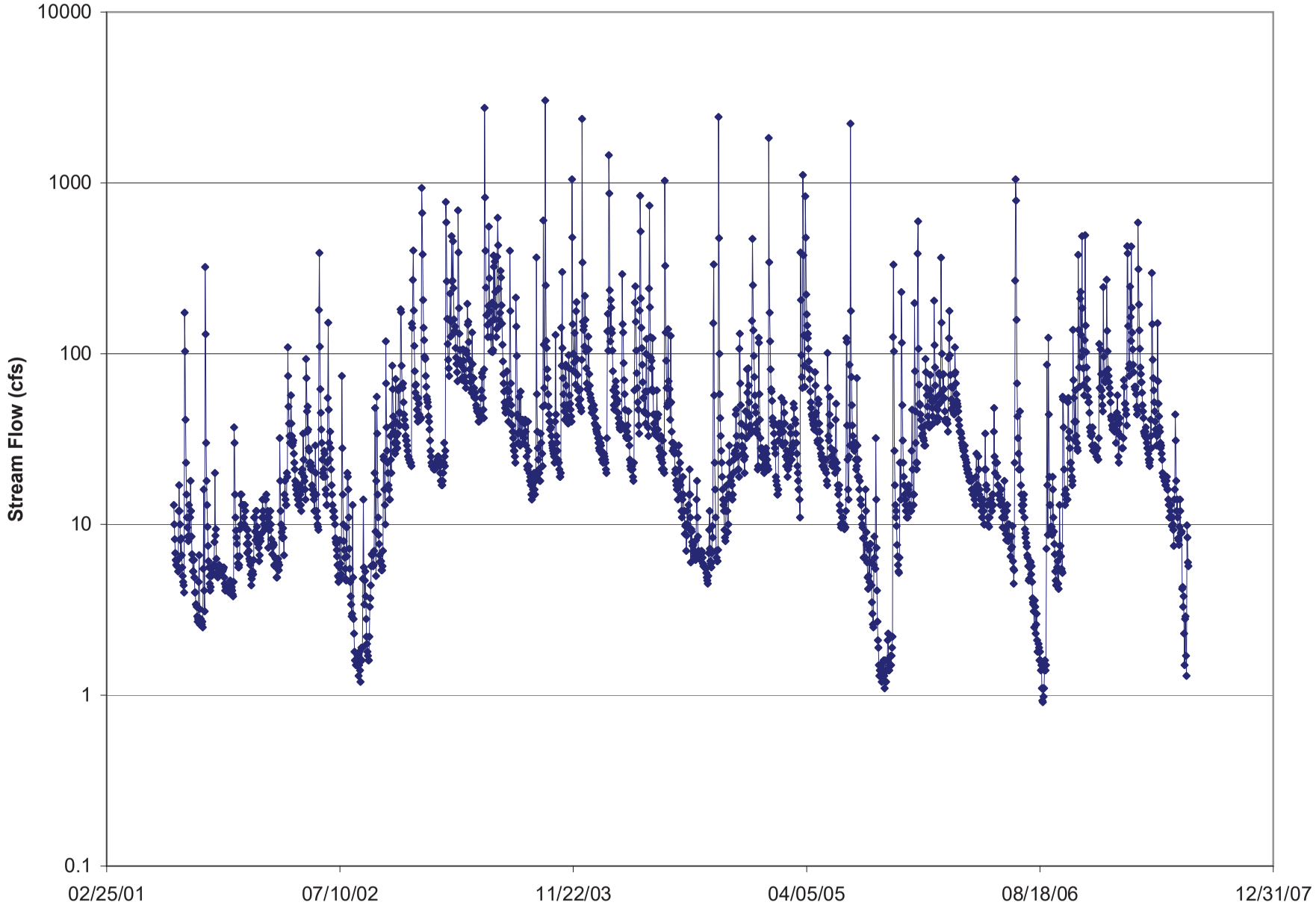
USGS Stream Flow



Cht_Lime

31-Aug-07

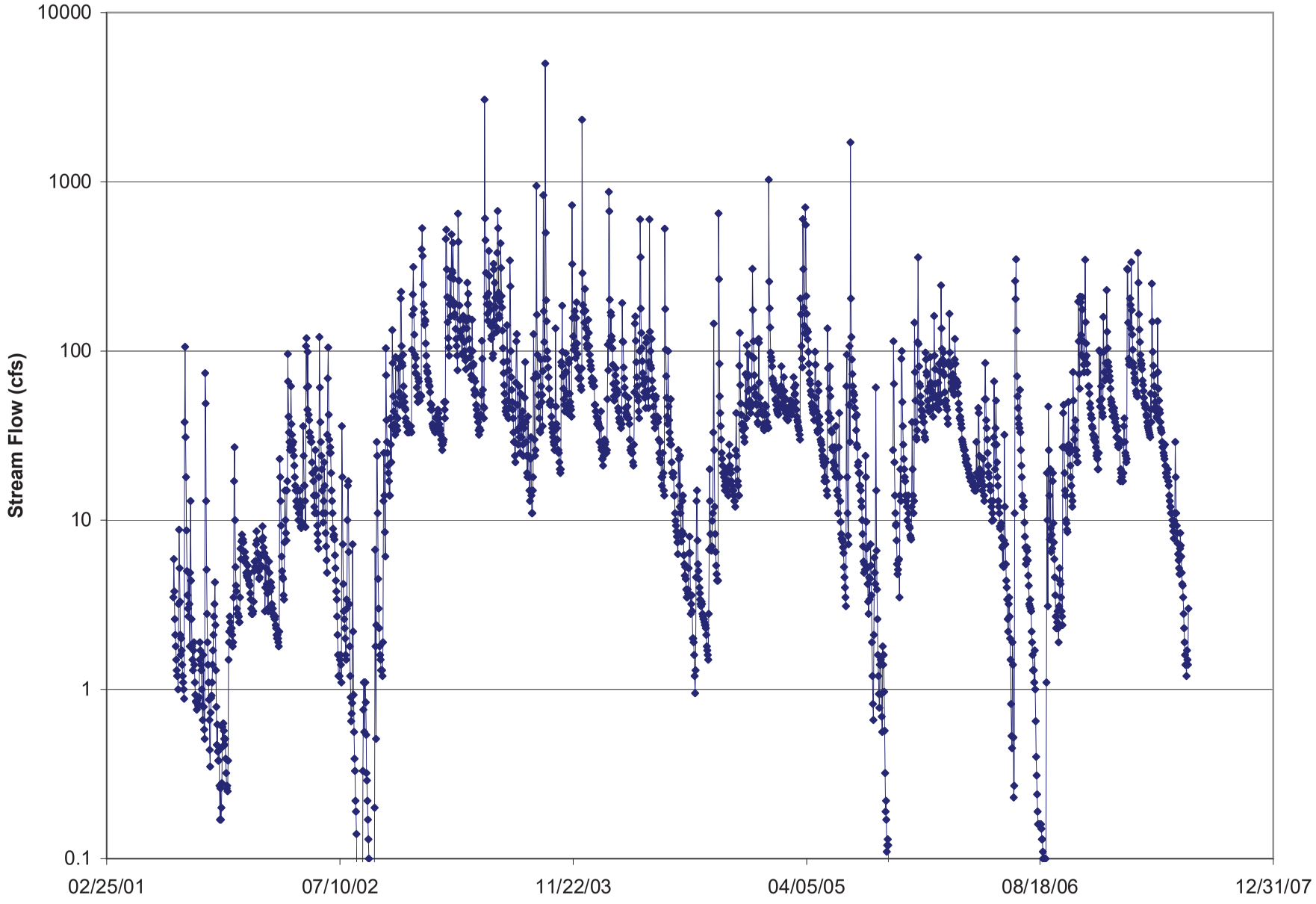
USGS Stream Flow



Cht_NF_GC

31-Aug-07

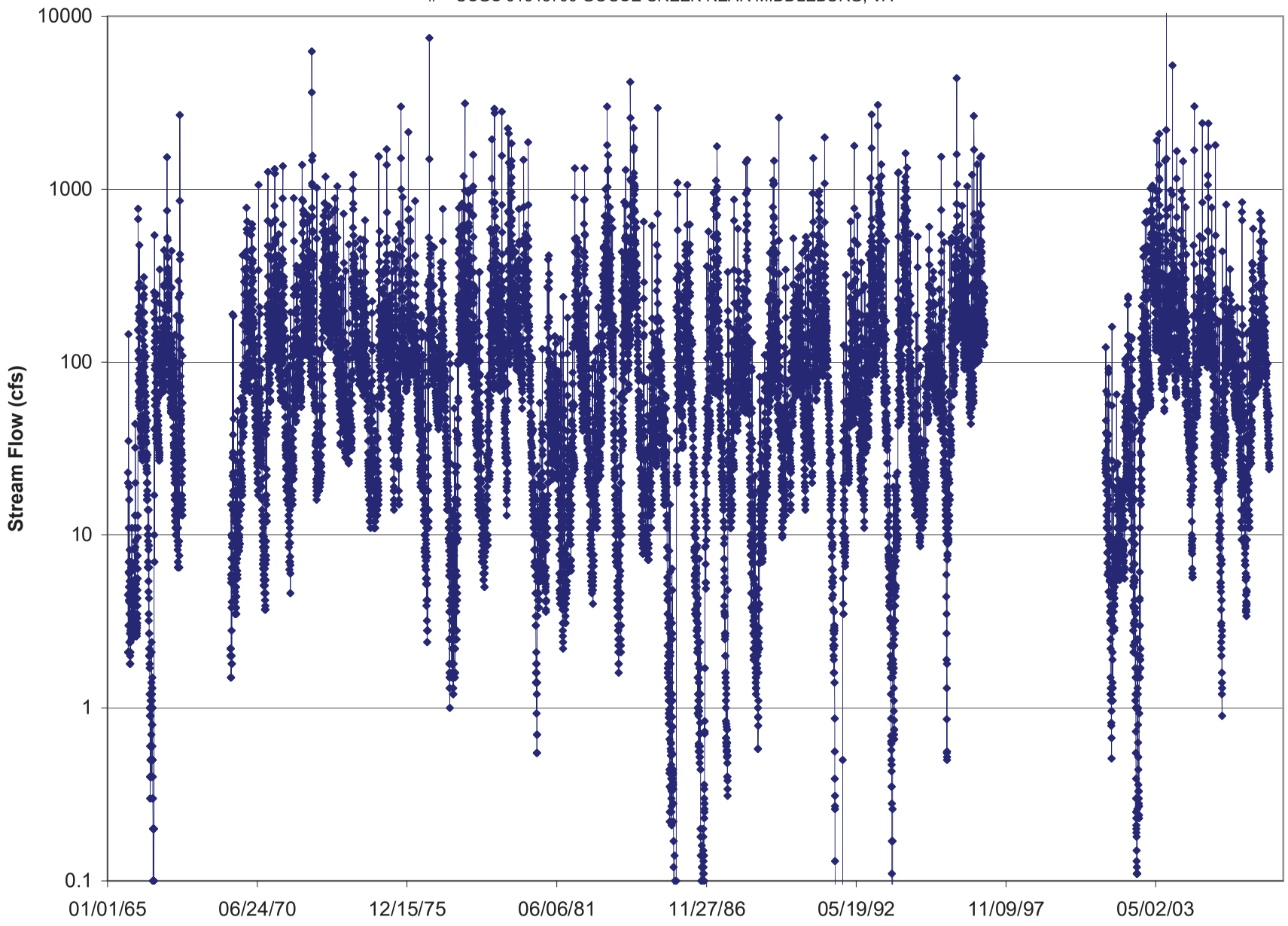
USGS Stream Flow



Cht_Beaver

31-Aug-07

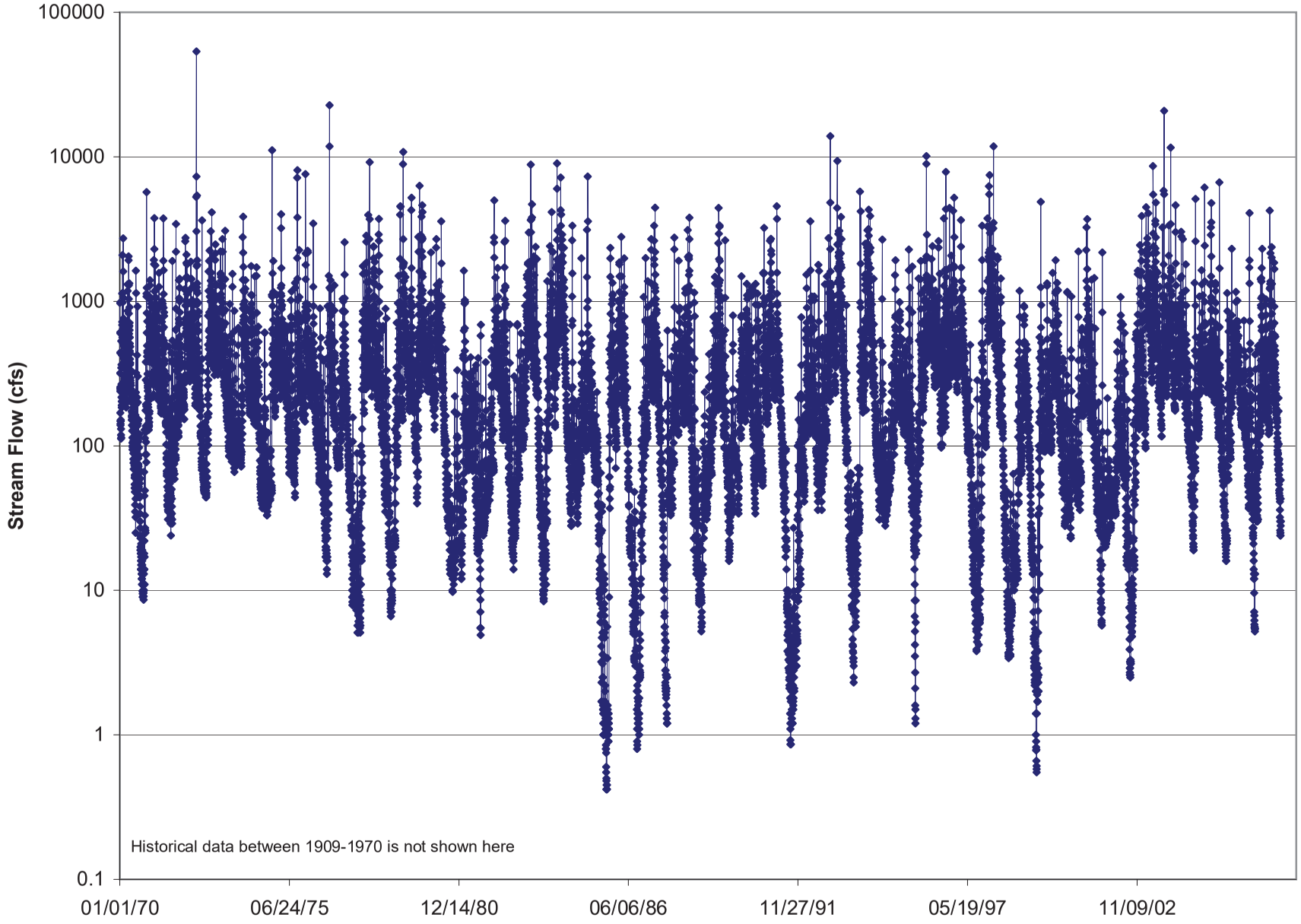
USGS Stream Flow



Cht_GC_Middle

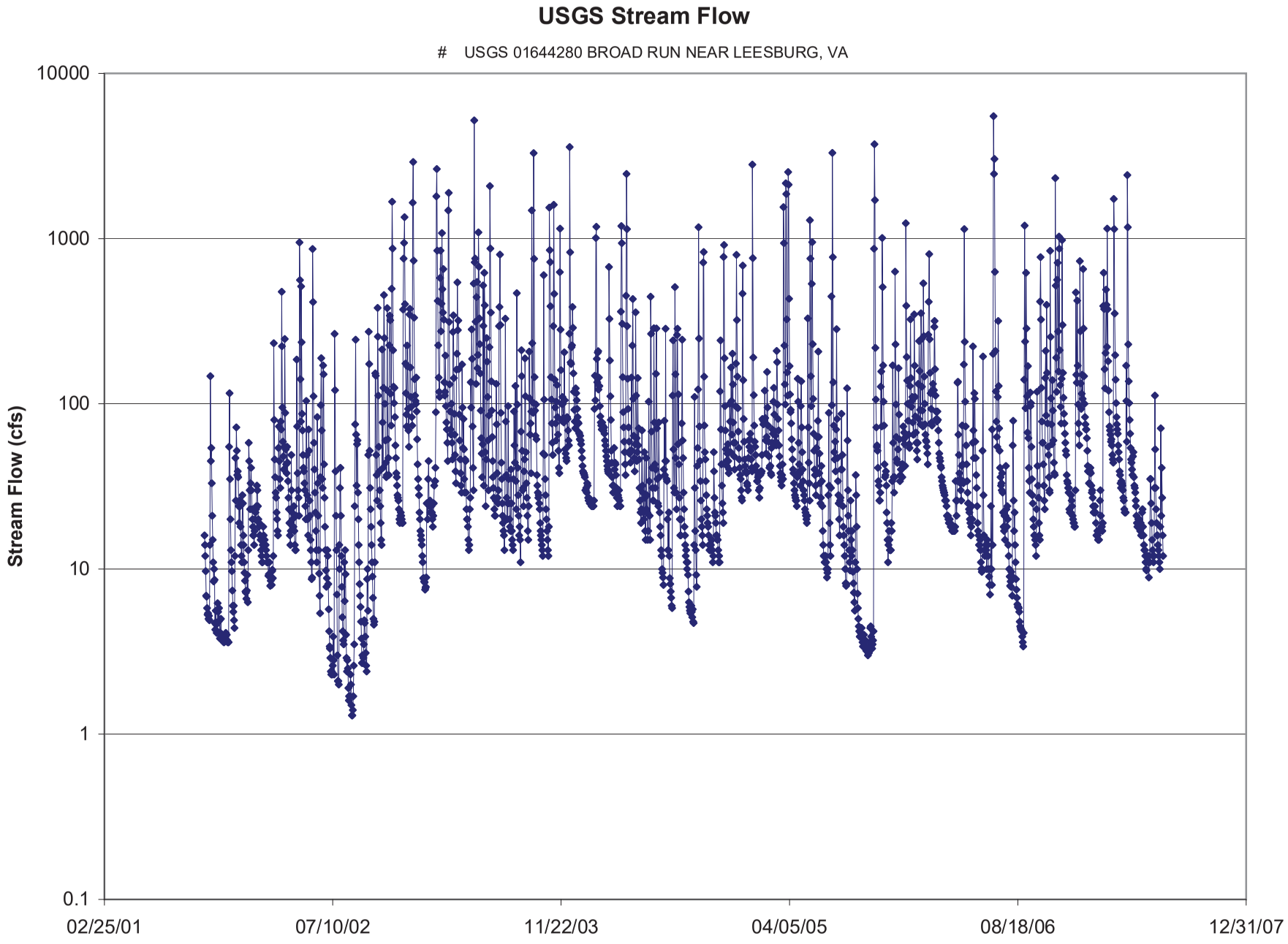
31-Aug-07

USGS Stream Flow



Cht_GC_Lee

31-Aug-07



Cht_BR

Water Resources National Water Information System: Web Interface

Data Category: Surface Water | Geographic Area: Virginia | GO

USGS Surface-Water Annual Statistics for Virginia

The statistics generated from this site are based on approved daily-mean data and may not match those published by the USGS in official publications. The user is responsible for assessment and use of statistics from this site. For more details on why the statistics may not match, click here.

USGS 01636690 PINEY RUN NEAR LOVETTSVILLE, VA

Loudoun County, Virginia Hydrologic Unit Code 02070008 Latitude 39°18'39.0", Longitude 77°43'06.6" NAD83 Drainage area 13.5 square miles Gage datum 396.78 feet above sea level NAVD88	**Output formats** HTML table of all data Tab-separated data Reselect output format

Water Year	00060, Discharge, cubic feet per second (Calculation Period: 2002-10-01 -> 2006-09-30) Calculation period restricted by USGS staff due to special conditions at/near site
2002	2.42
2003	25.6
2004	23.8
2005	15.8
2006	9.36

** No Incomplete Data is used for Statistical Calculation

USGS 01638350 S F CATOCTIN CREEK AT RT 698 NEAR WATERFORD, VA

Loudoun County, Virginia Hydrologic Unit Code 02070008 Latitude 39°11'28.0", Longitude 77°36'55.6" NAD83 Drainage area 31.6 square miles Gage datum 335.84 feet above sea level NAVD88	**Output formats** HTML table of all data Tab-separated data Reselect output format

Water Year	00060, Discharge, cubic feet per second (Calculation Period: 2002-10-01 -> 2006-09-30) Calculation period restricted by USGS staff due to special conditions at/near site
2002	10.4
2003	72.9
2004	52.6
2005	35.3
2006	25.8
** No Incomplete Data is used for Statistical Calculation	

USGS 01638420 N F CATOCTIN CREEK AT RT 681 NEAR WATERFORD, VA

Loudoun County, Virginia Hydrologic Unit Code 02070008 Latitude 39°12'18.0", Longitude 77°37'26.0" NAD83 Drainage area 23.1 square miles Gage datum 325.21 feet above sea level NAVD88	**Output formats** HTML table of all data Tab-separated data Reselect output format

Water Year	00060, Discharge, cubic feet per second (Calculation Period: 2002-10-01 -> 2006-09-30) Calculation period restricted by USGS staff due to special conditions at/near site
2002	3.69
2003	47.5

2004	38.1
2005	24.9
2006	17.0
** No Incomplete Data is used for Statistical Calculation	

USGS 01638480 CATOCTIN CREEK AT TAYLORSTOWN, VA

Loudoun County, Virginia Hydrologic Unit Code 02070008 Latitude 39°15'16", Longitude 77°34'36" NAD27 Drainage area 89.5 square miles Gage datum 247.37 feet above sea level NGVD29	**Output formats** HTML table of all data Tab-separated data Reselect output format

Water Year	00060, Discharge, cubic feet per second (Calculation Period: 1972-10-01 -> 2006-09-30) Calculation period restricted by USGS staff due to special conditions at/near site
1972	196.2
1973	133.3
1974	63.8
1975	109.8
1976	84.0
1977	87.3
1978	126.9
1979	132.3
1980	119.2
1981	34.6
1982	77.2
1983	116.2

1984	167.7
1985	51.5
1986	56.9
1987	118.9
1988	101.9
1989	84.5
1990	58.8
1991	78.4
1992	48.7
1993	143.9
1994	125.8
1995	53.7
1996	166.8
1997	111.3
1998	162.6
1999	30.9
2000	66.6
2001	59.7
2002	20.9
2003	206.8
2004	164.6
2005	104.5
2006	68.5
** No Incomplete Data is used for Statistical Calculation	

USGS 01643590 LIMESTONE BRANCH NEAR LEESBURG, VA

Loudoun County, Virginia	**Output formats**

Hydrologic Unit Code 02070008 Latitude 39°10'03.4", Longitude 77°32'09.3" NAD83 Drainage area 7.88 square miles Gage datum 219.97 feet above sea level NAVD88	HTML table of all data Tab-separated data Reselect output format

Water Year	00060, Discharge, cubic feet per second (Calculation Period: 2002-10-01 -> 2006-09-30) Calculation period restricted by USGS staff due to special conditions at/near site
2002	2.48
2003	19.2
2004	13.7
2005	10.4
2006	5.87
** No Incomplete Data is used for Statistical Calculation	

USGS 01643700 GOOSE CREEK NEAR MIDDLEBURG, VA

	Output formats
Loudoun County, Virginia Hydrologic Unit Code 02070008 Latitude 38°59'11", Longitude 77°47'49" NAD27 Drainage area 122 square miles Gage datum 329.80 feet above sea level NGVD29	HTML table of all data Tab-separated data Reselect output format

Water Year	00060, Discharge, cubic feet per second (Calculation Period: 1966-10-01 -> 2006-09-30) Calculation period restricted by USGS staff due to special conditions at/near site
1966	42.8
1967	109.9
1970	103.9

1971	150.1
1972	208.4
1973	193.7
1974	126.7
1975	153.5
1976	118.3
1977	110.7
1978	183.7
1979	201.1
1980	190.7
1981	36.5
1982	107.6
1983	155.7
1984	227.7
1985	49.8
1986	92.1
1987	107.0
1988	101.7
1989	99.7
1990	96.6
1991	133.6
1992	75.9
1993	215.4
1994	150.0
1995	83.8
1996	219.4
2002	20.8
2003	301.4

2004	197.4
2005	155.1
2006	80.5
** No Incomplete Data is used for Statistical Calculation	

USGS 01643805 N F GOOSE CREEK AT RT 729 NEAR LINCOLN, VA

Loudoun County, Virginia Hydrologic Unit Code 02070008 Latitude 39°04'20.3", Longitude 77°41'02.2" NAD83 Drainage area 38.1 square miles Gage datum 300 feet above sea level NGVD29	**Output formats** HTML table of all data Tab-separated data Reselect output format

Water Year	00060, Discharge, cubic feet per second (Calculation Period: 2002-10-01 -> 2006-09-30) Calculation period restricted by USGS staff due to special conditions at/near site
2002	15.1
2003	110.8
2004	85.6
2005	55.1
2006	38.2
** No Incomplete Data is used for Statistical Calculation	

USGS 01643880 BEAVERDAM CREEK AT RT 734 NEAR MOUNTVILLE, VA

Loudoun County, Virginia Hydrologic Unit Code 02070008 Latitude 39°02'15.8", Longitude 77°43'20.1" NAD83 Drainage area 47.2 square miles Gage datum 307.03 feet above sea level NAVD88	**Output formats** HTML table of all data Tab-separated data

Reselect output format

Water Year	00060, Discharge, cubic feet per second (Calculation Period: 2002-10-01 -> 2006-09-30) Calculation period restricted by USGS staff due to special conditions at/near site
2002	10.2
2003	129.3
2004	70.8
2005	54.8
2006	32.5
** No Incomplete Data is used for Statistical Calculation	

USGS 01644000 GOOSE CREEK NEAR LEESBURG, VA

Loudoun County, Virginia
Hydrologic Unit Code 02070008
Latitude 39°01'10", Longitude 77°34'40" NAD27
Drainage area 332 square miles
Gage datum 248.93 feet above sea level NGVD29

Output formats

HTML table of all data
Tab-separated data
Reselect output format

Water Year	00060, Discharge, cubic feet per second (Calculation Period: 1910-10-01 -> 2006-09-30) Calculation period restricted by USGS staff due to special conditions at/near site
1910	229.1
1912	530.3
1931	55.2
1932	205.7
1933	513.0

1934	179.4
1935	349.6
1936	357.2
1937	468.7
1938	308.4
1939	265.2
1940	247.3
1941	223.8
1942	180.5
1943	501.0
1944	161.9
1945	347.5
1946	364.4
1947	174.6
1948	282.6
1949	460.6
1950	268.6
1951	463.7
1952	394.0
1953	407.6
1954	119.0
1955	263.9
1956	308.5
1957	260.4
1958	412.8
1959	129.9
1960	285.0
1961	331.6

1962	184.6
1963	188.7
1964	307.4
1965	271.0
1966	125.4
1967	283.7
1968	296.4
1969	148.9
1970	258.1
1971	386.5
1972	663.7
1973	511.0
1974	311.9
1975	430.9
1976	318.9
1977	305.3
1978	466.3
1979	516.5
1980	452.7
1981	109.6
1982	289.6
1983	419.9
1984	623.1
1985	162.8
1986	256.9
1987	286.0
1988	297.2
1989	268.3

1990	254.1
1991	333.6
1992	191.4
1993	579.4
1994	439.9
1995	207.8
1996	617.5
1997	417.7
1998	567.3
1999	121.5
2000	247.4
2001	231.4
2002	80.0
2003	811.5
2004	526.5
2005	404.2
2006	248.0
** No Incomplete Data is used for Statistical Calculation	

USGS 01644280 BROAD RUN NEAR LEESBURG, VA

Loudoun County, Virginia Hydrologic Unit Code 02070008 Latitude 39°02'47.1", Longitude 77°25'56.6" NAD83 Drainage area 76.1 square miles Gage datum 193.65 feet above sea level NAVD88	**Output formats** HTML table of all data Tab-separated data Reselect output format

Water Year	00060, Discharge, cubic feet per second (Calculation Period: 2002-10-01 -> 2006-09-30)

	Calculation period restricted by USGS staff due to special conditions at/near site
2002	37.9
2003	203.9
2004	131.4
2005	121.6
2006	129.1
** No Incomplete Data is used for Statistical Calculation	

Questions about sites/data?
Feedback on this web site
Top
Explanation of terms

Surface Water data for Virginia: USGS Surface-Water Annual Statistics
http://waterdata.usgs.gov/va/nwis/annual?

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Department of the Interior, U.S. Geological Survey
USGS Water Resources of Virginia
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12.18 11.12 nadww01

USGS 01636690 PINEY RUN NEAR LOVETTSVILLE, VA

Water Year	Discharge, cubic feet per second
2002	2.42
2003	25.6
2004	23.8
2005	15.8
2006	9.36

USGS 01638350 S F CATOCTIN CREEK AT RT 698 NEAR WATERFORD, VA

Water Year	Discharge, cubic feet per second
2002	10.4
2003	72.9
2004	52.6
2005	35.3
2006	25.8

USGS 01638420 N F CATOCTIN CREEK AT RT 681 NEAR WATERFORD, VA

Water Year	Discharge, cubic feet per second
2002	3.69
2003	47.5
2004	38.1
2005	24.9
2006	17

USGS 01638480 CATOCTIN CREEK AT TAYLORSTOWN, VA

Water Year	Discharge, cubic feet per second
1972	196.2
1973	133.3
1974	63.8
1975	109.8
1976	84
1977	87.3
1978	126.9
1979	132.3
1980	119.2
1981	34.6
1982	77.2
1983	116.2
1984	167.7
1985	51.5
1986	56.9
1987	118.9
1988	101.9
1989	84.5
1990	58.8

1991	78.4
1992	48.7
1993	143.9
1994	125.8
1995	53.7
1996	166.8
1997	111.3
1998	162.6
1999	30.9
2000	66.6
2001	59.7
2002	20.9
2003	206.8
2004	164.6
2005	104.5
2006	68.5

USGS 01643590 LIMESTONE BRANCH NEAR LEESBURG, VA

Water Year	Discharge, cubic feet per second
2002	2.48
2003	19.2
2004	13.7
2005	10.4
2006	5.87

USGS 01643700 GOOSE CREEK NEAR MIDDLEBURG, VA

Water Year	Discharge, cubic feet per second
1966	42.8
1967	109.9
1970	103.9
1971	150.1
1972	208.4
1973	193.7
1974	126.7
1975	153.5
1976	118.3
1977	110.7
1978	183.7
1979	201.1
1980	190.7
1981	36.5
1982	107.6
1983	155.7
1984	227.7
1985	49.8
1986	92.1
1987	107
1988	101.7

1989	99.7
1990	96.6
1991	133.6
1992	75.9
1993	215.4
1994	150
1995	83.8
1996	219.4
2002	20.8
2003	301.4
2004	197.4
2005	155.1
2006	80.5

USGS 01643805 N F GOOSE CREEK AT RT 729 NEAR LINCOLN, VA

Water Year	Discharge, cubic feet per second
2002	15.1
2003	110.8
2004	85.6
2005	55.1
2006	38.2

USGS 01643880 BEAVERDAM CREEK AT RT 734 NEAR MOUNTVILLE, VA

Water Year	Discharge, cubic feet per second
2002	10.2
2003	129.3
2004	70.8
2005	54.8
2006	32.5

USGS 01644000 GOOSE CREEK NEAR LEESBURG, VA

Water Year	Discharge, cubic feet per second
1910	229.1
1912	530.3
1931	55.2
1932	205.7
1933	513
1934	179.4
1935	349.6
1936	357.2
1937	468.7
1938	308.4
1939	265.2
1940	247.3
1941	223.8
1942	180.5

Mean Annual

1943	501
1944	161.9
1945	347.5
1946	364.4
1947	174.6
1948	282.6
1949	460.6
1950	268.6
1951	463.7
1952	394
1953	407.6
1954	119
1955	263.9
1956	308.5
1957	260.4
1958	412.8
1959	129.9
1960	285
1961	331.6
1962	184.6
1963	188.7
1964	307.4
1965	271
1966	125.4
1967	283.7
1968	296.4
1969	148.9
1970	258.1
1971	386.5
1972	663.7
1973	511
1974	311.9
1975	430.9
1976	318.9
1977	305.3
1978	466.3
1979	516.5
1980	452.7
1981	109.6
1982	289.6
1983	419.9
1984	623.1
1985	162.8
1986	256.9
1987	286
1988	297.2
1989	268.3
1990	254.1
1991	333.6
1992	191.4
1993	579.4
1994	439.9

Mean Annual

1995	207.8
1996	617.5
1997	417.7
1998	567.3
1999	121.5
2000	247.4
2001	231.4
2002	80
2003	811.5
2004	526.5
2005	404.2
2006	248

USGS 01644280 BROAD RUN NEAR LEESBURG, VA

Water Year	Discharge, cubic feet per second
2002	37.9
2003	203.9
2004	131.4
2005	121.6
2006	129.1

The above data maybe refreshed using
http://nwis.waterdata.usgs.gov/va/nwis/annual/?referred_module=sw&site_no=01636690&por_01636690_2=188986,00060,2,2002,2006&site_no=01638350&por_01638350_2=1955020,00060,2,2002,2006&site_no=01638420&por_01638420_2=1955021,00060,2,2002,2006&site_no=01638480&por_01638480_1=188988,00060,1,1971,2006&site_no=01643590&por_01643590_2=188990,00060,2,2002,2006&site_no=01643700&por_01643700_1=188994,00060,1,1966,2006&site_no=01643805&por_01643805_2=1955022,00060,2,2002,2006&site_no=01643880&por_01643880_2=1955023,00060,2,2002,2006&site_no=01644000&por_01644000_2=189001,00060,2,1910,2006&site_no=01644280&por_01644280_2=189017,00060,2,2002,2006&year_type=W&format=html_table&date_format=YYYY-MM-DD&rdb_compression=file&submitted_form=parameter_selection_list

Mean Annual Streamflow Statistics



G:\BLDG_DEV\Engineering\H2O Team\WRMP\USGSFlowData\web_query_all_dates_flow_only\USGS_Mean_Annual_Statistics.xls Annual_chart

Streamflow Duration Plots

Streamflow-duration plots, which depict the flow-duration curves of daily-streamflow data grouped by months, are posted by the US Geological Survey for all streamflow gages in Virginia. Flow-duration plots are used to place current streamflow conditions in context of historic flow-conditions. Combined with other information such as ground-water levels, precipitation, and soil moisture, flow-duration plots can help local government agencies and water-resource managers assess regional drought conditions.

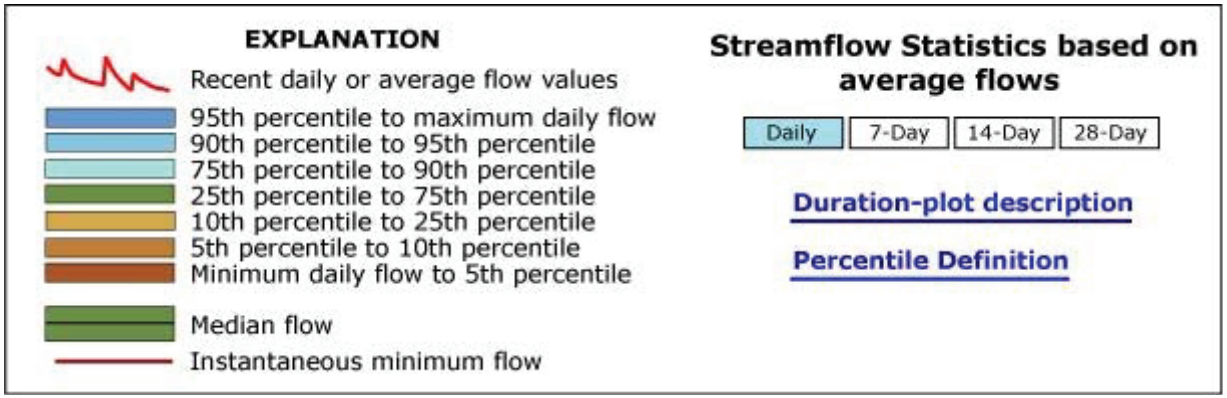
Currently available plots include statistics of daily streamflow data and the current daily streamflow data. Additional plots based on 7-day, 14-day, and 28-day running averages of the streamflow data are planned.

The following table are the ten stations in Loudoun County.

Station	Location
1636690	PINEY RUN NEAR LOVETTSVILLE, VA
1638350	S F CATOCTIN CREEK AT RT 698 NEAR WATERFORD, VA
1638420	N F CATOCTIN CREEK AT RT 681 NEAR WATERFORD, VA
1638480	CATOCTIN CREEK AT TAYLORSTOWN, VA
1643590	LIMESTONE BRANCH NEAR LEESBURG, VA
1643700	GOOSE CREEK NEAR MIDDLEBURG, VA
1643805	N F GOOSE CREEK AT RT 729 NEAR LINCOLN, VA
1643880	BEAVERDAM CREEK AT RT 734 NEAR MOUNTVILLE, VA
1644000	GOOSE CREEK NEAR LEESBURG, VA
1644280	BROAD RUN NEAR LEESBURG, VA

Tin review of the statictics, most of the stations only have a few years of data, therefore only the ‘daily” statictics are presented here. For complete data, the reader is referred to http://va.water.usgs.gov/duration_plots/dp_map_potomac.htm

For each of the ten stations, the following key applies for each chart:


EXPLANATION
Recent daily or average flow values
95th percentile to maximum daily flow
90th percentile to 95th percentile
75th percentile to 90th percentile
25th percentile to 75th percentile
10th percentile to 25th percentile
5th percentile to 10th percentile
Minimum daily flow to 5th percentile
Median flow
Instantaneous minimum flow
Streamflow Statistics based on average flows
Daily
7-Day
14-Day
28-Day
Duration-plot description
Percentile Definition

Duration Plot and Table of Daily Streamflow

01636690 PINEY RUN NEAR LOVETTSVILLE, VA

LOCATION.--Latitude 39°18'39.0", Longitude 77°43'06.6", North American Datum of 1983, Loudoun County, VA, Hydrologic Unit 02070008.

DRAINAGE AREA.--13.5 square miles.

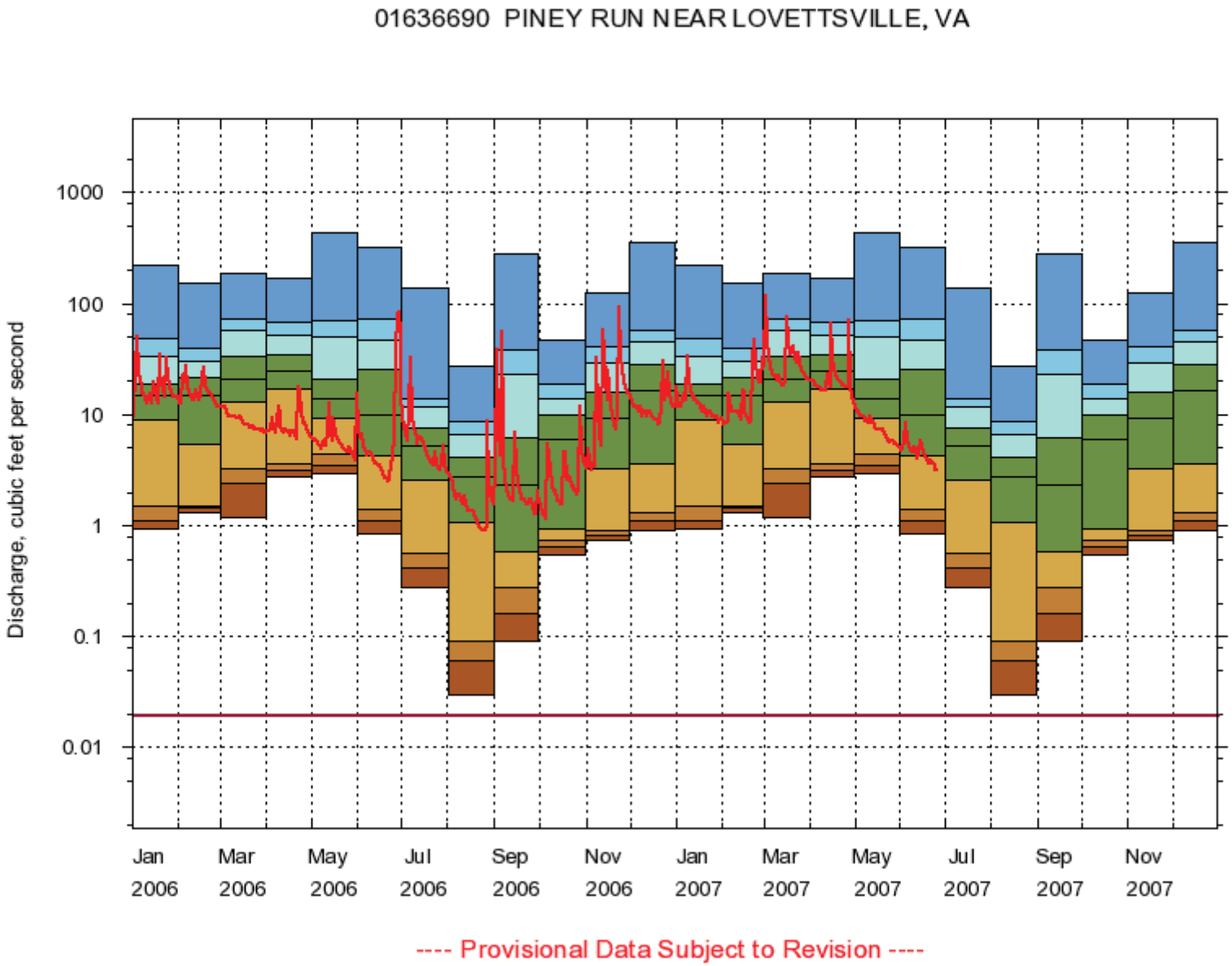
PERIOD OF RECORD.--October 2001 to current year.

DURATION STATISTIC COMPUTATION PERIOD.--All data through September 2005.

REGULATION.--No known regulation.

GAGE OPERATION.--U.S. Geological Survey, Virginia Water Science Center.

Duration Plot with Daily Streamflow Conditions



Duration Table of Daily Streamflow

Flow values in cubic feet per second

01636690 PINEY RUN NEAR LOVETTSVILLE, VA

	Minimum daily flow	5th percentile	10th percentile	25th percentile	Median	75th percentile	90th percentile	95th percentile	Maximum daily flow		Years of record
January	0.95	1.12	1.50	8.90	15.0	19.0	33.8	48.0	219		4
February	1.30	1.46	1.52	5.50	15.0	22.0	30.0	39.2	151		3
March	1.20	2.42	3.30	13.0	21.0	33.0	57.7	73.8	185		4
April	2.80	3.20	3.60	16.8	24.5	35.0	52.0	68.6	169		4
May	3.00	3.52	4.43	9.42	14.0	21.0	49.5	70.6	436		4
June	0.84	1.10	1.39	4.30	10.0	25.2	46.6	73.2	327		4
July	0.28	0.41	0.56	2.58	5.30	7.72	11.7	14.0	140		4
August	0.03	0.06	0.09	1.08	2.80	4.20	6.62	8.78	27.0		4
September	0.09	0.16	0.28	0.58	2.30	6.25	23.1	38.0	281		4
October	0.54	0.64	0.73	0.95	6.00	10.0	14.0	18.8	47.0		4
November	0.75	0.82	0.90	3.30	9.45	16.0	29.1	41.0	126		4
December	0.92	1.10	1.33	3.65	16.5	28.2	45.4	57.4	352		4

Instantaneous minimum flow for period of record = 0.02 cubic feet per second

Duration Plot and Table of Daily Streamflow

01638350 SOUTH FORK CATOCTIN CREEK AT ROUTE 698 NEAR WATERFORD, VA

LOCATION.--Latitude 39°11'28.0", Longitude 77°36'55.6", North American Datum of 1983,
Loudoun County, VA, Hydrologic Unit 02070008.

DRAINAGE AREA.--31.6 square miles.

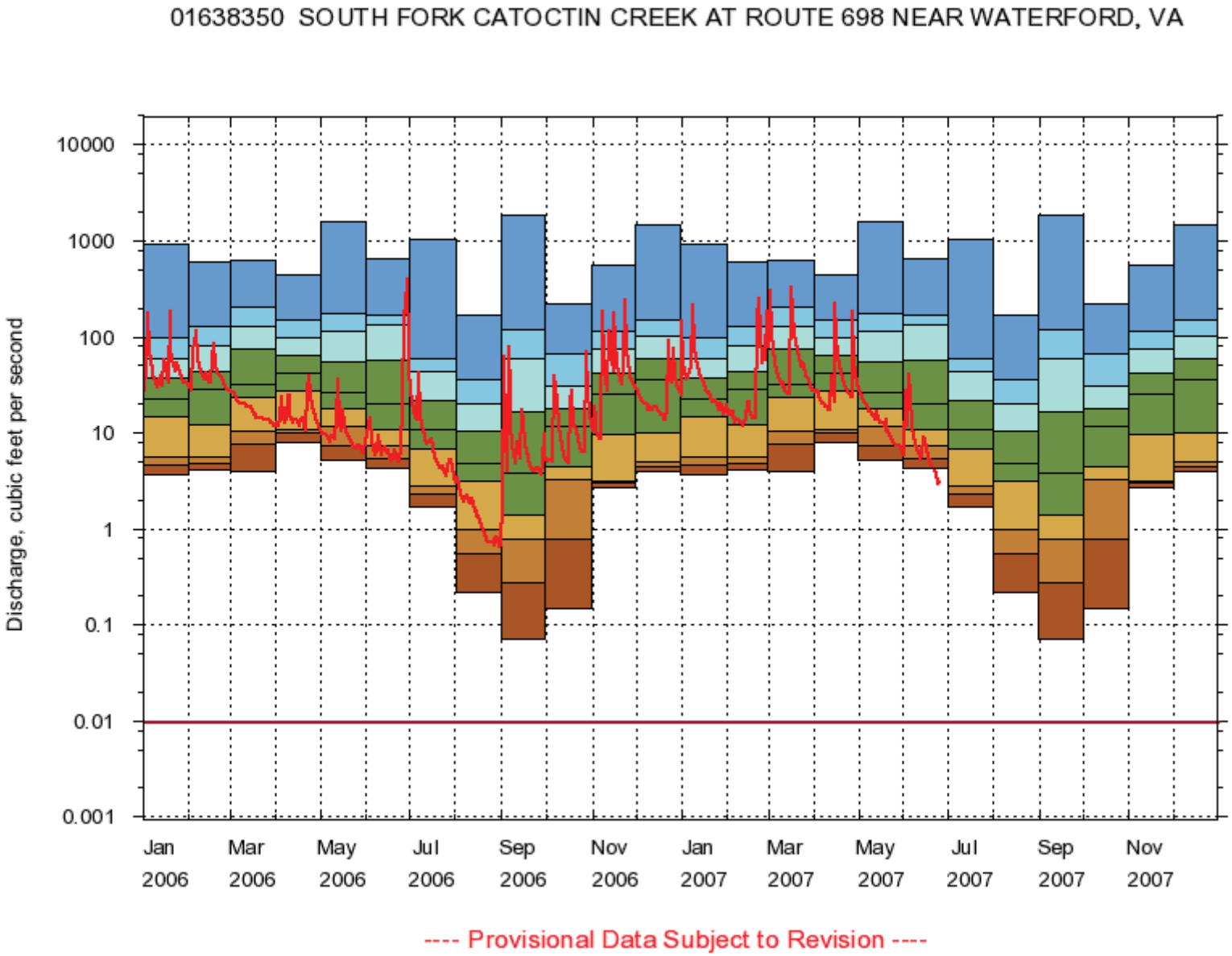
PERIOD OF RECORD.--July 2001 to current year.

DURATION STATISTIC COMPUTATION PERIOD.--All data through September 2005.

REGULATION.--No known regulation.

GAGE OPERATION.--U.S. Geological Survey, Virginia Water Science Center.

Duration Plot with Daily Streamflow Conditions



Duration Table of Daily Streamflow

Flow values in cubic feet per second

01638350 SOUTH FORK CATOCTIN CREEK AT ROUTE 698 NEAR WATERFORD, VA

	Minimum daily flow	5th percentile	10th percentile	25th percentile	Median	75th percentile	90th percentile	95th percentile	Maximum daily flow		Years of record
January	3.70	4.63	5.66	15.0	22.5	37.2	58.5	99.8	939		4
February	4.10	4.90	5.60	12.0	29.0	43.0	82.2	129	607		3
March	4.00	7.72	10.3	23.8	32.5	74.8	129	207	638		4
April	8.10	10.0	11.0	27.0	41.5	63.5	96.6	150	440		4
May	5.20	7.30	11.6	17.8	26.5	54.0	115	174	1,560		4
June	4.30	5.50	7.30	10.8	20.0	58.2	136	168	665		4
July	1.70	2.30	2.84	6.80	11.0	22.0	43.6	58.6	1,050		5
August	0.22	0.55	0.98	3.10	4.80	10.5	20.0	35.5	166		5
September	0.07	0.28	0.78	1.40	3.80	16.8	60.2	118	1,840		5
October	0.15	0.77	3.33	4.38	11.5	18.2	30.7	65.8	221		4
November	2.70	3.00	3.10	9.52	25.5	42.2	75.2	113	550		4
December	4.00	4.43	4.93	10.0	36.0	60.0	101	148	1,450		4

Instantaneous minimum flow for period of record = 0.01 cubic feet per second

Duration Plot and Table of Daily Streamflow

01638420 NORTH FORK CATOCTIN CREEK AT ROUTE 681 NEAR WATERFORD, VA

LOCATION.--Latitude 39°12'18.0", Longitude 77°37'26.0", North American Datum of 1983,
Loudoun County, VA, Hydrologic Unit 02070008.

DRAINAGE AREA.--23.1 square miles.

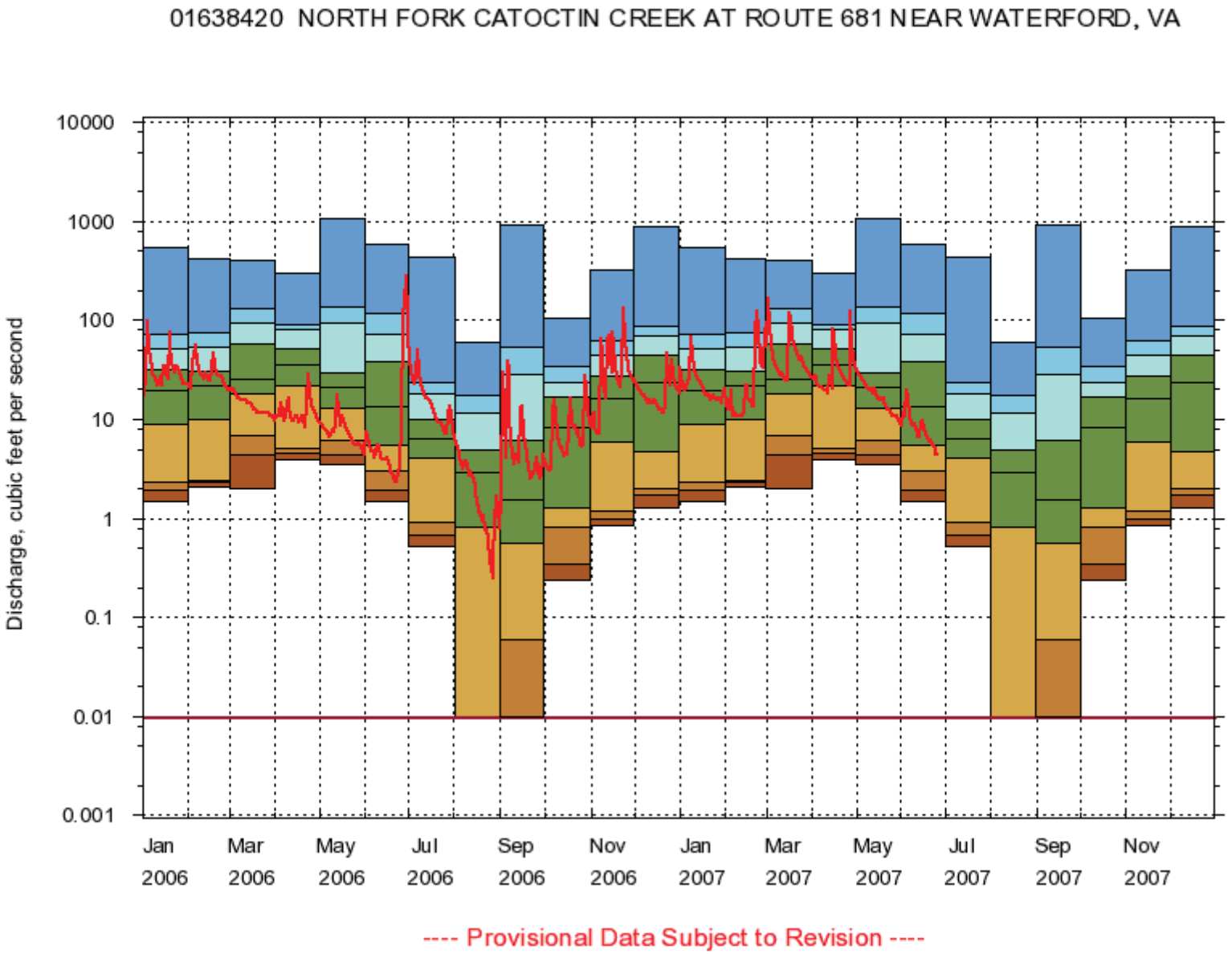
PERIOD OF RECORD.--July 2001 to current year.

DURATION STATISTIC COMPUTATION PERIOD.--All data through September 2005.

REGULATION.--No known regulation.

GAGE OPERATION.--U.S. Geological Survey, Virginia Water Science Center.

Duration Plot with Daily Streamflow Conditions



Duration Table of Daily Streamflow

Flow values in cubic feet per second

01638420 NORTH FORK CATOCTIN CREEK AT ROUTE 681 NEAR WATERFORD, VA

	Minimum daily flow	5th percentile	10th percentile	25th percentile	Median	75th percentile	90th percentile	95th percentile	Maximum daily flow		Years of record
January	1.50	1.90	2.30	9.02	19.5	32.0	51.9	71.8	542		4
February	2.10	2.30	2.40	10.0	22.0	31.0	52.8	76.4	418		3
March	2.00	4.34	6.93	18.0	25.0	57.2	95.4	133	407		4
April	3.90	4.60	5.10	21.8	36.0	51.0	81.0	91.1	300		4
May	3.50	4.38	6.25	13.0	21.0	30.0	92.8	136	1,060		4
June	1.50	1.90	2.99	5.42	13.5	37.8	73.3	116	587		4
July	0.52	0.69	0.92	4.08	6.35	10.0	18.5	24.0	429		4
August	0.00	0.00	0.00	0.82	2.90	4.85	11.6	17.3	61.0		5
September	0.00	0.00	0.06	0.56	1.55	6.10	28.5	53.6	933		5
October	0.24	0.35	0.81	1.30	8.25	17.0	23.7	34.2	105		4
November	0.86	0.99	1.19	5.82	16.0	27.0	44.3	62.6	325		4
December	1.30	1.72	2.00	4.65	23.5	44.0	70.9	87.1	897		4

Instantaneous minimum flow for period of record = 0.00 cubic feet per second
Flow values of 0.00 are plotted as 0.01

Duration Plot and Table of Daily Streamflow

01638480 CATOCTIN CREEK AT TAYLORSTOWN, VA

LOCATION.--Latitude 39°15'16", Longitude 77°34'36", North American Datum of 1927, Loudoun County, VA, Hydrologic Unit 02070008.

DRAINAGE AREA.--89.5 mi2.

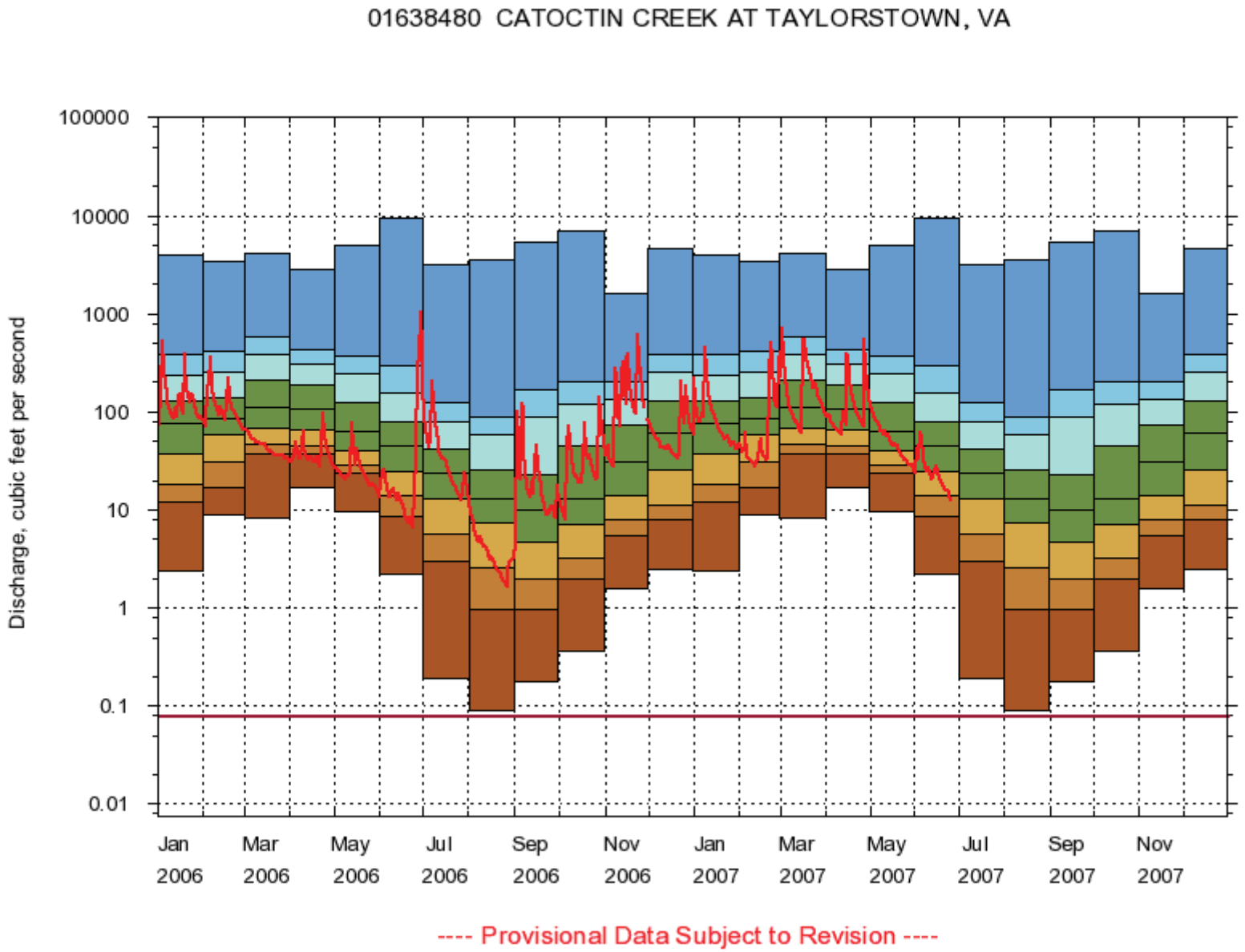
PERIOD OF RECORD.--August 1971 to current year.

DURATION STATISTIC COMPUTATION PERIOD.--All data through September 2005.

REGULATION.--No known regulation.

GAGE OPERATION.--Virginia Department of Environmental Quality - Water Division.

Duration Plot with Daily Streamflow Conditions



Duration Table of Daily Streamflow

Flow values in cubic feet per second

01638480 CATOCTIN CREEK AT TAYLORSTOWN, VA

	Minimum daily flow	5th percentile	10th percentile	25th percentile	Median	75th percentile	90th percentile	95th percentile	Maximum daily flow		Years of record
January	2.40	12.0	18.0	38.0	77.0	127	239	384	4,050		35
February	8.90	17.0	31.0	58.0	85.0	140	256	417	3,400		32
March	8.40	38.0	46.3	68.0	113	209	379	574	4,160		35
April	17.0	37.0	45.9	65.8	108	185	311	428	2,810		34
May	9.50	23.6	28.3	40.0	64.0	124	244	375	5,030		35
June	2.20	8.70	14.0	25.0	45.0	78.0	158	292	9,530		34
July	0.19	2.96	5.73	13.0	24.0	42.0	79.7	126	3,190		35
August	0.09	0.98	2.54	7.40	13.0	26.0	59.0	90.0	3,500		36
September	0.18	0.96	2.00	4.70	9.90	23.0	89.0	169	5,400		35
October	0.36	1.97	3.24	7.10	13.0	45.0	121	205	7,040		35
November	1.60	5.50	8.10	14.0	30.5	74.2	135	200	1,620		34
December	2.50	7.90	11.0	25.2	61.0	127	255	384	4,580		35

Instantaneous minimum flow for period of record = 0.08 cubic feet per second

Duration Plot and Table of Daily Streamflow

01643590 LIMESTONE BRANCH NEAR LEESBURG, VA

LOCATION.--Latitude 39°10'03.4", Longitude 77°32'09.3", North American Datum of 1983, Loudoun County, VA, Hydrologic Unit 02070008.

DRAINAGE AREA.--7.88 square miles.

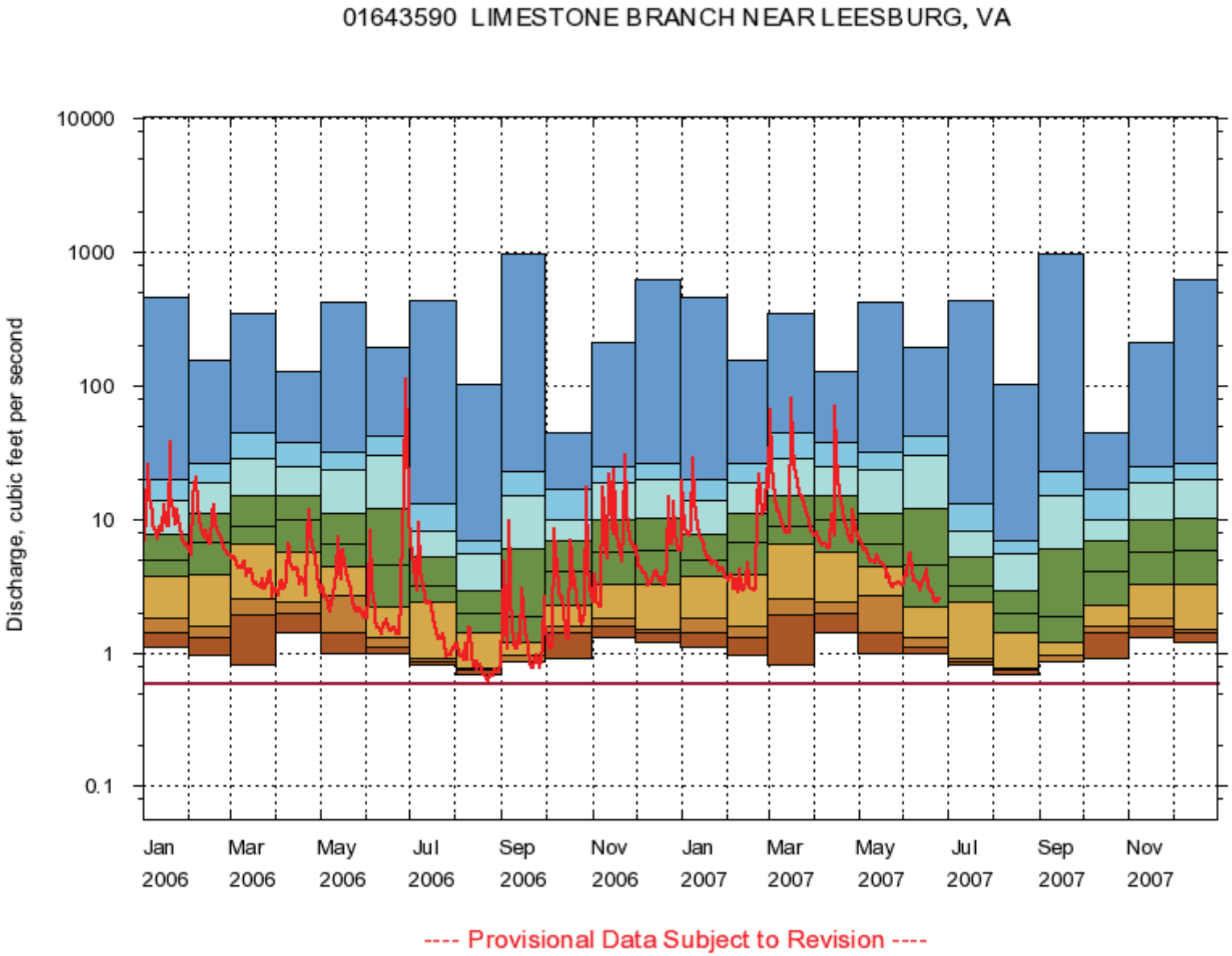
PERIOD OF RECORD.--August 2001 to current year.

DURATION STATISTIC COMPUTATION PERIOD.--All data through September 2005.

REGULATION.--No known regulation.

GAGE OPERATION.--U.S. Geological Survey, Virginia Water Science Center.

Duration Plot with Daily Streamflow Conditions



Duration Table of Daily Streamflow

Flow values in cubic feet per second

01643590 LIMESTONE BRANCH NEAR LEESBURG, VA

	Minimum daily flow	5th percentile	10th percentile	25th percentile	Median	75th percentile	90th percentile	95th percentile	Maximum daily flow		Years of record
January	1.10	1.43	1.80	3.78	5.00	7.70	13.7	19.8	459		4
February	0.97	1.30	1.60	3.90	6.70	11.0	18.8	26.2	158		3
March	0.81	1.92	2.53	6.50	8.80	15.2	28.8	44.0	347		4
April	1.40	2.00	2.40	5.70	10.0	15.0	25.1	37.4	128		4
May	1.00	1.40	2.69	4.38	6.50	11.0	23.7	32.4	424		4
June	0.98	1.10	1.30	2.20	4.55	12.0	30.1	42.2	195		4
July	0.82	0.86	0.91	2.40	3.15	5.22	8.14	13.0	440		4
August	0.68	0.75	0.77	1.40	2.00	2.90	5.50	6.90	102		4
September	0.85	0.87	0.96	1.20	1.90	6.05	15.0	23.0	976		5
October	0.90	1.40	1.60	2.30	4.10	7.00	9.85	16.8	44.0		4
November	1.30	1.60	1.80	3.25	5.70	10.0	19.0	25.2	210		4
December	1.20	1.42	1.50	3.28	5.90	10.2	19.7	26.6	633		4

Instantaneous minimum flow for period of record = 0.60 cubic feet per second

Duration Plot and Table of Daily Streamflow

01643700 GOOSE CREEK NEAR MIDDLEBURG, VA

LOCATION.--Latitude 38°59'11", Longitude 77°47'49", North American Datum of 1927,
Loudoun County, VA, Hydrologic Unit 02070008.

DRAINAGE AREA.--122 square miles.

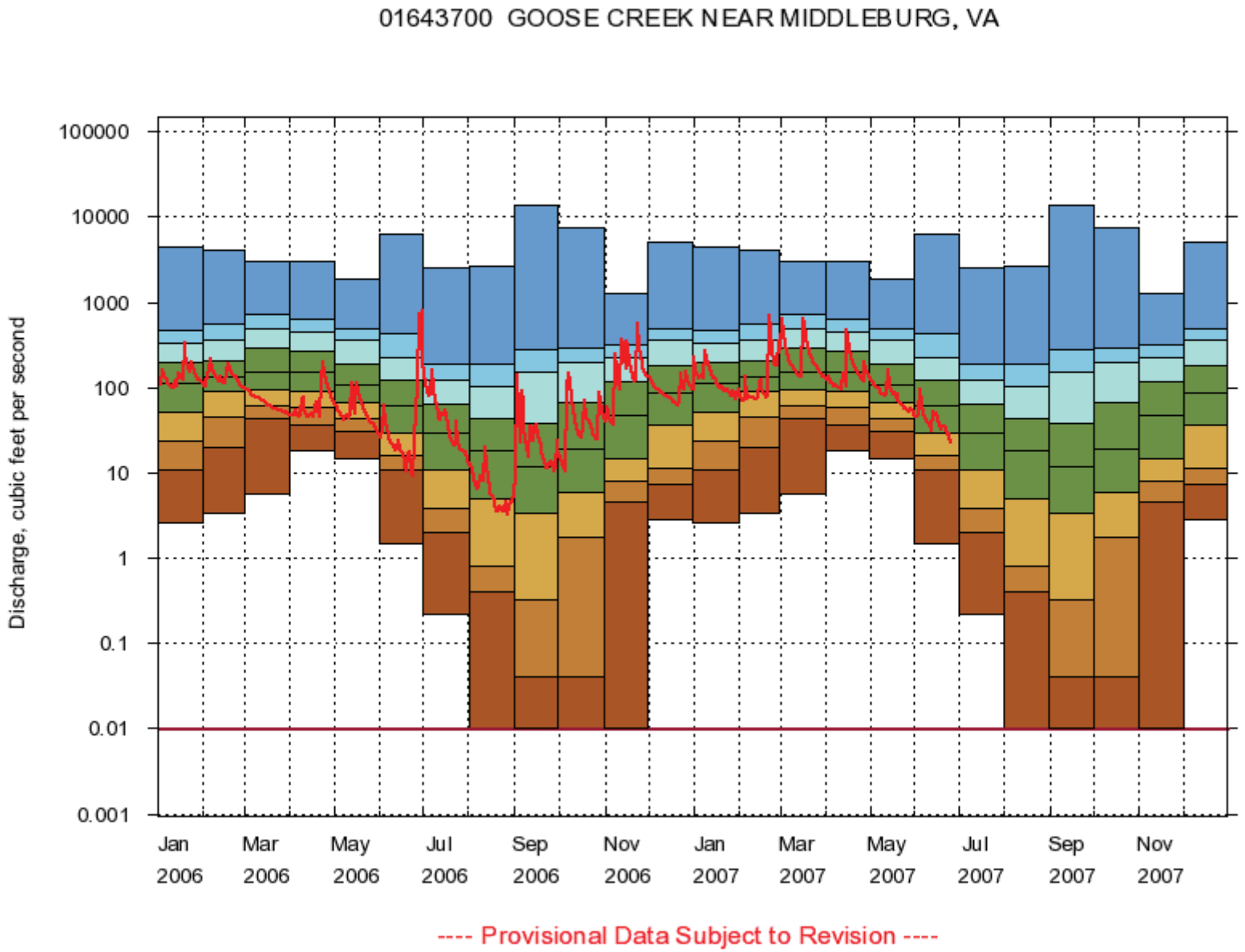
PERIOD OF RECORD.--October 1965 to September 1967, July 1969 to September 1996, June 2001 to current year.

DURATION STATISTIC COMPUTATION PERIOD.--All data through September 2005.

REGULATION.--No known regulation.

GAGE OPERATION.--U.S. Geological Survey, Virginia Water Science Center.

Duration Plot with Daily Streamflow Conditions



Duration Table of Daily Streamflow

Flow values in cubic feet per second

01643700 GOOSE CREEK NEAR MIDDLEBURG, VA

	Minimum daily flow	5th percentile	10th percentile	25th percentile	Median	75th percentile	90th percentile	95th percentile	Maximum daily flow	Years of record
January	2.60	11.0	24.0	51.0	112	200	338	466	4,380	35
February	3.30	20.0	45.1	90.0	133	202	360	570	4,160	31
March	5.60	43.0	61.0	95.0	155	288	491	732	3,070	34
April	18.0	36.0	57.8	90.0	154	270	452	640	3,000	33
May	15.0	31.0	43.2	66.0	109	189	356	490	1,910	34
June	1.50	11.0	16.0	29.0	62.0	122	221	434	6,270	33
July	0.22	2.00	3.80	11.0	29.0	64.0	123	190	2,590	36
August	0.01	0.40	0.80	4.90	18.0	43.0	103	187	2,680	36
September	0.00	0.04	0.33	3.40	12.0	38.0	154	282	14,000	35
October	0.00	0.04	1.73	6.00	19.0	67.8	201	292	7,500	35
November	0.00	4.57	7.99	15.0	46.5	119	223	322	1,260	34
December	2.80	7.50	11.3	36.0	87.0	180	358	495	5,190	35

Instantaneous minimum flow for period of record = 0.00 cubic feet per second
Flow values of 0.00 are plotted as 0.01

Duration Plot and Table of Daily Streamflow

01643805 NORTH FORK GOOSE CREEK AT ROUTE 729 NEAR LINCOLN, VA

LOCATION.--Latitude 39°04'20.3", Longitude 77°41'02.2", North American Datum of 1983,
Loudoun County, VA, Hydrologic Unit 02070008.

DRAINAGE AREA.--38.1 square miles.

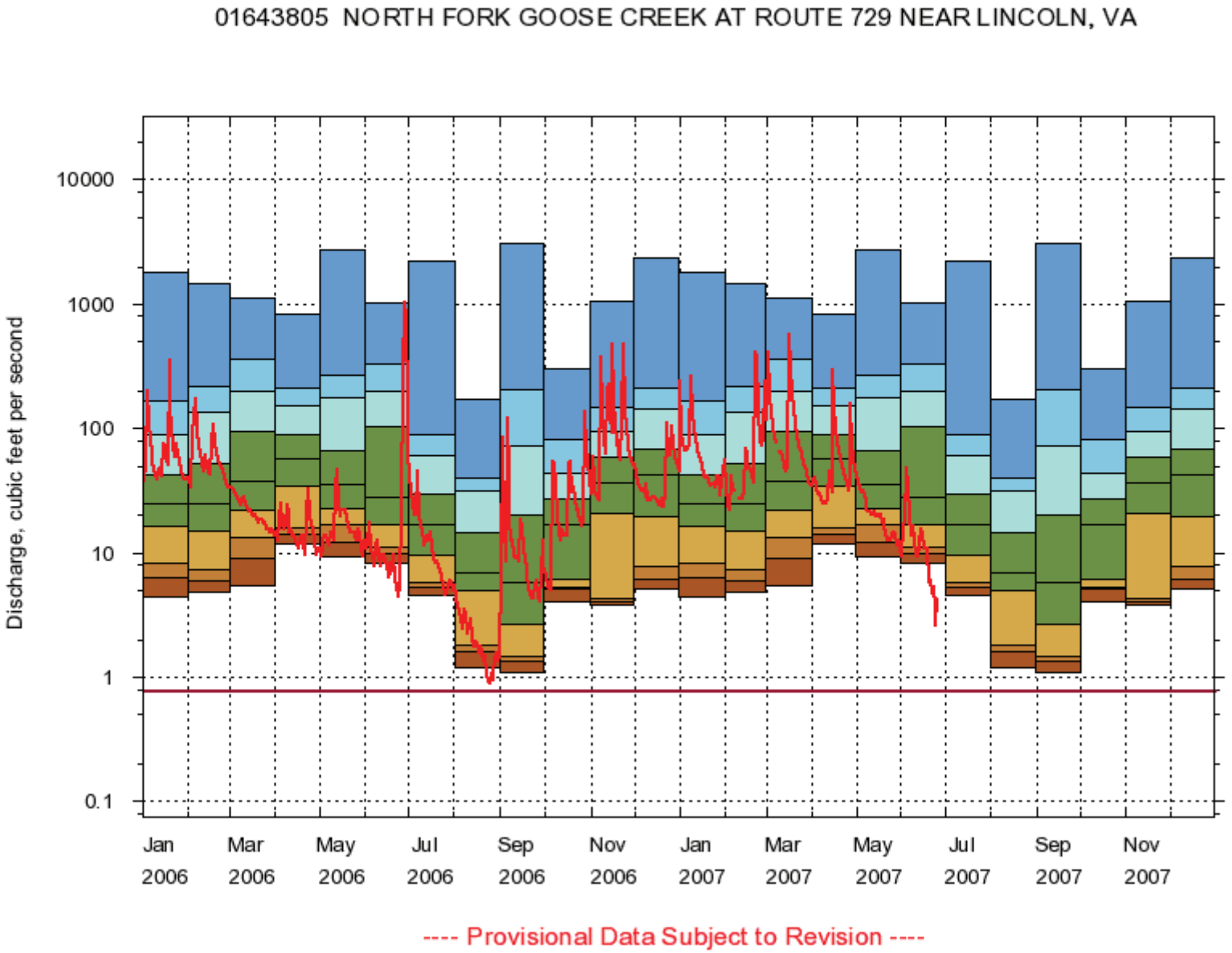
PERIOD OF RECORD.--July 2001 to current year.

DURATION STATISTIC COMPUTATION PERIOD.--All data through September 2005.

REGULATION.--No known regulation.

GAGE OPERATION.--U.S. Geological Survey, Virginia Water Science Center.

Duration Plot with Daily Streamflow Conditions



Duration Table of Daily Streamflow

Flow values in cubic feet per second

01643805 NORTH FORK GOOSE CREEK AT ROUTE 729 NEAR LINCOLN, VA

	Minimum daily flow	5th percentile	10th percentile	25th percentile	Median	75th percentile	90th percentile	95th percentile	Maximum daily flow		Years of record
January	4.40	6.26	8.16	16.2	25.0	42.0	89.4	169	1,830		4
February	4.90	5.92	7.32	15.0	25.0	52.0	134	218	1,450		3
March	5.40	9.08	13.3	22.0	38.0	95.8	200	363	1,110		4
April	12.0	14.0	16.0	34.8	57.5	90.2	154	212	839		4
May	9.30	12.3	17.0	23.0	36.0	65.5	175	271	2,750		4
June	8.30	10.0	11.0	17.0	28.0	103	202	328	1,030		4
July	4.60	5.26	5.86	9.60	17.0	30.0	60.8	88.2	2,220		4
August	1.20	1.60	1.84	4.95	7.00	14.5	31.2	40.0	174		5
September	1.10	1.34	1.49	2.70	5.85	20.0	72.9	206	3,040		5
October	4.10	5.10	5.23	6.10	17.0	27.0	43.4	83.0	301		4
November	3.80	4.10	4.30	20.8	37.0	59.5	93.5	150	1,050		4
December	5.10	6.13	7.70	19.5	43.0	68.5	144	212	2,370		4

Instantaneous minimum flow for period of record = 0.80 cubic feet per second

Duration Plot and Table of Daily Streamflow

01643880 BEAVERDAM CREEK AT ROUTE 734 NEAR MOUNTVILLE, VA

LOCATION.--Latitude 39°02'15.8", Longitude 77°43'20.1", North American Datum of 1983,
Loudoun County, VA, Hydrologic Unit 02070008.

DRAINAGE AREA.--47.2 square miles.

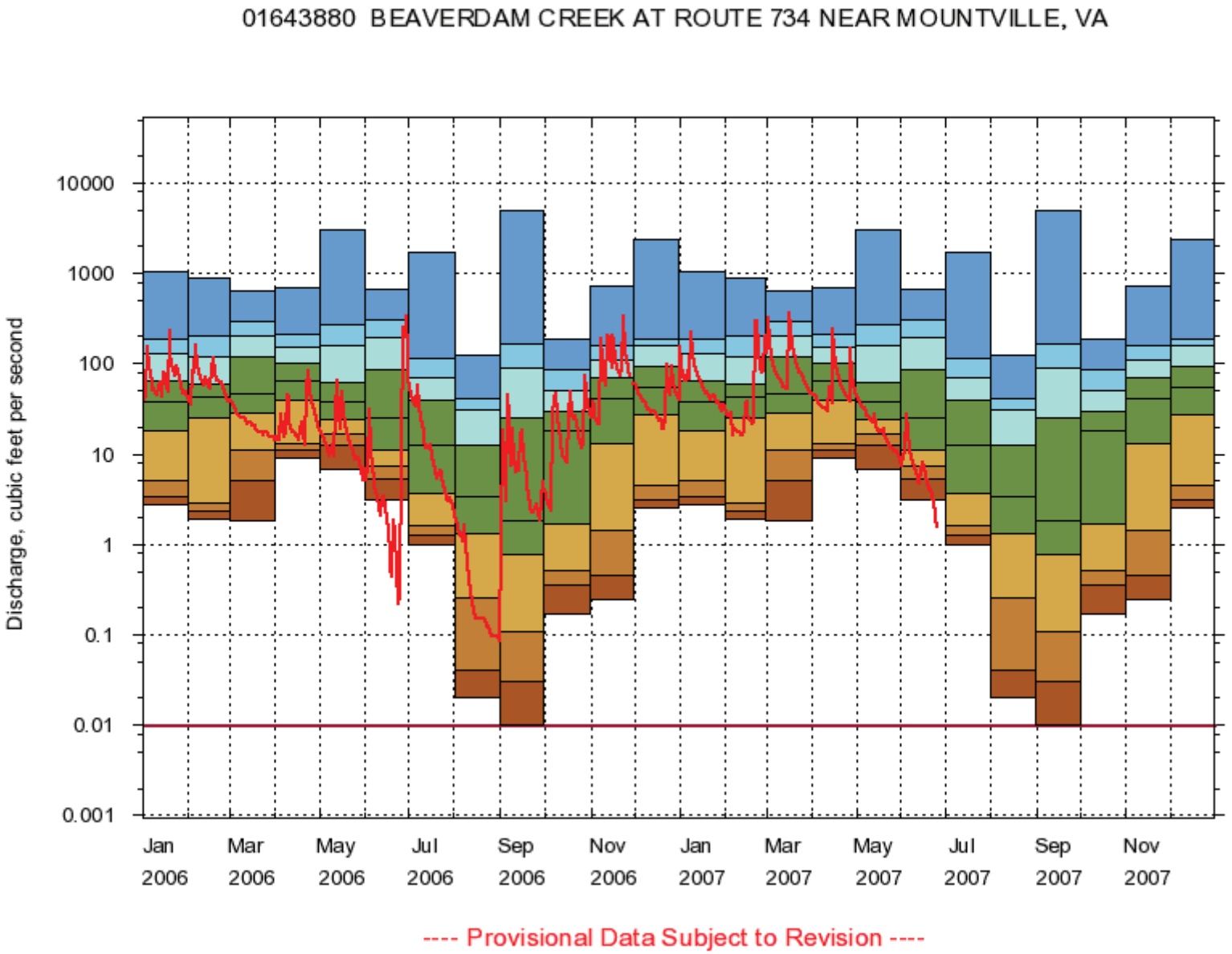
PERIOD OF RECORD.--July 2001 to current year.

DURATION STATISTIC COMPUTATION PERIOD.--All data through September 2005.

REGULATION.--No known regulation.

GAGE OPERATION.--U.S. Geological Survey, Virginia Water Science Center.

Duration Plot with Daily Streamflow Conditions



Duration Table of Daily Streamflow

Flow values in cubic feet per second

01643880 BEAVERDAM CREEK AT ROUTE 734 NEAR MOUNTVILLE, VA

	Minimum daily flow	5th percentile	10th percentile	25th percentile	Median	75th percentile	90th percentile	95th percentile	Maximum daily flow		Years of record
January	2.80	3.40	5.13	18.0	37.5	64.0	130	188	1,030		4
February	1.90	2.36	2.82	25.0	43.0	59.0	118	204	873		3
March	1.80	5.16	10.9	28.0	46.0	118	199	298	649		4
April	9.00	11.0	12.9	39.0	64.0	102	153	211	705		4
May	6.80	12.3	17.0	23.8	38.5	63.2	162	269	3,060		4
June	3.10	5.30	7.45	11.0	25.0	87.2	197	311	672		4
July	1.00	1.28	1.60	3.62	12.5	40.0	70.9	115	1,710		4
August	0.02	0.04	0.26	1.30	3.40	12.5	31.0	41.9	126		5
September	0.00	0.03	0.11	0.76	1.80	25.5	90.0	168	5,000		5
October	0.17	0.35	0.51	1.68	18.5	30.0	50.7	84.6	185		4
November	0.25	0.46	1.41	13.0	41.5	70.8	108	158	726		4
December	2.50	3.06	4.46	26.8	54.0	93.5	161	186	2,330		4

Instantaneous minimum flow for period of record = 0.00 cubic feet per second
Flow values of 0.00 are plotted as 0.01

Duration Plot and Table of Daily Streamflow

01644000 GOOSE CREEK NEAR LEESBURG, VA

LOCATION.--Latitude 39°01'10", Longitude 77°34'40", North American Datum of 1927,
Loudoun County, VA, Hydrologic Unit 02070008.

DRAINAGE AREA.--332 square miles.

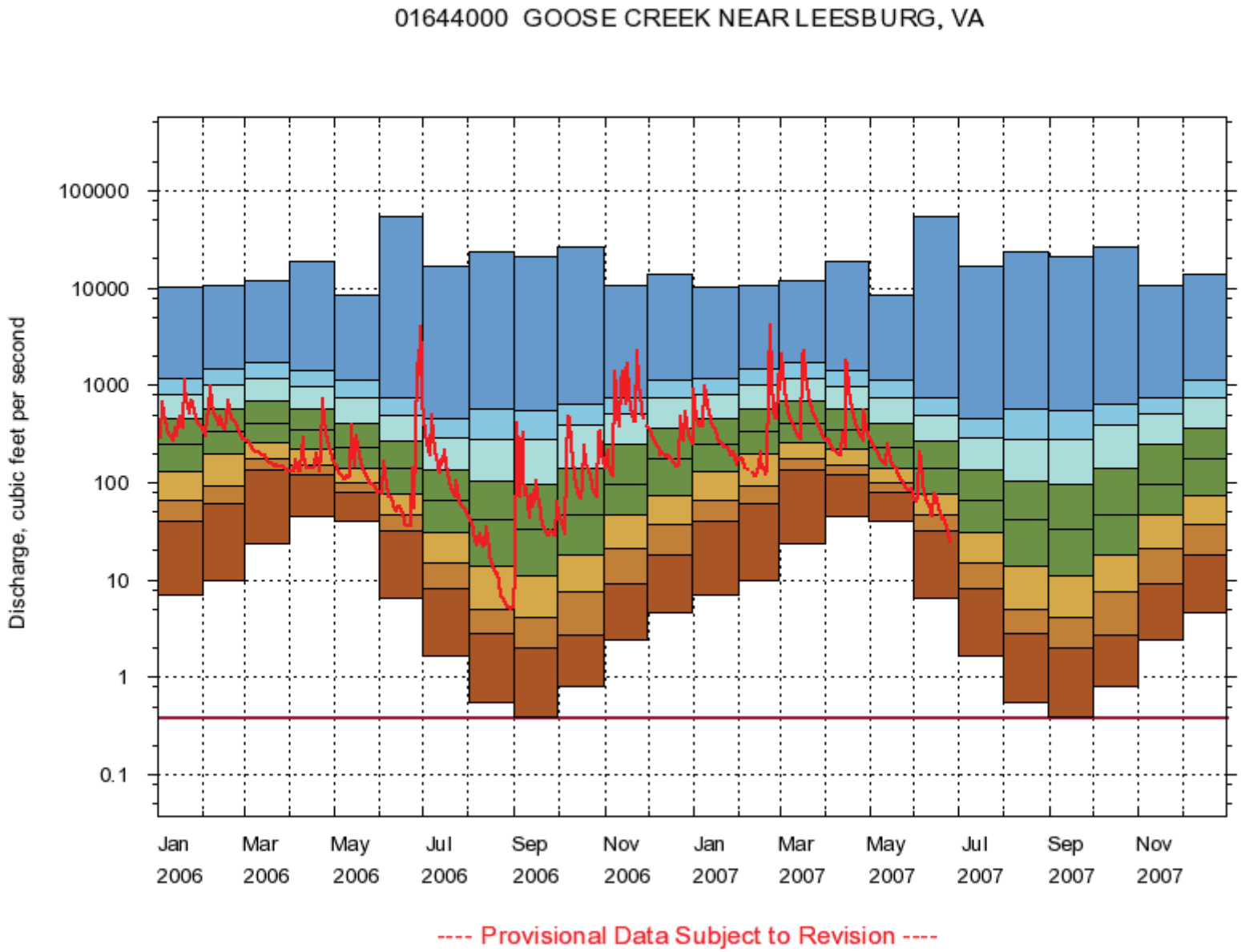
PERIOD OF RECORD.--July 1909 to April 1911, September 1911 to December 1912, January 1930 to current year.

DURATION STATISTIC COMPUTATION PERIOD.--All data through September 2005.

REGULATION.--No known regulation.

GAGE OPERATION.--Virginia Department of Environmental Quality - Water Division.

Duration Plot with Daily Streamflow Conditions



Duration Table of Daily Streamflow

Flow values in cubic feet per second

01644000 GOOSE CREEK NEAR LEESBURG, VA

	Minimum daily flow	5th percentile	10th percentile	25th percentile	Median	75th percentile	90th percentile	95th percentile	Maximum daily flow		Years of record
January	7.00	40.0	65.0	130	250	460	822	1,200	10,100		81
February	10.0	60.6	93.1	200	333	576	1,020	1,490	10,800		74
March	24.0	135	178	259	415	700	1,160	1,700	11,800		81
April	46.0	120	150	221	355	580	979	1,420	19,000		79
May	40.0	80.0	101	143	234	410	744	1,150	8,610		80
June	6.60	32.0	46.9	77.0	141	266	496	754	53,600		78
July	1.70	8.28	15.0	31.0	67.0	136	291	454	17,000		81
August	0.55	2.80	5.10	14.0	42.0	103	279	571	24,000		81
September	0.40	2.00	4.20	11.0	33.0	95.0	284	558	20,800		80
October	0.80	2.70	7.58	18.0	47.0	139	388	653	26,100		81
November	2.40	9.32	21.0	47.2	95.0	247	513	751	10,700		79
December	4.60	18.0	37.8	73.0	177	370	749	1,150	13,900		81

Instantaneous minimum flow for period of record = 0.40 cubic feet per second

Duration Plot and Table of Daily Streamflow

01644280 BROAD RUN NEAR LEESBURG, VA

LOCATION.--Latitude 39°02'47.1", Longitude 77°25'56.6", North American Datum of 1983, Loudoun County, VA, Hydrologic Unit 02070008.

DRAINAGE AREA.--76.1 square miles.

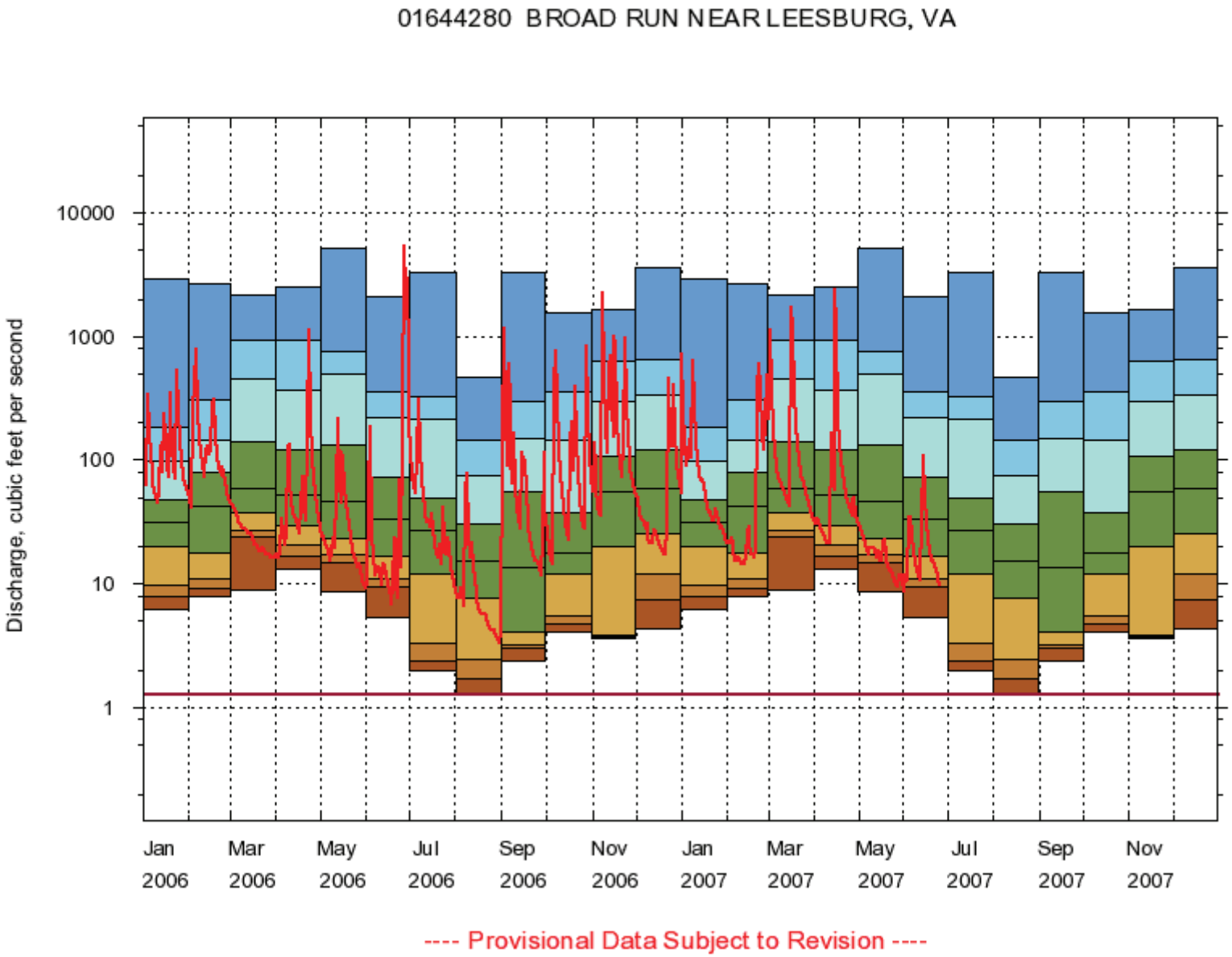
PERIOD OF RECORD.--October 2001 to current year.

DURATION STATISTIC COMPUTATION PERIOD.--All data through September 2005.

REGULATION.--No known regulation.

GAGE OPERATION.--U.S. Geological Survey, Virginia Water Science Center.

Duration Plot with Daily Streamflow Conditions



Duration Table of Daily Streamflow

Flow values in cubic feet per second

01644280 BROAD RUN NEAR LEESBURG, VA

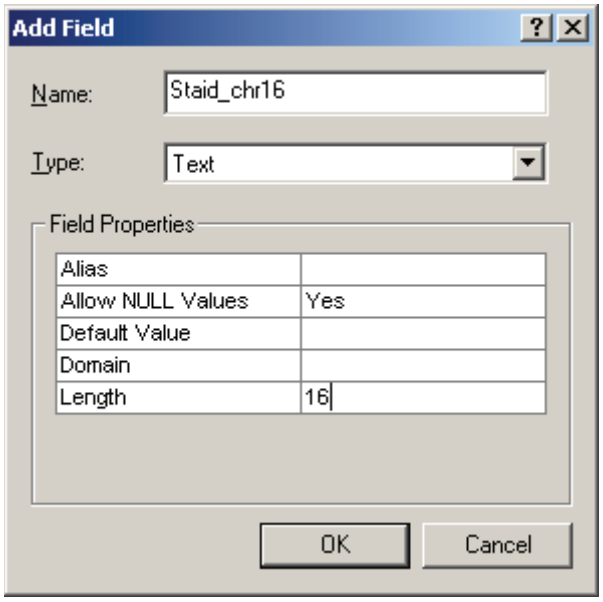
	Minimum daily flow	5th percentile	10th percentile	25th percentile	Median	75th percentile	90th percentile	95th percentile	Maximum daily flow		Years of record
January	6.30	7.88	9.74	20.0	31.0	47.5	97.0	184	2,910		4
February	7.90	9.22	11.0	18.0	42.0	80.0	147	304	2,640		3
March	8.80	24.0	27.0	37.8	59.0	140	455	924	2,160		4
April	13.0	17.0	20.9	30.0	52.0	121	368	938	2,530		4
May	8.70	15.0	17.3	23.0	46.5	133	492	750	5,200		4
June	5.40	9.38	10.9	17.0	33.0	72.5	223	359	2,080		4
July	2.00	2.40	3.33	12.0	27.0	49.5	215	324	3,300		4
August	1.30	1.70	2.43	7.75	15.5	30.2	75.7	144	467		4
September	2.40	3.00	3.20	4.08	13.5	54.8	149	295	3,290		4
October	4.10	4.82	5.46	12.0	18.0	37.5	146	362	1,540		4
November	3.60	3.70	3.90	19.8	55.5	107	298	633	1,670		4
December	4.40	7.56	12.0	25.8	58.5	120	339	653	3,580		4

Instantaneous minimum flow for period of record = 1.30 cubic feet per second

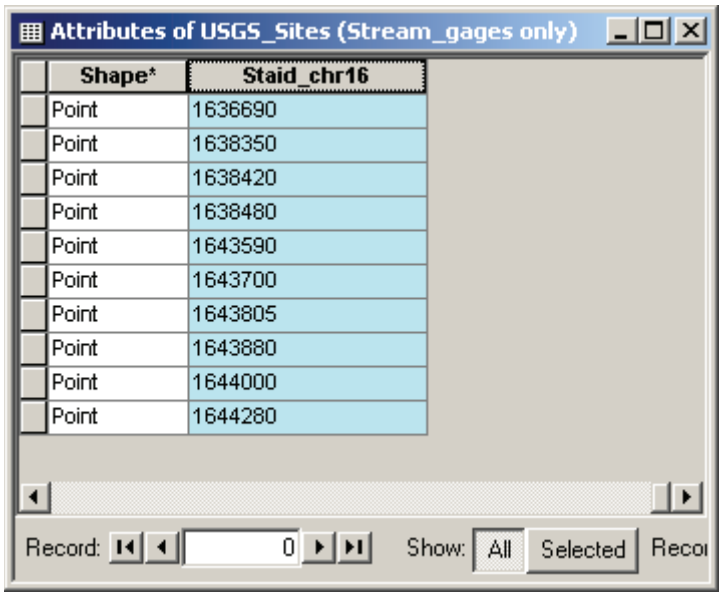
Relating USGS Streamflow Data

David Ward
December 21, 2006

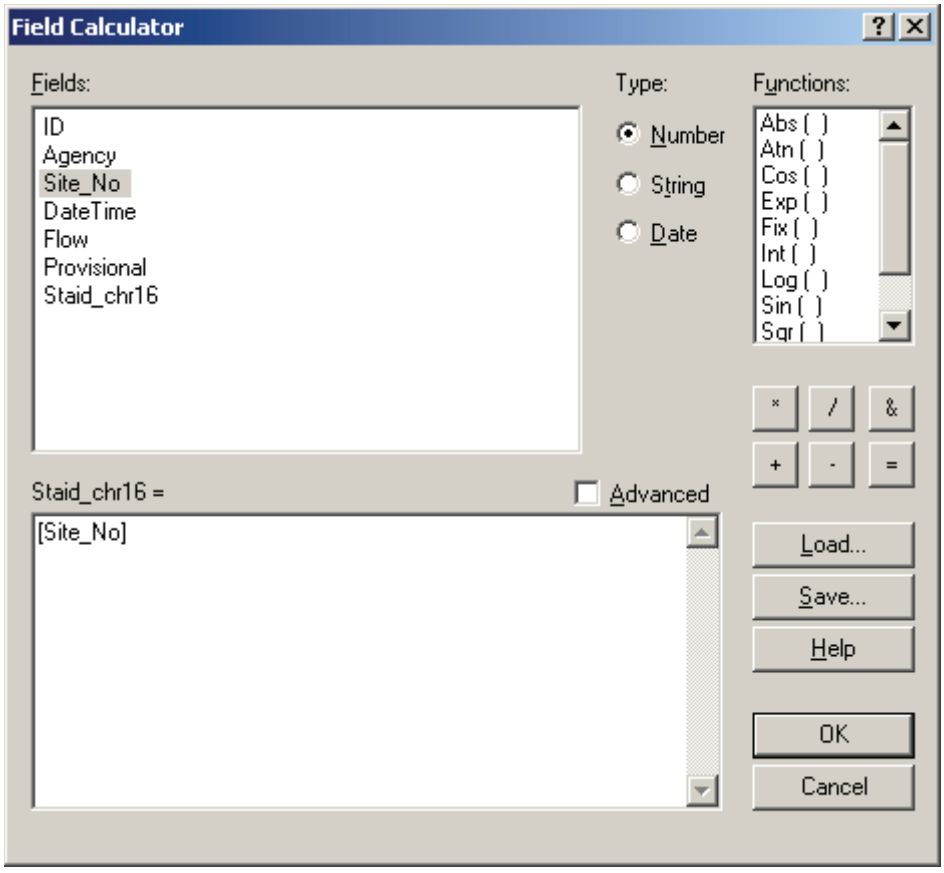
Stream flow is monitored at ten USGS stream gaging stations. These locations are stored separately from the actual streamflow data. The streamflow data is obtained via a web query which downloads all historical and also recent provisional data in one Excel file. The gagaing stations are part of the USGS site inventory station location file. The two tables are related through the identification number. Here we are storing the station as a "Double" for consistency with the groundwater data which actually uses all 15 digits. Because of problem with the "relate" crashing ArcGIS, we need to create character string of length 16 in the point feature class and the relate table.



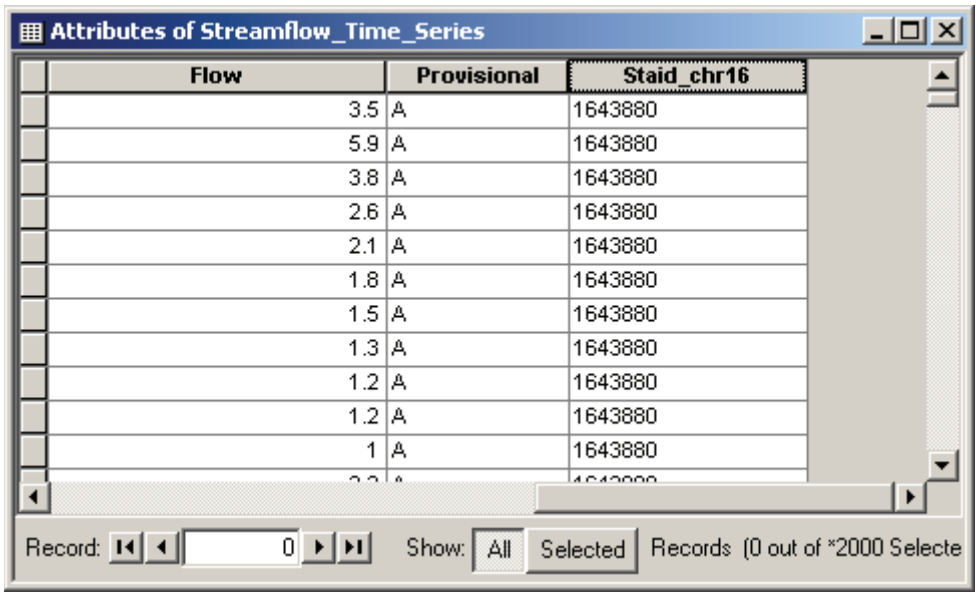
So now the stations have this additional field.



For the Time Series table, Add field
Use field calculator



to yield:



Presently the conversion from excel to Access is performed manually. There are ten named ranges in the Excel file and each is separately imported using "Get External Data". The separate tables are then copy and paste appended into one table which exceeds 75,000 records (more than one Excel worksheet can handle.

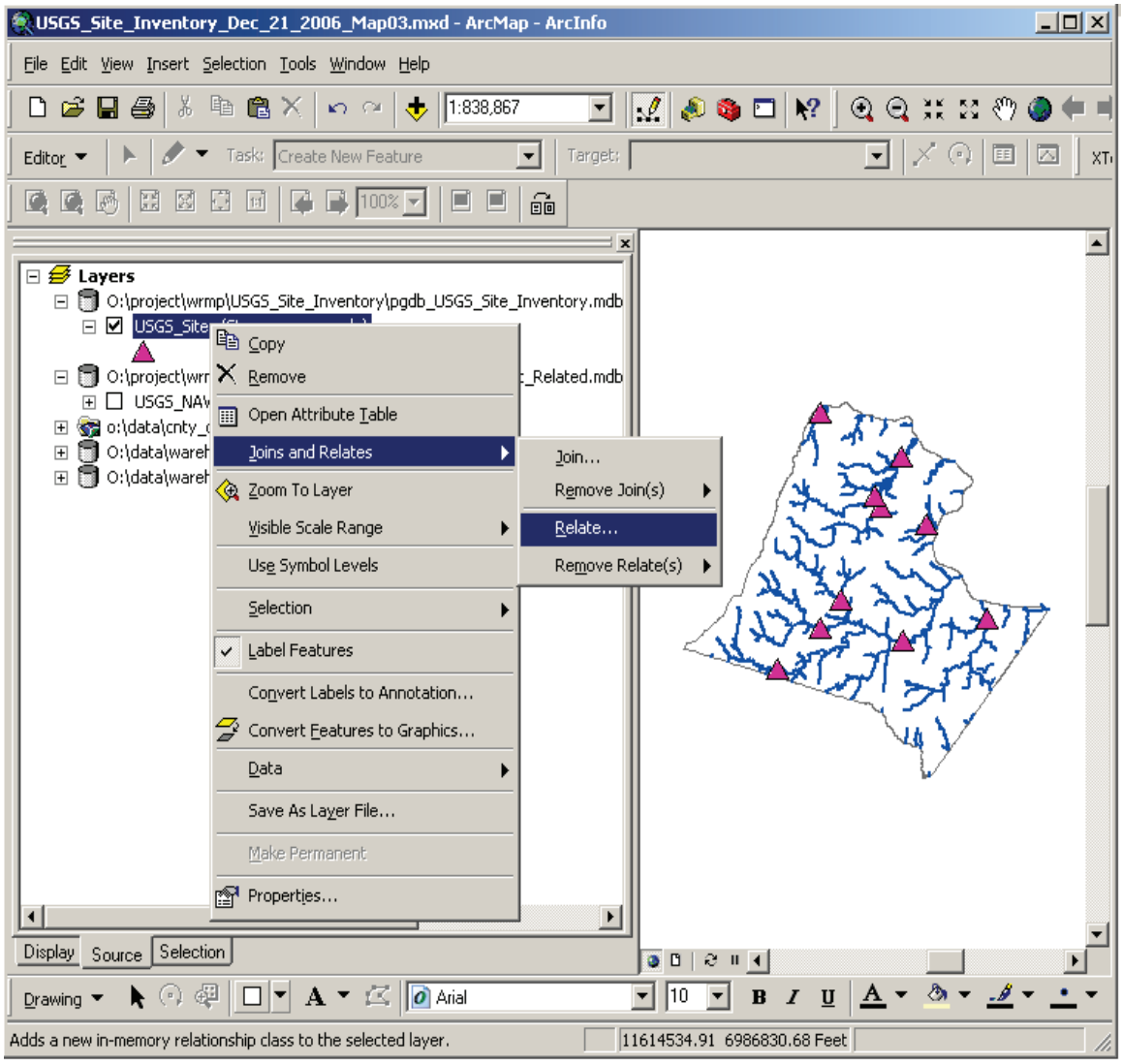
These Access tables are then copied to O:\project\wrmp\USGS_Streamflow and related to the site points in O:\project\wrmp\USGS_Site_Inventory.

Now these can be related in a one-to-many relationship. For each station there are numerous streamflow measurements.

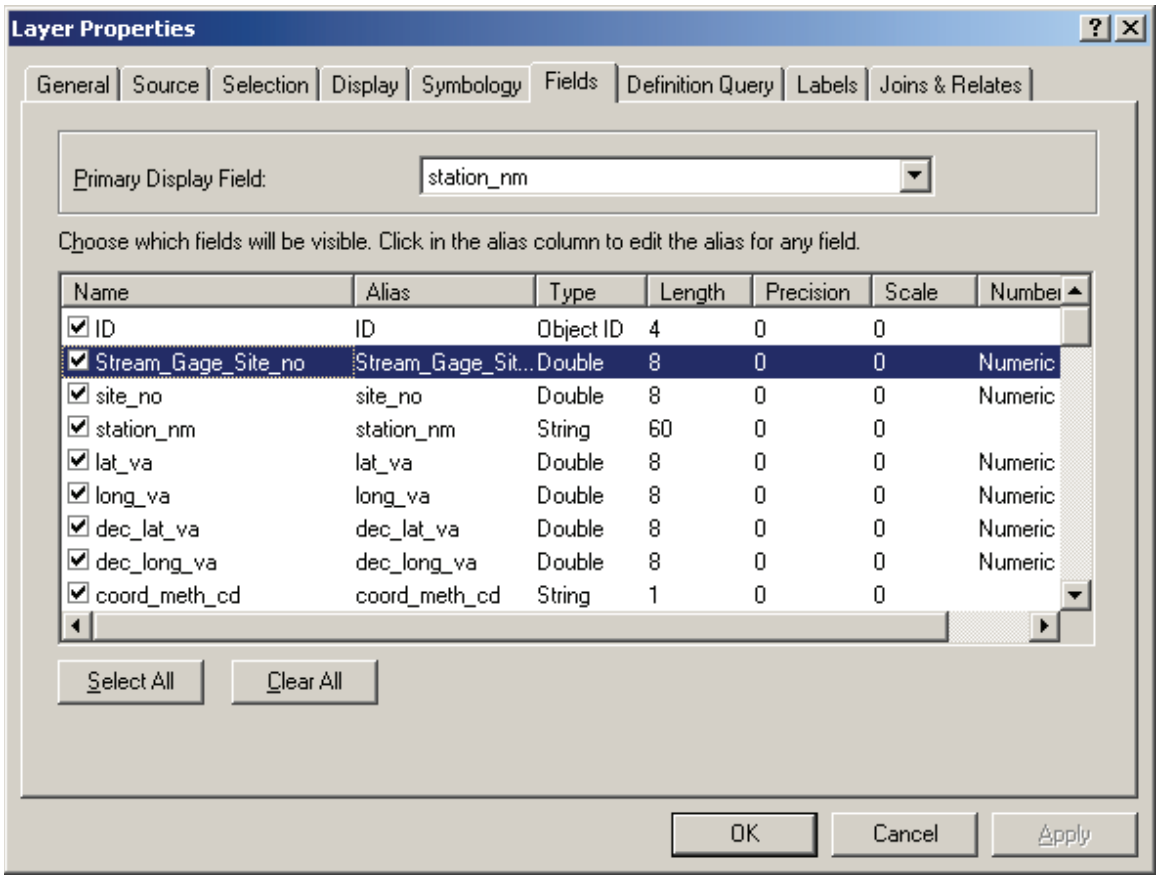
One can manually create the relate and store in the .mxd file, or one can use ArcToolBox to create a relationship class. If you create the relate in the .mxd, one needs to save as layer file such that others may use the data in the same way. Preferably the relate is stored as a relationship class in pgdb. Thus far experience in working with NAWQA data is that pgdb relationship classes crash ArcMap. Therefore, with streamfloe, we will only create the relate manually and store this in the .mxd and .lyr file.

Step 1: Relate directly within ArcMap.

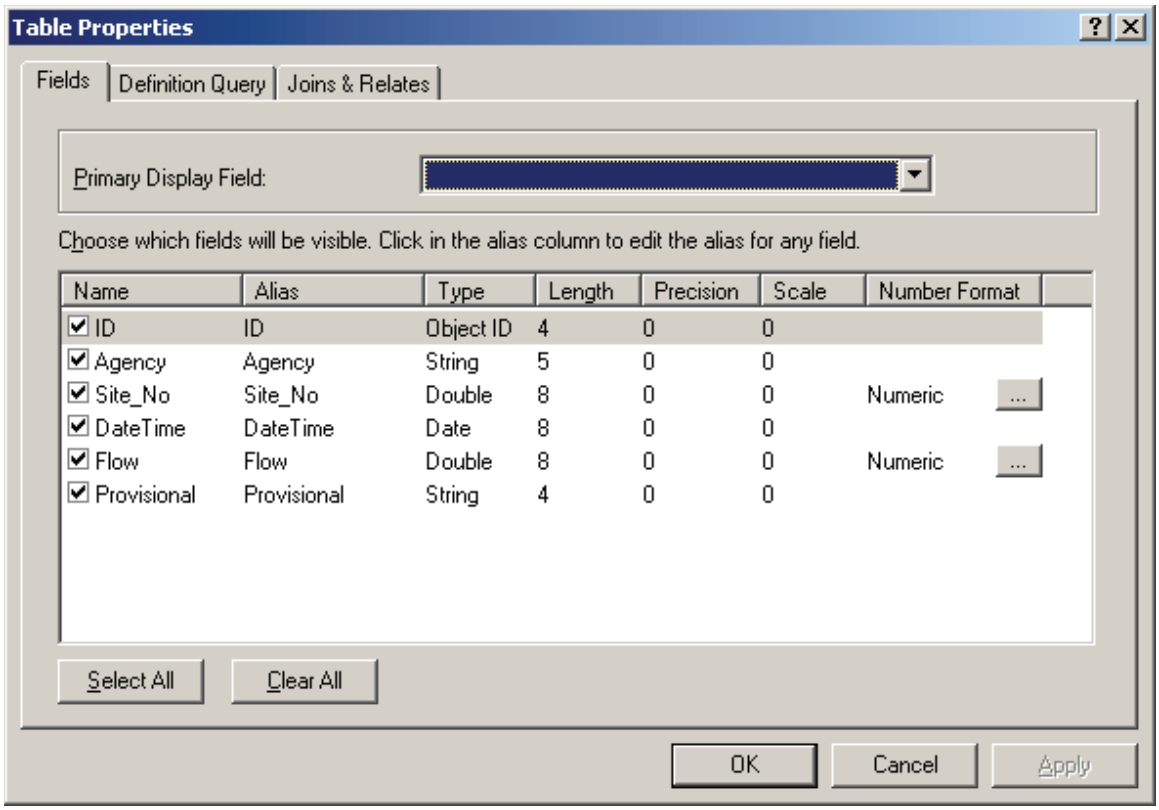
Select the "Site" layer and create the Relate.



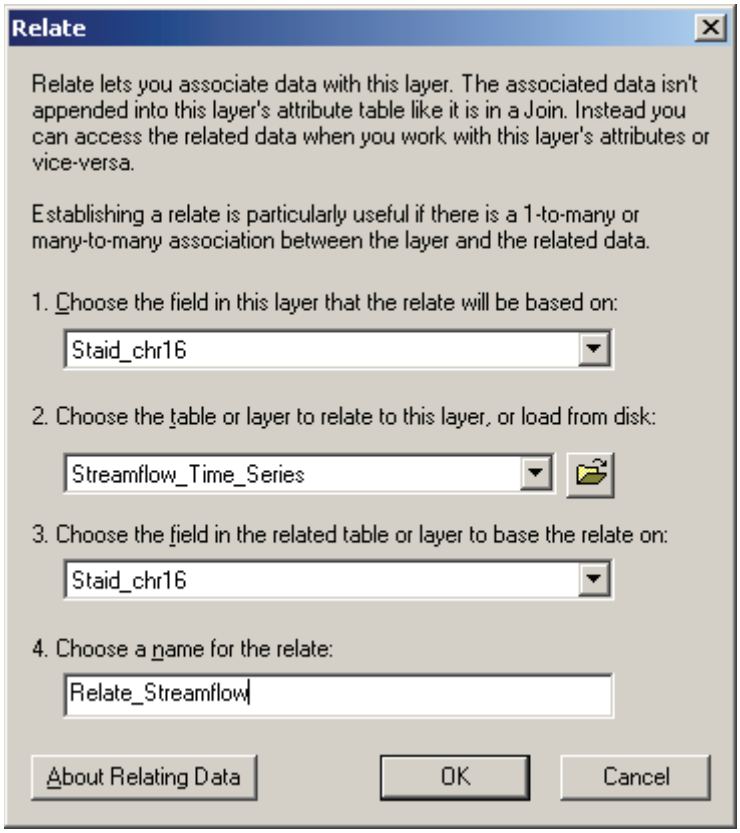
The station point GIS layer includes:

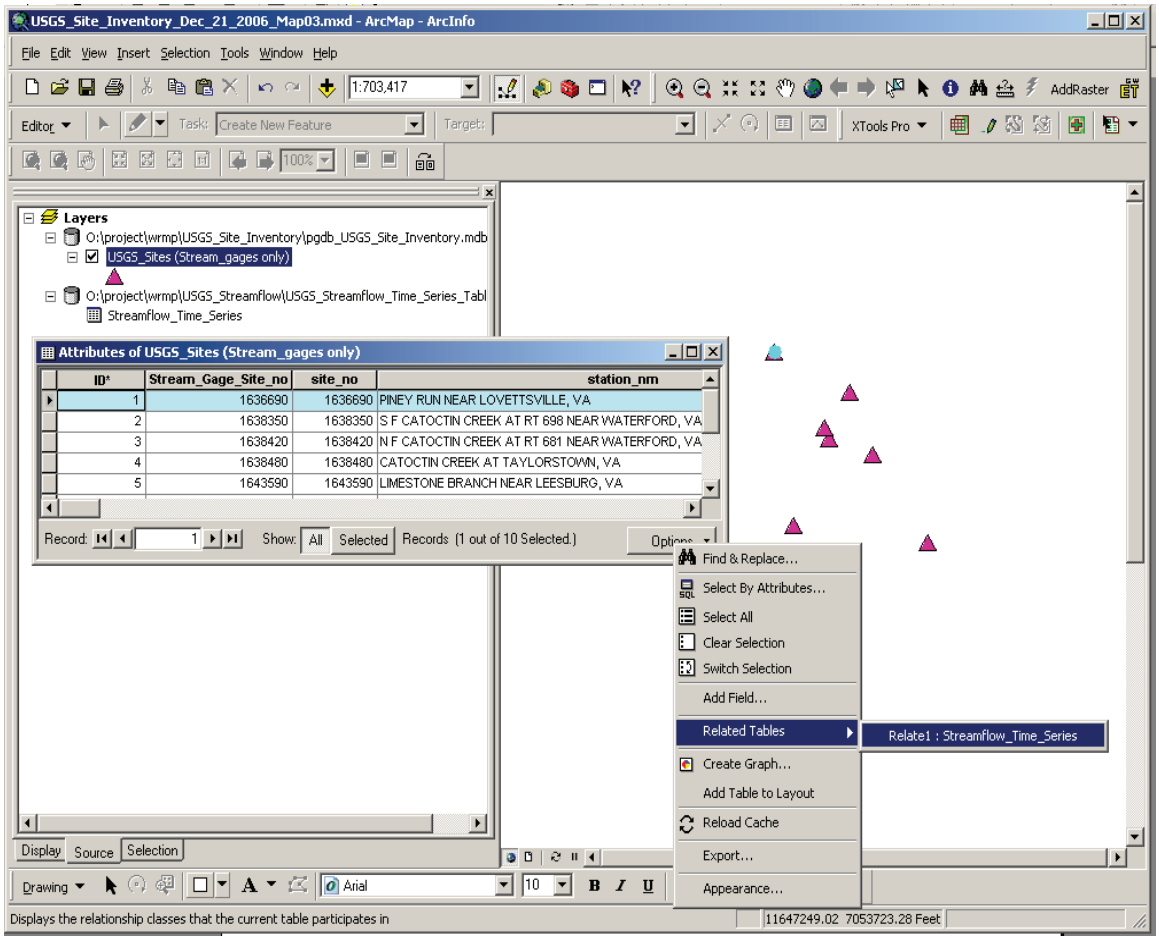


The streamflow time series tables contains:



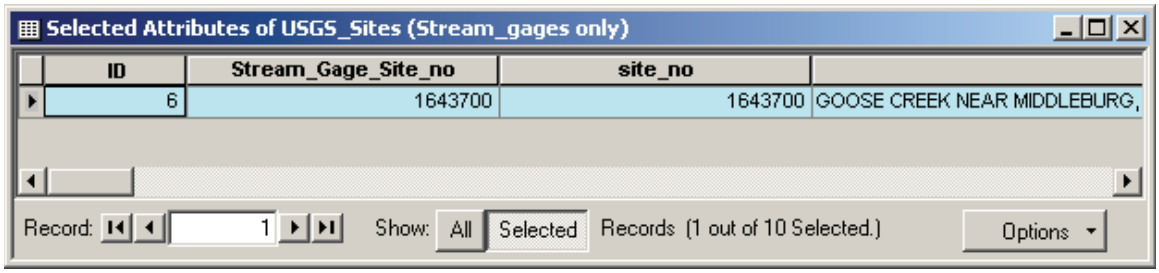
So we want to construct the relate as:


Relate
Relate lets you associate data with this layer. The associated data isn't appended into this layer's attribute table like it is in a Join. Instead you can access the related data when you work with this layer's attributes or vice-versa.
Establishing a relate is particularly useful if there is a 1-to-many or many-to-many association between the layer and the related data.
1. Choose the field in this layer that the relate will be based on:
Staid_chr16
2. Choose the table or layer to relate to this layer, or load from disk:
Streamflow_Time_Series
3. Choose the field in the related table or layer to base the relate on:
Staid_chr16
4. Choose a name for the relate:
Relate_Streamflow
About Relating Data
OK
Cancel

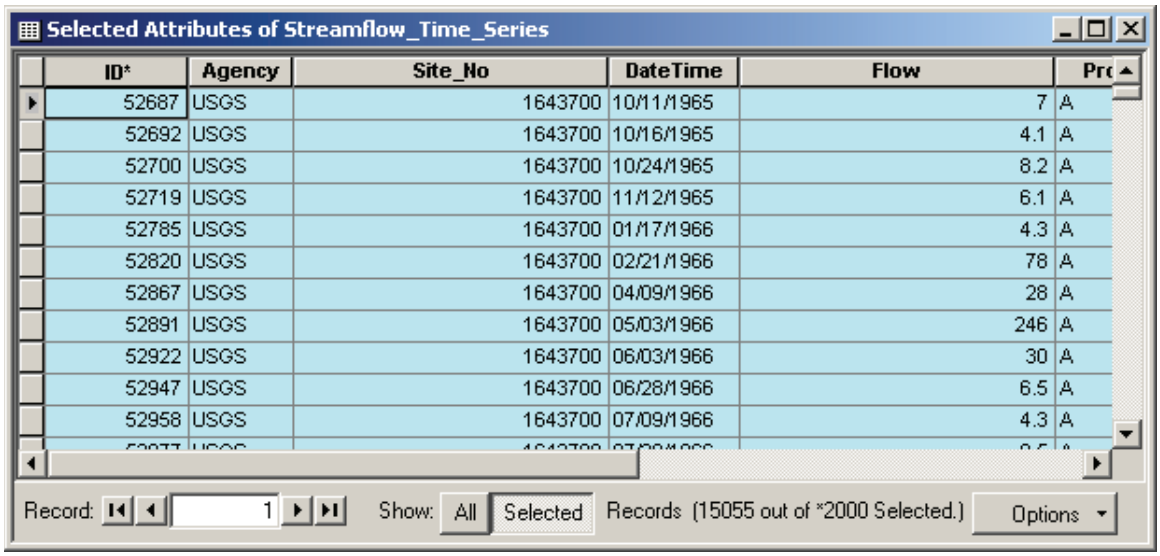

USGS_Site_Inventory_Dec_21_2006_Map03.mxd - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
Layers
O:\project\wrmp\USGS_Site_Inventory\pgdb_USGS_Site_Inventory.mdb
USGS_Sites (Stream_gages only)
O:\project\wrmp\USGS_Streamflow\USGS_Streamflow_Time_Series_Tabl
Streamflow_Time_Series
Attributes of USGS_Sites (Stream_gages only)
ID* Stream_Gage_Site_no site_no station_nm
1 1636690 1636690 PINEY RUN NEAR LOVETTSVILLE, VA
2 1638350 1638350 S F CATOCTIN CREEK AT RT 698 NEAR WATERFORD, VA
3 1638420 1638420 N F CATOCTIN CREEK AT RT 681 NEAR WATERFORD, VA
4 1638480 1638480 CATOCTIN CREEK AT TAYLORSTOWN, VA
5 1643590 1643590 LIMESTONE BRANCH NEAR LEESBURG, VA
Record: 1 Show: All Selected Records (1 out of 10 Selected.) Options...
Find & Replace...
Select By Attributes...
Select All
Clear Selection
Switch Selection
Add Field...
Related Tables
Relate1 : Streamflow_Time_Series
Create Graph...
Add Table to Layout
Reload Cache
Export...
Appearance...
Display Source Selection
Displays the relationship classes that the current table participates in
11647249.02 7053723.28 Feet

One can select one of the 10 stations and view the related records with that one station, as shown below.

Select one station:



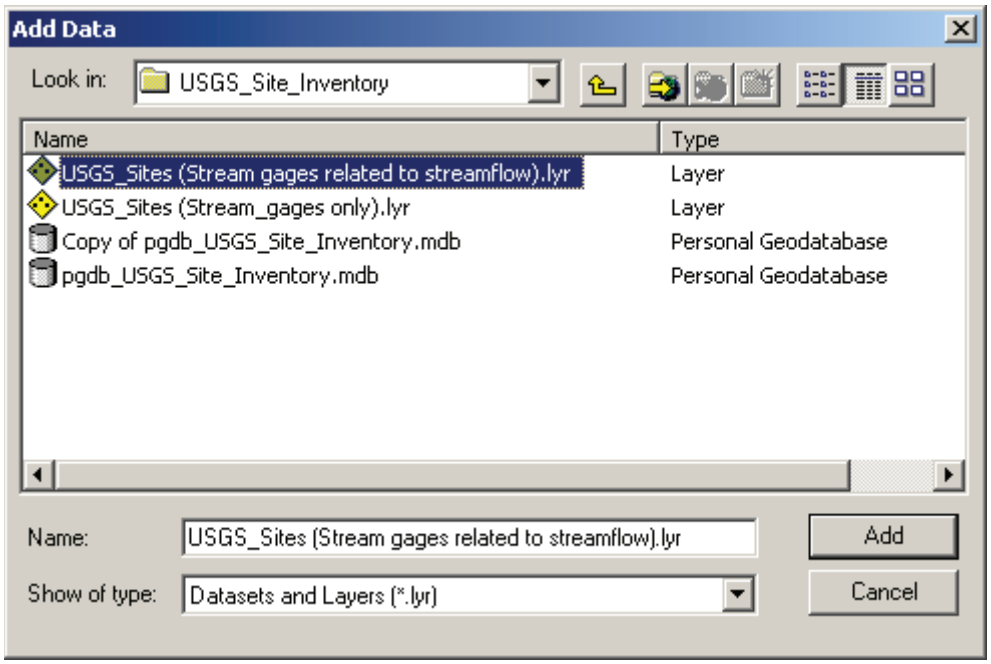
View related time series:



This is done by right clicking on Options on bottom right section of the table window.

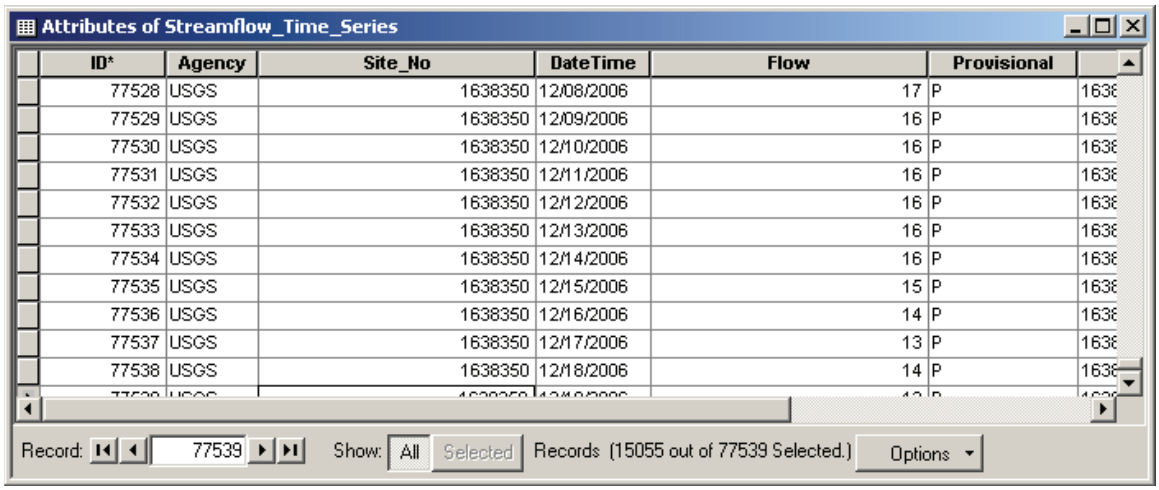
The relationship is saved with the .lyr file.

Now in future maps, just add the layer files as:



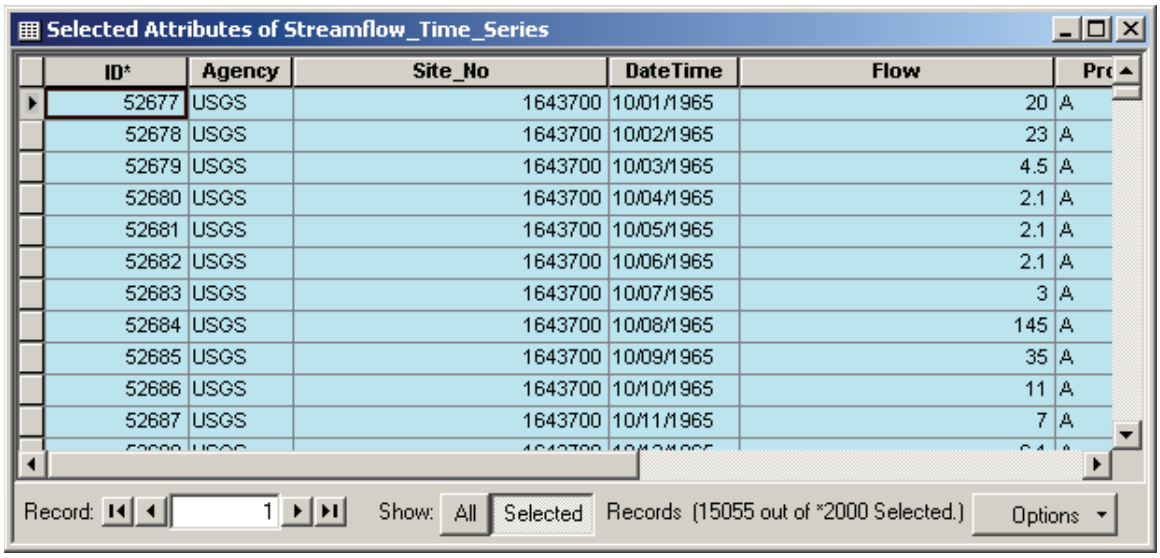
When you first add this, just the point data displays in Table of Contents, but once you open the table and "View Related Table", the related table is added to Table of Contents.

Oddly the related table does not allow one to view just those records that constitute the "relate"



The "Selected" button is dimmed out – Why???????????????

This does not happen in the source .mxd where the "relate" was first created:



- Let's see about merging this together intop one feature class and create a relationship class with the pgdb

Using MS Access, manally merge :

Sites

(1) O:\project\wrmp\USGS_Site_Inventory\ pgdb_USGS_Site_Inventory.mdb

and

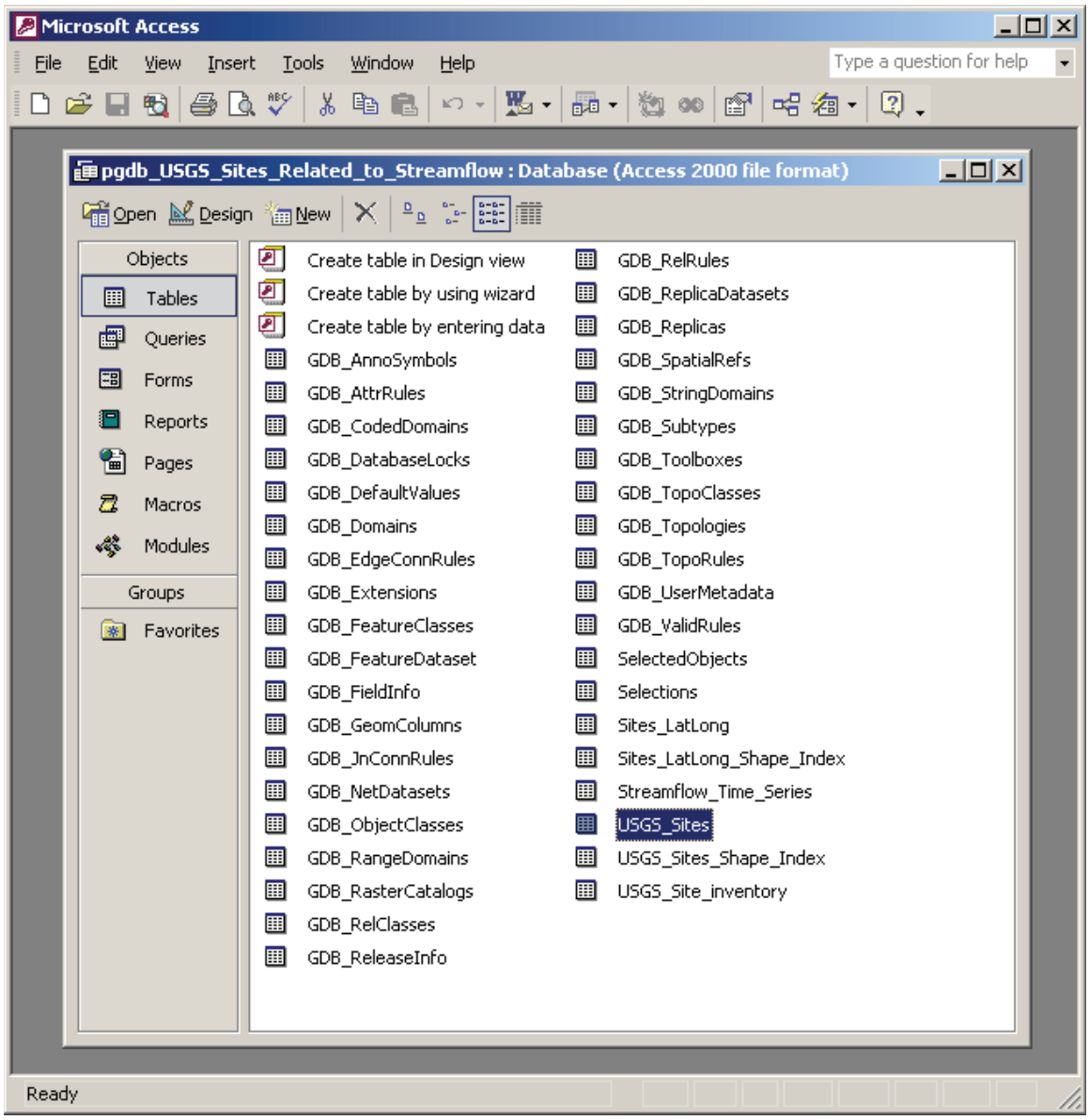
Time Series

(2) O:\project\wrmp\USGS_Streamflow\\USGS_Streamflow_Time_Series_Tables.mdb

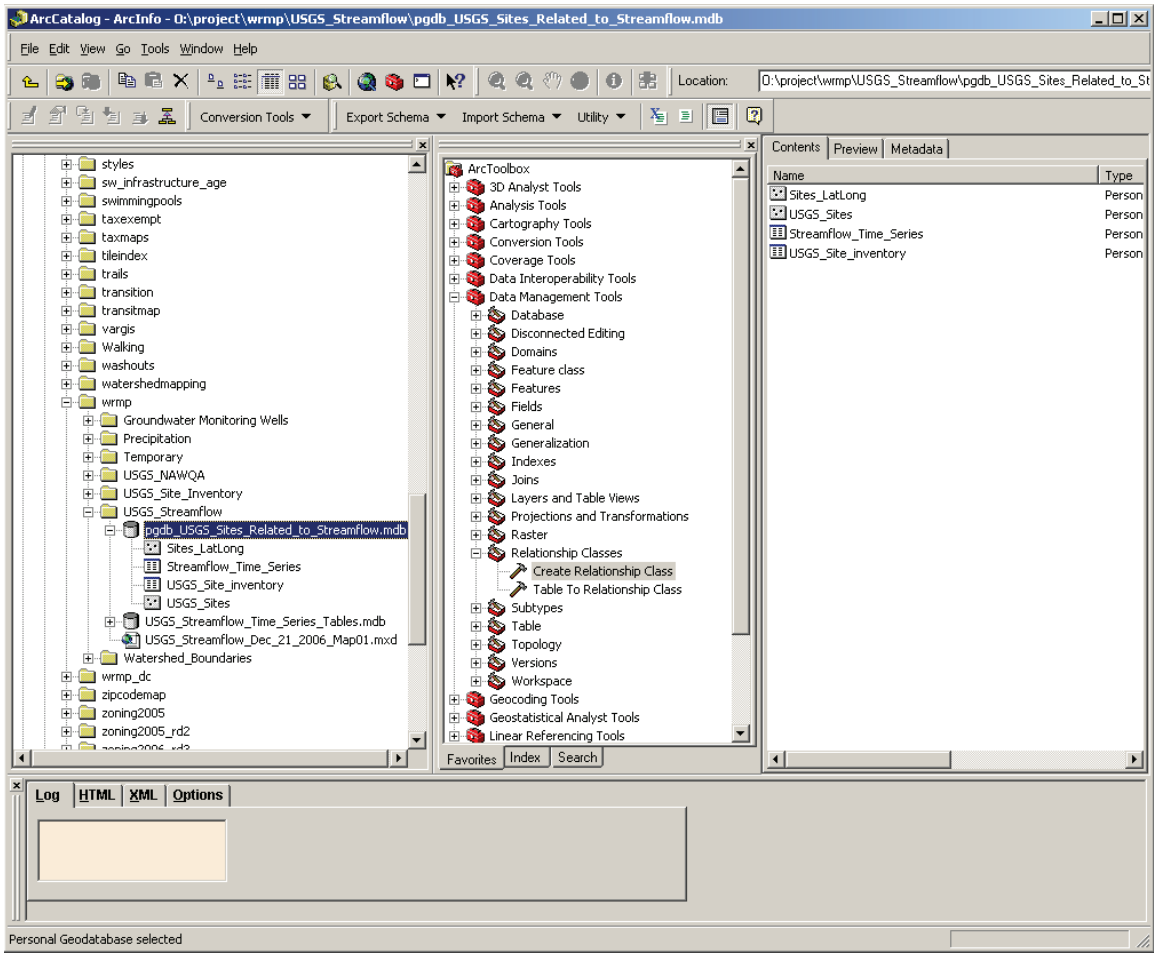
into

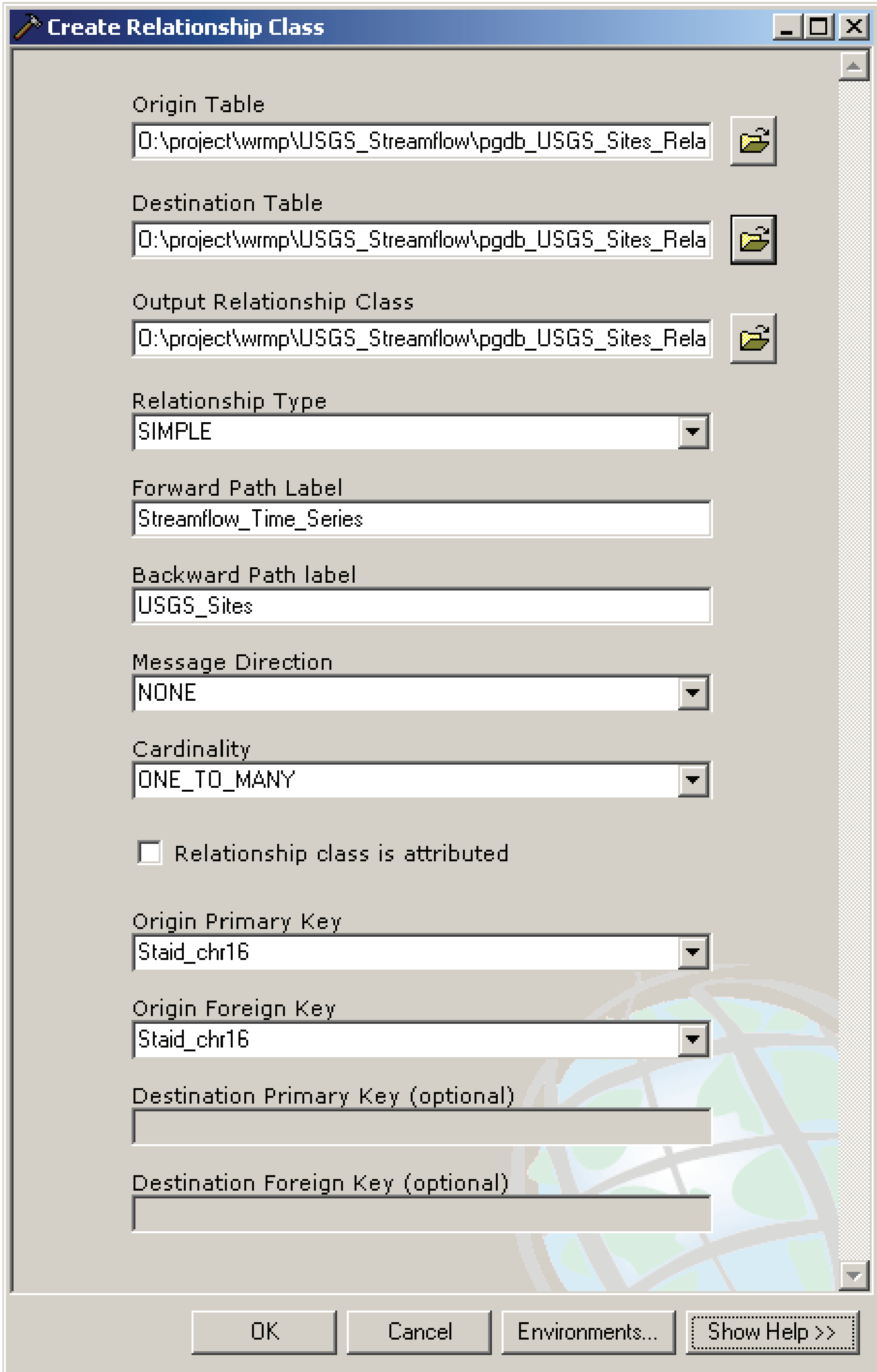
O:\project\wrmp\USGS_Streamflow\pgdb_USGS_Sites_Related_to_Streamflow.mdb

This contains:



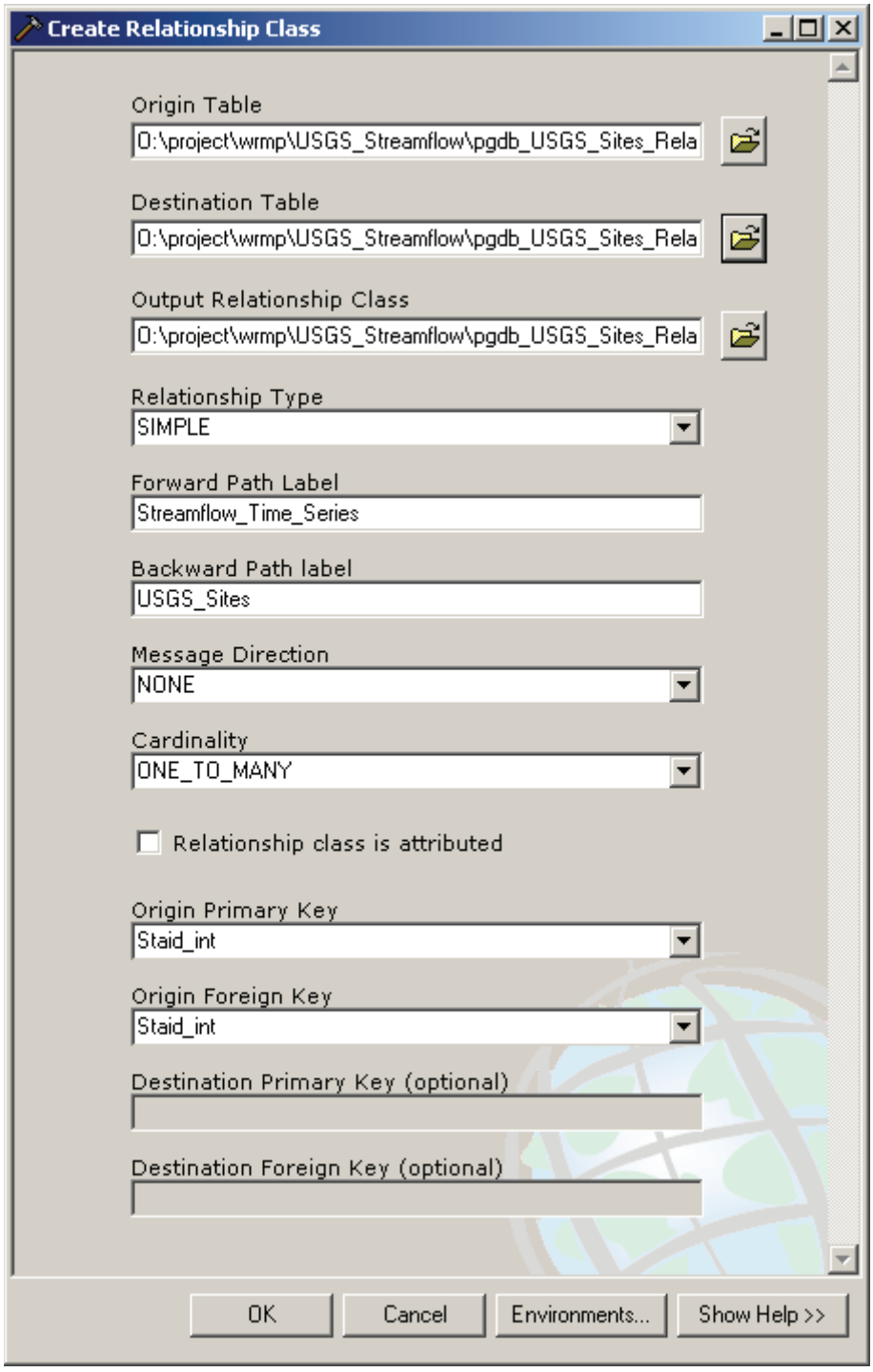
Go to ArcCatalog for ArcToolBox


ArcCatalog - ArcInfo - O:\project\wrmp\USGS_Streamflow\pgdb_USGS_Sites_Related_to_Streamflow.mdb
File Edit View Go Tools Window Help
Location: O:\project\wrmp\USGS_Streamflow\pgdb_USGS_Sites_Related_to_St
Conversion Tools
Export Schema
Import Schema
Utility
styles
sw_infrastructure_age
swimmingpools
taxexempt
taxmaps
tileindex
trails
transition
transitmap
vargis
Walking
washouts
watershedmapping
wrmp
Groundwater Monitoring Wells
Precipitation
Temporary
USGS_NAWQA
USGS_Site_Inventory
USGS_Streamflow
pgdb_USGS_Sites_Related_to_Streamflow.mdb
Sites_LatLong
Streamflow_Time_Series
USGS_Site_inventory
USGS_Sites
USGS_Streamflow_Time_Series_Tables.mdb
USGS_Streamflow_Dec_21_2006_Map01.mxd
Watershed_Boundaries
wrmp_dc
zipcodemap
zoning2005
zoning2005_rd2
ArcToolbox
3D Analyst Tools
Analysis Tools
Cartography Tools
Conversion Tools
Coverage Tools
Data Interoperability Tools
Data Management Tools
Database
Disconnected Editing
Domains
Feature class
Features
Fields
General
Generalization
Indexes
Joins
Layers and Table Views
Projections and Transformations
Raster
Relationship Classes
Create Relationship Class
Table To Relationship Class
Subtypes
Table
Topology
Versions
Workspace
Geocoding Tools
Geostatistical Analyst Tools
Linear Referencing Tools
Favorites
Index
Search
Contents
Preview
Metadata
Name
Type
Sites_LatLong
Person
USGS_Sites
Person
Streamflow_Time_Series
Person
USGS_Site_inventory
Person
Log
HTML
XML
Options
Personal Geodatabase selected



This crashes!!!

To rectify the situation, relating using a long integer is used. A field (long integer) named “Staid_int” is added to both the Site feature class and the time series table. These art related using



This also crashes?????????????????

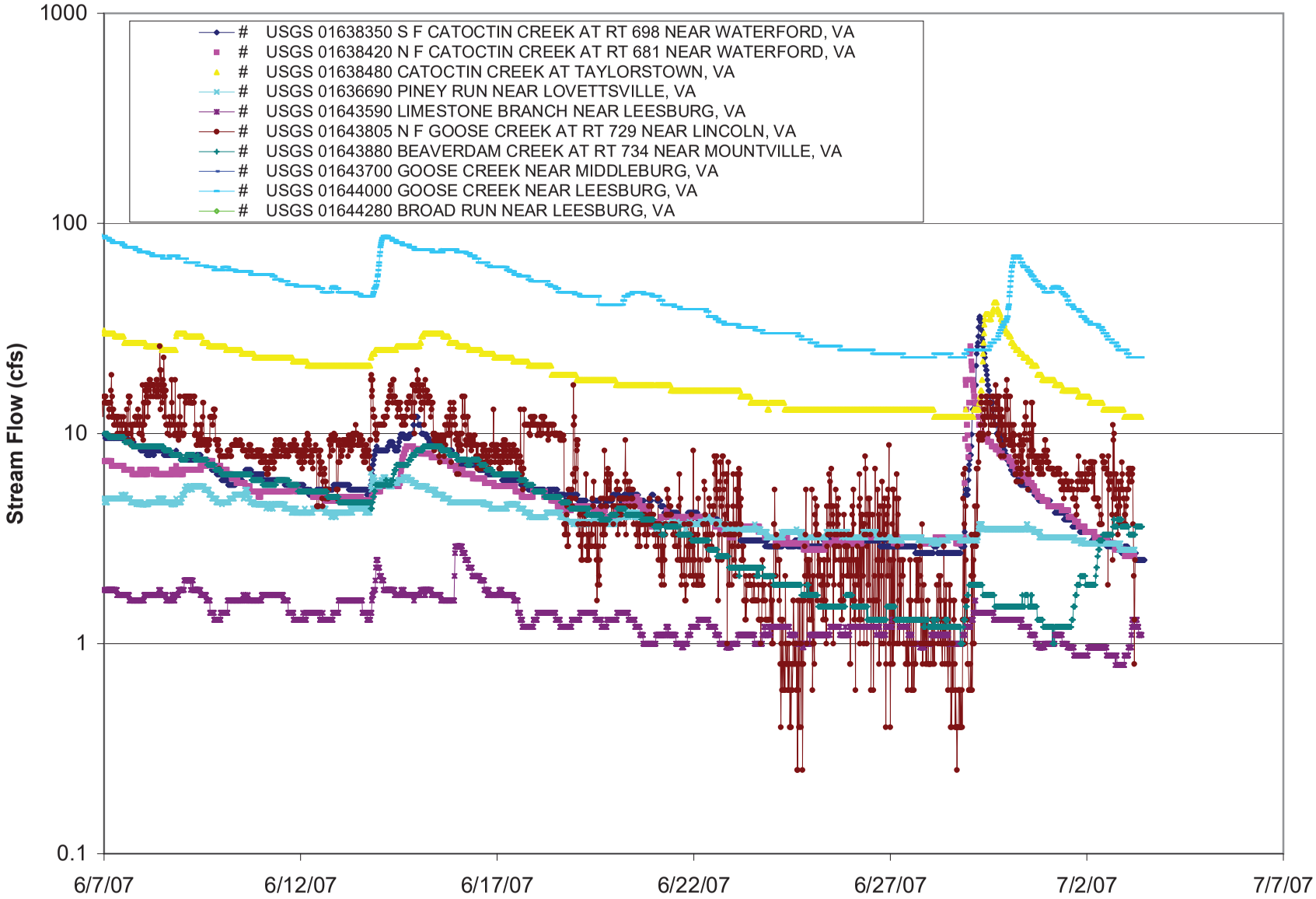
Summary and Conclusion:

Manually create the relations in ArcMap and save the feature class as .lyr file. When going to use the data, just add the station point file. To view the related data, do not add to TOC, rather, open the stations table and in lower right under options, select related tables. Now when you select a record, in stations, just the related table records are selected also.

USGS Real-time Streamflow 15-minute readings	
Start Date	11/19/06
End Date	08/16/07
Number of Days	270
Readings per Day	120
Number of Stations	10
Number of Readings	324,000

31-Aug-

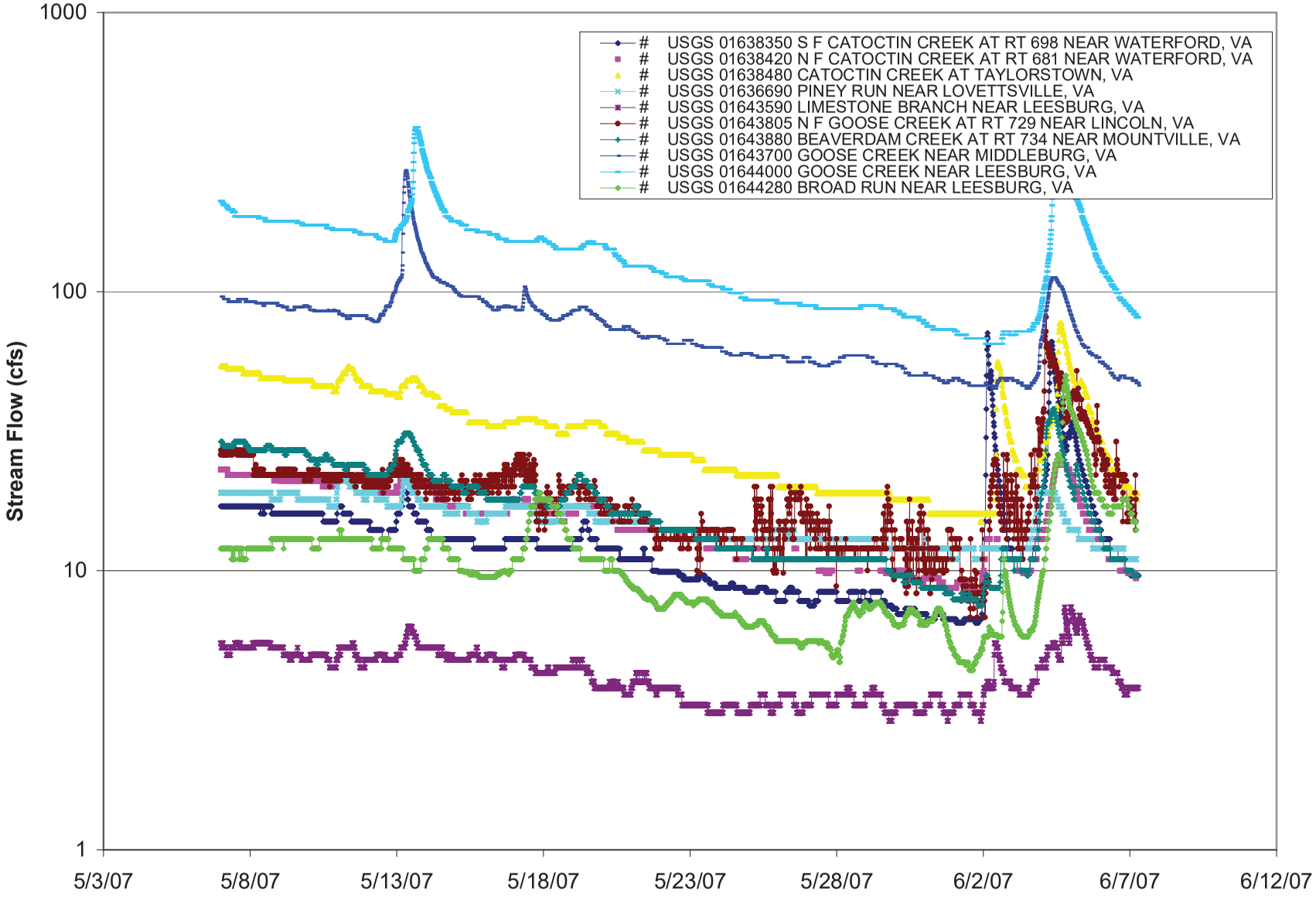
USGS Stream Flow



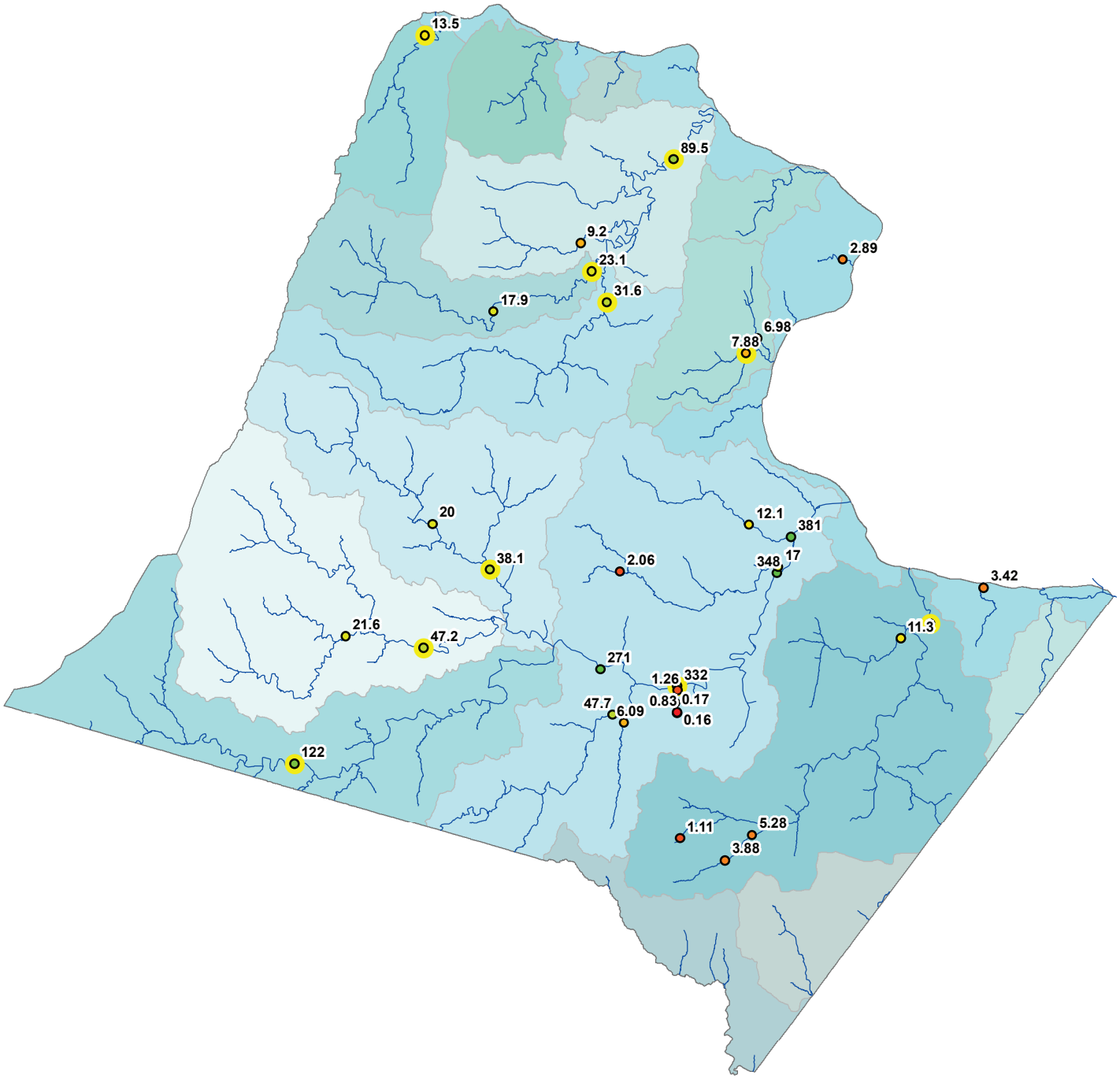
G:\BLDG_DEV\Engineering\H2O Team\WRMP\USGSFlowData\web_query_all_dates_flow_only\RealTime_Archive\USGS_Streamflow_Web_Query_just_30_day_15_minute_June_July_2007_snapshot.xls Cht_All_Sites

31-Aug-

USGS Stream Flow



G:\BLDG_DEV\Engineering\H2O Team\WRMP\USGSFlowData\web_query_all_dates_flow_only\RealTime_Archive\USGS_Streamflow_Web_Query_just_30_day_15_minute_May_June_2007_snapshot.xls Cht_All_Sites



Drainage Area

USGS Stream Gages

Area in sq miles

Groundwater Recharge from Streamflow Records

Background

Groundwater recharge can be calculated based on daily streamflow measurements. The USGS offers a computer program, RORA using the recession-curve displacement method. Also known as the Rorabaugh Method (Rorabaugh, 1964; Daniel, 1976), the method is based on the change in total potential ground-water discharge that is caused by each recharge event. The RORA program is intended for analyzing a ground-water-flow system that is characterized by diffuse areal recharge to the water table and ground-water discharge to a stream. The method is appropriate if all or most ground water in the basin discharges to the stream and if a streamflow-gaging station at the downstream end of the basin measures all or most outflow. The software program and documents are available from http://water.usgs.gov/ogw/rora/

"The computer program RORA (Rutledge, 1998, p. 5, 17–26) was used with the recession-curvedisplacement method to estimate ground-water recharge for each peak in streamflow during the period of record. The recession-curve-displacement method uses the pre-peak and post-peak recession periods to extrapolate the change in the total potential groundwater discharge as estimated at a critical time after the peak. Total potential base flow to the stream at the critical time when the streamflow hydrograph becomes log-linear again is about one-half of the total volume of water that recharged the ground-water system during the peak (Rutledge, 1998, p. 19). The method applies to flow systems driven by areally diffuse recharge that is roughly concurrent with peaks in streamflow (Rutledge, 1998, p. 3).

Recharge Calculation

Data from ten stream gages in Loudoun County were downloaded from USGS NWIS web site and modified for input into the RORA program. To facilitate download, an Excel file, using an automated web query was used. Text files are created for input to RORA as a batch process. The RORA program provides monthly, seasons and yearly recharge estimates provided that complete records are available for the calendar year.

Data Gaps

There was a problem with Catotin Creek at Taylorstown NWIS data in 1970 in which daily records needed to be manually deleted. Because Goose Creek Middleburg has a significant data gap 1977 to 2001, separate data sets were created.

Evaluation of Recession Index

DRAFT

The RORA manual and recent article in Ground Water Journal, May/June 2007 by Rutledge suggest that RORA is generally insensitive to the recession index (RI) provided. The recession index is defined as the time required for the groundwater discharge to recede by one log-cycle when the recession becomes linear (or nearly linear) on a semilog hydrograph.

Daily streamflow data at the ten stationswere examined for the period 2002 to 2005. A graph of all ten stations included along with a one log-cycle drop for recession indexes with values of 100, 50 and 30 days. The closest fit for all streams appears to be between 30 and 60 days. The smallest RI appears to be Broad Run.

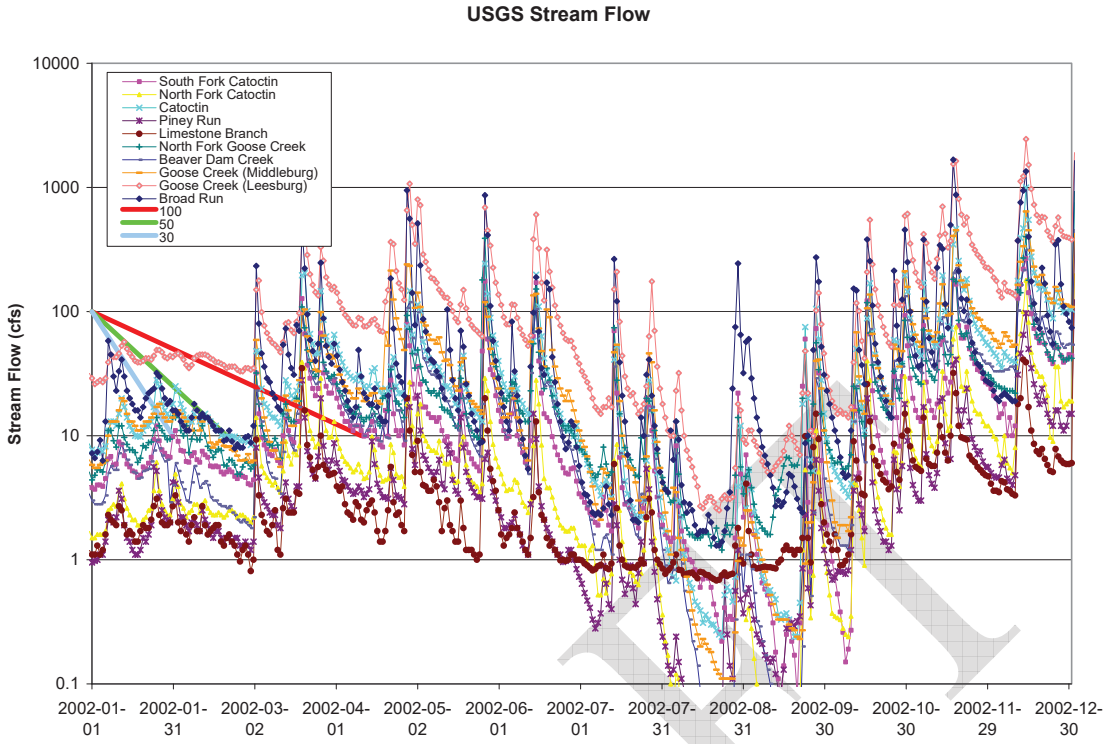
DRAFT

Station	Estimated Recession Index
South Fork Catoctin	50
North Fork Catoctin	50
Catoctin	60
Piney Run	60
Limestone Branch	40
North Fork Goose Creek	50
Beaver Dam Creek	50
Goose Creek (Middleburg)	50
Goose Creek (Leesburg)	50
Broad Run	30

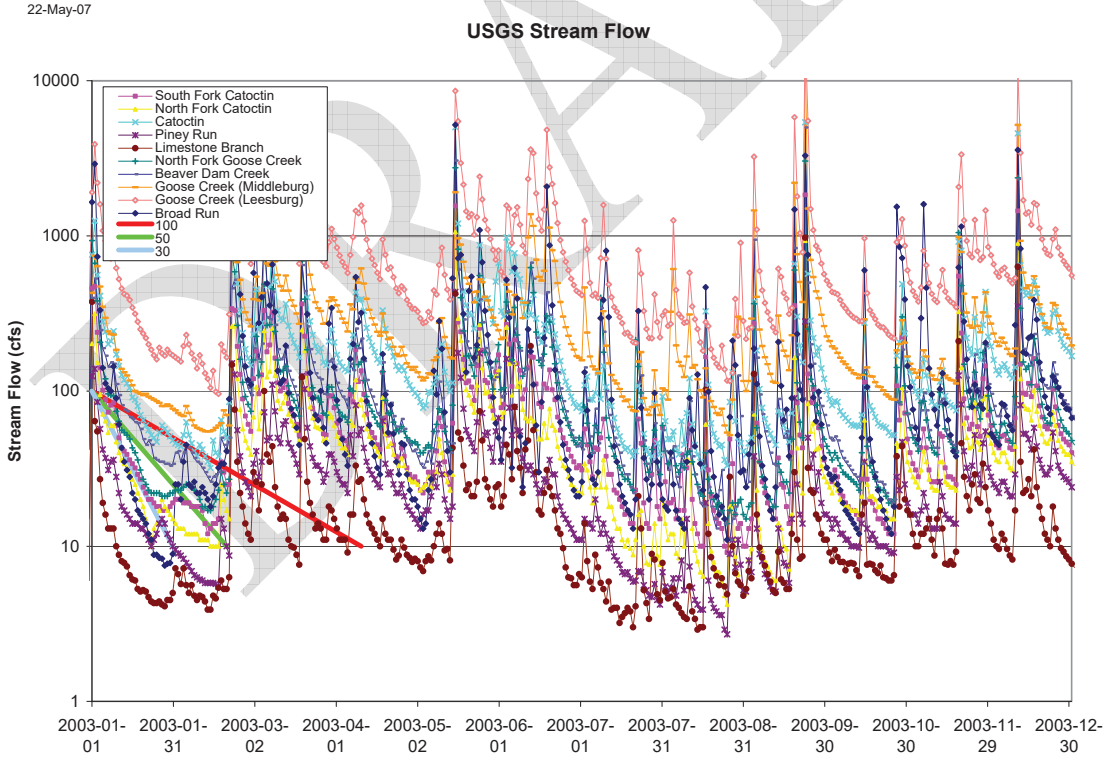
The follow charts are the daily stream flow records for 2002, 2003, 2004 and 2005 used to interpret the baseflow index value above..

DRAFT

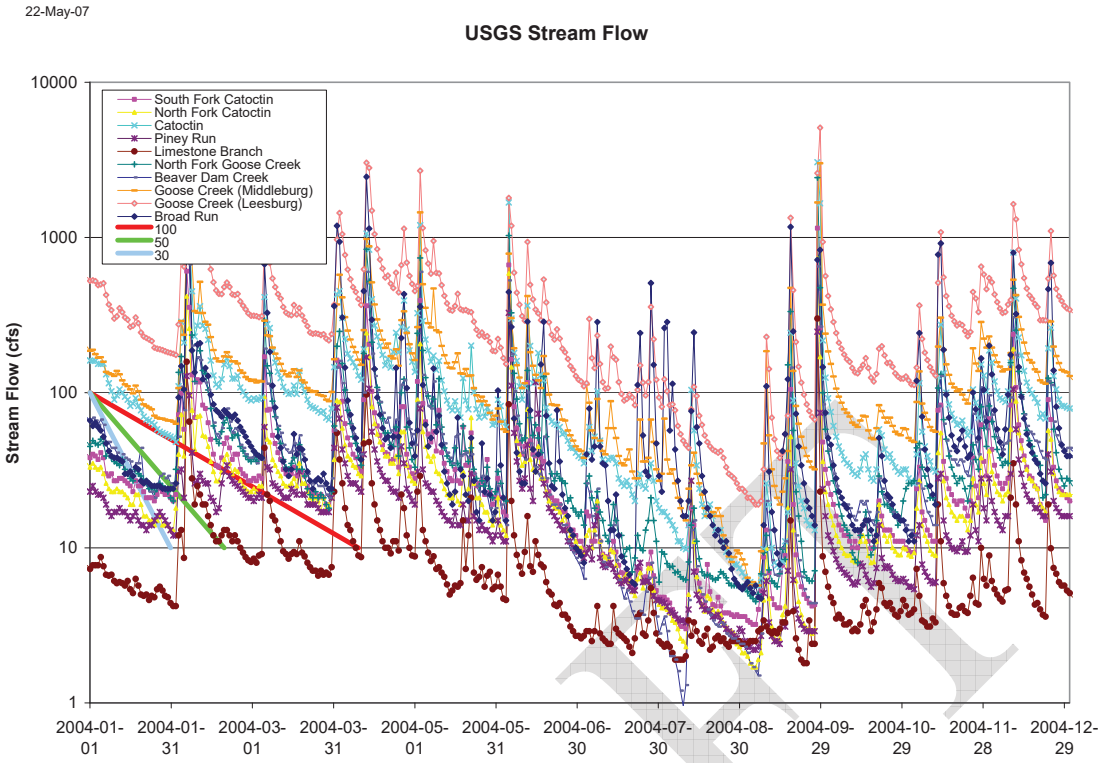
22-May-07

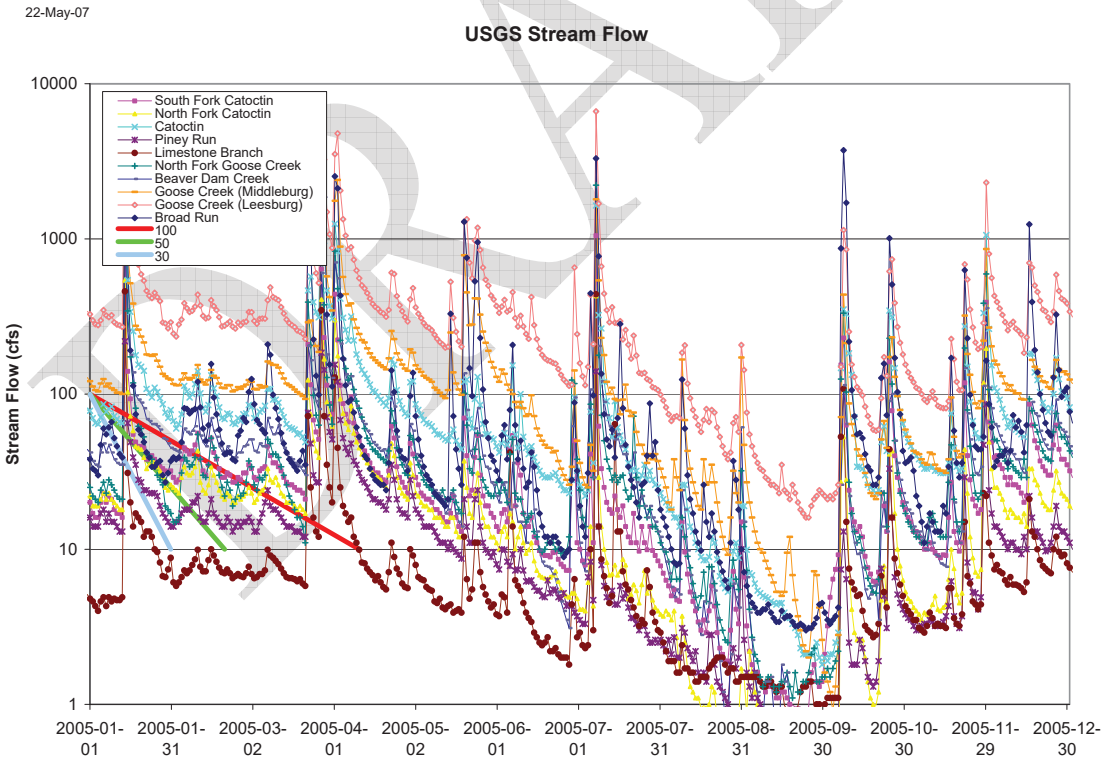


22-May-07



DRAFT





To check the sensitivity recharge due to RI RORA was used to evaluate Broad Run using RI of 30 and 50 days and Catoctin Creek at 60 and 100 days. The error introduced is 3 and 4.4%, respectively.

Summary of Findings:

RORA offers annual, quarterly and monthly summary values of recharge.

Annual Recharge Summary:

Because of missing data, the newer USGS stations do not offer sufficient data for reliable and representative annual averages. Therefore annual summaries are not presented. Data is generally limited to the period 2002 to 2005.

Quarterly Recharge Summary:

The quarterly recharge estimates are listed below. The average recharge for all records averaged over all stations is approximately 12 inches per year.

Note that there is a break in the Goose Creek (Middleburg) calculations due to incomplete data for this station.

Station	Station	Year	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Year Total
1638350 South Fork Catoctin	SF_Cat	2002	1.44	0.89	0.14	3.91	6.38
1638350 South Fork Catoctin	SF_Cat	2003	7.52	7.47	2.72	5.06	22.77
1638350 South Fork Catoctin	SF_Cat	2004	3.38	4.36	0.98	2.37	11.09
1638350 South Fork Catoctin	SF_Cat	2005	5.8	1.21	0.52	2.91	10.44
1638420 North Fork Catoctin	NF_Cat	2002	0.85	0.55	0.02	2.26	3.68
1638420 North Fork Catoctin	NF_Cat	2003	7.71	7.77	2.2	6	23.68
1638420 North Fork Catoctin	NF_Cat	2004	3.41	4.8	1.05	2.99	12.26
1638420 North Fork Catoctin	NF_Cat	2005	6.29	1.33	0.25	1.96	9.83
1638480 Catoctin	Cat	1972	5.96	8.04	-1.21	5.82	18.6
1638480 Catoctin	Cat	1973	4.13	5.14	0.67	2.42	12.36
1638480 Catoctin	Cat	1974	3.1	1.7	0.43	1.81	7.04
1638480 Catoctin	Cat	1975	5.15	2.13	3.31	2.36	12.95
1638480 Catoctin	Cat	1976	3.61	1.9	0.48	3.46	9.45
1638480 Catoctin	Cat	1977	2.5	1.52	0.18	3.89	8.09
1638480 Catoctin	Cat	1978	5.83	2.25	0.47	0.94	9.48
1638480 Catoctin	Cat	1979	5.65	1.95	3.18	4.76	15.54
1638480 Catoctin	Cat	1980	5.04	2.2	0.33	0.35	7.92
1638480 Catoctin	Cat	1981	1.44	1.65	0.21	0.48	3.77
1638480 Catoctin	Cat	1982	3.8	3.57	-0.25	1.37	8.49
1638480 Catoctin	Cat	1983	5.52	5.41	-0.11	4	14.81
1638480 Catoctin	Cat	1984	9.03	1.89	0.94	1.83	13.69
1638480 Catoctin	Cat	1985	2.33	0.77	0.2	2.41	5.7
1638480 Catoctin	Cat	1986	4.14	0.75	0.04	1.86	6.79
1638480 Catoctin	Cat	1987	3.61	3.68	1.54	2.52	11.35
1638480 Catoctin	Cat	1988	3.28	3.65	0.3	0.63	7.86
1638480 Catoctin	Cat	1989	4.1	3.59	0.33	0.67	8.68
1638480 Catoctin	Cat	1990	3.13	2.46	0.58	3.79	9.96
1638480 Catoctin	Cat	1991	4.36	0.22	0.04	0.43	5.05
1638480 Catoctin	Cat	1992	2.76	2.28	0.46	3.8	9.3
1638480 Catoctin	Cat	1993	9.34	0.58	0.05	2.61	12.58
1638480 Catoctin	Cat	1994	9.35	0.13	0.42	1.39	11.3
1638480 Catoctin	Cat	1995	3.5	1.02	0.36	2.65	7.53
1638480 Catoctin	Cat	1996	6.36	4.44	4.32	6.44	21.56

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1638480 Catoctin	Cat	1997	5.21	0.61	0.04	2.35	8.21
1638480 Catoctin	Cat	1998	10.2	3.22	-0.08	0.14	13.48
1638480 Catoctin	Cat	1999	1.76	0.72	0.91	1.57	4.97
1638480 Catoctin	Cat	2000	3.67	1.46	0.38	0.45	5.96
1638480 Catoctin	Cat	2001	4.33	1.34	0.37	0.29	6.34
1638480 Catoctin	Cat	2002	1.19	0.66	0.09	3.56	5.51
1638480 Catoctin	Cat	2003	6.5	7.59	2.88	7	23.97
1638480 Catoctin	Cat	2004	3.15	4.56	1.11	2.52	11.34
1636690 Piney Run	Piney	2002	0.84	0.6	0.11	2.52	4.07
1636690 Piney Run	Piney	2003	7.77	7.01	2.48	6.64	23.9
1636690 Piney Run	Piney	2004	4.8	5.91	1.26	3.62	15.6
1636690 Piney Run	Piney	2005	7.93	0.99	0.33	2.08	11.32
1643590 Limestone Branch	Lime	2002	1.16	0.77	0.49	3.03	5.45
1643590 Limestone Branch	Lime	2003	6.71	7.08	3.45	5.07	22.32
1643590 Limestone Branch	Lime	2004	4.11	3.94	1.56	2.1	11.71
1643590 Limestone Branch	Lime	2005	5.76	1.23	1.04	3.11	11.14
1643805 North Fork Goose Creek	NF_GC	2002	1.48	1.39	0.42	3.75	7.04
1643805 North Fork Goose Creek	NF_GC	2003	8.7	9.28	3.21	5.44	26.64
1643805 North Fork Goose Creek	NF_GC	2004	3.61	4.69	1.25	2.69	12.24
1643805 North Fork Goose Creek	NF_GC	2005	4.63	2.45	0.62	2.86	10.56
1643880 Beaver Dam Creek	Beaver	2002	1	0.96	0.06	3.67	5.68
1643880 Beaver Dam Creek	Beaver	2003	8.41	7.86	3.22	5.67	25.16
1643880 Beaver Dam Creek	Beaver	2004	2.73	3.42	0.96	2.9	10.02
1643700 Goose Creek (Middleburg)	GC_Mid	1970	3.84	3.24	0.78	3.73	11.58
1643700 Goose Creek (Middleburg)	GC_Mid	1971	5.73	4.02	0.29	2.89	12.93
1643700 Goose Creek (Middleburg)	GC_Mid	1972	6.45	7.95	-0.17	6.77	21.01
1643700 Goose Creek (Middleburg)	GC_Mid	1973	5.25	4.95	1.67	4.78	16.65
1643700 Goose Creek (Middleburg)	GC_Mid	1974	4.42	2.91	0.33	2.34	10
1643700 Goose Creek (Middleburg)	GC_Mid	1975	5.21	1.5	3.84	3.27	13.81
1643700 Goose Creek (Middleburg)	GC_Mid	1976	4.71	2.15	0.21	4.82	11.89
1643700 Goose Creek (Middleburg)	GC_Mid	1977	2.83	1.12	0.14	4.98	9.06
1643700 Goose Creek (Middleburg)	GC_Mid	1978	7.9	2.24	0.48	0.84	11.46
1643700 Goose Creek (Middleburg)	GC_Mid	1979	8.16	3.78	3.71	6.86	22.52
1643700 Goose Creek (Middleburg)	GC_Mid	1980	5.51	3.49	0.14	0.33	9.47
1643700 Goose Creek (Middleburg)	GC_Mid	1981	1.45	1.06	0.27	0.47	3.26
1643700 Goose Creek (Middleburg)	GC_Mid	1982	5.37	3.6	0.15	0.9	10.02
1643700 Goose Creek (Middleburg)	GC_Mid	1983	5.9	6.59	-0.14	4.9	17.25
1643700 Goose Creek (Middleburg)	GC_Mid	1984	12.92	1.58	0.41	1	15.9
1643700 Goose Creek (Middleburg)	GC_Mid	1985	2.59	0.28	0	2.79	5.66
1643700 Goose Creek (Middleburg)	GC_Mid	1986	4.66	1.4	0.03	1.09	7.18
1643700 Goose Creek (Middleburg)	GC_Mid	1987	4.17	4.77	0.34	1.73	11.02
1643700 Goose Creek (Middleburg)	GC_Mid	1988	3.18	4.53	-0.01	0.3	8.01
1643700 Goose Creek (Middleburg)	GC_Mid	1989	2.34	4.72	1.01	0.93	9
1643700 Goose Creek (Middleburg)	GC_Mid	1990	3.85	2.61	1.69	5.98	14.14
1643700 Goose Creek (Middleburg)	GC_Mid	1991	5.94	0.57	0	0.33	6.84
1643700 Goose Creek (Middleburg)	GC_Mid	1992	2.41	2.75	1.37	6.78	13.31
1643700 Goose Creek (Middleburg)	GC_Mid	1993	8.52	2.53	-0.06	1.4	12.39
1643700 Goose Creek (Middleburg)	GC_Mid	1994	10.38	0.26	0.52	1.07	12.23
1643700 Goose Creek (Middleburg)	GC_Mid	1995	3.43	3.74	-0.53	2.82	9.47
1643700 Goose Creek (Middleburg)	GC_Mid	1996	7.26	4.74	4.58	7.19	23.76
1643700 Goose Creek (Middleburg)	GC_Mid	2001			0.12	0.26	
1643700 Goose Creek (Middleburg)	GC_Mid	2002	0.65	0.78	0.03	2.95	4.41
1643700 Goose Creek (Middleburg)	GC_Mid	2003	8.33	8.78	4.83	5.91	27.85
1643700 Goose Creek (Middleburg)	GC_Mid	2004	3.38	4.61	1.5	2.98	12.47
1644000 Goose Creek (Leesburg)	GC_Lee	1930	2.79	0.97	-0.01	0.07	3.82
1644000 Goose Creek (Leesburg)	GC_Lee	1931	0.42	0.77	0.12	0.09	1.41
1644000 Goose Creek (Leesburg)	GC_Lee	1932	3.72	1.94	0.01	4.56	10.23
1644000 Goose Creek (Leesburg)	GC_Lee	1933	4.32	3.35	1.38	0.84	9.89

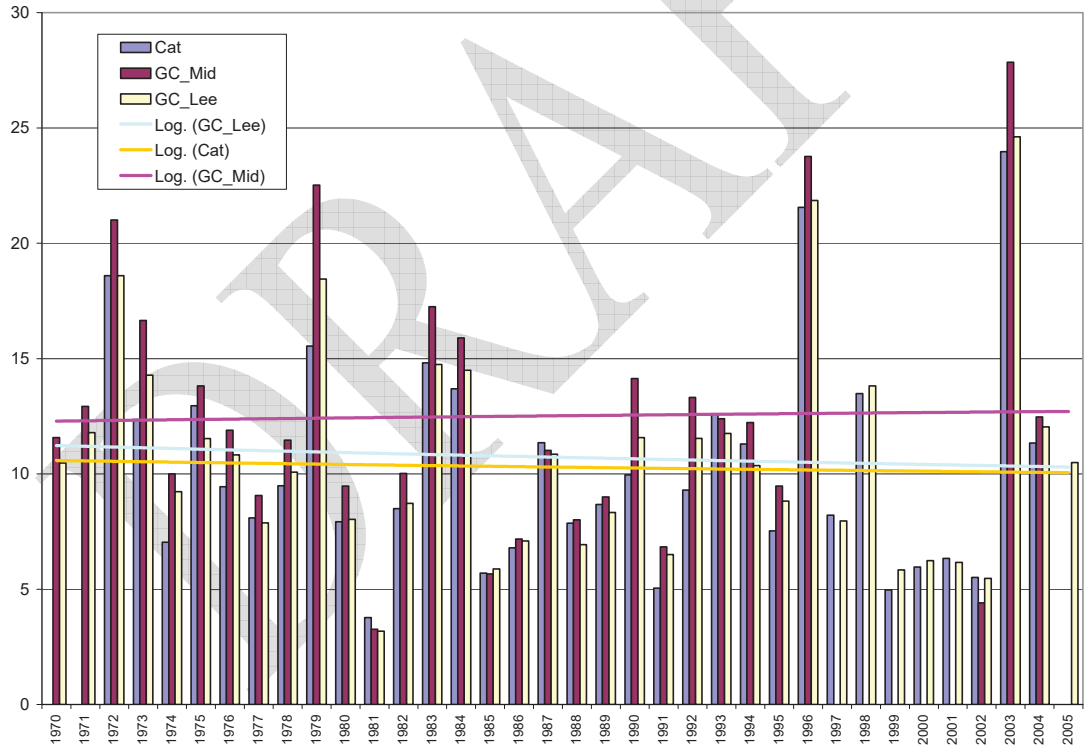
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1644000 Goose Creek (Leesburg)	GC_Lee	1934	2.72	1.33	0.79	1.6	6.45
1644000 Goose Creek (Leesburg)	GC_Lee	1935	5.08	3.43	0.38	2	10.88
1644000 Goose Creek (Leesburg)	GC_Lee	1936	7.31	0.89	0.05	1.04	9.29
1644000 Goose Creek (Leesburg)	GC_Lee	1937	4.67	2.88	1.28	3.6	12.43
1644000 Goose Creek (Leesburg)	GC_Lee	1938	3.27	1.27	0.18	1.18	5.89
1644000 Goose Creek (Leesburg)	GC_Lee	1939	5.15	1.7	0.16	0.46	7.47
1644000 Goose Creek (Leesburg)	GC_Lee	1940	2.57	2.95	0.28	3.17	8.97
1644000 Goose Creek (Leesburg)	GC_Lee	1941	2.73	1.38	0.3	0.25	4.65
1644000 Goose Creek (Leesburg)	GC_Lee	1942	2.4	0.94	1.8	5.97	11.1
1644000 Goose Creek (Leesburg)	GC_Lee	1943	4.04	2.15	0.09	0.26	6.54
1644000 Goose Creek (Leesburg)	GC_Lee	1944	3.69	0.92	0.06	1.53	6.2
1644000 Goose Creek (Leesburg)	GC_Lee	1945	2.83	1.22	3.6	3.93	11.57
1644000 Goose Creek (Leesburg)	GC_Lee	1946	3.83	2.43	0.55	1.1	7.92
1644000 Goose Creek (Leesburg)	GC_Lee	1947	2.77	1.15	0.32	0.64	4.88
1644000 Goose Creek (Leesburg)	GC_Lee	1948	3.06	2.74	1.76	7.47	15.04
1644000 Goose Creek (Leesburg)	GC_Lee	1949	4.82	2.32	0.51	1.08	8.73
1644000 Goose Creek (Leesburg)	GC_Lee	1950	3.53	1.92	1.26	4.38	11.09
1644000 Goose Creek (Leesburg)	GC_Lee	1951	6.27	2.32	0.05	0.49	9.13
1644000 Goose Creek (Leesburg)	GC_Lee	1952	5.74	4.03	0.57	2.56	12.9
1644000 Goose Creek (Leesburg)	GC_Lee	1953	6.33	2.25	0.11	0.42	9.12
1644000 Goose Creek (Leesburg)	GC_Lee	1954	1.67	1.29	0.08	1.63	4.68
1644000 Goose Creek (Leesburg)	GC_Lee	1955	2.63	1.05	1.83	0.94	6.46
1644000 Goose Creek (Leesburg)	GC_Lee	1956	4.13	0.81	2.3	2.74	9.99
1644000 Goose Creek (Leesburg)	GC_Lee	1957	4.4	1.57	0.15	2.68	8.8
1644000 Goose Creek (Leesburg)	GC_Lee	1958	5.73	1.89	1.11	0.38	9.11
1644000 Goose Creek (Leesburg)	GC_Lee	1959	1.35	1.95	0.06	0.75	4.1
1644000 Goose Creek (Leesburg)	GC_Lee	1960	3.96	2.7	0.68	0.4	7.74
1644000 Goose Creek (Leesburg)	GC_Lee	1961	4.09	3.11	0.15	0.9	8.24
1644000 Goose Creek (Leesburg)	GC_Lee	1962	3.26	0.87	0.15	0.67	4.95
1644000 Goose Creek (Leesburg)	GC_Lee	1963	3.78	0.57	0.08	0.86	5.29
1644000 Goose Creek (Leesburg)	GC_Lee	1964	5.45	2.11	0.15	1.35	9.05
1644000 Goose Creek (Leesburg)	GC_Lee	1965	6.74	0.8	0.08	0.16	7.78
1644000 Goose Creek (Leesburg)	GC_Lee	1966	1.72	1.45	0.45	1.88	5.51
1644000 Goose Creek (Leesburg)	GC_Lee	1967	4.67	0.48	1.09	2.25	8.5
1644000 Goose Creek (Leesburg)	GC_Lee	1968	4.5	1.47	0.17	1.4	7.53
1644000 Goose Creek (Leesburg)	GC_Lee	1969	2.88	0.43	0.24	0.68	4.23
1644000 Goose Creek (Leesburg)	GC_Lee	1970	3.9	2.61	0.53	3.43	10.47
1644000 Goose Creek (Leesburg)	GC_Lee	1971	4.82	3.3	0.52	3.15	11.79
1644000 Goose Creek (Leesburg)	GC_Lee	1972	5.43	7.18	-0.02	6.01	18.6
1644000 Goose Creek (Leesburg)	GC_Lee	1973	4.32	4.99	1.18	3.8	14.28
1644000 Goose Creek (Leesburg)	GC_Lee	1974	4.75	1.62	0.46	2.39	9.23
1644000 Goose Creek (Leesburg)	GC_Lee	1975	4.96	1.7	2.96	1.91	11.53
1644000 Goose Creek (Leesburg)	GC_Lee	1976	4.6	1.91	0.27	4.04	10.82
1644000 Goose Creek (Leesburg)	GC_Lee	1977	2.54	1.19	0.1	4.06	7.88
1644000 Goose Creek (Leesburg)	GC_Lee	1978	6.43	2.16	0.76	0.73	10.08
1644000 Goose Creek (Leesburg)	GC_Lee	1979	6.76	3.07	3.54	5.08	18.45
1644000 Goose Creek (Leesburg)	GC_Lee	1980	4.44	3.03	0.17	0.38	8.03
1644000 Goose Creek (Leesburg)	GC_Lee	1981	1.19	1.09	0.3	0.6	3.18
1644000 Goose Creek (Leesburg)	GC_Lee	1982	4.07	3.1	0.19	1.36	8.72
1644000 Goose Creek (Leesburg)	GC_Lee	1983	5.01	5.48	-0.12	4.37	14.74
1644000 Goose Creek (Leesburg)	GC_Lee	1984	10.43	2.12	0.73	1.22	14.5
1644000 Goose Creek (Leesburg)	GC_Lee	1985	2.79	0.36	0.02	2.7	5.88
1644000 Goose Creek (Leesburg)	GC_Lee	1986	4.45	1.43	0.04	1.17	7.09
1644000 Goose Creek (Leesburg)	GC_Lee	1987	4.43	4.08	0.28	2.05	10.85
1644000 Goose Creek (Leesburg)	GC_Lee	1988	3.19	3.16	0.16	0.42	6.93
1644000 Goose Creek (Leesburg)	GC_Lee	1989	2.84	4.16	0.57	0.76	8.33
1644000 Goose Creek (Leesburg)	GC_Lee	1990	2.47	3.3	1.22	4.58	11.58
1644000 Goose Creek (Leesburg)	GC_Lee	1991	5.62	0.6	0.01	0.26	6.5

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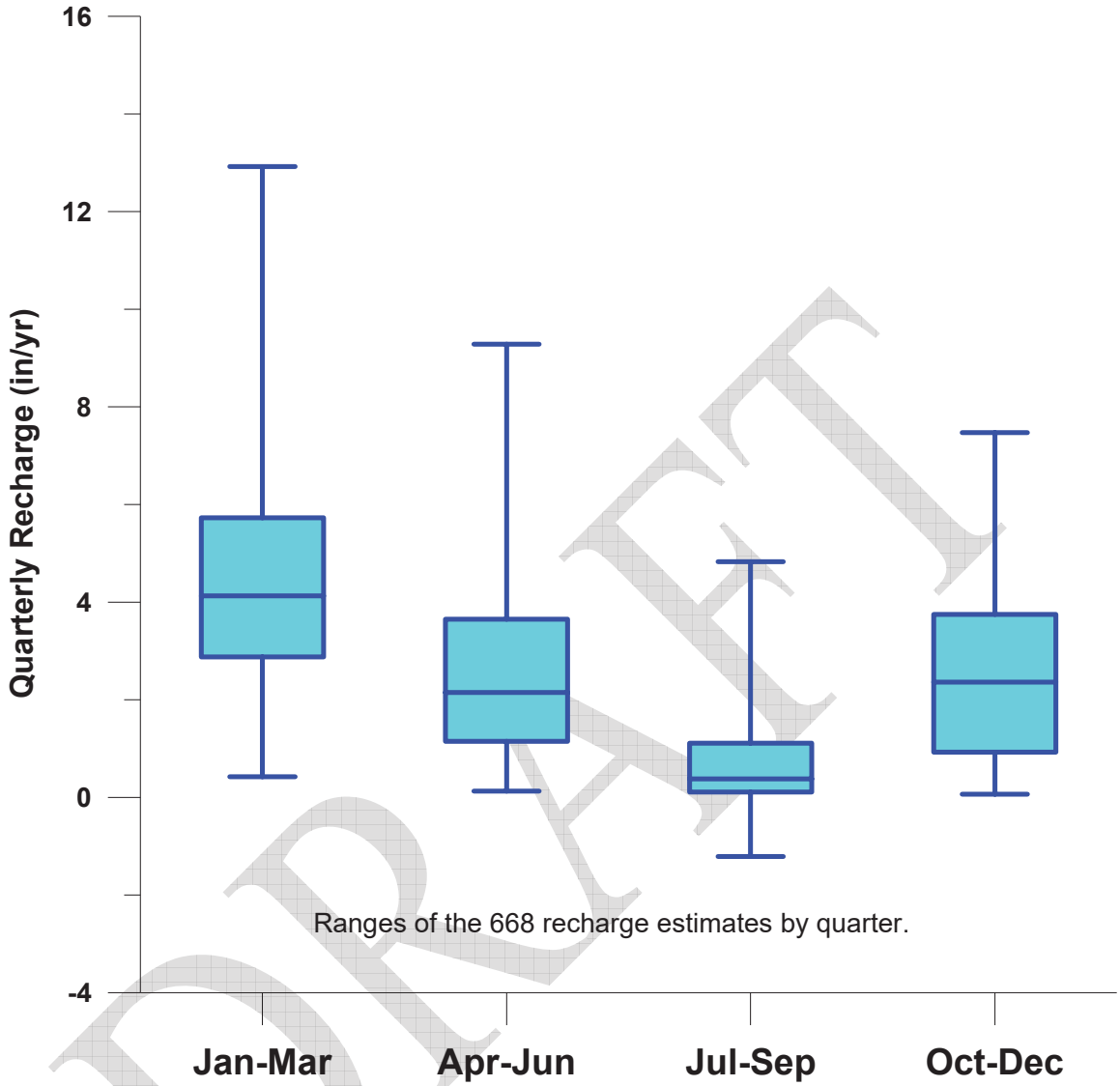
1644000 Goose Creek (Leesburg)	GC_Lee	1992	2.16	2.16	1.2	6.03	11.54
1644000 Goose Creek (Leesburg)	GC_Lee	1993	7.52	2.28	0.02	1.92	11.75
1644000 Goose Creek (Leesburg)	GC_Lee	1994	7.95	0.84	0.57	1	10.36
1644000 Goose Creek (Leesburg)	GC_Lee	1995	3.54	2.38	0.01	2.88	8.82
1644000 Goose Creek (Leesburg)	GC_Lee	1996	7.26	4.41	3.77	6.42	21.86
1644000 Goose Creek (Leesburg)	GC_Lee	1997	5.72	0.75	0.06	1.42	7.96
1644000 Goose Creek (Leesburg)	GC_Lee	1998	10.63	3.12	-0.08	0.13	13.81
1644000 Goose Creek (Leesburg)	GC_Lee	1999	2.31	0.6	1.33	1.58	5.84
1644000 Goose Creek (Leesburg)	GC_Lee	2000	3.23	1.75	0.61	0.65	6.24
1644000 Goose Creek (Leesburg)	GC_Lee	2001	4.06	1.4	0.35	0.35	6.16
1644000 Goose Creek (Leesburg)	GC_Lee	2002	0.9	1.08	0.07	3.42	5.47
1644000 Goose Creek (Leesburg)	GC_Lee	2003	7.1	7.52	3.55	6.46	24.62
1644000 Goose Creek (Leesburg)	GC_Lee	2004	3.01	4.44	1.32	3.27	12.04
1644000 Goose Creek (Leesburg)	GC_Lee	2005	3.02	4.08	0.75	2.65	10.49
1644280 Broad Run	BR	2002	1.1	1.14	0.48	2.97	5.7
1644280 Broad Run	BR	2003	3.2	4.91	1.46	4.25	13.81
1644280 Broad Run	BR	2004	2.3	2.09	1.16	1.77	7.33
1644280 Broad Run	BR	2005	3.48	1.39	0.73	2.4	8.01

Below is a graph of annual recharge for three stations from 1970 to present. The Excel trend line indicates a slight decrease in recharge at Catoctin Creek and Goose Creek Leesburg stations.



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Recharge varies seasonally with lowest recharge occurring in the summer months (July-September). In the following graph, all 668 recharges estimates are shown.



Ranges of the 668 recharge estimates by quarter.

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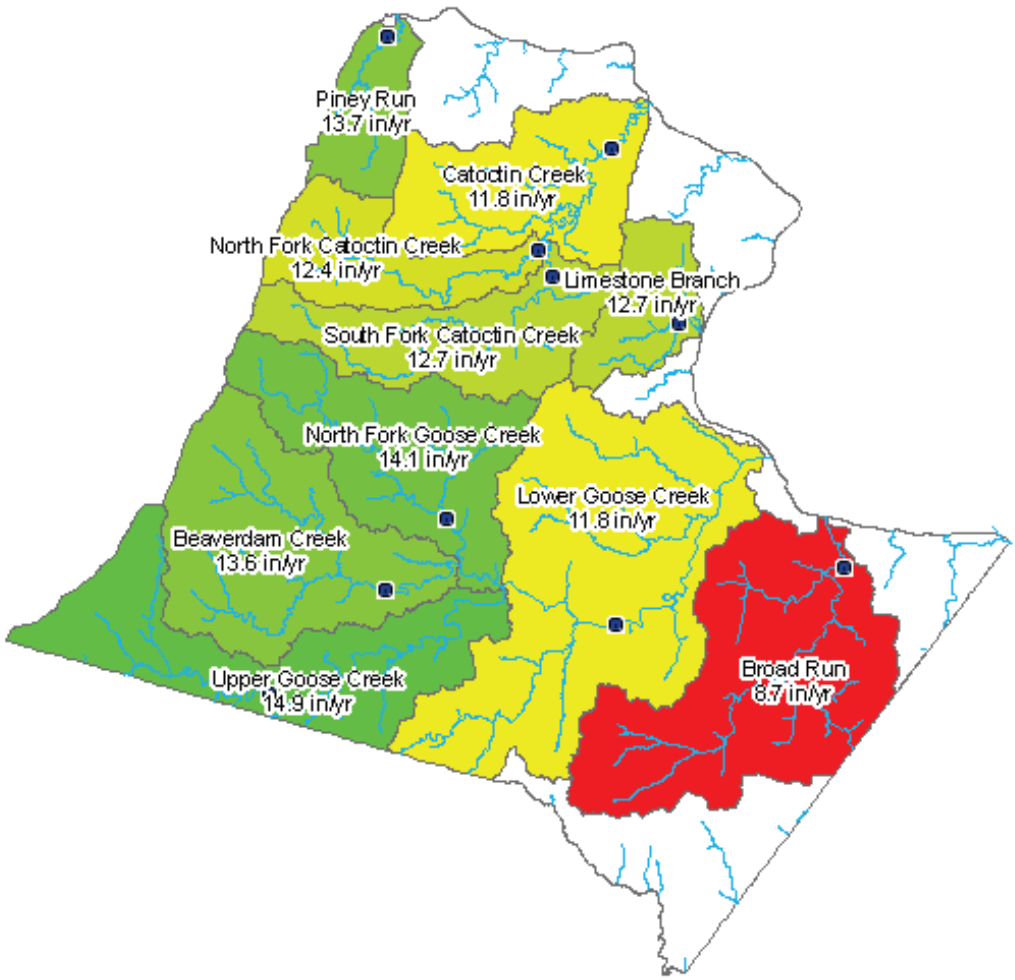
Taking annual averages for each station from the above quarterly data range from a high of over 14 inches per year in the headwaters of Goose Creek (North Fork Goose Creek) to a low of less than 9 inches per year at Broad Run.

Name	Abbreviation	Site_no	Year of First Complete Record	Annual Average for Entire Record (in/yr)	Annual Average for Recent 2002-2005 (in/yr)
South Fork Catoctin	SF_Cat	1638350	2002	12.67	12.67
North Fork Catoctin	NF_Cat	1638420	2002	12.36	12.36
Catoctin	Cat	1638480	1972	10.29	11.79
Piney Run	Piney	1636690	2002	13.72	13.72
Limestone Branch	Lime	1643590	2002	12.66	12.66
North Fork Goose Creek	NF_GC	1643805	2002	14.12	14.12
Beaver Dam Creek	Beaver	1643880	2002	13.62	13.62
Goose Creek (Middleburg)	GC_Middle	1643700	1970	12.49	14.91
Goose Creek (Leesburg)	GC_Lee	1644000	1930	9.26	11.76
Broad Run	BR	1644280	2002	8.71	8.71
Average				**11.99**	**12.63**

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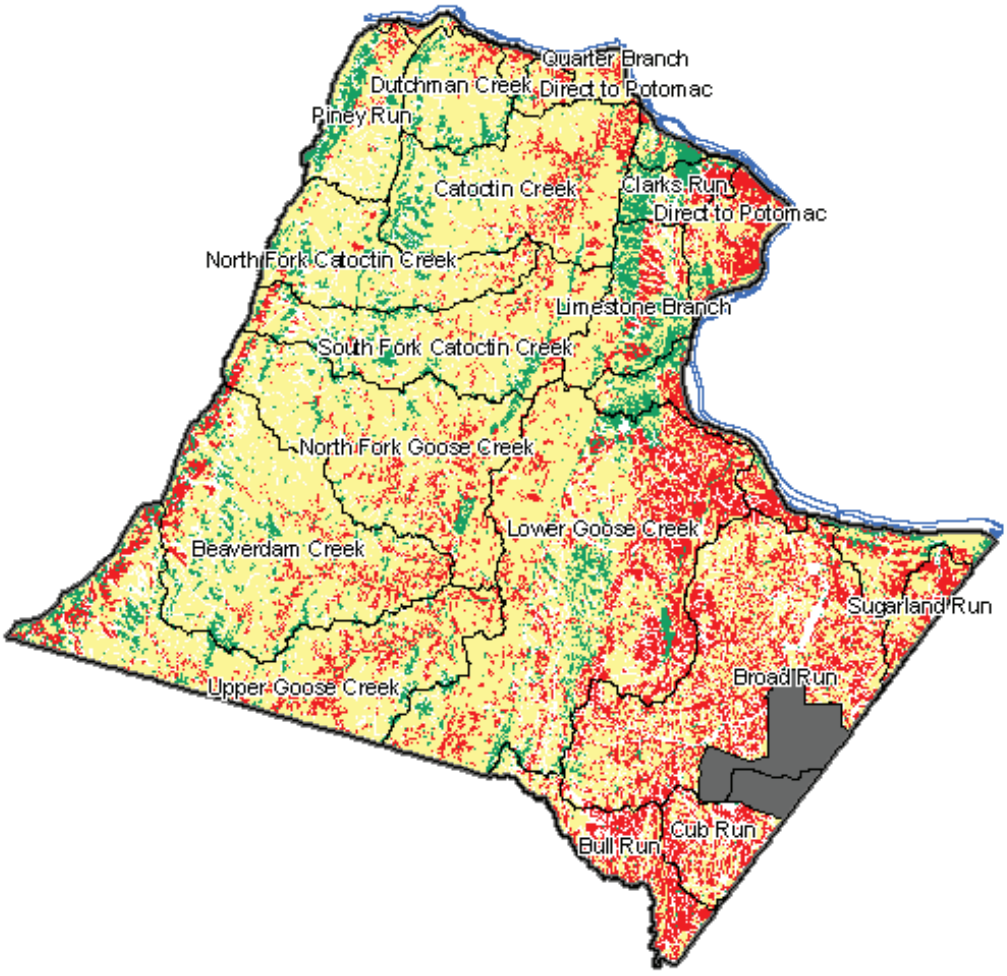
Spatial Distribution:

Stream gages cover most of the major watershed in Loudoun County. The highest recharge is generally observed in the headwater subwatersheds. The lowest recharge is in Broad Run, due to a combination on increased imperviousness, stormwater infrastructure, lesser terrain slope and soil types. The spatial distribution of the recent (2002-2005) data are shown in the below figure.



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Based on soil type, a “potential” groundwater recharge classification has been established. There is general agreement between the recharge calculated from streamflow and recharge “potential” east of Bull Run fault where there is less recharge in the Broad Run watershed.



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Published Recharge Estimates

The USGS has published recharge estimates at selected sites in Loudoun County. Calculations were performed using partial records (PR) using 9 to 11 stream flow measurements and from complete records (CR) where longer term gaging stations had been established. Published data appear in publications Hayes, 1991 and Nelms, et al, 1977.

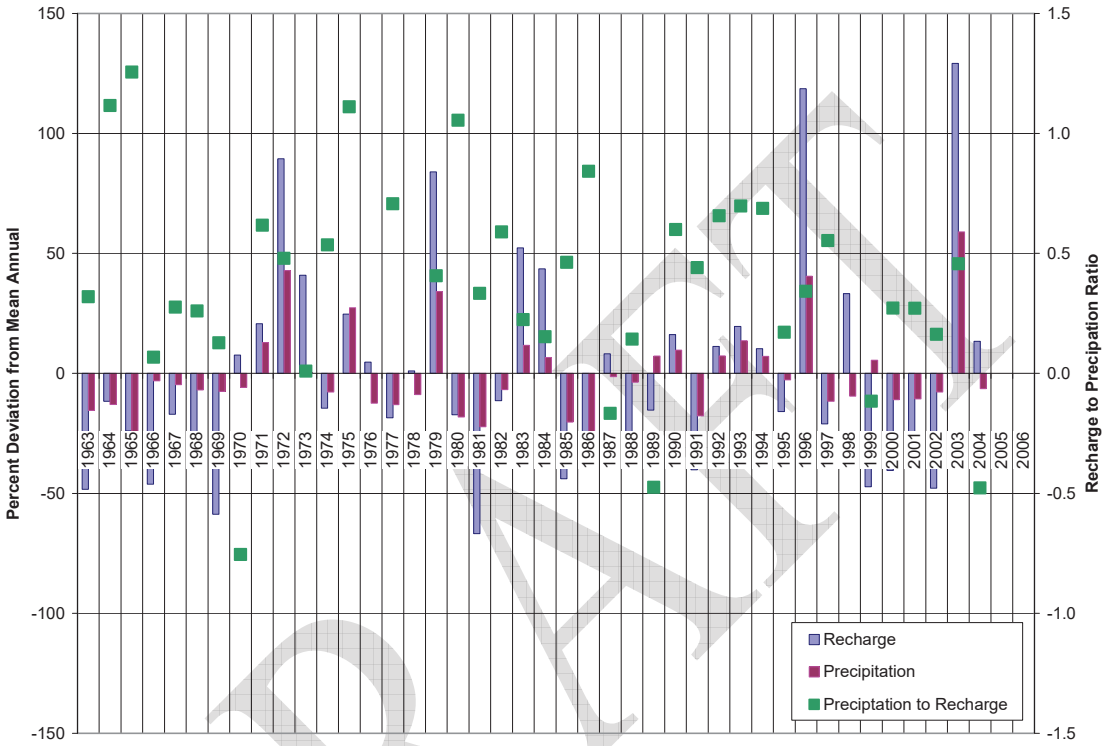
Published USGS					Calculations using RORA				
Station number	Station name	Period of record	Site type	Effective recharge (in/yr)	Period of record	Effective recharge (in/yr)	Period of record	Days in Record	Effective recharge (in/yr)
1636690	Piney Run near Lovettsville	Prior to 1997	PR	8.67			2003-2007	1,825	13.72
1638480	Catoctin Creek at Taylorstown	1973-84	CR	9.18	1973-84	10.94	1973-2007	12,782	10.29
1643700	Goose Creek near Middleburg	1967-84	CR	10.72	1967-84	13.12	1967-2007	14,974	12.49
1644000	Goose Creek near Leesburg	1931-84	CR	7.79	1931-84	8.91	1911-2007	35,428	9.263

Overall the published effective recharge values in 1984 are less than those calculated using the RORA program. The reason is likely the methodology used.

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Comparison with Precipitation

The recharge estimates are compared with monthly precipitation data from Dulles Airport for the period 1963 to 2006. Expectedly, above average precipitation correlates with above average recharge, however, using mean annual values, magnitude of the recharge deviations from the average is greater than those for precipitation.



The ration of recharge to precipitation to often between 0.1 to 0.7 which implies that precipitation is typically 1.5 to 10 times the calculated recharge. There are occasionally years when precipitation is below average and recharge is above average and visa versa.

Temporal Changes in Recharge

Have there been temporal changes in recharge? We can't examine all ten gages as seven have limited data. Using simple Excel trend fit shows that the three gages are trending downwards somewhat. We need to examine recharge concurrent with precipitation. How about cumulative recharge versus cumulative rainfall?

References

Hayes, D. C., 1971, Low-Flow Characteristics of Streams in Virginia, USGS Water Supply Paper WSP 2374, 69 p.

Nelms, D. L., G. E. Harlow and D. C. Hayes, 1977, Base-Flow Characteristics of Streams in the Valley and Ridge, the Blue Ridge and the Piedmont Physiographic Provinces of Virginia, USGS Water Supply Paper WSP 2457, 48 p.

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Rutledge, A. T., 1998, Computer programs for describing the recession of ground-water discharge and for estimating mean ground-water recharge and discharge from streamflow data – update: U.S. Geological Survey Water-Resources Investigations Report 98-4148, 43 p.

Rutledge, A. T., 2000, Considerations for use of the RORA program to estimate ground-water recharge from streamflow records: U.S. Geological Survey Open-File Report 00-156, 44 p.

Rutledge, A. T., 2003, Use of RORA for complex ground-water flow conditions: U.S. Geological Survey Water-Resources Investigations Report 03-4304, 5 p.

Rutledge, A. T., 2007, Update on the Use of the RORA Program for Recharge Estimation, Ground Water: 45 (3), 374–382.

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Low Flow and Baseflow Statistics from Streamflow Records

Background

Low-flow, base-flow, and mean-flow characteristics are an important part of assessing water resources in a watershed. These streamflow characteristics can be used by watershed planners and regulators to determine water availability, water use allocations, assimilative capacities of streams, and aquatic-habitat needs. Streamflow characteristics are commonly predicted by use of regression equations when a nearby streamflow-gaging station is not available.

Low flow and base flow are measures of streamflow that can help to identify environmentally vulnerable (stressed) watershed A more complete definition of stress includes streamflow quantity, quality and habitat factors.

In the 1999 work plan for the Massachusetts Water Resource Commission (WRC), these stresses are defined as:

Quantity: A significant reduction in streamflow is defined as a decrease in key low and high streamflow statistics. Low flows in most of Massachusetts reflect ground water levels and are a good indicator of the health of a system. Reduced low flows can impact aquatic habitat and water quality. In addition, low flows are often the first indicator of environmental impacts.

Quality: A degraded water quality is defined as water in a stream that does not meet surface water quality standards.

Habitat Factors: A degraded habitat is defined as a river reach in which key habitat factors, such as temperature, quality, cover, substrate and accessibility, necessary to sustain a biologically diverse community are degraded. The stress can be due to a lack of streamflow, quality degradation, presence of dams, channel modifications, culverting and other factors. Indicators of stressed habitat include the absence or degradation of a target fish or other aquatic community or the absence of the ability of fish to move between multiple habitats necessary to their life cycles. Factors that limit movement include lack of flow, or reaches with no flow, and the presence of dams or other restrictions that prevent passage.

Low flow statistics often include the “7Q10” value (defined below).

7Q10: The streamflow that occurs over 7 consecutive days and has a 10-year recurrence interval period, or a 1 in 10 chance of occurring in any one year. Daily streamflows in the 7Q10 range are general indicators of prevalent drought conditions which normally cover large areas. 7Q10 values are also used by the State for regulating water withdrawals and discharges into streams.

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30Q2 : The streamflow that occurs over 30 consecutive days and has a 2-year recurrence interval period, or a 1 in 2 chance of occurring in any one year. Daily streamflows in the 30Q2 range are general indicators of initial drought conditions which may cover large areas, and may be used by State regulators in determining water-use restrictions.

http://ga2.er.usgs.gov/lowflow/helplowflowstats.cfm

EPA has found that: "In 1986, the EPA determined that the hydrological-based 7Q10 design flow was similar to the biologically-based 4B3 design flow and recommended the use of either design flow for water quality standards and toxic wasteload allocation studies relating to chronic effects on aquatic life. Although the 7Q10 is used by about half the states in the nation, the 7Q10 is sometimes characterized as being either overprotective or under-protected of aquatic life in various areas of the country. States regularly propose alternative hydrologically-based design flow statistics for their water quality standards (in the form of xQy where x is the duration and y is the frequency). For example, one state currently uses the 3Q2 statistic for conventional pollutants and several other states use a 7Q2 statistic. States often justify the use of a design flow other than 7Q10 on the basis of different hydrogeology. States sometimes suggest the use of a percentile flow (e.g., the 4th percentile) on the basis of ease of calculation and communication with the public."
(http://www.epa.gov/waterscience/models/dflow/apps.htm)

In Massachussetts, both the 7Q10 and August Median flows for the sub-basin are used in their assessment of stressed streams.

In PA, Q7,10; Q7,2; Q30,10; Q30,2; and Q90,10 low-flow characteristics have been studied. http://pubs.usgs.gov/sir/2006/5130/pdf/sir2006-5130.pdf

Seasonal Streamflow Conditions and Historic Droughts in Virginia
(From http://va.water.usgs.gov/drought/histcond.htm)

In a typical year, highest streamflows occur during the winter months, decreasing through the spring and summer, with lowest streamflows occurring during the fall months. During the winter of 1998, above average precipitation recharged the ground-water system, which in turn, maintained streamflows in the above normal range of flows. Even though there was below average precipitation during the spring and summer of 1998, streamflows did not fall below normal until September of that year because of the high ground-water storage. With continued dry conditions in the fall, ground-water storage became depleted, and streamflows continued to decline to levels near those observed in past droughts. Streamflows remained in the below normal range during the winter of 1999 because precipitation was insufficient to fully recharge the ground-water system. During base-flow conditions (non-storm runoff), streams had about one-third of the flow during the winter of 1999 than they had during the winter of 1998. The already depleted ground-water storage conditions combined with less than normal precipitation during the past three months has resulted in continued low streamflows. June streamflows are

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already at or near typical annual low flow values, and streamflows are expected to continue to decline through the summer.

There have been four major Statewide droughts since the early 1900's. The drought of 1930-32 was one of the most severe droughts recorded in the State. Recurrence intervals ranged from 30 years to greater than 80 years. The droughts of 1938-42 and 1962-71 were less severe; however, the cumulative streamflow deficit for the 1962-71 drought was the greatest of the four droughts because of the duration of this drought. The drought of 1980-82 was the least severe and had the shortest duration. Recurrence intervals in the 1980-82 drought ranged from 15 years across most of the State to greater than 80 years in the James River Basin.
Last modified: 03/12/02

Base and Low flow in Loudoun County

In Loudoun County, there are three stream gages with long periods of record (more than 20 years) and seven gages with only a few years of data. Because it is not possible to calculate 7Q10 on the newer stream gages, other statistics are be analyzed also.

August Median Flows:

(Need to rewrite) "August median flows at streamgaging stations can be determined by two methods. The U.S. Fish and Wildlife Service (USFWS) (1981) recommends calculating August median streamflows as the median value of the annual series of August monthly mean streamflows for the period of record at a gaging station. The USFWS uses the August median flow calculated in this manner as the minimum streamflow required for summertime maintenance of habitat for biota in New England streams."

"Charles Ritzi and Associates (1987) suggested calculating August median flows as the median of the daily mean flows for all complete Augusts during the period of record at a streamgaging station. Kulik (1990) and Ries (1997) also used this method for calculating August median flows. This method typically results in values of August median flows that are somewhat lower than those determined by use of the method suggested by the USFWS. The monthly mean values used by the USFWS to calculate August median flows tend to be skewed by infrequent storm events that cause the monthly means to be larger than the medians, thus "the median is a more useful statistic than the mean for describing the central tendency" of the daily data (Kulik, 1990)." page 9
http://pubs.usgs.gov/wri/wri004135/pdf/report.pdf

Importance of minimum base flow

0.50 ft3/s/mi2, the ABF low-flow value recommended to "sustain and perpetuate indigenous aquatic fauna" (U.S. Fish and Wildlife Service, 1981). page 63
http://pubs.usgs.gov/wri/wri034330/pdf/wrir034330.pdf and
http://des.nh.gov/Rivers/instream/Archive/lang_policy.pdf

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References:

U.S. Fish and Wildlife Service, 1981, Interim regional policy for New England streamflow recommendations: Newton Corner, MA, U.S. Fish and Wildlife Service, 3 p.

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Streamflow Drainage Areas at USGS Stream Monitoring Sites

Background

For each stream gaging station it is important to know the drainage or contributing area. The area is subsequently used in streamflow analysis such as recharge calculation from recession curves using the RORA computer program. The USGS provides calculations of the drainage area for each of the ten stream stations in Loudoun.

Summary of Primary Loudoun Stations:

The drainage area, in square miles, is included in the GIS for the 39 USGS station locations. Note that most of these stations are generally inactive, but are listed in the USGS inventory of sites.

Additionally, the USGS has rechecked and verified these calculations for all 39 stations in Virginia in the report:

> Hayes, D. C. and U, Wiegand, 2006, USGS Open-File Report 2006-1308, "Drainage Areas of Selected Streams in Virginia", http://pubs.usgs.gov/of/2006/1308/

The drainage area is tabulated as:

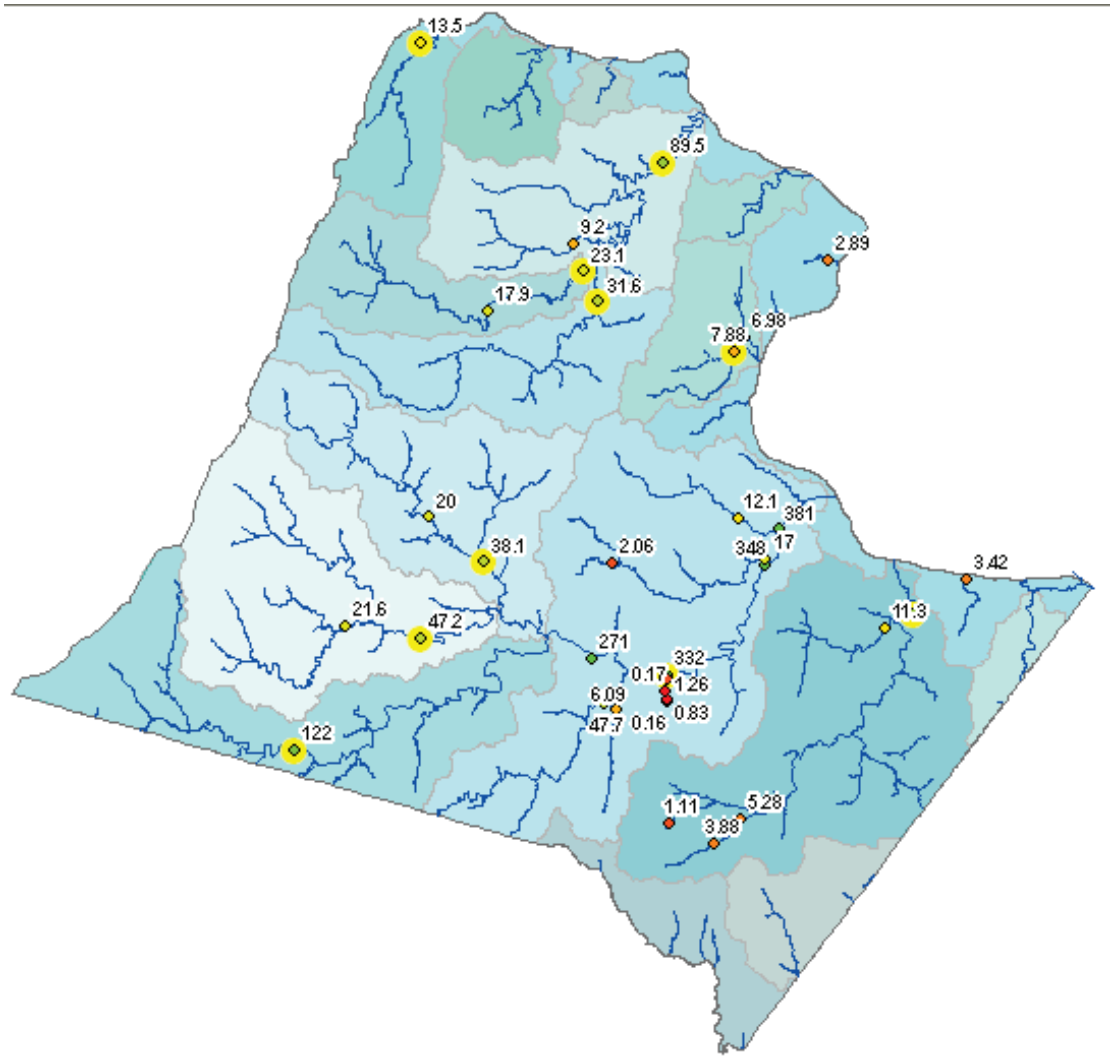
Station Number	Station Name	Drainage Area (sq miles)
1636690	PINEY RUN NEAR LOVETTSVILLE, VA	13.50
1638350	S F CATOCTIN CREEK AT RT 698 NEAR WATERFORD, VA	31.60
1638420	N F CATOCTIN CREEK AT RT 681 NEAR WATERFORD, VA	23.10
1638480	CATOCTIN CREEK AT TAYLORSTOWN, VA	89.50
1643590	LIMESTONE BRANCH NEAR LEESBURG, VA	7.88
1643700	GOOSE CREEK NEAR MIDDLEBURG, VA	122.00
1643805	N F GOOSE CREEK AT RT 729 NEAR LINCOLN, VA	38.10
1643880	BEAVERDAM CREEK AT RT 734 NEAR MOUNTVILLE, VA	47.20
1644000	GOOSE CREEK NEAR LEESBURG, VA	332.00
1644280	BROAD RUN NEAR LEESBURG, VA	76.10
1638400	N F CATOCTIN CREEK AT RT 9 NEAR HILLSBORO, VA	17.90
1638450	RICHARD CREEK NEAR WATERFORD, VA	9.20
1643585	POTOMAC RIVER TRIB NO 1 NEAR LUCKETTS, VA	2.89
1643587	LIMESTONE BR TRIB NO. 2 AT PVT RD NR LUCKETTS, VA	
1643600	LIMESTONE BRANCH TRIB NO 1 NEAR LEESBURG, VA	6.98

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1643610	BIG SPRING NEAR LEESBURG, VA	
1643800	NORTH FORK GOOSE CREEK NEAR LINCOLN, VA	20.00
164380375	CROOKED RUN NEAR LINCOLN, VA	
1643820	BEAVERDAM CREEK NEAR UNISON, VA	21.60
1643950	GOOSE CREEK AT OATLANDS, VA	271.00
1643988	LITTLE RIVER NEAR OATLANDS, VA	47.70
1643990	HOWSERS BRANCH NEAR OATLANDS, VA	6.09
1644005	BLACK BRANCH ABOVE TRIBUTARY NO. 1 NEAR WATSON, VA	
1644010	BLACK BRANCH TRIB NO 1 NEAR WATSON, VA	0.16
1644015	BLACK BRANCH NEAR WATSON, VA	0.83
1644020	BLACK BRANCH TRIB NO 2 NEAR WATSON, VA	0.17
1644025	BLACK BRANCH BELOW RT 860 NEAR WATSON, VA	1.26
1644090	GOOSE CREEK AB SYCOLIN CREEK NEAR LEESBURG, VA	348.00
1644100	S F SYCOLIN CREEK NEAR LEESBURG, VA	2.06
1644110	SYCOLIN CREEK NEAR LEESBURG, VA	17.00
1644115	DRY MILL BRANCH ALONG RT 699 NEAR LEESBURG, VA	
1644120	TUSCARORA CREEK ABOVE STP NEAR LEESBURG, VA	12.10
1644133	GOOSE CREEK AT ROUTE 7 NEAR ASHBURN, VA	381.00
1644200	LENAH RUN AT LENAH, VA	1.11
1644250	S F BROAD RUN NEAR ARCOLA, VA	3.88
1644255	S F BROAD RUN AT ARCOLA, VA	5.28
1644272	MERRYBROOK RUN (EAST BRANCH) NEAR HERNDON, VA	
1644277	BEAVERDAM RUN NEAR ASHBURN, VA	11.30
1644283	POTOMAC RIVER TRIB NO 2 NEAR STERLING, VA	3.42

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Below is a map with the ten primary stations highlighted:



REF: O:\project\wrmp\USGS_Site_Inventory\ and
O:\project\wrmp\USGS_Streamflow\USGS_Streamflow_Drainage_Area_Map01.mxd

Note: The GIS polygons of drainage area for each station has not been obtained.

Published USGS					Calculations using RORA				
Station number	Station name	Period of record	Site type	Effective recharge (in/yr)	Period of record	Effective recharge (in/yr)	Period of record	Days in Record	Effective recharge (in/yr)
1636690	Piney Run near Lovettsville	Prior to 1997	PR	8.67			2003-2007	1,825	13.72
1638480	Catoctin Creek at Taylorstown	1973-84	CR	9.18	1973-84	10.94	1973-2007	12,782	10.29
1643700	Goose Creek near Middleburg	1967-84	CR	10.72	1967-84	13.12	1967-2007	14,974	12.49
1644000	Goose Creek near Leesburg	1931-84	CR	7.79	1931-84	8.91	1911-2007	35,428	9.263

[Latitude and longitude are reported in degrees, minutes, and seconds; PR, partial-record gaging station; CR, continuous-record gaging station; mi2, square mile; ft3/s, cubic foot per second; in/yr, inch per year; Q50, Q90, and Q95, indicate the 50-, 90-, and 95-percent discharge on the streamflow-duration curve, respectively; 7Q2 and 7Q10, indicate the annual minimum average 7-consecutive-day low-flow discharge having 2-year and 10-year recurrence intervals, respectively; dashes (-) indicate value could not be determined]

http://va.water.usgs.gov/vadeq_data/citycount_scroll.htm

Generally there is a decrease in the baseflow calculations in the recent calculations as compared to the older historic one calculated in mid 1980's. Exceptions are Piney and Broad Run in which the recent stream flow measurements are higher accuracy, but only a short period of record.

The decline in baseflow may be associated with suburban development and changes in land use.

Previously Published									
Station number	Station name	Period of record	Site type	Number of Discharge Values	Drainage area (mi2)	Mean base flow (ft3/s)	7Q2 (ft3/s) Historic	7Q10 (ft3/s) Historic	Base-flow variability index
1636690	Piney Run near Lovettsville	Prior to 1997	PR	11	13.7	8.75	0.53	0.11	0.93
1638480	Catoctin Creek at Taylorstown	1973-84	CR	-	89.6	60.6	6.8	2.9	0.75
1643585	Potomac River Tributary No 1 near Lucketts	Prior to 1997	PR	-	2.95		0.1	0.04	0.65
1643600	Limestone Branch Tributary No 1 near Leesburg	Prior to 1997	PR	-	6.82		1.2	0.6	0.39
1643700	Goose Creek near Middleburg	1967-84	CR		123	97.1	6	0.71	0.91
1643800	North Fork Goose Creek at Route 722 near Lincoln	Prior to 1997	PR	9	24		1.1	0.34	
1643950	Goose Creek at Oatlands	Prior to 1997	PR	9	276	138	12	2.9	0.82
1643988	Little River near Oatlands	Prior to 1997	PR	-	47.7	26	2.1	0.5	0.81
1643990	Howsers Branch near Oatlands	Prior to 1997	PR	-	5.98		0	0	
1644000	Goose Creek near Leesburg	1931-84	CR		332	191	12	2.5	0.91
1644255	South Fork Broad Run at Arcola	Prior to 1997	PR	-	5.31	0.8	0.01	0	1.76
1644277	Beaverdam Run near Ashburn	Prior to 1997	PR	-	11.2		0	0	
1644280	Broad Run near Leesburg	Prior to 1997	PR	-	76.1		0.28	0.02	
1644283	Potomac River Tributary No 2 near Sterling	Prior to 1997	PR	-	3.47		0	0	

Current Calculations using DFLOW3					
Stream Gages	Station_ID	Period of record	Days in Record	7Q2 (ft3/s) Current	7Q10 (ft3/s) Current
Piney Run	1636690	2003-2007	1,825	1.03	
South Fork Catoctin	1638350	2003-2007	1,825	1.78	
North Fork Catoctin	1638420	2003-2007	1,825	0.56	
Catoctin	1638480	1973-2007	12,782	4.81	0.63
Limestone Branch	1643590	2003-2007	1,825	1.43	
Goose Creek (Middleburg)	1643700	1967-2007	14,974	4.56	0.02
North Fork Goose Creek	1643805	2003-2007	1,825	3.07	
Beaverdam Creek	1643880	2003-2007	1,825	0.31	
Goose Creek (Leesburg)	1644000	1911-2007	35,428	10.4	1.77
Broad Run	1644280	2003-2007	1,825	4.03	

Using RORA for Recharge Calculations

Prepared by: David Ward
Date: Feb 8, 2007, Updated 5/23/2007 and 6/28/2007

Reference:

http://water.usgs.gov/ogw/rora/

RORA: The recession-curve-displacement method for estimating recharge

This web site includes information about the use of the RORA computer program for analyzing a streamflow record. The version at this site will read streamflow data in the format that is available from USGS web sites.

The computer program RORA estimates ground-water recharge using the recession-curve-displacement method. The method is based on the change in total potential ground-water discharge that is caused by each recharge event.

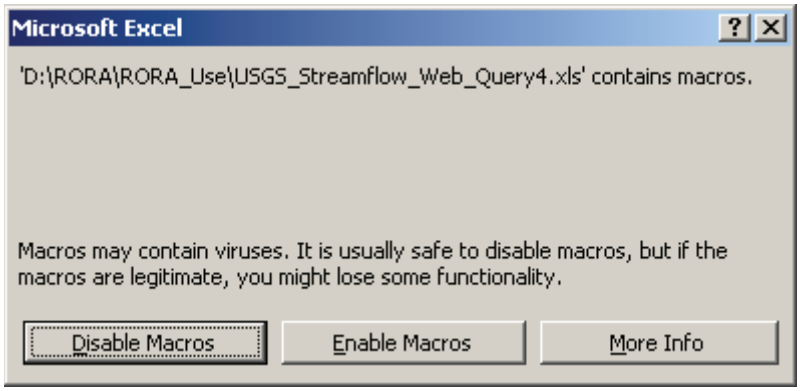
- Download software executable files and sample data sets (690kb ZIP file, updated January 2007)
  - Download README file describing files included in ZIP file
  - Download fortran source code (ZIP file)
  - Download user's manual (PDF file)

- **Background Literature**
  - Computer programs for describing the recession of ground-water discharge and for estimating mean ground-water recharge and discharge from streamflow records: USGS WRIR 98-4148.
  - Considerations for use of the RORA program to estimate ground-water recharge from streamflow records: USGS OFR 00-156.
  - Testing an automated method to estimate ground-water recharge from streamflow records: Ground Water, vol. 32, no. 2, pp. 180-189, 1994.
  - Use of RORA for complex ground-water flow conditions: USGS WRIR 03-4304

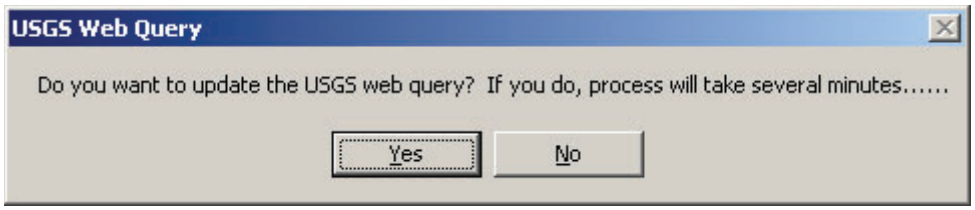
Instructions:

Start by copying and opening the USGS stream flow web query. The master files is located at "G:\BLDG_DEV\Engineering\H2O Team\WRMP\USGSFlowData\web_query_all_dates_flow_only"

Select yes, to: "Enable Macros":

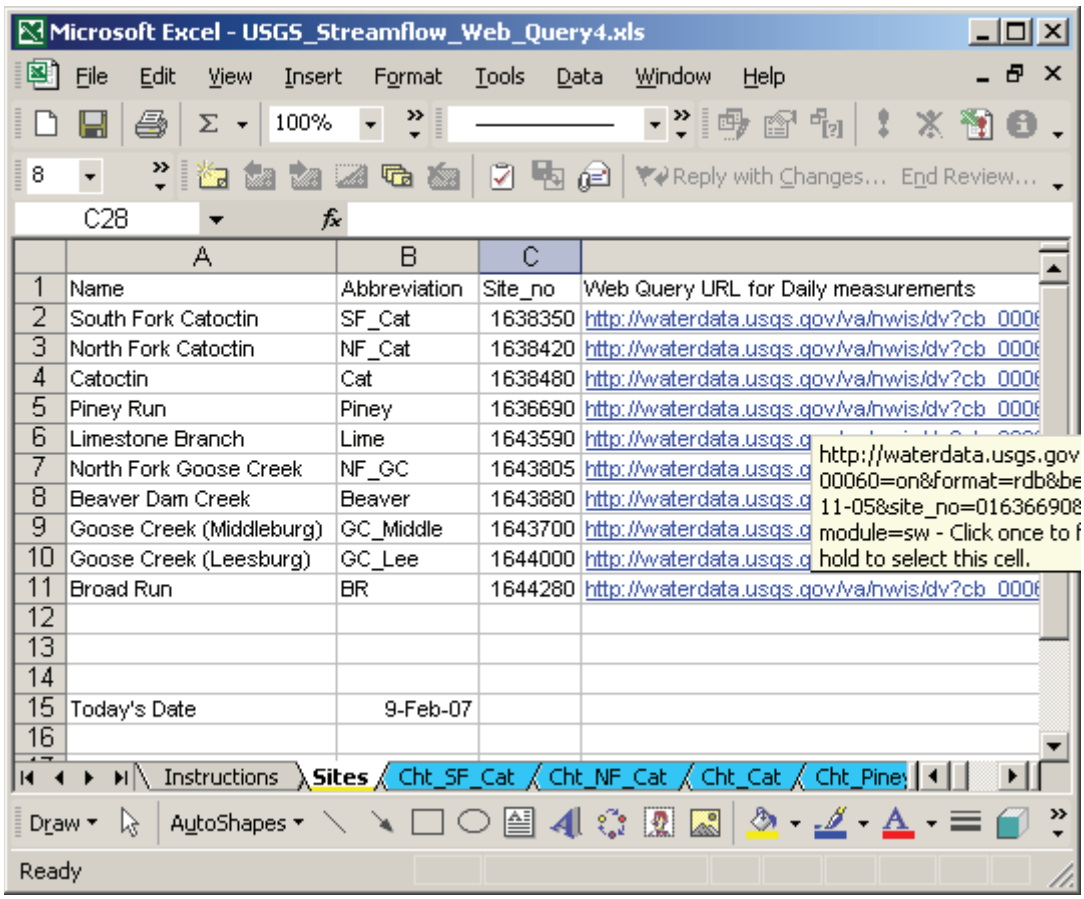


Select "Yes" to update data in which all historic data will be loaded.

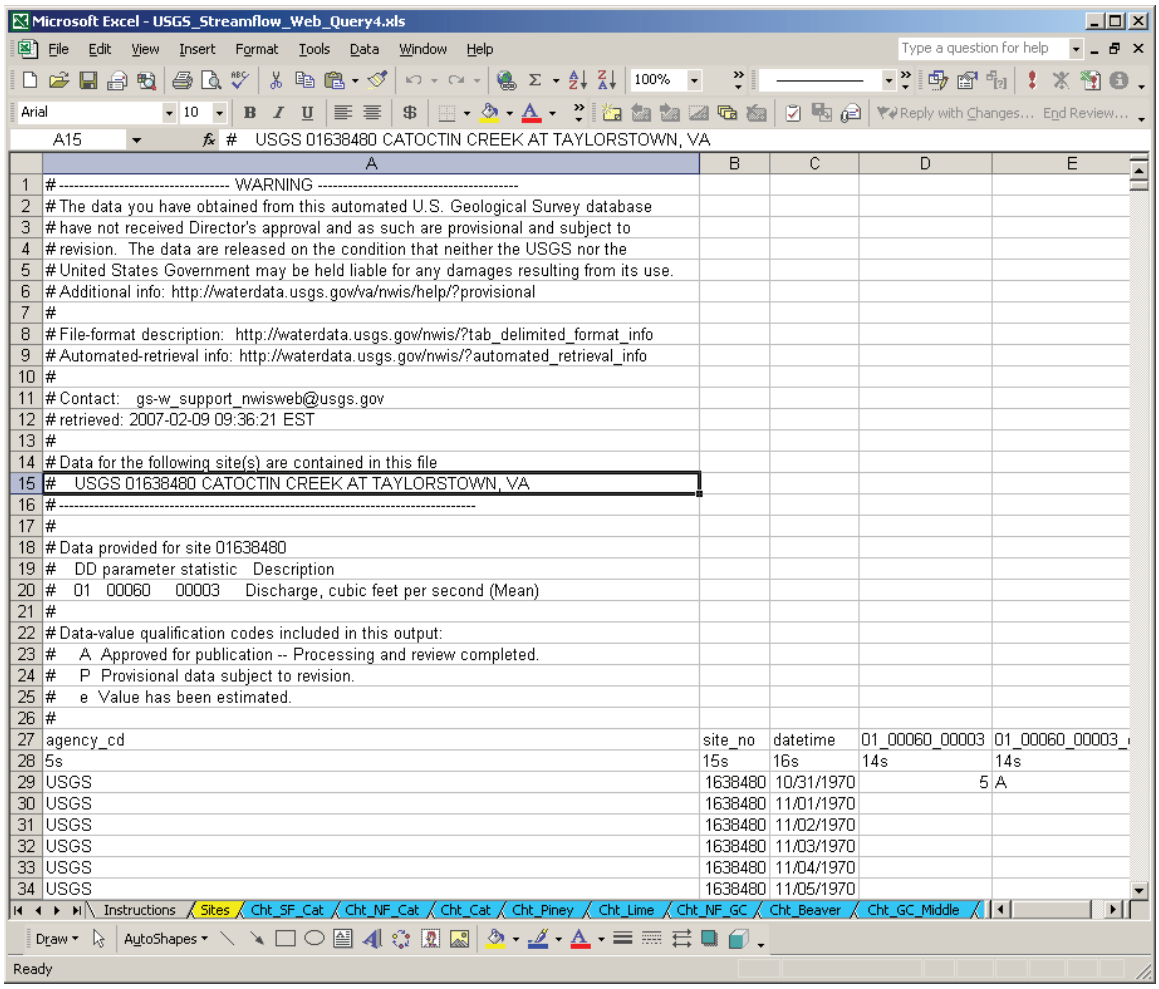


Wait a while. In lower left corner you will see the spreadsheet hitting the USGS NWIS file server for the ten gages.

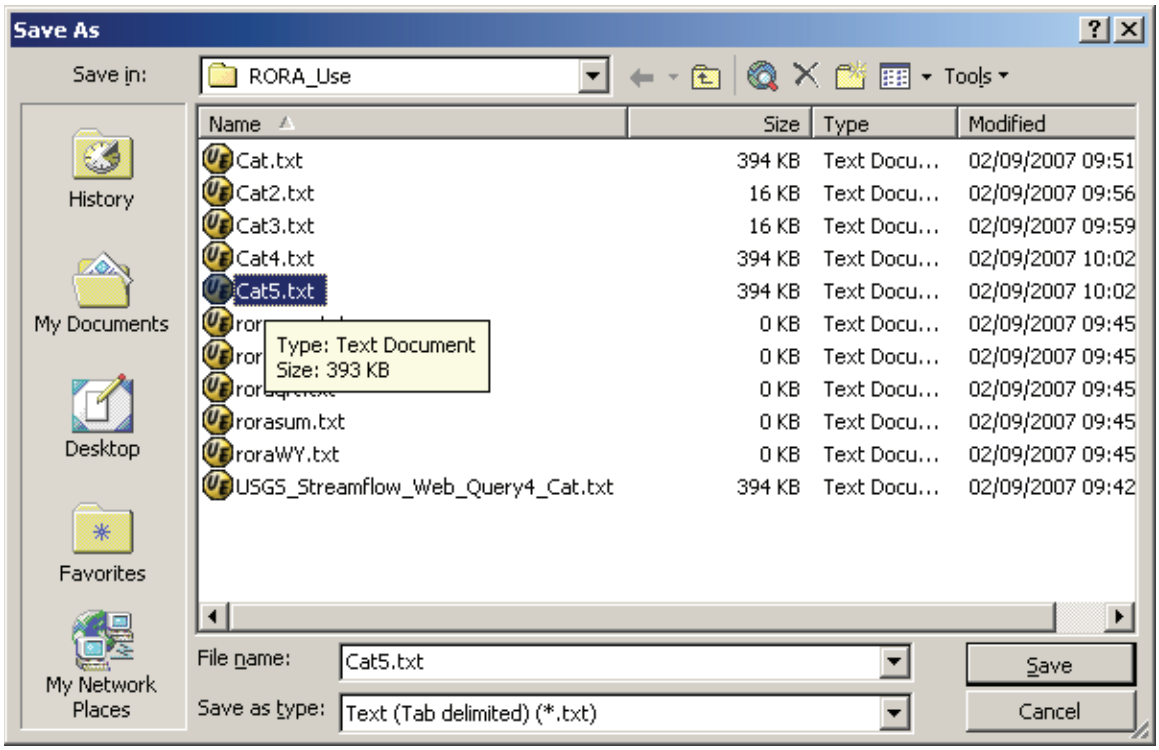
This will result in a spreadsheet with 10 tabs for the 10 gages which may be saved as tab-delimited text files.



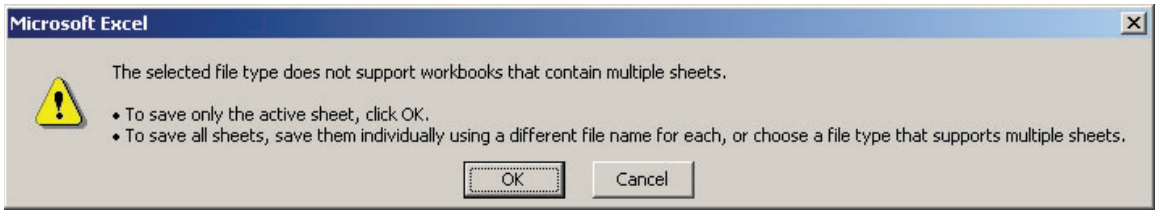
For example go to the tab “Cat”.



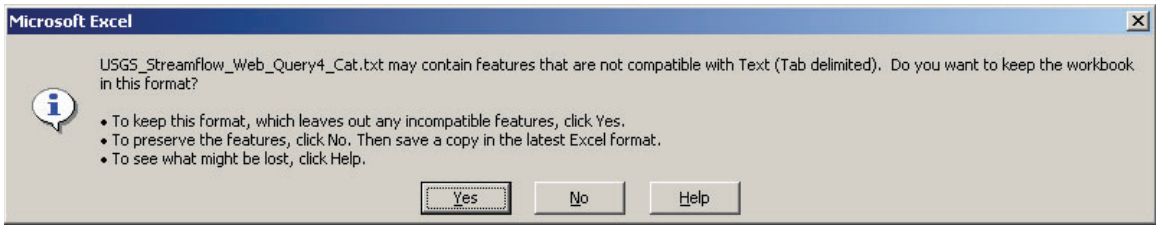
Now save a tab-delimited file using short file name (less than 12 characters.



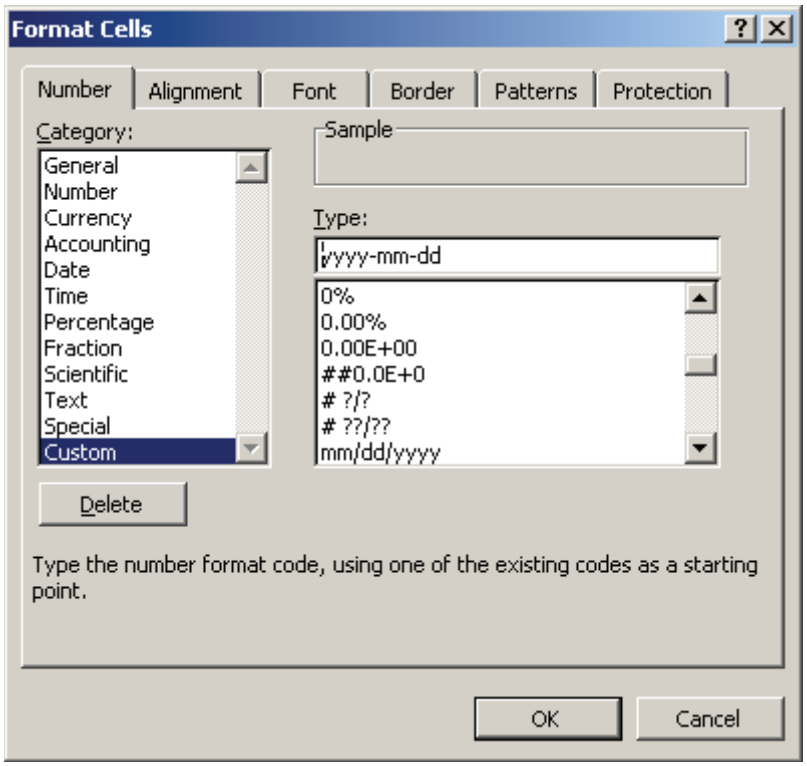
Select “OK”



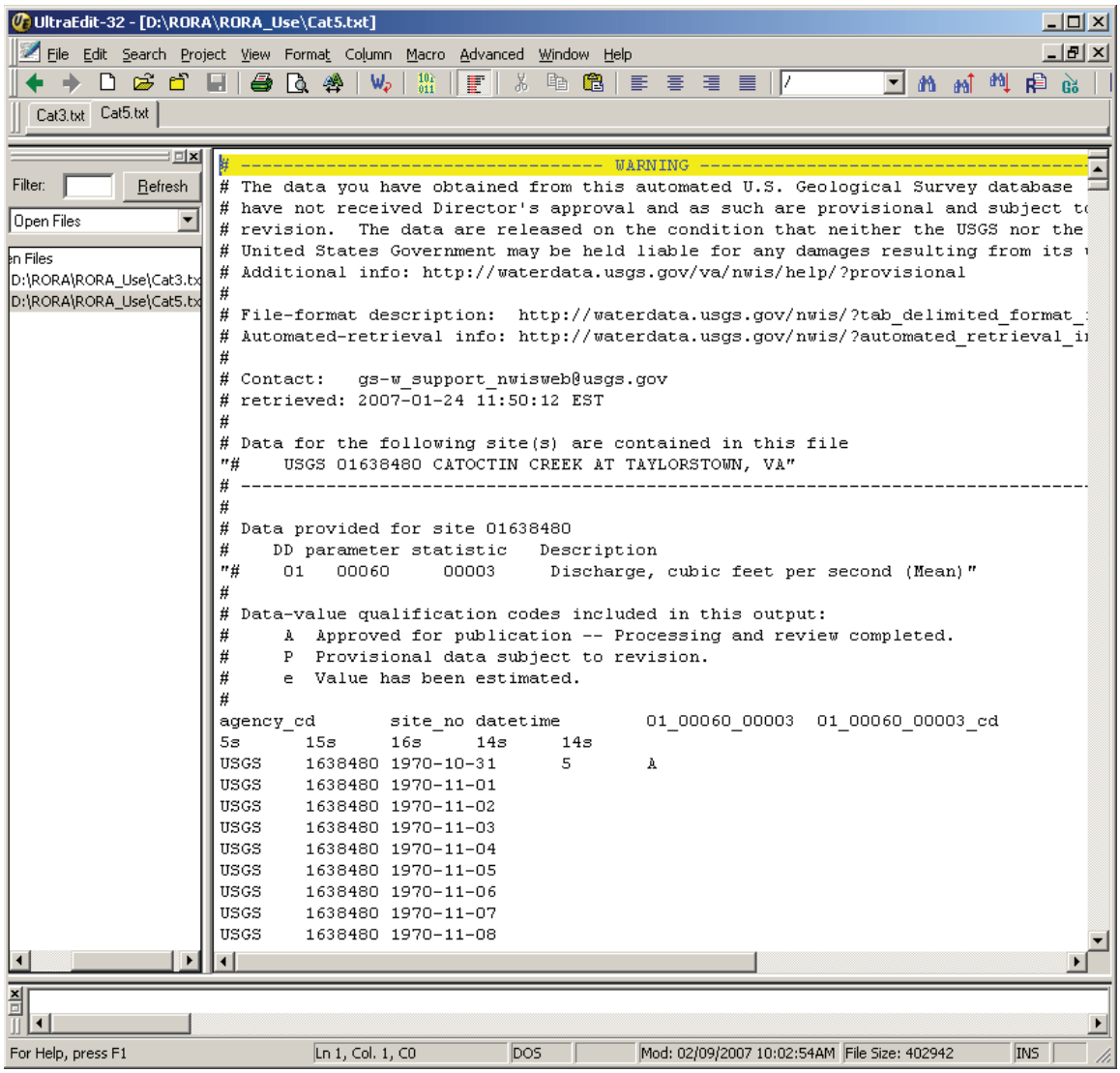
and “Yes”



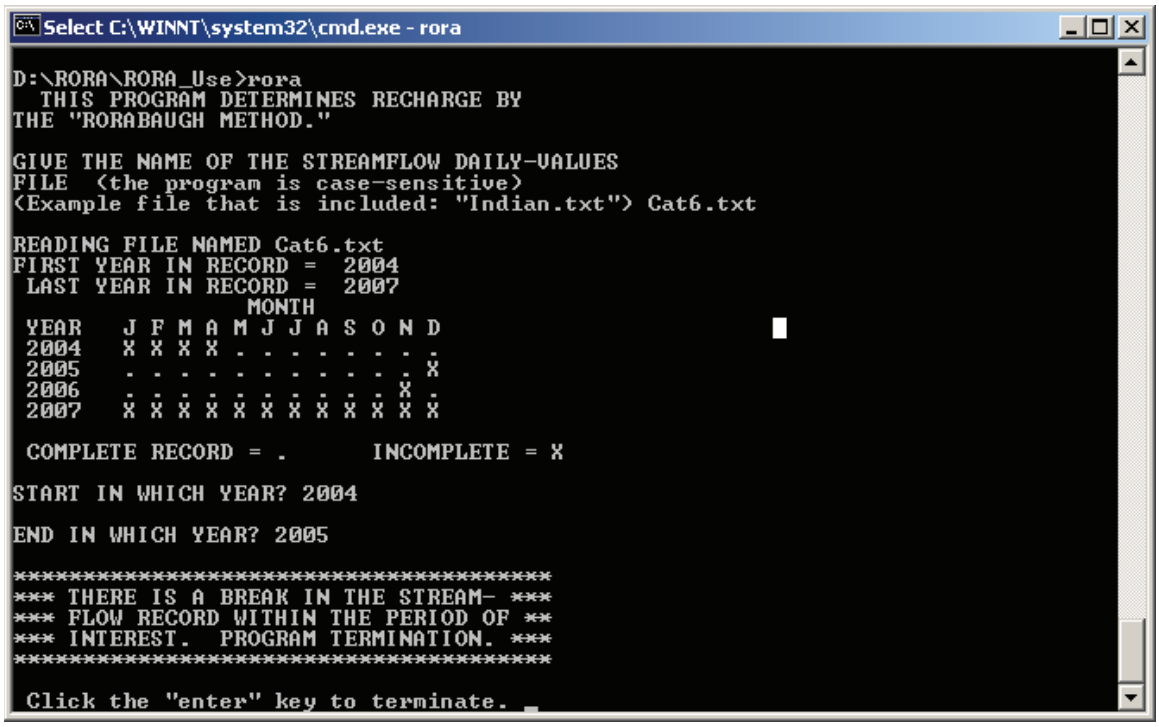
Note how the date filed is formatted:



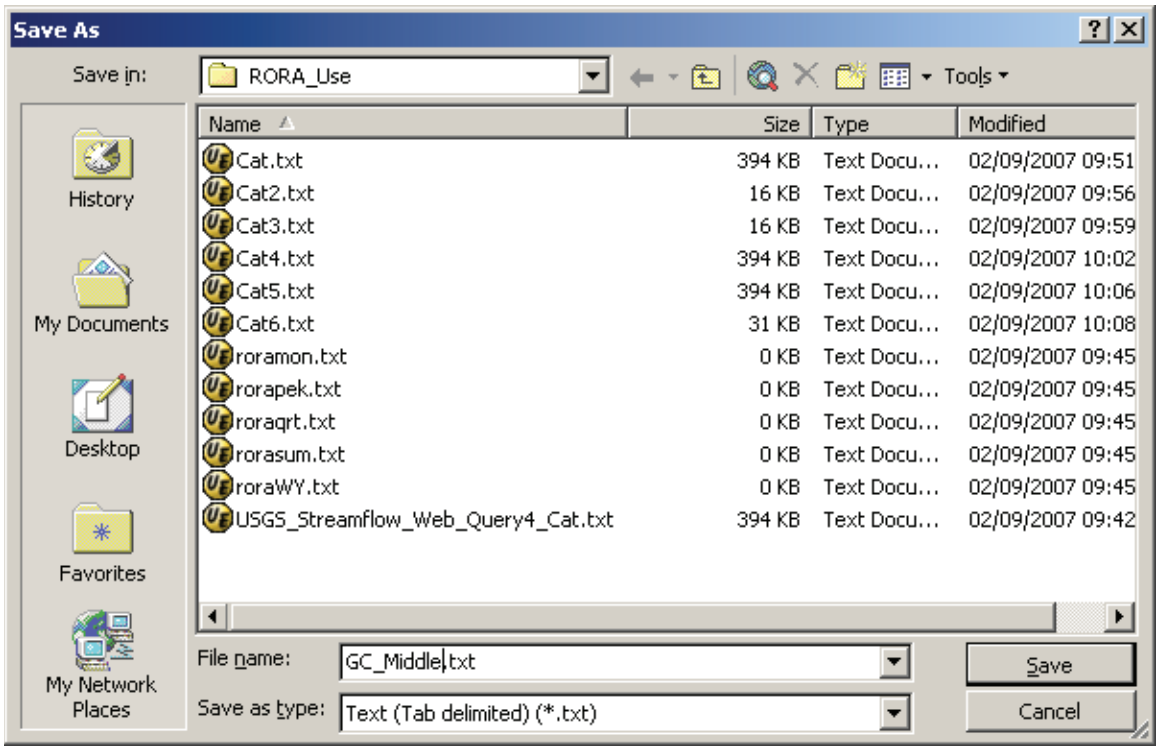
We can check the file contents:

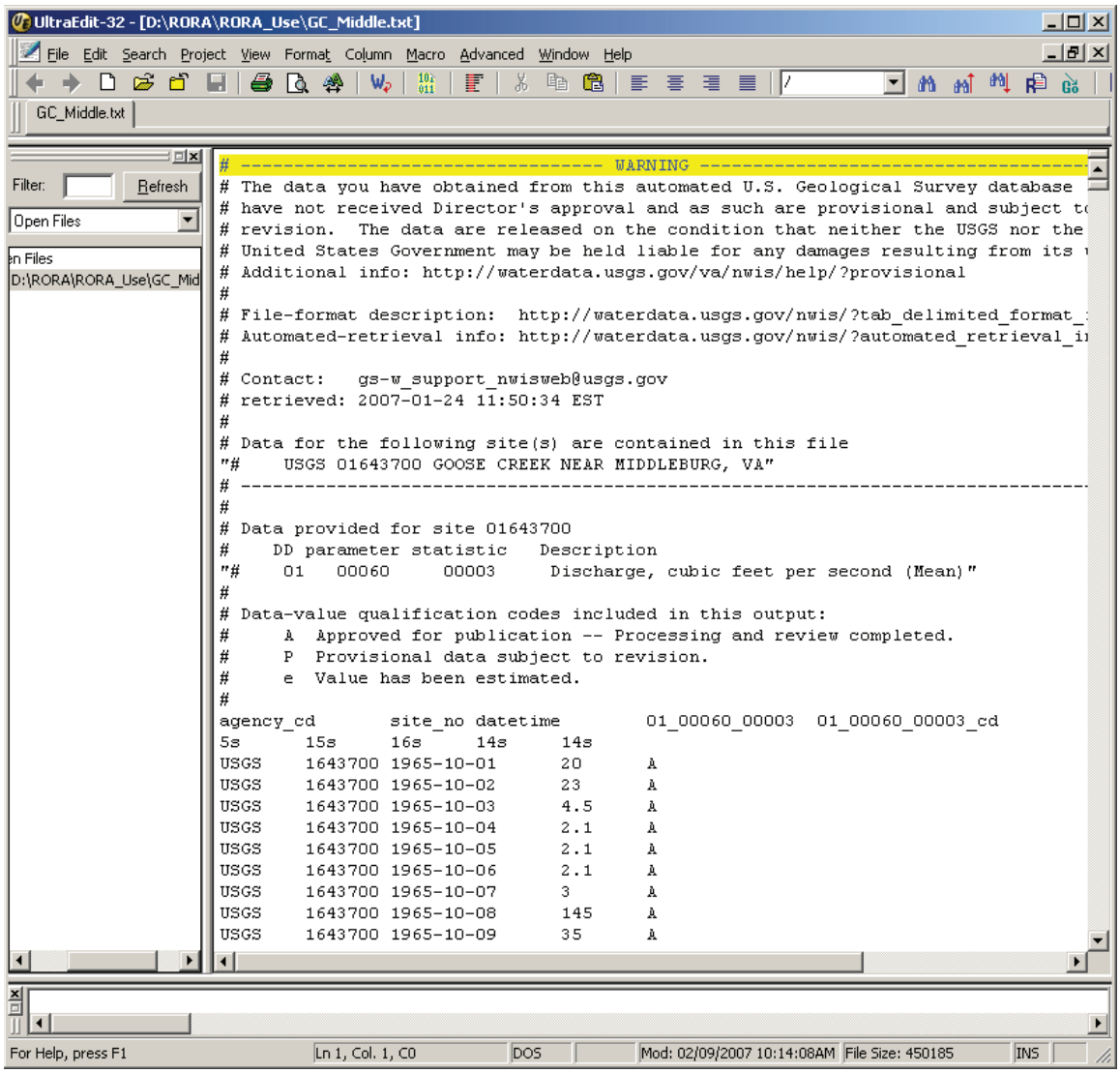


Now double click on “roar.exe” to execute the program.



The program is supposed to handle breaks in the record, but this doesn't work ????





Need to remove the apostrophes in first column where it appears twice.

Execution

To use RORA, one can simply double click on RORA.exe and a DOS windows will open.

For repeatbility, batch files were created including “Execute_all.bat” which has:

```
call batch_execute BR
call batch_execute Beaver
call batch_execute Cat
call batch_execute GC_Lee
call batch_execute GC_Mid
call batch_execute Lime
call batch_execute NF_Cat
call batch_execute NF_GC
call batch_execute Piney
call batch_execute SF_Cat
```

and the file “batch_execute.bat” which contains:

```
rora < %1.inp
rename roraqrt.txt %1_qrt.txt
rename roramon.txt %1_mon.txt
```

Note that there are ten .inp files creates, one for each station. For example, the file “SF_Cat.inp” contains:

```
SF_Cat.txt
2002
2005
n
100
```

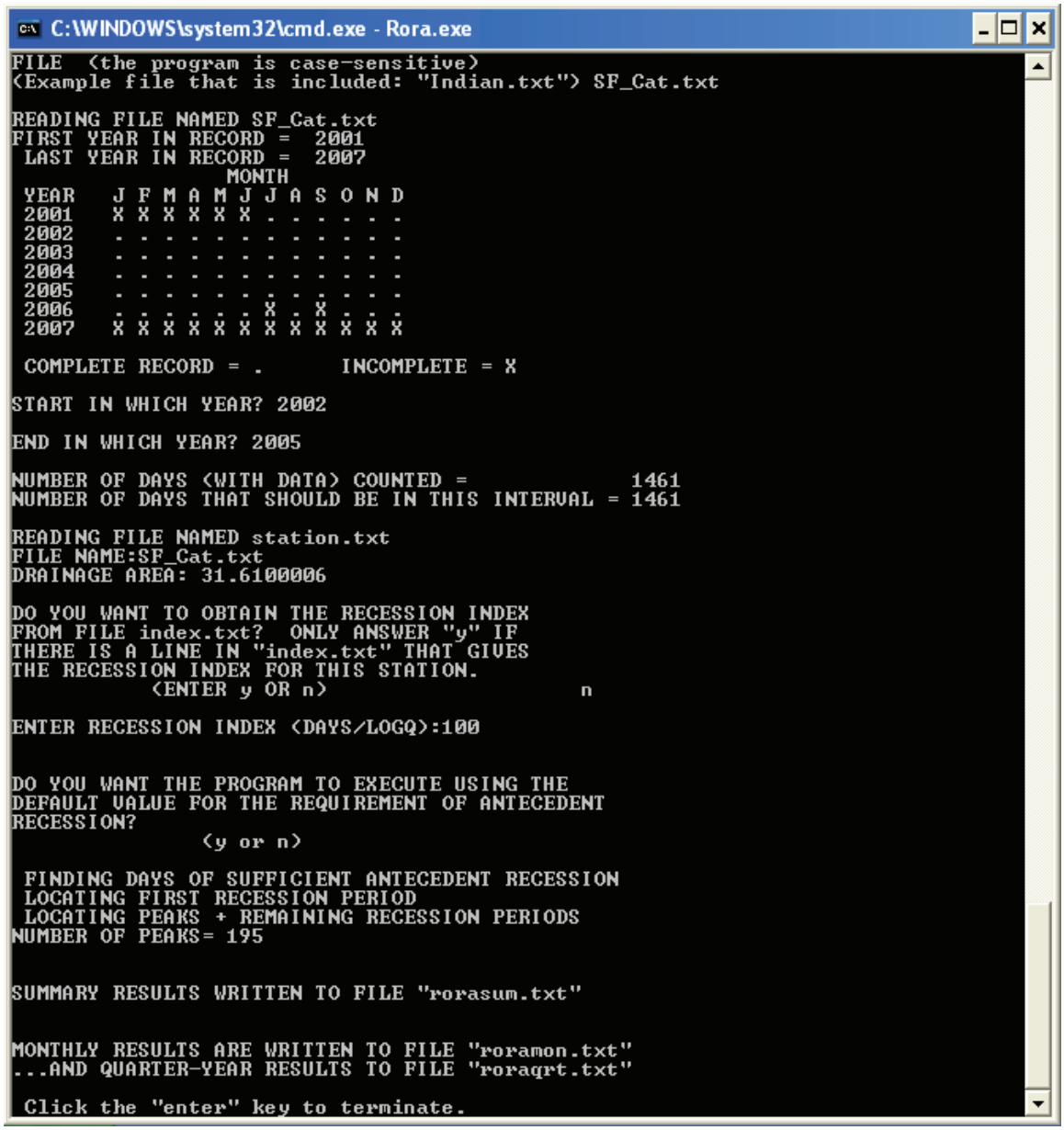
in which the responses are the start and ending year and other options, including the recession index value (100 days).

Need to pay attention to case in the file names. The system also uses the “Station.txt” file which contains:

```
File "station.txt"
This file is read by programs PREP, RECESS, RORA, and PART, to
obtain the drainage area.  Note: This file should have ten header
lines.  The streamflow file name should be 12 characters or less.  Note:  Needs to be
A12, F8 fields even though manual says free-format  DSW (2/8/07)
---------------------------------------------------------------
             Drainage
Name of      area            The space below, after drainage area, is
streamflow   (Square         for optional information that is not read
file         miles)          by the programs.  This is free-form.
-----------  ----------      ----------------------------------------
SF_Cat.txt   31.61                  South Fork Catoctin
NF_Cat.txt   23.11                  North Fork Catoctin
Cat.txt      89.51                  Catoctin
Piney.txt    13.51                  Piney Run
Lime.txt     7.881                  Limestone Branch
NF_GC.txt    38.11                  North Fork Goose Creek
Beaver.txt   47.21                  Beaver Dam Creek
GC_Mid.txt   122.0                  Goose Creek (Middleburg)
GC_Lee.txt   332.0                  Goose Creek (Leesburg)
BR.txt       76.11                  Broad Run
```

These are predefined file naming.

Below is the screem shot for simply executing RORA.exe directly and manually supplying the responses. Note that you can't end in 2006 as data is missing for this station.



There is a problem with Catotin at Taylorstown NWIS data data in 1970 (i.e. "Cat.txt"). You need to manually delete stream daily records for which there is no data.

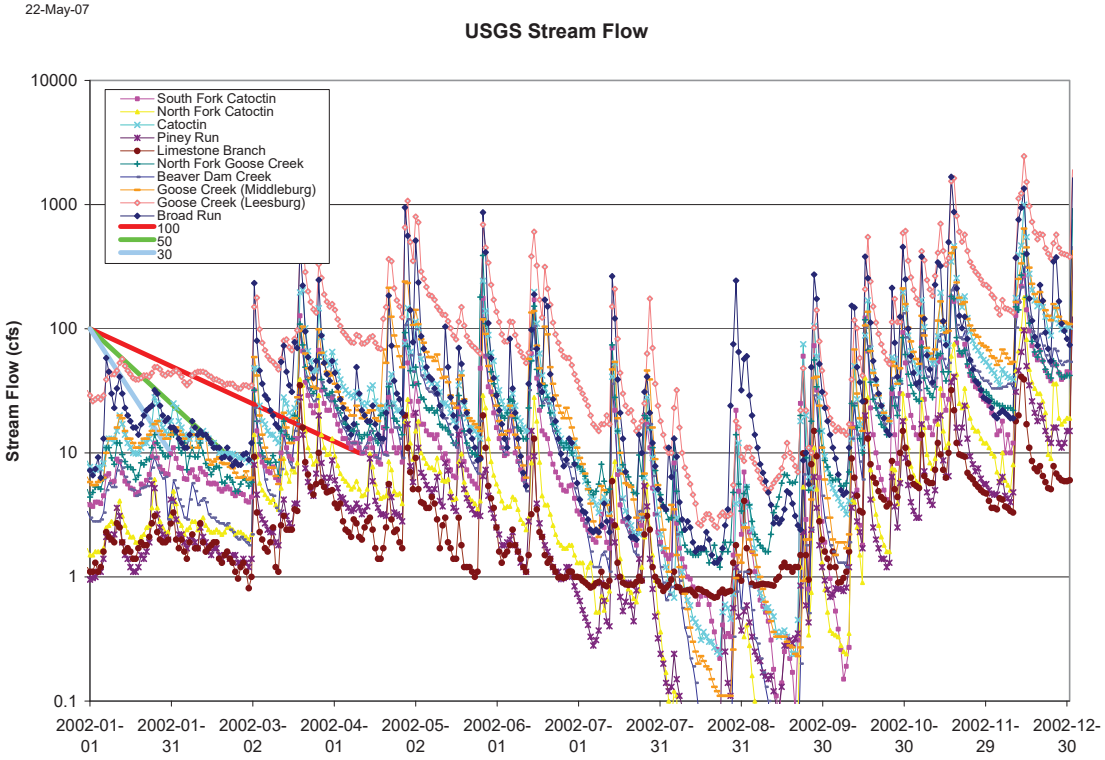
There is a small problem with Goose Creek Middleburg with a significant data gap 1977 to 2001. To resolve this a second data set GC_Mid2.txt was created.

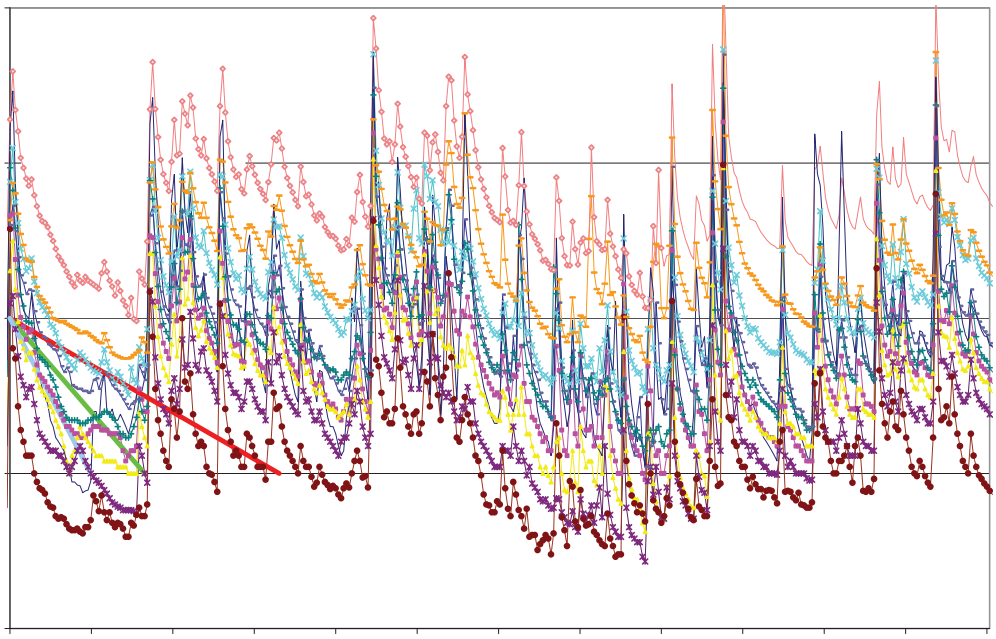
Evaluation of Recession Index:

The RORA manual and recent article in Ground Water Journal, May/June 2007 by Rutledge suggest that RORA is generally insensitive to the recession index (RI) provided. The recession index is defined as the time required for the groundwater discharge to recede by one log-cycle when the recession becomes linear (or nearly linear) on a semilog hydrograph.

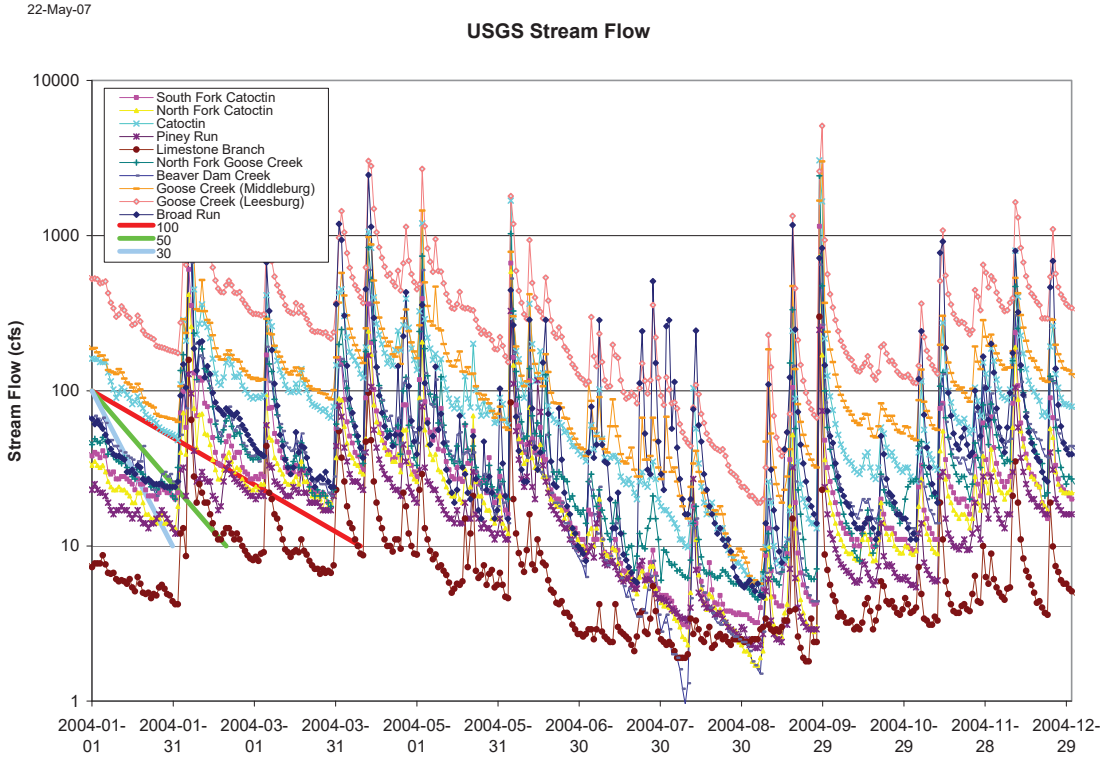
Let's look at years 2002 to 2005. A graph of all ten stations in included along with a one log-cycle drop for recession indexes with values of 100, 50 and 30 days. The closest fit for all stream appears to be between 30 and 60 days. The smallest RI appears to be Broad Run.

Chart labels (below)	Estimated Recession Index
South Fork Catoctin	50
North Fork Catoctin	50
Catoctin	60
Piney Run	60
Limestone Branch	40
North Fork Goose Creek	50
Beaver Dam Creek	50
Goose Creek (Middleburg)	50
Goose Creek (Leesburg)	50
Broad Run	30

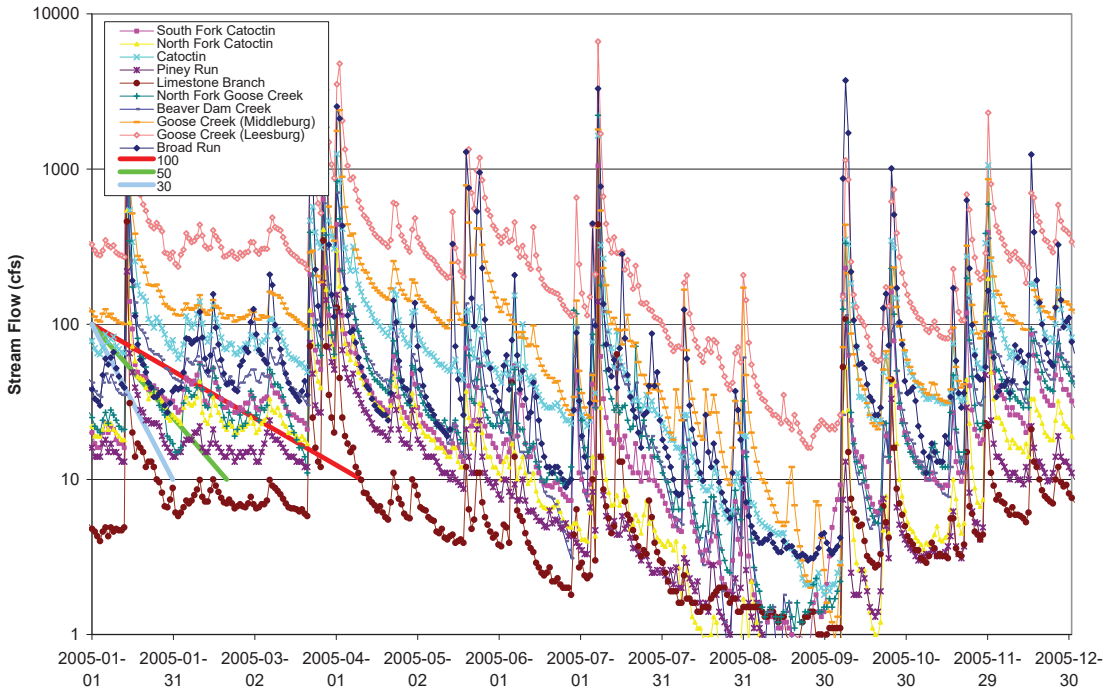

USGS Stream Flow
Stream Flow (cfs)
10000
1000
100
10
1
0.1
South Fork Catoctin
North Fork Catoctin
Catoctin
Piney Run
Limestone Branch
North Fork Goose Creek
Beaver Dam Creek
Goose Creek (Middleburg)
Goose Creek (Leesburg)
Broad Run
100
50
30
2002-01-01
2002-01-31
2002-03-02
2002-04-01
2002-05-02
2002-06-01
2002-07-01
2002-07-31
2002-08-31
2002-09-30
2002-10-30
2002-11-29
2002-12-30



22-May-07



22-May-07



To check the sensitivity recharge due to RI RORA was used to evaluate Broad Run using RI of 30 and 50 days and Catoctin at 60 and 100 days. The error introduced is 3 and 4.4%, respectively.

Check on Contributing Area

It is important to ensure that USGS provides correct values of the drainage area for each gage. This was checked and found to be correct. Below is working spreadsheet

File_Name	USGS Area (sq mi)	Watershed	Calculated from DRC for entire subshed (acres)	Majshed summaries (acres)	Truncated by County boundary	Comments
SF_Cat.txt	31.61	South Fork Catoctin		33.08	no	Good match as expected - gage is near outlet
NF_Cat.txt	23.11	North Fork Catoctin		23.30	no	Good match as expected - gage is near outlet
Cat.txt	89.51	Catoctin	92.46	92.53	no	Good match as expected - gage is near outlet
Piney.txt	13.51	Piney Run		14.91	no	Good match as expected - gage is near outlet
Lime.txt	7.881	Limestone Branch		16.16	no	Varies as gages is not near watershed outlet
NF_GC.txt	38.11	North Fork Goose Creek				
Beaver.txt	47.21	Beaver Dam Creek				
GC_Mid.txt	122	Goose Creek (Middleburg)			yes	
GC_Lee.txt	332	Goose Creek (Leesburg)			yes	
BR.txt	76.11	Broad Run	77.92	63.52	yes	

Because there is a limited number of watersheds that are fully within the County boundaries, it is difficult to fully check the contributing areas. Nonetheless it appears that the USGS offers reasonably accurate contributing areas which are slightly less than the total watershed boundary. In other words, the USGS provides good estimates of the actual contributing area for each of the gaging stations.

Also see http://pubs.usgs.gov/of/2006/1308/ for more station drainage areas.

Summary of Findings:

RORA offers annual, quarterly and monthly summary values of recharge.

Annual Recharge Summary:

Because of missing data, the newer USGS stations do not offer sufficient data for annual averages. Therefore annual; summaries are not presented. Data is generally limited to the period 2002 to 2005.

Quarterly Recharge Summary:

The quarterly recharge estimates are listed below. The average recharge for all records averaged over all stations is 9.34 inches per year.

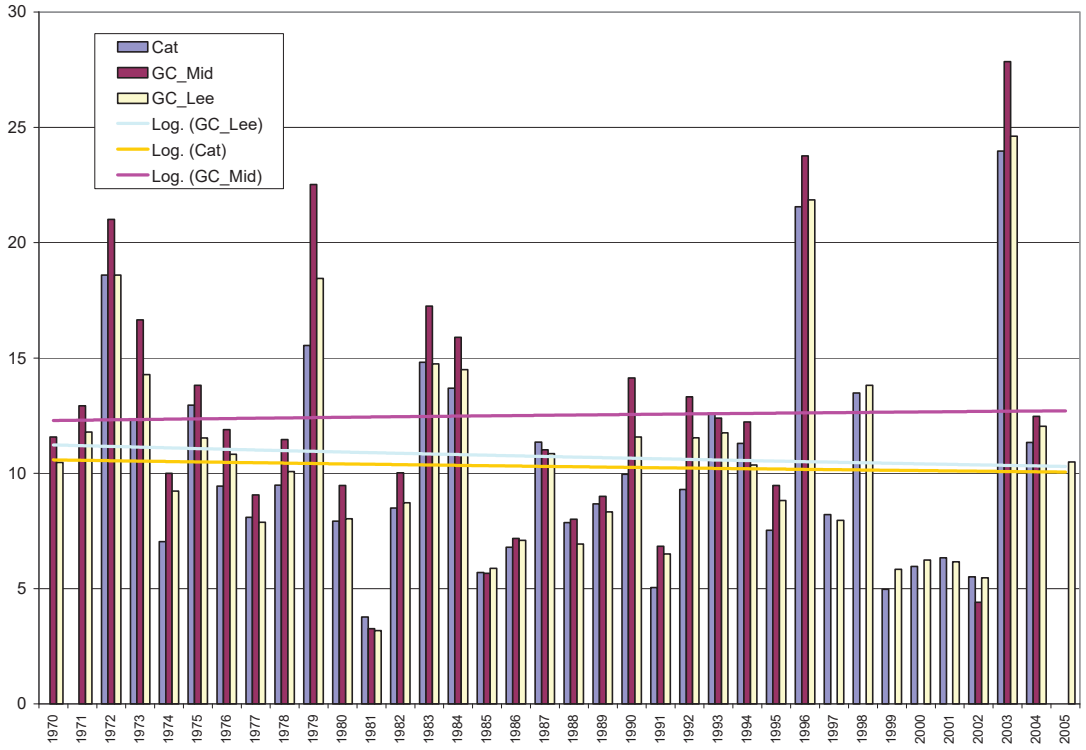
Note that there is a break in the Goose Creek (Middleburg) calculations due to incomplete data for this station.

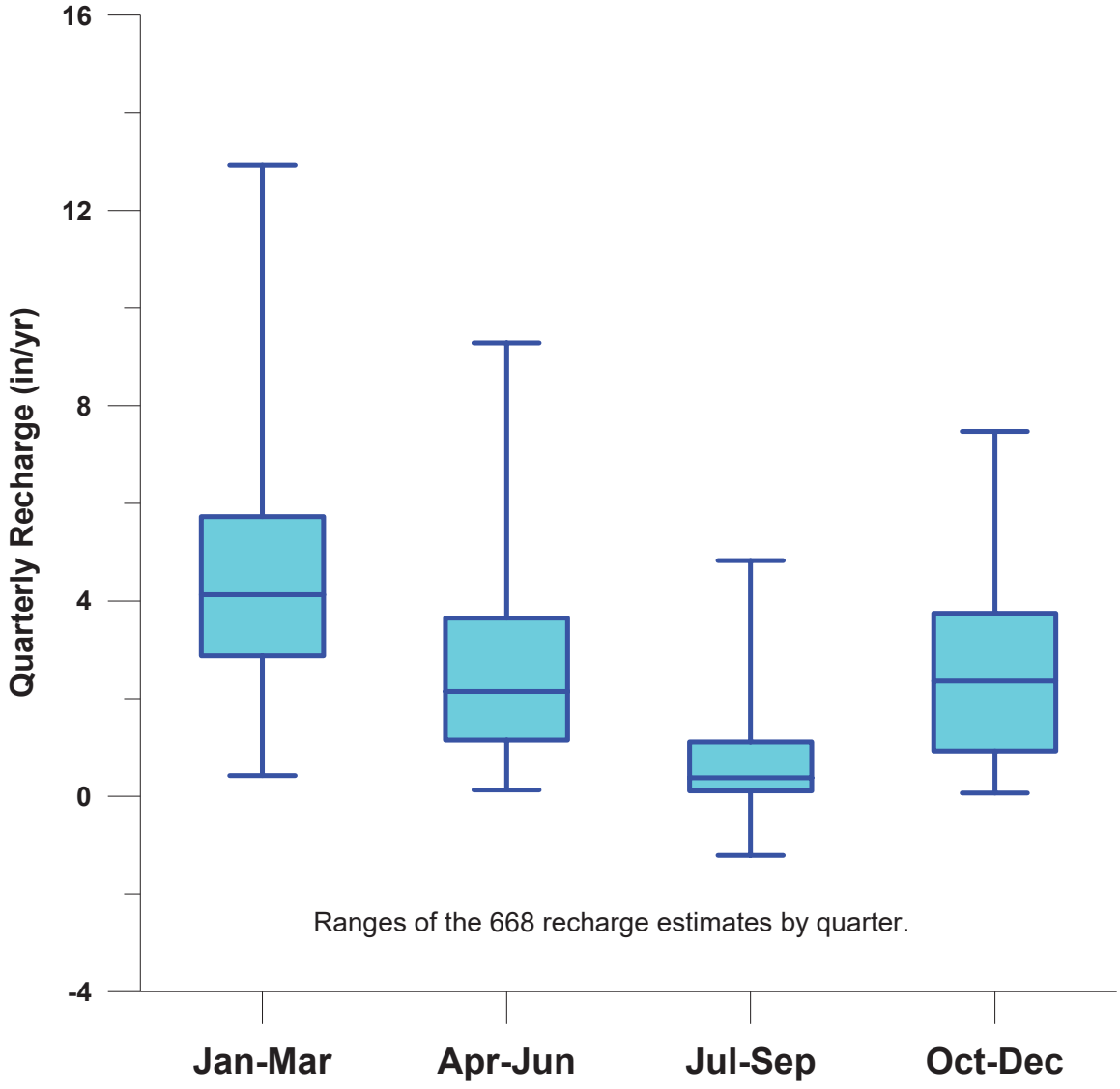
Station	Station	Year	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Year Total
1638350 South Fork Catoctin	SF_Cat	2002	1.44	0.89	0.14	3.91	6.38
1638350 South Fork Catoctin	SF_Cat	2003	7.52	7.47	2.72	5.06	22.77
1638350 South Fork Catoctin	SF_Cat	2004	3.38	4.36	0.98	2.37	11.09
1638350 South Fork Catoctin	SF_Cat	2005	5.8	1.21	0.52	2.91	10.44
1638420 North Fork Catoctin	NF_Cat	2002	0.85	0.55	0.02	2.26	3.68
1638420 North Fork Catoctin	NF_Cat	2003	7.71	7.77	2.2	6	23.68
1638420 North Fork Catoctin	NF_Cat	2004	3.41	4.8	1.05	2.99	12.26
1638420 North Fork Catoctin	NF_Cat	2005	6.29	1.33	0.25	1.96	9.83
1638480 Catoctin	Cat	1972	5.96	8.04	-1.21	5.82	18.6
1638480 Catoctin	Cat	1973	4.13	5.14	0.67	2.42	12.36
1638480 Catoctin	Cat	1974	3.1	1.7	0.43	1.81	7.04
1638480 Catoctin	Cat	1975	5.15	2.13	3.31	2.36	12.95
1638480 Catoctin	Cat	1976	3.61	1.9	0.48	3.46	9.45
1638480 Catoctin	Cat	1977	2.5	1.52	0.18	3.89	8.09
1638480 Catoctin	Cat	1978	5.83	2.25	0.47	0.94	9.48
1638480 Catoctin	Cat	1979	5.65	1.95	3.18	4.76	15.54
1638480 Catoctin	Cat	1980	5.04	2.2	0.33	0.35	7.92
1638480 Catoctin	Cat	1981	1.44	1.65	0.21	0.48	3.77
1638480 Catoctin	Cat	1982	3.8	3.57	-0.25	1.37	8.49
1638480 Catoctin	Cat	1983	5.52	5.41	-0.11	4	14.81
1638480 Catoctin	Cat	1984	9.03	1.89	0.94	1.83	13.69
1638480 Catoctin	Cat	1985	2.33	0.77	0.2	2.41	5.7
1638480 Catoctin	Cat	1986	4.14	0.75	0.04	1.86	6.79
1638480 Catoctin	Cat	1987	3.61	3.68	1.54	2.52	11.35
1638480 Catoctin	Cat	1988	3.28	3.65	0.3	0.63	7.86
1638480 Catoctin	Cat	1989	4.1	3.59	0.33	0.67	8.68
1638480 Catoctin	Cat	1990	3.13	2.46	0.58	3.79	9.96
1638480 Catoctin	Cat	1991	4.36	0.22	0.04	0.43	5.05
1638480 Catoctin	Cat	1992	2.76	2.28	0.46	3.8	9.3
1638480 Catoctin	Cat	1993	9.34	0.58	0.05	2.61	12.58
1638480 Catoctin	Cat	1994	9.35	0.13	0.42	1.39	11.3
1638480 Catoctin	Cat	1995	3.5	1.02	0.36	2.65	7.53
1638480 Catoctin	Cat	1996	6.36	4.44	4.32	6.44	21.56
1638480 Catoctin	Cat	1997	5.21	0.61	0.04	2.35	8.21
1638480 Catoctin	Cat	1998	10.2	3.22	-0.08	0.14	13.48

1638480 Catoctin	Cat	1999	1.76	0.72	0.91	1.57	4.97
1638480 Catoctin	Cat	2000	3.67	1.46	0.38	0.45	5.96
1638480 Catoctin	Cat	2001	4.33	1.34	0.37	0.29	6.34
1638480 Catoctin	Cat	2002	1.19	0.66	0.09	3.56	5.51
1638480 Catoctin	Cat	2003	6.5	7.59	2.88	7	23.97
1638480 Catoctin	Cat	2004	3.15	4.56	1.11	2.52	11.34
1636690 Piney Run	Piney	2002	0.84	0.6	0.11	2.52	4.07
1636690 Piney Run	Piney	2003	7.77	7.01	2.48	6.64	23.9
1636690 Piney Run	Piney	2004	4.8	5.91	1.26	3.62	15.6
1636690 Piney Run	Piney	2005	7.93	0.99	0.33	2.08	11.32
1643590 Limestone Branch	Lime	2002	1.16	0.77	0.49	3.03	5.45
1643590 Limestone Branch	Lime	2003	6.71	7.08	3.45	5.07	22.32
1643590 Limestone Branch	Lime	2004	4.11	3.94	1.56	2.1	11.71
1643590 Limestone Branch	Lime	2005	5.76	1.23	1.04	3.11	11.14
1643805 North Fork Goose Creek	NF_GC	2002	1.48	1.39	0.42	3.75	7.04
1643805 North Fork Goose Creek	NF_GC	2003	8.7	9.28	3.21	5.44	26.64
1643805 North Fork Goose Creek	NF_GC	2004	3.61	4.69	1.25	2.69	12.24
1643805 North Fork Goose Creek	NF_GC	2005	4.63	2.45	0.62	2.86	10.56
1643880 Beaver Dam Creek	Beaver	2002	1	0.96	0.06	3.67	5.68
1643880 Beaver Dam Creek	Beaver	2003	8.41	7.86	3.22	5.67	25.16
1643880 Beaver Dam Creek	Beaver	2004	2.73	3.42	0.96	2.9	10.02
1643700 Goose Creek (Middleburg)	GC_Mid	1970	3.84	3.24	0.78	3.73	11.58
1643700 Goose Creek (Middleburg)	GC_Mid	1971	5.73	4.02	0.29	2.89	12.93
1643700 Goose Creek (Middleburg)	GC_Mid	1972	6.45	7.95	-0.17	6.77	21.01
1643700 Goose Creek (Middleburg)	GC_Mid	1973	5.25	4.95	1.67	4.78	16.65
1643700 Goose Creek (Middleburg)	GC_Mid	1974	4.42	2.91	0.33	2.34	10
1643700 Goose Creek (Middleburg)	GC_Mid	1975	5.21	1.5	3.84	3.27	13.81
1643700 Goose Creek (Middleburg)	GC_Mid	1976	4.71	2.15	0.21	4.82	11.89
1643700 Goose Creek (Middleburg)	GC_Mid	1977	2.83	1.12	0.14	4.98	9.06
1643700 Goose Creek (Middleburg)	GC_Mid	1978	7.9	2.24	0.48	0.84	11.46
1643700 Goose Creek (Middleburg)	GC_Mid	1979	8.16	3.78	3.71	6.86	22.52
1643700 Goose Creek (Middleburg)	GC_Mid	1980	5.51	3.49	0.14	0.33	9.47
1643700 Goose Creek (Middleburg)	GC_Mid	1981	1.45	1.06	0.27	0.47	3.26
1643700 Goose Creek (Middleburg)	GC_Mid	1982	5.37	3.6	0.15	0.9	10.02
1643700 Goose Creek (Middleburg)	GC_Mid	1983	5.9	6.59	-0.14	4.9	17.25
1643700 Goose Creek (Middleburg)	GC_Mid	1984	12.92	1.58	0.41	1	15.9
1643700 Goose Creek (Middleburg)	GC_Mid	1985	2.59	0.28	0	2.79	5.66
1643700 Goose Creek (Middleburg)	GC_Mid	1986	4.66	1.4	0.03	1.09	7.18
1643700 Goose Creek (Middleburg)	GC_Mid	1987	4.17	4.77	0.34	1.73	11.02
1643700 Goose Creek (Middleburg)	GC_Mid	1988	3.18	4.53	-0.01	0.3	8.01
1643700 Goose Creek (Middleburg)	GC_Mid	1989	2.34	4.72	1.01	0.93	9
1643700 Goose Creek (Middleburg)	GC_Mid	1990	3.85	2.61	1.69	5.98	14.14
1643700 Goose Creek (Middleburg)	GC_Mid	1991	5.94	0.57	0	0.33	6.84
1643700 Goose Creek (Middleburg)	GC_Mid	1992	2.41	2.75	1.37	6.78	13.31
1643700 Goose Creek (Middleburg)	GC_Mid	1993	8.52	2.53	-0.06	1.4	12.39
1643700 Goose Creek (Middleburg)	GC_Mid	1994	10.38	0.26	0.52	1.07	12.23
1643700 Goose Creek (Middleburg)	GC_Mid	1995	3.43	3.74	-0.53	2.82	9.47
1643700 Goose Creek (Middleburg)	GC_Mid	1996	7.26	4.74	4.58	7.19	23.76
1643700 Goose Creek (Middleburg)	GC_Mid	2001			0.12	0.26	
1643700 Goose Creek (Middleburg)	GC_Mid	2002	0.65	0.78	0.03	2.95	4.41
1643700 Goose Creek (Middleburg)	GC_Mid	2003	8.33	8.78	4.83	5.91	27.85
1643700 Goose Creek (Middleburg)	GC_Mid	2004	3.38	4.61	1.5	2.98	12.47
1644000 Goose Creek (Leesburg)	GC_Lee	1930	2.79	0.97	-0.01	0.07	3.82
1644000 Goose Creek (Leesburg)	GC_Lee	1931	0.42	0.77	0.12	0.09	1.41
1644000 Goose Creek (Leesburg)	GC_Lee	1932	3.72	1.94	0.01	4.56	10.23
1644000 Goose Creek (Leesburg)	GC_Lee	1933	4.32	3.35	1.38	0.84	9.89
1644000 Goose Creek (Leesburg)	GC_Lee	1934	2.72	1.33	0.79	1.6	6.45
1644000 Goose Creek (Leesburg)	GC_Lee	1935	5.08	3.43	0.38	2	10.88
1644000 Goose Creek (Leesburg)	GC_Lee	1936	7.31	0.89	0.05	1.04	9.29
1644000 Goose Creek (Leesburg)	GC_Lee	1937	4.67	2.88	1.28	3.6	12.43

1644000 Goose Creek (Leesburg)	GC_Lee	1938	3.27	1.27	0.18	1.18	5.89
1644000 Goose Creek (Leesburg)	GC_Lee	1939	5.15	1.7	0.16	0.46	7.47
1644000 Goose Creek (Leesburg)	GC_Lee	1940	2.57	2.95	0.28	3.17	8.97
1644000 Goose Creek (Leesburg)	GC_Lee	1941	2.73	1.38	0.3	0.25	4.65
1644000 Goose Creek (Leesburg)	GC_Lee	1942	2.4	0.94	1.8	5.97	11.1
1644000 Goose Creek (Leesburg)	GC_Lee	1943	4.04	2.15	0.09	0.26	6.54
1644000 Goose Creek (Leesburg)	GC_Lee	1944	3.69	0.92	0.06	1.53	6.2
1644000 Goose Creek (Leesburg)	GC_Lee	1945	2.83	1.22	3.6	3.93	11.57
1644000 Goose Creek (Leesburg)	GC_Lee	1946	3.83	2.43	0.55	1.1	7.92
1644000 Goose Creek (Leesburg)	GC_Lee	1947	2.77	1.15	0.32	0.64	4.88
1644000 Goose Creek (Leesburg)	GC_Lee	1948	3.06	2.74	1.76	7.47	15.04
1644000 Goose Creek (Leesburg)	GC_Lee	1949	4.82	2.32	0.51	1.08	8.73
1644000 Goose Creek (Leesburg)	GC_Lee	1950	3.53	1.92	1.26	4.38	11.09
1644000 Goose Creek (Leesburg)	GC_Lee	1951	6.27	2.32	0.05	0.49	9.13
1644000 Goose Creek (Leesburg)	GC_Lee	1952	5.74	4.03	0.57	2.56	12.9
1644000 Goose Creek (Leesburg)	GC_Lee	1953	6.33	2.25	0.11	0.42	9.12
1644000 Goose Creek (Leesburg)	GC_Lee	1954	1.67	1.29	0.08	1.63	4.68
1644000 Goose Creek (Leesburg)	GC_Lee	1955	2.63	1.05	1.83	0.94	6.46
1644000 Goose Creek (Leesburg)	GC_Lee	1956	4.13	0.81	2.3	2.74	9.99
1644000 Goose Creek (Leesburg)	GC_Lee	1957	4.4	1.57	0.15	2.68	8.8
1644000 Goose Creek (Leesburg)	GC_Lee	1958	5.73	1.89	1.11	0.38	9.11
1644000 Goose Creek (Leesburg)	GC_Lee	1959	1.35	1.95	0.06	0.75	4.1
1644000 Goose Creek (Leesburg)	GC_Lee	1960	3.96	2.7	0.68	0.4	7.74
1644000 Goose Creek (Leesburg)	GC_Lee	1961	4.09	3.11	0.15	0.9	8.24
1644000 Goose Creek (Leesburg)	GC_Lee	1962	3.26	0.87	0.15	0.67	4.95
1644000 Goose Creek (Leesburg)	GC_Lee	1963	3.78	0.57	0.08	0.86	5.29
1644000 Goose Creek (Leesburg)	GC_Lee	1964	5.45	2.11	0.15	1.35	9.05
1644000 Goose Creek (Leesburg)	GC_Lee	1965	6.74	0.8	0.08	0.16	7.78
1644000 Goose Creek (Leesburg)	GC_Lee	1966	1.72	1.45	0.45	1.88	5.51
1644000 Goose Creek (Leesburg)	GC_Lee	1967	4.67	0.48	1.09	2.25	8.5
1644000 Goose Creek (Leesburg)	GC_Lee	1968	4.5	1.47	0.17	1.4	7.53
1644000 Goose Creek (Leesburg)	GC_Lee	1969	2.88	0.43	0.24	0.68	4.23
1644000 Goose Creek (Leesburg)	GC_Lee	1970	3.9	2.61	0.53	3.43	10.47
1644000 Goose Creek (Leesburg)	GC_Lee	1971	4.82	3.3	0.52	3.15	11.79
1644000 Goose Creek (Leesburg)	GC_Lee	1972	5.43	7.18	-0.02	6.01	18.6
1644000 Goose Creek (Leesburg)	GC_Lee	1973	4.32	4.99	1.18	3.8	14.28
1644000 Goose Creek (Leesburg)	GC_Lee	1974	4.75	1.62	0.46	2.39	9.23
1644000 Goose Creek (Leesburg)	GC_Lee	1975	4.96	1.7	2.96	1.91	11.53
1644000 Goose Creek (Leesburg)	GC_Lee	1976	4.6	1.91	0.27	4.04	10.82
1644000 Goose Creek (Leesburg)	GC_Lee	1977	2.54	1.19	0.1	4.06	7.88
1644000 Goose Creek (Leesburg)	GC_Lee	1978	6.43	2.16	0.76	0.73	10.08
1644000 Goose Creek (Leesburg)	GC_Lee	1979	6.76	3.07	3.54	5.08	18.45
1644000 Goose Creek (Leesburg)	GC_Lee	1980	4.44	3.03	0.17	0.38	8.03
1644000 Goose Creek (Leesburg)	GC_Lee	1981	1.19	1.09	0.3	0.6	3.18
1644000 Goose Creek (Leesburg)	GC_Lee	1982	4.07	3.1	0.19	1.36	8.72
1644000 Goose Creek (Leesburg)	GC_Lee	1983	5.01	5.48	-0.12	4.37	14.74
1644000 Goose Creek (Leesburg)	GC_Lee	1984	10.43	2.12	0.73	1.22	14.5
1644000 Goose Creek (Leesburg)	GC_Lee	1985	2.79	0.36	0.02	2.7	5.88
1644000 Goose Creek (Leesburg)	GC_Lee	1986	4.45	1.43	0.04	1.17	7.09
1644000 Goose Creek (Leesburg)	GC_Lee	1987	4.43	4.08	0.28	2.05	10.85
1644000 Goose Creek (Leesburg)	GC_Lee	1988	3.19	3.16	0.16	0.42	6.93
1644000 Goose Creek (Leesburg)	GC_Lee	1989	2.84	4.16	0.57	0.76	8.33
1644000 Goose Creek (Leesburg)	GC_Lee	1990	2.47	3.3	1.22	4.58	11.58
1644000 Goose Creek (Leesburg)	GC_Lee	1991	5.62	0.6	0.01	0.26	6.5
1644000 Goose Creek (Leesburg)	GC_Lee	1992	2.16	2.16	1.2	6.03	11.54
1644000 Goose Creek (Leesburg)	GC_Lee	1993	7.52	2.28	0.02	1.92	11.75
1644000 Goose Creek (Leesburg)	GC_Lee	1994	7.95	0.84	0.57	1	10.36
1644000 Goose Creek (Leesburg)	GC_Lee	1995	3.54	2.38	0.01	2.88	8.82
1644000 Goose Creek (Leesburg)	GC_Lee	1996	7.26	4.41	3.77	6.42	21.86
1644000 Goose Creek (Leesburg)	GC_Lee	1997	5.72	0.75	0.06	1.42	7.96

1644000 Goose Creek (Leesburg)	GC_Lee	1998	10.63	3.12	-0.08	0.13	13.81
1644000 Goose Creek (Leesburg)	GC_Lee	1999	2.31	0.6	1.33	1.58	5.84
1644000 Goose Creek (Leesburg)	GC_Lee	2000	3.23	1.75	0.61	0.65	6.24
1644000 Goose Creek (Leesburg)	GC_Lee	2001	4.06	1.4	0.35	0.35	6.16
1644000 Goose Creek (Leesburg)	GC_Lee	2002	0.9	1.08	0.07	3.42	5.47
1644000 Goose Creek (Leesburg)	GC_Lee	2003	7.1	7.52	3.55	6.46	24.62
1644000 Goose Creek (Leesburg)	GC_Lee	2004	3.01	4.44	1.32	3.27	12.04
1644000 Goose Creek (Leesburg)	GC_Lee	2005	3.02	4.08	0.75	2.65	10.49
1644280 Broad Run	BR	2002	1.1	1.14	0.48	2.97	5.7
1644280 Broad Run	BR	2003	3.2	4.91	1.46	4.25	13.81
1644280 Broad Run	BR	2004	2.3	2.09	1.16	1.77	7.33
1644280 Broad Run	BR	2005	3.48	1.39	0.73	2.4	8.01




16
12
8
4
0
-4
Quarterly Recharge (in/yr)
Ranges of the 668 recharge estimates by quarter.
Jan-Mar
Apr-Jun
Jul-Sep
Oct-Dec

Taking annual averages for each station from the above quarterly data yields:

Name	Abbreviation	Site_no	Year of First Complete Record	Annual Average for Entire Record (in/yr)	Annual Average for Recent 2002-2005 (in/yr)
South Fork Catoctin	SF_Cat	1638350	2002	12.67	12.67
North Fork Catoctin	NF_Cat	1638420	2002	12.36	12.36
Catoctin	Cat	1638480	1972	10.29	11.79
Piney Run	Piney	1636690	2002	13.72	13.72
Limestone Branch	Lime	1643590	2002	12.66	12.66
North Fork Goose Creek	NF_GC	1643805	2002	14.12	14.12
Beaver Dam Creek	Beaver	1643880	2002	13.62	13.62
Goose Creek (Middleburg)	GC_Middle	1643700	1970	12.49	14.91
Goose Creek (Leesburg)	GC_Lee	1644000	1930	9.26	11.76
Broad Run	BR	1644280	2002	8.71	8.71
Average				**11.99**	**12.63**

Low Flow and Baseflow Statistics from Streamflow Records

Background

Low-flow, base-flow, and mean-flow characteristics are an important part of assessing water resources in a watershed. These streamflow characteristics can be used by watershed planners and regulators to determine water availability, water use allocations, assimilative capacities of streams, and aquatic-habitat needs. Streamflow characteristics are commonly predicted by use of regression equations when a nearby streamflow-gaging station is not available.

Low flow and base flow are measures of streamflow that can help to identify environmentally vulnerable (stressed) watershed A more complete definition of stress includes streamflow quantity, quality and habitat factors.

In the 1999 work plan for the Massachusetts Water Resource Commission (WRC), these stresses are defined as:

Quantity: A significant reduction in streamflow is defined as a decrease in key low and high streamflow statistics. Low flows in most of Massachusetts reflect ground water levels and are a good indicator of the health of a system. Reduced low flows can impact aquatic habitat and water quality. In addition, low flows are often the first indicator of environmental impacts.

Quality: A degraded water quality is defined as water in a stream that does not meet surface water quality standards.

Habitat Factors: A degraded habitat is defined as a river reach in which key habitat factors, such as temperature, quality, cover, substrate and accessibility, necessary to sustain a biologically diverse community are degraded. The stress can be due to a lack of streamflow, quality degradation, presence of dams, channel modifications, culverting and other factors. Indicators of stressed habitat include the absence or degradation of a target fish or other aquatic community or the absence of the ability of fish to move between multiple habitats necessary to their life cycles. Factors that limit movement include lack of flow, or reaches with no flow, and the presence of dams or other restrictions that prevent passage.

Low flow statistics often include the “7Q10” value (defined below).

7Q10: The streamflow that occurs over 7 consecutive days and has a 10-year recurrence interval period, or a 1 in 10 chance of occurring in any one year. Daily streamflows in the 7Q10 range are general indicators of prevalent drought conditions which normally cover large areas. 7Q10 values are also used by the State for regulating water withdrawals and discharges into streams.

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30Q2 : The streamflow that occurs over 30 consecutive days and has a 2-year recurrence interval period, or a 1 in 2 chance of occurring in any one year. Daily streamflows in the 30Q2 range are general indicators of initial drought conditions which may cover large areas, and may be used by State regulators in determining water-use restrictions.

http://ga2.er.usgs.gov/lowflow/helplowflowstats.cfm

EPA has found that: "In 1986, the EPA determined that the hydrological-based 7Q10 design flow was similar to the biologically-based 4B3 design flow and recommended the use of either design flow for water quality standards and toxic wasteload allocation studies relating to chronic effects on aquatic life. Although the 7Q10 is used by about half the states in the nation, the 7Q10 is sometimes characterized as being either overprotective or under-protected of aquatic life in various areas of the country. States regularly propose alternative hydrologically-based design flow statistics for their water quality standards (in the form of xQy where x is the duration and y is the frequency). For example, one state currently uses the 3Q2 statistic for conventional pollutants and several other states use a 7Q2 statistic. States often justify the use of a design flow other than 7Q10 on the basis of different hydrogeology. States sometimes suggest the use of a percentile flow (e.g., the 4th percentile) on the basis of ease of calculation and communication with the public."
(http://www.epa.gov/waterscience/models/dflow/apps.htm)

In Massachussetts, both the 7Q10 and August Median flows for the sub-basin are used in their assessment of stressed streams.

In PA, Q7,10; Q7,2; Q30,10; Q30,2; and Q90,10 low-flow characteristics have been studied. http://pubs.usgs.gov/sir/2006/5130/pdf/sir2006-5130.pdf

Seasonal Streamflow Conditions and Historic Droughts in Virginia
(From http://va.water.usgs.gov/drought/histcond.htm)

In a typical year, highest streamflows occur during the winter months, decreasing through the spring and summer, with lowest streamflows occurring during the fall months. During the winter of 1998, above average precipitation recharged the ground-water system, which in turn, maintained streamflows in the above normal range of flows. Even though there was below average precipitation during the spring and summer of 1998, streamflows did not fall below normal until September of that year because of the high ground-water storage. With continued dry conditions in the fall, ground-water storage became depleted, and streamflows continued to decline to levels near those observed in past droughts. Streamflows remained in the below normal range during the winter of 1999 because precipitation was insufficient to fully recharge the ground-water system. During base-flow conditions (non-storm runoff), streams had about one-third of the flow during the winter of 1999 than they had during the winter of 1998. The already depleted ground-water storage conditions combined with less than normal precipitation during the past three months has resulted in continued low streamflows. June streamflows are

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already at or near typical annual low flow values, and streamflows are expected to continue to decline through the summer.

There have been four major Statewide droughts since the early 1900's. The drought of 1930-32 was one of the most severe droughts recorded in the State. Recurrence intervals ranged from 30 years to greater than 80 years. The droughts of 1938-42 and 1962-71 were less severe; however, the cumulative streamflow deficit for the 1962-71 drought was the greatest of the four droughts because of the duration of this drought. The drought of 1980-82 was the least severe and had the shortest duration. Recurrence intervals in the 1980-82 drought ranged from 15 years across most of the State to greater than 80 years in the James River Basin.
Last modified: 03/12/02

Base and Low flow in Loudoun County

In Loudoun County, there are three stream gages with long periods of record (more than 20 years) and seven gages with only a few years of data. Because it is not possible to calculate 7Q10 on the newer stream gages, other statistics are be analyzed also.

August Median Flows:

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http://pubs.usgs.gov/wri/wri004135/pdf/report.pdf

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0.50 ft3/s/mi2, the ABF low-flow value recommended to "sustain and perpetuate indigenous aquatic fauna" (U.S. Fish and Wildlife Service, 1981). page 63
http://pubs.usgs.gov/wri/wri034330/pdf/wrir034330.pdf and
http://des.nh.gov/Rivers/instream/Archive/lang_policy.pdf

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References:

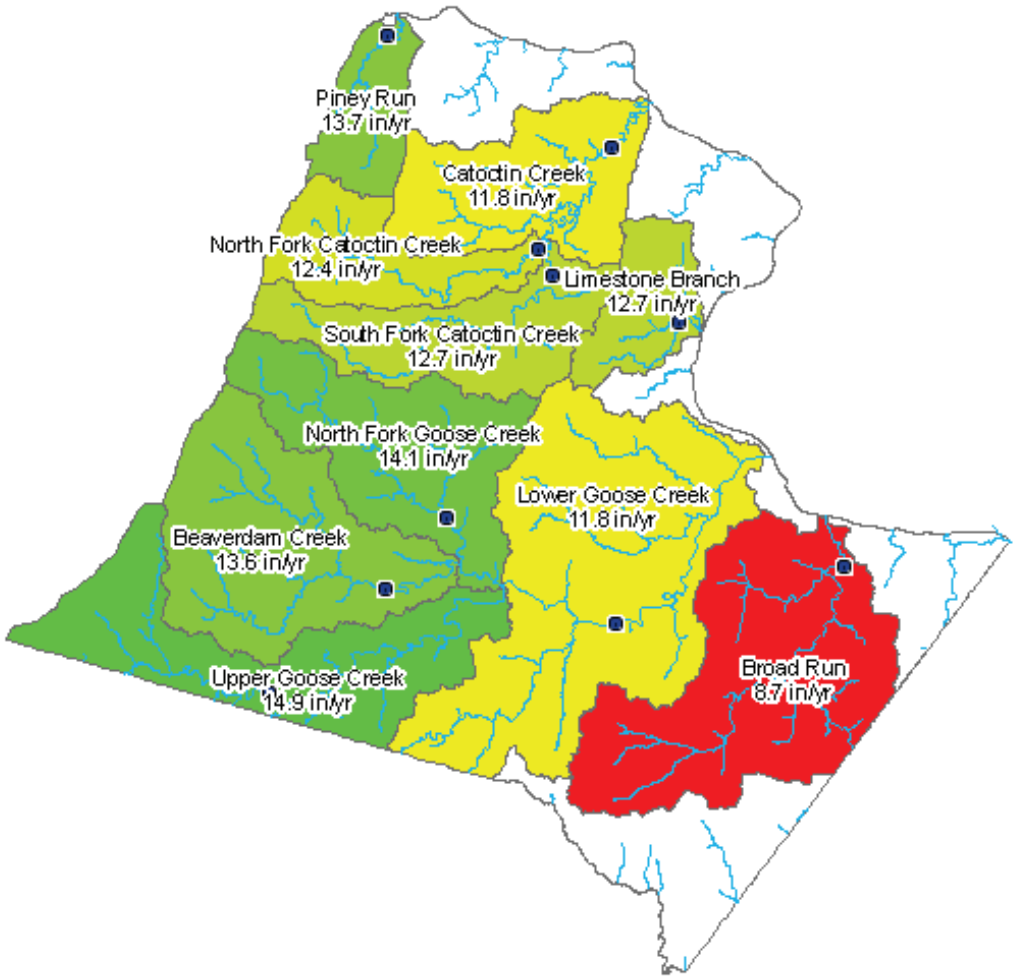
U.S. Fish and Wildlife Service, 1981, Interim regional policy for New England streamflow recommendations: Newton Corner, MA, U.S. Fish and Wildlife Service, 3 p.

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Spatial Distribution:

What about the fact that 3 gages are long-term and others have only a few years? Let's go back and calculate recharge using similar recent data for those 3 gages thereby providing a more consistent basis for spatial comparison.

The spatial distribution of the recent (2002-2005) data may be mapped as:



O:\project\wrmp\Recharge\ Recharge_Analysis_Map06.mxd

Temporal Changes:

Have there been temporal changes in recharge? We can't examine all ten gages as seven have limited data. Using simple Excel trend fit shows that the three gages are trending downwards somewhat. We need to examine recharge concurrent with precipitation. How about cumulative recharge versus cumulative rainfall?

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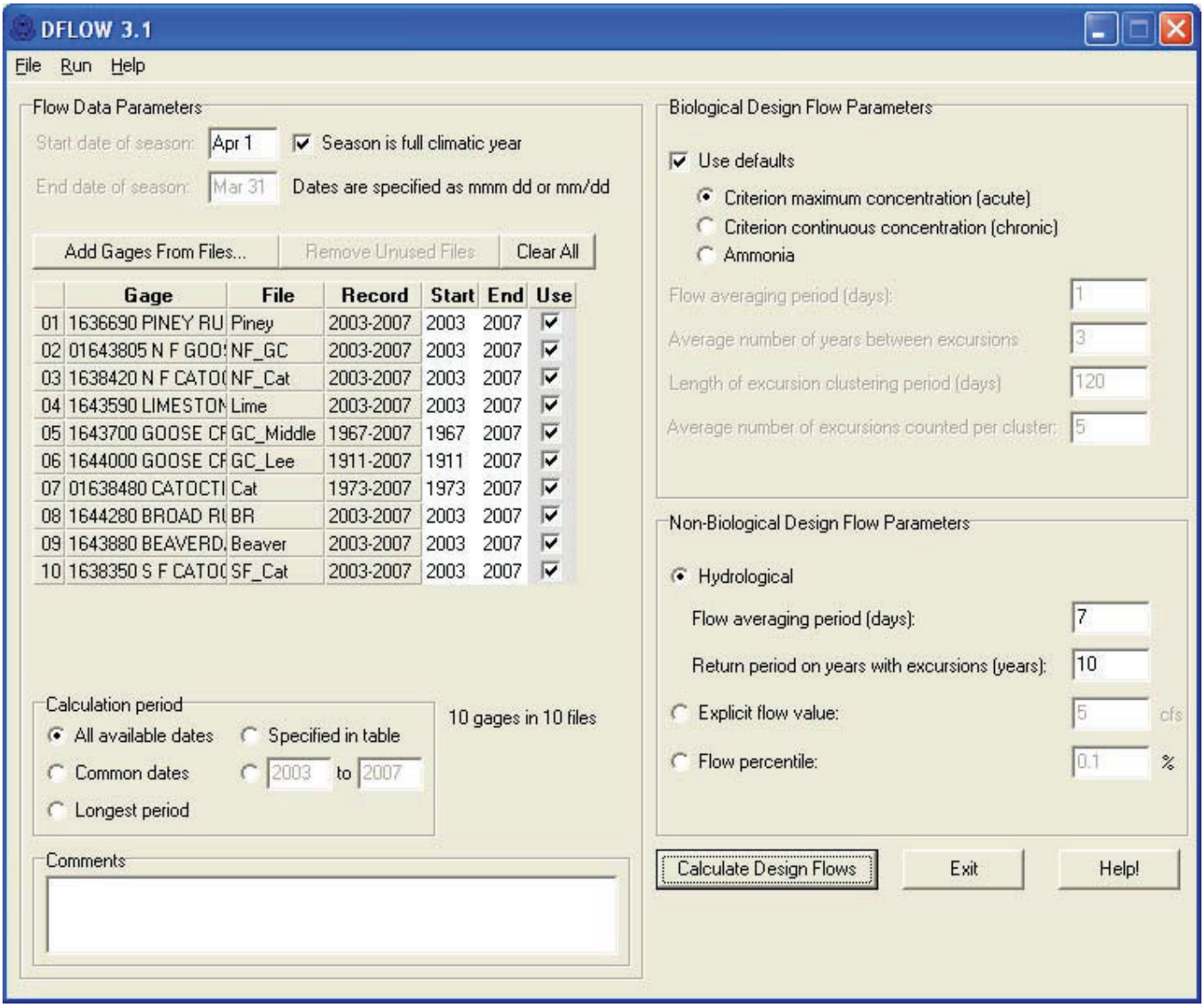
U.S. Fish and Wildlife Service, 1981, Interim regional policy for New England streamflow recommendations: Newton Corner, MA, U.S. Fish and Wildlife Service, 3 p.

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Calculating Baseflow Using DFLOW

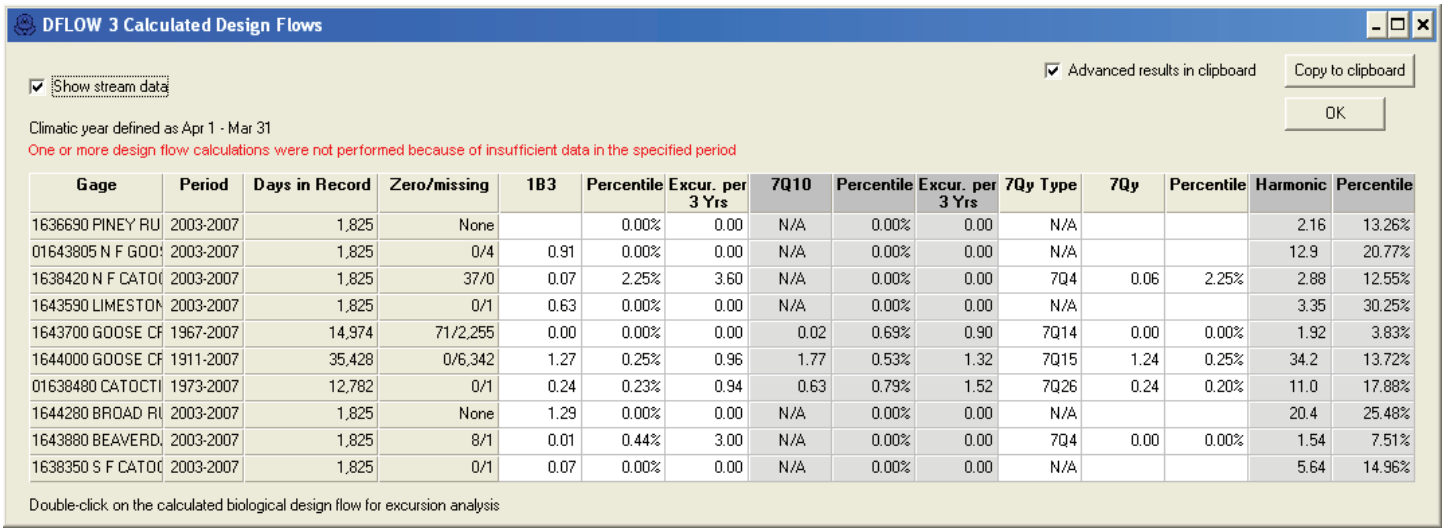
Background: DFLOW 3.1 is an update to the Windows-based revision of the DFLOW computer code developed by U.S. EPA in the early 1990s to estimate design stream flows for use in water quality studies. DFLOW 3.1 directly incorporates the USGS A193 calculation for Log Pearson Type III estimation, but otherwise uses the same algorithms as the original program. It also provides an easier-to-use interface and additional functionality.

Application: Edit and load data. This done starting with the USGS Streamflow web query. The DFLOW program cl.aims to use NWIS formatted data, but there are numerous manual edits required including, use of older header records, removal of blank readings, formatting date and adding leading zero to match station id.



Note that 7 of the 10 only began recording data in July 2001. It's not clear why DFLOW won't allow these early dates.

Now "Calculate Design Flows" for the 7Q10, 7Q5, 7Q2 and 1Q10.



DFLOW 3 Calculated Design Flows

Show stream data

Advanced results in clipboard

Copy to clipboard

OK

Climatic year defined as Apr 1 - Mar 31

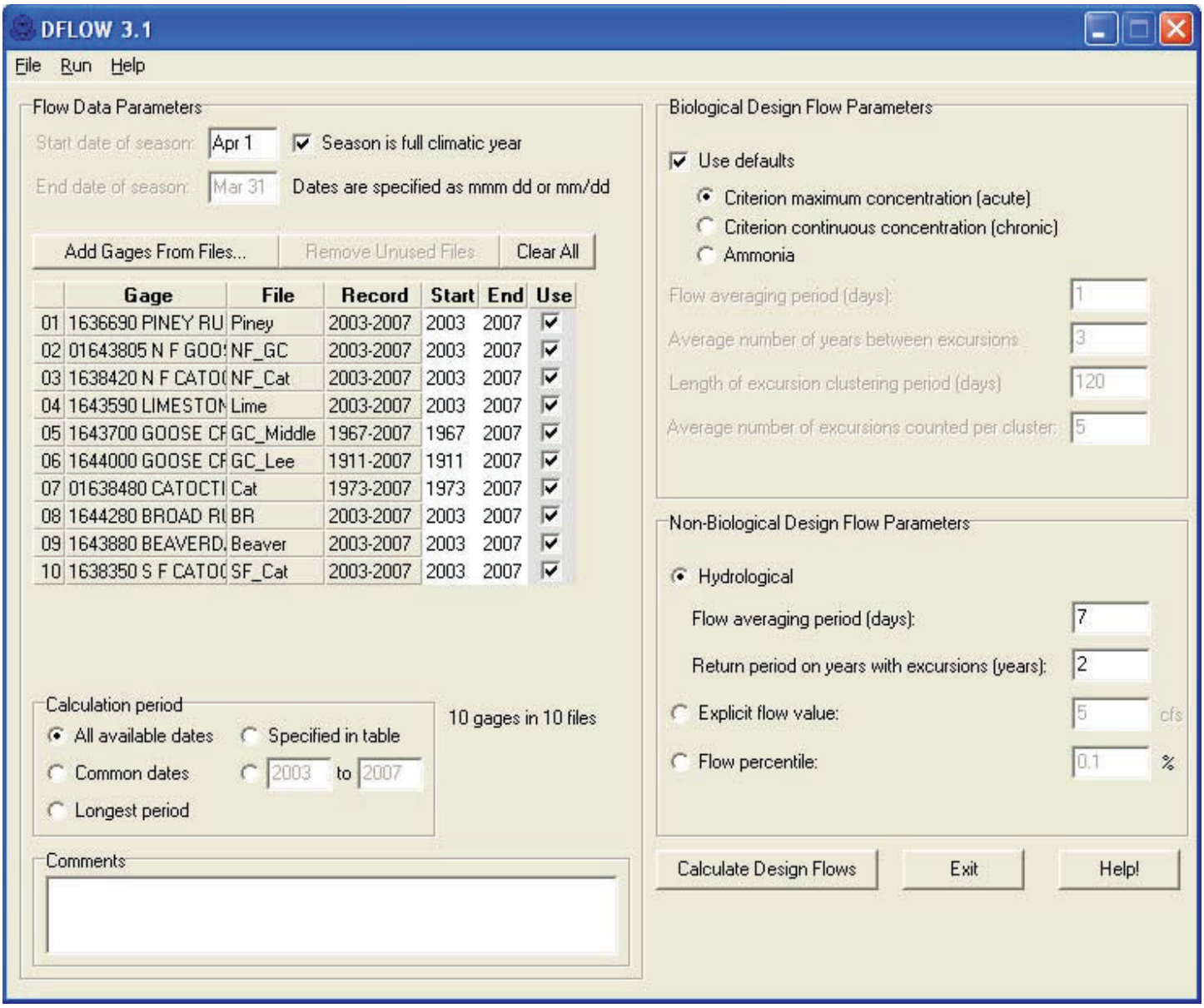
One or more design flow calculations were not performed because of insufficient data in the specified period

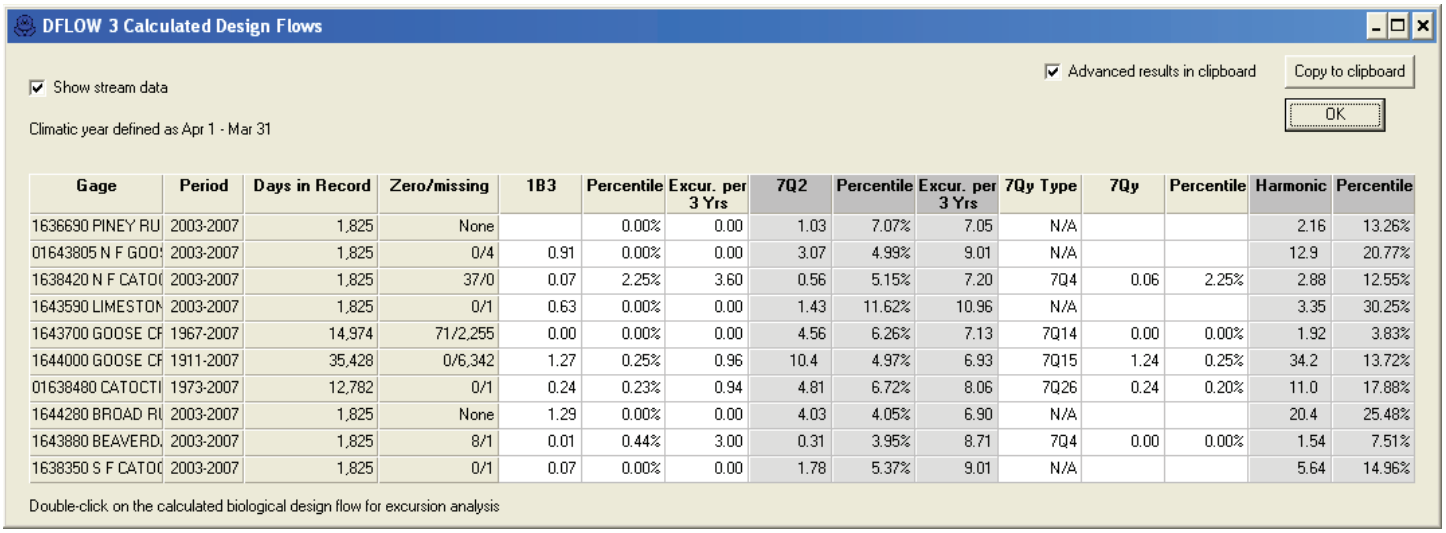
Gage	Period	Days in Record	Zero/missing	1B3	Percentile	Excur. per 3 Yrs	7Q10	Percentile	Excur. per 3 Yrs	7Qy Type	7Qy	Percentile	Harmonic	Percentile
1636690 PINEY RU	2003-2007	1,825	None		0.00%	0.00	N/A	0.00%	0.00	N/A			2.16	13.26%
01643805 N F GOO	2003-2007	1,825	0/4	0.91	0.00%	0.00	N/A	0.00%	0.00	N/A			12.9	20.77%
1638420 N F CATO	2003-2007	1,825	37/0	0.07	2.25%	3.60	N/A	0.00%	0.00	7Q4	0.06	2.25%	2.88	12.55%
1643590 LIMESTON	2003-2007	1,825	0/1	0.63	0.00%	0.00	N/A	0.00%	0.00	N/A			3.35	30.25%
1643700 GOOSE CF	1967-2007	14,974	71/2,255	0.00	0.00%	0.00	0.02	0.69%	0.90	7Q14	0.00	0.00%	1.92	3.83%
1644000 GOOSE CF	1911-2007	35,428	0/6,342	1.27	0.25%	0.96	1.77	0.53%	1.32	7Q15	1.24	0.25%	34.2	13.72%
01638480 CATOCTI	1973-2007	12,782	0/1	0.24	0.23%	0.94	0.63	0.79%	1.52	7Q26	0.24	0.20%	11.0	17.88%
1644280 BROAD RU	2003-2007	1,825	None	1.29	0.00%	0.00	N/A	0.00%	0.00	N/A			20.4	25.48%
1643880 BEAVERD	2003-2007	1,825	8/1	0.01	0.44%	3.00	N/A	0.00%	0.00	7Q4	0.00	0.00%	1.54	7.51%
1638350 S F CATO	2003-2007	1,825	0/1	0.07	0.00%	0.00	N/A	0.00%	0.00	N/A			5.64	14.96%

Double-click on the calculated biological design flow for excursion analysis

Copy this to clipboard and baste into new Excel sheet.

Now return and change from 7Q10 to 7Q2 to include short records





Gage	Period	Days in Record	Zero/missing	1B3	Percentile	Excur. per 3 Yrs	7Q2	Percentile	Excur. per 3 Yrs	7Qy Type	7Qy	Percentile	Harmonic	Percentile
1636690 PINEY RU	2003-2007	1,825	None		0.00%	0.00	1.03	7.07%	7.05	N/A			2.16	13.26%
01643805 N F GOO	2003-2007	1,825	0/4	0.91	0.00%	0.00	3.07	4.99%	9.01	N/A			12.9	20.77%
1638420 N F CATO	2003-2007	1,825	37/0	0.07	2.25%	3.60	0.56	5.15%	7.20	7Q4	0.06	2.25%	2.88	12.55%
1643590 LIMESTON	2003-2007	1,825	0/1	0.63	0.00%	0.00	1.43	11.62%	10.96	N/A			3.35	30.25%
1643700 GOOSE CF	1967-2007	14,974	71/2,255	0.00	0.00%	0.00	4.56	6.26%	7.13	7Q14	0.00	0.00%	1.92	3.83%
1644000 GOOSE CF	1911-2007	35,428	0/6,342	1.27	0.25%	0.96	10.4	4.97%	6.93	7Q15	1.24	0.25%	34.2	13.72%
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1644280 BROAD RU	2003-2007	1,825	None	1.29	0.00%	0.00	4.03	4.05%	6.90	N/A			20.4	25.48%
1643880 BEAVERD.	2003-2007	1,825	8/1	0.01	0.44%	3.00	0.31	3.95%	8.71	7Q4	0.00	0.00%	1.54	7.51%
1638350 S F CATO	2003-2007	1,825	0/1	0.07	0.00%	0.00	1.78	5.37%	9.01	N/A			5.64	14.96%

To verify this work, Catoctin data was truncated to 1984. A 7Q10 was calculated as 3.01 cfs. This compares well with USGS reported value of 2.99.

Automated Base Flow Separation and Recesssion using SWAT

WR Analysis: Stream base flow

Program: BFLOW by Arnold, et al, 1995

Finding: The SWAT program provides a quick determination of the baseflow component for the ten stream gages.

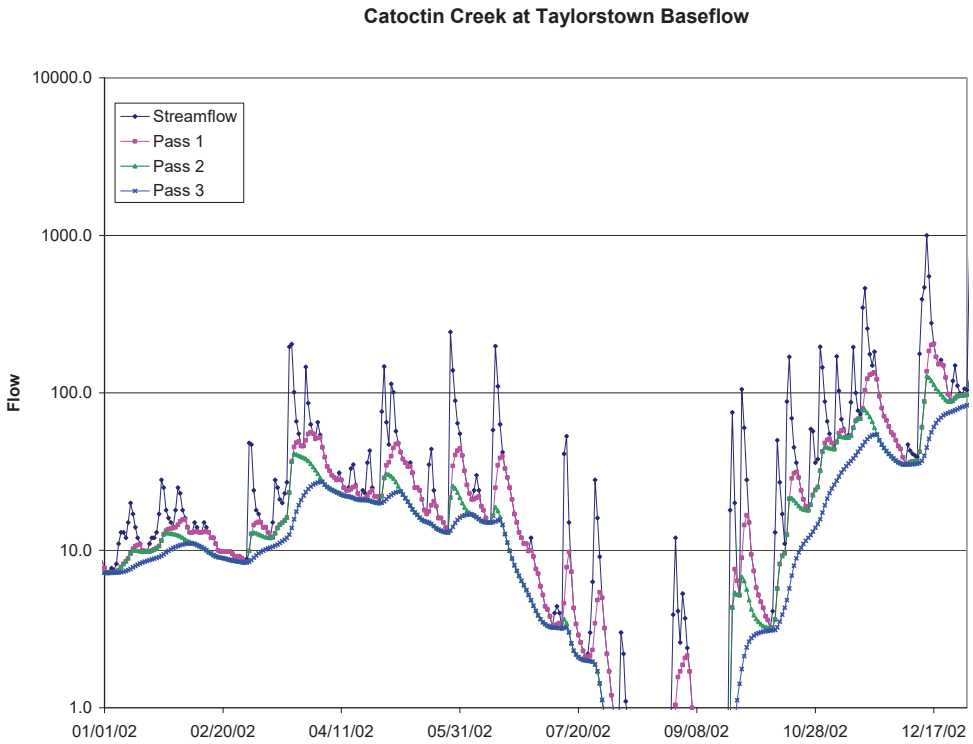
As an example, the period of record at Catoctin Creek at Taylorstown 1971-2006, was analyzed. There are about 13,000 daily measurements of stream flow. Data is currently maintained through a web query. Data must be manually reformatted to conform to BFLOW program specifications.

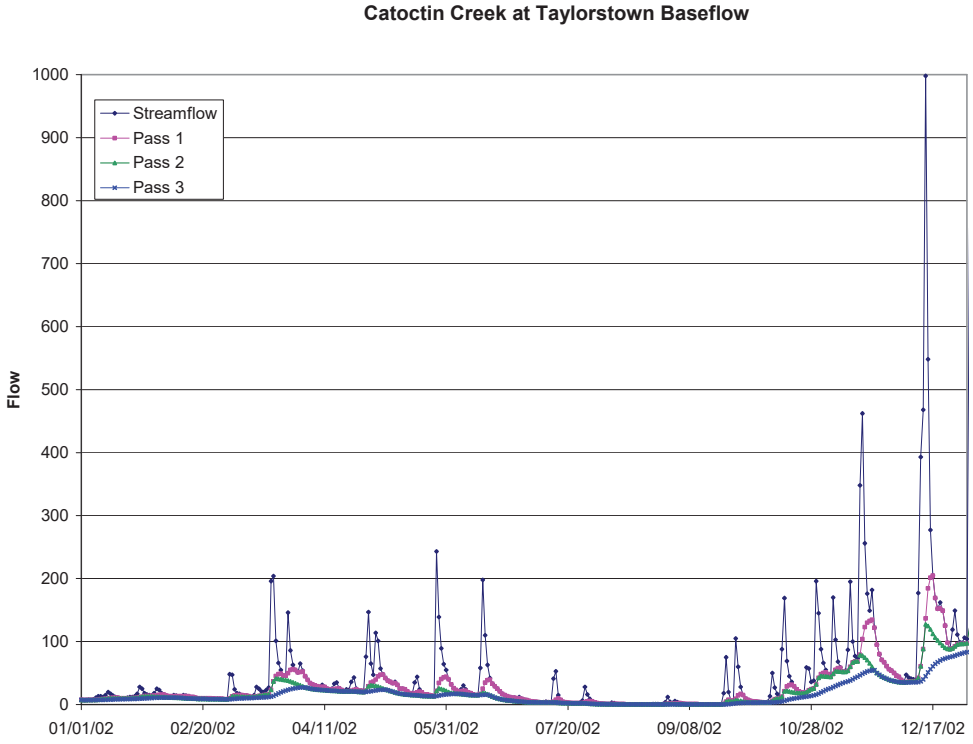
Arnold, et al, 1995

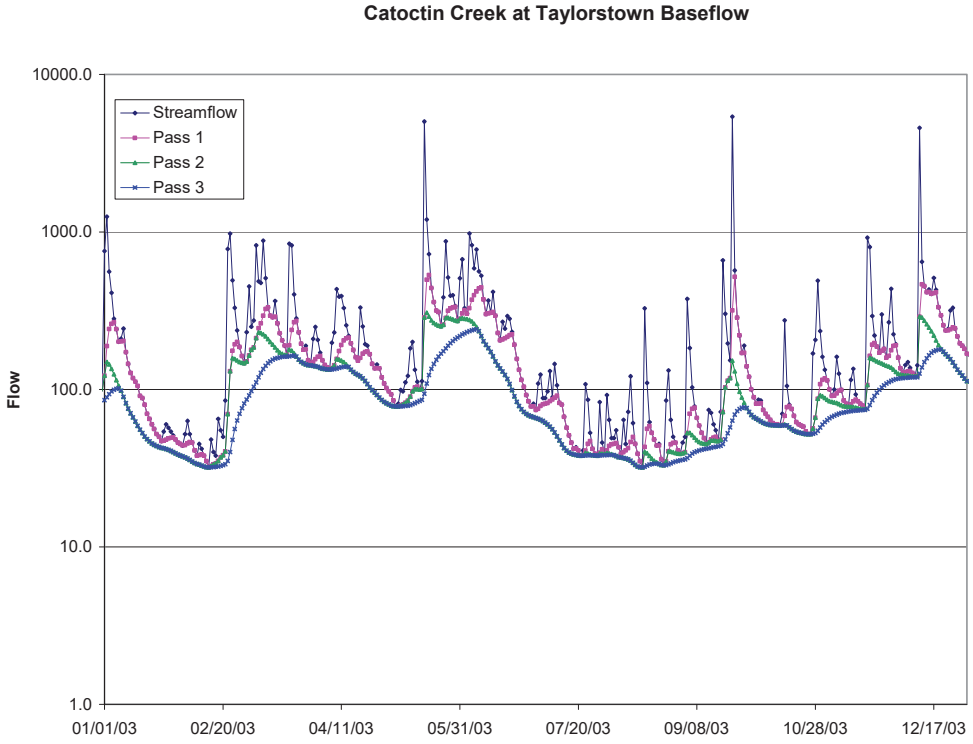
Baseflow Fr1	Baseflow Fr2	Baseflow Fr3
0.61	0.46	0.39

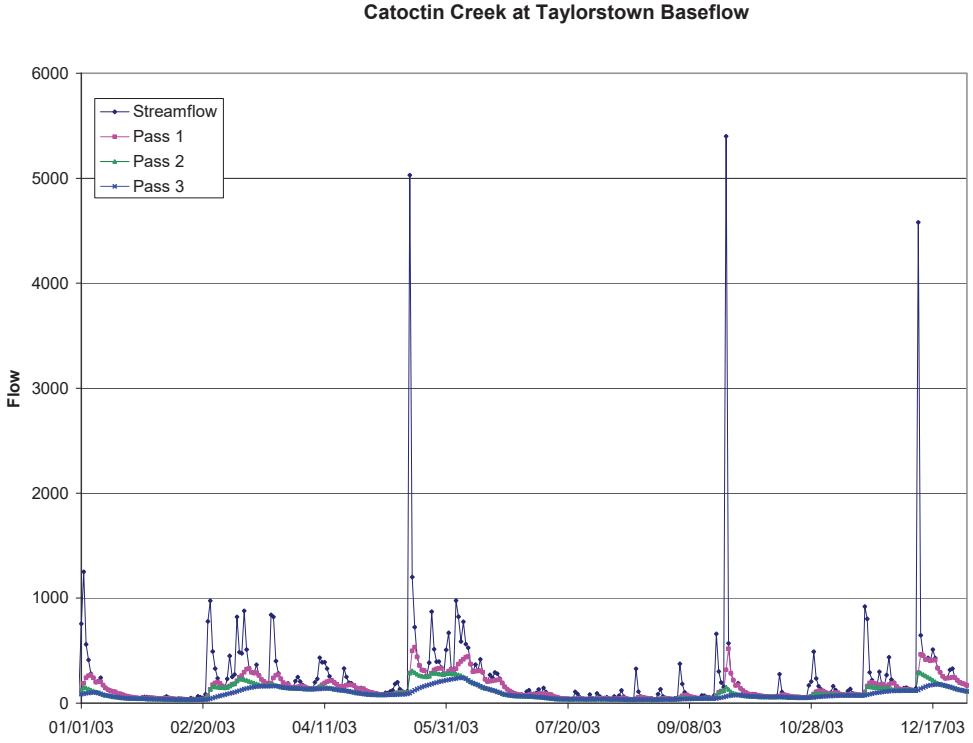
This indicates that 61 percent of the flow in Catoctin is baseflow and 39 percent is storm events.

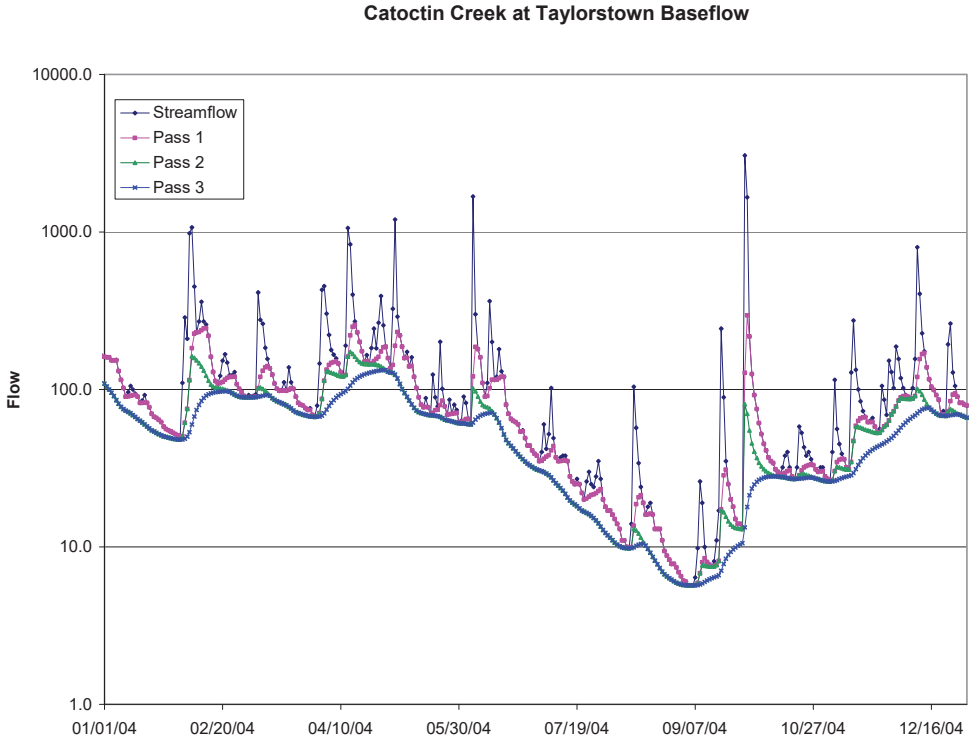
Example outputs display in log flow and linear flow for the years 2002 to 2006 are presented.

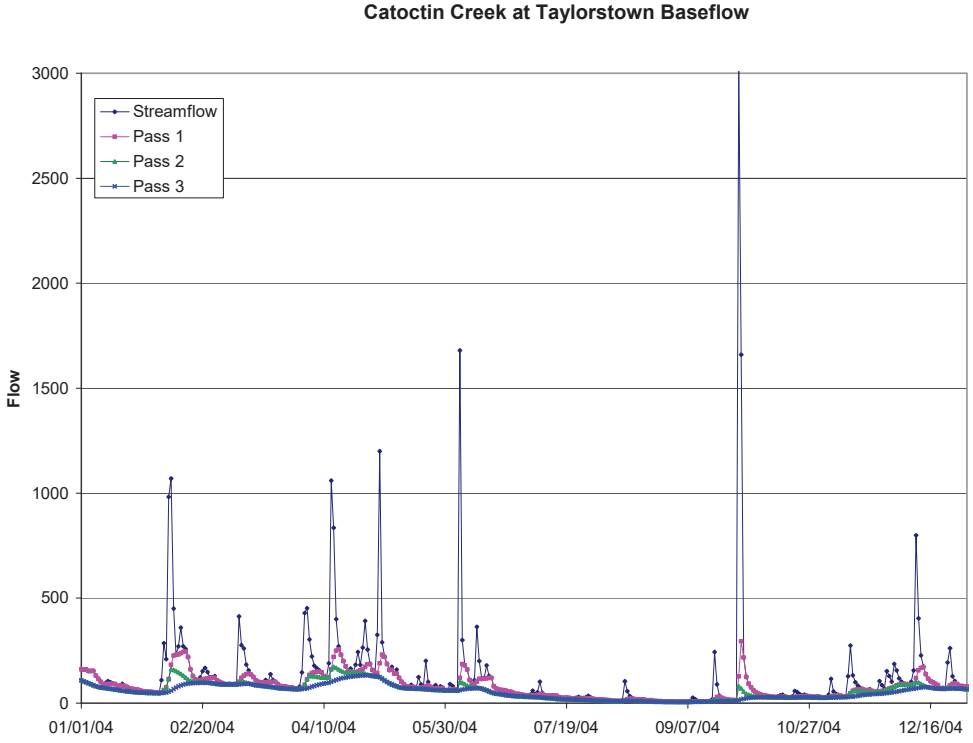


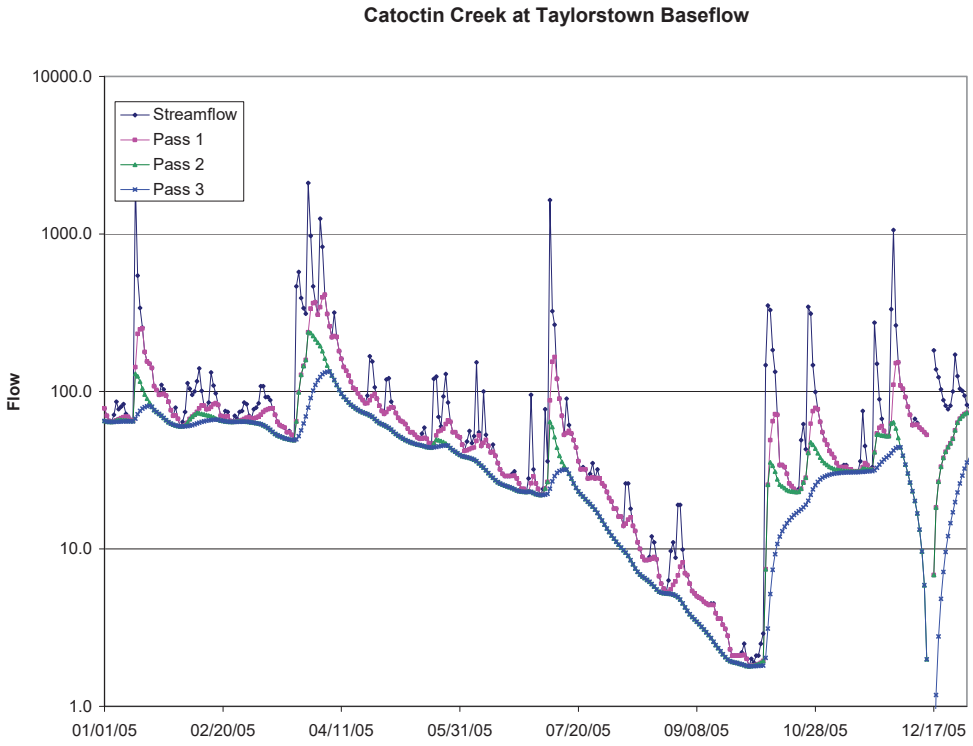


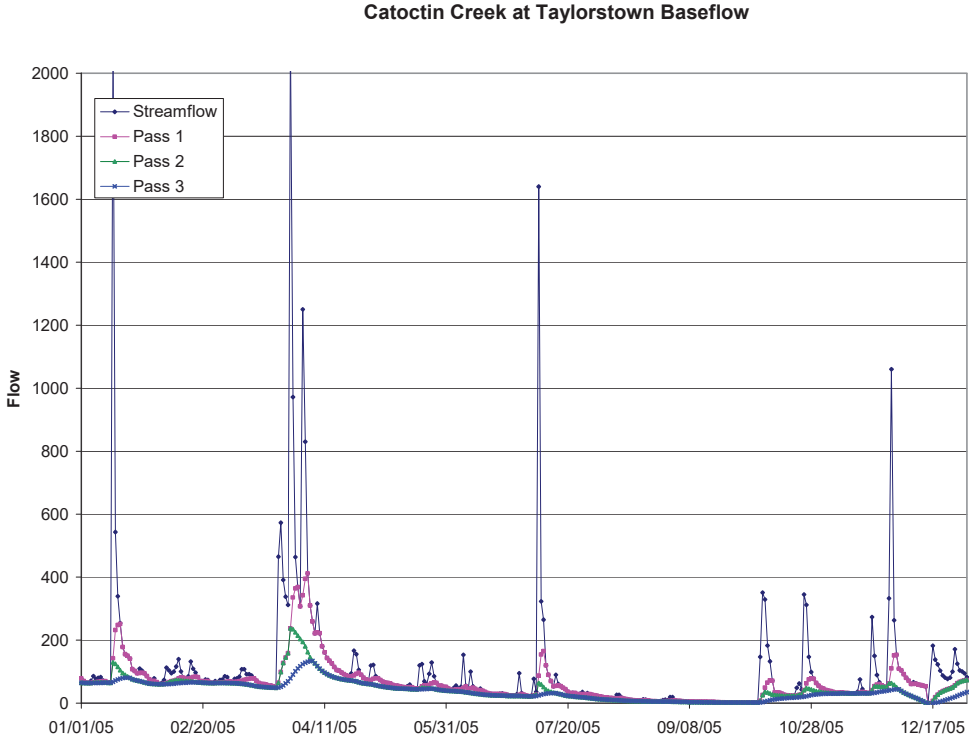

Catoctin Creek at Taylorstown Baseflow
Streamflow
Pass 1
Pass 2
Pass 3
Flow
10000.0
1000.0
100.0
10.0
1.0
01/01/03
02/20/03
04/11/03
05/31/03
07/20/03
09/08/03
10/28/03
12/17/03

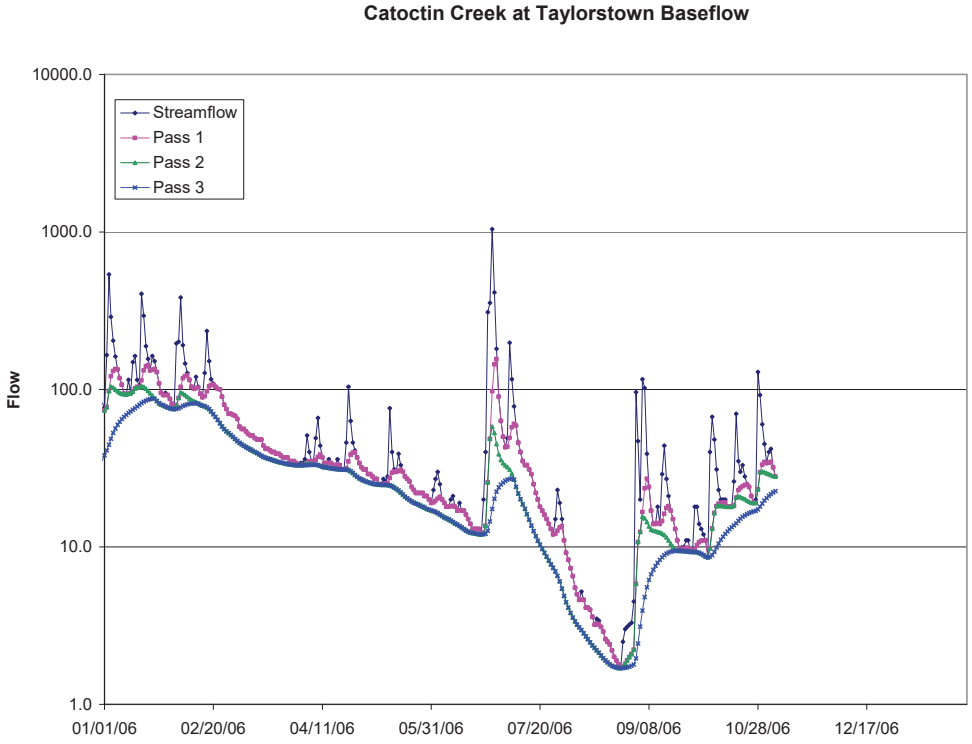

Catoctin Creek at Taylorstown Baseflow
Streamflow
Pass 1
Pass 2
Pass 3
Flow
6000
5000
4000
3000
2000
1000
0
01/01/03
02/20/03
04/11/03
05/31/03
07/20/03
09/08/03
10/28/03
12/17/03

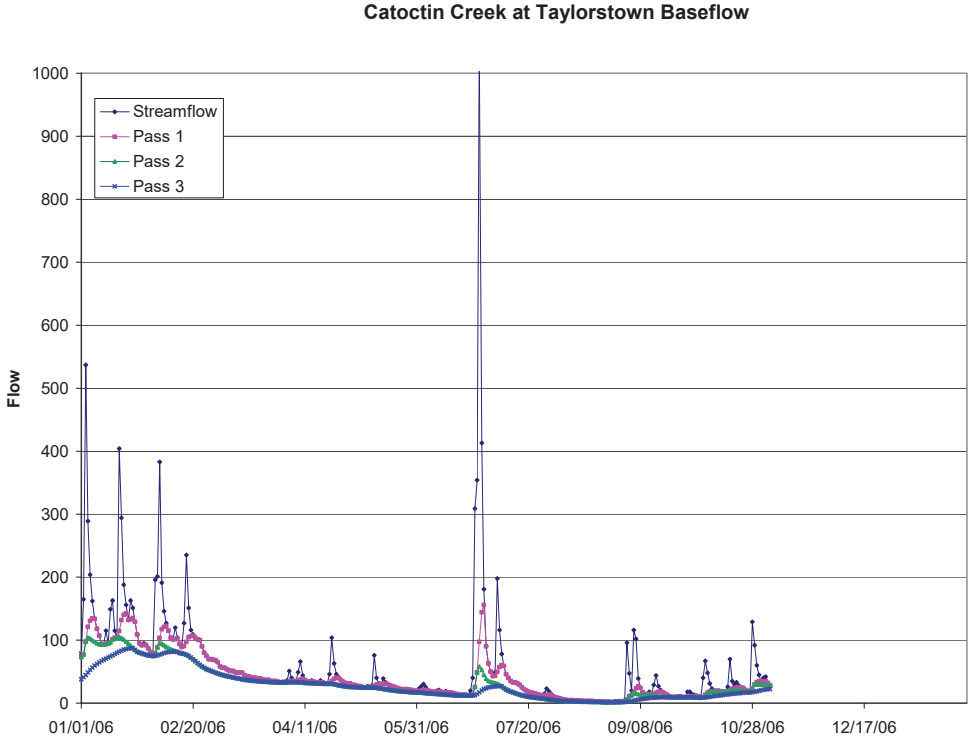

Catoctin Creek at Taylorstown Baseflow
Streamflow
Pass 1
Pass 2
Pass 3
Flow
10000.0
1000.0
100.0
10.0
1.0
01/01/04
02/20/04
04/10/04
05/30/04
07/19/04
09/07/04
10/27/04
12/16/04


Catoctin Creek at Taylorstown Baseflow
Streamflow
Pass 1
Pass 2
Pass 3
Flow
3000
2500
2000
1500
1000
500
0
01/01/04
02/20/04
04/10/04
05/30/04
07/19/04
09/07/04
10/27/04
12/16/04


Catoctin Creek at Taylorstown Baseflow
Streamflow
Pass 1
Pass 2
Pass 3
Flow
10000.0
1000.0
100.0
10.0
1.0
01/01/05
02/20/05
04/11/05
05/31/05
07/20/05
09/08/05
10/28/05
12/17/05


Catoctin Creek at Taylorstown Baseflow
Streamflow
Pass 1
Pass 2
Pass 3
Flow
2000
1800
1600
1400
1200
1000
800
600
400
200
0
01/01/05
02/20/05
04/11/05
05/31/05
07/20/05
09/08/05
10/28/05
12/17/05

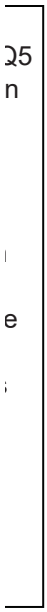

Catoctin Creek at Taylorstown Baseflow
Streamflow
Pass 1
Pass 2
Pass 3
Flow
10000.0
1000.0
100.0
10.0
1.0
01/01/06
02/20/06
04/11/06
05/31/06
07/20/06
09/08/06
10/28/06
12/17/06


Catoctin Creek at Taylorstown Baseflow
Streamflow
Pass 1
Pass 2
Pass 3
Flow
1000
900
800
700
600
500
400
300
200
100
0
01/01/06
02/20/06
04/11/06
05/31/06
07/20/06
09/08/06
10/28/06
12/17/06

Because a procedure had not been developed for calculating design flow based on the durations and frequencies specified in aquatic life criteria, the U.S. EPA recommended interim use of the 1Q5 and 1Q1Q low flows as the CMC design flow and the 7Q5 and 7Q1Q low flows as the CCC design flow for unstressed and stressed systems, respectively.

Recommendations:

If steady-state modeling is used, the hydrologically-based or the biologically-based stream design flow method should be used. If the hydrologically-based method is used, the 1Q10 and 7Q10 low flows should be used as the CMC and CCC design flow, except that the 30Q10 low flow should be used as the CCC design flow for ammonia is situations involving POTWs designed to remove ammonia where limited variability of effluent pollutant concentrations and resulting concentrations the receiving water can be demonstrated.


Q5
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Climatic year defined as Apr 1 - Mar 31

Gage	Period	Days in Record	Zero/missing	1B3	Percentile	Excur. per 3 Yrs	7Q10	Percentile	Excur. per 3 Yrs	7Qy Type	7Qy	Percentile	Harmonic	Percentile
1636690 PINEY RUN NEAR LOVETTSVILLE, VA	2003-2007	1,825	None	0	0.00%	0	N/A	0.00%	0	N/A			2.16	13.26%
01643805 N F GOOSE CREEK AT RT 729 NEAR LINCOLN,	2003-2007	1,825	0/4	0.91	0.00%	0	N/A	0.00%	0	N/A			12.9	20.77%
1638420 N F CATOCTIN CREEK AT RT 681 NEAR WATER	2003-2007	1,825	37/0	0.07	2.25%	3.6	N/A	0.00%	0	7Q4	0.06	2.25%	2.88	12.55%
1643590 LIMESTONE BRANCH NEAR LEESBURG, VA	2003-2007	1,825	0/1	0.63	0.00%	0	N/A	0.00%	0	N/A			3.35	30.25%
1643700 GOOSE CREEK NEAR MIDDLEBURG, VA	1967-2007	14,974	71/2,255	0	0.00%	0	0.02	0.69%	0.9	7Q14	0	0.00%	1.92	3.83%
1644000 GOOSE CREEK NEAR LEESBURG, VA	1911-2007	35,428	0/6,342	1.27	0.25%	0.96	1.77	0.53%	1.32	7Q15	1.24	0.25%	34.2	13.72%
01638480 CATOCTIN CREEK AT TAYLORSTOWN, VA	1973-2007	12,782	0/1	0.24	0.23%	0.94	0.63	0.79%	1.52	7Q26	0.24	0.20%	11	17.88%
1644280 BROAD RUN NEAR LEESBURG, VA	2003-2007	1,825	None	1.29	0.00%	0	N/A	0.00%	0	N/A			20.4	25.48%
1643880 BEAVERDAM CREEK AT RT 734 NEAR MOUNTV	2003-2007	1,825	8/1	0.01	0.44%	3	N/A	0.00%	0	7Q4	0	0.00%	1.54	7.51%
1638350 S F CATOCTIN CREEK AT RT 698 NEAR WATER	2003-2007	1,825	0/1	0.07	0.00%	0	N/A	0.00%	0	N/A			5.64	14.96%

Advanced information

1636690 PINEY RUN NEAR LOVETTSVILLE, VA

Recurrence Period	1	2	3	4	5
Calculated		1.03	0.48	0.29	0.2
Recurrence Period	5	2.5	1.667	1.25	1
Observed	0.04	0.53	0.99	2.36	3.59
	2002	2005	2006	2004	2003

01643805 N F GOOSE CREEK AT RT 729 NEAR LINCOLN, VA

Recurrence Period	1	2	3	4
Calculated		3.07	1.92	1.5
Recurrence Period	4	2	1.333	1
Observed	1.31	1.49	5.06	16.71
	2005	2002	2004	2003

1638420 N F CATOCTIN CREEK AT RT 681 NEAR WATERFORD, VA

Recurrence Period	1	2	3	4	5
Calculated		0.56	0.18	0.06	0
Recurrence Period	5	2.5	1.667	1.25	1
Observed	0	0.12	0.51	1.9	6.54
	2002	2005	2006	2004	2003

1643590 LIMESTONE BRANCH NEAR LEESBURG, VA

Recurrence Period	1	2	3	4
Calculated		1.43	1.06	0.9
Recurrence Period	4	2	1.333	1
Observed	0.72	0.97	2	3.57
	2002	2005	2004	2003

1643700 GOOSE CREEK NEAR MIDDLEBURG, VA

Recurrence Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Calculated		4.56	1.14	0.41	0.2	0.09	0.05	0.03	0.02	0.02	0.01	0.01	0.01	0
Recurrence Period	31	15.5	10.333	7.75	6.2	5.167	4.429	3.875	3.444	3.1	2.818	2.583	2.385	2.214
Observed	0	0	0	0.05	0.11	0.13	0.41	0.83	0.86	0.87	1.69	1.9	2.13	2.97
	1991	1985	1986	1993	2002	1966	1987	1988	1980	1995	2005	1977	1983	1981
1644000 GOOSE CREEK NEAR LEESBURG, VA														
Recurrence Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Calculated		10.36	5.8	4.12	3.31	2.69	2.31	2.07	1.9	1.77	1.6	1.48	1.38	1.3
Recurrence Period	77	38.5	25.667	19.25	15.4	12.833	11	9.625	8.556	7.7	7	6.417	5.923	5.5
Observed	0.45	0.51	0.68	1.03	1.2	1.34	1.43	1.7	1.71	1.99	2.03	2.27	2.84	3.03
	1985	1941	1999	1991	1986	1966	1987	1932	1930	1995	1910	1931	2002	1993
01638480 CATOCTIN CREEK AT TAYLORSTOWN, VA														
Recurrence Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Calculated		4.81	2.6	1.77	1.37	1.06	0.88	0.77	0.69	0.63	0.55	0.5	0.45	0.42
Recurrence Period	34	17	11.333	8.5	6.8	5.667	4.857	4.25	3.778	3.4	3.091	2.833	2.615	2.429
Observed	0.1	0.27	0.29	0.31	1.09	1.47	1.71	2.06	2.17	2.27	2.5	2.99	3.96	4.11
	1999	1986	2002	1991	1998	1997	1993	2005	1977	1995	1985	1981	2001	1983
1644280 BROAD RUN NEAR LEESBURG, VA														
Recurrence Period	1	2	3	4	5									
Calculated		4.03	2.9	2.44	2.19									
Recurrence Period	5	2.5	1.667	1.25	1									
Observed	1.64	3.16	3.97	5.36	15.14									
	2002	2005	2006	2004	2003									
1643880 BEAVERDAM CREEK AT RT 734 NEAR MOUNTVILLE, VA														
Recurrence Period	1	2	3	4										
Calculated		0.31	0.01	0										
Recurrence Period	4	2	1.333	1										
Observed	0	0.03	1.56	16.86										
	2005	2002	2004	2003										
1638350 S F CATOCTIN CREEK AT RT 698 NEAR WATERFORD, VA														
Recurrence Period	1	2	3	4										
Calculated		1.78	0.79	0.5										
Recurrence Period	4	2	1.333	1										
Observed	0.18	0.95	3.41	13										
	2002	2005	2004	2003										

Climatic year defined as Apr 1 - Mar 31

Gage	Period	Days in Record	Zero/missing	1B3	Percentile	Excur. per 3 Yrs	7Q5	Percentile	Excur. per 3 Yrs	7Qy Type	7Qy	Percentile	Harmonic	Percentile
1636690 PINEY RUN NEAR LOVETTSVILLE, VA	2003-2007	1,825	None	0	0.00%	0	0.2	1.70%	3	N/A			2.16	13.26%
01643805 N F GOOSE CREEK AT RT 729 NEAR LINCOLN,	2003-2007	1,825	0/4	0.91	0.00%	0	N/A	0.00%	0	N/A			12.9	20.77%
1638420 N F CATOCTIN CREEK AT RT 681 NEAR WATER	2003-2007	1,825	37/0	0.07	2.25%	3.6	0	0.00%	0	7Q4	0.06	2.25%	2.88	12.55%
1643590 LIMESTONE BRANCH NEAR LEESBURG, VA	2003-2007	1,825	0/1	0.63	0.00%	0	N/A	0.00%	0	N/A			3.35	30.25%
1643700 GOOSE CREEK NEAR MIDDLEBURG, VA	1967-2007	14,974	71/2,255	0	0.00%	0	0.2	1.48%	1.9	7Q14	0	0.00%	1.92	3.83%
1644000 GOOSE CREEK NEAR LEESBURG, VA	1911-2007	35,428	0/6,342	1.27	0.25%	0.96	3.31	1.50%	2.29	7Q15	1.24	0.25%	34.2	13.72%
01638480 CATOCTIN CREEK AT TAYLORSTOWN, VA	1973-2007	12,782	0/1	0.24	0.23%	0.94	1.37	1.51%	2.06	7Q26	0.24	0.20%	11	17.88%
1644280 BROAD RUN NEAR LEESBURG, VA	2003-2007	1,825	None	1.29	0.00%	0	2.19	0.77%	2.4	N/A			20.4	25.48%
1643880 BEAVERDAM CREEK AT RT 734 NEAR MOUNTV	2003-2007	1,825	8/1	0.01	0.44%	3	N/A	0.00%	0	7Q4	0	0.00%	1.54	7.51%
1638350 S F CATOCTIN CREEK AT RT 698 NEAR WATER	2003-2007	1,825	0/1	0.07	0.00%	0	N/A	0.00%	0	N/A			5.64	14.96%

Advanced information

1636690 PINEY RUN NEAR LOVETTSVILLE, VA

Recurrence Period	1	2	3	4	5
Calculated		1.03	0.48	0.29	0.2
Recurrence Period	5	2.5	1.667	1.25	1
Observed	0.04	0.53	0.99	2.36	3.59
	2002	2005	2006	2004	2003

01643805 N F GOOSE CREEK AT RT 729 NEAR LINCOLN, VA

Recurrence Period	1	2	3	4
Calculated		3.07	1.92	1.5
Recurrence Period	4	2	1.333	1
Observed	1.31	1.49	5.06	16.71
	2005	2002	2004	2003

1638420 N F CATOCTIN CREEK AT RT 681 NEAR WATERFORD, VA

Recurrence Period	1	2	3	4	5
Calculated		0.56	0.18	0.06	0
Recurrence Period	5	2.5	1.667	1.25	1
Observed	0	0.12	0.51	1.9	6.54
	2002	2005	2006	2004	2003

1643590 LIMESTONE BRANCH NEAR LEESBURG, VA

Recurrence Period	1	2	3	4
Calculated		1.43	1.06	0.9
Recurrence Period	4	2	1.333	1
Observed	0.72	0.97	2	3.57
	2002	2005	2004	2003

1643700 GOOSE CREEK NEAR MIDDLEBURG, VA

Recurrence Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Calculated		4.56	1.14	0.41	0.2	0.09	0.05	0.03	0.02	0.02	0.01	0.01	0.01	0
Recurrence Period	31	15.5	10.333	7.75	6.2	5.167	4.429	3.875	3.444	3.1	2.818	2.583	2.385	2.214
Observed	0	0	0	0.05	0.11	0.13	0.41	0.83	0.86	0.87	1.69	1.9	2.13	2.97
	1991	1985	1986	1993	2002	1966	1987	1988	1980	1995	2005	1977	1983	1981
1644000 GOOSE CREEK NEAR LEESBURG, VA														
Recurrence Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Calculated		10.36	5.8	4.12	3.31	2.69	2.31	2.07	1.9	1.77	1.6	1.48	1.38	1.3
Recurrence Period	77	38.5	25.667	19.25	15.4	12.833	11	9.625	8.556	7.7	7	6.417	5.923	5.5
Observed	0.45	0.51	0.68	1.03	1.2	1.34	1.43	1.7	1.71	1.99	2.03	2.27	2.84	3.03
	1985	1941	1999	1991	1986	1966	1987	1932	1930	1995	1910	1931	2002	1993
01638480 CATOCTIN CREEK AT TAYLORSTOWN, VA														
Recurrence Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Calculated		4.81	2.6	1.77	1.37	1.06	0.88	0.77	0.69	0.63	0.55	0.5	0.45	0.42
Recurrence Period	34	17	11.333	8.5	6.8	5.667	4.857	4.25	3.778	3.4	3.091	2.833	2.615	2.429
Observed	0.1	0.27	0.29	0.31	1.09	1.47	1.71	2.06	2.17	2.27	2.5	2.99	3.96	4.11
	1999	1986	2002	1991	1998	1997	1993	2005	1977	1995	1985	1981	2001	1983
1644280 BROAD RUN NEAR LEESBURG, VA														
Recurrence Period	1	2	3	4	5									
Calculated		4.03	2.9	2.44	2.19									
Recurrence Period	5	2.5	1.667	1.25	1									
Observed	1.64	3.16	3.97	5.36	15.14									
	2002	2005	2006	2004	2003									
1643880 BEAVERDAM CREEK AT RT 734 NEAR MOUNTVILLE, VA														
Recurrence Period	1	2	3	4										
Calculated		0.31	0.01	0										
Recurrence Period	4	2	1.333	1										
Observed	0	0.03	1.56	16.86										
	2005	2002	2004	2003										
1638350 S F CATOCTIN CREEK AT RT 698 NEAR WATERFORD, VA														
Recurrence Period	1	2	3	4										
Calculated		1.78	0.79	0.5										
Recurrence Period	4	2	1.333	1										
Observed	0.18	0.95	3.41	13										
	2002	2005	2004	2003										

Climatic year defined as Apr 1 - Mar 31

Gage	Period	Days in Record	Zero/missing	1B3	Percentile	Excur. per 3 Yrs	7Q2	Percentile	Excur. per 3 Yrs	7Qy Type	7Qy	Percentile	Harmonic	Percentile
1636690 PINEY RUN NEAR LOVETTSVILLE, VA	2003-2007	1,825	None	0	0.00%	0	1.03	7.07%	7.05	N/A			2.16	13.26%
01643805 N F GOOSE CREEK AT RT 729 NEAR LINCOLN,	2003-2007	1,825	0/4	0.91	0.00%	0	3.07	4.99%	9.01	N/A			12.9	20.77%
1638420 N F CATOCTIN CREEK AT RT 681 NEAR WATER	2003-2007	1,825	37/0	0.07	2.25%	3.6	0.56	5.15%	7.2	7Q4	0.06	2.25%	2.88	12.55%
1643590 LIMESTONE BRANCH NEAR LEESBURG, VA	2003-2007	1,825	0/1	0.63	0.00%	0	1.43	11.62%	10.96	N/A			3.35	30.25%
1643700 GOOSE CREEK NEAR MIDDLEBURG, VA	1967-2007	14,974	71/2,255	0	0.00%	0	4.56	6.26%	7.13	7Q14	0	0.00%	1.92	3.83%
1644000 GOOSE CREEK NEAR LEESBURG, VA	1911-2007	35,428	0/6,342	1.27	0.25%	0.96	10.4	4.97%	6.93	7Q15	1.24	0.25%	34.2	13.72%
01638480 CATOCTIN CREEK AT TAYLORSTOWN, VA	1973-2007	12,782	0/1	0.24	0.23%	0.94	4.81	6.72%	8.06	7Q26	0.24	0.20%	11	17.88%
1644280 BROAD RUN NEAR LEESBURG, VA	2003-2007	1,825	None	1.29	0.00%	0	4.03	4.05%	6.9	N/A			20.4	25.48%
1643880 BEAVERDAM CREEK AT RT 734 NEAR MOUNTV	2003-2007	1,825	8/1	0.01	0.44%	3	0.31	3.95%	8.71	7Q4	0	0.00%	1.54	7.51%
1638350 S F CATOCTIN CREEK AT RT 698 NEAR WATER	2003-2007	1,825	0/1	0.07	0.00%	0	1.78	5.37%	9.01	N/A			5.64	14.96%

Advanced information

1636690 PINEY RUN NEAR LOVETTSVILLE, VA

Recurrence Period	1	2	3	4	5
Calculated		1.03	0.48	0.29	0.2
Recurrence Period	5	2.5	1.667	1.25	1
Observed	0.04	0.53	0.99	2.36	3.59
	2002	2005	2006	2004	2003

01643805 N F GOOSE CREEK AT RT 729 NEAR LINCOLN, VA

Recurrence Period	1	2	3	4
Calculated		3.07	1.92	1.5
Recurrence Period	4	2	1.333	1
Observed	1.31	1.49	5.06	16.71
	2005	2002	2004	2003

1638420 N F CATOCTIN CREEK AT RT 681 NEAR WATERFORD, VA

Recurrence Period	1	2	3	4	5
Calculated		0.56	0.18	0.06	0
Recurrence Period	5	2.5	1.667	1.25	1
Observed	0	0.12	0.51	1.9	6.54
	2002	2005	2006	2004	2003

1643590 LIMESTONE BRANCH NEAR LEESBURG, VA

Recurrence Period	1	2	3	4
Calculated		1.43	1.06	0.9
Recurrence Period	4	2	1.333	1
Observed	0.72	0.97	2	3.57
	2002	2005	2004	2003

1643700 GOOSE CREEK NEAR MIDDLEBURG, VA

Recurrence Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Calculated		4.56	1.14	0.41	0.2	0.09	0.05	0.03	0.02	0.02	0.01	0.01	0.01	0
Recurrence Period	31	15.5	10.333	7.75	6.2	5.167	4.429	3.875	3.444	3.1	2.818	2.583	2.385	2.214
Observed	0	0	0	0.05	0.11	0.13	0.41	0.83	0.86	0.87	1.69	1.9	2.13	2.97
	1991	1985	1986	1993	2002	1966	1987	1988	1980	1995	2005	1977	1983	1981
1644000 GOOSE CREEK NEAR LEESBURG, VA														
Recurrence Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Calculated		10.36	5.8	4.12	3.31	2.69	2.31	2.07	1.9	1.77	1.6	1.48	1.38	1.3
Recurrence Period	77	38.5	25.667	19.25	15.4	12.833	11	9.625	8.556	7.7	7	6.417	5.923	5.5
Observed	0.45	0.51	0.68	1.03	1.2	1.34	1.43	1.7	1.71	1.99	2.03	2.27	2.84	3.03
	1985	1941	1999	1991	1986	1966	1987	1932	1930	1995	1910	1931	2002	1993
01638480 CATOCTIN CREEK AT TAYLORSTOWN, VA														
Recurrence Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Calculated		4.81	2.6	1.77	1.37	1.06	0.88	0.77	0.69	0.63	0.55	0.5	0.45	0.42
Recurrence Period	34	17	11.333	8.5	6.8	5.667	4.857	4.25	3.778	3.4	3.091	2.833	2.615	2.429
Observed	0.1	0.27	0.29	0.31	1.09	1.47	1.71	2.06	2.17	2.27	2.5	2.99	3.96	4.11
	1999	1986	2002	1991	1998	1997	1993	2005	1977	1995	1985	1981	2001	1983
1644280 BROAD RUN NEAR LEESBURG, VA														
Recurrence Period	1	2	3	4	5									
Calculated		4.03	2.9	2.44	2.19									
Recurrence Period	5	2.5	1.667	1.25	1									
Observed	1.64	3.16	3.97	5.36	15.14									
	2002	2005	2006	2004	2003									
1643880 BEAVERDAM CREEK AT RT 734 NEAR MOUNTVILLE, VA														
Recurrence Period	1	2	3	4										
Calculated		0.31	0.01	0										
Recurrence Period	4	2	1.333	1										
Observed	0	0.03	1.56	16.86										
	2005	2002	2004	2003										
1638350 S F CATOCTIN CREEK AT RT 698 NEAR WATERFORD, VA														
Recurrence Period	1	2	3	4										
Calculated		1.78	0.79	0.5										
Recurrence Period	4	2	1.333	1										
Observed	0.18	0.95	3.41	13										
	2002	2005	2004	2003										

Climatic year defined as Apr 1 - Mar 31

Gage	Period	Days in Record	Zero/missing	1B3	Percentile	Excur. per 3 Yrs	1Q10	Percentile	Excur. per 3 Yrs	1Qy Type	1Qy	Percentile	Harmonic	Percentile
1636690 PINEY RUN NEAR LOVETTSVILLE, VA	2003-2007	1,825	None	0	0.00%	0	N/A	0.00%	0	N/A			2.16	13.26%
01643805 N F GOOSE CREEK AT RT 729 NEAR LINCOLN,	2003-2007	1,825	0/4	0.91	0.00%	0	N/A	0.00%	0	N/A			12.9	20.77%
1638420 N F CATOCTIN CREEK AT RT 681 NEAR WATER	2003-2007	1,825	37/0	0.07	2.25%	3.6	N/A	0.00%	0	1Q3	0.07	2.25%	2.88	12.55%
1643590 LIMESTONE BRANCH NEAR LEESBURG, VA	2003-2007	1,825	0/1	0.63	0.00%	0	N/A	0.00%	0	N/A			3.35	30.25%
1643700 GOOSE CREEK NEAR MIDDLEBURG, VA	1967-2007	14,974	71/2,255	0	0.00%	0	0.01	0.47%	0.6	1Q11	0	0.00%	1.92	3.83%
1644000 GOOSE CREEK NEAR LEESBURG, VA	1911-2007	35,428	0/6,342	1.27	0.25%	0.96	1.43	0.36%	0.93	1Q12	1.19	0.19%	34.2	13.72%
01638480 CATOCTIN CREEK AT TAYLORSTOWN, VA	1973-2007	12,782	0/1	0.24	0.23%	0.94	0.5	0.65%	1.52	1Q21	0.23	0.20%	11	17.88%
1644280 BROAD RUN NEAR LEESBURG, VA	2003-2007	1,825	None	1.29	0.00%	0	N/A	0.00%	0	N/A			20.4	25.48%
1643880 BEAVERDAM CREEK AT RT 734 NEAR MOUNTV	2003-2007	1,825	8/1	0.01	0.44%	3	N/A	0.00%	0	1Q4	0	0.00%	1.54	7.51%
1638350 S F CATOCTIN CREEK AT RT 698 NEAR WATER	2003-2007	1,825	0/1	0.07	0.00%	0	N/A	0.00%	0	N/A			5.64	14.96%

Advanced information

1636690 PINEY RUN NEAR LOVETTSVILLE, VA

Recurrence Period	1	2	3	4	5
Calculated		0.91	0.41	0.24	0.17
Recurrence Period	5	2.5	1.667	1.25	1
Observed	0.03	0.45	0.95	2.2	2.7
	2002	2005	2006	2004	2003

01643805 N F GOOSE CREEK AT RT 729 NEAR LINCOLN, VA

Recurrence Period	1	2	3	4
Calculated		2.63	1.62	1.25
Recurrence Period	4	2	1.333	1
Observed	1.1	1.2	4.5	14
	2005	2002	2004	2003

1638420 N F CATOCTIN CREEK AT RT 681 NEAR WATERFORD, VA

Recurrence Period	1	2	3	4	5
Calculated		0.31	0.07	0.02	0
Recurrence Period	5	2.5	1.667	1.25	1
Observed	0	0.04	0.26	1.7	4.2
	2002	2005	2006	2004	2003

1643590 LIMESTONE BRANCH NEAR LEESBURG, VA

Recurrence Period	1	2	3	4
Calculated		1.28	0.96	0.82
Recurrence Period	4	2	1.333	1
Observed	0.68	0.86	1.8	2.9
	2002	2005	2004	2003

1643700 GOOSE CREEK NEAR MIDDLEBURG, VA

Recurrence Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Calculated		2.86	0.56	0.17	0.08	0.03	0.02	0.01	0.01	0.01	0	0	0	0
Recurrence Period	31	15.5	10.333	7.75	6.2	5.167	4.429	3.875	3.444	3.1	2.818	2.583	2.385	2.214
Observed	0	0	0	0.04	0.1	0.11	0.31	0.5	0.55	0.58	0.9	1	1.6	2.2
	1991	1986	1985	1993	1966	2002	1987	1995	1980	1988	2005	1977	1983	1981

1644000 GOOSE CREEK NEAR LEESBURG, VA

Recurrence Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Calculated		8.45	4.73	3.35	2.69	2.18	1.87	1.67	1.53	1.43	1.29	1.19	1.11	1.05
Recurrence Period	77	38.5	25.667	19.25	15.4	12.833	11	9.625	8.556	7.7	7	6.417	5.923	5.5
Observed	0.4	0.42	0.55	0.8	0.86	1.2	1.2	1.2	1.2	1.5	1.6	1.8	2.1	2.3
	1941	1985	1999	1986	1991	1932	1987	1966	1995	1930	1910	1931	1936	1993

01638480 CATOCTIN CREEK AT TAYLORSTOWN, VA

Recurrence Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Calculated		3.96	2.13	1.44	1.11	0.85	0.71	0.61	0.55	0.5	0.44	0.4	0.36	0.33
Recurrence Period	34	17	11.333	8.5	6.8	5.667	4.857	4.25	3.778	3.4	3.091	2.833	2.615	2.429
Observed	0.09	0.18	0.2	0.24	0.87	1.3	1.3	1.4	1.8	1.9	2	2.5	2.9	3.3
	1999	1991	1986	2002	1998	1985	1993	1997	2005	1977	1995	1981	2000	2001

1644280 BROAD RUN NEAR LEESBURG, VA

Recurrence Period	1	2	3	4	5
Calculated		3.62	2.6	2.16	1.92
Recurrence Period	5	2.5	1.667	1.25	1
Observed	1.3	3	3.4	4.7	11
	2002	2005	2006	2004	2003

1643880 BEAVERDAM CREEK AT RT 734 NEAR MOUNTVILLE, VA

Recurrence Period	1	2	3	4
Calculated		0.2	0.01	0
Recurrence Period	4	2	1.333	1
Observed	0	0.02	0.95	11
	2005	2002	2004	2003

1638350 S F CATOCTIN CREEK AT RT 698 NEAR WATERFORD, VA

Recurrence Period	1	2	3	4
Calculated		1.51	0.59	0.33
Recurrence Period	4	2	1.333	1
Observed	0.07	0.85	3	9.1
	2002	2005	2004	2003

Task B.3.4 Stream Water Quality

B.3.4 Stream water quality (using data sets 3.2, 3.4, and 3.7)

DEQ WQ Statistics (Field and Analyte)

DEQ SW Quality Table Relates (memo)

DEQ SW Quality Station Mapping (memo)

DEQ SW Quality Data Maintenance (memo)

DEQ SW Quality Maps (example of analyst data counts)

Relating USGS NAWQA Data (memo)

NAWQA Station Map (example graphic)

Creating Time-Averages Values [stream assessments] (memo)

Stream Assessment - Categorized (example map)

Data Set 3.2
VA DEQ Water Quality (Trend and Ambient Stream Monitoring)
The Dept of Environmental Quality (DEQ) operates numerous stream monitoring sites, often coincident with USGS streamflow gages. Water chemistry data includes basic cations and anions as well as pH, temperature, fecal/E.Coli. Trend stations are long-term sites and ambient stations are used on a rotating basis. Data are obtained from DEQ web site. There a total of 57 monitoring sites in Loudoun County. Only nine of these are designated at "trend" sites. There are 82,000 water measurements on file.

Data Set 3.4
Broad Run Water Quality Monitoring Program (OWML)
Since 1990, a station on Broad Run, upstream of the LCSA plant now under construction has been monitored for water chemistry and flow. Only an approximate site location is known. Over 430 sampling events have been recorded every two weeks with approximately 20 to 50 analyses per sample. In general the recent stream flow data were found to be consistent with the new USGS station on Broad Run. Review of the fecal concentration display the expected positive correlation with increased streamflow. Comparisons with DEQ data have not been examined. Data are available in raw Excel format only.

Data Set 3.7
Loudoun Soil & Water Conservation District Stream Monitoring
Since 1999, the LSWCD has monitored 14 stations in the Piney Run, Catoctin Creek, Little River, North Fork Goose Creek, and Beaver Dam watersheds for fecal coliform. This effort is related to the potential development of fecal coliform Total Maximum Daily Loads (TMDL) for these waterways, and was expanded to include E-Coli in 2003. Some water chemistry and macroinvertebrate data are also available. Data are periodically posted to the LSWCD web site (http://loudoun.vaswcd.org/) and the most recent data can be obtained by contacting the LSWCD office.

Task B.3.4 Analysis of Surface Water Quality Data.

The only data set used here is from DEQ, due to higher level of quality control, better spatial distribution and longer temporal records.

Section A) Surface Water Quality Field data. Includes parameters pH, Dissolved Oxygen by probe, Dissolved Oxygen by Winkler method, Temperature, and Specific Conductance.

1) Summary statistic table for field parameters for all DEQ field data.
2) Summary statistics table for specific conductance measurements at each DEQ sample site with data collected. (87 sites)
3) Summary statistics table for temperature measurements at each DEQ sample site with data collected. (122 sites)
4) Summary statistics table DO (probe) measurements at each DEQ sample site with data collected. (86 sites)
5) Summary statistics table for DO (Winkler) measurements at each DEQ sample site with data collected. (93 sites)
6) Summary statistics table pH measurements at each DEQ sample site with data collected. (133 sites)

Section B) Monthly averages for several field and lab analytes including Total Suspended Solids, DO (probe), Total Phosphorous, Total Nitrogen, Turbidity, and Temperature.

Section C) Surface Water Quality lab analyses. Summary statistics for 72 analytes sampled by DEQ at 142 sites in Loudoun County or contributing watersheds.

Section D) Twenty sites in Loudoun County and contributing watersheds were chosen for more detailed analysis based on the length of sampling record found at those sites. This section show statistics for those 20 sites by a subset of 13 major analytes.

1) Summary Statistics table for conductivity at DEQ long records sites.
2) Summary Statistics table for TOC at DEQ long records sites.
3) Summary Statistics table for Alkalinity at DEQ long records sites.
4) Summary Statistics table for pH at DEQ long records sites.
5) Summary Statistics table for Turbidity at DEQ long records sites.
6) Summary Statistics table for Total P at DEQ long records sites.
7) Summary Statistics table for Nitrate at DEQ long records sites.
8) Summary Statistics table for Ammonia at DEQ long records sites.
9) Summary Statistics table for Chloride at DEQ long records sites.
10) Summary Statistics table for Sulfate at DEQ long records sites.
11) Summary Statistics table for Fluoride at DEQ long records sites.
12) Summary Statistics table for 5 day BOD at DEQ long records sites.
13) Summary Statistics table for COD at DEQ long records sites.

Section E) Statistical and graphical analysis of individual analytes for all sites with long records.

1) One variable analysis – Nitrogen
2) One variable analysis – Ammonia
3) One variable analysis – Nitrite
4) One variable analysis – Nitrate
5) One variable analysis – Total Phosphorous
6) One variable analysis – Orthophosphate
7) One variable analysis – Chloride
8) One variable analysis – Sulfate
9) One variable analysis – Fluoride
10) One variable analysis – Arsenic
11) One variable analysis – Lead
12) One variable analysis – Zinc
13) One variable analysis – Manganese
14) One variable analysis – Specific Conductance
15) One variable analysis – Turbidity
16) One variable analysis – 5 day BOD
17) One variable analysis – COD
18) One variable analysis – pH
19) One variable analysis – TOC

Section A) Surface Water Quality Field data. Includes parameters pH, Dissolved Oxygen by probe, Dissolved Oxygen by Winkler method, Temperature, and Specific Conductance.

Summary Statistics for Sites Sampled by DEQ in Loudoun County or contributing watersheds.

Analytes for all Sites	*Count*	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
pH (std. units)	8257	7.44	7.40	0.519	6.98%	0.07	10.7	10.63	7.14	7.7	0.56	5.33762	146.055
DO Probe (mg/L)	5759	10.07	10.00	2.645	26.27%	3.13	18.1	14.97	7.98	12	4.02	6.70847	-9.63094
DO Winkler (mg/L)	2835	10.18	10.10	2.641	25.94%	0	73.5	73.5	8.4	12	3.6	102.586	1258.69
Temp oC	8576	13.55	13.90	7.741	57.14%	-0.08	32	32.08	7	20.4	13.4	-2.60734	-22.737
Spec. Cond. (uS/cm)	6828	227.49	180.20	274.035	120.46%	0	19100	19100	140.4	266	125.6	1647.64	55731.7

Summary Statistics for Sites Sampled by DEQ in Loudoun County or contributing watersheds.

Specific Conductance (uS/cm)	Count	Mean	Median	Standard deviation	Coeff. of variation	Minimum	Maximum	Range	Lower quartile	Upper quartile	Interquartile range	Stnd. skewness	Stnd. kurtosis
1ABEC004.76	223	182.354	166.3	48.8991	26.82%	63.1	281	217.9	150.9	224.4	73.5	2.87995	-1.37371
1ABEC011.19	66	230.833	183.1	106.362	46.08%	114	457.8	343.8	147.4	311.3	163.9	2.84177	-0.773317
1ABEE000.40	2	121.5	121.5	0.707107	0.58%	121	122	1	121	122	1		
1ABEE001.40	1	122	122		%	122	122	0	122	122	0		
1ABEM000.60	19	397.868	415	68.4829	17.21%	301	499	198	332	427	95	0.125027	-0.96293
1ABOL002.56	60	207.742	183.2	67.0432	32.27%	128.7	312.5	183.8	150.5	295.4	144.9	1.80697	-2.14659
1ABRB002.15	369	299.356	289	135.378	45.22%	54.9	1720	1665.1	228	352.7	124.7	26.8616	126.721
1ABRB006.33	28	350.925	395.8	126.529	36.06%	133.8	542	408.2	226	455	229	-0.58129	-1.09447
1ABRB015.04	6	328.8	328.8	116.555	35.45%	222.4	435.2	212.8	222.4	435.2	212.8	-6.18E-16	-1.66667
1ABRB015.38	0				%								
1ABUL016.31	24	232.5	230.35	48.7745	20.98%	151.2	327.8	176.6	206.5	253.65	47.15	0.778824	0.390393
1ABUL025.94	174	171.025	159.1	55.5791	32.50%	16.3	371.4	355.1	133.2	194.7	61.5	5.64954	5.31938
1ACAA000.83	6	133	133	0	0.00%	133	133	0	133	133	0		
1ACAA003.46	27	178.633	172.5	48.4746	27.14%	111	255	144	137	207.3	70.3	0.518711	-1.19604
1ACAX004.57	415	167.55	158.6	90.4155	53.96%	72.4	1660	1587.6	144	177	33	107.021	818.396
1ACLK002.40	33	294.836	270.5	49.6176	16.83%	234.8	404.9	170.1	266	326	60	2.40932	0.213713
1ACRA000.42	36	179.794	181.5	64.9087	36.10%	95.2	273.6	178.4	110.5	219	108.5	-0.138071	-1.73258
1ACRF001.18	24	211.287	213.3	19.7949	9.37%	176.3	248	71.7	200.3	219.4	19.1	0.156698	0.288701
1ACRM001.20	155	142.386	125.2	46.5131	32.67%	71	256.3	185.3	111.8	167.3	55.5	6.01065	1.57035
1ACRM009.86	6	112.8	112.8	0	0.00%	112.8	112.8	0	112.8	112.8	0		
1ACUB002.61	123	468.92	418.7	258.108	55.04%	160.4	1309	1148.6	301	537.5	236.5	8.50736	8.33284
1ACUB003.74	94	326.763	324	150.205	45.97%	80.2	757	676.8	244	417	173	1.04195	0.901899
1ACUB008.60	52	569.683	539.1	164.12	28.81%	395.4	938	542.6	438.6	651.9	213.3	3.17915	0.789178
1ADUT000.62	20	160.995	144	43.9723	27.31%	106	237.4	131.4	129	193.1	64.1	1.0441	-0.791812
1ADUT002.72	2	138.5	138.5	0	0.00%	138.5	138.5	0	138.5	138.5	0		
1AELC001.39	67	516.699	416.5	235.145	45.51%	221.6	988.4	766.8	325.1	784.7	459.6	2.26666	-1.32793
1AFLL000.62	6	363.7	363.7	0	0.00%	363.7	363.7	0	363.7	363.7	0		
1AFOL000.53	1	384	384		%	384	384	0	384	384	0		
1AFOL001.52	1	437	437		%	437	437	0	437	437	0		
1AGAR002.24	48	221.148	205.1	65.722	29.72%	122.3	313	190.7	152.9	281.85	128.95	-0.314083	-1.97959
1AGOO002.38	441	215.44	181.3	122.689	56.95%	67.3	1900	1832.7	144	255.5	111.5	55.6973	345.14
1AGOO003.82	1	127	127		%	127	127	0	127	127	0		
1AGOO004.89	1	164	164		%	164	164	0	164	164	0		
1AGOO011.23	242	180.198	157.55	133.218	73.93%	7	1603	1596	135.4	194.8	59.4	56.0276	281.423
1AGOO021.28	6	139	139	0	0.00%	139	139	0	139	139	0		
1AGOO022.44	363	166.094	140.4	104.855	63.13%	8	1220	1212	127	171.8	44.8	45.9555	169.39
1AGOO030.75	84	154.014	147.6	29.744	19.31%	98.1	237	138.9	138	171	33	3.26108	3.66911

Summary Statistics for Sites Sampled by DEQ in Loudoun County or contributing watersheds.

Specific Conductance (uS/cm)	Count	Mean	Median	Standard deviation	Coeff. of variation	Minimum	Maximum	Range	Lower quartile	Upper quartile	Interquartile range	Stnd. skewness	Stnd. kurtosis
1AGOO034.20	36	136.025	134.8	15.5085	11.40%	111.8	162.9	51.1	124.5	146.9	22.4	0.608507	-1.2651
1AGOO036.61	30	204.023	192	84.1627	41.25%	108.1	330.7	222.6	143.6	272	128.4	0.888993	-1.55274
1AGOO044.36	336	185.224	140.5	134.273	72.49%	49.6	832.4	782.8	119.1	196.5	77.4	23.9732	41.5471
1AGOO046.37	23	324.004	309.2	59.0893	18.24%	239.3	380.1	140.8	239.3	380.1	140.8	-0.897575	-1.43958
1AHOW003.68	12	180.925	169.85	58.7782	32.49%	114	270	156	140.85	221	80.15	0.920727	-0.526149
1AHPR003.87	200	342.273	317	161.246	47.11%	86.7	1366	1279.3	244	399.1	155.1	11.2517	23.0411
1ALII003.97	110	204.88	180.4	102.242	49.90%	82	632	550	136	241	105	7.6702	8.55318
1ALII006.75	27	364.933	389	101.34	27.77%	171.7	531.9	360.2	332	432.1	100.1	-0.805629	-0.145777
1ALIM001.16	155	224.717	228	62.4366	27.78%	60.2	342.1	281.9	178	270.4	92.4	-2.74858	-0.001282
1ALIM001.80	15	217.32	209	40.1316	18.47%	177	284.3	107.3	184	232.3	48.3	1.21418	-0.562544
1ALIV001.70	74	172.064	170.2	26.8762	15.62%	109	212.4	103.4	161.1	188.9	27.8	-2.57527	0.488445
1ALIV004.78	162	149.346	146	42.4348	28.41%	87	297.1	210.1	116	181.8	65.8	6.15877	6.12072
1ALIV006.92	29	116.948	119.9	7.83949	6.70%	103.7	128.4	24.7	109.8	122	12.2	-0.957519	-1.0909
1ALIV012.12	9	108	108	6.06218	5.61%	101	115	14	101	115	14	0	-1.04978
1AMIH001.98	29	141.934	142.9	10.6539	7.51%	123.6	153.3	29.7	136.9	151.6	14.7	-1.37379	-1.10442
1ANOB005.49	66	211.392	190.95	54.9864	26.01%	139.1	299.8	160.7	164	283	119	1.86125	-2.01932
1ANOC000.42	162	156.575	137.3	156.358	99.86%	0	1520	1520	122	162	40	43.211	185.785
1ANOC004.38	59	172.629	177.7	42.6647	24.71%	119.4	276	156.6	134.4	200.1	65.7	3.07121	0.967022
1ANOC007.28	15	154.56	144	32.6201	21.11%	124	209.9	85.9	128	166.9	38.9	1.38428	-0.497397
1ANOC009.13	65	150.138	142.2	48.4318	32.26%	97	282.4	185.4	112	178.1	66.1	4.6056	3.27298
1ANOC009.37	29	122.014	116.5	15.2412	12.49%	98.7	144.9	46.2	111.7	140.4	28.7	0.338442	-1.34131
1ANOG000.08	15	200.36	192	52.2536	26.08%	122	274.7	152.7	185	228.1	43.1	-0.145717	-0.571281
1ANOG000.91	6	149	149	0	0.00%	149	149	0	149	149	0		
1ANOG005.69	293	209.056	189	75.5235	36.13%	6	434.6	428.6	161.6	243	81.4	6.9142	4.40003
1ANOG011.60	24	205.35	197.5	52.2445	25.44%	146.6	315	168.4	165.35	227.75	62.4	1.94556	0.297875
1APAE004.21	36	142.358	140.5	18.9057	13.28%	118.5	190.6	72.1	128.5	151.35	22.85	2.97557	1.87532
1APIA001.80	175	106.469	100.4	26.1964	24.60%	72.9	194.9	122	92	113.9	21.9	10.6087	11.341
1ASFS000.28	65	168.617	131.1	84.1724	49.92%	107.4	393.9	286.5	115.9	184.4	68.5	5.75234	3.22761
1ASOC000.01	2	164	164	0	0.00%	164	164	0	164	164	0		
1ASOC001.66	195	268.582	183	1356.13	504.92%	8	19100	19092	158.4	200.1	41.7	79.4961	554.787
1ASOC007.06	86	172.888	176.05	30.8827	17.86%	113.1	243.4	130.3	143.8	193	49.2	0.451619	0.066969
1ASOC010.09	7	176.429	177	0.9759	0.55%	175	177	2	175	177	2	-1.32816	-0.453652
1ASOC012.38	66	161.5	144.7	45.558	28.21%	105.4	254.3	148.9	131.5	205.2	73.7	1.76946	-1.40587
1ASOR002.99	24	204.475	191.45	59.5392	29.12%	141.6	293.4	151.8	153.35	255.6	102.25	1.06775	-1.26224
1ASUG004.42	290	318.008	282	212.056	66.68%	89	2480	2391	216.3	370.5	154.2	33.8752	138.636
1ASYC002.03	154	232.594	229.5	66.7726	28.71%	73.7	340.6	266.9	197	278	81	-1.65175	-0.633793
1ASYC004.93	60	187.817	174.2	64.0502	34.10%	101.4	369.9	268.5	157.2	188.75	31.55	5.67044	5.33139

Summary Statistics for Sites Sampled by DEQ in Loudoun County or contributing watersheds.

Specific Conductance (uS/cm)	Count	Mean	Median	Standard deviation	Coeff. of variation	Minimum	Maximum	Range	Lower quartile	Upper quartile	Interquartile range	Stnd. skewness	Stnd. kurtosis
1ASYC007.43	70	190.803	167.1	69.8698	36.62%	100	366.7	266.7	151.8	202.4	50.6	4.93375	2.25526
1ATUS000.04	28	353.05	379	94.0247	26.63%	105.8	455.2	349.4	325.2	426.9	101.7	-2.93779	1.79955
1ATUS000.37	268	416.453	405.5	283.551	68.09%	2	4280	4278	301.35	506.5	205.15	63.4753	432.059
1AWAC003.31	6	318	318	0	0.00%	318	318	0	318	318	0		
1AXAQ000.85	24	267.625	264.5	38.2677	14.30%	194.2	321	126.8	250.45	297.95	47.5	-0.846573	-0.165945
1AXCO000.39	2	473	473	0	0.00%	473	473	0	473	473	0		
1AXCO000.92	2	344.4	344.4	0	0.00%	344.4	344.4	0	344.4	344.4	0		
1AXCO000.96	2	218.8	218.8	0	0.00%	218.8	218.8	0	218.8	218.8	0		
1AXDI000.01	2	240.3	240.3	0	0.00%	240.3	240.3	0	240.3	240.3	0		
1AXGJ000.42	15	204.34	206.6	27.9913	13.70%	171	240.1	69.1	177	227	50	-0.0021259	-1.41188
1AXJT002.22	29	150.559	150.8	11.9018	7.91%	124.9	166.5	41.6	145.1	162	16.9	-1.60148	0.270701
1AXKR000.77	6	162.2	162.2	3.11E-14	1.92E-16	162.2	162.2	0	162.2	162.2	0	-1.36931	-1.66667
1AXLE001.62	7	367.571	390	54.7383	14.89%	315	458	143	315	390	75	0.518509	-0.374554

Summary Statistics for Sites Sampled by DEQ in Loudoun County or contributing watersheds.

Temperature (°C)	Count	Mean	Median	Standard deviation	Coeff. of variation	Minimum	Maximum	Range	Lower quartile	Upper quartile	Interquartile range	Stnd. skewness	Stnd. kurtosis
1ABEC004.76	263	12.5066	13.5	6.951	55.58%	0	25	25	6.94	18.12	11.18	-0.519218	-4.02937
1ABEC011.19	61	12.0952	13.16	6.46032	53.41%	0.9	21.4	20.5	8.08	18.58	10.5	-0.424143	-1.65972
1ABEE000.40	2	22.45	22.45	0.777817	3.46%	21.9	23	1.1	21.9	23	1.1		
1ABEE001.40	2	22.15	22.15	0.919239	4.15%	21.5	22.8	1.3	21.5	22.8	1.3		
1ABEM000.60	22	15.7273	16.7	8.93656	56.82%	1	26.8	25.8	8.2	25	16.8	-0.516335	-1.11458
1ABIR000.76	43	13.5614	13	7.90551	58.29%	0	26	26	6.67	20.56	13.89	-0.572352	-1.60075
1ABIR005.21	1	19.7	19.7		%	19.7	19.7	0	19.7	19.7	0		
1ABLR000.10	1	7	7		%	7	7	0	7	7	0		
1ABOL002.56	60	14.7582	12.885	5.20902	35.30%	2.58	22.18	19.6	11.68	18.71	7.03	-0.919344	-0.693392
1ABRB002.15	450	14.0456	15.05	8.18174	58.25%	0.12	28.1	27.98	6.3	21.5	15.2	-1.22774	-5.71181
1ABRB006.33	31	13.2313	11.99	8.52893	64.46%	1.5	25.9	24.4	6.3	19.4	13.1	0.640943	-1.65919
1ABRB015.04	7	17.2514	22	7.22029	41.85%	9.55	23.37	13.82	9.55	23.37	13.82	-0.385734	-1.50061
1ABRB015.38	1	20.2	20.2		%	20.2	20.2	0	20.2	20.2	0		
1ABUL016.31	24	15.8663	18.45	8.25317	52.02%	4.4	25.8	21.4	7	22.915	15.915	-0.679142	-1.5478
1ABUL025.94	191	13.7541	13.2	7.59104	55.19%	0.04	28	27.96	8.1	19.77	11.67	-0.530602	-2.85642
1ACAA000.83	6	11.4	11.4	0	0.00%	11.4	11.4	0	11.4	11.4	0		
1ACAA003.46	27	15.1044	16	7.5396	49.92%	4.3	24.5	20.2	9.8	21.94	12.14	-0.451678	-1.62401
1ACAX000.19	53	12.9415	12.22	8.91028	68.85%	0.3	27.22	26.92	4.44	20	15.56	0.268668	-2.05913
1ACAX004.57	455	13.3318	13.2	7.91441	59.37%	0	27.5	27.5	6.9	19.91	13.01	-0.699882	-5.38826
1ACLK002.40	33	11.87	10.08	6.47318	54.53%	1.9	22.37	20.47	6.7	17.9	11.2	0.776559	-1.21853
1ACRA000.42	36	15.6011	14	3.55362	22.78%	11.32	20.98	9.66	12.21	18.42	6.21	0.562071	-1.82969
1ACRF001.18	27	14.9489	14.5	7.97938	53.38%	5.3	26.9	21.6	7.8	23.18	15.38	0.309703	-1.67326
1ACRM001.20	158	11.859	12.01	6.92669	58.41%	0.01	24.7	24.69	7.29	17.25	9.96	-0.702042	-2.5596
1ACRM005.39	1	25	25		%	25	25	0	25	25	0		
1ACRM008.59	1	25.5	25.5		%	25.5	25.5	0	25.5	25.5	0		
1ACRM009.86	8	14.575	14.5	0.138873	0.95%	14.5	14.8	0.3	14.5	14.65	0.15	1.66296	3.79E-14
1ACUB002.61	123	14.2935	12.9	7.54942	52.82%	1.31	26.89	25.58	7.29	20.99	13.7	-0.241463	-2.52191
1ACUB003.74	150	12.9341	12.89	7.6707	59.31%	0	26.1	26.1	6.76	17.9	11.14	-0.122836	-2.57507
1ACUB008.60	54	15.0319	15.73	6.52182	43.39%	6.06	23.06	17	7.68	20.73	13.05	-0.673538	-2.49233
1ADUT000.62	62	14.4587	15.56	8.66074	59.90%	0	26.8	26.8	7.22	22.3	15.08	-0.934173	-2.15647
1ADUT002.72	7	18.7714	21.7	6.7359	35.88%	8	24.9	16.9	10.8	24.9	14.1	-1.02702	-0.410559
1AELC001.39	67	14.6834	17.24	6.60834	45.01%	4.95	23.55	18.6	7.04	20.44	13.4	-0.877739	-2.61597
1AFLB000.64	23	14.3648	13.33	9.62899	67.03%	0.5	32	31.5	6.11	22.22	16.11	0.168384	-1.0922
1AFLB001.40	26	15.3954	15.75	8.9822	58.34%	1.3	31	29.7	6.2	23.89	17.69	0.0339072	-1.2018
1AFLB002.53	2	10.5	10.5	0.707107	6.73%	10	11	1	10	11	1		
1AFLL000.62	6	16.57	16.57	3.89E-15	2.35E-16	16.57	16.57	0	16.57	16.57	0	1.36931	-1.66667
1AFOL000.53	4	17.85	20.25	8.20508	45.97%	6.4	24.5	18.1	11.95	23.75	11.8	-1.05487	0.447543
1AFOL001.52	1	25.5	25.5		%	25.5	25.5	0	25.5	25.5	0		

Summary Statistics for Sites Sampled by DEQ in Loudoun County or contributing watersheds.

Temperature (°C)	Count	Mean	Median	Standard deviation	Coeff. of variation	Minimum	Maximum	Range	Lower quartile	Upper quartile	Interquartile range	Stnd. skewness	Stnd. kurtosis
1AFRY000.60	1	9.3	9.3		%	9.3	9.3	0	9.3	9.3	0		
1AGAR002.24	48	13.3671	12.625	6.14735	45.99%	0.86	21.23	20.37	10.58	18	7.42	-1.92796	-0.150305
1AGOO002.38	518	13.6419	13.41	8.31835	60.98%	0	28.33	28.33	6.39	21.4	15.01	0.170622	-6.10887
1AGOO003.82	1	24.4	24.4		%	24.4	24.4	0	24.4	24.4	0		
1AGOO004.89	6	22.1	21.5	2.16703	9.81%	20	25.3	5.3	20.2	24.1	3.9	0.687358	-0.668095
1AGOO011.23	297	13.1521	12.72	8.18894	62.26%	-0.08	28.12	28.2	6	21.11	15.11	0.290179	-4.65381
1AGOO014.44	56	14.0675	15.56	8.16226	58.02%	0	26.11	26.11	6.115	21.11	14.995	-0.702481	-2.15537
1AGOO021.28	6	16.1	16.1	3.89E-15	2.42E-16	16.1	16.1	0	16.1	16.1	0	1.36931	-1.66667
1AGOO022.44	431	13.2586	13.16	7.97986	60.19%	0	29	29	6.6	19.9	13.3	-0.0912195	-5.21039
1AGOO030.75	168	13.2967	13.79	8.44171	63.49%	0	27.7	27.7	5.28	20.88	15.6	-0.167537	-3.58585
1AGOO034.20	36	14.3358	13.69	8.45692	58.99%	-0.08	23.68	23.76	6.875	22.865	15.99	-0.772583	-1.6478
1AGOO036.47	8	13.6	15.7	3.88844	28.59%	7.3	15.7	8.4	11.5	15.7	4.2	-1.66296	1.03E-15
1AGOO036.61	30	12.663	12.6	6.93855	54.79%	0.72	21.62	20.9	12.37	17.47	5.1	-1.47438	-0.509406
1AGOO044.36	382	12.9866	12.55	7.50203	57.77%	0	26.9	26.9	6.6	19.2	12.6	0.479456	-4.77355
1AGOO046.37	18	15.1167	12.5	3.89545	25.77%	12.38	20.47	8.09	12.38	20.47	8.09	1.33801	-1.38023
1AHOW003.68	12	16.675	19.85	8.80187	52.78%	2.6	24.4	21.8	10.35	23	12.65	-1.4966	-0.434979
1AHPR002.28	9	13.4567	11.11	7.20485	53.54%	2.22	22.22	20	8.89	20.56	11.67	-0.110346	-0.953817
1AHPR003.87	245	13.924	14.6	7.72966	55.51%	0	29	29	7.2	20.1	12.9	0.339653	-3.85871
1AHPR004.91	2	3.9	3.9	4.10122	105.16%	1	6.8	5.8	1	6.8	5.8		
1AHPR006.51	1	1	1		%	1	1	0	1	1	0		
1AINI000.80	1	6	6		%	6	6	0	6	6	0		
1AJEE002.22	1	7	7		%	7	7	0	7	7	0		
1AJEE004.84	1	7	7		%	7	7	0	7	7	0		
1ALII003.97	131	13.3616	12.3	7.86762	58.88%	0	27	27	7.36	20.22	12.86	-0.197348	-2.50589
1ALII006.75	27	16.0022	18.6	7.3883	46.17%	5.33	24.1	18.77	10.3	23.32	13.02	-0.716403	-1.67687
1ALIM001.16	183	12.8313	13.16	6.378	49.71%	0.4	26.11	25.71	7.19	18.47	11.28	-0.666433	-3.04903
1ALIM001.80	15	20.52	23.5	8.30699	40.48%	5	27.9	22.9	21.6	24.6	3	-2.21015	0.377583
1ALIV001.70	74	11.2245	8.68	7.72656	68.84%	0.14	24.25	24.11	4.63	17.52	12.89	1.02888	-2.16865
1ALIV004.78	165	12.0525	11.8	7.82427	64.92%	0.01	25.1	25.09	4.5	18.7	14.2	0.185464	-3.32777
1ALIV005.76	15	15.5487	16.19	8.26689	53.17%	0.6	26	25.4	10	22	12	-1.22544	-0.468382
1ALIV006.92	32	14.4169	17.91	7.67353	53.23%	0.04	22.41	22.37	5.79	20.53	14.74	-1.69614	-1.16684
1ALIV012.12	9	9.56667	10.1	6.93974	72.54%	1.3	17.3	16	1.3	17.3	16	-0.180721	-1.04978
1ALNR001.04	1	22	22		%	22	22	0	22	22	0		
1AMIH001.98	32	14.8994	19.08	7.50945	50.40%	0.16	22.78	22.62	7.14	20.415	13.275	-1.96004	-0.887737
1ANOB005.49	61	12.6185	12.56	6.24669	49.50%	2.02	21.32	19.3	8.19	19.05	10.86	-0.745133	-1.68243
1ANOC000.42	167	13.6663	14	7.62754	55.81%	0.5	28.5	28	7.3	19.72	12.42	-0.185593	-3.11487
1ANOC004.38	103	13.4664	14.4	8.48272	62.99%	0	26.67	26.67	4.6	21	16.4	-1.03068	-2.98223
1ANOC007.28	16	20.2688	22.7	9.11919	44.99%	3	30.2	27.2	21.3	23.6	2.3	-2.02606	0.45912

Summary Statistics for Sites Sampled by DEQ in Loudoun County or contributing watersheds.

Temperature (°C)	Count	Mean	Median	Standard deviation	Coeff. of variation	Minimum	Maximum	Range	Lower quartile	Upper quartile	Interquartile range	Stnd. skewness	Stnd. kurtosis
1ANOC009.13	66	14.1561	14.1	7.93122	56.03%	2	24.62	22.62	7.3	21.4	14.1	-0.898326	-2.42681
1ANOC009.37	32	14.7184	18.13	7.47096	50.76%	0.55	22.65	22.1	7.23	20.365	13.135	-1.82802	-1.02432
1ANOC011.74	1	21.5	21.5		%	21.5	21.5	0	21.5	21.5	0		
1ANOG000.08	15	19.24	22.9	8.19641	42.60%	3.7	25.5	21.8	20.7	23.4	2.7	-2.40207	0.504427
1ANOG000.91	6	14.28	14.28	0	0.00%	14.28	14.28	0	14.28	14.28	0		
1ANOG005.69	400	13.3309	14.25	7.99133	59.95%	0	28.5	28.5	5.68	20.2	14.52	0.270039	-5.24878
1ANOG011.60	32	15.9356	15.8	7.71179	48.39%	5.63	26.3	20.67	10.3	24.34	14.04	0.0523846	-1.82126
1APAE004.21	36	14.1817	14.91	8.19699	57.80%	0.4	23.4	23	7.105	22.215	15.11	-0.979985	-1.63434
1APIA001.80	181	11.8563	12.82	6.76008	57.02%	0	24.3	24.3	6.35	16.88	10.53	-0.70236	-3.00596
1APOT170.40	107	14.357	13.33	9.05292	63.06%	0	28.89	28.89	6.67	23	16.33	-0.0440456	-2.98476
1ASFS000.28	65	13.0554	14.8	7.65479	58.63%	0.8	22.3	21.5	6.7	20.8	14.1	-0.708323	-2.51652
1ASOC000.01	2	17.7	17.7	0	0.00%	17.7	17.7	0	17.7	17.7	0		
1ASOC001.66	244	13.9485	14.43	8.02763	57.55%	0	29	29	7.2	21	13.8	-0.278671	-3.99436
1ASOC005.46	1	22	22		%	22	22	0	22	22	0		
1ASOC007.06	90	14.2254	17.96	7.65771	53.83%	-0.06	23.2	23.26	6.2	20.63	14.43	-1.68566	-2.60338
1ASOC010.09	7	13.9	16.46	4.37203	31.45%	7.5	16.46	8.96	7.5	16.46	8.96	-1.32816	-0.453652
1ASOC011.82	64	14.1189	14.445	8.61946	61.05%	0.4	29	28.6	6.835	21.805	14.97	-0.06922	-2.04999
1ASOC012.38	109	12.865	12.4	7.71132	59.94%	0.5	25.56	25.06	7.4	21	13.6	-0.203656	-2.93776
1ASOR000.59	1	19.5	19.5		%	19.5	19.5	0	19.5	19.5	0		
1ASOR002.99	24	17.7075	18.78	5.83077	32.93%	8.76	24.51	15.75	13.31	22.105	8.795	-1.13018	-0.924204
1ASUG000.05	2	25.2	25.2	1.55563	6.17%	24.1	26.3	2.2	24.1	26.3	2.2		
1ASUG004.42	355	13.5421	14.47	7.29789	53.89%	0	27	27	7.3	19.8	12.5	-1.50435	-4.34497
1ASUG008.46	29	14.5793	16.11	9.00504	61.77%	1.11	27.78	26.67	6.67	21.7	15.03	-0.115956	-1.66724
1ASUG009.07	2	27.15	27.15	1.06066	3.91%	26.4	27.9	1.5	26.4	27.9	1.5		
1ASYC002.03	151	12.5791	11.5	7.03206	55.90%	1.1	25.1	24	6	19.71	13.71	0.792819	-3.21694
1ASYC004.93	60	14.3583	14.8	7.20239	50.16%	2.4	25.07	22.67	8	20.64	12.64	-0.521009	-2.12486
1ASYC006.23	1	4.5	4.5		%	4.5	4.5	0	4.5	4.5	0		
1ASYC007.43	71	13.1638	14.9	7.83668	59.53%	1.1	25.12	24.02	6.9	20.75	13.85	-0.534502	-2.37653
1ASYC009.78	1	7.5	7.5		%	7.5	7.5	0	7.5	7.5	0		
1ATUS000.04	28	15.3143	18.11	7.56656	49.41%	0.08	23.37	23.29	8.02	21.64	13.62	-1.63572	-0.862693
1ATUS000.37	390	12.9109	12.71	7.51426	58.20%	0	27.6	27.6	6	19.87	13.87	0.227889	-5.15494
1ATUS003.19	82	14.1066	15.56	7.8123	55.38%	0.56	30.56	30	6.11	21	14.89	-0.163879	-2.19987
1AWAC003.31	6	14.6	14.6	0	0.00%	14.6	14.6	0	14.6	14.6	0		
1AXAC000.09	2	11.25	11.25	1.06066	9.43%	10.5	12	1.5	10.5	12	1.5		
1AXAQ000.85	27	15.1556	15.4	6.54098	43.16%	6.84	25.1	18.26	9.67	21.64	11.97	0.405789	-1.65566
1AXBL000.28	1	23	23		%	23	23	0	23	23	0		
1AXCO000.39	6	20.4667	22.3	5.80643	28.37%	9.8	25.1	15.3	18.2	25.1	6.9	-1.55395	1.15997
1AXCO000.92	4	24.6	24.6	0.11547	0.47%	24.5	24.7	0.2	24.5	24.7	0.2	-7.54E-14	-2.44949

Summary Statistics for Sites Sampled by DEQ in Loudoun County or contributing watersheds.

Temperature (°C)	*Count*	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1AXCO000.96	4	25.15	25.15	2.02073	8.03%	23.4	26.9	3.5	23.4	26.9	3.5	0	-2.44949
1AXDI000.01	4	24.5	24.5	0.34641	1.41%	24.2	24.8	0.6	24.2	24.8	0.6	0	-2.44949
1AXGB000.07	1	15.2	15.2		%	15.2	15.2	0	15.2	15.2	0		
1AXGJ000.42	15	18.78	21	8.26742	44.02%	3.5	25.6	22.1	19.2	24.6	5.4	-2.10468	0.247331
1AXGU000.18	8	15.2	14.8	0.740656	4.87%	14.8	16.4	1.6	14.8	15.6	0.8	1.66296	6.15E-15
1AXJT002.22	32	15.2763	19.35	7.69696	50.39%	0.12	23.13	23.01	7.41	21.205	13.795	-1.99481	-0.871125
1AXKR000.77	6	13.14	13.14	0	0.00%	13.14	13.14	0	13.14	13.14	0		
1AXLE001.62	7	7.02857	8.5	8.07315	114.86%	0.3	22.8	22.5	0.3	8.5	8.2	1.44588	1.12015

Summary Statistics for Sites Sampled by DEQ in Loudoun County or contributing watersheds.

pH (Standard Units)	Count	Mean	Median	Standard deviation	Coeff. of variation	Minimum	Maximum	Range	Lower quartile	Upper quartile	Interquartile range	Stnd. skewness	Stnd. kurtosis
1ABEC004.76	257	7.21136	7.2	0.399737	5.54%	5.7	8.27	2.57	7.02	7.4	0.38	-3.26876	10.7002
1ABEC011.19	66	7.19924	7.06	0.48696	6.76%	6.54	8.31	1.77	7	7.4	0.4	3.26411	0.789723
1ABEE000.40	2	7.5	7.5	0.424264	5.66%	7.2	7.8	0.6	7.2	7.8	0.6		
1ABEE001.40	2	7.5	7.5	0	0.00%	7.5	7.5	0	7.5	7.5	0		
1ABEM000.60	22	8.14091	7.8	1.0595	13.01%	7.3	10.7	3.4	7.7	8	0.3	4.03397	2.94991
1ABIR000.76	43	7.21163	7.2	0.225947	3.13%	6.8	7.8	1	7	7.3	0.3	0.0819174	0.013035
1ABIR005.21	2	7.35	7.35	0.494975	6.73%	7	7.7	0.7	7	7.7	0.7		
1ABOL002.56	60	7.101	7.04	0.396342	5.58%	6.35	8.03	1.68	6.935	7.285	0.35	1.07694	1.36266
1ABRB002.15	433	7.36046	7.4	0.398792	5.42%	6	8.5	2.5	7.2	7.6	0.4	-3.91806	2.30541
1ABRB006.33	31	7.57323	7.6	0.234782	3.10%	7.1	7.88	0.78	7.48	7.8	0.32	-1.72351	-0.035263
1ABRB015.04	7	7.45286	7.5	0.087505	1.17%	7.36	7.53	0.17	7.36	7.53	0.17	-0.346034	-1.47968
1ABRB015.38	2	7.85	7.85	0.494975	6.31%	7.5	8.2	0.7	7.5	8.2	0.7		
1ABUL016.31	24	7.605	7.51	0.361446	4.75%	7.15	8.4	1.25	7.385	7.75	0.365	2.36953	1.01956
1ABUL025.94	181	7.63519	7.5	0.494018	6.47%	6.6	9.2	2.6	7.38	7.85	0.47	5.20759	3.49502
1ABUT000.69	1	7.3	7.3		%	7.3	7.3	0	7.3	7.3	0		
1ACAA000.83	6	7.8	7.8	0	0.00%	7.8	7.8	0	7.8	7.8	0		
1ACAA003.46	28	7.2825	7.4	0.453673	6.23%	6.13	7.9	1.77	7.3	7.465	0.165	-3.5443	3.14112
1ACAA008.01	1	7.5	7.5		%	7.5	7.5	0	7.5	7.5	0		
1ACAX000.19	52	7.80577	7.6	0.674875	8.65%	7	9.5	2.5	7.25	8.4	1.15	2.00561	-0.922712
1ACAX004.57	434	7.42809	7.4	0.430555	5.80%	6.4	9.5	3.1	7.2	7.62	0.42	6.99498	15.4137
1ACAX008.61	1	6.9	6.9		%	6.9	6.9	0	6.9	6.9	0		
1ACLK002.40	36	7.67667	7.7	0.171181	2.23%	7.2	7.81	0.61	7.65	7.8	0.15	-4.58189	3.78139
1ACRA000.42	36	7.065	7.12	0.533685	7.55%	6.32	8.06	1.74	6.79	7.13	0.34	1.60947	-0.031744
1ACRF001.18	27	7.69111	7.7	0.225189	2.93%	7.18	8	0.82	7.61	7.8	0.19	-2.17828	1.18861
1ACRM001.20	147	7.0266	7.03	0.337936	4.81%	5.8	7.9	2.1	6.9	7.2	0.3	-6.51222	11.591
1ACRM009.86	8	7.5	7.6	0.185164	2.47%	7.2	7.6	0.4	7.4	7.6	0.2	-1.66296	3.44E-14
1ACUB002.61	123	7.6887	7.66	0.320392	4.17%	7.1	8.4	1.3	7.45	7.85	0.4	1.41871	-0.848294
1ACUB003.74	138	7.37609	7.4	0.417589	5.66%	6	8.2	2.2	7.2	7.62	0.42	-3.30576	1.77546
1ACUB008.60	54	7.6613	7.41	0.51169	6.68%	7.04	9	1.96	7.34	8	0.66	3.23271	0.521964
1ADRL001.00	1	7.5	7.5		%	7.5	7.5	0	7.5	7.5	0		
1ADUT000.62	62	7.80806	7.8	0.507743	6.50%	6.8	8.8	2	7.4	8.1	0.7	0.899613	-1.10686
1ADUT002.72	7	7.42143	7.4	0.162934	2.20%	7.3	7.75	0.45	7.3	7.5	0.2	1.78096	1.4986
1AELC001.39	67	7.67448	7.49	0.431591	5.62%	7.21	8.86	1.65	7.44	7.69	0.25	6.1076	4.62026
1AFLB000.64	23	7.74783	7.7	0.535868	6.92%	7	9.5	2.5	7.5	7.8	0.3	3.85893	4.57381
1AFLB001.40	26	7.51923	7.5	0.384728	5.12%	6.9	8.5	1.6	7.4	7.7	0.3	1.41826	1.31542
1AFLB002.53	2	7.45	7.45	0.212132	2.85%	7.3	7.6	0.3	7.3	7.6	0.3		
1AFLL000.62	6	7.5	7.5	0	0.00%	7.5	7.5	0	7.5	7.5	0		
1AFOL000.53	3	7.3	7.3	0.3	4.11%	7	7.6	0.6	7	7.6	0.6	0	
1AFOL001.52	1	7.1	7.1		%	7.1	7.1	0	7.1	7.1	0		

Summary Statistics for Sites Sampled by DEQ in Loudoun County or contributing watersheds.

pH (Standard Units)	Count	Mean	Median	Standard deviation	Coeff. of variation	Minimum	Maximum	Range	Lower quartile	Upper quartile	Interquartile range	Stnd. skewness	Stnd. kurtosis
1AFRY000.60	1	7.3	7.3		%	7.3	7.3	0	7.3	7.3	0		
1AGAR002.24	48	7.22979	7.105	0.446235	6.17%	6.77	8.27	1.5	6.925	7.35	0.425	4.11024	1.90135
1AGOO002.38	495	7.49877	7.5	0.445259	5.94%	6	9	3	7.27	7.7	0.43	3.00942	5.72858
1AGOO003.82	1	7	7		%	7	7	0	7	7	0		
1AGOO004.89	3	7.56667	7.4	0.288675	3.82%	7.4	7.9	0.5	7.4	7.9	0.5	1.22474	
1AGOO011.23	297	7.36949	7.3	0.44504	6.04%	6.3	9.3	3	7.12	7.5	0.38	9.39176	11.9893
1AGOO014.44	56	7.38036	7.25	0.574114	7.78%	6.5	9.2	2.7	7	7.7	0.7	3.05433	1.17172
1AGOO021.28	6	8	8	0	0.00%	8	8	0	8	8	0		
1AGOO022.44	408	7.33576	7.3	0.412753	5.63%	6.1	9.5	3.4	7.1	7.5	0.4	5.41625	13.5623
1AGOO030.75	168	7.33256	7.3	0.503139	6.86%	5.98	9	3.02	7	7.67	0.67	1.0639	2.76195
1AGOO034.20	36	7.33	7.255	0.492568	6.72%	6.65	8.45	1.8	6.955	7.48	0.525	2.35359	0.519516
1AGOO036.47	8	7.75	7.8	0.092582	1.19%	7.6	7.8	0.2	7.7	7.8	0.1	-1.66296	1.28E-14
1AGOO036.61	30	7.48033	7.48	0.563496	7.53%	6.77	8.44	1.67	7.21	7.57	0.36	1.37089	-0.590275
1AGOO044.36	362	7.28644	7.385	0.503352	6.91%	5.89	9.1	3.21	7	7.57	0.57	0.770654	3.64527
1AGOO046.37	23	7.25739	7.26	0.043612	0.60%	7.2	7.32	0.12	7.24	7.32	0.08	0.582696	-1.00813
1AHOW003.68	12	7.25	7.2	0.227636	3.14%	7	7.6	0.6	7.1	7.4	0.3	1.05941	-0.496041
1AHPR000.32	1	7.8	7.8		%	7.8	7.8	0	7.8	7.8	0		
1AHPR002.28	8	7.9125	7.75	0.574301	7.26%	7.3	8.7	1.4	7.45	8.45	1	0.576407	-0.92979
1AHPR003.87	231	7.5913	7.7	0.566243	7.46%	6.2	9.4	3.2	7.2	7.9	0.7	1.94228	1.91485
1AHPR004.91	2	7.65	7.65	0.212132	2.77%	7.5	7.8	0.3	7.5	7.8	0.3		
1AHPR006.51	1	7.5	7.5		%	7.5	7.5	0	7.5	7.5	0		
1AINI000.80	1	8.5	8.5		%	8.5	8.5	0	8.5	8.5	0		
1AJEE002.22	1	7.9	7.9		%	7.9	7.9	0	7.9	7.9	0		
1AJEE004.84	1	7.6	7.6		%	7.6	7.6	0	7.6	7.6	0		
1ALII003.97	121	7.51314	7.6	0.436014	5.80%	6.6	8.7	2.1	7.3	7.73	0.43	-0.96581	0.117469
1ALII006.75	27	7.49	7.5	0.153723	2.05%	7.24	7.8	0.56	7.4	7.57	0.17	0.943118	0.194393
1ALIM001.16	178	7.54208	7.58	0.716182	9.50%	4.4	9.2	4.8	7.4	7.8	0.4	-11.213	24.0699
1ALIM001.80	15	7.84	7.7	0.572962	7.31%	7.4	8.9	1.5	7.4	7.8	0.4	2.1155	0.255468
1ALIV001.70	74	7.22986	7.12	0.271053	3.75%	6.97	7.9	0.93	7.06	7.36	0.3	5.2971	2.21605
1ALIV004.78	154	7.06104	7.1	0.498461	7.06%	5.7	8.2	2.5	6.8	7.3	0.5	-2.36054	0.953448
1ALIV005.76	15	7.39333	7.3	0.252039	3.41%	6.9	7.9	1	7.3	7.5	0.2	0.380845	0.514559
1ALIV006.92	32	7.21719	7.21	0.291827	4.04%	6.97	8.02	1.05	6.99	7.27	0.28	4.49443	4.16461
1ALIV012.12	10	7.54	7.6	0.150555	2.00%	7.3	7.7	0.4	7.4	7.7	0.3	-0.479187	-1.02544
1ALIV016.50	1	7.3	7.3		%	7.3	7.3	0	7.3	7.3	0		
1ALIV018.08	1	7.3	7.3		%	7.3	7.3	0	7.3	7.3	0		
1ALNR001.04	2	7.35	7.35	0.494975	6.73%	7	7.7	0.7	7	7.7	0.7		
1AMIH001.98	33	7.47909	7.47	0.27977	3.74%	6.97	7.91	0.94	7.33	7.63	0.3	-0.561984	-0.586157
1ANOB005.49	66	7.31742	7.305	0.538463	7.36%	6.27	8.5	2.23	7.05	7.49	0.44	1.67425	0.957614
1ANOC000.42	162	7.41136	7.4	0.544538	7.35%	6.2	9.5	3.3	7.1	7.6	0.5	4.8503	5.78165

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1ANOC004.38	89	7.3118	7.3	0.380611	5.21%	6.6	8.3	1.7	7	7.6	0.6	0.140967	-0.002763
1ANOC007.28	17	7.48824	7.4	0.22606	3.02%	7	7.8	0.8	7.4	7.6	0.2	-0.155992	-0.166141
1ANOC009.13	46	7.2	7.32	0.524426	7.28%	5.9	8.6	2.7	7.18	7.42	0.24	-3.44505	4.06944
1ANOC009.37	32	7.425	7.44	0.250148	3.37%	6.86	7.9	1.04	7.36	7.53	0.17	-1.04585	1.58678
1ANOC011.74	1	7.7	7.7		%	7.7	7.7	0	7.7	7.7	0		
1ANOG000.08	15	7.46	7.3	0.241424	3.24%	7.3	7.9	0.6	7.3	7.5	0.2	2.027	0.046644
1ANOG000.91	6	7.04	7.04	0	0.00%	7.04	7.04	0	7.04	7.04	0		
1ANOG005.69	394	7.46129	7.4	0.629173	8.43%	5.6	9.5	3.9	7.11	7.71	0.6	4.29966	6.72576
1ANOG011.60	32	7.7625	7.81	0.267847	3.45%	7.3	8.7	1.4	7.6	7.9	0.3	2.23346	4.30588
1APAE004.21	36	7.2975	7.3	0.558403	7.65%	6.04	8.43	2.39	7.075	7.405	0.33	-0.236774	1.68944
1APIA000.18	1	7	7		%	7	7	0	7	7	0		
1APIA001.80	175	7.23669	7.28	0.492498	6.81%	5.1	8.01	2.91	7.1	7.5	0.4	-11.4477	22.2284
1APIA004.67	1	7	7		%	7	7	0	7	7	0		
1APIA007.08	1	7	7		%	7	7	0	7	7	0		
1APOT170.40	107	8.53551	8.7	0.661652	7.75%	6.7	9.5	2.8	8	9	1	-2.54005	-0.897448
1ASFS000.28	46	7.225	7.2	0.247644	3.43%	6.7	7.54	0.84	7.1	7.4	0.3	-1.91991	-0.005488
1ASOC000.01	2	7.8	7.8	0	0.00%	7.8	7.8	0	7.8	7.8	0		
1ASOC001.66	239	7.45841	7.4	0.506212	6.79%	6.4	9.3	2.9	7.1	7.7	0.6	5.56387	4.5126
1ASOC005.46	3	7.2	7.1	0.264575	3.67%	7	7.5	0.5	7	7.5	0.5	1.03086	
1ASOC007.06	75	7.40773	7.4	0.295962	4.00%	6.8	8.03	1.23	7.23	7.6	0.37	-0.687056	-0.496906
1ASOC008.46	2	7.05	7.05	0.070711	1.00%	7	7.1	0.1	7	7.1	0.1		
1ASOC010.09	7	8.55714	8.5	0.09759	1.14%	8.5	8.7	0.2	8.5	8.7	0.2	1.32816	-0.453652
1ASOC011.82	64	7.48297	7.5	1.08684	14.52%	0.07	9	8.93	7.2	7.825	0.625	-16.4089	57.1141
1ASOC012.38	88	7.43068	7.4	0.472778	6.36%	6.7	9.8	3.1	7.2	7.65	0.45	7.86787	16.1952
1ASOC014.58	4	7.5	7.5	0.522813	6.97%	7	8	1	7.05	7.95	0.9	0	-2.30195
1ASOC015.92	2	7.05	7.05	0.070711	1.00%	7	7.1	0.1	7	7.1	0.1		
1ASOR000.59	2	7.7	7.7	0.565685	7.35%	7.3	8.1	0.8	7.3	8.1	0.8		
1ASOR002.99	24	7.06	7.05	0.065408	0.93%	6.99	7.15	0.16	7	7.12	0.12	0.585779	-1.64555
1ASUG000.05	2	7.45	7.45	0.212132	2.85%	7.3	7.6	0.3	7.3	7.6	0.3		
1ASUG004.42	339	7.37652	7.4	0.390905	5.30%	5.9	9.7	3.8	7.2	7.6	0.4	3.41485	16.9547
1ASUG008.46	27	7.57407	7.4	0.890373	11.76%	6	10	4	7	8	1	1.95127	0.951853
1ASUG009.07	2	7.9	7.9	0	0.00%	7.9	7.9	0	7.9	7.9	0		
1ASYC002.03	152	7.42079	7.4	0.299219	4.03%	6.6	8.2	1.6	7.28	7.6	0.32	1.85741	2.11576
1ASYC004.93	45	7.37889	7.41	0.239338	3.24%	6.9	7.7	0.8	7.3	7.58	0.28	-1.937	-0.440902
1ASYC006.23	1	7.7	7.7		%	7.7	7.7	0	7.7	7.7	0		
1ASYC007.43	51	7.32627	7.4	0.234827	3.21%	6.9	7.66	0.76	7.3	7.52	0.22	-2.54091	-0.375551
1ASYC009.78	1	7.3	7.3		%	7.3	7.3	0	7.3	7.3	0		
1ATOW000.60	1	8.6	8.6		%	8.6	8.6	0	8.6	8.6	0		
1ATUS000.04	28	7.90607	7.93	0.263837	3.34%	7.44	8.3	0.86	7.7	8.05	0.35	-0.493085	-0.956119

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1ATUS000.37	377	7.6595	7.69	0.490896	6.41%	6.35	9	2.65	7.4	7.92	0.52	1.48845	0.567567
1ATUS003.19	82	7.83171	7.8	0.623387	7.96%	6.2	10	3.8	7.5	8.2	0.7	1.01828	2.10403
1AWAC003.31	6	7.1	7.1	9.73E-16	1.37E-16	7.1	7.1	0	7.1	7.1	0	-1.36931	-1.66667
1AXAC000.09	3	7.43333	7.4	0.152753	2.05%	7.3	7.6	0.3	7.3	7.6	0.3	0.6613	
1AXAQ000.85	27	7.92111	7.92	0.122139	1.54%	7.7	8.1	0.4	7.9	8	0.1	-1.25235	-0.544561
1AXBL000.28	1	7.6	7.6		%	7.6	7.6	0	7.6	7.6	0		
1AXCO000.39	6	7.25	7.3	0.122474	1.69%	7.1	7.4	0.3	7.1	7.3	0.2	-0.489898	-0.733333
1AXCO000.92	4	7.4	7.4	0.11547	1.56%	7.3	7.5	0.2	7.3	7.5	0.2	-1.87E-14	-2.44949
1AXCO000.96	4	7.35	7.35	0.057735	0.79%	7.3	7.4	0.1	7.3	7.4	0.1	-3.77E-14	-2.44949
1AXDI000.01	4	7.5	7.5	0	0.00%	7.5	7.5	0	7.5	7.5	0		
1AXGB000.07	2	8	8	0.282843	3.54%	7.8	8.2	0.4	7.8	8.2	0.4		
1AXGJ000.42	15	7.66	7.6	0.250143	3.27%	7.4	8.1	0.7	7.5	7.7	0.2	1.58257	-0.135933
1AXGU000.18	8	7.325	7.4	0.138873	1.90%	7.1	7.4	0.3	7.25	7.4	0.15	-1.66296	5.13E-16
1AXJT002.22	32	7.23781	7.28	0.157741	2.18%	6.9	7.44	0.54	7.17	7.33	0.16	-2.46405	0.100102
1AXKR000.77	6	6.98	6.98	9.73E-16	1.39E-16	6.98	6.98	0	6.98	6.98	0	-1.36931	-1.66667
1AXLE001.62	7	7.04286	7.3	0.320713	4.55%	6.7	7.3	0.6	6.7	7.3	0.6	-0.404145	-1.51217

Summary Statistics for Sites Sampled by DEQ in Loudoun County or contributing watersheds.

DO (probe) mg/L	*Count*	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1ABEC004.76	227	9.89471	10.19	2.29207	23.16%	3.9	14.2	10.3	8.24	11.54	3.3	-1.93406	-1.58011
1ABEC011.19	66	9.08485	7.98	3.33463	36.71%	3.13	13.58	10.45	6.69	11.76	5.07	-0.8282	-1.88617
1ABEE000.40	2	6.95	6.95	0.353553	5.09%	6.7	7.2	0.5	6.7	7.2	0.5		
1ABEE001.40	2	7.3	7.3	1.55563	21.31%	6.2	8.4	2.2	6.2	8.4	2.2		
1ABEM000.60	19	11.2737	10.9	1.84205	16.34%	8.1	14.9	6.8	10	11.9	1.9	1.7539	0.638498
1ABOL002.56	60	9.82733	9.78	1.98409	20.19%	6.91	14.63	7.72	8.04	11.52	3.48	1.54433	-0.48343
1ABRB002.15	265	8.90234	8.5	2.6083	29.30%	4.58	15.08	10.5	6.62	11.1	4.48	1.60912	-3.38037
1ABRB006.33	31	9.45258	9.9	2.48802	26.32%	3.2	13.2	10	8.2	10.9	2.7	-1.75009	0.260608
1ABRB015.04	6	9.075	9.075	1.86773	20.58%	7.37	10.78	3.41	7.37	10.78	3.41	-3.026E-15	-1.66667
1ABUL016.31	24	9.80375	9.1	2.89324	29.51%	6.5	14.6	8.1	7.185	12.38	5.195	1.00748	-1.23078
1ABUL025.94	168	10.0935	9.25	2.95326	0.292591	5.3	16.4	11.1	7.55	12.5	4.95	2.20207	-2.28007
1ACAA000.83	6	12.3	12.3	1.95E-15	0.00%	12.3	12.3	0	12.3	12.3	0	1.36931	-1.66667
1ACAA003.46	27	9.95	9	2.18018	0.219114	7.4	14.6	7.2	8.59	10.4	1.81	2.33047	0.262097
1ACAX004.57	308	10.1149	10	2.47978	0.245161	5.13	16.73	11.6	8.335	12	3.665	0.785574	-1.47591
1ACLK002.40	33	10.9564	10.64	2.20756	20.15%	7.53	14	6.47	8.8	13.5	4.7	-0.327977	-1.47355
1ACRA000.42	36	9.06139	8.97	1.88348	20.79%	6.95	12.37	5.42	7.04	9.96	2.92	1.45789	-0.907627
1ACRF001.18	24	10.74	10.25	2.20632	20.54%	8.19	14.9	6.71	9.055	12.11	3.055	1.34507	-0.692989
1ACRM001.20	155	9.7131	9.6	2.4245	24.96%	4.2	14.4	10.2	7.6	11.34	3.74	0.585341	-2.35E+00
1ACRM009.86	8	10.6	10.9	0.555492	5.24%	9.7	10.9	1.2	10.3	10.9	0.6	-1.66296	1.43581E-14
1ACUB002.61	117	10.3217	9.83	2.56678	0.248678	6.36	15.13	8.77	8.3	13	4.7	1.49671	-2.25809
1ACUB003.74	94	9.4	9.295	2.91045	30.96%	4.9	15.8	10.9	7.1	10.8	3.7	2.64253	-0.588678
1ACUB008.60	52	9.69577	9.18	3.40568	35.13%	4.72	14.94	10.22	6.93	11	4.07	0.805172	-1.68461
1ADUT000.62	22	10.8182	9.2	2.94936	27.26%	7.9	16.6	8.7	8.8	13.8	5	2.09038	-0.217614
1ADUT002.72	6	8.46667	7.8	1.69076	19.97%	7.4	11.8	4.4	7.4	8.6	1.2	2.11157	2.29039
1AELC001.39	67	9.46284	8.67	2.9238	30.90%	6.19	15.74	9.55	6.52	11.65	5.13	2.41385	-0.636349
1AFLL000.62	6	7.8	7.8	0	0.00%	7.8	7.8	0	7.8	7.8	0		
1AGAR002.24	48	10.1533	10.295	2.10974	20.78%	6.96	13.3	6.34	8.42	12.08	3.66	0.161585	-1.87561
1AGOO002.38	335	10.4338	10.55	2.52327	24.18%	4.96	14.8	9.84	8.2	12.7	4.5	-1.61431	-3.50116
1AGOO003.82	1	8.2	8.2		%	8.2	8.2	0	8.2	8.2	0		
1AGOO004.89	1	8.5	8.5		%	8.5	8.5	0	8.5	8.5	0		
1AGOO011.23	162	10.4683	10.36	2.46304	23.53%	6.45	15.89	9.44	7.99	12.49	4.5	1.0427	-2.45844
1AGOO021.28	6	11.7	11.7	1.95E-15	0.00%	11.7	11.7	0	11.7	11.7	0	-1.36931	-1.66667
1AGOO022.44	255	10.0147	10.1	2.30916	0.230578	5.3	14.8	9.5	8.07	11.83	3.76	-0.40069	-2.632
1AGOO030.75	78	10.8369	10.68	3.06057	28.24%	5.9	15.1	9.2	7.83	13.7	5.87	-0.264966	-2.4188
1AGOO034.20	36	10.3458	9.615	2.79369	27.00%	6.32	15.17	8.85	7.69	13.01	5.32	0.597379	-1.54542
1AGOO036.47	8	12.15	11.7	0.833238	6.86%	11.7	13.5	1.8	11.7	12.6	0.9	1.66296	-6.1535E-15

Summary Statistics for Sites Sampled by DEQ in Loudoun County or contributing watersheds.

DO (probe) mg/L	*Count*	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1AGOO036.61	30	10.4537	9.45	2.15076	0.205742	8.3	14.06	5.76	8.81	11.53	2.72	1.63781	-1.06955
1AGOO044.36	307	10.6285	10.7	2.41944	0.227637	5.78	16.03	10.25	8.7	12.17	3.47	0.0179479	-2.60669
1AGOO046.37	23	9.19478	10.12	1.21259	0.131878	7.7	10.5	2.8	8.21	10.5	2.29	-0.237057	-1.96652
1AHOW003.68	12	9.075	7.75	3.8165	0.420551	5.7	15.1	9.4	6.2	11.95	5.75	1.38917	-0.52127
1AHPR003.87	103	10.45	10.9	2.6578	25.43%	6.28	17.4	11.12	8.36	11.5	3.14	1.76787	0.172782
1ALII003.97	110	9.90673	9.85	2.87102	0.289806	5.1	15.2	10.1	7	12.1	5.1	1.44699	-2.22584
1ALII006.75	27	10.7067	11.5	2.067	0.193057	8	12.9	4.9	8.8	12.79	3.99	-0.383751	-2.05543
1ALIM001.16	158	10.3959	10	2.29345	22.06%	6	16.5	10.5	8.8	12.2	3.4	2.40651	-1.01209
1ALIM001.80	15	9.72	8.6	3.27549	33.70%	5.9	14.2	8.3	7.3	12.6	5.3	0.472601	-1.34865
1ALIV001.70	74	10.4904	10.6	2.73584	26.08%	5.99	15.5	9.51	8.88	12.9	4.02	-0.426175	-1.70769
1ALIV004.78	162	10.136	10.02	2.53484	25.01%	6.2	15.6	9.4	7.9	12.4	4.5	1.55501	-2.26421
1ALIV006.92	26	8.85808	8.48	2.34132	26.43%	6.24	12.79	6.55	7.3	8.9	1.6	1.75382	-0.697236
1ALIV012.12	9	12.7667	12.8	1.60234	12.55%	10.9	14.6	3.7	10.9	14.6	3.7	-0.0491206	-1.04978
1AMIH001.98	26	9.84462	9.32	2.39955	24.37%	6.91	14.17	7.26	8.46	9.97	1.51	1.57755	-0.60849
1ANOB005.49	66	10.9103	10.95	2.27868	20.89%	7.41	16.6	9.19	8.72	11.78	3.06	1.61777	0.496133
1ANOC000.42	89	9.72494	10.1	2.43832	25.07%	5.6	14.1	8.5	7.9	11.5	3.6	0.0204148	-1.85831
1ANOC004.38	59	9.3	6.7	4.24293	45.62%	4.8	18.1	13.3	5.88	13.9	8.02	2.44498	-1.06469
1ANOC007.28	15	8.08	8	3.09105	0.382555	4.7	13.4	8.7	5.9	8.4	2.5	1.34524	-0.255827
1ANOC009.13	65	10.6623	10.1	3.51957	33.01%	5.86	17.6	11.74	7.6	13.9	6.3	1.33406	-1.48465
1ANOC009.37	26	9.84154	9.32	2.20942	0.224499	7	13.76	6.76	8.39	10.2	1.81	1.48641	-0.657438
1ANOG000.08	15	8.9	7.9	2.7736	31.16%	6.3	13.6	7.3	6.7	10	3.3	1.39121	-0.515572
1ANOG000.91	6	10.27	10.27	1.95E-15	0.00%	10.27	10.27	0	10.27	10.27	0	1.36931	-1.66667
1ANOG005.69	218	10.5389	10.8	2.58387	24.52%	5.83	16.1	10.27	8.3	12.95	4.65	-0.0655446	-2.70058
1ANOG011.60	24	10.4275	9.75	2.39758	22.99%	7.68	15.9	8.22	8.995	11.175	2.18	2.81074	1.52612
1APAE004.21	36	10.6858	10.21	2.47876	23.20%	7.73	15.4	7.67	8.59	12.585	3.995	1.59981	-1.02647
1APIA001.80	178	10.1893	10	2.15367	21.14%	5.76	15.05	9.29	8.55	11.7	3.15	1.34925	-1.30947
1ASFS000.28	65	10.0492	8.9	3.36423	33.48%	5.4	16.4	11	7.08	12.2	5.12	1.29391	-1.57853
1ASOC000.01	2	11.4	11.4	0	0.00%	11.4	11.4	0	11.4	11.4	0		
1ASOC001.66	115	9.742	9.8	2.56824	26.36%	5.2	15.25	10.05	7.8	11.6	3.8	0.532737	-1.81501
1ASOC007.06	83	9.86301	8.71	3.52899	35.78%	5.5	17.3	11.8	7.05	13.6	6.55	2.21583	-1.60302
1ASOC010.09	7	13.0714	12.3	1.31747	10.08%	12.3	15	2.7	12.3	15	2.7	1.32816	-0.453652
1ASOC012.38	66	10.7932	11	3.40435	31.54%	6.02	17.6	11.58	7.87	13.5	5.63	0.975961	-1.38287
1ASOR002.99	24	8.555	8.245	1.6	0.187025	6.7	11.03	4.33	7.39	9.72	2.33	1.20443	-0.8805
1ASUG004.42	182	9.69791	9.21	2.33575	24.09%	6	15.67	9.67	7.79	11.2	3.41	3.59401	-0.770989
1ASYC002.03	154	9.82818	9.82	2.38E+00	2.42E-01	5.94	14.2	8.26	7.63	11.79	4.16	0.210403	-3.13827
1ASYC004.93	60	9.515	8.66	3.2934	34.61%	5.3	15.6	10.3	6.635	12.3	5.665	1.5295	-1.71879

Summary Statistics for Sites Sampled by DEQ in Loudoun County or contributing watersheds.

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1ASYC007.43	70	10.4379	9.8	3.14778	0.301573	6.17	16.6	10.43	7.7	12.8	5.1	1.60179	-1.73906
1ATUS000.04	23	10.3335	10.2	2.36139	22.85%	6.55	13.83	7.28	9.06	13.34	4.28	1.76E-01	-0.838689
1ATUS000.37	160	10.4499	10.55	2.77258	26.53%	5.1	15.8	10.7	7.98	12.84	4.86	0.0737901	-2.84618
1AWAC003.31	6	8.4	8.4	0	0.00%	8.4	8.4	0	8.4	8.4	0		
1AXAQ000.85	24	10.91	11.005	1.62825	14.92%	8.53	12.9	4.37	9.42	12.5	3.08	-0.572066	-1.38473
1AXCO000.39	4	7.95	7.95	0.404145	5.08%	7.6	8.3	0.7	7.6	8.3	0.7	0	-2.44949
1AXCO000.92	4	9.25	9.25	0.519615	5.62%	8.8	9.7	0.9	8.8	9.7	0.9	0	-2.44949
1AXCO000.96	4	9.95	9.95	0.057735	0.58%	9.9	10	0.1	9.9	10	0.1	7.5438E-14	-2.44949
1AXDI000.01	4	8.25	8.25	0.057735	0.70%	8.2	8.3	0.1	8.2	8.3	0.1	0	-2.44949
1AXGJ000.42	15	8.76	7.8	2.92375	33.38%	6.1	14	7.9	6.7	9.2	2.5	1.80689	-0.0449087
1AXGU000.18	8	9.6	9.9	0.555492	5.79%	8.7	9.9	1.2	9.3	9.9	0.6	-1.66296	-4.6151E-15
1AXJT002.22	26	9.41577	9.01	2.54599	27.04%	6.38	13.78	7.4	7.64	9.6	1.96	1.52351	-0.745306
1AXKR000.77	6	9.77	9.77	1.95E-15	0.00%	9.77	9.77	0	9.77	9.77	0	1.36931	-1.66667
1AXLE001.62	7	12.0857	11.1	2.94133	24.34%	6.9	14.8	7.9	11.1	14.8	3.7	-0.815454	0.0765587

Summary Statistics for Sites Sampled by DEQ in Loudoun County or contributing watersheds.

DO (Winkler) mg/L	Count	Mean	Median	Standard deviation	Coeff. of variation	Minimum	Maximum	Range	Lower quartile	Upper quartile	Interquartile range	Stnd. skewness	Stnd. kurtosis
1ABEC004.76	36	8.89	8.7	2.24584	25.26%	3.6	13.29	9.69	7.45	10.6	3.15	-0.479628	-0.076006
1ABIR000.76	43	8.94186	8.8	2.31517	25.89%	3.8	13.59	9.79	7.7	10.2	2.5	-0.42311	0.042282
1ABIR005.21	2	9.4	9.4	0.424264	4.51%	9.1	9.7	0.6	9.1	9.7	0.6		
1ABLR000.10	1	12.6	12.6		%	12.6	12.6	0	12.6	12.6	0		
1ABRB002.15	191	9.40414	9.1	2.81534	29.94%	0	15.19	15.19	7.2	11.8	4.6	-0.465467	-1.51107
1ABRB015.04	1	7.8	7.8		%	7.8	7.8	0	7.8	7.8	0		
1ABRB015.38	2	9.15	9.15	0.212132	2.32%	9	9.3	0.3	9	9.3	0.3		
1ABUL025.94	17	9.93353	10	1.58089	0.159146	7.6	13.1	5.5	8.5	11.3	2.8	0.301711	-0.608356
1ABUT000.69	1	12	12		%	12	12	0	12	12	0		
1ACAA003.46	1	13	13		%	13	13	0	13	13	0		
1ACAA008.01	1	14.1	14.1		%	14.1	14.1	0	14.1	14.1	0		
1ACAX000.19	53	10.6277	10.5	1.81624	17.09%	7.8	14.19	6.39	9.2	12.39	3.19	0.61464	-1.53047
1ACAX004.57	148	10.6284	10.45	2.26313	0.212933	0.5	16.4	15.9	8.85	12.25	3.4	-1.70071	3.72103
1ACAX008.61	1	13.3	13.3		%	13.3	13.3	0	13.3	13.3	0		
1ACRM001.20	3	10.1	10.4	2.86182	28.33%	7.1	12.8	5.7	7.1	12.8	5.7	-0.329897	
1ACRM005.39	1	7.9	7.9		%	7.9	7.9	0	7.9	7.9	0		
1ACRM008.59	1	8	8		%	8	8	0	8	8	0		
1ACUB003.74	55	8.63745	9.1	2.93665	34.00%	3	13.69	10.69	6.2	11.1	4.9	-0.622428	-1.56703
1ACUB008.60	7	7.92857	6.9	1.75757	22.17%	6.9	10.6	3.7	6.9	10.4	3.5	1.33317	-0.438001
1ADRL001.00	1	11.8	11.8		%	11.8	11.8	0	11.8	11.8	0		
1ADUT000.62	40	10.7943	10.49	1.91571	17.75%	8	14.29	6.29	9.2	12.29	3.09	1.01395	-1.50553
1ADUT002.72	1	8.7	8.7		%	8.7	8.7	0	8.7	8.7	0		
1AELC001.39	6	8.6	8.6	0	0.00%	8.6	8.6	0	8.6	8.6	0		
1AFLB000.64	22	9.17091	8.9	2.99514	32.66%	4.6	17.8	13.2	7	10.8	3.8	1.96273	1.87191
1AFLB001.40	25	9.158	9.1	2.25838	0.246602	4.8	13.5	8.7	7.6	11.2	3.6	0.0802894	-0.897685
1AFLB002.53	2	10.3	10.3	0.707107	0.068651	9.8	10.8	1	9.8	10.8	1		
1AFOL000.53	4	7	6.1	3.84621	54.95%	3.5	12.3	8.8	4.25	9.75	5.5	0.937636	0.427814
1AFOL001.52	1	7.6	7.6		%	7.6	7.6	0	7.6	7.6	0		
1AFRY000.60	1	12	12		%	12	12	0	12	12	0		
1AGOO002.38	185	10.206	10.19	2.26652	22.21%	5.6	15.8	10.2	8.3	11.9	3.6	0.641205	-2.56843
1AGOO004.89	5	7	6.9	0.4	5.71%	6.5	7.5	1	6.8	7.3	0.5	0.106977	-0.647211
1AGOO011.23	134	10.2001	10.1	2.06663	20.26%	5.6	15.2	9.6	8.5	12	3.5	1.38587	-1.77849
1AGOO014.44	55	10.1531	9.8	2.26361	22.29%	6.4	14.79	8.39	8.4	12.39	3.99	1.16861	-1.70116
1AGOO022.44	175	10.688	10.2	5.27403	0.493454	4.8	73.5	68.7	8.6	12.2	3.6	52.8358	315.161
1AGOO030.75	84	10.3336	9.95	2.02233	19.57%	7	15.59	8.59	8.45	12	3.55	1.5947	-1.50809
1AGOO044.36	71	10.3392	10.1	2.02375	0.195736	5.1	14.5	9.4	8.8	11.79	2.99	1.10044	-0.627382
1AHPR000.32	1	12.6	12.6		%	12.6	12.6	0	12.6	12.6	0		
1AHPR002.28	9	10.8622	11.39	2.5264	23.26%	6.8	15.19	8.39	9.2	12.39	3.19	0.164512	-0.086365

Summary Statistics for Sites Sampled by DEQ in Loudoun County or contributing watersheds.

DO (Winkler) mg/L	Count	Mean	Median	Standard deviation	Coeff. of variation	Minimum	Maximum	Range	Lower quartile	Upper quartile	Interquartile range	Stnd. skewness	Stnd. kurtosis
1AHPR003.87	142	10.3035	10.395	2.45483	23.83%	5	15.19	10.19	8.6	12.2	3.6	-0.516576	-2.08285
1AHPR004.91	2	12.6	12.6	0.282843	2.24%	12.4	12.8	0.4	12.4	12.8	0.4		
1AHPR006.51	1	12.8	12.8		%	12.8	12.8	0	12.8	12.8	0		
1AINI000.80	1	13.2	13.2		%	13.2	13.2	0	13.2	13.2	0		
1AJEE002.22	1	13.3	13.3		%	13.3	13.3	0	13.3	13.3	0		
1AJEE004.84	1	12.7	12.7		%	12.7	12.7	0	12.7	12.7	0		
1ALII003.97	21	10.05	10.29	1.81463	0.180561	6.1	13.5	7.4	8.8	11	2.2	0.0383014	0.19992
1ALIM001.16	25	10.8764	10.59	2.08755	19.19%	7.4	14.19	6.79	9.1	12.39	3.29	0.132404	-1.27295
1ALIV004.78	9	11.0378	11.59	1.58807	14.39%	7.1	12.5	5.4	11.59	11.59	0	-2.82644	3.54632
1ALIV005.76	15	9.358	9.2	2.1144	22.59%	5.4	13.59	8.19	8	10.19	2.19	0.721787	0.40654
1ALIV006.92	3	5.36	5.36	0	0.00%	5.36	5.36	0	5.36	5.36	0		
1ALIV012.12	1	12.2	12.2		%	12.2	12.2	0	12.2	12.2	0		
1ALIV016.50	1	11.6	11.6		%	11.6	11.6	0	11.6	11.6	0		
1ALIV018.08	1	11.6	11.6		%	11.6	11.6	0	11.6	11.6	0		
1ALNR001.04	2	8.3	8.3	0	0.00%	8.3	8.3	0	8.3	8.3	0		
1ANOC000.42	77	10.9805	11.4	1.84498	16.80%	5	15.5	10.5	9.6	12	2.4	-1.61798	1.126
1ANOC004.38	44	10.467	10.645	2.00439	19.15%	7.3	14.29	6.99	8.65	12.045	3.395	0.233971	-1.44492
1ANOC007.28	1	9.5	9.5		%	9.5	9.5	0	9.5	9.5	0		
1ANOC009.13	1	9.6	9.6		%	9.6	9.6	0	9.6	9.6	0		
1ANOC009.37	2	8.43	8.43	0	0	8.43	8.43	0	8.43	8.43	0		
1ANOC011.74	1	8.6	8.6		%	8.6	8.6	0	8.6	8.6	0		
1ANOG005.69	181	10.7591	10.9	2.16225	20.10%	0	15.2	15.2	9.1	12.4	3.3	-3.85844	5.70809
1ANOG011.60	5	9.96	10.2	1.61338	16.20%	8.1	12	3.9	8.6	10.9	2.3	0.0347573	-0.831199
1APAE004.21	6	8.94	8.94	1.09545	12.25%	7.94	9.94	2	7.94	9.94	2	1.8243E-15	-1.66667
1APIA000.18	1	8.4	8.4		%	8.4	8.4	0	8.4	8.4	0		
1APIA001.80	8	9.1375	8.6	1.4362	15.72%	7.7	12.3	4.6	8.6	9.35	0.75	2.13632	2.08284
1APIA004.67	1	7.7	7.7		%	7.7	7.7	0	7.7	7.7	0		
1APIA007.08	1	7.4	7.4		%	7.4	7.4	0	7.4	7.4	0		
1APOT170.40	107	10.735	10.5	2.27906	21.23%	0	16.09	16.09	9.4	12.19	2.79	-3.02313	7.63701
1ASFS000.28	1	12.5	12.5		%	12.5	12.5	0	12.5	12.5	0		
1ASOC001.66	125	10.6347	11	2.23964	21.06%	0.2	16.3	16.1	8.9	12	3.1	-3.63007	6.36048
1ASOC005.46	3	9.7	9.1	2.65141	27.33%	7.4	12.6	5.2	7.4	12.6	5.2	0.68319	
1ASOC007.06	1	8	8		%	8	8	0	8	8	0		
1ASOC008.46	2	11.4	11.4	1.69706	14.89%	10.2	12.6	2.4	10.2	12.6	2.4		
1ASOC011.82	64	10.5903	10.74	1.8464	17.43%	6	14	8	9.25	12.14	2.89	-1.4011	-0.694418
1ASOC012.38	43	10.746	10.5	1.96327	18.27%	7.5	17.59	10.09	9.2	12.5	3.3	2.25494	2.41303
1ASOC014.58	4	10.05	10.1	2.12525	21.15%	7.4	12.6	5.2	8.7	11.4	2.7	-0.114832	0.598849
1ASOC015.92	2	11.3	11.3	1.55563	0.137667	10.2	12.4	2.2	10.2	12.4	2.2		

Summary Statistics for Sites Sampled by DEQ in Loudoun County or contributing watersheds.

DO (Winkler) mg/L	*Count*	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1ASOR000.59	2	8.3	8.3	0.141421	1.70%	8.2	8.4	0.2	8.2	8.4	0.2		
1ASOR002.99	6	8.16	8.16	1.95E-15	2.38E-16	8.16	8.16	0	8.16	8.16	0	1.36931	-1.66667
1ASUG000.05	2	7.5	7.5	0.424264	0.056569	7.2	7.8	0.6	7.2	7.8	0.6		
1ASUG004.42	175	9.97571	9.7	2.37528	23.81%	5.1	15.2	10.1	8	11.8	3.8	0.723638	-2.86716
1ASUG008.46	29	9.88	9	2.90516	29.40%	5.6	16.79	11.19	7.6	11.79	4.19	1.34619	-0.500136
1ASUG009.07	2	10.8	10.8	0.282843	2.62%	10.6	11	0.4	10.6	11	0.4		
1ASYC002.03	3	11.5333	11.1	9.29E-01	8.06E-02	10.9	12.6	1.7	10.9	12.6	1.7	1.16122	
1ASYC006.23	1	15	15		%	15	15	0	15	15	0		
1ASYC007.43	1	12.8	12.8		%	12.8	12.8	0	12.8	12.8	0		
1ASYC009.78	1	13	13		%	13	13	0	13	13	0		
1ATOW000.60	1	12	12		%	12	12	0	12	12	0		
1ATUS000.37	228	9.78294	9.8	2.44209	24.96%	4.6	15.9	11.3	7.85	11.8	3.95	1.30023	-1.95062
1ATUS003.19	82	10.1107	10	2.89811	28.66%	2	17.59	15.59	9	12.19	3.19	-2.55822	2.54481
1AXAC000.09	3	9.23333	9.6	2.66896	28.91%	6.4	11.7	5.3	6.4	11.7	5.3	-0.428896	
1AXBL000.28	1	7.8	7.8		%	7.8	7.8	0	7.8	7.8	0		
1AXCO000.39	2	10.15	10.15	1.76777	17.42%	8.9	11.4	2.5	8.9	11.4	2.5		
1AXGB000.07	2	9.3	9.3	1.83848	19.77%	8	10.6	2.6	8	10.6	2.6		

Section B) Monthly averages for several field and lab analytes including Total Suspended Solids, DO (probe), Total Phosphorous, Total Nitrogen, Turbidity, and Temperature

Summary Statistics; Data from selected analytes by month for period of record.

Summary Statistics
Data variable: Turbidity (NTU)

Month	Count	Average	Median	Standard Deviation	Minimum	Maximum	Range	Standardized Skewness	Standardized Kurtosis
Jan	62	26.8177	9.4	66.6136	1.8	453.0	451.2	16.122	46.1071
Feb	78	13.8145	6.25	18.1987	1.1	94.2	93.1	9.51865	12.9017
Mar	80	9.678	5.835	10.6297	2.33	55.0	52.67	9.4822	12.1689
April	72	8.365	6.31	8.19578	1.9	54.0	52.1	11.1479	23.6865
May	94	10.365	6.865	12.245	1.6	93.0	91.4	16.5449	45.6229
June	59	10.1758	9.8	6.29478	1.61	26.0	24.39	2.50882	-0.126304
July	90	15.0004	7.22	29.7136	0.98	208.5	207.52	18.4375	49.2327
Aug	64	13.9981	6.725	24.4384	2.87	155.0	152.13	14.2756	33.8485
Sept	67	39.85	7.01	187.582	1.4	1540.0	1538.6	26.6857	108.164
Oct	56	7.98232	3.245	31.0025	1.0	235.0	234.0	22.6043	84.2153
Nov	76	6.27566	4.14	8.68141	1.26	66.0	64.74	18.1304	55.5674
Dec	69	8.34551	4.63	10.093	0.83	49.0	48.17	8.18447	9.22178
Total	867	13.9644	6.1	57.8664	0.83	1540.0	1539.17	264.399	3389.93

Summary Statistics
Data variable: Total Suspended Solids (mg/L)

Month	Count	Average	Median	Standard Deviation	Minimum	Maximum	Range	Standardized Skewness	Standardized Kurtosis
Jan	163	165.135	127.0	102.942	66.0	640.0	574.0	11.234	12.8761
Feb	151	149.94	112.0	95.5285	0.0	642.0	642.0	12.0255	16.9022
Mar	182	143.546	112.0	125.555	20.39	1187.0	1166.61	28.9654	96.8586
April	229	137.966	118.0	63.2187	22.29	379.0	356.71	8.55334	5.56461
May	209	143.311	119.0	64.8356	11.0	418.0	407.0	8.1628	5.97226
June	173	149.786	131.0	55.7896	71.0	344.0	273.0	6.25358	2.61862
July	203	163.222	142.0	79.7596	64.0	633.0	569.0	13.9378	25.1566
Aug	184	173.978	138.0	165.402	21.0	2097.0	2076.0	49.3757	278.883
Sept	147	169.517	134.0	187.077	38.0	2167.0	2129.0	42.9954	223.758
Oct	157	159.134	139.0	65.8691	78.0	425.0	347.0	8.36385	8.32367
Nov	166	145.988	126.5	65.5837	68.0	445.0	377.0	10.7425	14.4161
Dec	137	142.234	123.0	70.306	32.0	549.0	517.0	12.5201	24.2397
Total	2101	153.218	127.0	102.369	0.0	2167.0	2167.0	159.905	1316.31

Summary Statistics
Data variable: Dissolved Oxygen (mg/L)

Month	Count	Average	Median	Standard Deviation	Minimum	Maximum	Range	Standardized Skewness	Standardized Kurtosis
Jan	309	12.66	12.7	1.29515	9.09	16.73	7.64	0.28802	1.63184
Feb	300	12.9669	13.14	1.13911	9.92	15.5	5.58	-2.61752	-1.92205
Mar	572	12.0305	12.0	1.4962	8.0	17.4	9.4	-1.30597	-0.631311
April	598	10.8178	10.88	1.37419	6.2	16.6	10.4	2.86605	4.27342
May	630	9.27756	9.16	1.26216	6.0	13.66	7.66	2.20485	1.30646
June	571	8.04305	8.0	1.21425	3.2	11.9	8.7	1.17997	1.5938
July	605	7.31565	7.37	1.176	4.58	11.3	6.72	3.67866	-0.730233
Aug	323	7.40146	7.41	1.23608	3.9	11.2	7.3	2.41506	1.22318
Sept	471	7.67966	7.8	1.41608	5.07	12.38	7.31	2.40215	-0.224485
Oct	362	9.58793	9.9	1.58914	3.13	13.5	10.37	-6.97853	4.47855
Nov	431	11.1819	11.4	1.89395	5.82	14.4	8.58	-6.90272	0.715359
Dec	288	12.1636	11.8	1.71455	7.98	18.1	10.12	2.63556	2.92716
Total	5460	9.8566	9.82	2.41344	3.13	18.1	14.97	4.0349	-11.7663

Summary Statistics
Data variable: Total Phosphorous (mg/L)

				Standard				*Standardized*	*Standardized*
Month	*Count*	*Average*	*Median*	*Deviation*	*Minimum*	*Maximum*	*Range*	*Skewness*	*Kurtosis*
Jan	194	0.0997938	0.05	0.109104	0.01	1.1	1.09	27.7654	106.093
Feb	188	0.116436	0.05	0.210482	0.005	1.5	1.495	27.1852	71.1491
Mar	231	0.0772727	0.05	0.238464	0.01	3.6	3.59	87.8783	650.023
April	234	0.0735897	0.05	0.0696892	0.01	0.52	0.51	25.2664	66.0178
May	228	0.0807675	0.05	0.0671966	0.005	0.5	0.495	17.4659	33.6956
June	206	0.100534	0.09	0.0793523	0.02	0.5	0.48	14.3682	21.7285
July	251	0.110956	0.06	0.186954	0.01	1.8	1.79	41.9707	155.391
Aug	182	0.101731	0.1	0.0915846	0.005	0.6	0.595	19.0195	39.7738
Sept	192	0.12276	0.07	0.187916	0.01	2.0	1.99	36.7962	158.243
Oct	204	0.108382	0.05	0.139718	0.01	1.3	1.29	25.6843	82.0246
Nov	202	0.0802376	0.05	0.145663	0.005	1.99	1.985	66.2033	430.98
Dec	170	0.0720882	0.05	0.0627517	0.005	0.4	0.395	12.7445	18.4339
Total	2482	0.0950657	0.05	0.147142	0.005	3.6	3.595	215.094	1803.34

Summary Statistics
Data variable: Total Nitrogen (mg/L)

				Standard				*Standardized*	*Standardized*
Month	*Count*	*Average*	*Median*	*Deviation*	*Minimum*	*Maximum*	*Range*	*Skewness*	*Kurtosis*
Jan	26	1.68577	1.625	0.526621	0.91	3.01	2.1	1.8044	0.366031
Feb	9	1.30111	1.44	0.441968	0.68	1.77	1.09	-0.607763	-0.95452
Mar	31	1.27839	1.26	0.346267	0.7	1.99	1.29	0.783583	-0.423835
April	16	0.9175	0.885	0.492131	0.22	1.82	1.6	0.5669	-0.67017
May	20	1.1535	1.15	0.390415	0.67	2.0	1.33	1.40111	-0.0555273
June	20	1.1595	1.13	0.394641	0.6	2.14	1.54	1.19924	0.373354
July	30	1.21633	1.165	0.406766	0.48	2.54	2.06	2.45273	3.03506
Aug	18	1.00556	0.915	0.585704	0.54	3.21	2.67	5.95968	11.5163
Sept	27	1.14185	0.88	0.600609	0.6	2.83	2.23	2.69458	0.95867
Oct	19	1.12737	1.22	0.37868	0.36	1.59	1.23	-1.78363	0.103699
Nov	20	1.3015	1.245	0.496973	0.51	2.13	1.62	0.305579	-1.05816
Dec	19	1.29632	1.27	0.494404	0.63	2.28	1.65	0.453245	-0.726405
Total	255	1.22984	1.18	0.494337	0.22	3.21	2.99	5.56736	4.08905

Summary Statistics
Data variable: Temperature (oC)

				Standard				*Standardized*	*Standardized*
Month	*Count*	*Average*	*Median*	*Deviation*	*Minimum*	*Maximum*	*Range*	*Skewness*	*Kurtosis*
Jan	363	3.12975	2.5	2.84322	-0.06	23.0	23.06	11.7472	22.3381
Feb	305	3.6098	2.94	2.93885	-0.08	13.89	13.97	8.58085	3.74367
Mar	424	6.7225	7.0	2.95397	0.0	17.0	17.0	1.17256	-0.491924
April	459	12.1564	12.0	3.71932	4.44	25.56	21.12	3.90501	2.18579
May	486	17.0981	17.1	3.45998	1.0	32.0	31.0	0.975957	7.48408
June	436	21.3741	21.6	3.15545	9.0	31.0	22.0	-1.46105	0.4839
July	483	23.7072	23.82	2.55646	2.0	30.2	28.2	-15.6305	56.041
Aug	370	23.0322	23.365	3.58646	1.9	29.5	27.6	-23.9905	62.4793
Sept	388	19.2823	19.78	4.1905	1.8	27.22	25.42	-17.394	29.7027
Oct	379	12.8436	12.78	3.54625	1.0	20.0	19.0	-6.97811	6.8192
Nov	377	8.24032	8.0	3.30742	0.3	17.78	17.48	0.29229	-0.962849
Dec	345	4.04971	3.89	2.52245	-0.08	12.29	12.37	3.01863	-2.05273
Total	4815	13.5247	13.5	8.05414	-0.08	32.0	32.08	-0.607585	-17.9235

Summary Statistics Monthly averages and medians
Data variable: TSS (mg/L)

						Standardized
Collection_Date_Time_1	*Count*	*Average*	*Median*	*Minimum*	*Maximum*	*Skewness*
12/68	5	156.8	187.0	96.0	209.0	-0.465324
5/69	5	178.2	193.0	106.0	260.0	0.0123768
8/69	5	114.2	130.0	21.0	196.0	-0.227062
3/70	6	245.232	138.5	20.39	895.0	2.31037
4/70	6	139.882	155.5	22.29	211.0	-1.46304
5/70	6	199.5	204.5	129.0	266.0	-0.150859
1/75	1	86.0	86.0	86.0	86.0	
2/75	8	129.5	107.0	72.0	304.0	2.64586
3/75	9	264.0	134.0	94.0	1187.0	3.50423
4/75	7	114.571	103.0	57.0	218.0	1.52263
5/75	7	173.571	154.0	92.0	346.0	1.87165
6/75	10	167.1	154.5	85.0	294.0	0.601293
7/75	4	281.5	187.5	118.0	633.0	1.49324
8/75	2	172.5	172.5	170.0	175.0	
10/75	4	142.25	146.0	102.0	175.0	-0.437607
12/75	4	88.5	88.0	83.0	95.0	0.372468
3/76	4	125.25	121.0	115.0	144.0	1.05668
5/76	4	218.0	210.0	188.0	264.0	1.02598
6/76	5	192.6	200.0	106.0	315.0	0.560085
7/76	4	287.0	227.5	146.0	547.0	1.3771
8/76	9	160.222	166.0	54.0	280.0	0.300968
9/76	5	350.6	275.0	215.0	735.0	1.96397
11/76	7	198.857	200.0	148.0	234.0	-0.907599
2/77	3	184.0	174.0	146.0	232.0	0.687725
4/77	2	295.0	295.0	272.0	318.0	
5/77	4	257.75	257.0	192.0	325.0	0.00785612
4/78	2	115.0	115.0	84.0	146.0	
5/78	2	140.0	140.0	115.0	165.0	
6/78	3	128.0	111.0	83.0	190.0	0.883357
7/78	2	270.0	270.0	140.0	400.0	
8/78	2	319.0	319.0	141.0	497.0	
9/78	4	201.0	198.5	77.0	330.0	0.00344488
10/78	3	238.333	210.0	80.0	425.0	0.503753
11/78	2	272.0	272.0	115.0	429.0	
12/78	3	135.333	156.0	77.0	173.0	-1.07476
1/79	2	292.5	292.5	214.0	371.0	
3/79	4	128.25	113.5	80.0	206.0	0.914197
4/79	3	122.667	101.0	83.0	184.0	1.07273
5/79	2	122.0	122.0	11.0	233.0	
6/79	4	143.5	132.0	97.0	213.0	0.924213
7/79	14	148.571	135.5	97.0	332.0	3.97784
8/79	23	235.522	127.0	74.0	2097.0	8.96302
9/79	3	135.333	125.0	124.0	157.0	1.22084
10/79	10	131.6	111.0	78.0	212.0	0.949987
11/79	5	124.2	129.0	71.0	170.0	-0.303321
12/81	1	150.0	150.0	150.0	150.0	
10/82	4	217.0	224.5	167.0	252.0	-0.34152
4/83	3	187.0	204.0	145.0	212.0	-1.15922
3/85	2	135.5	135.5	113.0	158.0	
5/85	1	153.0	153.0	153.0	153.0	
6/85	1	149.0	149.0	149.0	149.0	
7/85	2	156.5	156.5	132.0	181.0	
8/85	2	257.5	257.5	113.0	402.0	
11/85	2	159.5	159.5	141.0	178.0	
12/85	1	171.0	171.0	171.0	171.0	

1/86	2	111.0	111.0	102.0	120.0	
2/86	1	108.0	108.0	108.0	108.0	
4/86	2	143.0	143.0	115.0	171.0	
5/86	2	169.0	169.0	148.0	190.0	
6/86	1	198.0	198.0	198.0	198.0	
7/86	2	170.5	170.5	148.0	193.0	
8/86	1	193.0	193.0	193.0	193.0	
9/86	2	106.5	106.5	80.0	133.0	
10/86	1	176.0	176.0	176.0	176.0	
11/88	8	182.25	173.5	68.0	342.0	0.758663
12/88	5	173.8	168.0	32.0	316.0	0.00960785
1/89	7	177.857	165.0	112.0	265.0	0.469535
2/89	7	179.857	185.0	103.0	285.0	0.298898
3/89	9	188.667	222.0	60.0	328.0	0.017362
4/89	8	154.75	158.0	76.0	251.0	0.430822
5/89	8	218.875	199.5	81.0	418.0	0.786422
6/89	8	164.125	157.0	101.0	325.0	2.2269
7/89	7	154.429	168.0	76.0	292.0	1.2176
8/89	6	165.5	143.5	90.0	309.0	1.31595
9/89	7	201.857	230.0	85.0	391.0	0.61226
10/89	3	217.333	217.0	94.0	341.0	0.00858826
11/89	7	163.429	158.0	77.0	328.0	1.35841
12/89	6	244.833	182.0	87.0	549.0	1.20007
1/90	7	219.286	186.0	99.0	389.0	0.453429
2/90	7	152.857	138.0	72.0	298.0	1.20992
3/90	5	141.6	102.0	91.0	242.0	1.07703
4/90	5	218.4	222.0	86.0	340.0	-0.266252
5/90	7	175.286	168.0	90.0	326.0	0.899777
6/90	7	171.714	167.0	100.0	277.0	0.908473
7/90	7	186.286	127.0	95.0	402.0	1.54331
8/90	9	140.778	125.0	57.0	255.0	0.853931
9/90	13	178.231	135.0	100.0	500.0	3.08047
10/90	9	109.889	106.0	88.0	144.0	1.17985
11/90	4	96.0	96.5	81.0	110.0	-0.0521631
12/90	3	96.3333	96.0	90.0	103.0	0.16259
1/91	18	168.556	112.0	66.0	640.0	4.28413
2/91	4	97.5	99.5	80.0	111.0	-0.289024
3/91	4	92.0	93.5	74.0	107.0	-0.19151
4/91	13	114.769	108.0	80.0	207.0	2.4232
5/91	9	100.667	95.0	80.0	135.0	1.48382
6/91	5	114.8	107.0	86.0	156.0	0.540801
7/91	12	151.5	127.5	96.0	316.0	2.44185
8/91	5	217.4	205.0	106.0	400.0	0.849157
9/91	4	198.75	197.0	100.0	301.0	0.104279
10/91	8	200.375	192.0	136.0	278.0	0.390693
11/91	10	165.1	134.0	86.0	412.0	3.31369
12/91	5	137.4	136.0	112.0	162.0	-0.0758339
1/92	17	141.353	132.0	76.0	247.0	1.68939
2/92	10	116.0	106.0	79.0	181.0	1.64147
3/92	5	110.6	103.0	86.0	167.0	1.6869
4/92	19	119.842	106.0	77.0	190.0	1.55951
5/92	4	108.0	107.5	33.0	184.0	0.0371049
6/92	5	105.4	100.0	76.0	155.0	1.28322
7/92	14	157.571	134.5	93.0	334.0	2.44435
8/92	10	113.0	108.0	70.0	170.0	1.07652
9/92	5	124.4	107.0	90.0	186.0	0.888921
10/92	14	168.5	144.5	105.0	358.0	3.21873
11/92	10	117.3	110.0	86.0	164.0	1.0289
12/92	5	93.8	84.0	57.0	152.0	1.14625
1/93	17	144.765	125.0	82.0	415.0	4.71475
2/93	5	97.4	86.0	82.0	134.0	1.52701

3/93	5	99.0	77.0	71.0	168.0	1.46022
4/93	14	117.571	101.0	72.0	184.0	1.07468
5/93	9	118.778	114.0	76.0	185.0	0.974859
6/93	5	96.4	84.0	71.0	162.0	1.88527
7/93	11	149.273	142.0	67.0	364.0	2.59106
8/93	12	153.25	114.5	76.0	376.0	2.39781
9/93	9	130.333	133.0	94.0	189.0	0.952744
10/93	16	160.563	136.0	94.0	391.0	3.6974
11/93	13	131.077	126.0	72.0	205.0	0.705306
1/94	11	181.455	185.0	97.0	321.0	0.7035
2/94	5	69.0	86.0	0.0	95.0	-1.89176
3/94	10	95.8	96.5	61.0	155.0	1.38188
4/94	13	117.692	103.0	72.0	200.0	1.09812
5/94	10	101.9	93.0	70.0	184.0	2.75963
6/94	6	148.167	125.0	91.0	246.0	0.906275
7/94	11	163.636	128.0	91.0	338.0	2.21693
8/94	8	126.25	117.0	102.0	170.0	0.921657
9/94	4	139.75	124.5	103.0	207.0	1.38419
10/94	13	162.462	146.0	98.0	412.0	3.58516
11/94	10	128.7	125.5	77.0	220.0	1.01272
12/94	5	118.6	113.0	85.0	184.0	1.26821
1/95	13	134.846	121.0	90.0	213.0	1.04165
2/95	9	106.778	97.0	84.0	179.0	2.48609
3/95	5	134.4	120.0	95.0	208.0	1.43867
4/95	13	138.769	128.0	80.0	220.0	0.623719
5/95	11	117.182	112.0	71.0	216.0	2.33064
6/95	4	135.75	126.0	97.0	194.0	0.949633
7/95	13	148.538	141.0	77.0	222.0	0.584651
8/95	12	129.25	110.0	81.0	218.0	1.51484
9/95	7	137.571	115.0	91.0	266.0	2.03688
10/95	12	157.583	140.0	92.0	248.0	0.94816
11/95	5	92.6	80.0	76.0	124.0	1.03222
12/95	5	112.4	97.0	79.0	176.0	1.2675
1/96	6	128.833	94.5	77.0	255.0	1.4984
2/96	11	165.636	103.0	78.0	451.0	2.35124
3/96	10	89.9	95.0	56.0	116.0	-0.802391
4/96	13	133.077	116.0	72.0	216.0	0.840155
5/96	9	109.778	112.0	87.0	137.0	0.454136
6/96	5	134.2	122.0	93.0	212.0	1.59965
7/96	13	149.077	143.0	89.0	220.0	0.60133
8/96	11	205.091	133.0	106.0	600.0	3.00276
9/96	6	118.0	102.5	82.0	165.0	0.758747
10/96	3	131.667	100.0	99.0	196.0	1.2243
11/96	11	131.091	123.0	77.0	198.0	0.704737
12/96	10	122.3	124.5	84.0	162.0	0.131568
1/97	5	118.2	106.0	84.0	187.0	1.56838
2/97	12	165.583	107.5	82.0	400.0	1.89252
3/97	11	108.455	108.0	63.0	197.0	2.18587
4/97	5	112.0	100.0	83.0	184.0	1.80924
5/97	14	151.571	128.5	82.0	250.0	0.735207
6/97	11	131.909	119.0	89.0	220.0	2.15887
7/97	5	159.4	138.0	122.0	256.0	1.83833
8/97	10	182.5	157.0	115.0	293.0	0.904828
9/97	13	123.615	112.0	80.0	218.0	1.61417
10/97	7	132.571	102.0	77.0	215.0	0.767807
11/97	7	125.0	116.0	90.0	181.0	1.01298
12/97	17	130.647	109.0	71.0	234.0	1.43627
1/98	5	139.6	117.0	96.0	242.0	1.83124
2/98	14	117.714	110.0	71.0	163.0	0.389629
3/98	10	94.3	83.0	62.0	151.0	1.49504
4/98	5	99.6	90.0	79.0	146.0	1.74443

5/98	8	135.0	125.5	80.0	221.0	0.667224
6/98	11	117.455	103.0	82.0	207.0	2.046
7/98	11	128.091	123.0	77.0	207.0	1.24854
8/98	17	154.882	143.0	73.0	258.0	0.885034
10/98	5	160.6	122.0	117.0	224.0	0.553998
11/98	7	177.714	181.0	118.0	250.0	0.244184
12/98	11	147.727	133.0	104.0	245.0	1.32953
1/99	10	137.8	124.0	79.0	331.0	3.3001
2/99	14	179.143	163.0	92.0	410.0	2.4873
3/99	11	115.818	112.0	76.0	210.0	2.13925
4/99	14	182.929	146.5	93.0	307.0	0.943039
5/99	11	133.364	112.0	81.0	248.0	1.86848
6/99	5	157.2	117.0	103.0	233.0	0.530324
7/99	21	217.476	182.0	120.0	429.0	1.90567
8/99	9	224.889	151.0	118.0	557.0	2.39201
9/99	20	272.45	161.5	110.0	2167.0	8.04701
10/99	6	113.667	109.5	88.0	154.0	0.581729
11/99	20	149.25	122.0	78.0	445.0	4.88809
12/99	18	125.667	118.5	88.0	233.0	3.29024
1/00	12	113.333	104.5	82.0	207.0	2.75833
2/00	7	162.0	106.0	87.0	464.0	2.63907
3/00	26	146.077	99.5	60.0	749.0	8.09238
4/00	12	97.75	110.0	47.0	171.0	0.398014
5/00	27	131.519	118.0	66.0	345.0	4.31132
6/00	13	145.538	122.0	100.0	304.0	3.30414
7/00	25	127.52	120.0	64.0	217.0	0.824584
8/00	12	192.667	175.0	154.0	264.0	1.65408
9/00	20	104.65	92.0	38.0	228.0	1.82171
10/00	5	146.8	126.0	117.0	238.0	1.98992
11/00	15	144.267	117.0	81.0	296.0	2.5443
12/00	9	168.0	140.0	122.0	271.0	1.72616
1/01	14	272.929	223.5	117.0	560.0	1.00791
2/01	5	155.2	108.0	87.0	366.0	1.99874
3/01	13	172.462	137.0	76.0	448.0	2.32265
4/01	11	131.545	121.0	82.0	221.0	1.59145
5/01	15	157.467	120.0	71.0	308.0	1.48628
6/01	11	151.364	123.0	102.0	256.0	1.44244
8/01	9	180.667	146.0	138.0	257.0	0.98638
9/01	15	157.733	151.0	86.0	259.0	0.824001
10/01	20	173.8	150.5	90.0	344.0	1.89946
11/01	13	139.154	126.0	80.0	284.0	2.81747
12/01	17	159.941	140.0	82.0	354.0	2.4587
1/02	11	160.0	122.0	79.0	501.0	3.92343
2/02	16	201.5	143.0	74.0	505.0	1.99346
3/02	11	136.091	129.0	94.0	224.0	2.09058
4/02	20	160.15	131.0	84.0	334.0	2.33186
5/02	22	136.091	131.5	91.0	227.0	1.9582
6/02	20	154.9	149.5	107.0	249.0	1.7855
7/02	13	158.923	153.0	115.0	275.0	2.26683
10/02	4	139.0	137.0	89.0	193.0	0.219607
2/03	4	253.0	143.0	84.0	642.0	1.5688
3/03	16	142.938	120.0	82.0	310.0	3.15246
4/03	22	135.545	117.5	68.0	270.0	2.48727
6/03	21	163.619	146.0	87.0	344.0	3.17056
7/03	4	161.5	173.0	83.0	217.0	-0.321966
8/03	8	131.625	116.0	107.0	232.0	3.09995
9/03	5	158.2	169.0	96.0	219.0	-0.0965921
10/03	8	133.75	121.5	93.0	245.0	2.80492
11/03	5	144.6	142.0	80.0	198.0	-0.152772
12/03	8	133.375	109.5	98.0	269.0	2.80631
1/04	5	243.2	147.0	70.0	476.0	0.51748

2/04	6	117.833	115.5	103.0	136.0	0.296862
3/04	5	192.0	129.0	75.0	328.0	0.454514
4/04	8	147.75	117.0	99.0	273.0	1.64281
5/04	5	112.2	113.0	72.0	144.0	-0.694186
6/04	9	156.778	139.0	107.0	230.0	0.86312
7/04	4	105.25	93.0	64.0	171.0	0.906276
8/04	2	163.5	163.5	148.0	179.0	
9/04	1	137.0	137.0	137.0	137.0	
10/04	2	196.0	196.0	128.0	264.0	
12/04	2	169.5	169.5	111.0	228.0	
3/05	2	293.0	293.0	157.0	429.0	
4/05	1	135.0	135.0	135.0	135.0	
5/05	1	119.0	119.0	119.0	119.0	
6/05	1	254.0	254.0	254.0	254.0	
7/05	2	198.0	198.0	186.0	210.0	
9/05	2	256.0	256.0	236.0	276.0	
10/05	2	183.5	183.5	183.0	184.0	
12/05	2	283.5	283.5	127.0	440.0	
2/06	2	158.5	158.5	100.0	217.0	
4/06	4	164.5	105.0	95.0	353.0	1.62425
5/06	1	191.0	191.0	191.0	191.0	
6/06	2	189.0	189.0	134.0	244.0	
8/06	2	167.0	167.0	133.0	201.0	
4/07	4	177.5	122.5	86.0	379.0	1.55011
5/07	3	100.667	97.0	94.0	111.0	1.07586
6/07	2	205.5	205.5	128.0	283.0	
Total	2101	153.218	127.0	0.0	2167.0	159.905

Summary Statistics Monthly Averages and Medians
Data variable: DO_Probe (mg/L)

						Standardized
Collection_Date_Time	*Count*	*Average*	*Median*	*Minimum*	*Maximum*	*Skewness*
8/75	1	8.6	8.6	8.6	8.6	
3/79	1	11.8	11.8	11.8	11.8	
11/91	10	9.48	10.1	7.8	11.3	-0.289718
12/91	5	10.82	10.8	10.0	11.5	-0.557136
1/92	17	11.6059	11.8	10.0	12.7	-0.842345
2/92	10	12.78	12.85	12.2	13.3	-0.287998
3/92	5	10.36	10.4	9.8	11.0	0.38524
4/92	19	10.7158	11.0	9.4	11.9	-0.598243
5/92	4	9.325	9.65	7.9	10.1	-1.33484
6/92	5	8.16	8.4	6.8	8.8	-1.64647
7/92	14	6.58571	6.6	4.9	7.9	-0.363549
8/92	10	8.11	8.2	6.1	9.9	-0.523629
9/92	7	8.04286	8.3	6.3	10.4	0.496302
10/92	14	9.48571	9.65	6.8	11.1	-1.48463
11/92	10	10.27	10.3	9.2	11.3	-0.109051
12/92	5	11.5	11.5	10.6	12.1	-0.882762
1/93	17	11.6	11.2	9.9	14.2	1.76271
2/93	10	12.82	12.95	12.2	13.6	0.0595918
3/93	5	11.72	11.8	10.9	12.6	0.197971
4/93	14	10.7929	10.7	9.9	13.3	3.53437
5/93	9	9.46667	9.6	7.8	11.3	-0.0308459
6/93	6	8.05	8.3	7.2	8.7	-0.710466
7/93	11	6.97273	6.6	5.4	9.1	0.552937
8/93	12	6.925	6.4	4.2	9.3	0.172585
9/93	9	7.75556	7.7	7.4	8.6	2.07654
10/93	11	8.95455	9.0	7.1	11.5	0.640522
11/93	13	10.8615	11.3	8.1	13.1	-0.849303

1/94	14	13.2	13.25	12.1	14.2	-0.0628215
2/94	5	13.38	13.6	12.3	13.8	-1.87402
3/94	10	11.59	11.55	10.2	13.0	0.0362064
4/94	13	9.44615	9.6	8.0	10.3	-1.74986
5/94	10	9.12	9.25	7.1	9.9	-2.6946
6/94	6	7.2	6.85	6.0	8.6	0.520243
7/94	11	6.99091	7.2	5.1	9.1	-0.108387
8/94	8	7.525	7.4	5.7	9.2	0.0228396
9/94	4	8.65	8.5	7.7	9.9	0.372737
10/94	11	9.48182	9.7	7.4	11.6	-0.260376
11/94	10	9.06	8.85	7.1	11.7	0.511084
12/94	5	10.2	10.4	8.5	11.4	-1.01765
1/95	13	12.4462	12.4	11.1	13.9	0.17719
2/95	9	12.1333	12.1	11.8	12.8	1.38478
3/95	5	11.3	11.6	10.2	11.8	-1.66907
4/95	13	10.1692	10.2	8.9	11.1	-0.41112
5/95	11	8.71818	8.3	7.3	10.3	0.511027
6/95	4	8.5	8.65	7.0	9.7	-0.62348
7/95	13	6.80769	6.7	5.3	8.5	0.397847
8/95	12	7.09167	6.95	5.4	8.8	0.274373
9/95	7	8.0	8.1	6.4	8.9	-1.67266
10/95	12	8.33333	8.2	7.3	9.9	1.02852
11/95	5	12.68	12.4	12.3	13.9	1.96861
12/95	5	12.24	12.3	10.6	13.3	-1.01145
1/96	6	13.3667	13.55	12.3	14.2	-0.60964
2/96	11	13.7818	13.6	12.2	15.0	-0.275021
3/96	10	12.73	12.65	12.0	13.6	0.403168
4/96	13	10.8308	12.0	6.2	12.8	-1.7391
5/96	9	10.3333	10.4	9.5	10.9	-1.59707
6/96	5	9.02	9.1	7.9	9.8	-1.01614
7/96	13	7.38462	7.5	5.2	8.8	-1.77863
8/96	11	8.60909	8.7	7.6	9.9	0.327066
9/96	6	8.88333	9.05	7.7	9.5	-1.70146
10/96	3	9.1	9.6	7.8	9.9	-1.12932
11/96	11	12.6455	12.9	11.5	13.3	-1.49527
12/96	10	11.85	11.85	11.1	12.5	-0.428482
1/97	5	11.74	11.9	10.7	12.6	-0.52849
2/97	14	11.8214	12.0	11.0	12.9	-0.0268298
3/97	11	12.0273	11.5	10.7	13.8	0.464193
4/97	5	9.02	9.2	8.2	9.7	-0.470354
5/97	9	8.05556	8.0	6.9	9.2	-0.00472205
6/97	11	9.66364	9.7	8.0	10.6	-2.13938
7/97	5	9.06	9.0	7.0	11.3	0.228073
8/97	10	7.17	7.4	5.2	9.0	-0.4736
9/97	13	7.94615	8.1	6.2	8.6	-2.29192
10/97	7	8.87143	8.8	7.4	11.3	1.25407
11/97	7	11.4143	11.5	10.5	12.0	-1.04221
12/97	16	13.1375	13.2	10.6	14.3	-1.92813
1/98	5	12.0	12.2	10.7	13.0	-0.73608
2/98	12	11.8333	11.75	10.4	13.3	0.30958
3/98	10	11.75	11.7	10.3	13.0	-0.0482633
4/98	5	9.2	9.2	8.5	10.0	0.384574
5/98	8	9.6625	9.75	7.8	10.7	-1.33093
6/98	11	9.06364	9.2	7.9	10.1	-0.243247
7/98	11	7.74545	8.0	6.5	8.6	-1.29788
8/98	17	6.39412	6.5	3.9	8.7	-0.371477
9/98	2	7.4	7.4	7.3	7.5	
10/98	5	8.02	8.2	6.7	8.7	-1.30557
11/98	7	8.88571	8.1	6.3	12.0	0.429193
12/98	10	11.94	11.7	10.6	14.5	1.58445
1/99	34	13.1176	13.1	12.5	13.9	0.413136

2/99	44	12.9091	12.7	11.8	15.5	1.74985
3/99	28	13.7643	13.8	12.9	14.8	0.302519
4/99	58	10.2793	10.1	8.7	12.5	1.65572
5/99	56	9.38929	9.4	8.3	10.6	0.322821
6/99	26	7.06923	7.5	5.5	8.2	-1.27897
7/99	105	7.11905	6.7	5.1	10.3	3.88614
8/99	41	7.48293	7.2	4.8	11.2	2.14014
9/99	80	7.80625	7.9	5.3	11.0	-0.167103
10/99	45	10.4022	10.1	9.6	12.2	3.80282
11/99	98	11.1071	10.8	9.2	14.4	2.81899
12/99	53	13.017	12.6	10.8	18.1	3.98561
1/00	24	14.3875	14.3	13.3	16.4	1.291
2/00	23	13.7696	13.9	13.3	14.8	1.66018
3/00	130	11.3577	11.2	8.0	14.3	-0.436532
4/00	55	9.92873	9.9	8.6	11.5	1.56868
5/00	135	8.49444	8.3	6.0	11.2	2.62326
6/00	59	7.0839	7.3	5.8	7.87	-1.68865
7/00	125	7.0728	7.23	5.16	8.6	-1.33695
8/00	60	6.87833	6.62	5.92	8.56	2.9903
9/00	100	5.9675	5.975	5.07	6.86	-0.928633
10/00	17	5.63	5.78	4.65	5.98	-2.29647
11/00	40	8.895	7.15	5.82	13.01	1.35955
12/00	24	13.4175	13.3	13.11	13.88	1.0515
3/01	61	11.5226	11.49	10.71	14.43	5.21347
4/01	50	11.647	11.79	9.71	14.91	0.455268
5/01	70	9.91214	9.735	8.97	12.24	3.70212
6/01	55	7.88273	7.54	6.44	9.82	1.05908
8/01	45	8.00556	7.78	6.41	9.98	0.675552
9/01	74	7.86676	7.96	5.99	9.76	-0.206479
10/01	114	9.13561	9.48	3.13	11.12	-4.33174
11/01	78	11.4546	12.49	7.92	13.87	-2.15889
12/01	108	11.0878	11.17	7.98	13.56	-2.64265
1/02	66	12.2564	12.67	10.43	13.24	-2.49119
2/02	80	12.9323	12.98	11.03	14.56	-1.7869
3/02	66	10.9691	11.03	10.01	12.04	0.583799
4/02	119	10.4067	10.68	7.27	12.5	-3.12963
5/02	130	8.85785	8.79	8.02	10.12	2.97479
6/02	109	7.54358	7.41	4.84	9.44	2.55985
7/02	73	6.66507	6.45	4.99	8.21	2.91587
10/02	22	9.79636	9.75	9.64	10.07	1.41904
2/03	22	11.7645	11.33	10.69	13.69	1.85526
3/03	94	12.5732	13.22	8.93	14.06	-5.69334
4/03	120	11.1231	11.41	8.16	15.74	0.136214
5/03	11	11.1136	10.47	9.94	13.66	1.82196
6/03	119	8.53933	8.38	4.72	9.96	-4.79285
7/03	33	8.35061	8.48	5.73	9.35	-4.44515
8/03	30	8.003	7.9	7.6	8.56	1.56617
9/03	29	8.27828	8.27	7.23	9.54	0.849681
10/03	30	10.67	10.595	9.8	11.54	0.240417
11/03	15	11.232	11.27	10.46	12.13	0.250806
12/03	16	13.835	14.23	11.14	15.51	-1.78845
1/04	7	15.0271	15.05	14.22	16.73	1.10997
2/04	18	13.9139	13.865	13.44	14.52	0.550192
3/04	15	12.552	12.69	11.3	13.41	-1.43389
4/04	24	11.0037	11.06	9.95	12.05	-0.269262
5/04	18	9.47833	9.435	8.51	10.27	-0.0754824
6/04	54	8.35944	8.11	5.48	11.9	1.37337
7/04	55	7.42509	7.08	4.58	10.27	2.03116
8/04	33	7.41727	7.44	6.16	8.81	0.219718
9/04	53	8.00698	7.65	6.47	10.17	1.41566
10/04	34	10.3774	10.55	9.12	11.4	-1.17298

11/04	27	12.3233	13.33	8.79	13.69	-2.89204
12/04	40	12.576	12.01	10.42	15.4	1.01484
1/05	28	12.2789	12.03	10.88	14.9	2.58245
2/05	14	13.6336	13.635	12.2	15.07	0.0125559
3/05	49	12.9298	13.76	8.04	16.03	-3.61716
4/05	35	11.4294	11.3	9.16	16.6	2.20931
5/05	33	10.0873	9.99	8.9	12.3	3.14387
6/05	40	9.266	9.43	7.39	11.01	-1.5929
7/05	61	8.0159	7.92	5.12	10.14	-1.78669
8/05	9	7.80667	7.71	7.4	8.31	0.545004
9/05	54	8.52944	8.295	6.76	12.38	4.0074
10/05	18	11.8283	11.855	11.13	12.96	1.05596
11/05	32	10.9937	10.78	9.47	13.51	1.15976
12/05	6	15.04	15.11	14.29	15.89	0.0131321
1/06	54	12.5317	12.92	9.09	14.05	-3.68401
2/06	8	12.9325	14.245	9.92	15.08	-0.620961
3/06	38	12.6263	12.8	9.8	17.4	0.581189
4/06	26	11.5808	11.35	10.6	13.7	2.38896
5/06	59	9.66949	9.9	6.6	12.6	-0.669085
6/06	32	7.79062	7.95	6.0	9.2	-1.04981
7/06	55	7.61091	7.6	5.7	10.0	0.718068
8/06	44	7.22955	7.0	4.7	9.9	0.970097
9/06	31	9.14516	8.8	8.2	11.0	3.04216
10/06	21	10.2952	10.4	8.7	13.5	2.0126
11/06	43	12.107	12.2	10.6	14.1	0.730757
12/06	10	14.13	13.5	12.9	16.5	1.14426
1/07	19	12.9474	12.1	10.1	16.6	0.208326
2/07	19	13.9158	14.0	13.2	15.1	1.00845
3/07	29	13.1172	12.8	12.2	14.4	0.495297
4/07	35	12.3743	12.3	10.9	15.0	1.02016
5/07	58	9.97069	10.35	6.7	12.6	-1.97856
6/07	29	7.93448	8.2	3.2	9.8	-3.99097
Total	5460	9.8566	9.82	3.13	18.1	4.0349

Summary Statistics Monthly averages and medians
Data variable: Phos_P (mg/L)

						Standardized
Phos_P_dte	*Count*	*Average*	*Median*	*Minimum*	*Maximum*	*Skewness*
7/79	9	0.0611111	0.05	0.05	0.1	1.9839
8/79	15	0.123333	0.1	0.05	0.4	3.189
9/79	3	0.05	0.05	0.05	0.05	-1.73205
10/79	9	0.127778	0.1	0.05	0.3	1.31085
11/79	9	0.1	0.1	0.05	0.2	1.81827
12/79	9	0.0555556	0.05	0.05	0.1	3.67423
1/80	10	0.095	0.1	0.05	0.2	1.8911
2/80	9	0.0211111	0.01	0.005	0.05	1.00943
3/80	11	0.0681818	0.05	0.05	0.1	0.894575
4/80	9	0.144444	0.1	0.05	0.4	2.20338
5/80	9	0.116667	0.1	0.05	0.2	1.31223
6/80	9	0.122222	0.1	0.05	0.3	1.33495
7/80	4	0.075	0.075	0.05	0.1	-1.22663E-15
8/80	4	0.0625	0.05	0.05	0.1	1.63299
11/80	9	0.0888889	0.05	0.05	0.3	3.22515
12/80	9	0.0888889	0.05	0.05	0.2	1.70768
1/81	2	0.05	0.05	0.05	0.05	
2/81	9	0.6	0.7	0.1	1.5	0.844929
3/81	9	0.0777778	0.05	0.05	0.2	2.59807
4/81	9	0.0666667	0.05	0.05	0.1	1.04978
5/81	9	0.0722222	0.05	0.05	0.1	0.33197
6/81	9	0.144444	0.1	0.05	0.4	2.20338

7/81	8	0.075	0.075	0.05	0.1	-1.17107E-15
8/81	9	0.0944444	0.1	0.05	0.2	1.80031
9/81	9	0.116667	0.1	0.05	0.3	2.01422
10/81	9	0.0777778	0.05	0.05	0.2	2.59807
11/81	9	0.0888889	0.1	0.05	0.2	1.95922
12/81	9	0.116667	0.05	0.05	0.3	1.78704
1/82	9	0.194444	0.2	0.05	0.5	1.1544
2/82	9	0.238889	0.3	0.05	0.5	0.41612
3/82	9	0.0722222	0.05	0.05	0.1	0.33197
4/82	9	0.05	0.05	0.05	0.05	1.48461
5/82	9	0.0722222	0.05	0.05	0.1	0.33197
6/82	9	0.166667	0.2	0.1	0.2	-1.04978
7/82	9	0.0555556	0.05	0.05	0.1	3.67423
9/82	9	0.15	0.2	0.05	0.2	-0.642857
10/82	9	0.156667	0.1	0.05	0.3	0.732691
11/82	9	0.0666667	0.05	0.05	0.15	2.59808
12/82	9	0.0888889	0.05	0.05	0.2	1.70768
1/83	3	0.05	0.05	0.05	0.05	-1.73205
2/83	9	0.0777778	0.05	0.05	0.2	2.59807
3/83	9	0.242222	0.3	0.05	0.35	-0.980008
4/83	9	0.05	0.05	0.05	0.05	1.48461
5/83	9	0.0611111	0.05	0.05	0.1	1.9839
6/83	9	0.216667	0.2	0.05	0.5	1.03356
7/83	9	0.116667	0.1	0.05	0.2	0.566829
8/83	9	0.144444	0.1	0.05	0.6	3.20246
9/83	9	0.188889	0.05	0.05	0.85	2.98445
10/83	9	0.166667	0.1	0.05	0.3	0.468997
11/83	9	0.0922222	0.1	0.03	0.15	0.186674
12/83	9	0.137778	0.13	0.1	0.2	1.27359
1/84	1	0.05	0.05	0.05	0.05	
2/84	9	0.102222	0.1	0.05	0.16	0.469079
3/84	9	0.0722222	0.05	0.05	0.2	3.06918
4/84	9	0.05	0.05	0.05	0.05	1.48461
5/84	9	0.0611111	0.05	0.05	0.1	1.9839
6/84	8	0.09375	0.05	0.05	0.2	1.39699
7/84	9	0.108889	0.1	0.05	0.3	2.72596
8/84	8	0.14375	0.1	0.05	0.6	3.14999
9/84	9	0.133333	0.05	0.05	0.5	2.83913
10/84	8	0.14375	0.075	0.05	0.5	2.50335
1/85	7	0.0928571	0.1	0.05	0.2	1.64184
2/85	9	0.155556	0.2	0.1	0.2	-0.33197
3/85	9	0.0611111	0.05	0.05	0.1	1.9839
5/85	2	0.15	0.15	0.1	0.2	
6/85	7	0.228571	0.2	0.2	0.3	1.32816
7/85	9	0.327778	0.05	0.05	1.8	3.20304
9/85	9	0.355556	0.1	0.05	2.0	3.08214
10/85	9	0.263333	0.3	0.1	0.6	1.25798
11/85	7	0.0928571	0.05	0.05	0.3	2.64267
12/85	9	0.05	0.05	0.05	0.05	1.48461
1/86	9	0.1	0.05	0.05	0.3	2.21727
2/86	6	0.0833333	0.05	0.05	0.2	1.95171
3/86	9	0.0611111	0.05	0.05	0.1	1.9839
4/86	9	0.05	0.05	0.05	0.05	1.48461
5/86	9	0.122222	0.2	0.02	0.2	-0.33854
6/86	7	0.1	0.1	0.1	0.1	1.4
7/86	9	0.206667	0.2	0.05	0.7	2.62794
8/86	4	0.0875	0.06	0.03	0.2	1.10306
9/86	9	0.134444	0.2	0.01	0.3	0.0523295
10/86	9	0.167778	0.1	0.05	0.5	2.1288
11/86	1	0.1	0.1	0.1	0.1	
12/86	1	0.1	0.1	0.1	0.1	

1/87	1	0.1	0.1	0.1	0.1	
2/87	1	0.05	0.05	0.05	0.05	
3/87	1	0.05	0.05	0.05	0.05	
4/87	9	0.155556	0.2	0.1	0.2	-0.33197
5/87	9	0.0611111	0.05	0.05	0.1	1.9839
6/87	9	0.111111	0.1	0.1	0.2	3.67423
7/87	8	0.11875	0.1	0.05	0.2	1.0541
8/87	8	0.1125	0.1	0.1	0.2	3.26599
9/87	8	0.10625	0.1	0.05	0.2	1.0116
10/87	8	0.075	0.05	0.05	0.2	2.70031
11/87	8	0.05625	0.05	0.05	0.1	3.26599
12/87	8	0.1125	0.1	0.1	0.2	3.26599
1/88	5	0.05	0.05	0.05	0.05	
2/88	6	0.0833333	0.1	0.05	0.1	-0.968246
3/88	7	0.107143	0.1	0.05	0.2	0.86212
4/88	8	0.1	0.1	0.1	0.1	1.44016
5/88	7	0.178571	0.1	0.05	0.4	1.07465
6/88	8	0.1125	0.1	0.1	0.2	3.26599
7/88	8	0.1125	0.1	0.1	0.2	3.26599
8/88	8	0.14375	0.1	0.05	0.3	1.19683
9/88	8	0.1	0.1	0.1	0.1	1.44016
10/88	8	0.0875	0.075	0.05	0.2	1.93361
11/88	8	0.11875	0.1	0.05	0.2	1.0541
1/89	1	0.05	0.05	0.05	0.05	
2/89	7	0.0928571	0.1	0.05	0.1	-2.85774
3/89	8	0.08125	0.1	0.05	0.1	-0.743698
4/89	8	0.0825	0.1	0.05	0.11	-0.669565
5/89	8	0.20625	0.15	0.05	0.5	1.22121
6/89	7	0.107143	0.05	0.05	0.35	2.59523
7/89	7	0.0857143	0.1	0.05	0.1	-1.32816
8/89	8	0.10625	0.1	0.05	0.2	1.95132
9/89	7	0.114286	0.05	0.05	0.3	1.55983
10/89	7	0.0857143	0.05	0.05	0.2	1.92652
11/89	7	0.0928571	0.1	0.05	0.2	1.64184
12/89	6	0.0833333	0.05	0.05	0.2	1.95171
1/90	7	0.0928571	0.1	0.05	0.1	-2.85774
2/90	7	0.0714286	0.05	0.05	0.2	2.85774
3/90	7	0.0714286	0.05	0.05	0.1	0.404145
4/90	5	0.24	0.2	0.1	0.5	0.993671
5/90	7	0.15	0.1	0.05	0.4	2.12992
6/90	7	0.0928571	0.1	0.05	0.1	-2.85774
7/90	7	0.114286	0.1	0.1	0.2	2.85774
8/90	7	0.0864286	0.05	0.005	0.2	1.10989
9/90	11	0.140909	0.1	0.05	0.5	3.03366
10/90	8	0.08125	0.1	0.05	0.1	-0.743698
11/90	4	0.0625	0.05	0.05	0.1	1.63299
12/90	3	0.05	0.05	0.05	0.05	-1.73205
1/91	14	0.0857143	0.05	0.05	0.2	2.36313
2/91	4	0.1	0.1	0.1	0.1	
3/91	4	0.05	0.05	0.05	0.05	
4/91	11	0.0545455	0.05	0.05	0.1	4.49073
5/91	8	0.0875	0.075	0.05	0.2	1.93361
6/91	5	0.12	0.1	0.05	0.3	1.75066
7/91	10	0.175	0.075	0.05	0.8	3.01428
8/91	5	0.18	0.1	0.05	0.6	1.98426
9/91	4	0.1875	0.2	0.05	0.3	-0.100993
10/91	7	0.178571	0.1	0.05	0.6	2.55352
11/91	8	0.1	0.075	0.05	0.3	2.73252
12/91	5	0.18	0.1	0.1	0.4	1.56502
1/92	14	0.1	0.1	0.05	0.2	2.6232
2/92	10	0.065	0.05	0.05	0.1	1.33631

3/92	5	0.05	0.05	0.05	0.05	
4/92	16	0.0875	0.1	0.05	0.1	-2.08656
5/92	4	0.1125	0.1	0.05	0.2	0.922101
6/92	5	0.19	0.05	0.05	0.5	1.02061
7/92	12	0.1625	0.1	0.05	0.9	4.66177
8/92	9	0.0777778	0.1	0.05	0.1	-0.33197
9/92	5	0.1	0.05	0.05	0.3	2.04124
10/92	12	0.0958333	0.05	0.05	0.5	4.7118
11/92	8	0.0875	0.1	0.05	0.1	-1.66296
12/92	5	0.05	0.05	0.05	0.05	
1/93	14	0.0678571	0.05	0.05	0.1	1.02399
2/93	4	0.05	0.05	0.05	0.05	
3/93	5	0.05	0.05	0.05	0.05	
4/93	12	0.0666667	0.05	0.05	0.1	1.14891
5/93	8	0.069375	0.05	0.005	0.2	2.13828
6/93	6	0.05	0.05	0.05	0.05	1.36931
7/93	11	0.168182	0.05	0.05	1.2	4.45447
8/93	11	0.113636	0.05	0.05	0.4	2.65526
10/93	10	0.18	0.1	0.05	0.6	2.23229
11/93	11	0.0636364	0.05	0.05	0.2	4.49073
1/94	10	0.185	0.15	0.05	0.4	1.37982
2/94	5	0.05	0.05	0.05	0.05	
3/94	9	0.0555556	0.05	0.05	0.1	3.67423
4/94	11	0.0727273	0.05	0.05	0.2	3.2611
5/94	9	0.05	0.05	0.05	0.05	1.48461
6/94	6	0.075	0.075	0.05	0.1	1.18768E-15
7/94	10	0.24	0.1	0.05	1.6	4.01481
8/94	6	0.0833333	0.075	0.05	0.15	0.857321
9/94	4	0.075	0.075	0.05	0.1	-1.22663E-15
10/94	11	0.177273	0.05	0.05	1.3	4.38035
11/94	9	0.138889	0.1	0.05	0.3	1.50057
12/94	5	0.05	0.05	0.05	0.05	
1/95	11	0.0909091	0.05	0.05	0.2	1.81913
2/95	8	0.05	0.05	0.05	0.05	1.44016
3/95	5	0.05	0.05	0.05	0.05	
4/95	11	0.0636364	0.05	0.05	0.1	1.61042
5/95	10	0.11	0.1	0.1	0.2	4.08248
6/95	4	0.1	0.1	0.1	0.1	
7/95	11	0.122727	0.1	0.05	0.2	1.09311
8/95	11	0.109091	0.1	0.05	0.2	1.51812
9/95	5	0.1	0.1	0.1	0.1	
10/95	11	0.0727273	0.05	0.05	0.3	4.49073
11/95	4	0.05	0.05	0.05	0.05	
12/95	5	0.05	0.05	0.05	0.05	
1/96	5	0.05	0.05	0.05	0.05	
2/96	10	0.055	0.05	0.05	0.1	4.08248
3/96	9	0.05	0.05	0.05	0.05	1.48461
4/96	11	0.0590909	0.05	0.05	0.1	2.60337
5/96	8	0.05	0.05	0.05	0.05	1.44016
6/96	5	0.06	0.05	0.05	0.1	2.04124
7/96	11	0.0636364	0.05	0.05	0.1	1.61042
8/96	10	0.13	0.05	0.05	0.4	1.8953
9/96	6	0.0916667	0.1	0.05	0.1	-2.44949
10/96	2	0.05	0.05	0.05	0.05	
11/96	10	0.05	0.05	0.05	0.05	1.53093
12/96	9	0.116667	0.05	0.05	0.2	0.33197
1/97	5	0.1	0.1	0.05	0.2	1.24226
2/97	12	0.0708333	0.05	0.05	0.1	0.549285
3/97	10	0.05	0.05	0.05	0.05	1.53093
4/97	5	0.1	0.1	0.1	0.1	
5/97	12	0.0625	0.05	0.05	0.1	1.87617

6/97	10	0.06	0.05	0.05	0.1	2.2964
7/97	5	0.08	0.1	0.05	0.1	-0.555556
8/97	9	0.0666667	0.05	0.05	0.1	1.04978
9/97	9	0.0888889	0.1	0.05	0.2	1.95922
10/97	7	0.0857143	0.1	0.05	0.1	-1.32816
11/97	6	0.0583333	0.05	0.05	0.1	2.44949
12/97	15	0.0666667	0.05	0.05	0.1	1.2463
1/98	5	0.07	0.05	0.05	0.1	0.555556
2/98	12	0.175	0.1	0.05	1.2	4.84997
3/98	9	0.0888889	0.1	0.05	0.1	-1.9839
4/98	5	0.1	0.1	0.1	0.1	
5/98	6	0.1	0.1	0.1	0.1	1.36931
6/98	10	0.11	0.1	0.1	0.2	4.08248
7/98	10	0.1	0.1	0.05	0.2	1.97642
8/98	14	0.0928571	0.1	0.05	0.1	-3.5054
10/98	5	0.05	0.05	0.05	0.05	
11/98	6	0.075	0.075	0.05	0.1	-1.18768E-15
12/98	10	0.06	0.05	0.05	0.1	2.2964
1/99	9	0.2	0.2	0.1	0.3	-2.89732E-15
2/99	12	0.0875	0.1	0.05	0.2	2.22681
3/99	10	0.05	0.05	0.05	0.05	1.53093
4/99	12	0.0708333	0.05	0.05	0.2	3.59073
5/99	10	0.065	0.05	0.05	0.2	4.08248
6/99	5	0.05	0.05	0.05	0.05	
7/99	13	0.0730769	0.06	0.03	0.25	4.28473
8/99	6	0.0616667	0.05	0.04	0.1	1.14753
9/99	12	0.1525	0.06	0.03	1.05	4.76629
10/99	10	0.04	0.04	0.01	0.11	1.93965
11/99	14	0.186429	0.04	0.03	1.99	5.68636
12/99	11	0.0218182	0.02	0.01	0.03	-0.0374228
1/00	4	0.03	0.025	0.02	0.05	1.1547
2/00	2	0.71	0.71	0.02	1.4	
3/00	17	0.252353	0.04	0.02	3.6	6.93124
4/00	6	0.0233333	0.02	0.01	0.04	0.665669
5/00	18	0.065	0.04	0.02	0.22	3.11827
6/00	6	0.0683333	0.065	0.05	0.1	0.505524
7/00	16	0.045	0.05	0.03	0.07	0.484873
8/00	6	0.0666667	0.06	0.04	0.1	0.455086
9/00	17	0.0882353	0.05	0.02	0.43	4.44223
10/00	5	0.032	0.03	0.01	0.05	-0.503556
11/00	13	0.0344615	0.02	0.01	0.2	5.07525
12/00	9	0.0116667	0.01	0.005	0.03	2.01422
1/01	14	0.200714	0.1	0.02	1.1	4.11097
2/01	5	0.034	0.04	0.02	0.04	-1.1482
3/01	11	0.0390909	0.03	0.02	0.13	3.99043
4/01	10	0.036	0.03	0.01	0.07	0.963772
5/01	13	0.0438462	0.03	0.02	0.14	4.42739
6/01	11	0.0472727	0.05	0.04	0.07	2.21765
8/01	1	0.04	0.04	0.04	0.04	
9/01	10	0.126	0.075	0.03	0.3	0.930481
10/01	8	0.05375	0.03	0.02	0.21	2.90268
11/01	8	0.0475	0.02	0.01	0.24	3.20505
12/01	8	0.0725	0.04	0.01	0.33	3.11716
1/02	8	0.05375	0.03	0.01	0.25	3.18213
2/02	9	0.0522222	0.02	0.005	0.25	2.99898
3/02	8	0.04625	0.035	0.01	0.11	1.28645
4/02	9	0.04	0.03	0.01	0.17	3.39541
5/02	15	0.054	0.04	0.01	0.12	0.901467
6/02	8	0.06375	0.06	0.02	0.13	1.23863
7/02	8	0.07125	0.055	0.02	0.22	2.58403
10/02	3	0.0366667	0.03	0.02	0.06	0.914531

2/03	3	0.03	0.03	0.02	0.04	-1.12302E-15
3/03	10	0.038	0.035	0.02	0.06	0.263495
4/03	12	0.105833	0.025	0.01	0.52	2.89374
6/03	12	0.0708333	0.06	0.03	0.18	2.28398
7/03	6	0.0483333	0.05	0.03	0.06	-0.667628
8/03	7	0.0485714	0.05	0.03	0.07	0.0761851
9/03	6	0.0933333	0.045	0.01	0.36	2.26828
10/03	7	0.03	0.03	0.01	0.06	0.496951
11/03	5	0.038	0.04	0.02	0.07	0.933293
12/03	7	0.0271429	0.03	0.02	0.04	0.642991
1/04	5	0.022	0.02	0.02	0.03	2.04124
2/04	5	0.034	0.03	0.02	0.06	0.993671
3/04	5	0.02	0.02	0.01	0.03	-6.83447E-16
4/04	7	0.0257143	0.02	0.01	0.04	0.254021
5/04	3	0.0433333	0.04	0.04	0.05	1.22474
6/04	10	0.054	0.05	0.04	0.11	3.10851
7/04	6	0.0466667	0.04	0.01	0.09	0.392301
8/04	8	0.0625	0.05	0.04	0.13	2.36273
9/04	7	0.0542857	0.05	0.04	0.07	0.298835
10/04	9	0.0511111	0.05	0.02	0.12	2.07221
11/04	3	0.0366667	0.04	0.03	0.04	-1.22474
12/04	8	0.03125	0.02	0.02	0.07	1.89304
1/05	6	0.0433333	0.04	0.02	0.07	0.254274
2/05	1	0.03	0.03	0.03	0.03	
3/05	13	0.0253846	0.02	0.01	0.05	1.73375
4/05	1	0.06	0.06	0.06	0.06	
5/05	2	0.055	0.055	0.04	0.07	
6/05	3	0.0533333	0.05	0.05	0.06	1.22474
7/05	13	0.0661538	0.05	0.03	0.13	1.0448
8/05	2	0.045	0.045	0.04	0.05	
9/05	13	0.0453846	0.04	0.02	0.11	2.83208
10/05	5	0.042	0.04	0.03	0.05	-0.46761
11/05	8	0.035	0.025	0.02	0.09	2.33457
12/05	3	0.02	0.02	0.02	0.02	
1/06	9	0.0655556	0.06	0.03	0.15	1.7132
2/06	3	0.0166667	0.02	0.01	0.02	-1.22474
3/06	8	0.025	0.025	0.02	0.03	-1.52483E-15
4/06	3	0.0266667	0.02	0.02	0.04	1.22474
5/06	8	0.05125	0.045	0.02	0.1	0.944568
6/06	3	0.04	0.04	0.04	0.04	
7/06	7	0.0557143	0.05	0.03	0.09	0.680441
8/06	3	0.04	0.04	0.03	0.05	0.0
9/06	1	0.04	0.04	0.04	0.04	
10/06	1	0.04	0.04	0.04	0.04	
11/06	4	0.04	0.035	0.03	0.06	1.1547
12/06	3	0.0466667	0.04	0.02	0.08	0.6613
1/07	6	0.0233333	0.02	0.01	0.04	0.665669
2/07	1	0.03	0.03	0.03	0.03	
3/07	6	0.02	0.02	0.01	0.03	-5.32694E-16
4/07	8	0.02625	0.025	0.02	0.04	0.951206
5/07	7	0.03	0.03	0.02	0.04	1.38657E-15
6/07	8	0.05625	0.05	0.03	0.13	2.28722
Total	2482	0.0950657	0.05	0.005	3.6	215.094

Summary Statistics Monthly averages and medians
Data variable: Nitrogen_N (mg/L)

						Standardized
Nitrogen_N_dte	*Count*	*Average*	*Median*	*Minimum*	*Maximum*	*Skewness*
7/03	5	1.266	1.42	0.75	1.52	-1.40866
8/03	6	1.26667	0.99	0.59	3.21	2.23276

9/03	6	1.51167	1.57	0.71	2.08	-0.569442
10/03	6	0.96	1.055	0.45	1.22	-1.16648
11/03	5	1.262	1.39	0.76	1.56	-0.719547
12/03	6	1.35333	1.46	0.64	1.99	-0.331125
1/04	5	1.918	1.8	1.12	3.01	0.919271
2/04	5	1.474	1.61	0.93	1.77	-1.42429
3/04	5	1.152	1.04	0.83	1.69	1.15344
4/04	6	1.0	0.96	0.44	1.51	-0.0190248
5/04	3	1.14333	1.21	0.92	1.3	-0.947853
6/04	9	1.27222	1.31	0.66	1.66	-1.05025
7/04	6	1.295	1.24	0.48	2.54	1.04732
8/04	7	0.955714	0.98	0.64	1.33	0.316311
9/04	8	1.12375	0.875	0.63	2.83	2.62196
10/04	8	1.26125	1.3	0.4	1.59	-2.28046
11/04	3	1.05	0.69	0.51	1.95	1.15263
12/04	7	1.28857	1.33	0.63	1.79	-0.440757
1/05	6	1.98167	2.1	1.17	2.43	-1.29453
2/05	1	1.76	1.76	1.76	1.76	
3/05	12	1.20833	1.225	0.7	1.88	0.275952
4/05	1	1.65	1.65	1.65	1.65	
5/05	2	1.245	1.245	1.18	1.31	
6/05	3	1.14	1.06	1.02	1.34	1.15263
7/05	12	1.195	1.16	0.74	1.8	0.877924
8/05	2	0.86	0.86	0.76	0.96	
9/05	12	0.983333	0.705	0.6	2.14	2.22164
10/05	4	1.3025	1.335	1.05	1.49	-0.672642
11/05	8	1.36375	1.155	0.65	2.13	0.425014
12/05	3	0.96	0.88	0.64	1.36	0.6613
1/06	9	1.5	1.44	1.14	1.92	0.402486
2/06	3	0.86	0.68	0.68	1.22	1.22474
3/06	8	1.40375	1.365	0.97	1.99	0.756346
4/06	3	0.636667	0.72	0.28	0.91	-0.765972
5/06	8	1.24125	1.17	0.67	2.0	0.518674
6/06	2	0.76	0.76	0.74	0.78	
7/06	7	1.15	1.0	0.73	1.87	1.2199
8/06	3	0.696667	0.75	0.54	0.8	-1.04626
9/06	1	0.97	0.97	0.97	0.97	
10/06	1	0.36	0.36	0.36	0.36	
11/06	4	1.415	1.4	1.02	1.84	0.142789
12/06	3	1.53667	1.22	1.11	2.28	1.18493
1/07	6	1.475	1.27	0.91	2.74	1.97619
3/07	6	1.35667	1.31	0.81	1.97	0.324192
4/07	6	0.853333	0.74	0.22	1.82	0.793199
5/07	7	1.03143	0.89	0.69	1.77	1.56919
6/07	6	1.13333	1.06	0.6	2.14	1.56512
Total	255	1.22984	1.18	0.22	3.21	5.56736

Summary Statistics Monthly Averages and Medians
Data variable: Turbidity (NTU)

						Standardized
Turb_dte	*Count*	*Average*	*Median*	*Minimum*	*Maximum*	*Skewness*
7/94	11	22.6982	8.7	0.98	92.0	2.41167
8/94	6	7.38333	6.8	3.7	12.0	0.398896
9/94	4	4.325	4.2	1.4	7.5	0.145094
10/94	12	3.83333	3.1	1.47	10.6	2.26877
11/94	9	11.3778	4.2	1.3	66.0	3.61183
12/94	5	16.9	12.0	2.4	49.0	1.6016
1/95	12	11.3417	10.45	2.0	32.0	1.89033
2/95	8	9.975	7.4	3.9	26.0	2.03985
3/95	5	18.0	14.9	5.2	42.0	1.57942

4/95	12	5.775	5.9	2.6	8.4	-0.103537
5/95	10	12.97	7.2	2.4	47.0	2.44036
6/95	4	17.2	18.1	8.6	24.0	-0.141157
7/95	12	28.4917	9.3	4.1	155.0	3.55288
8/95	11	7.79091	7.6	5.1	12.0	0.660317
9/95	5	4.98	3.9	2.5	10.3	1.54298
10/95	11	24.7427	3.56	1.37	235.0	4.48161
11/95	4	4.245	3.625	3.06	6.67	1.47859
12/95	5	6.74	4.2	3.1	13.0	0.747879
1/96	5	8.12	8.4	4.6	12.0	0.173524
2/96	11	6.82727	5.9	4.9	13.0	2.85297
3/96	9	5.57778	4.8	3.0	9.7	1.20445
4/96	12	14.7083	10.0	2.9	54.0	2.94952
5/96	8	19.6125	13.15	9.7	47.0	1.78006
6/96	5	11.4	10.9	5.7	18.7	0.725795
7/96	12	9.09167	8.2	3.9	26.0	3.43969
8/96	10	45.24	19.6	4.7	155.0	1.64066
9/96	6	9.31667	8.55	5.3	14.9	0.613963
10/96	2	3.75	3.75	2.8	4.7	
11/96	11	7.44545	6.4	3.8	25.7	4.05963
12/96	9	18.9	14.7	4.3	38.0	0.418437
1/97	5	9.08	4.8	2.9	21.0	0.971256
2/97	13	6.86923	5.9	3.3	13.3	1.40494
3/97	10	9.46	8.55	5.5	14.7	0.672298
4/97	5	5.32	3.6	2.6	10.2	0.948977
5/97	13	6.8	5.2	3.5	23.0	4.54138
6/97	10	13.85	12.6	4.5	26.0	0.367932
7/97	5	6.94	4.7	4.1	14.5	1.64311
8/97	10	8.64	6.55	3.8	27.0	3.14835
9/97	9	13.2778	8.5	2.0	28.0	0.356512
10/97	7	6.41429	5.1	1.5	21.4	2.37609
11/97	6	9.31667	8.6	4.7	17.4	1.08454
12/97	16	5.675	6.2	1.8	11.0	0.647921
1/98	5	11.04	11.8	6.2	14.6	-0.670155
2/98	13	24.6692	21.0	2.4	68.0	1.96388
3/98	9	14.7333	4.3	3.0	55.0	2.01181
4/98	5	6.26	6.0	4.5	9.1	1.23416
5/98	7	6.37857	6.3	2.24	12.3	0.663357
6/98	10	4.016	4.12	1.61	8.18	0.961509
7/98	10	4.69	5.14	1.26	7.97	-0.125705
8/98	15	7.46667	6.29	2.87	21.7	3.05497
10/98	5	2.372	1.46	1.15	5.19	1.54327
11/98	6	2.035	1.95	1.26	3.59	1.53358
12/98	11	3.39727	3.25	1.31	7.67	1.16737
1/99	9	12.9144	13.8	4.31	24.6	0.321447
2/99	13	31.0269	17.2	2.47	94.2	1.45017
3/99	10	6.613	4.545	2.37	23.5	3.21516
4/99	13	9.91923	7.5	1.95	30.2	2.23793
5/99	10	6.602	5.665	1.75	16.0	1.57374
6/99	5	10.474	4.97	4.11	23.9	1.03246
7/99	14	22.6643	8.105	3.45	208.5	5.65638
8/99	6	7.99667	4.88	4.02	17.7	1.3388
9/99	13	136.815	5.46	2.84	1540.0	5.26182
10/99	5	6.48	4.28	2.77	15.4	1.61081
11/99	14	6.86643	3.815	1.83	34.0	4.09813
12/99	11	2.95182	3.44	0.83	5.25	0.0922241
1/00	4	6.87	4.1	2.88	16.4	1.58066
2/00	2	2.385	2.385	1.87	2.9	
3/00	18	10.795	5.96	2.33	42.0	3.21963
4/00	6	5.38667	4.905	3.24	8.94	1.16819
5/00	19	15.5558	8.31	2.4	93.0	6.10793

6/00	6	12.2167	12.55	7.2	17.4	0.0216915
7/00	17	11.5741	6.5	2.76	34.1	2.27299
8/00	6	10.7333	6.245	4.65	23.0	0.979098
9/00	18	15.3928	6.195	1.79	61.0	2.78009
10/00	5	5.2	4.8	2.6	8.8	0.978816
11/00	13	4.7	4.7	1.4	9.4	0.664927
12/00	9	4.18889	3.5	1.8	8.1	1.3858
1/01	14	86.1136	25.15	3.46	453.0	3.35372
2/01	5	8.162	3.61	1.51	26.6	1.94549
3/01	12	5.34167	4.255	2.97	13.1	2.41652
4/01	10	11.141	8.045	4.09	28.1	2.19646
5/01	14	5.04857	4.35	2.29	10.8	2.20994
6/01	10	12.014	11.45	6.97	19.4	1.32271
8/01	1	11.9	11.9	11.9	11.9	
9/01	10	37.009	15.9	3.5	120.0	1.59521
10/01	8	2.5975	2.5	1.0	4.6	0.57306
11/01	8	2.96625	3.16	1.36	5.16	0.428608
12/01	8	14.475	7.25	1.6	38.7	1.15397
1/02	8	4.5125	3.9	1.8	11.7	2.26198
2/02	9	3.12222	2.8	1.1	6.2	0.797759
3/02	8	12.25	7.35	4.4	27.6	0.953761
4/02	9	2.87778	3.2	1.9	4.1	-0.0160703
5/02	13	9.41538	6.9	1.6	26.3	2.0104
6/02	9	5.56667	4.2	2.8	10.4	1.28867
7/02	8	5.5625	4.25	2.8	13.9	2.58522
10/02	3	4.0	5.1	1.3	5.6	-1.16275
2/03	3	6.63333	5.2	5.0	9.7	1.21695
Total	867	13.9644	6.1	0.83	1540.0	264.399

Summary Statistics
Data variable: Temp_Celsuis

						Standardized
Collection_Date_Temp	*Count*	*Average*	*Median*	*Minimum*	*Maximum*	*Skewness*
7/68	5	25.112	25.56	23.89	26.11	-0.475293
8/68	5	24.108	23.33	22.22	27.22	1.23126
9/68	5	21.888	21.67	21.11	23.33	0.990049
12/68	5	2.89	3.33	1.67	3.89	-0.400272
5/69	5	19.774	19.44	19.44	21.11	2.04124
8/69	5	23.222	22.78	22.22	25.56	1.52697
3/70	6	5.18333	4.44	3.33	8.89	1.76061
4/70	6	6.02	6.11	5.0	6.67	-0.663669
5/70	6	14.2567	14.44	12.22	16.11	-0.324208
6/70	6	19.63	20.0	18.33	20.56	-0.720686
7/70	6	24.2567	23.885	23.33	26.67	1.59006
8/70	5	25.442	24.44	24.44	27.22	0.636707
10/70	6	16.8533	16.67	15.56	18.33	0.389389
11/70	6	7.87	7.5	6.67	10.0	1.34321
12/70	6	7.315	7.22	6.67	7.78	-0.285844
1/71	6	2.68333	2.5	2.22	3.33	0.448885
2/71	6	0.186667	0.0	0.0	0.56	0.968246
3/71	5	4.778	5.0	3.89	5.56	-0.35467
4/71	6	16.115	16.115	15.56	16.67	-6.6695E-15
5/71	6	13.3317	13.33	12.22	13.89	-1.35699
6/71	6	22.8717	21.945	21.11	25.56	0.859633
7/71	6	26.9483	26.115	25.56	30.56	1.53262
8/71	6	23.9817	23.61	22.78	25.56	0.642971
9/71	6	23.425	23.33	20.56	27.22	0.825864
10/71	12	16.6675	16.67	15.56	17.78	0.00290394
11/71	4	6.25	6.11	6.11	6.67	1.63299
12/71	6	5.37333	5.56	4.44	5.56	-2.44949

1/72	4	4.165	4.165	3.33	5.0	1.63406E-16
2/72	1	0.56	0.56	0.56	0.56	
3/72	6	6.945	6.945	5.56	8.33	-2.45578E-15
4/72	6	13.055	13.055	12.22	13.89	5.67481E-15
5/72	8	19.235	19.165	17.78	21.11	0.629262
6/72	5	21.0	21.11	20.0	21.67	-1.16882
7/72	7	19.2857	18.89	16.67	21.11	-0.287592
8/72	7	24.92	24.44	23.33	27.78	1.04866
9/72	6	20.74	20.555	18.89	23.33	0.382733
10/72	7	16.4314	15.56	15.56	18.89	1.48488
11/72	7	7.46286	6.67	6.67	8.89	0.824768
12/72	8	5.4875	5.56	4.44	6.11	-1.02305
1/73	7	0.714286	1.11	0.0	1.67	-0.0256633
2/73	4	4.445	4.445	3.33	5.56	1.69899E-15
3/73	7	6.27143	6.11	5.0	7.78	0.396838
4/73	13	5.21462	5.56	4.44	6.67	0.434423
5/73	13	16.4969	16.67	15.0	18.33	0.270471
6/73	13	25.0	25.56	22.22	27.78	-0.0828729
7/73	13	25.0446	25.56	21.67	28.89	0.0809485
8/73	13	19.0192	17.78	16.67	26.67	2.89061
10/73	13	12.8208	12.78	11.67	16.11	2.61247
11/73	12	13.8417	13.885	8.89	17.78	-0.885505
12/73	15	1.55533	1.67	1.11	2.22	0.668097
1/74	14	7.73857	7.78	7.22	9.44	3.52704
2/74	14	4.40429	3.89	2.22	8.89	1.92659
3/74	14	8.01643	7.78	6.67	9.44	-0.0705394
4/74	14	11.0307	11.11	6.67	14.44	-0.628307
5/74	15	20.0	20.0	18.33	22.22	0.800389
6/74	14	20.3171	20.0	16.67	24.44	0.776749
7/74	24	22.5692	22.22	18.89	26.67	1.16273
8/74	4	24.025	24.44	22.22	25.0	-1.4006
9/74	14	20.4371	20.56	18.89	23.89	1.49825
10/74	15	12.7407	12.78	10.0	16.11	0.605164
11/74	18	9.59944	10.0	6.11	12.78	-0.371237
12/74	15	4.186	3.89	1.11	6.67	-0.0216453
1/75	21	2.7519	2.22	0.56	5.56	0.79583
2/75	11	3.63818	3.89	1.67	6.67	1.05143
3/75	21	3.36	2.78	1.67	8.33	3.18542
4/75	12	11.39	10.835	6.67	15.0	-0.179853
5/75	20	21.6115	21.945	12.22	26.67	-1.86519
6/75	15	23.11	22.22	20.0	26.11	0.18347
7/75	11	23.2382	23.33	20.0	25.0	-2.15088
8/75	16	24.3544	25.0	8.0	28.33	-4.94846
9/75	18	20.5244	20.0	17.78	22.78	0.0761195
10/75	16	15.1056	15.56	9.44	17.22	-4.42616
11/75	17	9.80412	10.0	6.67	12.78	0.168194
12/75	15	5.22333	6.11	2.78	6.67	-1.03136
1/76	19	1.55211	0.56	0.0	6.11	3.04374
2/76	15	11.186	11.11	7.78	13.89	-0.963013
3/76	20	8.8145	8.89	4.5	12.22	-0.397174
4/76	20	18.4445	20.835	11.11	25.56	-0.572801
5/76	22	16.3991	15.78	12.22	20.56	0.425266
6/76	14	22.5986	22.775	17.5	25.56	-1.06962
7/76	19	24.6184	24.44	22.22	27.78	0.940497
8/76	18	23.3644	22.5	20.56	28.89	1.78201
9/76	24	18.4729	18.89	13.89	22.22	-0.657874
10/76	17	11.2106	10.56	8.89	14.44	1.1752
11/76	23	6.56435	6.11	2.78	10.0	0.137101
12/76	19	1.66737	1.67	0.0	2.78	-1.14802
2/77	9	1.66667	2.0	1.0	3.0	0.742307
3/77	20	9.1795	8.05	7.0	17.0	4.08984

4/77	22	15.7736	16.24	10.0	20.0	-1.94425
5/77	14	16.8929	17.0	13.0	21.0	0.511063
6/77	25	22.7	23.0	16.0	26.0	-2.36087
7/77	20	24.75	24.5	21.0	31.0	2.06445
8/77	17	19.0353	25.0	1.9	28.5	-1.60189
9/77	17	6.12353	2.0	1.8	20.0	2.31564
10/77	17	7.72941	1.6	1.0	16.0	0.288608
11/77	21	2.9	1.0	0.3	9.0	2.02665
12/77	17	1.31176	0.6	0.1	6.0	4.22975
1/78	15	1.11333	1.0	0.0	6.2	4.92002
2/78	7	0.214286	0.1	0.0	0.5	0.966183
3/78	10	9.949	9.95	8.0	13.0	1.14466
4/78	26	10.1731	10.0	8.0	13.0	0.147549
5/78	25	18.04	17.5	13.5	27.0	1.568
6/78	22	23.7136	24.0	19.5	27.0	-0.875201
7/78	20	22.725	23.5	2.0	29.5	-6.04492
8/78	20	24.075	24.0	20.5	29.5	1.64658
9/78	21	23.9048	24.5	15.5	27.0	-4.0474
10/78	23	14.3391	16.0	8.0	18.0	-1.32127
11/78	19	7.89474	10.0	3.0	13.0	-0.249508
12/78	21	3.97619	4.0	2.0	6.0	0.829938
1/79	20	4.05	2.5	0.0	9.0	0.724562
3/79	23	8.50435	9.0	0.5	12.5	-1.86343
4/79	14	14.3786	15.1	8.0	18.2	-1.02481
5/79	21	18.6429	19.0	3.5	32.0	-0.693325
6/79	20	18.54	18.8	9.0	22.0	-4.59803
7/79	14	21.5714	21.7	18.8	24.6	0.254133
8/79	28	23.8857	23.75	20.0	28.5	0.679593
9/79	3	17.5	18.0	15.5	19.0	-0.814636
10/79	11	14.6364	14.0	11.5	19.3	0.983832
11/79	14	11.3571	12.0	7.0	13.5	-2.95864
12/79	10	1.78	1.6	0.5	3.5	0.594556
1/80	13	2.94615	3.7	0.0	5.0	-0.964965
2/80	11	1.18182	1.0	1.0	2.0	2.43676
3/80	13	6.17692	6.0	2.8	10.5	1.05586
4/80	7	13.6286	12.5	10.0	18.2	0.530278
5/80	11	19.0909	19.0	17.0	21.0	-0.138179
6/80	18	22.5333	22.5	21.0	23.5	-0.202192
7/80	5	23.08	23.1	19.9	26.5	0.197016
8/80	6	26.8667	27.0	25.0	28.2	-0.478001
9/80	1	21.0	21.0	21.0	21.0	
11/80	11	6.73636	6.6	4.3	8.8	-0.267447
12/80	11	4.08182	3.0	2.0	8.8	1.52939
1/81	2	0.9	0.9	0.0	1.8	
2/81	10	1.12	1.35	0.0	2.0	-0.680084
3/81	11	4.36364	4.3	3.5	5.7	0.644824
4/81	12	12.9742	13.4	9.69	15.0	-2.09123
5/81	11	15.4455	15.0	11.0	18.5	-0.320103
6/81	11	21.7909	23.0	16.5	25.5	-0.945797
7/81	11	26.2909	26.5	23.7	29.0	-0.281341
8/81	11	23.6455	23.7	22.0	26.0	0.735637
9/81	11	24.0636	24.5	22.0	26.0	-0.212216
10/81	11	15.6636	15.5	14.9	16.5	0.275601
11/81	11	11.5727	12.3	8.0	14.1	-1.07383
12/81	12	1.58333	1.0	0.2	7.0	3.46288
1/82	11	3.44545	3.0	2.1	5.8	1.83899
2/82	11	2.37273	1.0	0.7	7.2	1.7555
3/82	11	2.54545	2.5	2.0	3.0	-0.282999
4/82	11	10.2627	11.0	6.8	12.3	-1.69895
5/82	11	16.6818	18.5	1.0	20.0	-3.9483
6/82	11	15.7155	15.5	14.5	17.79	0.831727

7/82	11	24.5909	24.8	21.0	27.3	-0.44829
9/82	11	17.0545	17.0	16.0	18.0	-0.32674
10/82	12	8.5775	6.89	4.99	20.0	2.66725
11/82	11	8.31818	8.5	6.5	10.0	-0.324639
12/82	11	1.16364	1.0	0.0	2.8	0.396837
1/83	3	1.2	1.1	0.3	2.2	0.329897
2/83	11	3.91818	5.0	0.3	6.5	-0.958585
3/83	11	7.0	7.2	5.5	8.4	-0.516077
4/83	14	10.55	10.5	7.5	15.2	1.33602
5/83	11	16.2818	16.5	13.3	18.6	-0.376463
6/83	12	19.7333	19.5	18.2	21.5	0.910671
7/83	11	22.2818	22.5	20.7	23.5	-0.733486
8/83	11	25.3182	25.6	22.9	27.0	-1.27296
9/83	11	22.4091	23.0	19.4	25.0	-1.08645
10/83	11	16.3636	16.0	15.5	17.5	0.99107
11/83	11	5.30909	5.3	3.9	6.5	0.0359162
12/83	11	7.38182	7.5	5.9	8.0	-1.39742
1/84	1	23.0	23.0	23.0	23.0	
2/84	11	3.82727	3.9	3.0	5.0	1.13521
3/84	11	3.86364	3.8	2.5	5.2	-0.103064
4/84	11	10.1545	10.2	9.0	11.0	-0.5921
5/84	12	13.975	13.75	13.0	16.0	1.25485
6/84	9	26.4	27.0	23.7	27.5	-1.84013
7/84	11	21.1364	21.0	19.0	23.0	0.200504
8/84	11	23.9091	23.5	22.0	27.5	1.93954
9/84	11	20.2636	20.2	18.0	21.0	-2.52599
10/84	9	12.6444	12.7	11.5	13.9	0.183606
1/85	8	0.3125	0.0	0.0	1.0	1.15315
2/85	11	2.59091	2.0	1.0	10.0	3.99315
3/85	10	8.67	8.5	7.2	10.0	0.20918
5/85	8	23.025	22.6	21.5	25.0	0.537473
6/85	9	21.4444	21.2	19.5	23.0	-0.242654
7/85	12	23.8167	23.65	22.0	26.0	0.739599
8/85	10	24.37	24.35	23.0	27.0	1.20063
9/85	10	20.32	20.25	18.5	23.0	0.439327
10/85	12	11.775	11.15	10.5	14.5	1.95771
11/85	10	14.2	14.5	13.0	15.5	-0.214955
12/85	11	3.71818	3.5	3.0	5.2	1.3182
1/86	10	0.5	0.25	0.0	2.5	2.81496
2/86	8	2.0625	1.5	1.0	5.0	1.61368
3/86	11	5.09091	5.0	3.7	6.5	0.127944
4/86	11	15.3182	14.5	14.0	18.0	1.67778
5/86	11	17.0273	18.0	13.2	18.5	-1.89282
6/86	9	23.4222	24.0	19.8	26.0	-0.964184
7/86	11	22.4273	22.5	20.0	26.5	0.860679
8/86	6	20.1667	20.0	18.0	23.5	1.11592
9/86	10	18.75	18.75	15.5	22.0	-0.0608581
10/86	10	12.36	12.25	11.0	13.5	-0.160844
11/86	1	6.0	6.0	6.0	6.0	
12/86	1	5.0	5.0	5.0	5.0	
1/87	0					
2/87	0					
3/87	1	7.0	7.0	7.0	7.0	
4/87	17	6.20588	6.0	5.2	7.0	0.02983
5/87	11	10.1818	10.0	9.0	11.5	0.288081
6/87	13	23.0308	23.3	18.2	26.0	-1.63361
7/87	8	26.9125	26.75	24.7	29.0	0.153547
8/87	8	25.9375	25.85	23.8	27.7	-0.255812
9/87	8	20.2625	20.35	17.5	22.3	-0.521424
10/87	8	11.8	11.85	9.3	13.7	-0.649917
11/87	8	8.1625	8.75	1.8	12.5	-0.798621

12/87	8	5.8	6.0	3.8	7.0	-1.44827
1/88	5	0.24	0.2	0.1	0.4	0.287879
2/88	6	3.35	3.05	2.1	4.8	0.501465
3/88	6	6.81667	6.3	5.0	9.6	0.86977
4/88	8	12.6875	11.85	10.6	16.1	0.834113
5/88	6	18.3	18.0	16.9	20.1	0.690901
6/88	8	22.15	21.85	20.3	25.0	0.904768
7/88	8	23.1625	22.95	21.4	25.6	0.88133
8/88	8	24.4125	24.35	22.5	26.8	0.412102
9/88	8	18.8375	18.85	16.9	20.6	0.00994863
10/88	8	14.7875	16.65	9.4	19.0	-0.656233
11/88	8	10.4	10.3	6.5	14.5	-0.172957
12/88	5	4.56	4.3	3.6	6.3	1.4918
1/89	7	3.47143	3.5	2.2	4.8	0.199442
2/89	8	2.75	3.05	0.9	4.2	-0.355727
3/89	9	6.41111	6.4	1.6	12.3	0.656888
4/89	8	13.2125	14.05	8.9	15.8	-1.25529
5/89	8	15.375	15.35	12.6	18.8	0.656614
6/89	8	20.05	20.05	19.4	20.9	0.516735
7/89	6	26.1333	27.15	19.8	28.1	-2.35522
8/89	8	21.7	21.75	19.8	22.7	-1.15747
9/89	7	22.2143	23.0	17.9	23.6	-2.34458
10/89	4	14.0	13.95	12.8	15.3	0.216238
11/89	7	9.88571	9.8	7.0	12.8	0.00695899
12/89	5	1.3	1.6	0.0	3.2	0.399247
1/90	7	1.31429	1.0	0.0	3.5	0.586892
2/90	6	3.38333	3.55	1.7	5.7	0.354728
3/90	5	3.6	3.6	2.2	5.4	0.352561
4/90	5	8.88	8.7	8.4	9.5	0.450883
5/90	7	13.2714	13.4	11.4	15.4	0.227416
6/90	7	17.5571	18.4	15.0	19.5	-0.495561
7/90	7	23.2857	23.0	22.3	26.3	2.55119
8/90	8	20.8475	23.9	2.48	24.1	-3.18922
9/90	13	17.9538	16.7	13.8	24.5	0.90506
10/90	5	13.2	12.3	11.9	17.1	2.00104
11/90	4	6.025	6.1	5.3	6.6	-0.527862
12/90	3	4.26667	4.1	4.1	4.6	1.22474
1/91	17	3.72353	4.0	2.1	5.8	0.198735
2/91	0					
3/91	4	2.65	2.5	2.0	3.6	0.874756
4/91	13	12.5077	10.8	8.2	17.7	0.547625
5/91	9	21.2111	22.7	17.8	24.3	-0.25959
6/91	5	23.78	23.4	23.0	25.3	1.18923
7/91	6	24.6333	24.15	23.1	27.9	1.98828
8/91	5	23.18	24.4	17.8	25.2	-1.87885
9/91	4	17.95	17.95	17.3	18.6	1.15774E-14
10/91	5	11.96	11.6	10.8	14.0	0.845358
11/91	10	7.44	7.7	4.3	11.6	0.157274
12/91	5	5.4	5.1	4.5	6.9	0.836393
1/92	17	3.28824	3.5	0.5	6.2	-0.255511
2/92	10	2.08	1.65	1.1	4.0	1.38384
3/92	5	7.26	7.2	7.0	7.6	0.548968
4/92	19	10.7263	11.2	8.3	12.8	-1.07172
5/92	4	13.65	13.5	12.6	15.0	0.614689
6/92	5	18.42	18.2	17.3	19.6	0.18455
7/92	14	25.8286	26.05	21.8	27.7	-2.32446
8/92	10	21.22	21.0	20.3	22.2	0.393629
9/92	7	20.9429	21.0	19.3	21.9	-1.08925
10/92	14	10.0929	10.1	8.5	12.2	0.519041
11/92	10	9.44	10.2	6.5	11.8	-0.354549
12/92	5	5.1	5.1	3.7	6.3	-0.460067

1/93	17	5.03529	5.2	1.1	8.6	-0.521008
2/93	10	1.28	1.05	0.7	3.2	3.02003
3/93	5	6.22	5.8	5.3	7.3	0.422275
4/93	14	11.5571	11.65	8.6	14.1	-0.267421
5/93	9	18.2778	18.2	17.5	19.4	0.596667
6/93	8	22.525	21.9	21.3	26.4	2.49265
7/93	14	25.6286	26.35	22.9	28.6	-0.297239
8/93	16	24.0312	23.85	22.5	27.9	3.08861
9/93	9	18.1333	18.0	17.3	19.3	0.732269
10/93	11	12.4364	12.3	10.5	15.7	1.07763
11/93	13	6.4	6.3	4.8	9.6	1.72915
1/94	14	1.75	1.3	0.8	4.3	2.43958
2/94	5	1.0	1.0	0.5	1.4	-0.322067
3/94	10	8.49	8.55	6.7	10.4	-0.0741608
4/94	13	13.9462	13.3	12.2	16.5	1.33857
5/94	10	14.37	14.55	12.5	15.4	-1.20207
6/94	6	24.25	24.05	23.1	26.0	0.970091
7/94	11	25.7727	25.7	24.4	27.3	0.449206
8/94	8	21.65	22.9	17.8	24.0	-0.987733
9/94	4	18.95	18.65	17.9	20.6	1.12437
10/94	12	11.375	11.4	8.9	14.1	0.253904
11/94	10	12.51	13.0	6.5	14.8	-2.61136
12/94	5	9.84	9.9	9.2	10.3	-0.758515
1/95	13	2.07692	1.9	0.3	4.1	0.411233
2/95	9	3.23333	4.0	1.5	4.5	-0.338487
3/95	5	5.58	5.2	4.9	6.4	0.457511
4/95	13	12.8231	12.6	9.7	15.8	0.091644
5/95	11	16.0364	17.9	11.8	19.3	-0.419115
6/95	4	18.85	18.9	18.1	19.5	-0.111969
7/95	13	24.1692	24.1	21.8	26.3	-0.0422173
8/95	12	23.7833	23.55	20.7	28.3	0.232585
9/95	7	21.2571	20.3	18.8	25.3	1.1554
10/95	12	15.4833	16.4	10.3	19.7	-0.626296
11/95	5	4.18	4.1	3.8	4.6	0.295263
12/95	5	4.64	4.4	4.0	5.7	1.17455
1/96	6	1.36667	1.4	0.3	2.6	0.0376116
2/96	11	2.92727	3.0	0.6	8.6	1.69942
3/96	10	7.74	7.6	6.5	10.9	2.77758
4/96	13	12.4846	10.6	8.3	19.1	1.30653
5/96	9	12.1889	12.4	11.2	14.1	1.04315
6/96	5	18.02	18.0	17.2	18.9	0.174733
7/96	13	23.3538	23.4	21.2	24.6	-1.57333
8/96	11	20.2364	21.1	18.3	22.4	-0.0951372
9/96	6	19.65	20.05	16.0	21.9	-1.30196
10/96	3	14.8667	14.8	14.4	15.4	0.41407
11/96	11	5.13636	4.9	3.9	7.5	2.012
12/96	10	6.62	6.7	5.3	8.0	-0.08425
1/97	5	6.08	5.9	5.1	7.3	0.397313
2/97	14	6.35	5.1	2.6	11.1	0.755676
3/97	11	9.67273	10.1	7.2	12.1	-0.102438
4/97	5	12.82	13.3	12.0	13.5	-0.505241
5/97	14	16.4643	15.9	12.9	19.6	0.71638
6/97	11	15.3545	15.4	14.1	16.7	0.127769
7/97	5	23.7	23.5	22.9	24.9	0.991993
8/97	10	21.67	21.8	20.2	22.7	-0.636867
9/97	13	18.7308	16.1	14.3	23.0	0.209475
10/97	7	17.3143	17.4	15.5	18.5	-0.71033
11/97	7	6.9	7.1	5.6	8.1	-0.26302
12/97	17	4.17647	4.6	1.4	7.0	-0.962908
1/98	5	4.36	4.5	3.7	5.1	-0.0281273
2/98	12	7.35	7.9	4.5	9.9	-1.05076

3/98	10	6.05	6.4	4.2	7.9	-0.200132
4/98	5	17.58	17.5	15.3	19.5	-0.460585
5/98	8	19.5125	19.3	15.2	22.3	-0.546314
6/98	11	16.1455	16.0	14.4	17.6	0.0496018
7/98	11	25.5273	25.8	21.6	27.8	-1.41713
8/98	17	23.4882	23.7	21.2	25.6	-0.462556
9/98	2	23.25	23.25	22.6	23.9	
10/98	5	14.14	14.4	13.3	14.7	-0.902539
11/98	7	8.91429	9.4	6.9	10.6	-0.373433
12/98	11	5.27273	5.3	2.9	9.7	1.69539
1/99	34	0.208824	0.1	0.0	1.6	6.88231
2/99	56	4.69714	4.65	0.43	8.4	-0.608591
3/99	44	1.67273	1.6	0.0	4.2	1.24779
4/99	58	12.2931	11.8	9.5	14.7	0.838568
5/99	56	17.9554	18.1	15.9	19.9	-0.507311
6/99	26	23.7308	23.8	22.6	25.3	0.643575
7/99	105	22.0667	21.8	19.2	25.6	2.24843
8/99	45	21.6889	21.4	19.8	23.5	0.189936
9/99	80	18.7375	18.55	17.0	20.8	1.20823
10/99	45	12.7733	13.8	9.1	14.8	-1.82107
11/99	102	7.04412	7.3	3.8	9.6	-2.24196
12/99	90	2.00556	2.0	0.8	3.5	1.37056
1/00	60	2.69917	4.2	0.01	5.2	-0.977084
2/00	32	1.37969	1.3	0.05	2.8	0.366855
3/00	130	10.5885	10.7	7.0	14.0	-1.09008
4/00	55	13.3538	12.5	11.8	15.25	0.742152
5/00	135	16.4222	16.4	13.7	19.9	0.63884
6/00	59	20.5403	21.37	17.0	22.82	-1.80421
7/00	125	22.086	20.67	19.58	26.51	1.71573
8/00	60	22.765	21.225	19.94	26.5	1.49686
9/00	100	17.0515	17.185	14.17	20.9	0.959821
10/00	25	11.334	11.17	10.13	12.9	1.2161
11/00	40	6.8225	7.595	3.66	10.02	-0.434719
12/00	24	5.03917	4.94	4.0	6.86	1.65155
1/01	0					
2/01	0					
3/01	65	6.90462	7.18	4.78	8.87	-0.329412
4/01	54	8.64667	9.06	6.39	10.05	-2.20776
5/01	70	16.8686	16.69	13.98	19.41	-0.424299
6/01	55	21.02	21.24	18.76	22.9	-0.689769
8/01	35	21.6671	21.62	19.92	23.06	-0.363338
9/01	69	18.7433	18.42	16.5	22.13	1.14539
10/01	119	11.4847	10.75	8.26	17.33	4.49306
11/01	78	8.01846	7.26	4.42	14.0	2.24778
12/01	108	7.46278	7.165	6.0	12.29	9.02136
1/02	66	4.33455	4.23	2.79	5.76	0.333535
2/02	96	3.4575	2.255	0.14	9.09	3.31796
3/02	66	8.72727	8.67	7.98	10.19	3.34479
4/02	119	15.1692	14.2	11.95	21.9	5.79421
5/02	124	16.9283	17.37	12.05	20.99	-3.90689
6/02	114	22.0211	21.48	19.15	25.07	1.96379
7/02	78	23.69	24.21	20.47	26.33	-2.06401
10/02	22	11.3973	11.39	10.01	12.65	-0.164921
2/03	22	1.75545	1.31	0.56	4.1	2.20408
3/03	94	3.69053	3.89	0.72	8.22	0.613088
4/03	130	13.6892	13.79	10.42	15.99	-1.24146
5/03	11	13.3082	12.93	12.56	16.31	3.27558
6/03	124	18.4844	18.71	15.96	20.66	-0.589339
7/03	33	21.7045	21.38	20.13	25.41	3.0208
8/03	30	22.702	22.995	20.6	24.26	-1.26389
9/03	29	20.5859	20.68	18.18	22.17	-0.85792

10/03	30	12.419	12.6	10.69	14.18	-0.0503537
11/03	15	10.086	9.95	9.7	11.05	2.38577
12/03	23	2.41478	1.77	1.45	4.9	2.63543
1/04	15	1.304	1.02	0.44	3.55	2.31966
2/04	24	3.1225	3.115	2.11	4.17	0.318547
3/04	15	7.196	7.58	4.72	8.88	-0.759532
4/04	24	9.41375	9.325	8.4	11.14	1.37655
5/04	18	18.0617	18.93	14.28	21.02	-0.809687
6/04	54	20.915	20.765	18.64	23.55	1.02196
7/04	57	22.5226	22.78	19.55	25.68	-0.189766
8/04	33	23.4264	22.99	22.18	25.91	1.86562
9/04	53	20.0911	19.94	18.24	22.07	0.487516
10/04	55	13.7836	12.89	10.59	18.73	1.79295
11/04	27	8.71333	7.34	5.79	14.84	2.70599
12/04	46	5.25196	6.23	-0.08	10.13	-0.0653173
1/05	48	4.78812	4.36	-0.06	10.95	0.148452
2/05	22	2.20409	2.58	-0.08	6.4	0.363108
3/05	61	4.82115	4.91	1.01	8.89	-0.286529
4/05	37	11.0957	10.25	7.75	17.07	1.9115
5/05	33	16.8033	17.48	13.87	18.91	-1.8248
6/05	40	20.4683	20.4	17.91	25.23	0.841895
7/05	73	24.6682	24.77	22.35	27.7	0.591723
8/05	9	26.63	27.5	24.27	28.12	-0.944546
9/05	66	20.8905	20.885	17.69	26.2	2.08579
10/05	18	10.435	8.55	7.74	18.4	2.87203
11/05	32	10.4478	10.08	8.11	12.43	-0.269772
12/05	16	2.81937	2.69	2.31	3.38	0.333363
1/06	54	5.97278	5.775	4.6	9.56	4.88713
2/06	14	4.755	4.22	2.45	9.18	1.3471
3/06	48	7.93125	6.75	5.3	14.9	3.32913
4/06	26	13.65	13.65	11.9	15.7	0.417858
5/06	59	15.8153	15.8	12.6	18.6	-0.160771
6/06	32	23.7094	23.1	21.6	27.5	2.86356
7/06	67	24.4731	24.6	21.7	26.9	-1.11805
8/06	46	25.0196	25.1	21.0	30.2	0.983747
9/06	31	18.9032	19.0	17.2	20.8	0.139374
10/06	21	14.1524	16.0	7.3	18.1	-2.08605
11/06	43	8.57442	8.0	7.4	10.6	2.44433
12/06	19	6.57368	6.4	4.3	10.1	0.91208
1/07	31	3.91613	1.3	0.4	10.7	1.80094
2/07	27	2.83333	3.0	0.3	5.0	-0.321597
3/07	31	6.88065	8.0	2.3	10.1	-1.3802
4/07	41	8.96341	8.1	6.0	13.8	2.40196
5/07	58	17.8741	17.7	13.8	21.6	-0.0565366
6/07	29	21.4966	21.3	18.8	26.2	1.73109
Total	8576	13.5471	13.895	-0.08	32.0	-2.60734

Section C) Surface Water Quality lab analyses. Summary statistics for 72 analytes sampled by DEQ at 142 sites in Loudoun County or contributing watersheds.

Summary Statistics for DEQ Surface Water Quality Data

ParameterName	Count	Mean	Median	Standard deviation	Coeff. of variation	Minimum	Maximum	Range	Lower quartile	Upper quartile	Interquartile range	Stnd. skewness	Stnd. kurtosis
Field Turbidity (NTU)	1100	13.74	6.20	53.14	387%	0.83	1540	1539.17	3.93	10.8	6.87	307.61	4245.35
Specific Conductance (uS/cm)	1659	206.40	171.00	120.57	58%	31.1	1893	1861.9	135.2	235	99.8	61.1711	246.664
BOD 5 DAY (mg/L)	2981	2.39	2.00	2.57	107%	0.04	54	53.96	1	2	1	152.092	901.763
COD (mg/L)	2145	13.23	11.00	11.34	86%	0	181	181	7	16	9	121.035	694.854
pH (standard units)	1950	6.97	7.04	0.63	9%	0	10.28	10.28	6.69	7.39	0.7	-24.7585	100.659
Tot. Alkalinity as CaCO3 (mg/L)	1955	51.51	42.00	30.27	59%	0	321	321	30	66	36	28.409	40.4087
Total Residue (mg/L)	2101	153.22	127.00	102.37	67%	0	2167	2167	102	177	75	159.905	1316.31
Total Nitrogen (mg/L)	550	1.28	1.23	0.48	38%	0.18	3.21	3.03	0.92	1.56	0.64	5.43584	2.3604
NH3-N Total (mg/L)	4585	0.25	0.10	1.06	428%	0	22.5	22.5	0.04	0.1	0.06	299.447	2016.05
NO2-N Total (mg/L)	4120	0.06	0.01	0.49	830%	0	28	28	0.01	0.02	0.01	1225.59	34117
NO3-N Total (mg/L)	3541	1.18	0.95	1.27	107%	0	27	27	0.49	1.5	1.01	139.759	856.919
Total Kjeldahl N (mg/L)	4122	0.78	0.40	3.56	458%	0.01	183.9	183.89	0.3	0.6	0.3	978.755	23321.1
NO2 and NO3 N-TOTAL	1048	1.13	0.98	0.87	77%	0.02	9	8.98	0.55	1.5	0.95	34.7571	97.2044
Total Phosphorous (mg/L P)	3344	0.11	0.10	0.18	161%	0.01	4.8	4.79	0.05	0.1	0.05	311.426	2947.69
Dissolved PO4 (mg/L P)	1392	0.22	0.03	5.42	2510%	0	202	202	0.02	0.06	0.04	567.392	10578.9
Total Organic Carbon (mg/L)	2201	6.31	5.10	4.52	72%	0	62	62	3.66	8	4.34	75.8208	303.743
Total Hardness (mg/L CaCO3)	1804	72.98	60.50	41.00	56%	0.45	523	522.55	47	89.55	42.55	47.477	157.55
Dissolved Calcium (mg/L)	37	15.14	14.00	9.84	65%	1	45.6	44.6	9.6	16.8	7.2	3.03151	2.45617
Total Chloride (mg/L)	1567	17.64	11.50	22.06	125%	0	295	295	8.2	18.2	10	90.0417	347.711
Total SO4 (mg/L)	1487	15.95	14.30	8.57	54%	0	144	144	11.1	19	7.9	70.6968	383.347
Total Fluoride (mg/L)	399	0.18	0.12	0.13	72%	0.03	0.6	0.57	0.1	0.2	0.1	13.4323	6.61655
Dissolved Silica (mg/L)	511	12.52	12.60	3.80	30%	2.1	40	37.9	10.1	15	4.9	5.16463	21.8208
Dissolved Arsenic (ug/L)	29	0.75	0.21	1.48	198%	0.1	5	4.9	0.1	0.4	0.3	5.86973	6.24173
Total Arsenic (ug/L)	306	3.78	2.00	3.39	90%	0	11	11	1	5	4	7.96366	-1.47895
Total Cadmium (ug.L)	319	7.48	10.00	4.16	56%	0	32.99	32.99	2.5	10	7.5	-0.2731	10.9809
Dissolved Chromium (ug/L)	29	2.53	0.10	9.48	374%	0.1	50	49.9	0.1	0.18	0.08	10.6447	26.985
Total Chromium (ug/L)	392	11.40	10.00	10.23	90%	0	50	50	10	10	0	24.6907	37.3555
Total Coppeer (ug/L)	390	13.33	10.00	11.46	86%	0	99.99	99.99	10	10	0	29.1161	56.8657
Total Iron (ug/L)	132	484.00	350.00	380.48	79%	70	3010	2940	263.96	612.5	348.54	14.4879	35.9646
Dissolved Iron (ug/L)	29	197.76	100.00	370.14	187%	15	2030	2015	85	174	89	10.3262	25.6519
Dissolved Lead (ug/L)	29	0.61	0.10	1.52	250%	0.1	5	4.9	0.1	0.1	0	6.0425	6.55302
Total Lead (ug/L)	373	8.06	8.00	10.25	127%	0	164.9	164.9	3	10	7	80.6338	587.283
Total Manganese (ug/L)	136	87.74	60.00	87.44	100%	0.3	530	529.7	40	100	60	12.7353	20.4317
Dissolved Manganese (ug/L)	29	135.83	60.80	226.86	167%	0.1	1000	999.9	25	101	76	5.90753	8.16935
Dissolved Thallium (ug/L)	29	1.19	0.20	3.05	256%	0.1	10	9.9	0.2	0.2	0	6.04026	6.54921
Total Thallium (ug/L)	45	14.11	10.00	5.56	39%	1	20	19	10	20	10	-0.312529	-1.74543
Dissolved Nickel (ug/L)	215	75.34	99.99	41.70	55%	0	100	100	10	99.99	89.99	-6.65188	-2.25688
Total Nickel (ug/L)	142	25.56	10.00	27.43	107%	10	100	90	10	50	40	8.43159	4.75695

Summary Statistics for DEQ Surface Water Quality Data

ParameterName	Count	Mean	Median	Standard deviation	Coeff. of variation	Minimum	Maximum	Range	Lower quartile	Upper quartile	Interquartile range	Stnd. skewness	Stnd. kurtosis
Dissolved Zinc (ug/L)	29	4.62	1.19	10.32	223%	0.94	50	49.06	1	2.2	1.2	8.35923	16.2654
Total Zinc (ug/L)	391	19.39	10.00	24.01	124%	0	309.9	309.9	10	19.99	9.99	50.7301	244.589
Dissolved Antimony (ug/L)	29	1.22	0.10	3.04	248%	0.1	10	9.9	0.1	0.5	0.4	6.0073	6.49176
Dissolved Aluminum (ug/L)	26	2.93	3.32	1.73	59%	0.1	6.16	6.06	1.49	3.9	2.41	-0.309088	-0.497513
Dissolved Selenium (ug/L)	29	1.44	0.50	2.96	206%	0.1	10	9.9	0.5	0.5	0	6.02483	6.52359
Total Selenium (ug/L)	61	13.36	10.00	7.26	54%	1	23	22	10	20	10	-1.37287	-2.06226
Stream Flow Severity	1971	3.39	3.00	1.04	31%	0	9	9	3	5	2	11.3653	-2.8929
Total Coliform (MPN) ConfTube	118	8423.50	2400.00	14333.20	170%	30	110000	109970	430	11000	10570	16.5017	47.0399
Fecal Coliform MFM-FCBR /10	4101	1073.70	100.00	9819.86	915%	0	600000	600000	100	500	400	1457.55	44178.2
E. coli MTEC-MF NO/10	622	311.92	100.00	536.84	172%	10	4000	3990	25	300	275	34.2257	71.3658
Chlorophyl A (ug/L)	259	1.88	0.93	2.62	139%	0.5	20.96	20.46	0.5	2.14	1.64	25.8027	62.8279
Chlorophyl B (ug/L)	237	0.52	0.50	0.26	51%	0.5	4.54	4.04	0.5	0.5	0	95.3582	729.671
Chlorophyl C (ug/L)	237	0.50	0.50	0.03	6%	0.5	0.91	0.41	0.5	0.5	0	69.6162	398.82
Total Endosulfan (ug/L)	46	0.07	0.10	0.06	87%	0.01	0.2	0.19	0.01	0.1	0.09	1.62988	-0.344746
Total PCB 1016 (ug/L)	46	0.27	0.10	0.20	72%	0.1	0.5	0.4	0.1	0.5	0.4	0.894438	-2.686
2,4-DB Total (ug/L)	43	0.25	0.20	0.05	20%	0.2	0.3	0.1	0.2	0.3	0.1	0.129096	-2.80765
Total PCP (ug/L)	81	0.06	0.10	0.06	93%	0	0.2	0.2	0	0.1	0.1	0.804371	-1.51201
Total Aldrin (ug/L)	109	0.04	0.01	0.05	143%	0	0.2	0.2	0	0.1	0.1	5.29242	1.44452
Total Dieldrin (ug.L)	82	0.04	0.01	0.05	142%	0	0.2	0.2	0	0.1	0.1	4.78767	1.58565
Total Endrin (ug/L)	81	0.05	0.05	0.05	111%	0	0.2	0.2	0	0.1	0.1	3.6449	1.34909
Total Toxaphen (ug/L)	46	0.29	0.20	0.20	68%	0.1	0.5	0.4	0.1	0.5	0.4	0.387206	-2.81118
Total Heptachlor (ug/L)	46	0.07	0.10	0.06	87%	0.01	0.2	0.19	0.01	0.1	0.09	1.62988	-0.344746
PCB's Whole Sample (ug/L)	56	0.17	0.00	0.24	137%	0	0.5	0.5	0	0.5	0.5	2.0781	-2.40719
Atrazine Whole Sample (ug/L)	32	0.22	0.00	0.28	128%	0	1	1	0	0.5	0.5	2.33017	0.279815
2,4-D Whole Sample (ug/L)	43	0.25	0.20	0.05	20%	0.2	0.3	0.1	0.2	0.3	0.1	0.129096	-2.80765
2,4,5-T Whole Sample (ug/L)	43	0.15	0.20	0.05	33%	0.1	0.2	0.1	0.1	0.2	0.1	-0.129096	-2.80765
SILVEX Whole Sample (ug/L)	43	0.15	0.20	0.05	33%	0.1	0.2	0.1	0.1	0.2	0.1	-0.129096	-2.80765
Total Calcium Hardness (mg/L)	48	59.27	51.50	27.29	46%	11	166	155	42.125	72	29.875	4.74331	6.0684
Dissolved Residue @ 180°C (mg)	111	146.39	115.00	78.37	54%	59	454	395	98	181	83	8.2258	8.04593
Total PO4 (mg/L)	1317	0.23	0.10	0.73	309%	0.05	19.5	19.45	0.1	0.1	0	240.896	2870.41
Total Phosphorous (mg/L P)	2895	0.10	0.03	0.48	460%	0	17	17	0.02	0.08	0.06	433.357	6385.53
Dissolved Mercury (ug/L)	20	0.22	0.20	0.04	17%	0.2	0.3	0.1	0.2	0.2	0	3.87616	2.534
Total Mercury (ug/L)	367	0.49	0.50	0.55	113%	0	5	5	0.3	0.5	0.2	55.6551	209.205
TURBIDITY FIELD NTU	230	11.30	4.60	32.26	286%	0	440	440	2.7	9.7	7	67.0374	428.766

Section D) Twenty sites in Loudoun County and contributing watersheds were chosen for more detailed analysis based on the length of sampling record found at those sites. This section show statistics for those 20 sites by a subset of 13 major analytes

Summary Statistics for Specific Conductance (uS/cm).at DEQ stations with long records.

Site ID	*Count*	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1ABUL025.94	51	164.555	154	52.1168	31.67%	79.4	312	232.6	132	186	54	3.1901	2.05092
1ALII003.97	45	159.004	141	61.3421	38.58%	78.8	367	288.2	119	178	59	4.1225	3.37779
1ASUG004.42	60	306.535	284	124.764	40.70%	144	818	674	235.4	330	94.6	6.79903	9.32663
1ABRB002.15	115	295.517	285	109.251	36.97%	63.5	849	785.5	228	351	123	5.8974	11.3095
1AHPR003.87	53	374.651	352	153.362	40.93%	181	958	777	282	381.3	99.3	5.4662	5.7724
1AGOO002.38	144	191.055	171	77.5904	40.61%	57.4	632	574.6	141	219	78	11.9384	22.0667
1ASYC002.03	57	200.358	208	37.9851	18.96%	68.5	260.8	192.3	177	224	47	-3.61318	2.85194
1ATUS000.37	66	383.758	380.5	120.385	31.37%	33.6	826	792.4	327	439	112	1.07762	4.5176
1ABEC004.76	56	168.846	167	26.2625	15.55%	98.9	228	129.1	152	186.5	34.5	0.226148	0.252395
1ANOG005.69	54	194.689	186.1	46.8682	24.07%	44.6	311	266.4	165	215	50	0.198365	2.01819
1ACRM001.20	53	119.383	120	13.894	11.64%	89	161	72	108.5	129	20.5	0.820142	0.770341
1AGOO022.44	137	145.883	140	26.3267	18.05%	58	244	186	127	168.5	41.5	1.68986	2.24933
1AGOO044.36	135	154.941	132	110.16	71.10%	59.6	986	926.4	110	166	56	26.761	85.3721
1ALIM001.16	35	215.326	230	60.1352	27.93%	70.9	308	237.1	172	262	90	-1.44073	-0.239581
1ACAX004.57	135	161.644	160	32.4891	20.10%	62.5	434	371.5	147.9	173	25.1	19.7633	87.244
1ANOC000.42	44	145.24	144.65	32.899	22.65%	41	235.6	194.6	127.00	164.50	37.50	-0.42	2.72
1ANOC004.38	12	181.617	169.5	35.4773	19.53%	141	260	119	156	205.7	49.7	1.60238	0.456631
1ASOC001.66	45	180.027	187	36.1957	20.11%	59	224.7	165.7	169	206	37	-4.1287	3.73403
1APIA001.80	51	100.739	99.9	17.8384	17.71%	59.2	162	102.8	88.4	109	20.6	2.45535	3.59345

Summary Statistics for Total Organic Carbon (mg/L) at DEQ stations with long records.

Site ID	*Count*	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1ABUL025.94	24	5.27	4.30	2.664	50.59%	2.5	13.9	11.4	3.58	6.3	2.72	3.865	4.307
1ALII003.97	23	5.01	4.50	2.640	52.71%	1.6	12.3	10.7	3	6.2	3.2	2.633	1.971
1ASUG004.42	180	6.62	6.00	3.277	49.48%	0.5	19	18.5	4	8	4	5.674	3.413
1ABRB002.15	173	8.30	7.50	3.940	47.48%	2.4	36.2	33.8	5.81	10	4.19	14.579	39.014
1AHPR003.87	130	7.29	7.00	3.877	53.15%	0.5	26	25.5	4.7	9	4.3	7.302	9.470
1AGOO002.38	229	5.75	5.00	4.301	74.78%	0	37	37	3.3	7	3.7	23.920	69.463
1ASYC002.03	24	3.77	3.75	1.557	41.33%	1.7	8.3	6.6	2.695	4.55	1.855	1.906	1.679
1ATUS000.37	176	7.83	7.00	4.512	57.59%	0.5	36	35.5	5	9	4	15.813	40.175
1ABEC004.76	20	4.83	4.40	2.535	52.47%	1.13	10.7	9.57	3.35	5.75	2.4	1.680	0.904
1ANOG005.69	99	6.12	5.00	5.445	88.94%	1	53	52	4	7	3	27.501	115.666
1ACRM001.20	21	4.97	4.90	2.881	58.02%	1.19	14.9	13.71	3.3	5.6	2.3	3.955	6.190
1AGOO022.44	185	4.61	3.90	4.086	88.69%	0.5	37	36.5	2.7	5	2.3	25.006	79.207
1AGOO044.36	87	2.86	2.70	1.608	56.23%	0.2	11	10.8	1.8	3.4	1.6	7.088	13.083
1ALIM001.16	195	5.18	4.00	4.864	93.82%	0.5	60	59.5	3	6	3	44.063	237.936
1ACAX004.57	96	5.86	5.00	4.867	83.13%	0.01	37	36.99	3.5	7	3.5	15.179	40.527
1ASOC001.66	101	6.26	5.00	6.558	104.82%	1	62	61	3.60	7.00	3.40	26.452	108.279

Summary Statistics for Alkalinity (mg/L as CaCO3) at DEQ stations with long records.

Site ID	*Count*	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1ABUL025.94	47	48.72	41.70	23.367	47.96%	15.8	117	101.2	31.5	62.8	31.3	3.124	1.546
1ALII003.97	45	43.01	39.30	18.107	42.10%	10.1	91.2	81.1	31.8	50.3	18.5	1.501	0.186
1ASUG004.42	107	61.82	65.20	19.213	31.08%	7.8	100	92.2	48.7	73	24.3	-1.461	-0.574
1ABRB002.15	160	75.94	71.15	37.930	49.95%	3.4	321	317.6	47.7	96.1	48.4	10.103	25.853
1AHPR003.87	88	83.76	86.10	29.115	34.76%	17.8	149	131.2	61.8	105	43.2	0.197	-0.936
1AGOO002.38	195	46.75	40.00	22.525	48.19%	7.6	135	127.4	31	55.3	24.3	8.427	6.560
1ASYC002.03	45	65.47	66.30	23.862	36.45%	17	107	90	45.5	86.8	41.3	-0.073	-1.420
1ATUS000.37	134	88.34	88.50	31.820	36.02%	1.34	163	161.66	69.8	108	38.2	-0.228	0.100
1ABEC004.76	41	40.73	38.40	15.666	38.46%	24	105	81	30	46.2	16.2	5.842	9.047
1ANOG005.69	54	42.91	41.25	15.946	37.16%	19.2	105	85.8	30.8	46.2	15.4	4.520	5.010
1ACRM001.20	41	26.93	26.20	8.914	33.10%	13.2	56.9	43.7	20.4	30.6	10.2	3.579	3.087
1AGOO022.44	162	31.78	30.00	9.596	30.19%	6.7	56	49.3	24.8	39	14.2	1.057	-1.363
1AGOO044.36	142	30.02	29.00	11.322	37.71%	10.1	83.7	73.6	21.8	37	15.2	8.117	13.006
1ALIM001.16	29	85.19	92.70	35.766	41.98%	16.8	142	125.2	51.9	108	56.1	-0.468	-1.260
1ACAX004.57	203	38.38	37.20	11.020	28.72%	5.7	70	64.3	30.5	46.5	16	1.010	-0.714
1ANOC000.42	52	34.68	31.85	12.674	36.55%	13.9	62	48.1	25.4	41.1	15.7	1.838	-0.724
1ANOC004.38	12	48.33	42.65	19.431	40.20%	27.5	97.4	69.9	34.7	58.15	23.45	2.165	2.055
1ASOC001.66	55	41.62	40.00	13.401	32.20%	14.7	72	57.3	31.2	54.4	23.2	0.527	-0.956
1APIA001.80	43	24.19	23.00	7.250	29.97%	11.9	39.7	27.8	17.8	29.9	12.1	1.267	-0.756

Summary Statistics for pH (standard units) at DEQ stations with long records.

Site ID	*Count*	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1ABUL025.94	46	6.90	7.00	0.626	9.07%	5.65	8.1	2.45	6.51	7.33	0.82	-0.989	-1.014
1ALII003.97	45	6.80	6.85	0.536	7.88%	5.68	7.58	1.9	6.5	7.21	0.71	-1.390	-0.915
1ASUG004.42	107	7.23	7.30	0.593	8.21%	5.7	10.28	4.58	7	7.56	0.56	1.940	13.688
1ABRB002.15	160	7.20	7.27	0.548	7.60%	5.64	8.38	2.74	6.94	7.6	0.66	-3.908	1.194
1AHPR003.87	88	7.40	7.52	0.592	8.01%	5.81	8.55	2.74	7.09	7.885	0.795	-3.603	1.487
1AGOO002.38	195	7.02	7.05	0.512	7.29%	5.68	8.24	2.56	6.79	7.34	0.55	-3.849	1.668
1ASYC002.03	45	7.07	7.32	0.698	9.87%	5.67	8.02	2.35	6.66	7.6	0.94	-2.085	-0.948
1ATUS000.37	135	7.35	7.50	0.759	10.34%	1	8.46	7.46	7.2	7.75	0.55	-22.611	85.556
1ABEC004.76	41	6.77	6.93	0.562	8.30%	5.69	7.89	2.2	6.52	7.19	0.67	-1.228	-0.646
1ANOG005.69	54	6.93	7.07	0.581	8.38%	5.7	8	2.3	6.7	7.32	0.62	-2.024	-0.176
1ACRM001.20	41	6.61	6.74	0.528	7.98%	5.53	7.54	2.01	6.45	6.98	0.53	-1.283	-0.835
1AGOO022.44	162	6.82	6.90	0.488	7.16%	5.56	7.71	2.15	6.61	7.13	0.52	-4.422	0.830
1AGOO044.36	143	6.82	6.89	0.516	7.56%	5.55	7.77	2.22	6.66	7.1	0.44	-3.409	0.642
1ALIM001.16	29	7.08	7.39	0.792	11.18%	5.68	8.15	2.47	6.33	7.72	1.39	-1.137	-1.336
1ACAX004.57	203	6.93	6.99	0.479	6.91%	5.6	8.1	2.5	6.7	7.2	0.5	-4.337	2.067
1ANOC000.42	52	6.86	6.90	0.589	8.58%	5.61	8.5	2.89	6.555	7.2	0.645	-0.069	0.964
1ANOC004.38	12	6.19	6.12	0.367	5.93%	5.66	7	1.34	5.99	6.275	0.285	1.589	0.950
1ASOC001.66	55	6.85	6.98	0.560	8.17%	5.68	7.74	2.06	6.59	7.27	0.68	-2.436	-0.328
1APIA001.80	43	6.55	6.73	0.521	7.95%	5.57	7.43	1.86	6.05	6.9	0.85	-1.686	-0.791

Summary Statistics for turbidity (NTU) at DEQ stations with long records.

Site ID	*Count*	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1ABUL025.94	32	8.40	5.05	11.648	138.64%	1.6	63	61.4	3.55	8.22	4.67	9.05	19.27
1ALII003.97	31	16.96	8.60	37.529	221.25%	1.93	208.5	206.57	4.50	12.10	7.60	10.92	27.79
1ASUG004.42	32	13.27	5.87	23.921	180.23%	3.07	110	106.93	4.09	9.20	5.11	8.26	14.21
1ABRB002.15	72	20.15	11.90	22.442	111.39%	3.59	155	151.41	7.89	25.85	17.97	12.98	32.62
1AHPR003.87	31	16.10	5.50	41.824	259.85%	2.06	235	232.94	3.50	8.20	4.70	11.61	30.97
1AGOO002.38	86	9.82	6.90	8.941	91.02%	1.36	57	55.64	4.65	11.60	6.95	10.48	19.00
1ASYC002.03	42	14.00	8.05	22.489	160.61%	1.68	142	140.32	5.60	11.00	5.40	12.77	35.22
1ATUS000.37	42	52.17	4.65	237.858	455.95%	1.1	1540	1538.9	3.30	10.30	7.00	16.58	52.92
1ABEC004.76	42	12.06	5.70	17.019	141.11%	1.37	83	81.63	3.34	11.70	8.36	7.47	11.32
1ANOG005.69	38	17.83	7.37	31.701	177.81%	0.83	168	167.17	4.90	14.70	9.80	9.39	18.71
1ACRM001.20	41	13.31	5.50	26.362	198.12%	1.6	155	153.4	3.60	10.80	7.20	11.58	28.65
1AGOO022.44	84	7.10	4.06	13.788	194.14%	1.26	120	118.74	2.46	6.15	3.70	26.06	103.90
1AGOO044.36	78	4.90	4.06	3.828	78.16%	0.98	20.4	19.42	2.33	6.20	3.87	7.54	9.37
1ALIM001.16	32	12.49	8.83	12.796	102.48%	1.8	61	59.2	4.60	14.20	9.61	5.88	8.19
1ACAX004.57	77	8.43	5.60	9.547	113.25%	1.31	58	56.69	4.22	8.69	4.47	13.70	29.50
1ANOC000.42	28	7.61	6.48	5.111	67.19%	1.5	22	20.5	4.35	8.95	4.60	3.54	2.70
1ANOC004.38	12	8.71	8.22	5.603	64.36%	1.83	17.4	15.57	3.43	13.70	10.27	0.48	-0.99
1ASOC001.66	31	27.94	7.20	80.746	288.99%	3.11	453	449.89	5.04	18.40	13.36	11.81	31.78
1APIA001.80	36	10.38	4.62	16.337	157.40%	1.3	81.7	80.4	3.65	8.35	4.71	7.96	13.58

Summary Statistics for Total Phosphorous (mg/L) at DEQ stations with long records.

Site ID	*Count*	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1ABUL025.94	69	0.06	0.05	0.064	116.36%	0.01	0.52	0.51	0.03	0.05	0.02	19.99	70.06
1ALII003.97	69	0.06	0.05	0.068	114.27%	0.01	0.52	0.51	0.03	0.05	0.02	17.23	53.30
1ASUG004.42	189	0.08	0.05	0.099	117.46%	0.01	1.2	1.19	0.05	0.10	0.05	46.07	248.45
1ABRB002.15	238	0.08	0.05	0.058	72.19%	0.01	0.5	0.49	0.05	0.10	0.05	21.36	52.23
1AHPR003.87	163	0.11	0.10	0.164	148.31%	0.01	1.99	1.98	0.05	0.10	0.05	49.86	282.24
1AGOO002.38	273	0.10	0.05	0.132	131.66%	0.005	1.4	1.395	0.05	0.10	0.05	36.31	135.01
1ASYC002.03	57	0.07	0.05	0.048	69.32%	0.005	0.34	0.335	0.05	0.10	0.05	9.56	25.99
1ATUS000.37	173	0.20	0.10	0.298	149.30%	0.005	2	1.995	0.05	0.20	0.15	19.78	42.30
1ABEC004.76	74	0.06	0.05	0.050	84.63%	0.005	0.3	0.295	0.03	0.06	0.03	8.78	13.48
1ANOG005.69	150	0.14	0.10	0.148	102.37%	0.005	1.5	1.495	0.05	0.20	0.15	28.20	119.96
1ACRM001.20	53	0.07	0.05	0.063	86.52%	0.02	0.4	0.38	0.05	0.10	0.05	9.75	20.74
1AGOO022.44	244	0.08	0.05	0.056	72.67%	0.005	0.4	0.395	0.05	0.10	0.05	16.95	27.79
1AGOO030.75	24	0.04	0.04	0.033	76.97%	0.01	0.18	0.17	0.02	0.05	0.03	6.53	13.47
1AGOO044.36	173	0.08	0.05	0.274	333.50%	0.005	3.6	3.595	0.05	0.08	0.03	67.01	431.62
1ALIM001.16	55	0.05	0.05	0.036	70.17%	0.005	0.2	0.195	0.03	0.05	0.02	5.99	8.18
1ACAX004.57	263	0.08	0.05	0.087	103.40%	0.01	0.7	0.69	0.05	0.10	0.05	28.14	69.93
1ANOC004.38	12	0.06	0.05	0.029	50.36%	0.02	0.1	0.08	0.04	0.09	0.05	0.42	-0.87
1ASOC001.66	132	0.12	0.10	0.155	131.08%	0.005	1.3	1.295	0.05	0.10	0.05	26.29	87.75
1APIA001.80	71	0.06	0.05	0.057	100.68%	0.01	0.43	0.42	0.02	0.05	0.03	15.59	47.32

Summary Statistics for Nitrate (mg/L) at DEQ stations with long records.

Site ID	*Count*	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1ABUL025.94	51	0.23	0.18	0.219	95.39%	0.02	0.73	0.71	0.02	0.38	0.36	2.35	-0.52
1ALII003.97	45	0.35	0.31	0.292	84.58%	0.02	1.33	1.31	0.12	0.52	0.40	3.28	2.20
1ASUG004.42	189	0.85	0.79	0.492	57.52%	0.07	2.97	2.9	0.50	1.10	0.60	7.33	7.82
1ABRB002.15	258	0.85	0.69	1.196	141.15%	0	11.46	11.46	0.27	1.04	0.77	37.17	132.27
1AHPR003.87	167	1.11	1.00	1.112	100.02%	0.02	11.2	11.18	0.41	1.57	1.16	25.58	106.69
1AGOO002.38	277	1.27	1.11	0.944	74.09%	0.02	8.17	8.15	0.75	1.50	0.75	23.12	66.72
1ASYC002.03	57	0.88	0.87	0.303	34.58%	0.04	1.5	1.46	0.72	1.07	0.35	-1.77	1.54
1ATUS000.37	242	2.98	2.12	2.561	86.08%	0.02	17.9	17.88	1.31	3.75	2.44	12.27	16.26
1ABEC004.76	55	0.80	0.69	0.547	68.09%	0.02	2.6	2.58	0.37	1.23	0.86	2.45	1.29
1ANOG005.69	201	1.65	1.60	0.852	51.73%	0.025	4.29	4.265	0.98	2.29	1.31	1.93	-0.41
1ACRM001.20	53	0.72	0.74	0.405	55.93%	0.02	1.68	1.66	0.50	0.93	0.43	0.67	-0.26
1AGOO022.44	266	0.83	0.81	0.548	66.21%	0.005	3	2.995	0.37	1.20	0.83	2.33	-0.44
1AGOO030.75	40	1.27	1.19	0.642	50.44%	0.15	3.7	3.55	0.89	1.57	0.68	3.32	5.21
1AGOO044.36	164	0.58	0.54	0.385	66.25%	0.02	1.9	1.88	0.31	0.81	0.50	4.49	2.41
1ALIM001.16	46	1.43	1.30	0.732	51.26%	0.28	4.38	4.1	0.97	1.78	0.81	4.00	6.35
1ACAX004.57	238	1.20	1.10	1.823	152.29%	0.02	27	26.98	0.54	1.58	1.04	76.17	537.98
1ANOC004.38	26	0.92	0.88	0.474	51.41%	0.12	2.2	2.08	0.62	1.19	0.57	1.31	0.78
1ASOC001.66	150	1.59	1.53	0.855	53.69%	0.025	3.6	3.575	1.00	2.25	1.25	1.18	-1.84
1APIA001.80	51	0.57	0.56	0.290	50.81%	0.02	1.4	1.38	0.36	0.74	0.38	2.28	1.16

Summary Statistics for Ammonia (mg/L) at DEQ stations with long records.

Site ID	*Count*	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1ASUG004.42	232	0.14	0.05	0.290	209.57%	0.02	2.53	2.51	0.04	0.10	0.06	30.73	92.73
1ABRB002.15	302	0.08	0.05	0.098	123.93%	0.02	1	0.98	0.04	0.09	0.05	38.36	138.69
1AHPR003.87	189	0.08	0.05	0.131	155.66%	0.02	1.19	1.17	0.04	0.06	0.02	32.18	113.02
1AGOO002.38	319	0.16	0.05	0.504	307.82%	0.02	5.5	5.48	0.02	0.10	0.08	58.40	265.40
1ASYC002.03	57	0.04	0.02	0.055	131.64%	0.02	0.38	0.36	0.02	0.04	0.02	15.00	42.24
1ATUS000.37	268	0.89	0.31	1.938	217.05%	0	22.5	22.5	0.10	0.80	0.71	43.76	203.76
1ABEC004.76	102	0.05	0.04	0.056	102.26%	0.02	0.4	0.38	0.02	0.05	0.03	13.33	29.89
1ANOG005.69	242	0.09	0.05	0.116	125.70%	0.005	1.1	1.095	0.05	0.10	0.05	30.27	98.15
1ACRM001.20	53	0.05	0.02	0.060	110.55%	0.02	0.35	0.33	0.02	0.07	0.05	9.48	18.78
1AGOO022.44	294	0.05	0.05	0.094	181.26%	0.02	1.4	1.38	0.02	0.05	0.03	78.14	523.67
1AGOO030.75	194	0.06	0.02	0.331	540.89%	0.005	4.62	4.615	0.02	0.05	0.03	77.55	535.75
1AGOO044.36	74	0.06	0.04	0.071	118.82%	0.02	0.4	0.38	0.02	0.05	0.03	12.06	23.92
1ALIM001.16	271	0.05	0.04	0.066	131.00%	0.02	0.7	0.68	0.02	0.05	0.03	43.33	176.85
1ACAX004.57	55	0.08	0.05	0.055	70.52%	0.02	0.3	0.28	0.05	0.10	0.05	5.95	6.54
1ANOC004.38	52	0.08	0.05	0.057	73.37%	0.02	0.3	0.28	0.05	0.10	0.05	5.97	6.42
1ASOC001.66	173	0.08	0.05	0.084	106.96%	0.02	0.5	0.48	0.05	0.08	0.03	16.43	27.56
1APIA001.80	65	0.03	0.02	0.025	78.04%	0.02	0.13	0.11	0.02	0.04	0.02	8.26	10.41

Summary Statistics for Chloride (mg/L) at DEQ stations with long records.

Site ID	*Count*	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1ABUL025.94	46	9.96	9.15	4.331	43.48%	2.5	26	23.5	7.10	11.40	4.30	4.63	5.85
1ALII003.97	45	10.77	8.80	5.905	54.85%	3.7	26.3	22.6	6.30	13.70	7.40	3.01	0.61
1ASUG004.42	70	40.27	24.50	45.324	112.54%	9.7	295	285.3	19.80	40.40	20.60	12.29	26.57
1ABRB002.15	137	22.91	17.60	22.134	96.63%	3.8	193	189.2	13.10	23.70	10.60	22.55	69.03
1AHPR003.87	64	43.03	28.35	39.887	92.70%	3.8	221	217.2	20.00	48.80	28.80	8.05	11.29
1AGOO002.38	146	15.42	11.85	10.803	70.04%	5	69.4	64.4	8.70	18.30	9.60	12.64	19.07
1ASYC002.03	46	9.01	7.60	4.016	44.57%	4.7	25.6	20.9	6.80	9.50	2.70	5.83	7.80
1ATUS000.37	68	43.54	36.70	31.380	72.08%	5	191	186	25.30	55.85	30.55	7.67	12.94
1ABEC004.76	41	10.26	10.20	2.952	28.77%	5	16.8	11.8	8.20	11.60	3.40	0.80	-0.38
1ANOG005.69	41	13.22	12.40	5.213	39.43%	5	24.9	19.9	9.00	16.70	7.70	1.28	-0.76
1ACRM001.20	41	13.22	12.40	5.213	39.43%	5	24.9	19.9	9.00	16.70	7.70	1.28	-0.76
1AGOO022.44	139	11.97	10.80	4.442	37.12%	2.5	28.4	25.9	8.87	14.10	5.23	5.53	3.83
1AGOO044.36	130	15.97	10.25	27.833	174.33%	2.5	242	239.5	7.60	14.50	6.90	30.17	105.14
1ALIM001.16	29	5.35	5.50	1.612	30.12%	2.5	8.6	6.1	5.10	6.10	1.00	-0.82	0.17
1ACAX004.57	144	12.81	10.70	12.110	94.55%	5	120	115	9.00	13.05	4.05	35.15	139.31
1ANOC000.42	45	10.16	9.70	2.925	28.79%	5	17.5	12.5	7.80	12.40	4.60	1.21	-0.63
1ANOC004.38	12	13.93	13.65	3.999	28.70%	6.3	20.9	14.6	11.75	16.05	4.30	0.09	0.23
1ASOC001.66	47	15.11	14.60	5.592	37.01%	5	33.2	28.2	11.50	17.50	6.00	3.06	3.26
1APIA001.80	44	7.63	5.95	8.707	114.20%	2.5	62	59.5	5.00	8.20	3.20	15.98	50.73

Summary Statistics for Sulfate (mg/L) at DEQ stations with long records.

Site ID	*Count*	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1ABUL025.94	46	13.53	12.35	6.316	46.68%	5	41.1	36.1	10.00	15.30	5.30	6.01	10.24
1ALII003.97	45	14.50	12.50	10.433	71.93%	2.9	53.1	50.2	9.30	16.40	7.10	5.93	6.97
1ASUG004.42	66	20.55	19.35	16.006	77.89%	3.54	144	140.46	16.70	21.70	5.00	24.00	93.87
1ABRB002.15	120	22.53	22.40	7.383	32.78%	6.6	46.7	40.1	17.75	27.25	9.50	2.27	2.34
1AHPR003.87	62	24.06	23.15	8.715	36.22%	7.8	64.9	57.1	20.20	26.40	6.20	6.29	12.58
1AGOO002.38	141	15.91	14.70	6.360	39.98%	1.5	61.1	59.6	12.80	16.60	3.80	16.29	46.13
1ASYC002.03	46	11.55	11.20	3.909	33.85%	5	20.4	15.4	7.70	14.10	6.40	0.45	-1.06
1ATUS000.37	64	24.95	23.15	11.269	45.16%	5	89.8	84.8	19.10	27.80	8.70	10.19	27.62
1ABEC004.76	41	15.05	15.90	4.079	27.11%	5.5	21.8	16.3	13.20	17.40	4.20	-1.74	0.24
1ANOG005.69	40	17.99	17.85	4.776	26.55%	5	32.9	27.9	16.30	19.55	3.25	0.16	4.25
1ACRM001.20	42	10.78	11.35	2.462	22.84%	5	15.7	10.7	8.70	12.50	3.80	-0.56	-0.82
1AGOO022.44	138	12.88	12.40	4.108	31.90%	5.2	34.2	29	10.70	14.30	3.60	11.77	23.05
1AGOO044.36	130	12.95	10.95	10.434	80.57%	3.1	112.1	109	9.80	12.60	2.80	33.52	149.89
1ALIM001.16	29	9.95	10.40	3.945	39.64%	2.5	16.6	14.1	6.80	12.70	5.90	0.18	-1.01
1ACAX004.57	139	15.43	15.10	4.755	30.81%	2.5	38.8	36.3	12.80	17.30	4.50	8.66	17.24
1ANOC000.42	44	12.85	12.75	3.439	26.77%	5	22.9	17.9	10.90	14.70	3.80	1.60	2.09
1ANOC004.38	12	12.38	12.85	4.137	33.41%	6.4	21.9	15.5	9.40	14.35	4.95	1.09	1.07
1ASOC001.66	12	12.38	12.85	4.137	33.41%	6.4	21.9	15.5	9.40	14.35	4.95	1.09	1.07
1APIA001.80	44	10.00	10.05	4.772	47.74%	4.5	35.4	30.9	7.15	11.40	4.25	9.62	25.16

Summary Statistics for Fluoride (mg/L) at DEQ stations with long records.

Site ID	*Count*	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1ABUL025.94	10	0.10	0.05	0.073	74.95%	0.025	0.25	0.225	0.05	0.15	0.10	1.41	0.25
1ALII003.97	9	0.09	0.05	0.074	81.82%	0.025	0.25	0.225	0.05	0.14	0.09	1.82	0.99
1ASUG004.42	32	0.13	0.15	0.060	47.44%	0.025	0.23	0.205	0.05	0.16	0.11	-0.21	-1.20
1ABRB002.15	29	0.13	0.13	0.074	58.67%	0.05	0.25	0.2	0.05	0.19	0.14	0.59	-1.59
1AHPR003.87	26	0.17	0.15	0.114	68.77%	0.04	0.6	0.56	0.10	0.18	0.08	4.80	8.08
1AGOO002.38	48	0.14	0.12	0.112	82.07%	0.025	0.57	0.545	0.05	0.16	0.11	5.41	6.30
1ASYC002.03	48	0.14	0.12	0.112	82.07%	0.025	0.57	0.545	0.05	0.16	0.11	5.41	6.30
1ATUS000.37	9	0.08	0.05	0.050	63.51%	0.025	0.15	0.125	0.05	0.13	0.08	0.97	-0.89
1ABEC004.76	31	0.30	0.29	0.130	43.95%	0.05	0.52	0.47	0.19	0.38	0.19	0.93	-0.84
1ANOG005.69	7	0.12	0.05	0.095	78.91%	0.05	0.25	0.2	0.05	0.25	0.20	0.90	-0.82
1ACRM001.20	8	0.13	0.08	0.093	73.31%	0.05	0.25	0.2	0.05	0.23	0.18	0.64	-1.17
1AGOO022.44	7	0.12	0.05	0.094	79.63%	0.05	0.25	0.2	0.05	0.25	0.20	0.97	-0.74
1AGOO044.36	45	0.10	0.05	0.065	68.52%	0.025	0.29	0.265	0.05	0.12	0.07	4.01	2.15
1ACAX004.57	42	0.09	0.05	0.062	67.85%	0.025	0.25	0.225	0.05	0.13	0.08	3.41	1.35
1ANOC000.42	48	0.10	0.08	0.076	72.72%	0.025	0.43	0.405	0.05	0.14	0.09	5.96	8.98
1ASOC001.66	8	0.10	0.08	0.051	53.97%	0.05	0.16	0.11	0.05	0.15	0.10	0.40	-1.32
1APIA001.80	9	0.09	0.05	0.052	60.05%	0.025	0.15	0.125	0.05	0.15	0.10	0.52	-1.18

Summary Statistics for Biochemical Oxygen Demand (mg/L) at DEQ stations with long records.

	Count	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1ABUL025.94	46	1.86	1.00	1.773	95.37%	0.5	11	10.5	1.00	2.00	1.00	9.52	21.38
1ALII003.97	45	1.47	1.00	0.566	38.53%	0.5	3	2.5	1.00	2.00	1.00	1.53	-0.80
1ASUG004.42	203	2.03	2.00	1.477	72.70%	0.5	11	10.5	1.00	2.00	1.00	15.41	30.82
1ABRB002.15	228	2.78	2.00	3.223	115.97%	0.5	28	27.5	1.00	3.00	2.00	30.86	94.57
1AHPR003.87	157	2.10	2.00	1.982	94.50%	0.5	22	21.5	1.00	2.00	1.00	35.40	168.49
1AGOO002.38	286	2.38	2.00	2.389	100.37%	0.5	17	16.5	1.00	3.00	2.00	25.06	54.41
1ASYC002.03	46	1.70	1.45	1.141	66.95%	0.5	7	6.5	1.00	2.00	1.00	6.73	12.99
1ATUS000.37	214	3.81	3.00	2.952	77.43%	0.5	24	23.5	2.00	5.00	3.00	16.20	35.80
1ABEC004.76	43	1.83	1.20	1.407	76.67%	0.5	8.3	7.8	1.00	2.00	1.00	7.21	13.12
1ANOG005.69	123	2.10	2.00	2.224	106.02%	0.5	21	20.5	1.00	2.00	1.00	28.08	106.73
1ACRM001.20	42	1.88	1.85	1.209	64.45%	0.5	6	5.5	1.00	2.00	1.00	4.70	4.18
1AGOO022.44	240	1.62	1.00	1.552	95.97%	0.5	14	13.5	1.00	2.00	1.00	32.75	103.92
1AGOO044.36	145	1.56	1.00	2.020	129.20%	0.5	21	20.5	1.00	2.00	1.00	35.90	158.05
1ALIM001.16	30	1.95	1.50	1.315	67.45%	0.5	5	4.5	1.00	2.00	1.00	2.98	0.97
1ACAX004.57	251	1.73	1.00	1.973	114.15%	0.5	25	24.5	1.00	2.00	1.00	50.47	264.62
1ANOC000.42	116	2.13	2.00	2.177	102.38%	0.04	14	13.96	1.00	2.00	1.00	16.03	32.90
1ANOC004.38	13	1.62	1.00	0.768	47.54%	1	3	2	1.00	2.00	1.00	1.25	-0.43
1ASOC001.66	123	2.17	2.00	2.893	133.14%	0.5	27	26.5	1.00	2.00	1.00	27.58	104.58
1APIA001.80	44	1.50	1.00	0.833	55.35%	0.5	4	3.5	1.00	2.00	1.00	3.80	2.81

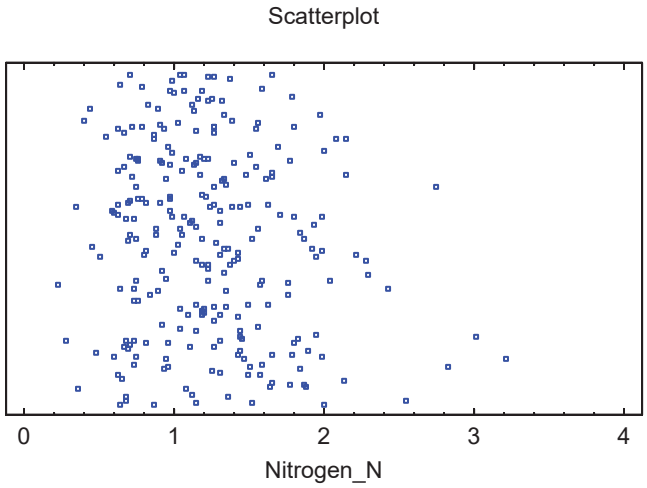
Summary statistics for Chemical Oxygen Demand (mg/L) at DEQ stations with long records.

Site ID	*Count*	*Mean*	*Median*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1ABUL025.94	33	14.67	12.00	7.45	0.51	6	37	31	10	18	8	2.933	1.699
1ALII003.97	32	14.29	11.55	9.70	0.68	5.2	51	45.8	8.6	16	7.4	6.150	9.102
1ASUG004.42	151	13.33	11.00	7.95	0.60	2	53	51	8.1	16	7.9	8.005	10.150
1ABRB002.15	192	19.44	17.00	15.74	0.81	0	180	180	13.25	22.9	9.65	40.891	188.123
1AHPR003.87	145	16.00	15.00	8.28	0.52	0.25	53	52.75	10.2	20	9.8	5.514	5.685
1AGOO002.38	217	12.06	11.00	9.13	0.76	0.5	108	107.5	7	15	8	34.456	169.313
1ASYC002.03	33	11.37	9.20	6.48	0.57	1.9	29	27.1	7.4	13.2	5.8	2.619	1.067
1ATUS000.37	149	17.49	16.00	10.93	0.62	0	91	91	12	22	10	12.348	33.784
1ABEC004.76	28	13.35	12.00	8.07	0.60	2.5	40.2	37.7	9	14.5	5.5	3.983	4.575
1ANOG005.69	106	12.75	11.00	13.29	1.04	0.5	131	130.5	8	14	6	29.502	127.568
1ACRM001.20	30	13.62	12.25	6.83	0.50	2.5	35	32.5	9.3	16.7	7.4	2.787	2.506
1AGOO022.44	207	9.52	8.00	8.49	0.89	0.5	75	74.5	5	11	6	27.841	97.845
1AGOO044.36	118	8.12	7.00	6.45	0.79	0.5	41	40.5	4.5	10	5.5	12.255	22.839
1ALIM001.16	211	11.27	9.40	13.52	1.20	0.5	181	180.5	6	13	7	57.282	352.684
1ACAX004.57	105	12.80	10.00	11.33	0.89	0.04	91	90.96	7	15	8	17.090	50.240
1ASOC001.66	110	12.43	9.50	16.41	1.32	0.5	164	163.5	6.1	15	8.9	31.990	145.199

Section E) Statistical and graphical analysis of individual analytes for all sites with long records.

1) One-Variable Analysis - Nitrogen_N (mg/L)

Data variable: Nitrogen_N
255 values ranging from 0.22 to 3.21



Summary Statistics for Nitrogen_N (mg/L)

Count	255
Average	1.22984
Median	1.18
Standard deviation	0.494337
Coeff. of variation	40.1951%
Minimum	0.22
Maximum	3.21
Range	2.99
Lower quartile	0.86
Upper quartile	1.51
Interquartile range	0.65
Stnd. skewness	5.56736
Stnd. kurtosis	4.08905

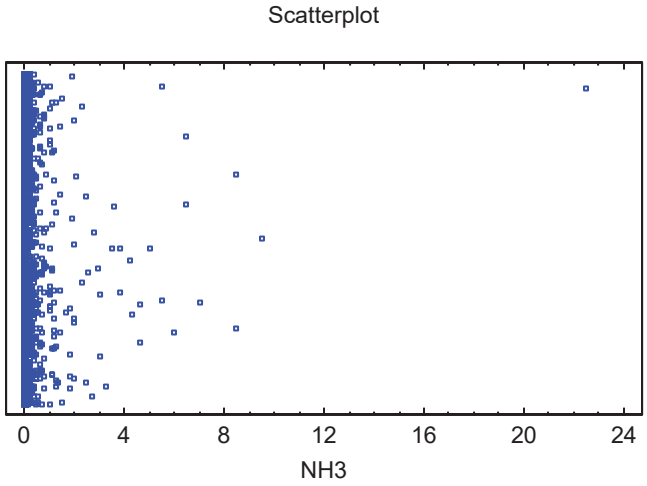
Percentiles for Nitrogen_N

	Percentiles
1.0%	0.35
5.0%	0.6
10.0%	0.68
25.0%	0.86
50.0%	1.18
75.0%	1.51
90.0%	1.88
95.0%	2.08
99.0%	2.83

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2) One-Variable Analysis - NH3 (mg/L)

Data variable: NH3
2957 values ranging from 0.0 to 22.5



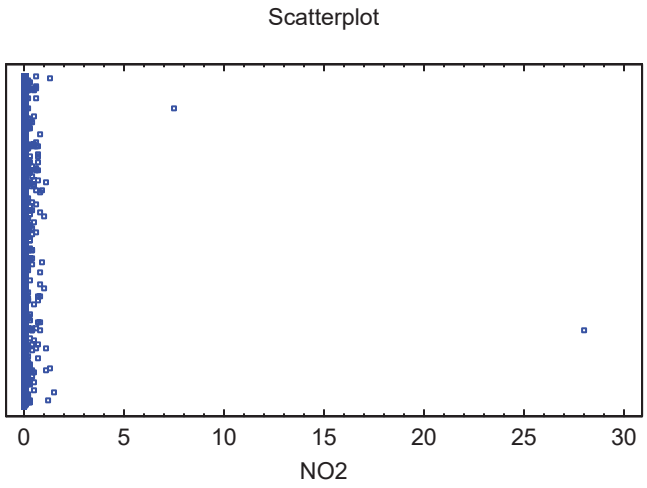
Summary Statistics for NH3

Count	2957
Average	0.157276
Median	0.05
Standard deviation	0.663862
Coeff. of variation	422.1%
Minimum	0.0
Maximum	22.5
Range	22.5
Lower quartile	0.02
Upper quartile	0.09
Interquartile range	0.07
Stnd. skewness	395.157
Stnd. kurtosis	5351.07

The StatAdvisor
This table shows summary statistics for NH3. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.

3) One-Variable Analysis - NO2 (mg/L)

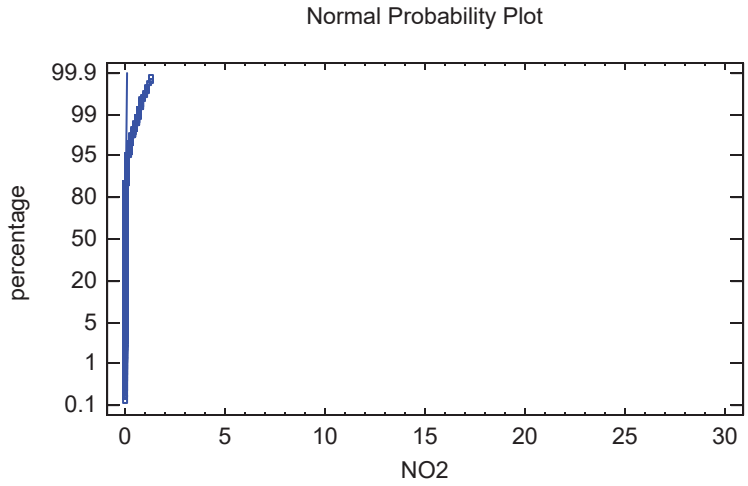
Data variable: NO2
2784 values ranging from 0.0 to 28.0



Summary Statistics for NO2

Count	2784
Average	0.0545366
Median	0.01
Standard deviation	0.5603
Coeff. of variation	1027.38%
Minimum	0.0
Maximum	28.0
Range	28.0
Lower quartile	0.005
Upper quartile	0.03
Interquartile range	0.025
Stnd. skewness	980.269
Stnd. kurtosis	24089.6

The StatAdvisor
This table shows summary statistics for NO2. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.

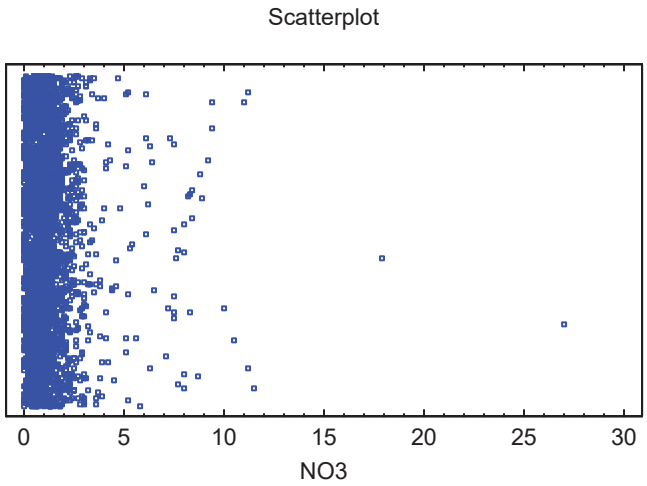


Percentiles for NO2

	Percentiles
1.0%	0.005
5.0%	0.005
10.0%	0.005
25.0%	0.005
50.0%	0.01
75.0%	0.03
90.0%	0.07
95.0%	0.17
99.0%	0.7

4) One-Variable Analysis - NO3 (mg/L)

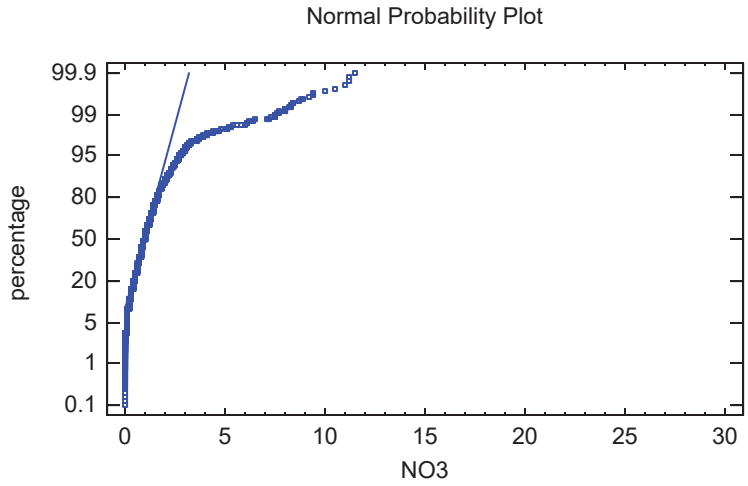
Data variable: NO3
2576 values ranging from 0.0 to 27.0



Summary Statistics for NO3

Count	2576
Average	1.21822
Median	0.96
Standard deviation	1.36392
Coeff. of variation	111.96%
Minimum	0.0
Maximum	27.0
Range	27.0
Lower quartile	0.5
Upper quartile	1.5
Interquartile range	1.0
Stnd. skewness	122.371
Stnd. kurtosis	722.174

The StatAdvisor
This table shows summary statistics for NO3. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.

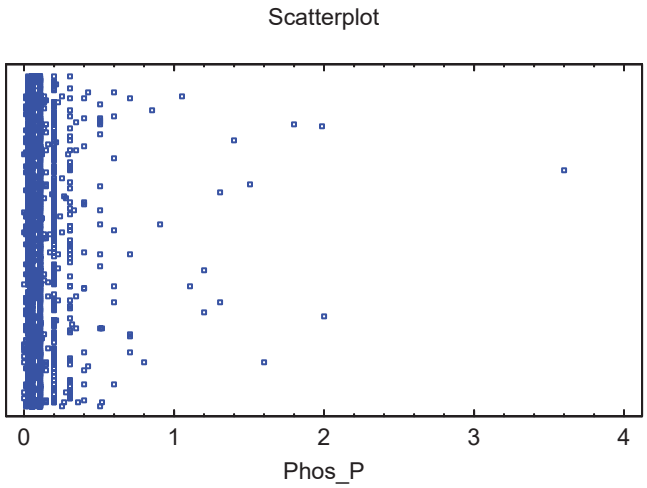


Percentiles for NO3

	Percentiles
1.0%	0.02
5.0%	0.05
10.0%	0.16
25.0%	0.5
50.0%	0.96
75.0%	1.5
90.0%	2.3
95.0%	2.97
99.0%	7.64

5) One-Variable Analysis – Total Phosphorous (mg/L)

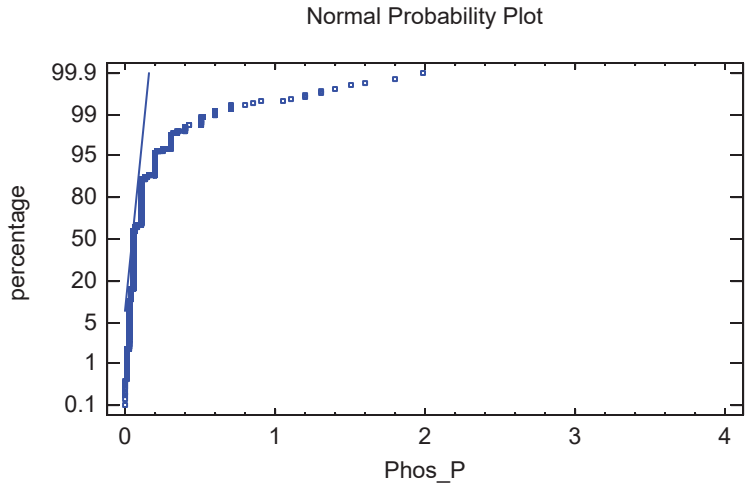
Data variable: Phos_P
2482 values ranging from 0.005 to 3.6



Summary Statistics for Phos_P

Count	2482
Average	0.0950657
Median	0.05
Standard deviation	0.147142
Coeff. of variation	154.779%
Minimum	0.005
Maximum	3.6
Range	3.595
Lower quartile	0.05
Upper quartile	0.1
Interquartile range	0.05
Stnd. skewness	215.094
Stnd. kurtosis	1803.34

The StatAdvisor
This table shows summary statistics for Phos_P. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.

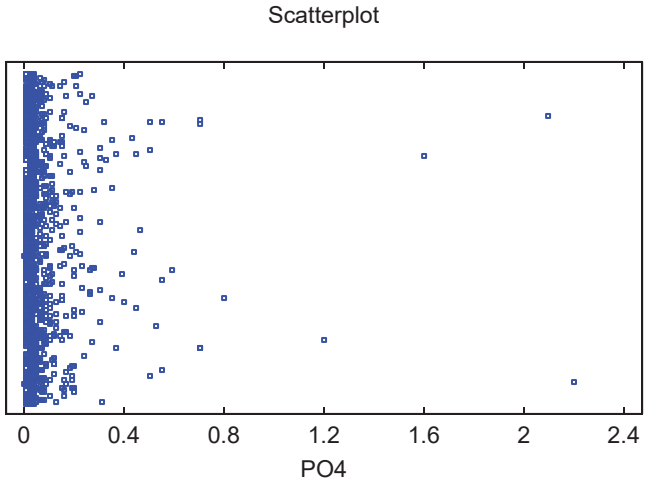


Percentiles for Phos_P

	Percentiles
1.0%	0.01
5.0%	0.02
10.0%	0.03
25.0%	0.05
50.0%	0.05
75.0%	0.1
90.0%	0.2
95.0%	0.24
99.0%	0.6

6) One-Variable Analysis - PO4 (mg/L)

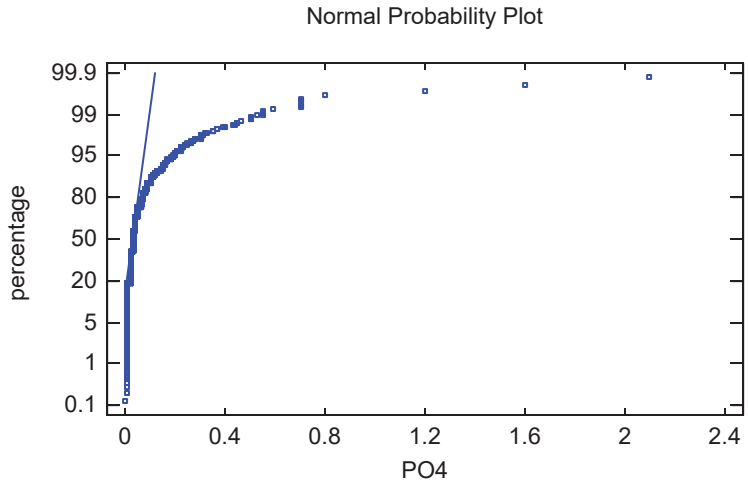
Data variable: PO4
1217 values ranging from 0.0 to 2.2



Summary Statistics for PO4

Count	1217
Average	0.0637839
Median	0.03
Standard deviation	0.13264
Coeff. of variation	207.952%
Minimum	0.0
Maximum	2.2
Range	2.2
Lower quartile	0.02
Upper quartile	0.06
Interquartile range	0.04
Stnd. skewness	132.33
Stnd. kurtosis	869.199

The StatAdvisor
This table shows summary statistics for PO4. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.

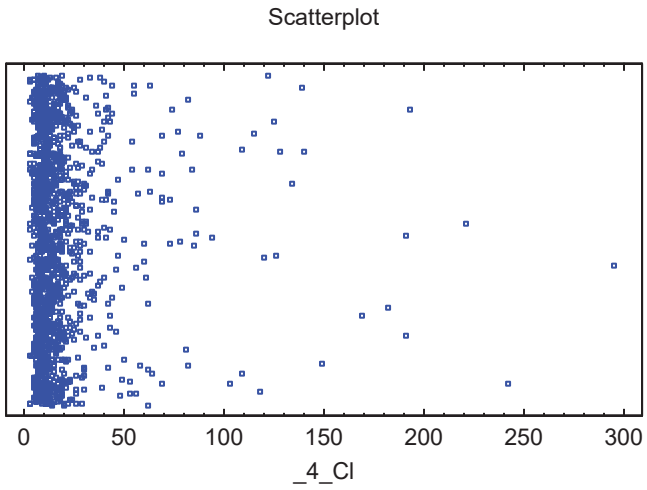


Percentiles for PO4

	Percentiles
1.0%	0.005
5.0%	0.005
10.0%	0.01
25.0%	0.02
50.0%	0.03
75.0%	0.06
90.0%	0.14
95.0%	0.22
99.0%	0.55

7) One-Variable Analysis - _Chloride (mg/L)

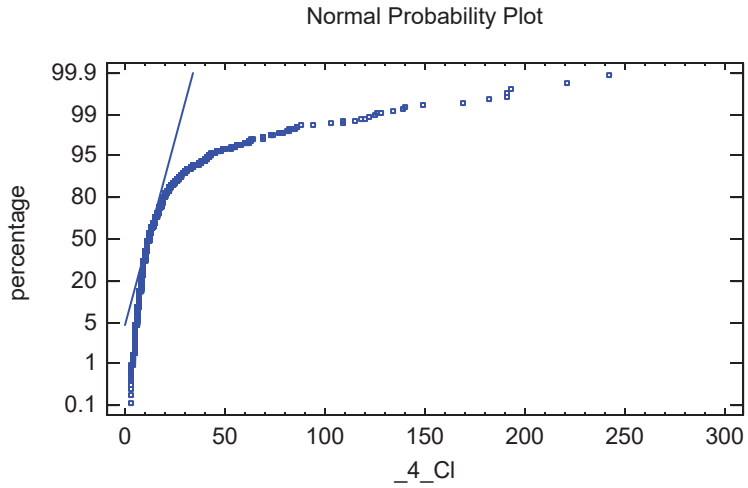
Data variable: Cl
1336 values ranging from 2.5 to 295.0



Summary Statistics for Cl

Count	1336
Average	17.9484
Median	11.6
Standard deviation	22.6946
Coeff. of variation	126.444%
Minimum	2.5
Maximum	295.0
Range	292.5
Lower quartile	8.5
Upper quartile	18.4
Interquartile range	9.9
Stnd. skewness	84.3242
Stnd. kurtosis	324.556

The StatAdvisor
This table shows summary statistics for Cl. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.

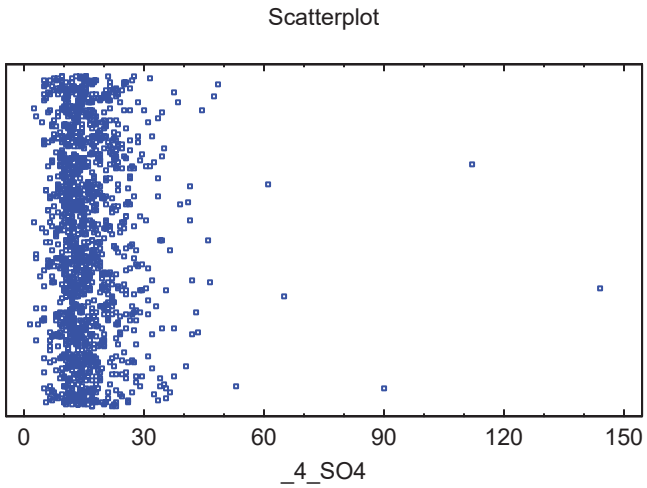


Percentiles for Cl

	Percentiles
1.0%	3.5
5.0%	5.2
10.0%	6.3
25.0%	8.5
50.0%	11.6
75.0%	18.4
90.0%	30.5
95.0%	48.1
99.0%	126.0

8) One-Variable Analysis - _SO4 (mg/L)

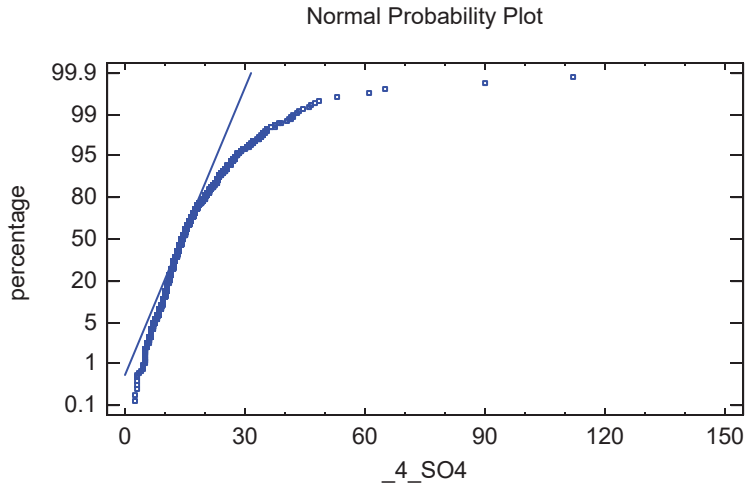
Data variable: SO4
1295 values ranging from 1.5 to 144.0



Summary Statistics for SO4

Count	1295
Average	16.0583
Median	14.3
Standard deviation	8.67813
Coeff. of variation	54.0416%
Minimum	1.5
Maximum	144.0
Range	142.5
Lower quartile	11.3
Upper quartile	18.9
Interquartile range	7.6
Stnd. skewness	71.7196
Stnd. kurtosis	389.713

The StatAdvisor
This table shows summary statistics for SO4. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.

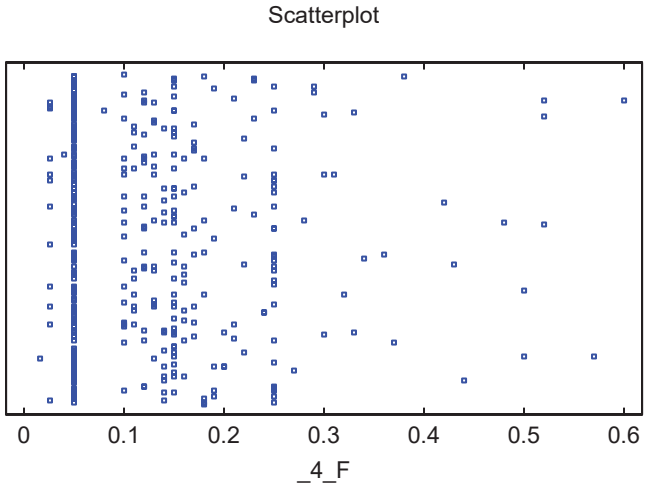


Percentiles for SO4

	Percentiles
1.0%	4.7
5.0%	6.8
10.0%	8.8
25.0%	11.3
50.0%	14.3
75.0%	18.9
90.0%	25.1
95.0%	29.2
99.0%	43.2

9) One-Variable Analysis - _Fluoride (mg/L)

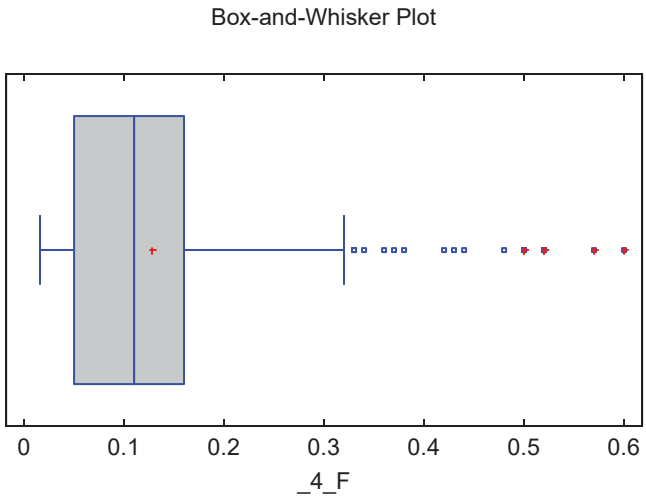
Data variable: F
376 values ranging from 0.015 to 0.6



Summary Statistics for F

Count	376
Average	0.128816
Median	0.11
Standard deviation	0.100914
Coeff. of variation	78.3397%
Minimum	0.015
Maximum	0.6
Range	0.585
Lower quartile	0.05
Upper quartile	0.16
Interquartile range	0.11
Stnd. skewness	14.1248
Stnd. kurtosis	16.2402

The StatAdvisor
This table shows summary statistics for F. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



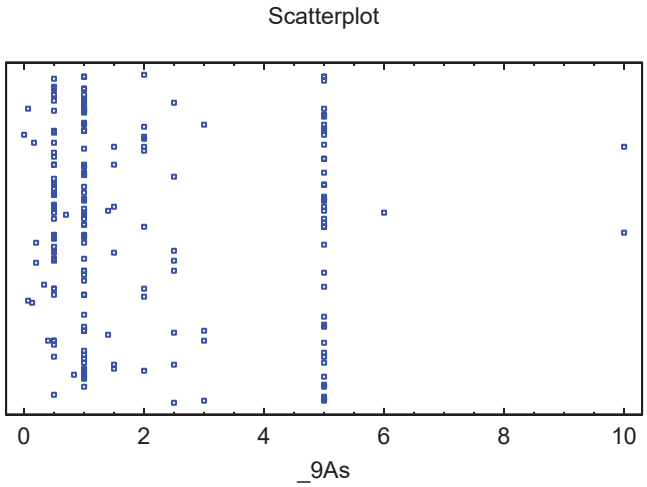
Percentiles for F

	Percentiles
1.0%	0.025
5.0%	0.05
10.0%	0.05
25.0%	0.05
50.0%	0.11
75.0%	0.16
90.0%	0.25
95.0%	0.31
99.0%	0.52

10) One-Variable Analysis - _Arsenic (ug/L)

Data variable: _9As
186 values ranging from 0.0 to 10.0

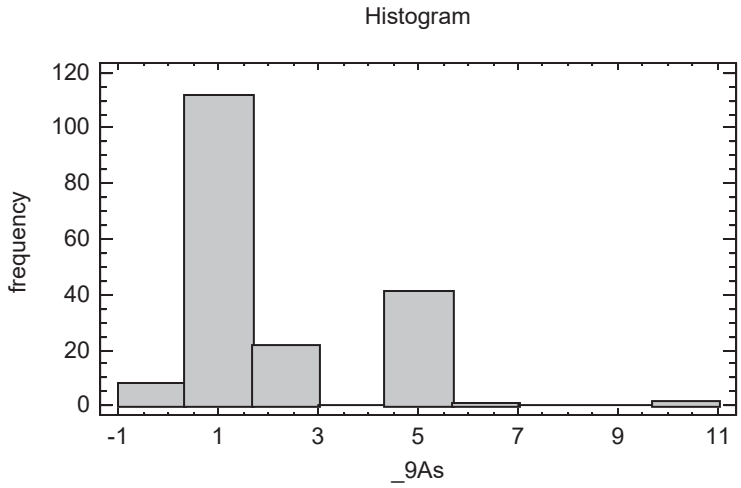
The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.



Summary Statistics for As

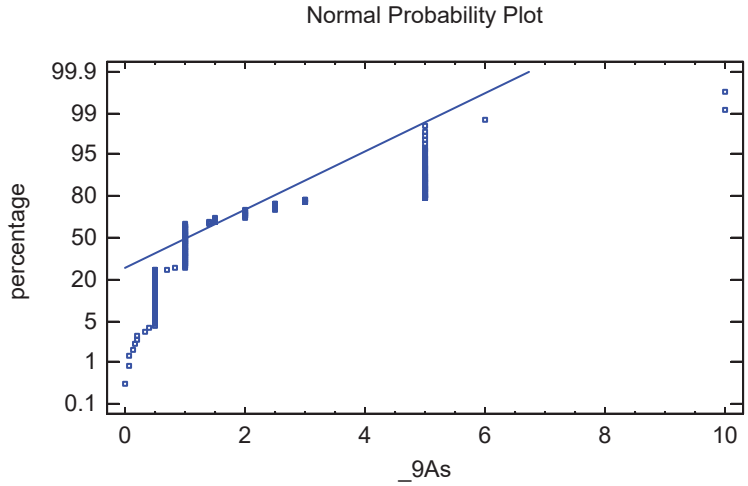
Count	186
Average	2.02898
Median	1.0
Standard deviation	1.95772
Coeff. of variation	96.488%
Minimum	0.0
Maximum	10.0
Range	10.0
Lower quartile	0.5
Upper quartile	3.0
Interquartile range	2.5
Stnd. skewness	7.60093
Stnd. kurtosis	4.1424

The StatAdvisor
This table shows summary statistics for 9As. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



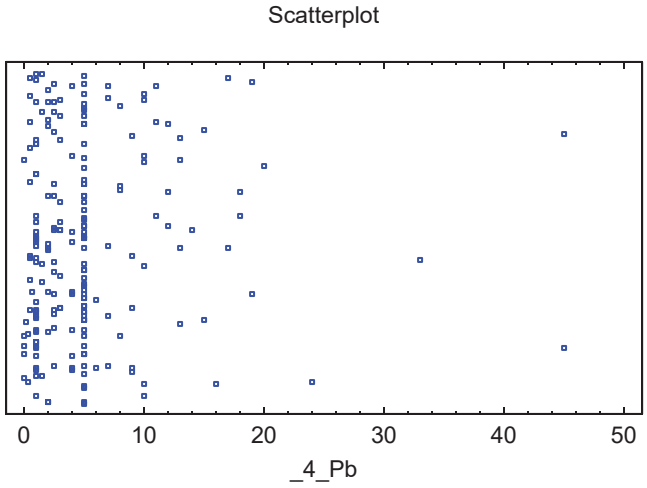
Percentiles for As

	Percentiles
1.0%	0.05
5.0%	0.5
10.0%	0.5
25.0%	0.5
50.0%	1.0
75.0%	3.0
90.0%	5.0
95.0%	5.0
99.0%	10.0



11) One-Variable Analysis - _Lead (ug/L)

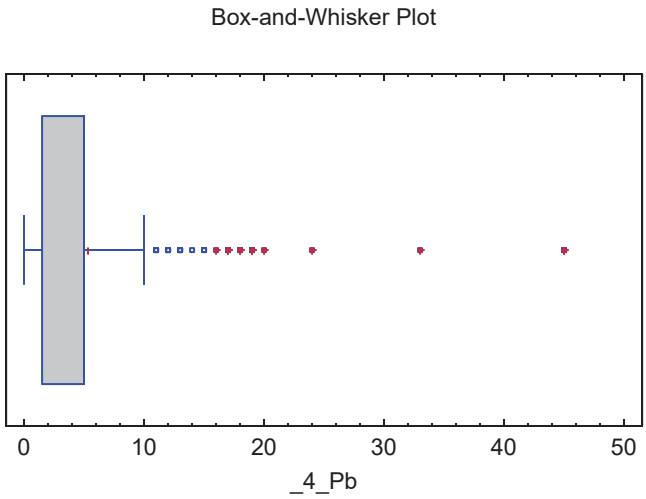
Data variable: Pb
210 values ranging from 0.0 to 45.0



Summary Statistics for Pb

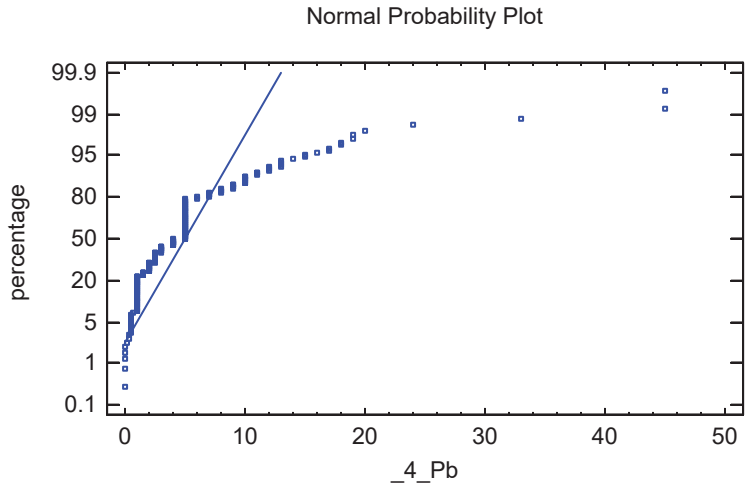
Count	210
Average	5.32979
Median	5.0
Standard deviation	6.20085
Coeff. of variation	116.343%
Minimum	0.0
Maximum	45.0
Range	45.0
Lower quartile	1.5
Upper quartile	5.0
Interquartile range	3.5
Stnd. skewness	20.3492
Stnd. kurtosis	49.6496

The StatAdvisor
This table shows summary statistics for Pb. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



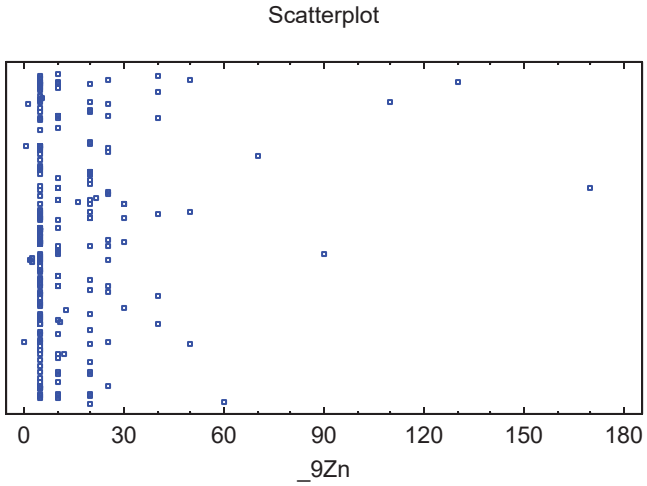
Percentiles for Pb (ug/L)

	Percentiles
1.0%	0.05
5.0%	0.5
10.0%	1.0
25.0%	1.5
50.0%	5.0
75.0%	5.0
90.0%	12.0
95.0%	16.99
99.0%	33.0



12) One-Variable Analysis – Zinc (ug/L)

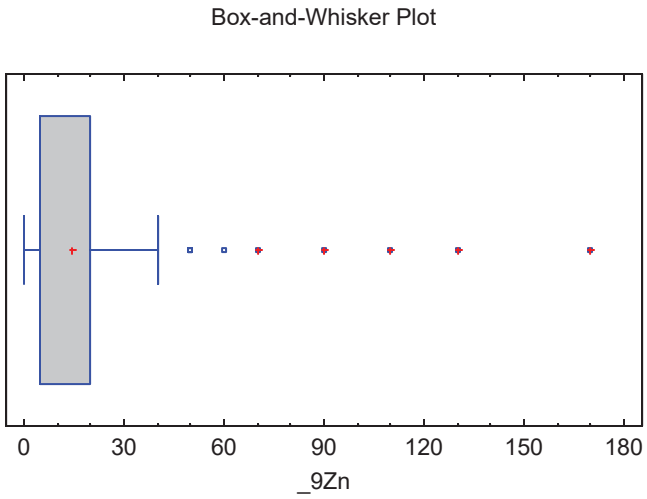
Data variable: Zn
211 values ranging from 0.0 to 169.9



Summary Statistics for Zn

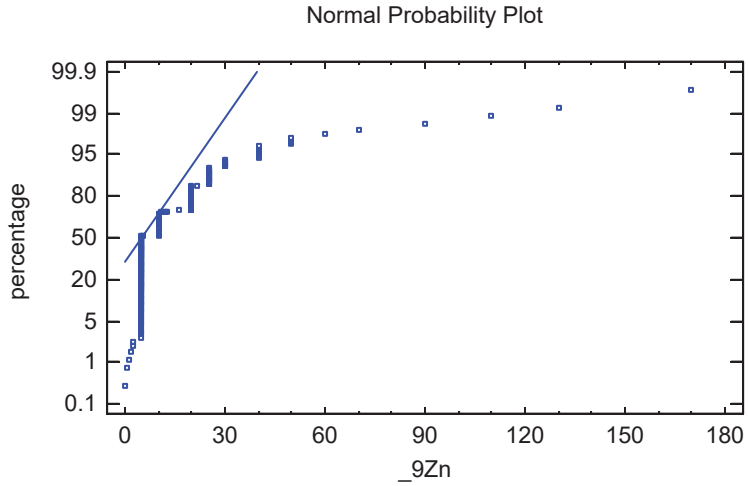
Count	211
Average	14.3877
Median	5.0
Standard deviation	19.4979
Coeff. of variation	135.518%
Minimum	0.0
Maximum	169.9
Range	169.9
Lower quartile	5.0
Upper quartile	19.99
Interquartile range	14.99
Stnd. skewness	27.1185
Stnd. kurtosis	81.6428

The StatAdvisor
This table shows summary statistics for Zn. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



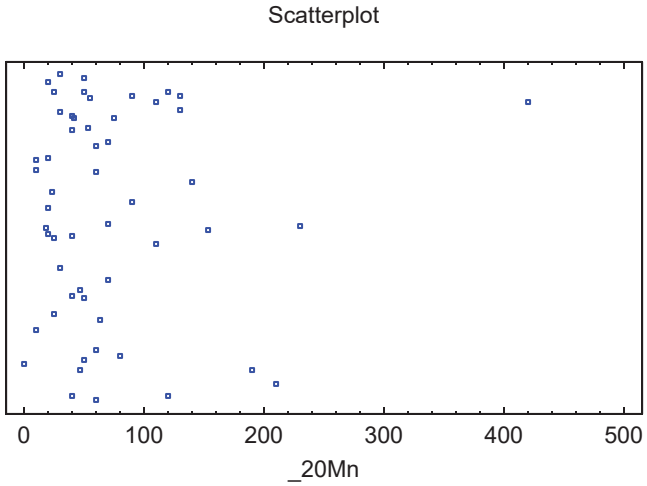
Percentiles for Zn (ug/L)

	Percentiles
1.0%	1.1
5.0%	5.0
10.0%	5.0
25.0%	5.0
50.0%	5.0
75.0%	19.99
90.0%	25.0
95.0%	40.0
99.0%	110.0



13) One-Variable Analysis – Manganese (ug/L)

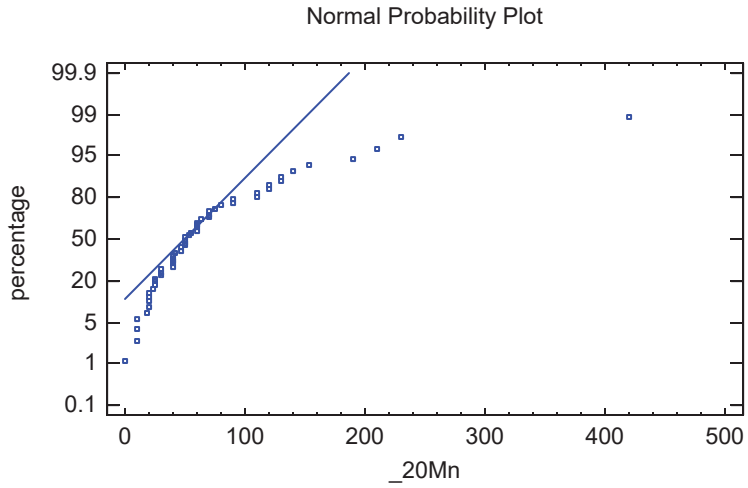
Data variable: Mn
54 values ranging from 0.5 to 420.0



Summary Statistics for Mn (ug/L)

Count	54
Average	71.7106
Median	50.0
Standard deviation	70.1037
Coeff. of variation	97.7592%
Minimum	0.5
Maximum	420.0
Range	419.5
Lower quartile	30.0
Upper quartile	89.99
Interquartile range	59.99
Stnd. skewness	8.43672
Stnd. kurtosis	16.4311

The StatAdvisor
This table shows summary statistics for Mn. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



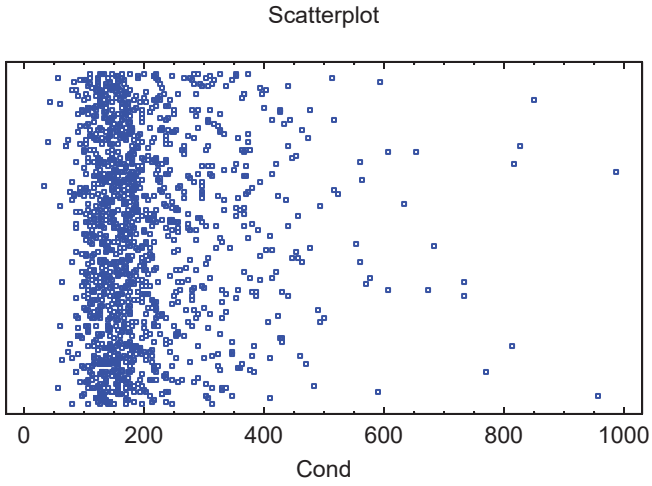
Percentiles for Mn (ug/L)

	Percentiles
1.0%	0.5
5.0%	10.0
10.0%	20.0
25.0%	30.0
50.0%	50.0
75.0%	89.99
90.0%	140.0
95.0%	210.0
99.0%	420.0

.

14) One-Variable Analysis – Specific Conductance (mS/cm)

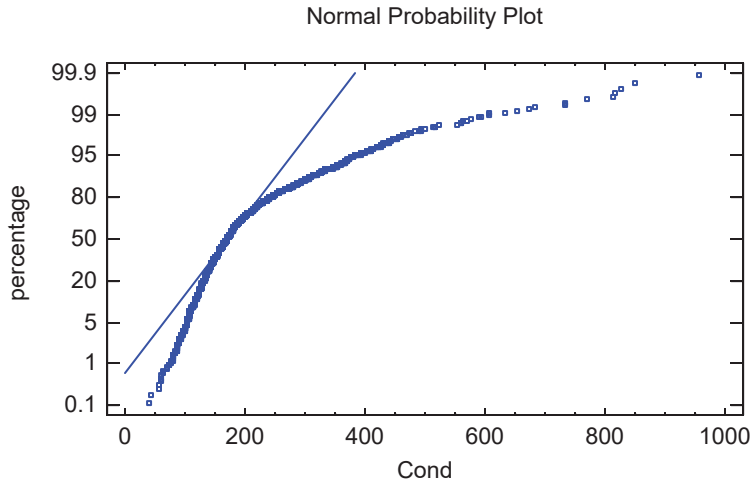
Data variable: Cond
1348 values ranging from 33.6 to 986.0



Summary Statistics for Cond

Count	1348
Average	200.599
Median	170.0
Standard deviation	107.738
Coeff. of variation	53.7085%
Minimum	33.6
Maximum	986.0
Range	952.4
Lower quartile	135.0
Upper quartile	228.0
Interquartile range	93.0
Stnd. skewness	37.5062
Stnd. kurtosis	71.7963

The StatAdvisor
This table shows summary statistics for Cond. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



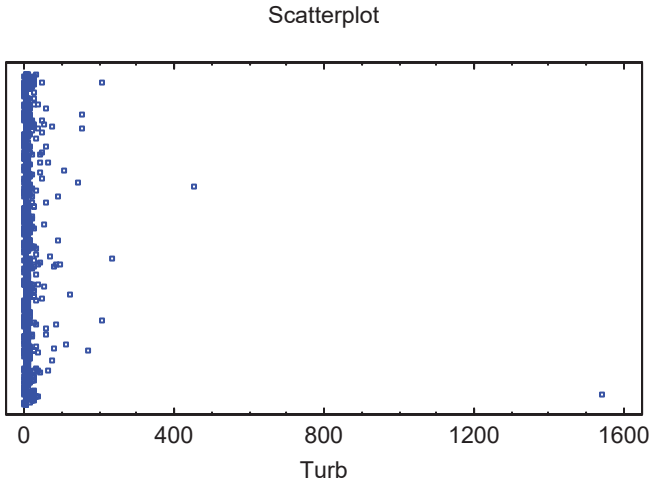
Percentiles for Cond

	Percentiles
1.0%	73.0
5.0%	99.7
10.0%	111.0
25.0%	135.0
50.0%	170.0
75.0%	228.0
90.0%	334.0
95.0%	411.0
99.0%	608.0

.

15) One-Variable Analysis – Turbidity (NTU)

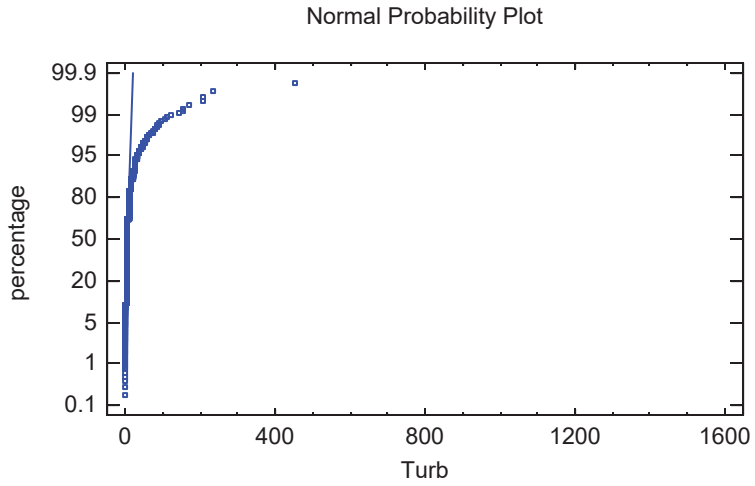
Data variable: Turb
867 values ranging from 0.83 to 1540.0



Summary Statistics for Turb

Count	867
Average	13.9644
Median	6.1
Standard deviation	57.8664
Coeff. of variation	414.387%
Minimum	0.83
Maximum	1540.0
Range	1539.17
Lower quartile	3.8
Upper quartile	10.8
Interquartile range	7.0
Stnd. skewness	264.399
Stnd. kurtosis	3389.93

The StatAdvisor
This table shows summary statistics for Turb. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.

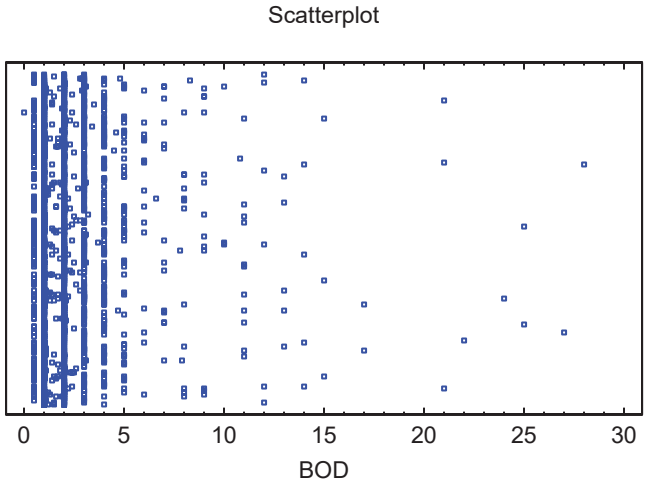


Percentiles for Turb

	Percentiles
1.0%	1.3
5.0%	1.83
10.0%	2.47
25.0%	3.8
50.0%	6.1
75.0%	10.8
90.0%	24.0
95.0%	38.7
99.0%	142.0

16) One-Variable Analysis - 5 day BOD (mg/L)

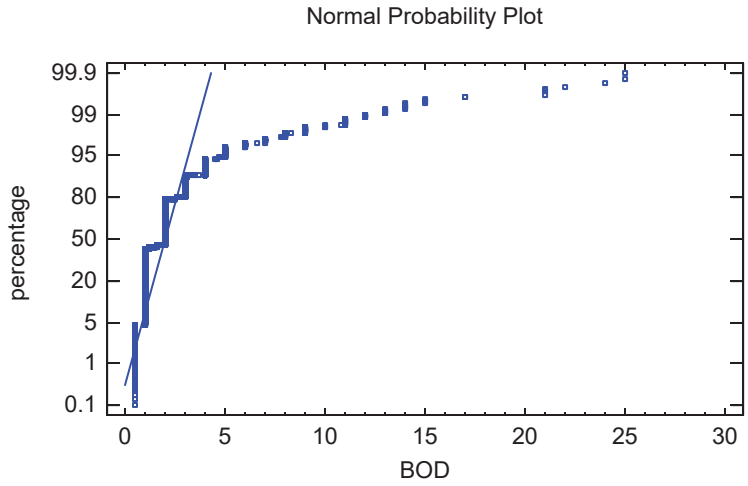
Data variable: BOD
2395 values ranging from 0.04 to 28.0



Summary Statistics for BOD

Count	2395
Average	2.1821
Median	2.0
Standard deviation	2.2915
Coeff. of variation	105.014%
Minimum	0.04
Maximum	28.0
Range	27.96
Lower quartile	1.0
Upper quartile	2.0
Interquartile range	1.0
Stnd. skewness	101.843
Stnd. kurtosis	375.027

The StatAdvisor
This table shows summary statistics for BOD. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.

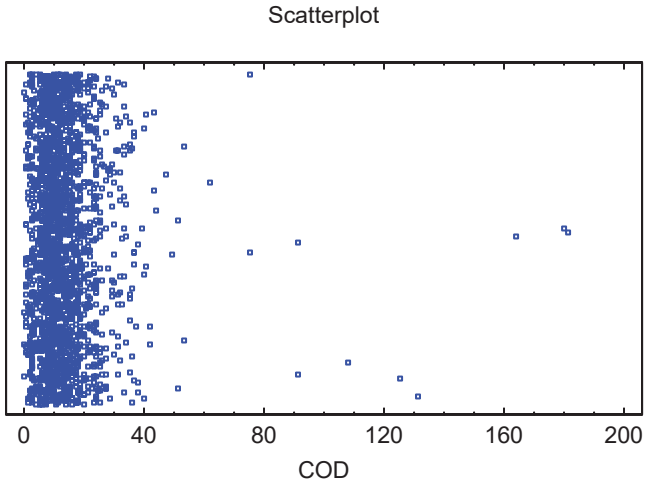


Percentiles for BOD

	Percentiles
1.0%	0.5
5.0%	0.5
10.0%	1.0
25.0%	1.0
50.0%	2.0
75.0%	2.0
90.0%	4.0
95.0%	5.0
99.0%	13.0

17) One-Variable Analysis – COD (mg/L)

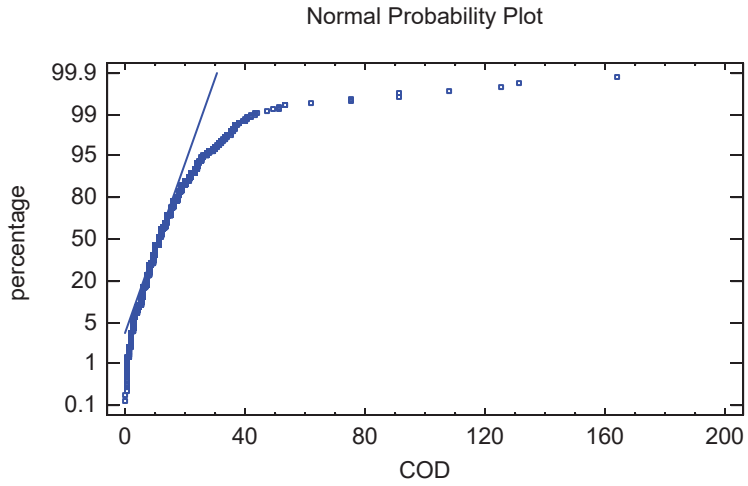
Data variable: COD
1867 values ranging from 0.0 to 181.0



Summary Statistics for COD

Count	1867
Average	13.2609
Median	11.0
Standard deviation	11.5619
Coeff. of variation	87.1874%
Minimum	0.0
Maximum	181.0
Range	181.0
Lower quartile	7.5
Upper quartile	16.0
Interquartile range	8.5
Stnd. skewness	117.097
Stnd. kurtosis	677.68

The StatAdvisor
This table shows summary statistics for COD. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.

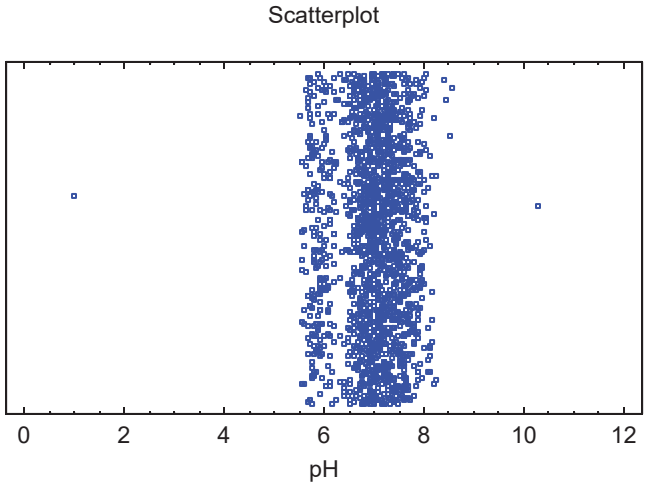


Percentiles for COD

	Percentiles
1.0%	0.5
5.0%	2.5
10.0%	4.0
25.0%	7.5
50.0%	11.0
75.0%	16.0
90.0%	23.0
95.0%	29.0
99.0%	43.0

18) One-Variable Analysis – pH (standard units)

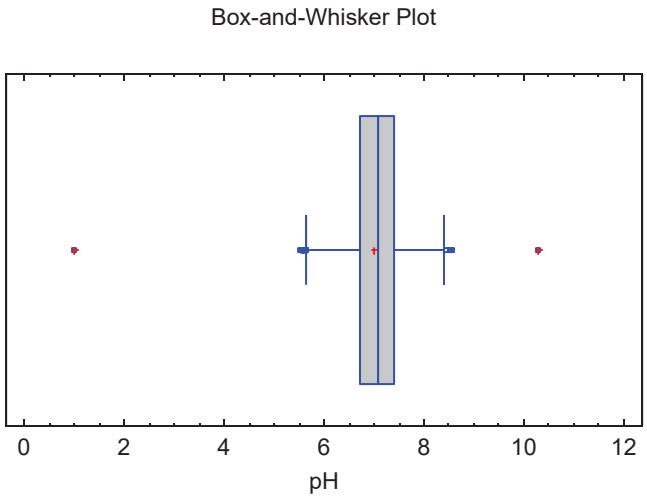
Data variable: pH
1656 values ranging from 1.0 to 10.28



Summary Statistics for pH

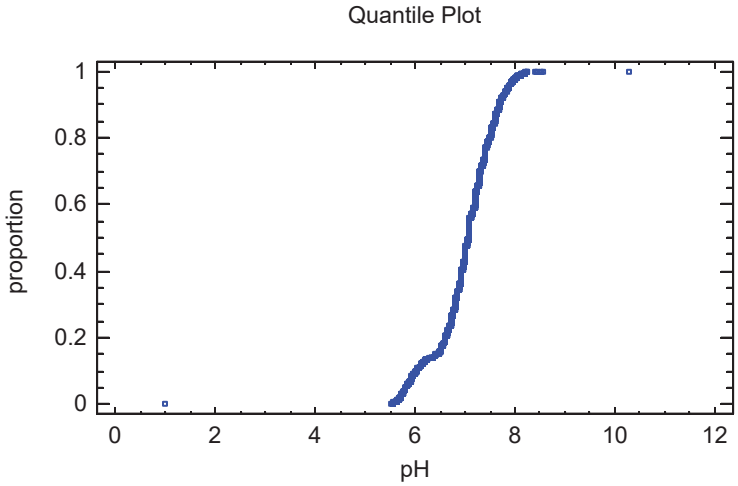
Count	1656
Average	6.99518
Median	7.06
Standard deviation	0.605716
Coeff. of variation	8.65905%
Minimum	1.0
Maximum	10.28
Range	9.28
Lower quartile	6.7
Upper quartile	7.4
Interquartile range	0.7
Stnd. skewness	-15.6138
Stnd. kurtosis	48.4786

The StatAdvisor
This table shows summary statistics for pH. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



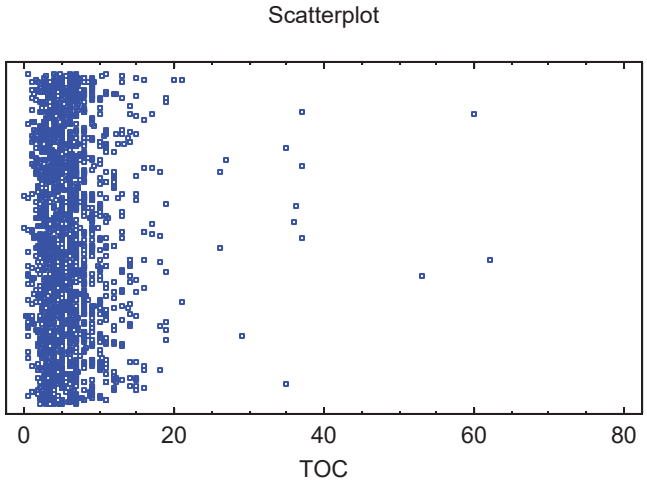
Percentiles for pH

	Percentiles
1.0%	5.63
5.0%	5.81
10.0%	6.01
25.0%	6.7
50.0%	7.06
75.0%	7.4
90.0%	7.7
95.0%	7.88
99.0%	8.12



19) One-Variable Analysis – TOC (mg/L)

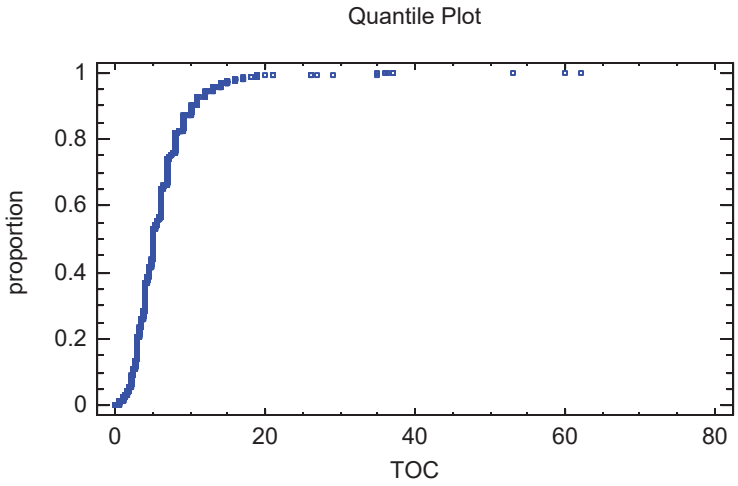
Data variable: TOC
1763 values ranging from 0.0 to 62.0



Summary Statistics for TOC

Count	1763
Average	6.07879
Median	5.0
Standard deviation	4.49945
Coeff. of variation	74.0188%
Minimum	0.0
Maximum	62.0
Range	62.0
Lower quartile	3.5
Upper quartile	7.5
Interquartile range	4.0
Stnd. skewness	77.8974
Stnd. kurtosis	338.969

The StatAdvisor
This table shows summary statistics for TOC. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for TOC

	Percentiles
1.0%	0.5
5.0%	1.86
10.0%	2.4
25.0%	3.5
50.0%	5.0
75.0%	7.5
90.0%	10.3
95.0%	13.0
99.0%	19.0

DEQ Surface Water Quality Table Relates

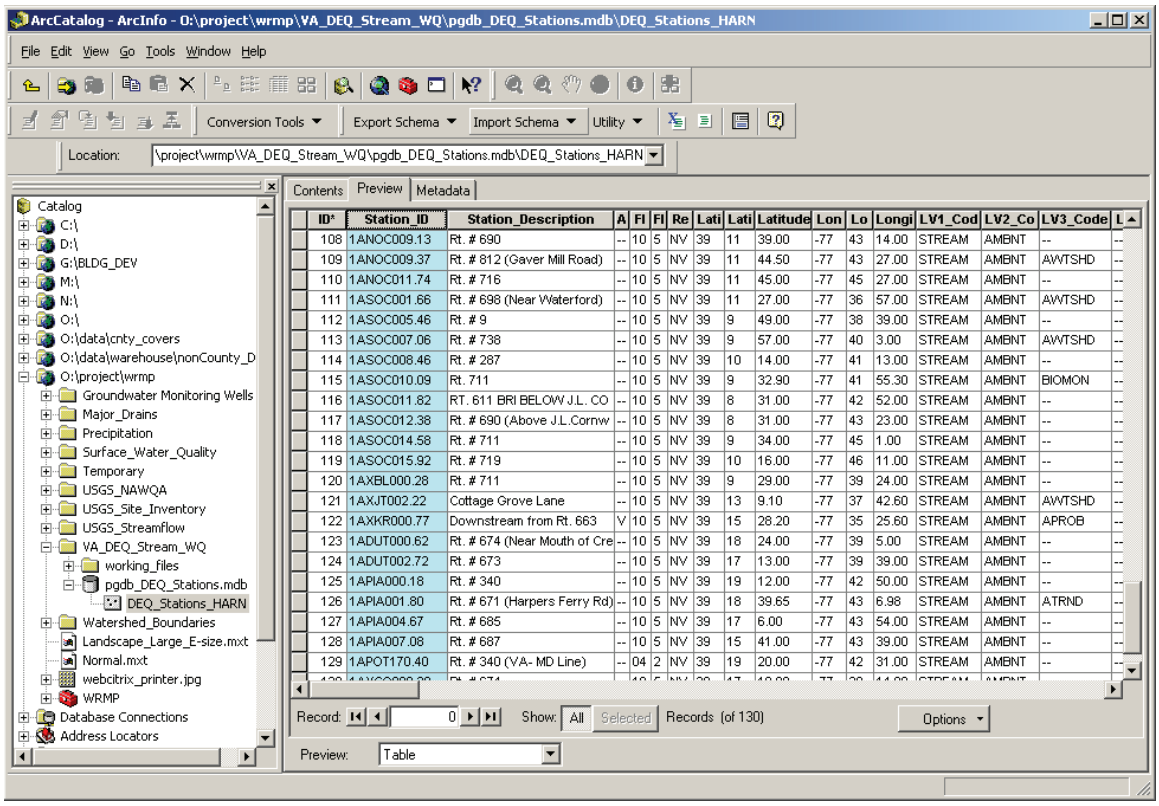
David Ward
February 21, 2007

Background:

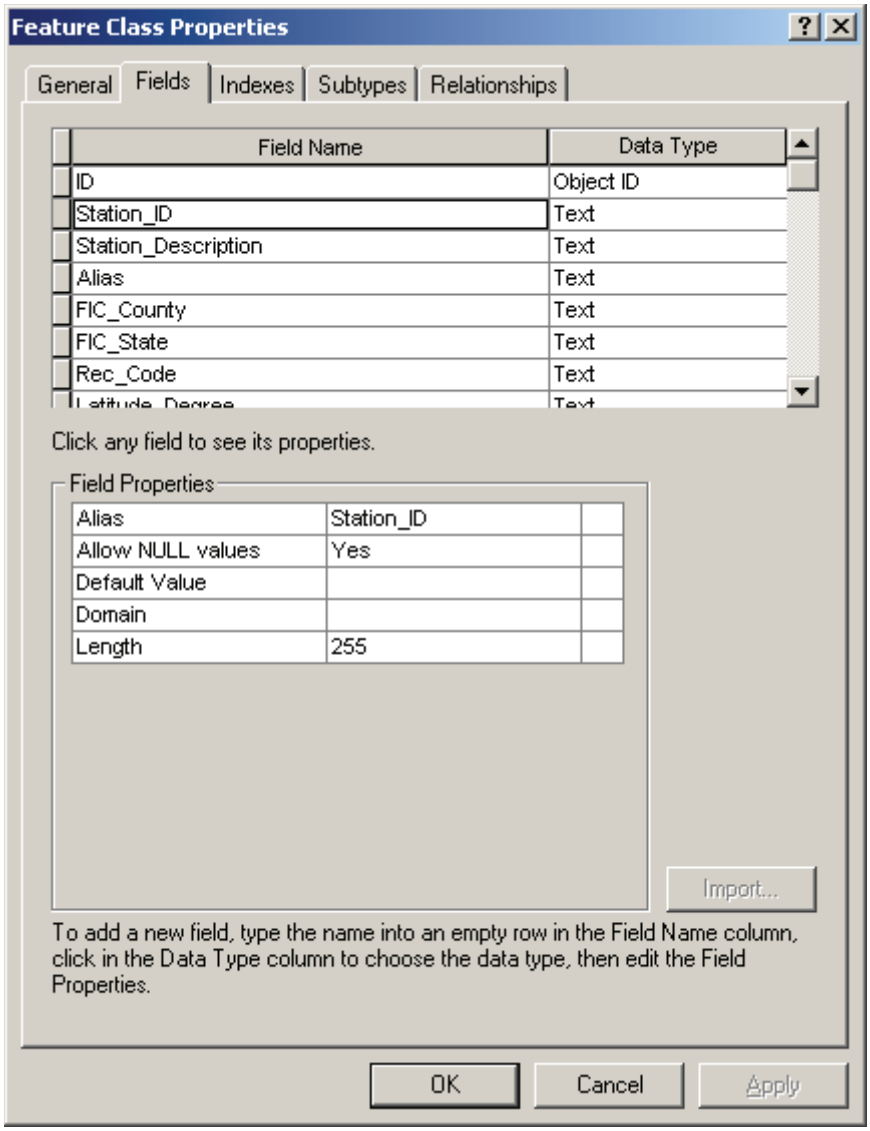
The VA Dept of Environmental Quality (DEQ), samples surface water through out Loudoun. Data is posted on their web site. Other memos describe download and formatting. This memo summarizes how to work with data in GIS

Previous Work:

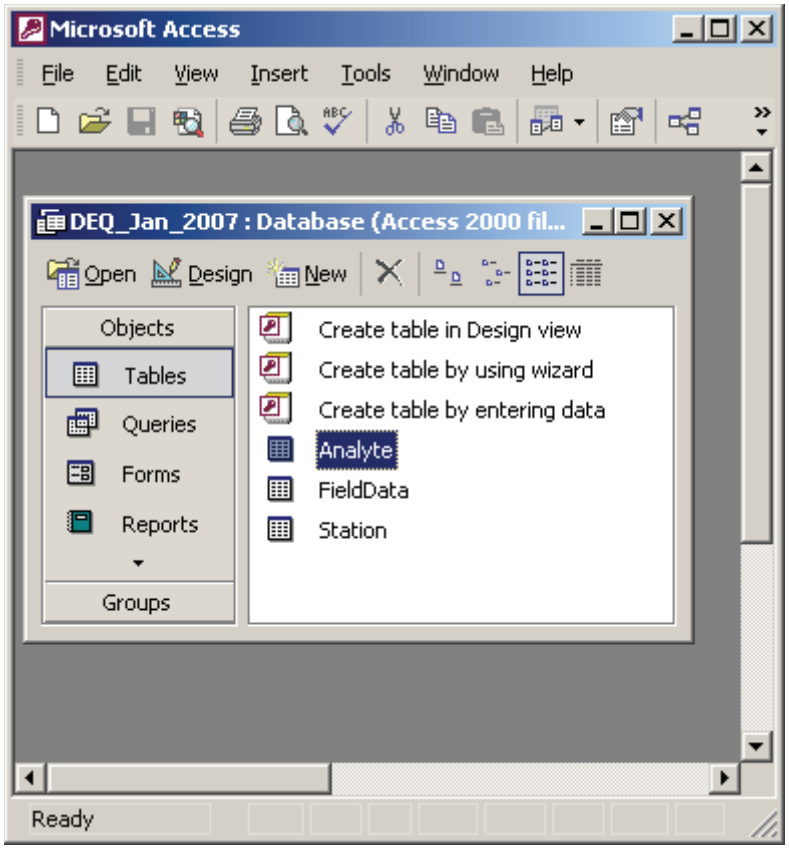
The station locations are stored in a personal geodatabase (692 KB)



This includes the 15-character variable: “Station_ID”.



The analyte and field data contain the chemical concentration and monitoring time series data are stored in a MS Access file (18 MB). There are over 80,000 records.

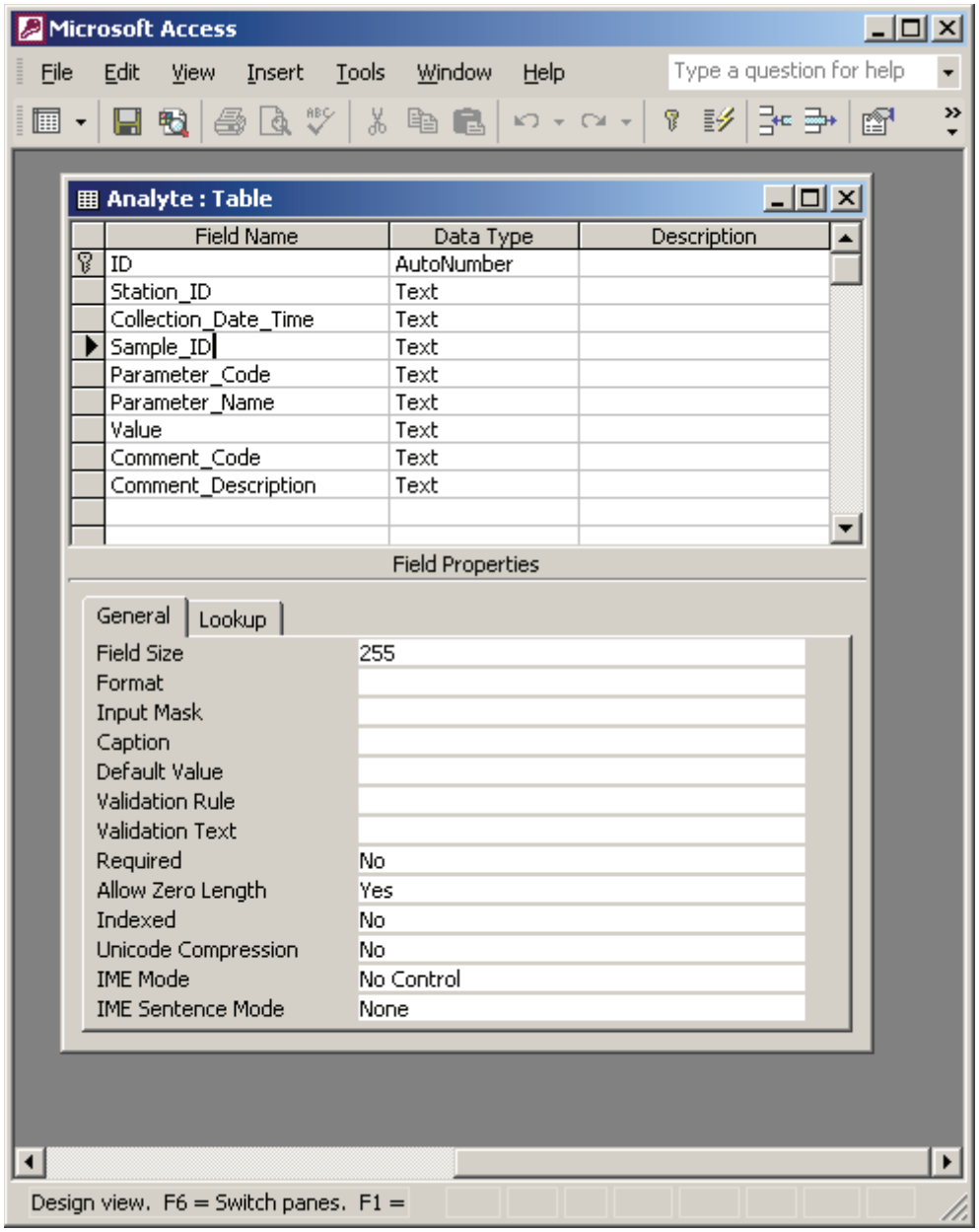


Here we also have “Station_ID” as a 255 character variable.

We can related these two fields even though they are 255 characters. This may impact performance and need to be reduced later to speed up the GIS. For now, keep both at 255 characters.

In ArcGIS 9.1, time values are not handled well. Revisions in ArcMap 9.2 have improved charting that allow for a proper date field.

We also want to be able to use data with AquaChem.


Microsoft Access
File Edit View Insert Tools Window Help
Type a question for help
Analyte : Table
Field Name
Data Type
Description
ID
AutoNumber
Station_ID
Text
Collection_Date_Time
Text
Sample_ID
Text
Parameter_Code
Text
Parameter_Name
Text
Value
Text
Comment_Code
Text
Comment_Description
Text
Field Properties
General
Lookup
Field Size
255
Format
Input Mask
Caption
Default Value
Validation Rule
Validation Text
Required
No
Allow Zero Length
Yes
Indexed
No
Unicode Compression
No
IME Mode
No Control
IME Sentence Mode
None
Design view. F6 = Switch panes. F1 =

DEQ Surface Water Quality Station Mapping

David Ward
January 22, 2007

Background:

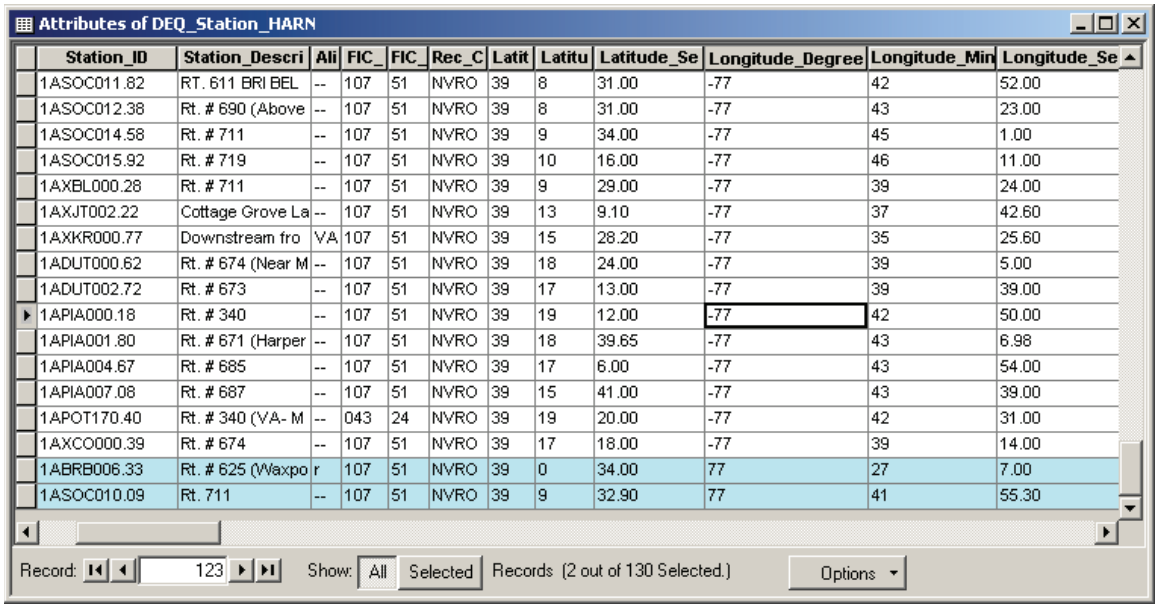
The VA Dept of Environmental Quality (DEQ), samples surface water through out Loudoun. Data is posted on their web site and need to be downloaded on a scheduled basis. Data must be queried by watershed, therefore data outside of Loudoun is included.

DEQ Stations:

Prefer to separate document on downloading data. This memo is limited to the post processing and conversion of latitude/longitude into personal geodata feature class in SPC VA N HARN.

The DEQ stations have been downloaded and merged into one file. The table is in MS Access and can be used directly to create a feature class.

As of Jan 2007 some clean-up is necessary. Before we do this, there are two data errors in DEQ's tables. The negative sign is missing on 2 stations. An email has been sent to DEQ. As of Aug 2007, DEQ has made the revisions.



Attributes of DEQ_Station_HARN

Station_ID	Station_Descri	Ali	FIC_	FIC_	Rec_C	Latit	Latitu	Latitude_Se	Longitude_Degree	Longitude_Min	Longitude_Se
1ASOC011.82	RT. 611 BRI BEL	--	107	51	NVRO	39	8	31.00	-77	42	52.00
1ASOC012.38	Rt. # 690 (Above	--	107	51	NVRO	39	8	31.00	-77	43	23.00
1ASOC014.58	Rt. # 711	--	107	51	NVRO	39	9	34.00	-77	45	1.00
1ASOC015.92	Rt. # 719	--	107	51	NVRO	39	10	16.00	-77	46	11.00
1AXBL000.28	Rt. # 711	--	107	51	NVRO	39	9	29.00	-77	39	24.00
1AXJT002.22	Cottage Grove La	--	107	51	NVRO	39	13	9.10	-77	37	42.60
1AXKR000.77	Downstream fro	VA	107	51	NVRO	39	15	28.20	-77	35	25.60
1ADUT000.62	Rt. # 674 (Near M	--	107	51	NVRO	39	18	24.00	-77	39	5.00
1ADUT002.72	Rt. # 673	--	107	51	NVRO	39	17	13.00	-77	39	39.00
1APIA000.18	Rt. # 340	--	107	51	NVRO	39	19	12.00	-77	42	50.00
1APIA001.80	Rt. # 671 (Harper	--	107	51	NVRO	39	18	39.65	-77	43	6.98
1APIA004.67	Rt. # 685	--	107	51	NVRO	39	17	6.00	-77	43	54.00
1APIA007.08	Rt. # 687	--	107	51	NVRO	39	15	41.00	-77	43	39.00
1APOT170.40	Rt. # 340 (VA- M	--	043	24	NVRO	39	19	20.00	-77	42	31.00
1AXCO000.39	Rt. # 674	--	107	51	NVRO	39	17	18.00	-77	39	14.00
1ABRB006.33	Rt. # 625 (Waxpo	r	107	51	NVRO	39	0	34.00	77	27	7.00
1ASOC010.09	Rt. 711	--	107	51	NVRO	39	9	32.90	77	41	55.30

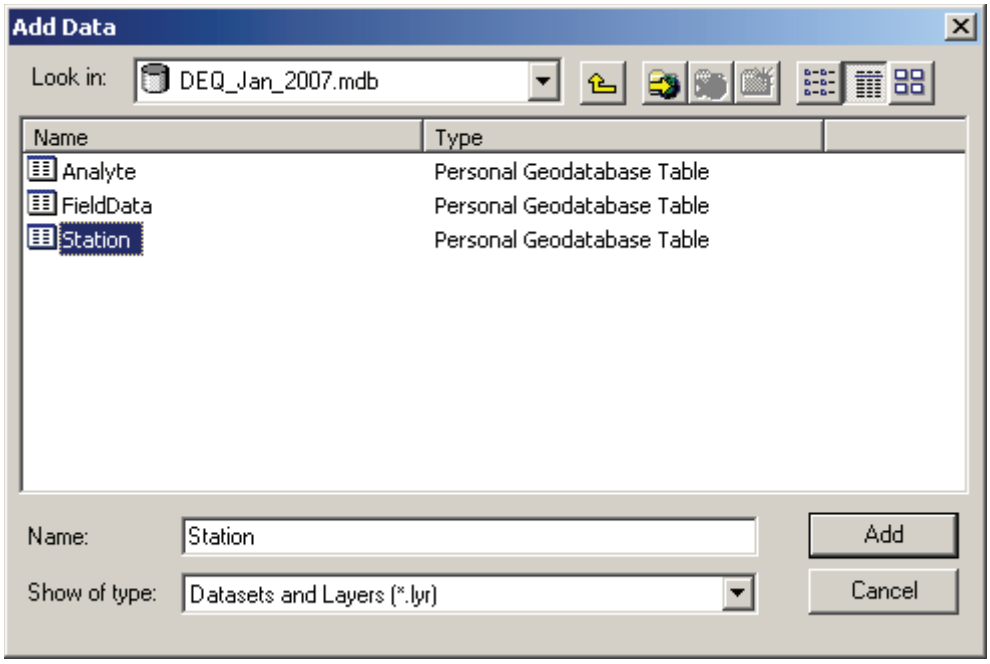
Record: 123 Show: All Selected Records (2 out of 130 Selected.) Options

Edit these values in MS Access and save.

There are two ways to populate decimal degrees. One is using MS Access, the other is using ArcGIS.

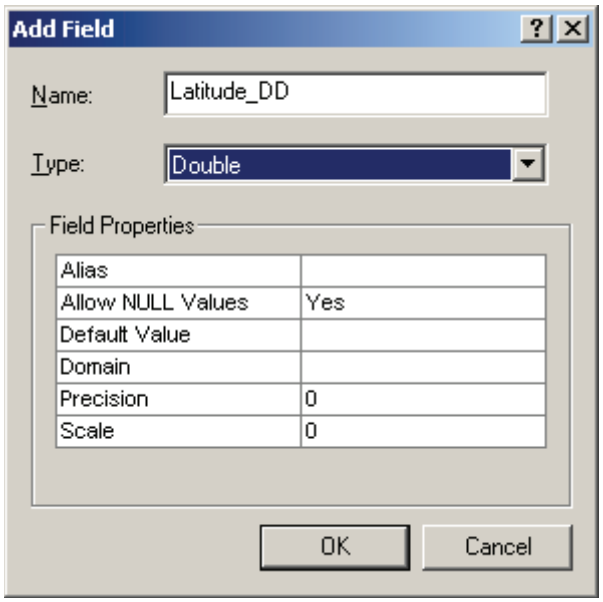
Adding decimal degrees Using ArcGIS

Add the table to ArcGIS:

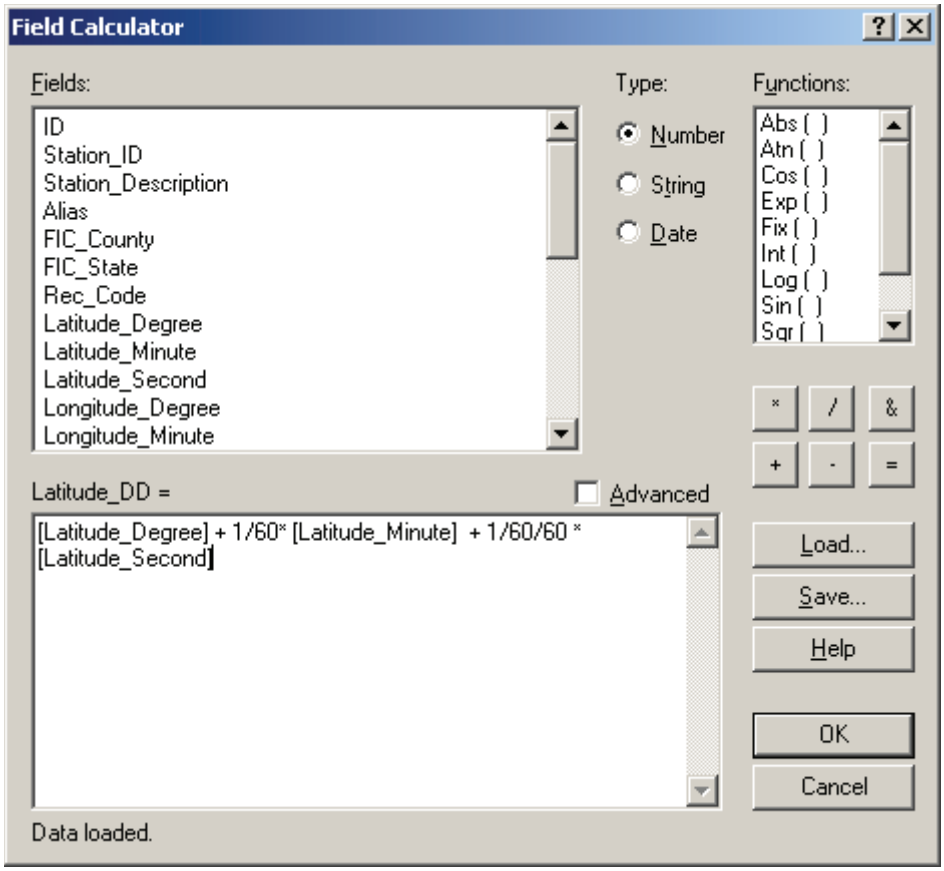


We can calculate decimal degrees using field calculator in ArcMap.

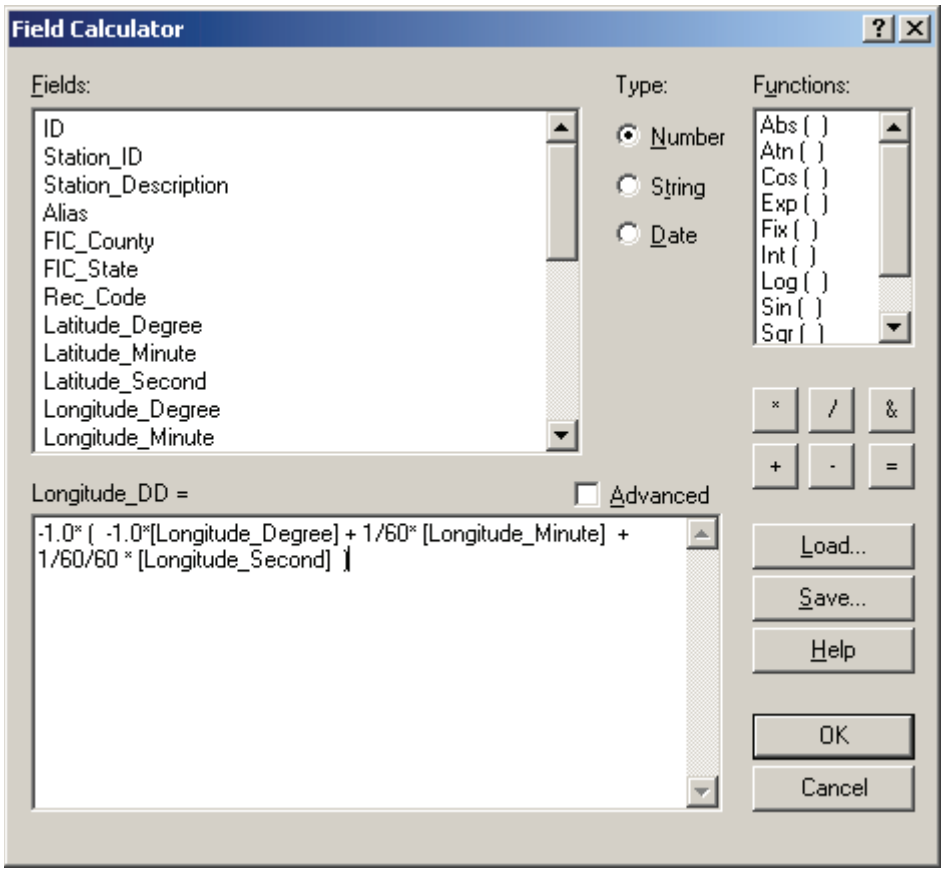
First add fields: Latitude_DD and Longitude_DD as double.



Then use field calculator with the expressions:

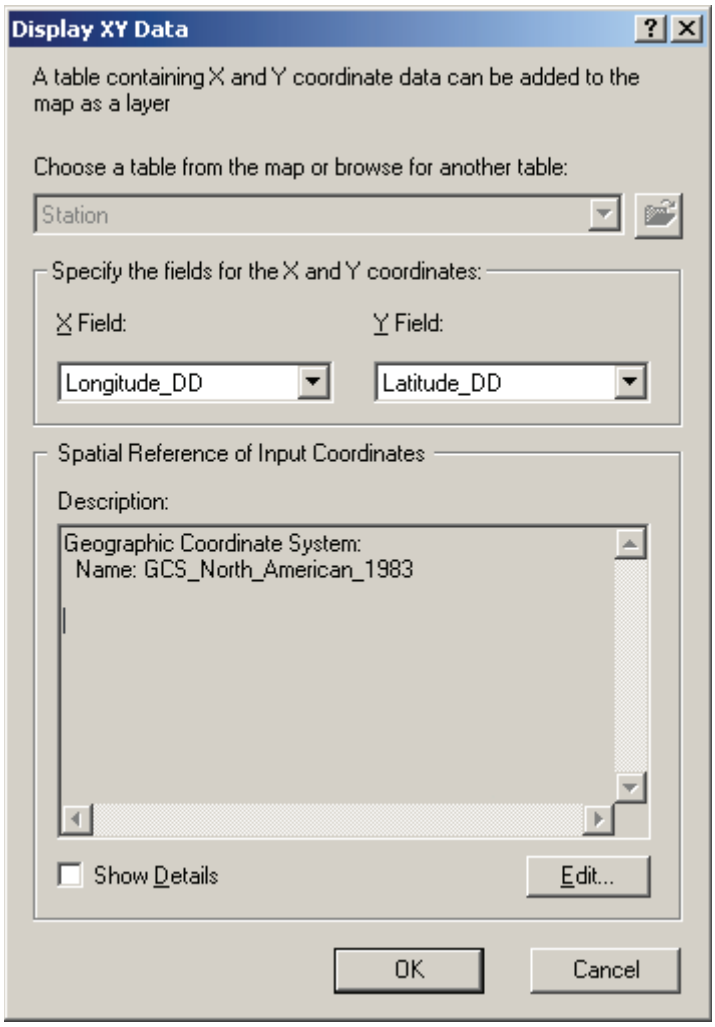


and

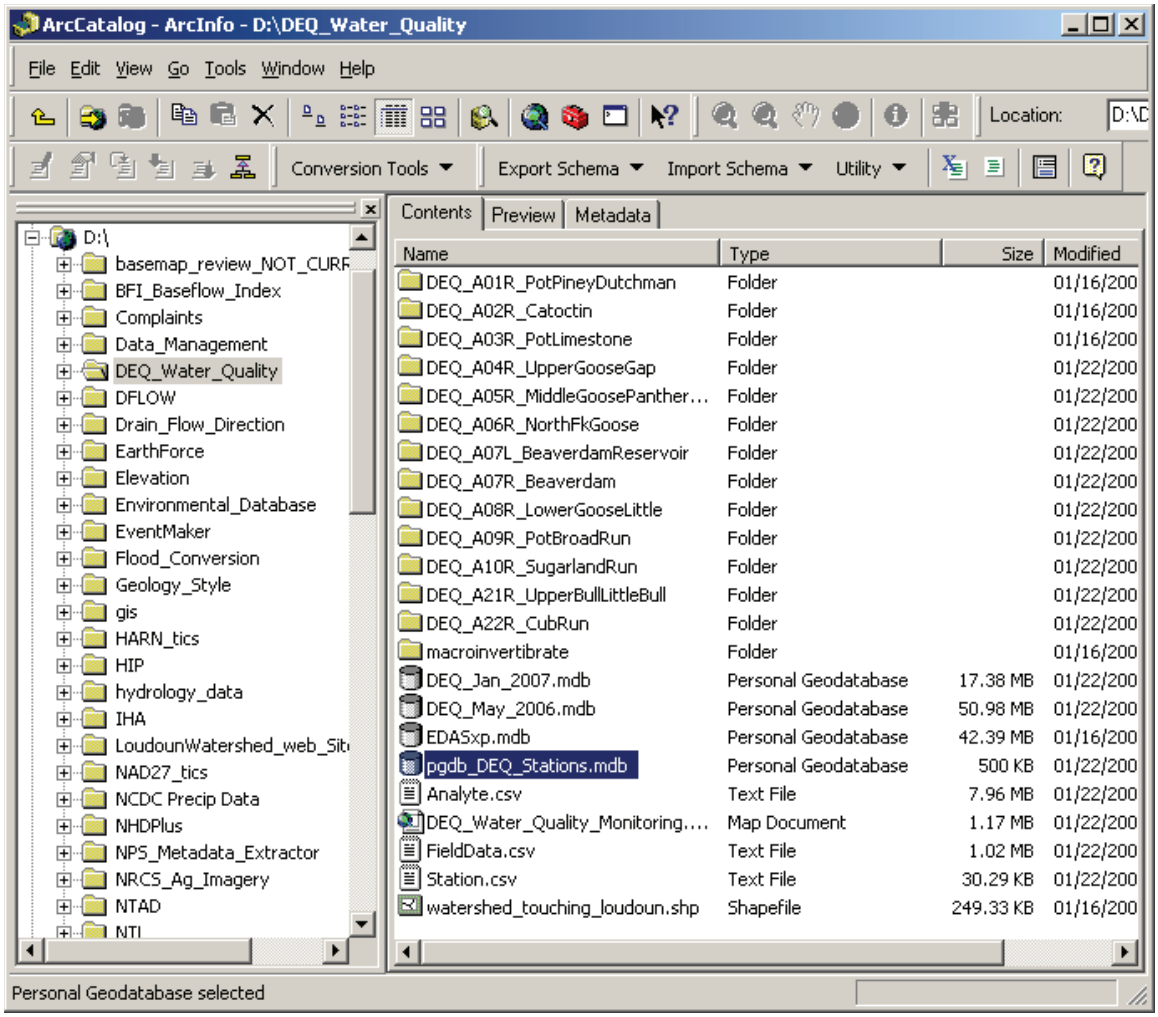


Carefully note the syntax on longitude as DEQ's way of providing D-M-S is a little unusual.

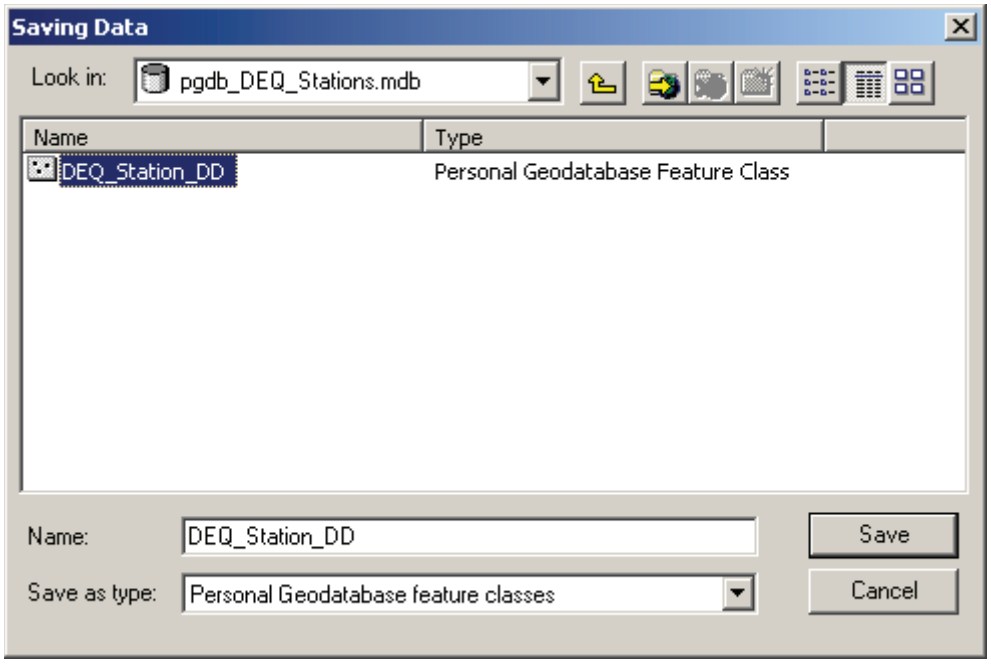
We can now use “Display XY” in ArcMap. Here, we select geographic projection of simple NAD83.

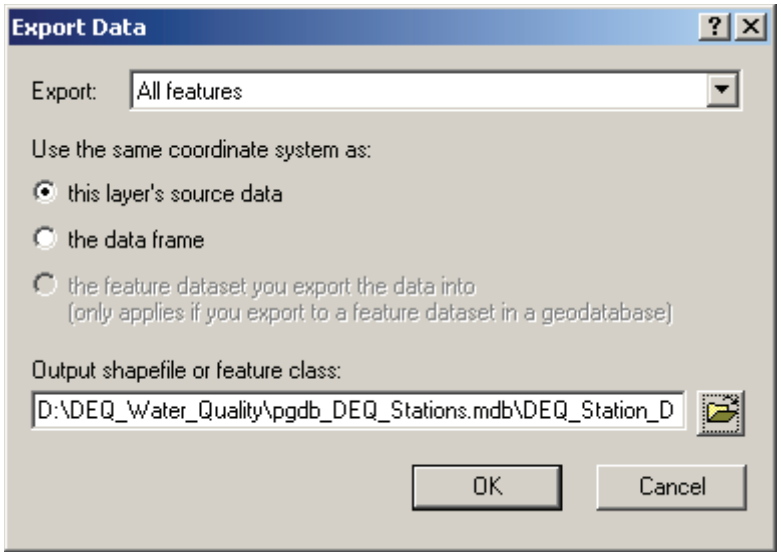


Now we want to create blank personal geodatabase in ArcCatalog.

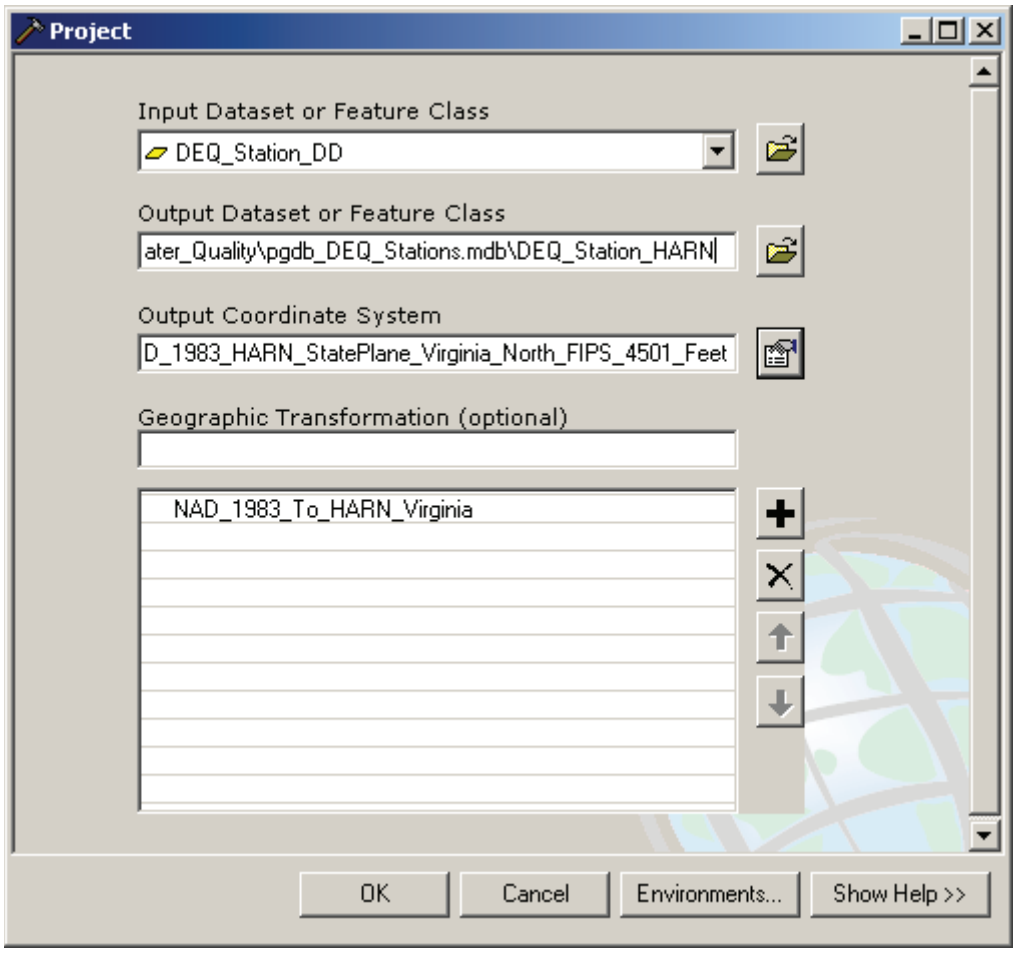


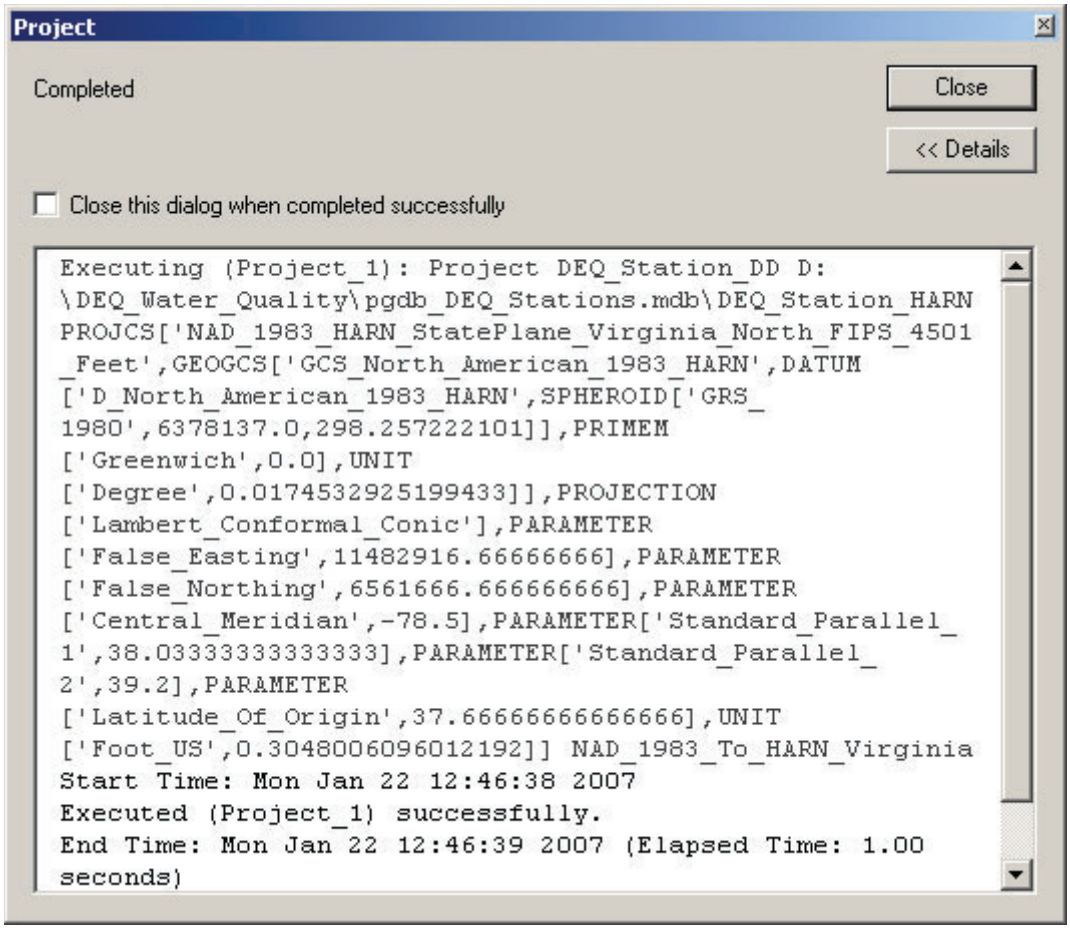
Going back to the marker events, we export these to the new pgdb in native NAD83 DD:





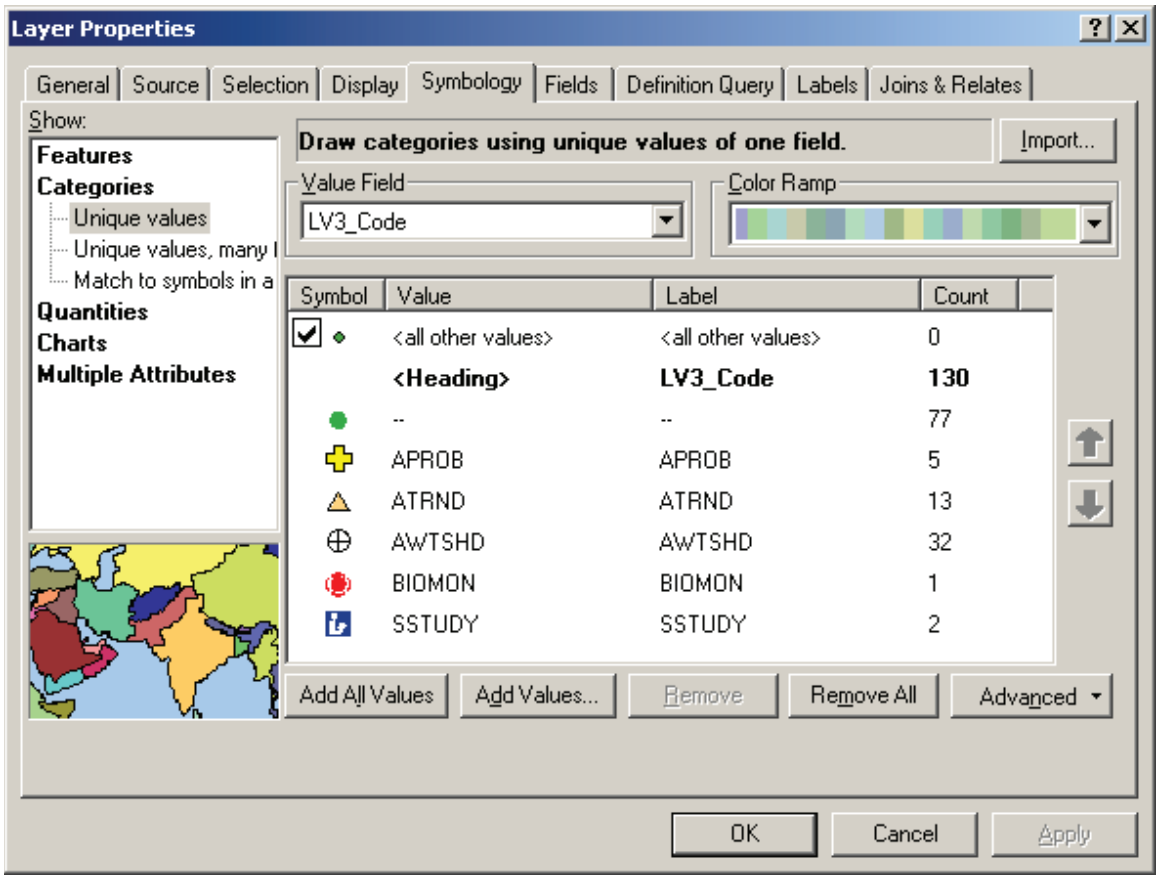
Now project the data to Virginia State Plane, HARN, US Feet.





For now, we will maintain those stations outside of Loudoun and they may be useful in analysis of upstream and downstream conditions.

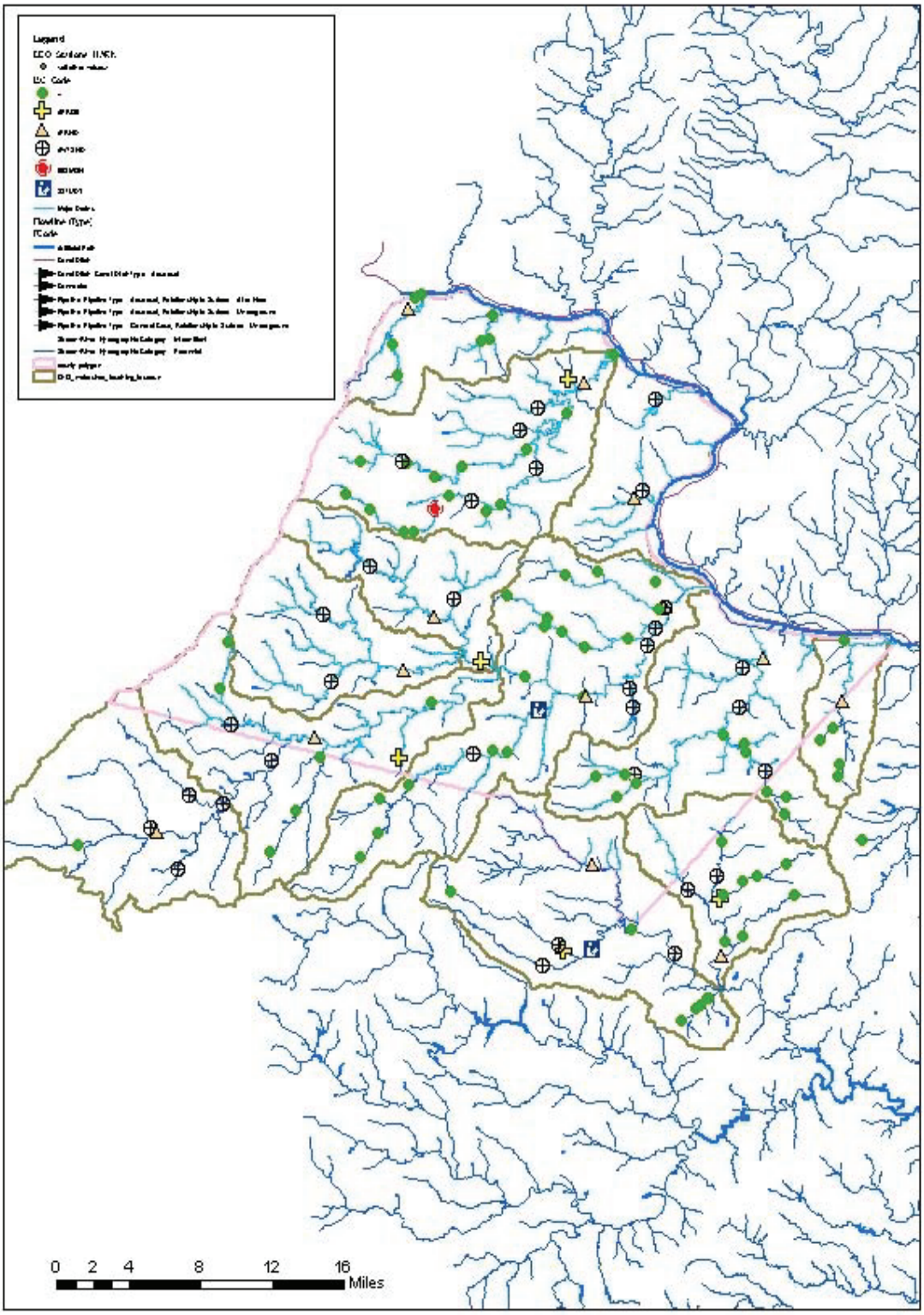
In ArcGIS, symbolize based on type of monitoring stations



where:

- PROB = Probabilistic
- TRND = Trend
- WTSHD = ?? watershed ??
- BIOMON = Macroinvertibrate or biological monitoring
- SSTUDY = Special studies.

not

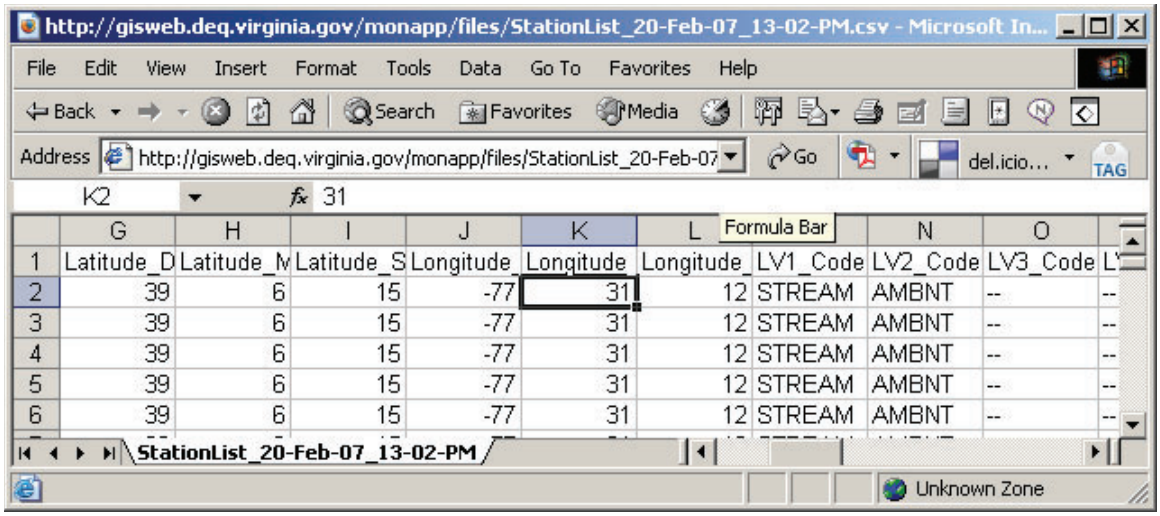


Note that stations outside of Loudoun are important. For example, Cub Run Bull Run flowing out of Loudoun has two stations in Fairfax County, but none in Loudoun. On Sugarland Run flowing into Loudoun has a station in Fairfax County.

Revisions:

In reviewing station 1ATUS003.19 on Tuscarora Creek in Leesburg, the coordinates were found to be incorrect http://gisweb.deq.virginia.gov/monapp/mon_query_form.cfm Values are provided in D-M-S. These were converted these to decimal degrees for mapping. The site should be located along Rt 643, aka Plaza St. I believe the location is due west of the coordinates provided. I believe the error is that the report "Longitude_Minute" needs to be changed from 31 to 33. DEQ replied on 2/20/2007 that there were in error. The web has not yet been updated

http://gisweb.deq.virginia.gov/monapp/files/StationList_20-Feb-07_13-02-PM.csv

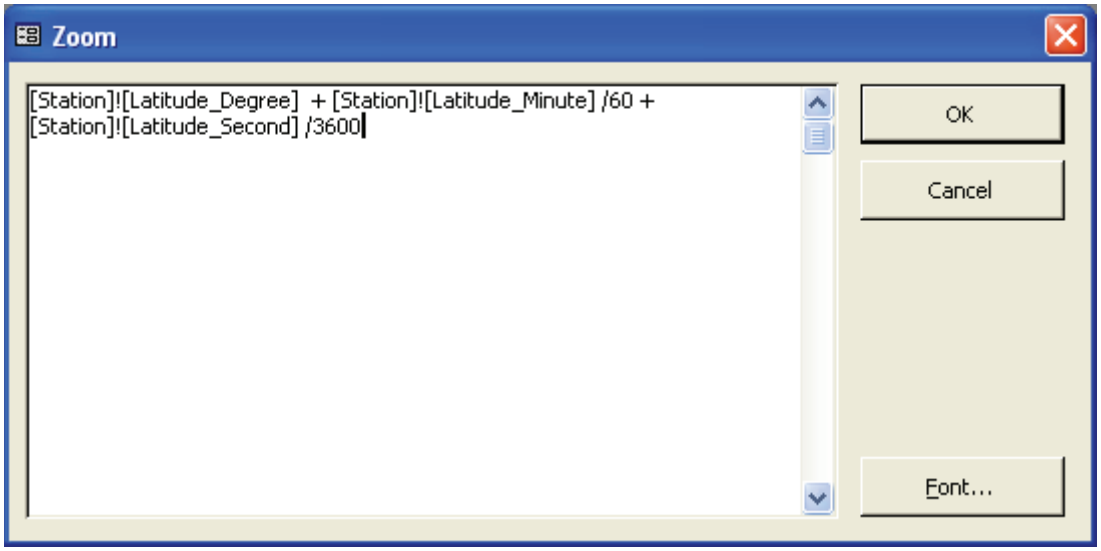


	G	H	I	J	K	L	N	O
1	Latitude_D	Latitude_M	Latitude_S	Longitude_	Longitude	Longitude_	LV1_Code	LV2_Code	LV3_Code	L
2	39	6	15	-77	31	12	STREAM	AMBNT	--	--
3	39	6	15	-77	31	12	STREAM	AMBNT	--	--
4	39	6	15	-77	31	12	STREAM	AMBNT	--	--
5	39	6	15	-77	31	12	STREAM	AMBNT	--	--
6	39	6	15	-77	31	12	STREAM	AMBNT	--	--

Data revisions were made to both the station pgdb "pgdb_DEQ_Stations.mdb" and the related table Access file, "DEQ_Jan_2007.mdb".

Adding decimal degrees using MS Access

We can populate the decimal degrees directly in MS Access.



Data Clean-up

In order to make data for efficient, the character fields needs to be trimmed.

DEQ Surface Water Quality Data Maintenance

David Ward
January 22, 2007

Background:

The VA Dept of Environmental Quality (DEQ), samples surface water through out Loudoun. Data is posted on their web site and need to be downloaded on a scheduled basis.

DEQ Web Server:

Presently DEQ uses a Cold Fusion web server to provide water quality measurements to the public. This will likely change in 2007 to an Oracle-based web server. It is anticipated that this will change the procedures somewhat. Hopefully the query will allow for all of Loudoun data to be queried at once. Regardless of the web server used, the process will continue as:

Download ASCII files from web server --- >

Load to MS Access --- >

Construct time series tables to relate to DEQ stations feature class in GIS.

Overview of Watersheds:

The DEQ data are currently downloaded by watershed. To cover Loudoun County, there are thirteen watersheds of interest. There are actually 12 watersheds ("R" for river and one reservoir"L" for lake):

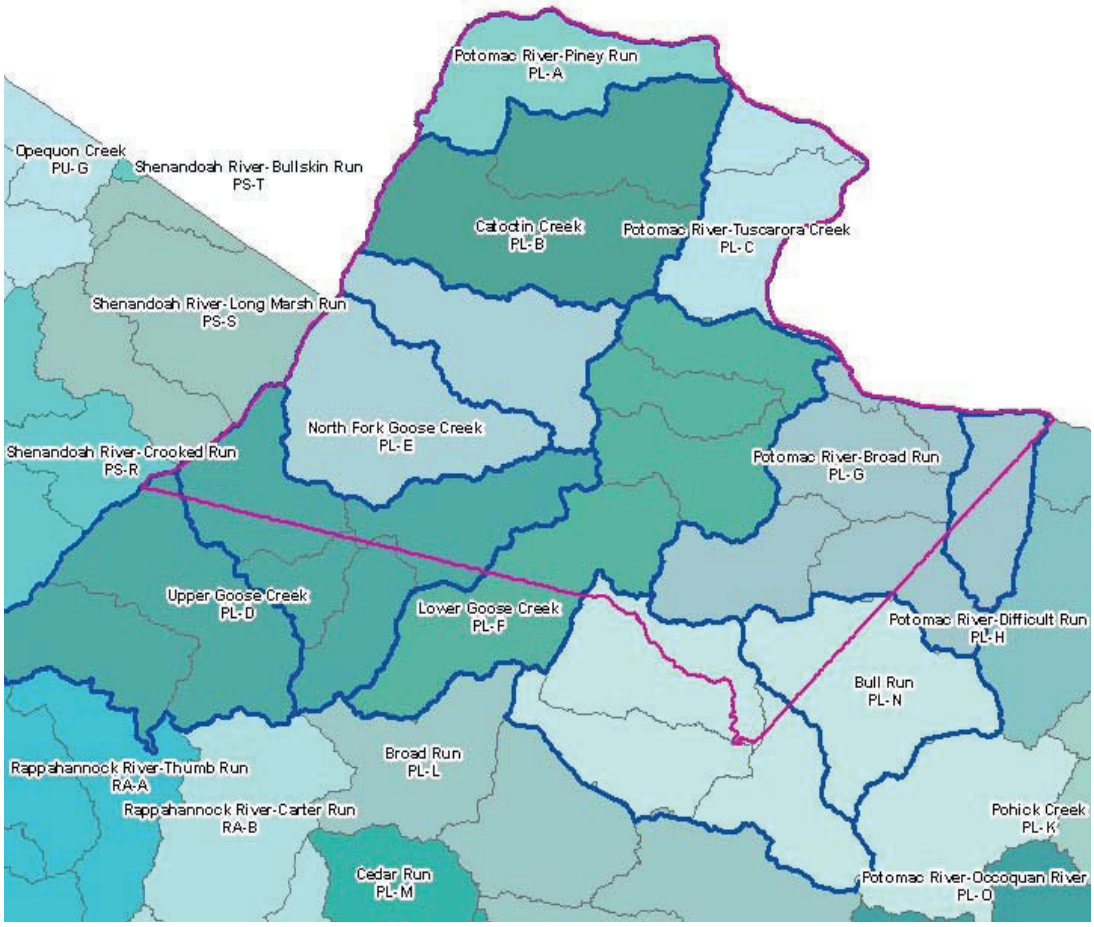
A01R	Potomac River/Piney Run/Dutchman Creek
A02R	Catoctin Creek
A03R	Potomac River/Limestone Branch
A04R	Upper Goose Creek/Gap Run
A05R	Middle Goose Creek/Panther Skin Creek
A06R	North Fork Goose Creek
A07R	Beaverdam Creek
A08L	Beaverdam Creek Reservoir
A08R	Lower Goose Creek/Little River
A09R	Potomac River/Broad Run
A10R	Sugarland Run
A21R	Upper Bull Run/Little Bull Run
A22R	Cub Run

Some watersheds extend into neighboring counties:

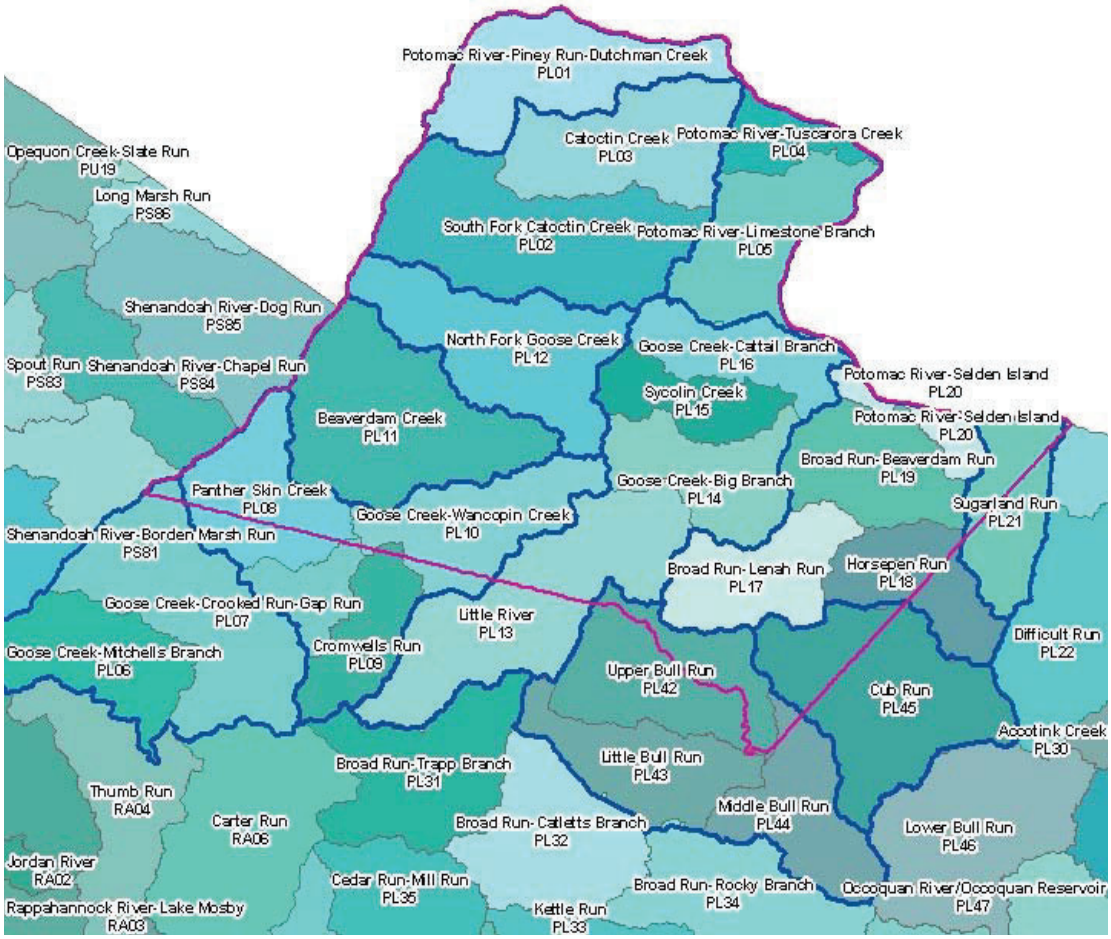


Note that the DEQ watershed numbering (A01, A02, etc.) are currently stored in the obsolete shapefile located at O:\data\warehouse\nonCounty_Data\DEQ_Watershed_Boundaries.

The DCR watershed boundaries use a different coding. DCR offers a less detailed Level 5 boundary:



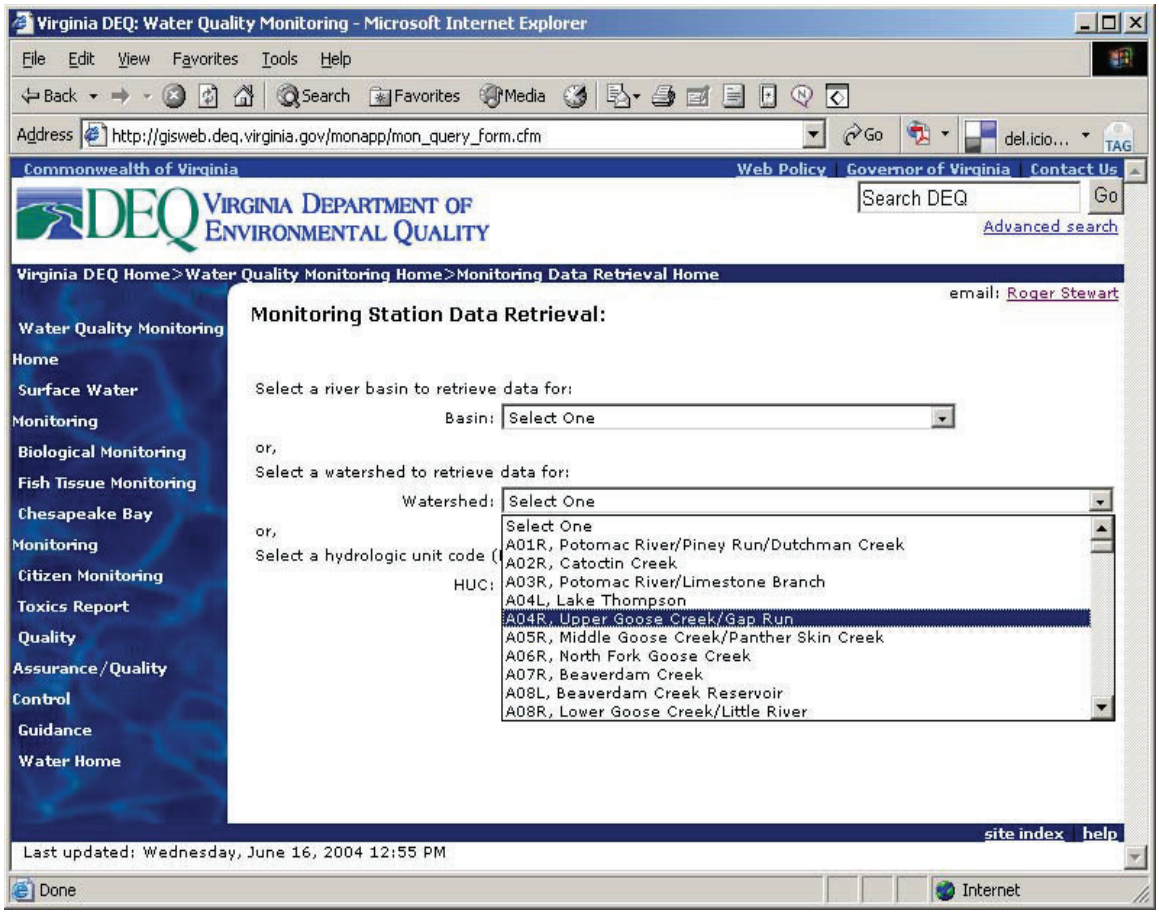
and Level 6 with more details boundary:



Although DCR published their watershed boundaries and provides GIS files (http://www.dcr.virginia.gov/soil_&_water/hu.shtml), we will use the DEQ boundaries for the query.

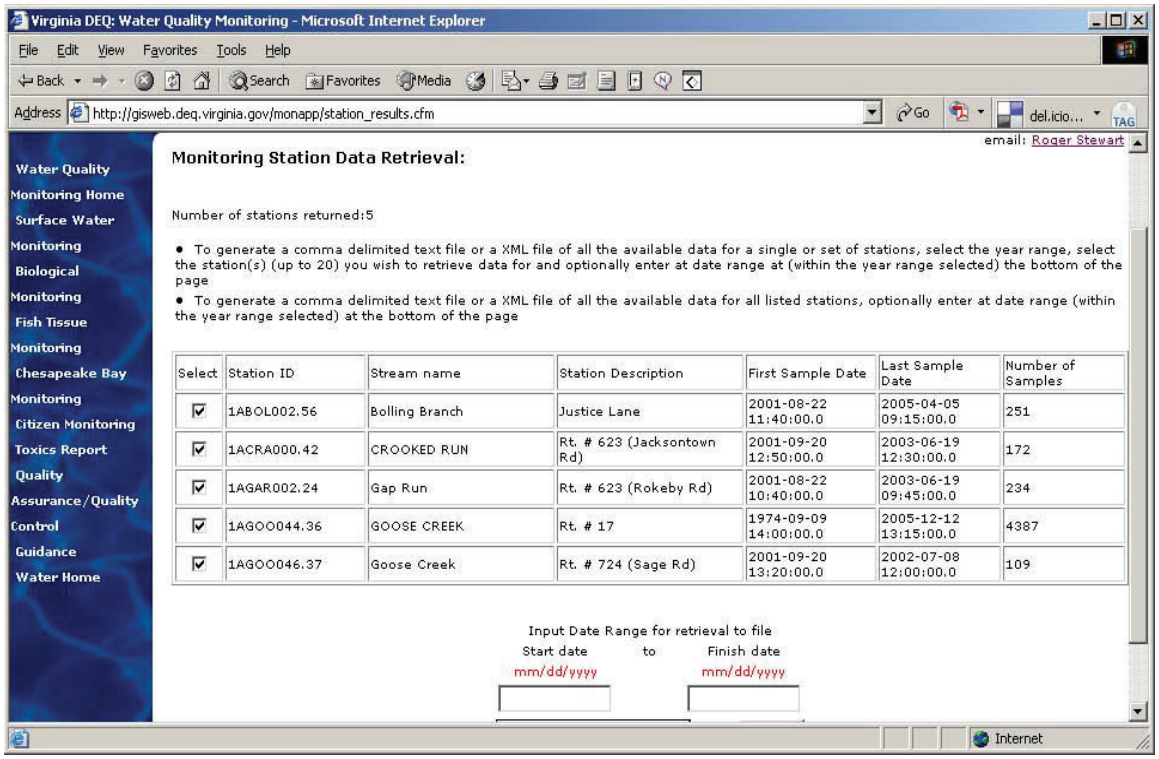
Running the DEQ Web Query:

Start at the page http://gisweb.deq.virginia.gov/monapp/mon_query_form.cfm and select one of the twelve watersheds to cover Loudoun:



(Note: Ignore Lake Thomas, A04L, as this is not in Loudoun County).

Now check the boxes on all the stations in the subwatershed:

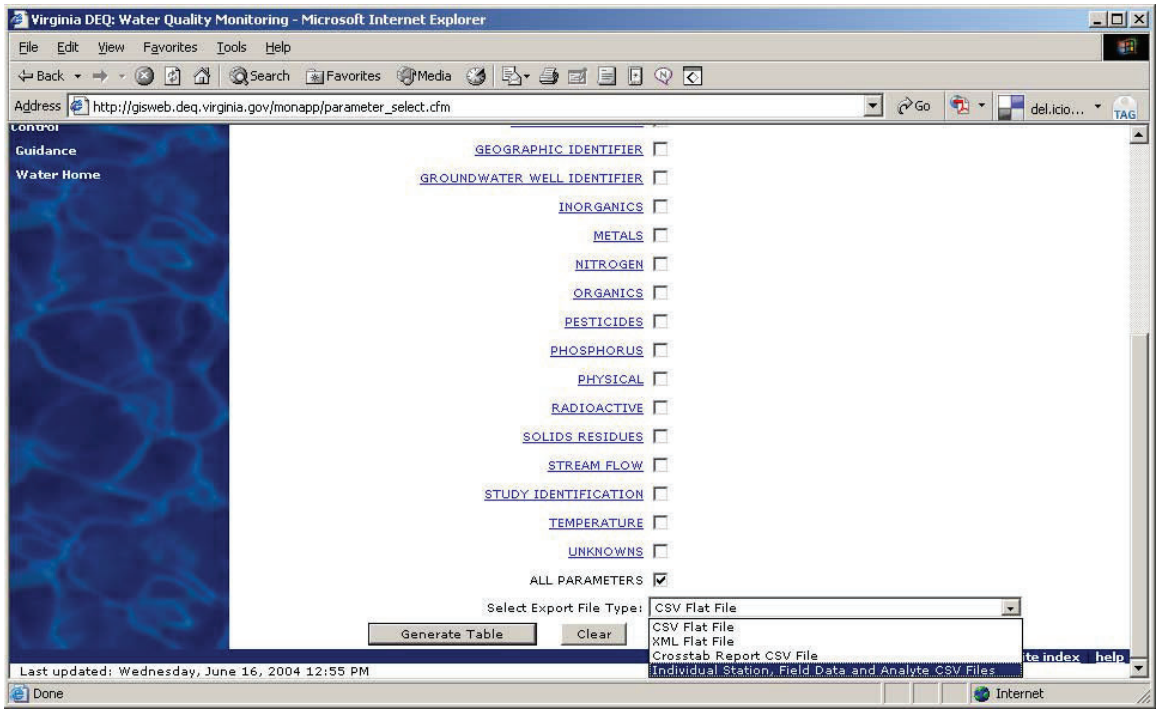


chosing "Select Parameters" button at bottom of the screen.

With the parameter screen, scroll down the bottom at check “All Paramaters”.

Change the “Select Export File Type” to “Individual Station, Field Data and Analyte Data CSV”.

Note that “analyte” means water quality analysis performed in the lab versus the field using probes and meters. CSV is comma-separated variable.

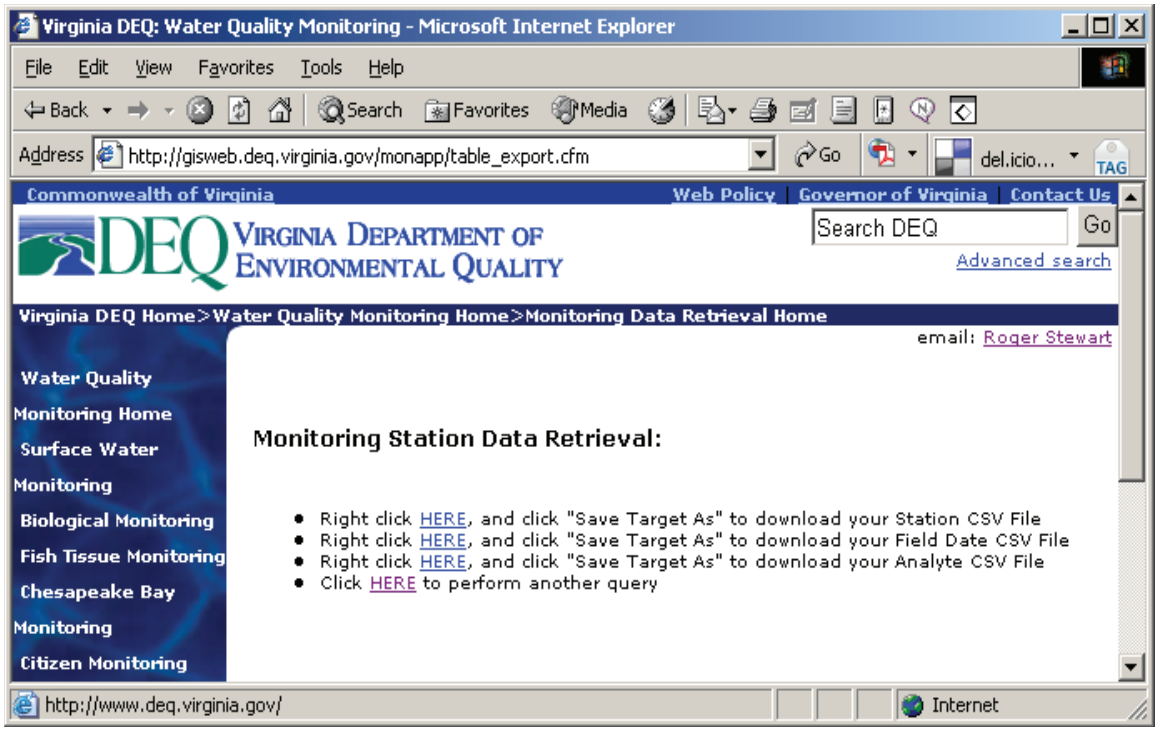


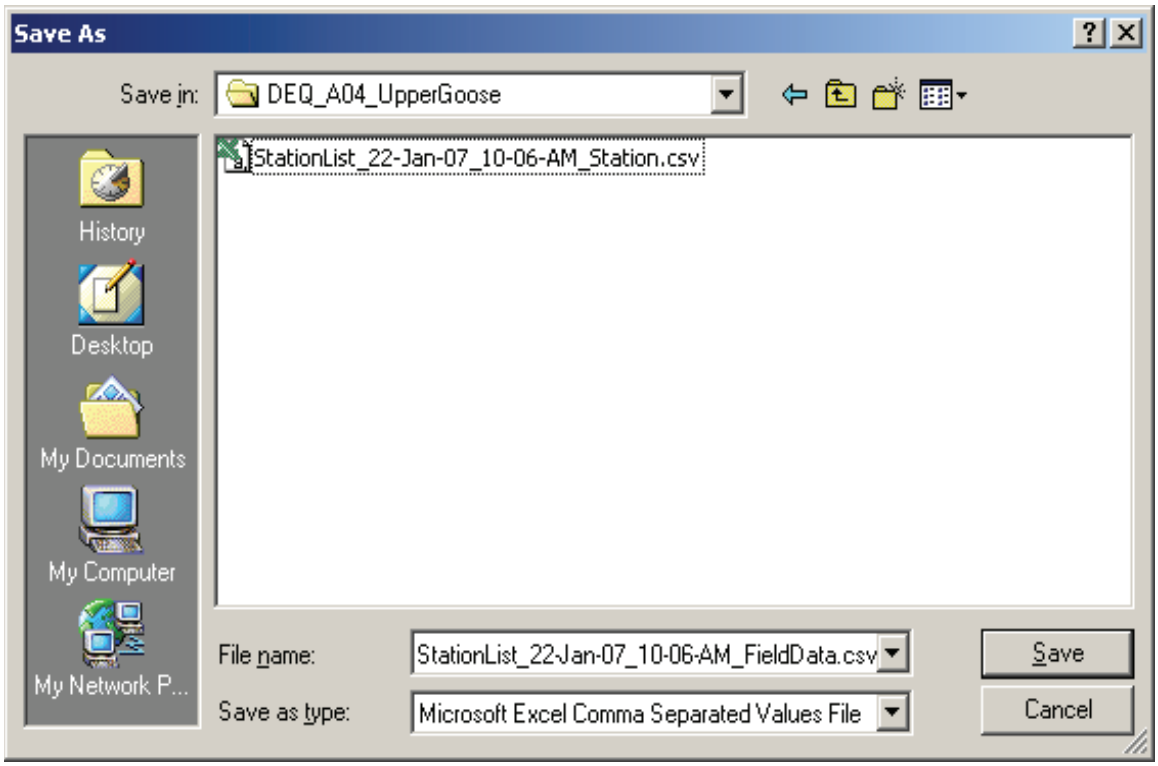
Now click on the button “Generate Table”:

We need right click and save three files:

1. Station CSV File
2. Field Date CSV File
3. Analyte CSV File

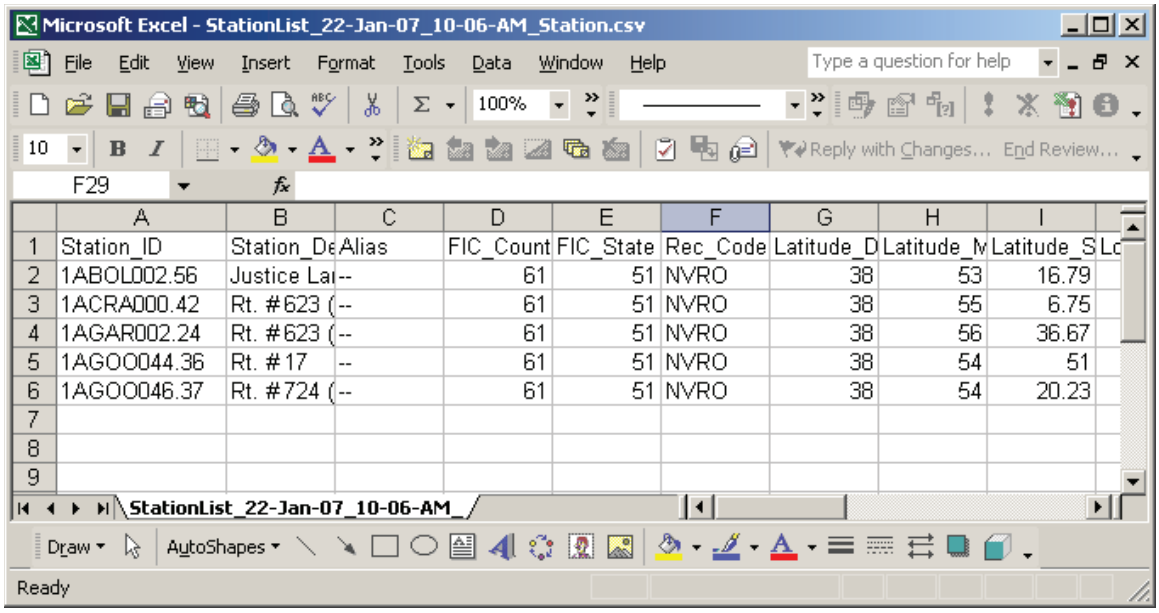
To disk:


Virginia DEQ: Water Quality Monitoring - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://gisweb.deq.virginia.gov/monapp/table_export.cfm
Go
del.icio...
TAG
Commonwealth of Virginia
Web Policy | Governor of Virginia | Contact Us
DEQ VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY
Search DEQ
Go
Advanced search
Virginia DEQ Home>Water Quality Monitoring Home>Monitoring Data Retrieval Home
email: Roger Stewart
Water Quality Monitoring Home
Surface Water Monitoring
Biological Monitoring
Fish Tissue Monitoring
Chesapeake Bay Monitoring
Citizen Monitoring
Monitoring Station Data Retrieval:
Right click HERE, and click "Save Target As" to download your Station CSV File
Right click HERE, and click "Save Target As" to download your Field Date CSV File
Right click HERE, and click "Save Target As" to download your Analyte CSV File
Click HERE to perform another query
http://www.deq.virginia.gov/
Internet


Save As
Save in: DEQ_A04_UpperGoose
StationList_22-Jan-07_10-06-AM_Station.csv
History
Desktop
My Documents
My Computer
My Network P...
File name: StationList_22-Jan-07_10-06-AM_FieldData.csv
Save as type: Microsoft Excel Comma Separated Values File
Save
Cancel

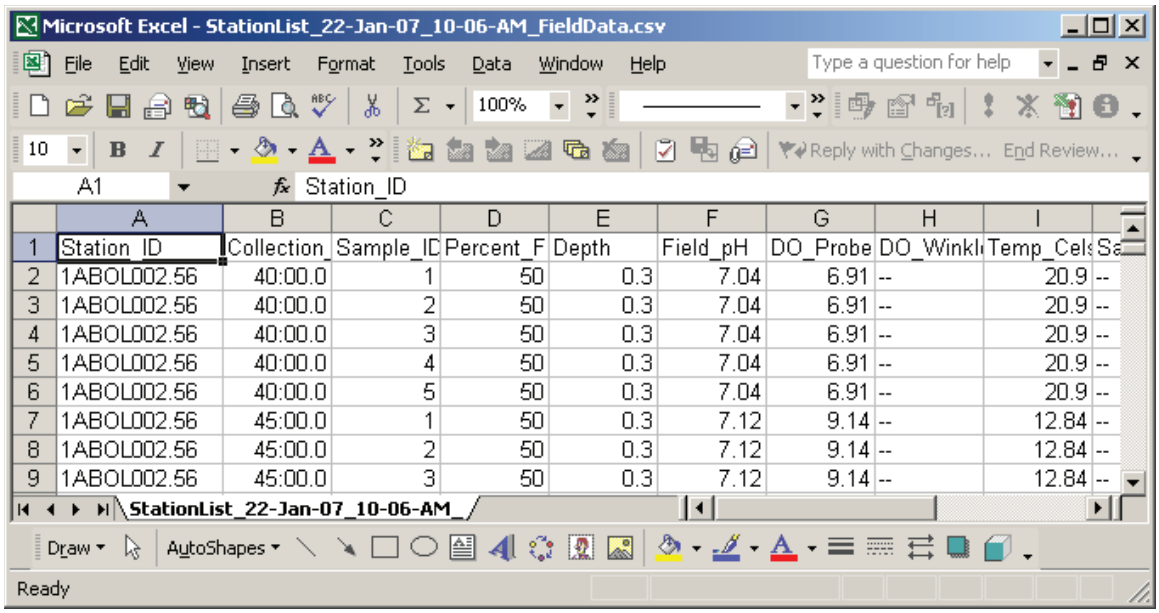
Review of Data:

The station data tables are downloaded for completeness, but not really needed we already have a feature class with these locations:



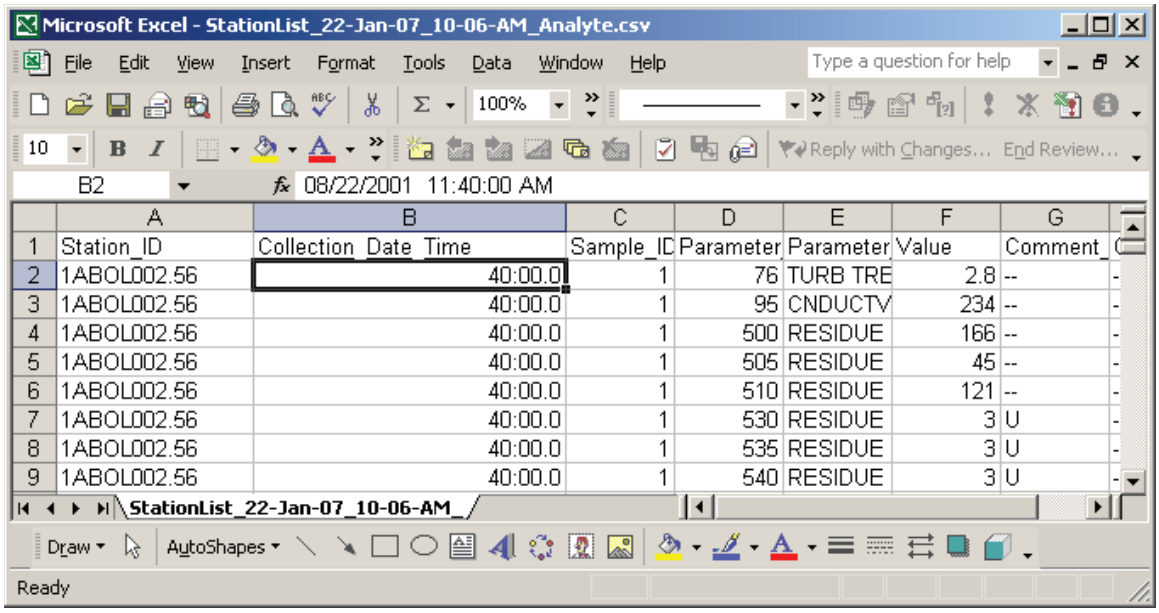
	A	B	C	D	E	F	G	H	I
1	Station_ID	Station_De	Alias	FIC_Count	FIC_State	Rec_Code	Latitude_D	Latitude_M	Latitude_S
2	1ABOL002.56	Justice Lai	--	61	51	NVRO	38	53	16.79
3	1ACRA000.42	Rt. #623 (	--	61	51	NVRO	38	55	6.75
4	1AGAR002.24	Rt. #623 (	--	61	51	NVRO	38	56	36.67
5	1AGOO044.36	Rt. #17	--	61	51	NVRO	38	54	51
6	1AGOO046.37	Rt. #724 (	--	61	51	NVRO	38	54	20.23
7									
8									
9									

The “Field” and Analyte” data tables are needed.



	A	B	C	D	E	F	G	H	I
1	Station_ID	Collection_	Sample_ID	Percent_F	Depth	Field_pH	DO_Probe	DO_Winkl	Temp_Cels
2	1ABOL002.56	40:00.0	1	50	0.3	7.04	6.91	--	20.9
3	1ABOL002.56	40:00.0	2	50	0.3	7.04	6.91	--	20.9
4	1ABOL002.56	40:00.0	3	50	0.3	7.04	6.91	--	20.9
5	1ABOL002.56	40:00.0	4	50	0.3	7.04	6.91	--	20.9
6	1ABOL002.56	40:00.0	5	50	0.3	7.04	6.91	--	20.9
7	1ABOL002.56	45:00.0	1	50	0.3	7.12	9.14	--	12.84
8	1ABOL002.56	45:00.0	2	50	0.3	7.12	9.14	--	12.84
9	1ABOL002.56	45:00.0	3	50	0.3	7.12	9.14	--	12.84

and



	A	B	C	D	E	F	G
1	Station_ID	Collection_Date_Time	Sample_ID	Parameter	Parameter	Value	Comment_
2	1ABOL002.56	40:00.0	1	76	TURB TRE	2.8	--
3	1ABOL002.56	40:00.0	1	95	CNDUCTV	234	--
4	1ABOL002.56	40:00.0	1	500	RESIDUE	166	--
5	1ABOL002.56	40:00.0	1	505	RESIDUE	45	--
6	1ABOL002.56	40:00.0	1	510	RESIDUE	121	--
7	1ABOL002.56	40:00.0	1	530	RESIDUE	3	U
8	1ABOL002.56	40:00.0	1	535	RESIDUE	3	U
9	1ABOL002.56	40:00.0	1	540	RESIDUE	3	U

Note the field “Collection_Date_Time” actually contains date and time information although not initially display when housed in MS Excel. We’ll adjust for this later.

Merging the Data Tables:

There are many way to merge the twelve tables. Probably the most simple is to use DOS batch files. Below is the listing of “copy_merge2.bat” file.

```
REM Utility to copy and merge DEQ water quality data downloaded into separate folders and merge into one

del FieldData.csv
copy D:\DEQ_Water_Quality\DEQ_A01R_PotPineyDutchman\StationList*FieldData.csv         1.csv
copy D:\DEQ_Water_Quality\DEQ_A02R_Catoctin\StationList*FieldData.csv +               1.csv 2.csv
copy D:\DEQ_Water_Quality\DEQ_A03R_PotLimestone\StationList*FieldData.csv +           2.csv 3.csv
copy D:\DEQ_Water_Quality\DEQ_A04R_UpperGooseGap\StationList*FieldData.csv +          3.csv 4.csv
copy D:\DEQ_Water_Quality\DEQ_A05R_MiddleGoosePantherSkin\StationList*FieldData.csv + 4.csv 5.csv
copy D:\DEQ_Water_Quality\DEQ_A06R_NorthFkGoose\StationList*FieldData.csv +           5.csv 6.csv
copy D:\DEQ_Water_Quality\DEQ_A07R_Beaverdam\StationList*FieldData.csv +              6.csv 7.csv
copy D:\DEQ_Water_Quality\DEQ_A07L_BeaverdamReservoir\StationList*FieldData.csv +     7.csv 8.csv
copy D:\DEQ_Water_Quality\DEQ_A08R_LowerGooseLittle\StationList*FieldData.csv +       8.csv 9.csv
copy D:\DEQ_Water_Quality\DEQ_A09R_PotBroadRun\StationList*FieldData.csv +            9.csv 10.csv
copy D:\DEQ_Water_Quality\DEQ_A10R_SugarlandRun\StationList*FieldData.csv +           10.csv 11.csv
copy D:\DEQ_Water_Quality\DEQ_A21R_UpperBullLittleBull\StationList*FieldData.csv +    11.csv 12.csv
copy D:\DEQ_Water_Quality\DEQ_A22R_CubRun\StationList*FieldData.csv +                 12.csv FieldData.csv
Del 1.csv, 2.csv, 3.csv, 4.csv, 5.csv, 6.csv, 7.csv, 8.csv, 9.csv, 10.csv, 11.csv, 12.csv

del Station.csv
copy D:\DEQ_Water_Quality\DEQ_A01R_PotPineyDutchman\StationList*Station.csv         1.csv
copy D:\DEQ_Water_Quality\DEQ_A02R_Catoctin\StationList*Station.csv +               1.csv 2.csv
copy D:\DEQ_Water_Quality\DEQ_A03R_PotLimestone\StationList*Station.csv +           2.csv 3.csv
copy D:\DEQ_Water_Quality\DEQ_A04R_UpperGooseGap\StationList*Station.csv +          3.csv 4.csv
copy D:\DEQ_Water_Quality\DEQ_A05R_MiddleGoosePantherSkin\StationList*Station.csv + 4.csv 5.csv
copy D:\DEQ_Water_Quality\DEQ_A06R_NorthFkGoose\StationList*Station.csv +           5.csv 6.csv
copy D:\DEQ_Water_Quality\DEQ_A07R_Beaverdam\StationList*Station.csv +              6.csv 7.csv
copy D:\DEQ_Water_Quality\DEQ_A07L_BeaverdamReservoir\StationList*Station.csv +     7.csv 8.csv
copy D:\DEQ_Water_Quality\DEQ_A08R_LowerGooseLittle\StationList*Station.csv +       8.csv 9.csv
copy D:\DEQ_Water_Quality\DEQ_A09R_PotBroadRun\StationList*Station.csv +            9.csv 10.csv
copy D:\DEQ_Water_Quality\DEQ_A10R_SugarlandRun\StationList*Station.csv +           10.csv 11.csv
copy D:\DEQ_Water_Quality\DEQ_A21R_UpperBullLittleBull\StationList*Station.csv +    11.csv 12.csv
copy D:\DEQ_Water_Quality\DEQ_A22R_CubRun\StationList*Station.csv +                 12.csv Station.csv
Del 1.csv, 2.csv, 3.csv, 4.csv, 5.csv, 6.csv, 7.csv, 8.csv, 9.csv, 10.csv, 11.csv, 12.csv


del Analyte.csv
copy D:\DEQ_Water_Quality\DEQ_A01R_PotPineyDutchman\StationList*Analyte.csv         1.csv
copy D:\DEQ_Water_Quality\DEQ_A02R_Catoctin\StationList*Analyte.csv +               1.csv 2.csv
copy D:\DEQ_Water_Quality\DEQ_A03R_PotLimestone\StationList*Analyte.csv +           2.csv 3.csv
copy D:\DEQ_Water_Quality\DEQ_A04R_UpperGooseGap\StationList*Analyte.csv +          3.csv 4.csv
copy D:\DEQ_Water_Quality\DEQ_A05R_MiddleGoosePantherSkin\StationList*Analyte.csv + 4.csv 5.csv
copy D:\DEQ_Water_Quality\DEQ_A06R_NorthFkGoose\StationList*Analyte.csv +           5.csv 6.csv
copy D:\DEQ_Water_Quality\DEQ_A07R_Beaverdam\StationList*Analyte.csv +              6.csv 7.csv
copy D:\DEQ_Water_Quality\DEQ_A07L_BeaverdamReservoir\StationList*Analyte.csv +     7.csv 8.csv
copy D:\DEQ_Water_Quality\DEQ_A08R_LowerGooseLittle\StationList*Analyte.csv +       8.csv 9.csv
copy D:\DEQ_Water_Quality\DEQ_A09R_PotBroadRun\StationList*Analyte.csv +            9.csv 10.csv
copy D:\DEQ_Water_Quality\DEQ_A10R_SugarlandRun\StationList*Analyte.csv +           10.csv 11.csv
copy D:\DEQ_Water_Quality\DEQ_A21R_UpperBullLittleBull\StationList*Analyte.csv +    11.csv 12.csv
copy D:\DEQ_Water_Quality\DEQ_A22R_CubRun\StationList*Analyte.csv +                 12.csv Analyte.csv
Del 1.csv, 2.csv, 3.csv, 4.csv, 5.csv, 6.csv, 7.csv, 8.csv, 9.csv, 10.csv, 11.csv, 12.csv
```

At this point, we need to load to MS Access as the “Analyte” table contains more than 84,000 records which is more then the 64K limit of Excel rows.

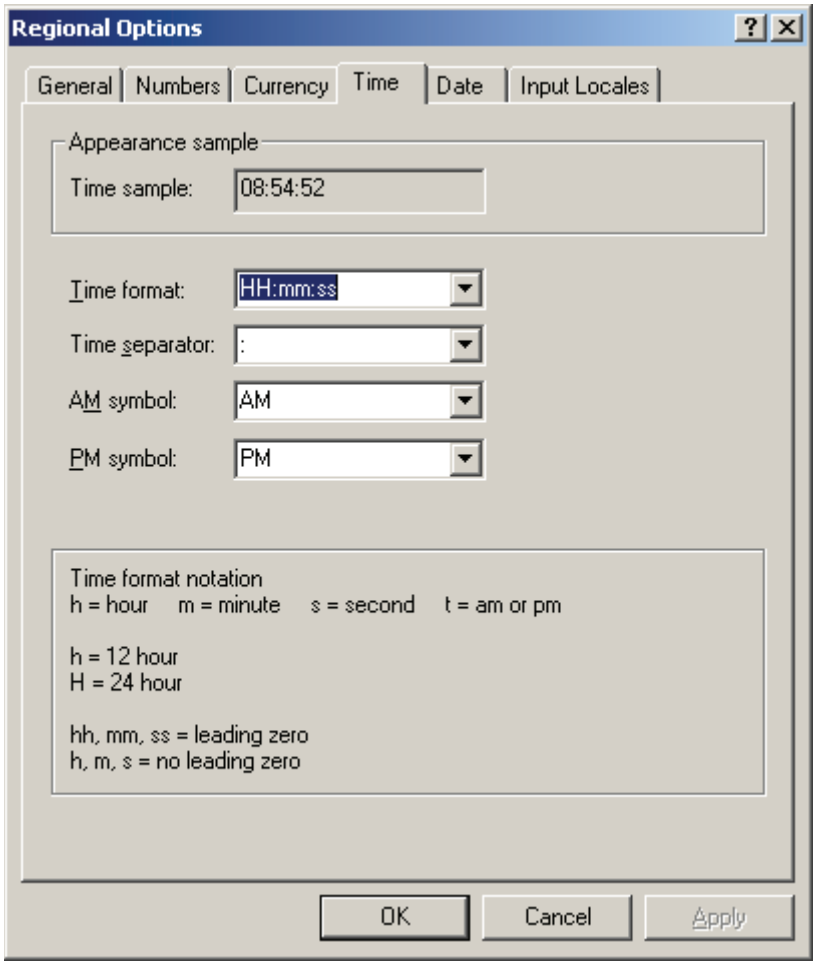
Loading the Data Tables:

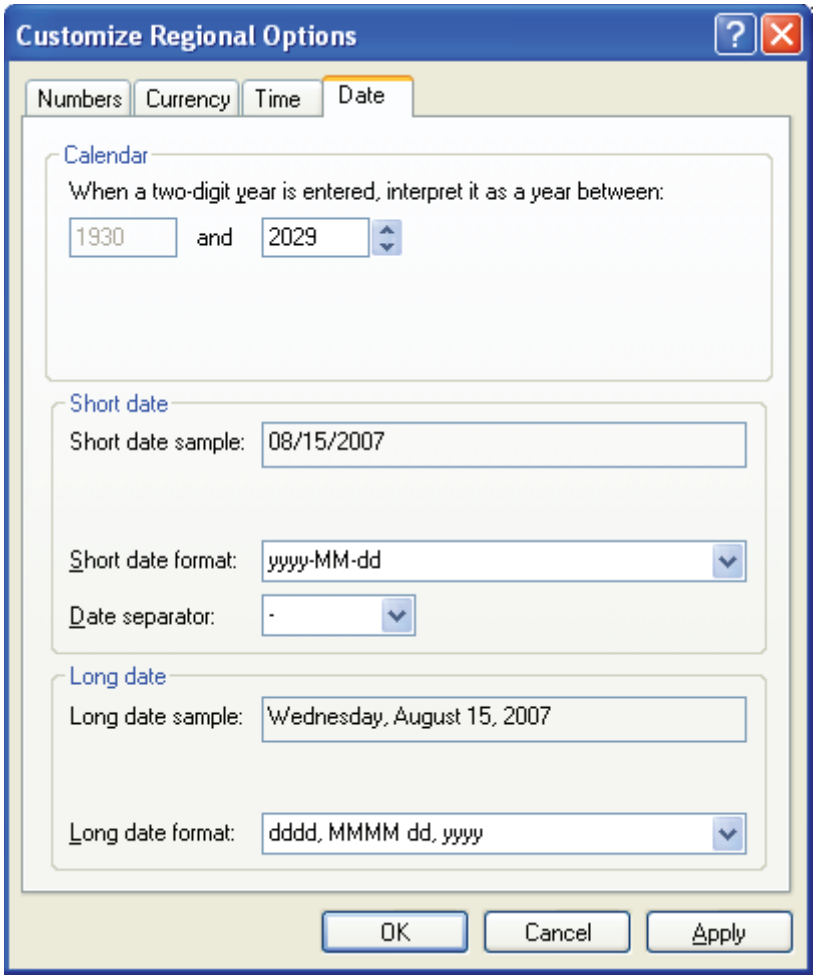
Using Data Load template: You start with the file “DEQ_Jan_2007_Template.mdb “ and copy this to “DEQ_Jan_2007_Data_Load.lmdb”.

before we do this, we need to manually edit the .csv files coming from DEQ.

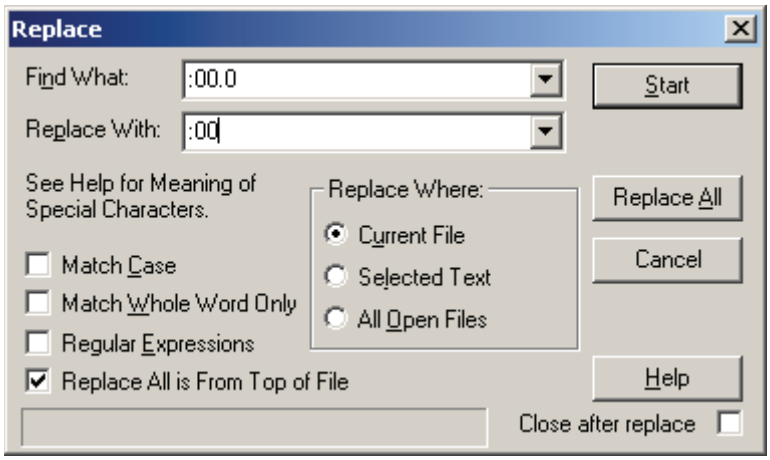
The typical date/time format is: "1974-10-07 11:30:00.0" and we need to drop the ending “.0” from time to have "1974-10-07 11:30:00"

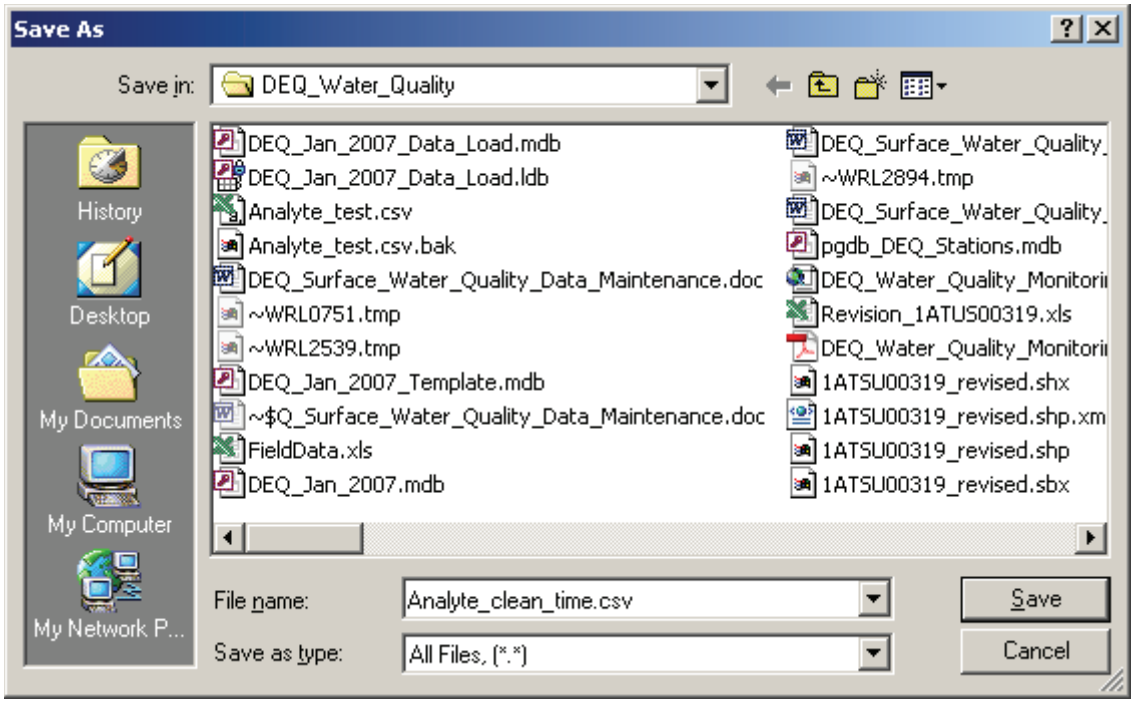
This should be consistent with local Windows Control Panel > Regional Setting which uses the 24 hours clock



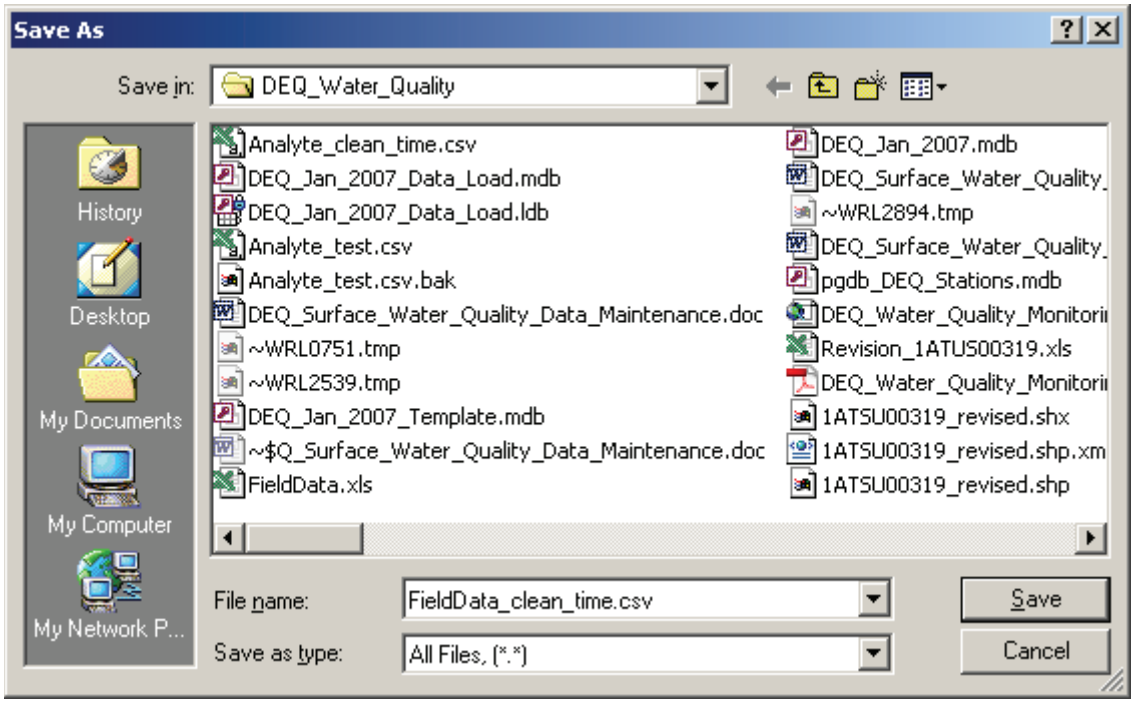


Now manually edit all records replacing:

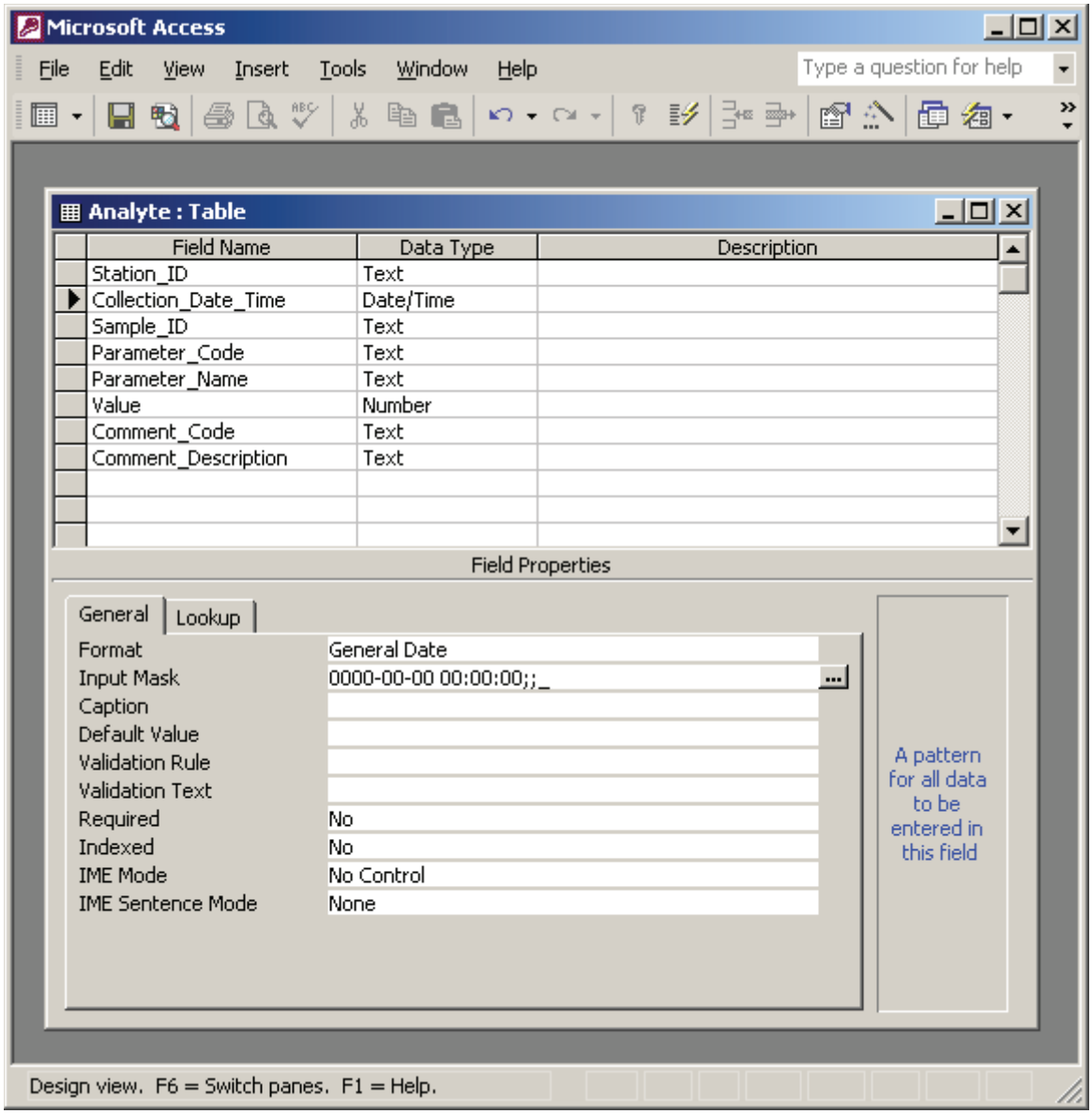




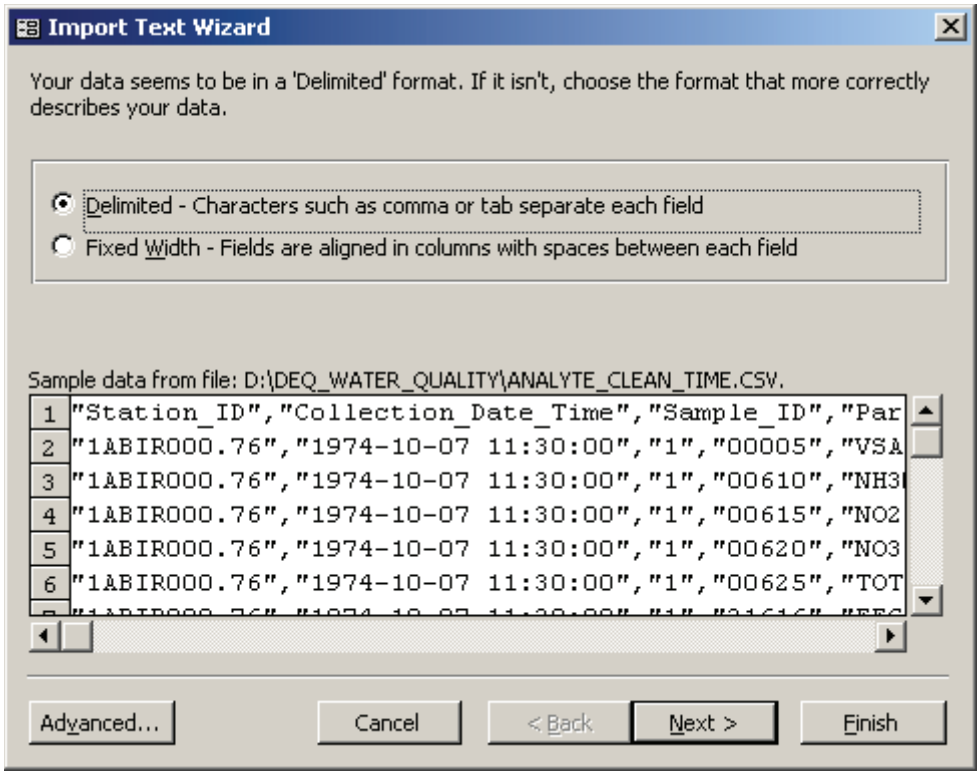
also do this for field data

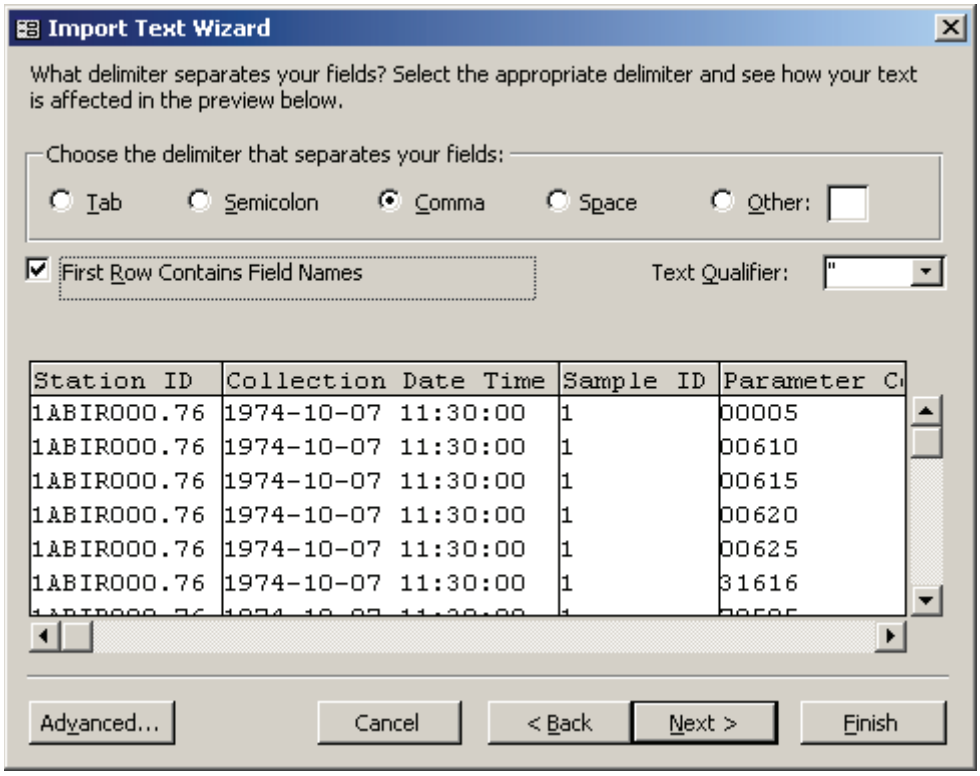


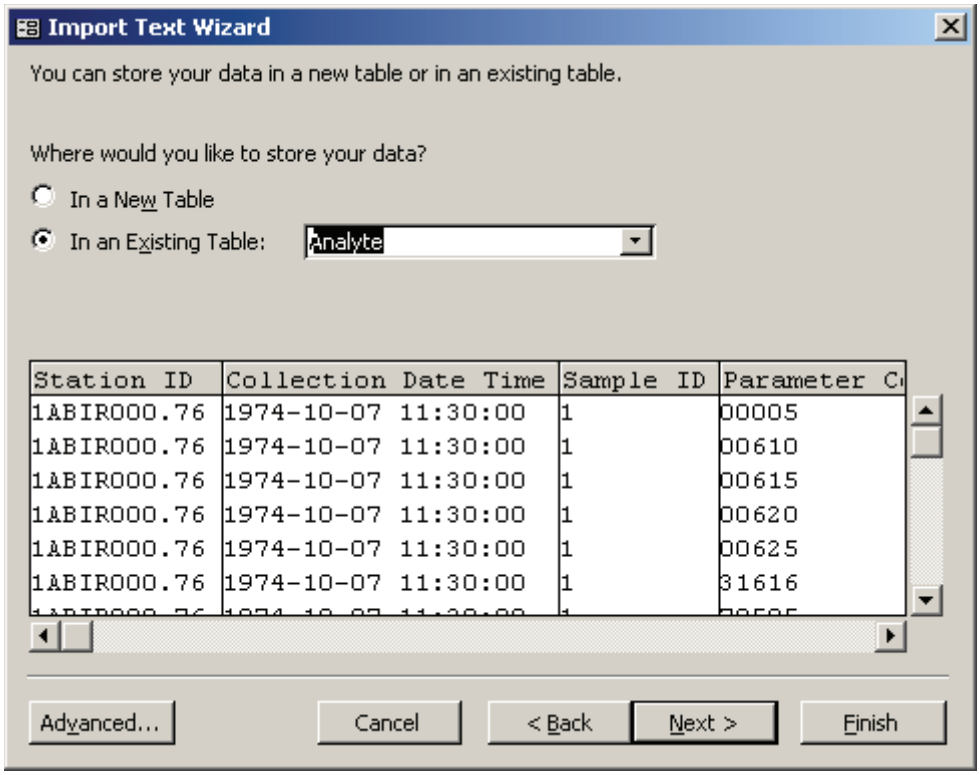
In the table properties, we should have a “General Time” and input mask as follows

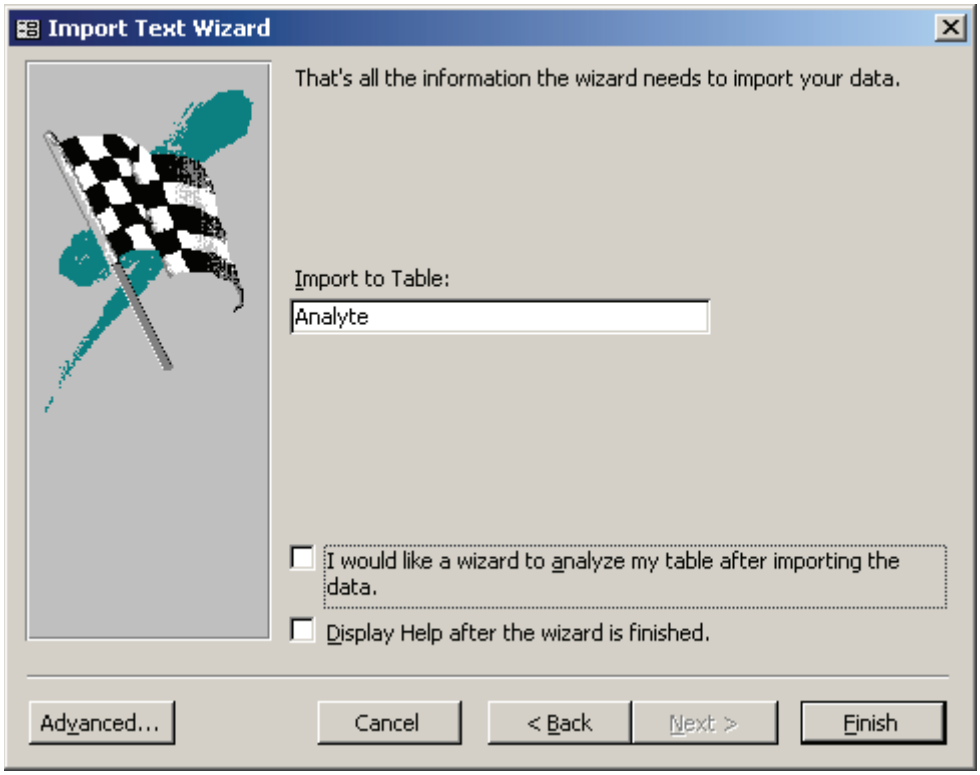


Now Get External Data > Import


Import Text Wizard
Your data seems to be in a 'Delimited' format. If it isn't, choose the format that more correctly describes your data.
Delimited - Characters such as comma or tab separate each field
Fixed Width - Fields are aligned in columns with spaces between each field
Sample data from file: D:\DEQ_WATER_QUALITY\ANALYTE_CLEAN_TIME.CSV.
1 "Station_ID","Collection_Date_Time","Sample_ID","Par
2 "1ABIR000.76","1974-10-07 11:30:00","1","00005","VSA
3 "1ABIR000.76","1974-10-07 11:30:00","1","00610","NH3
4 "1ABIR000.76","1974-10-07 11:30:00","1","00615","NO2
5 "1ABIR000.76","1974-10-07 11:30:00","1","00620","NO3
6 "1ABIR000.76","1974-10-07 11:30:00","1","00625","TOT
Advanced...
Cancel
< Back
Next >
Finish

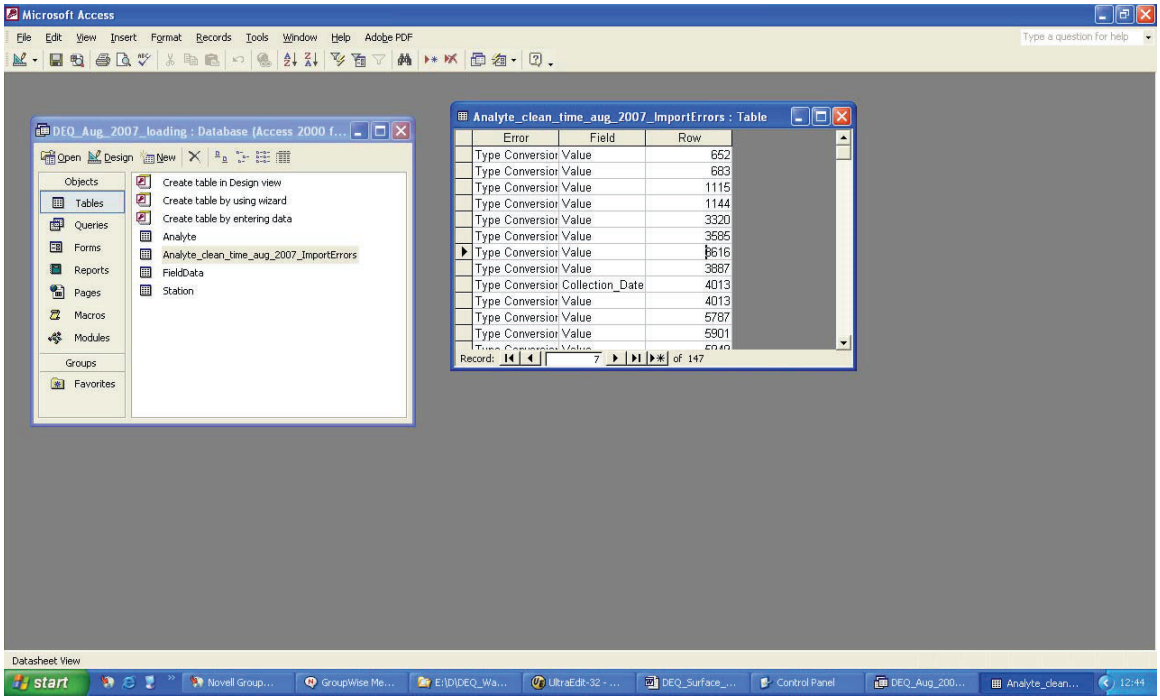

Import Text Wizard
What delimiter separates your fields? Select the appropriate delimiter and see how your text is affected in the preview below.
Choose the delimiter that separates your fields:
Tab
Semicolon
Comma
Space
Other:
First Row Contains Field Names
Text Qualifier:
Station ID | Collection Date Time | Sample ID | Parameter C
1ABIR000.76 | 1974-10-07 11:30:00 | 1 | 00005
1ABIR000.76 | 1974-10-07 11:30:00 | 1 | 00610
1ABIR000.76 | 1974-10-07 11:30:00 | 1 | 00615
1ABIR000.76 | 1974-10-07 11:30:00 | 1 | 00620
1ABIR000.76 | 1974-10-07 11:30:00 | 1 | 00625
1ABIR000.76 | 1974-10-07 11:30:00 | 1 | 31616
Advanced...
Cancel
< Back
Next >
Finish







There will be some data errors:

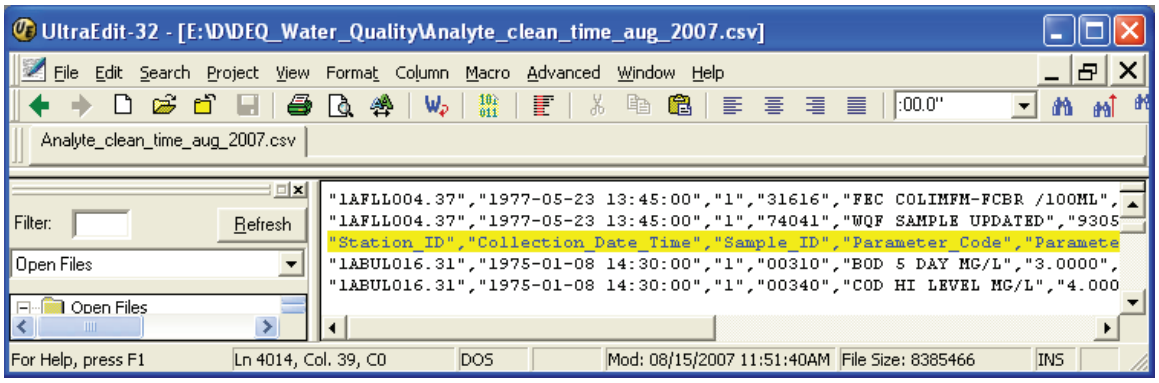


For example records such as:

"PHEOPHTN RATIO SPECTRO","--","O","--"

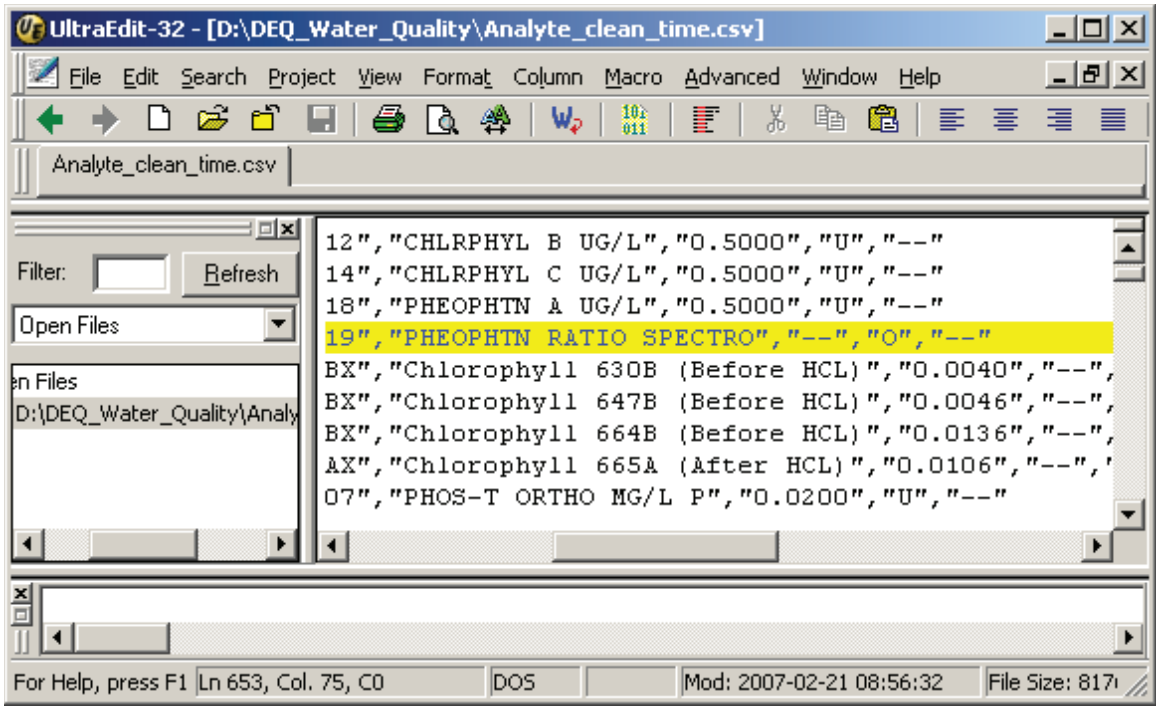
cause a problem because “Value” is "--"

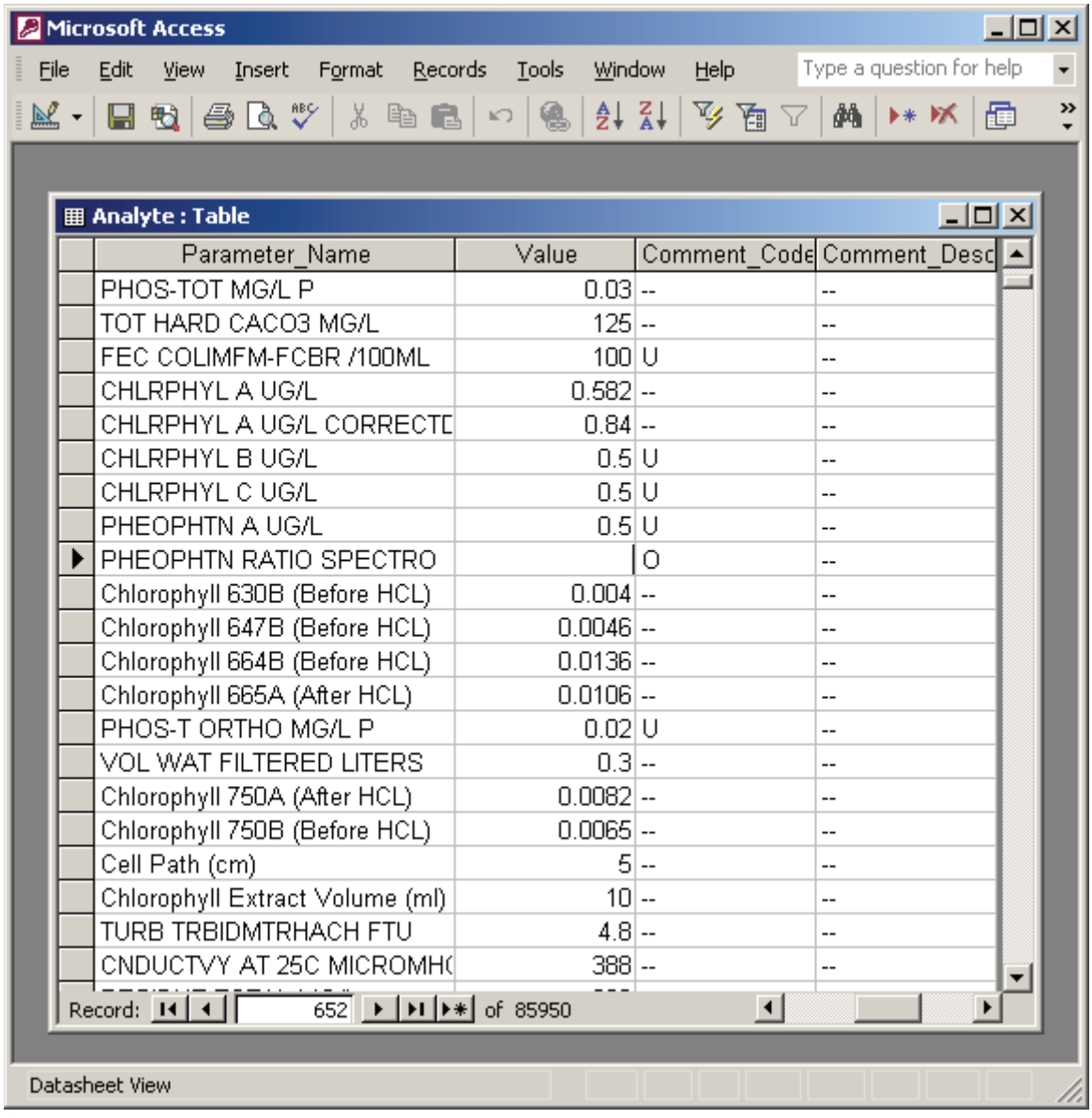
There are also date value problems…..



because of extraneous header records not being removed after copying together the files, but this is OK.

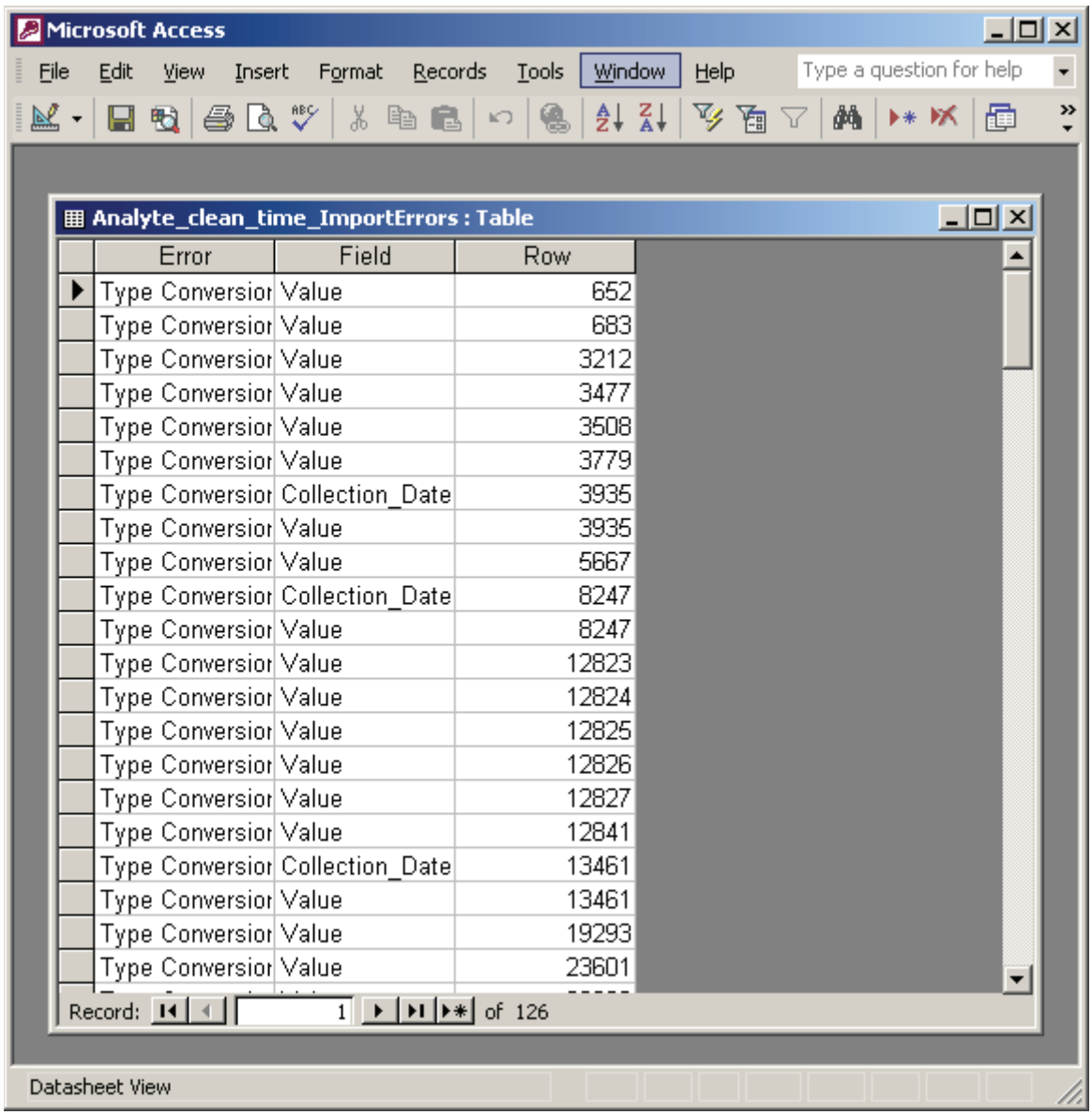
This occurs when the .csv file has blanks such as:


UltraEdit-32 - [D:\DEQ_Water_Quality\Analyte_clean_time.csv]
File Edit Search Project View Format Column Macro Advanced Window Help
Analyte_clean_time.csv
Filter:
Refresh
Open Files
D:\DEQ_Water_Quality\Analy
12","CHLRPHYL B UG/L","0.5000","U","--"
14","CHLRPHYL C UG/L","0.5000","U","--"
18","PHEOPHTN A UG/L","0.5000","U","--"
19","PHEOPHTN RATIO SPECTRO","--","O","--"
BX","Chlorophyll 630B (Before HCL)","0.0040","--",
BX","Chlorophyll 647B (Before HCL)","0.0046","--",
BX","Chlorophyll 664B (Before HCL)","0.0136","--",
AX","Chlorophyll 665A (After HCL)","0.0106","--",
07","PHOS-T ORTHO MG/L P","0.0200","U","--"
For Help, press F1
Ln 653, Col. 75, C0
DOS
Mod: 2007-02-21 08:56:32
File Size: 817

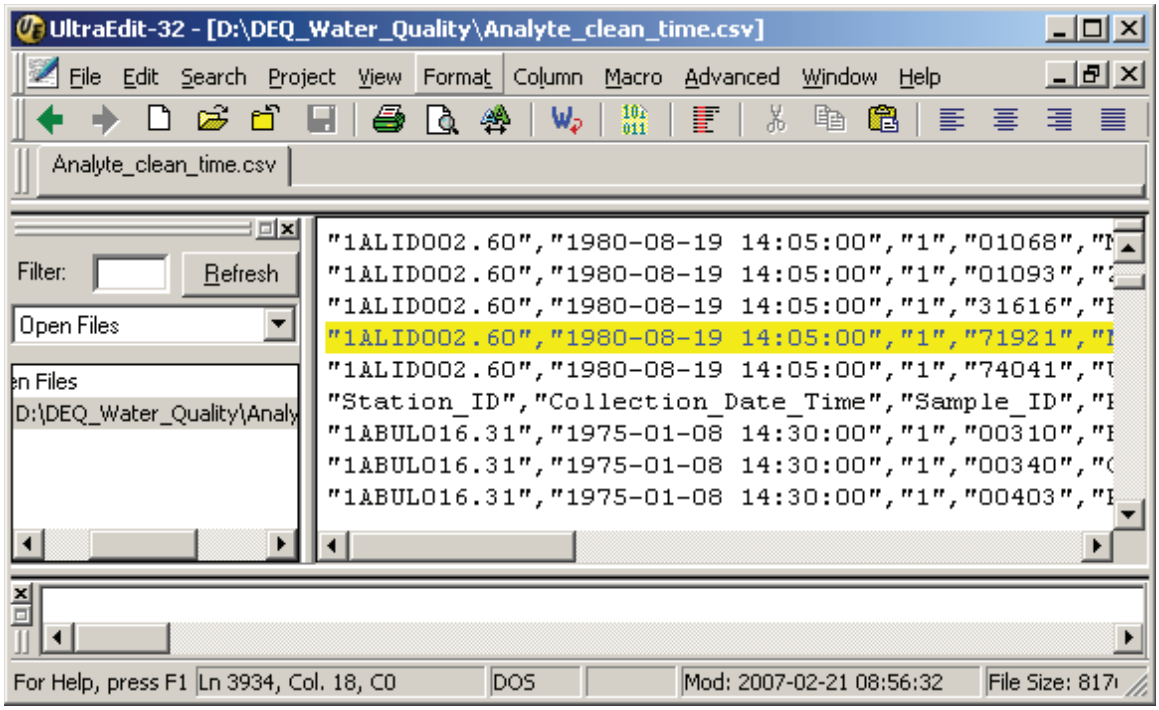

Microsoft Access
File Edit View Insert Format Records Tools Window Help
Type a question for help
Analyte : Table
Parameter_Name | Value | Comment_Code | Comment_Desc
PHOS-TOT MG/L P | 0.03 | -- | --
TOT HARD CACO3 MG/L | 125 | -- | --
FEC COLIMFM-FCBR /100ML | 100 | U | --
CHLRPHYL A UG/L | 0.582 | -- | --
CHLRPHYL A UG/L CORRECTE | 0.84 | -- | --
CHLRPHYL B UG/L | 0.5 | U | --
CHLRPHYL C UG/L | 0.5 | U | --
PHEOPHTN A UG/L | 0.5 | U | --
PHEOPHTN RATIO SPECTRO | | O | --
Chlorophyll 630B (Before HCL) | 0.004 | -- | --
Chlorophyll 647B (Before HCL) | 0.0046 | -- | --
Chlorophyll 664B (Before HCL) | 0.0136 | -- | --
Chlorophyll 665A (After HCL) | 0.0106 | -- | --
PHOS-T ORTHO MG/L P | 0.02 | U | --
VOL WAT FILTERED LITERS | 0.3 | -- | --
Chlorophyll 750A (After HCL) | 0.0082 | -- | --
Chlorophyll 750B (Before HCL) | 0.0065 | -- | --
Cell Path (cm) | 5 | -- | --
Chlorophyll Extract Volume (ml) | 10 | -- | --
TURB TRBIDMTRHACH FTU | 4.8 | -- | --
CNDUCTVY AT 25C MICROMH | 388 | -- | --
Record: 652 of 85950
Datasheet View

This is OK.

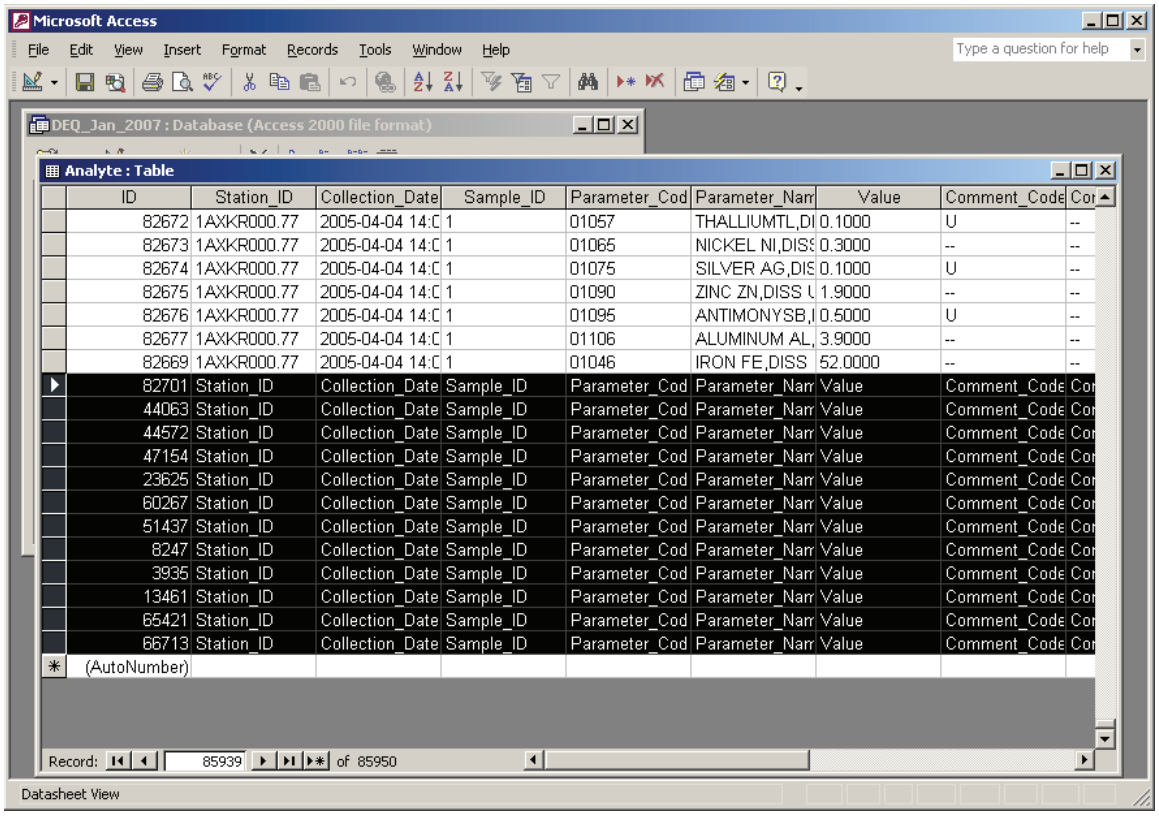
A second problem occurs when tabs were merged together resulting in redundant header records in the .csv file such as:



This is OK.



Now clean-up the repeated headings generated while merging the files: Sort by Station ID by right clicking on column header.

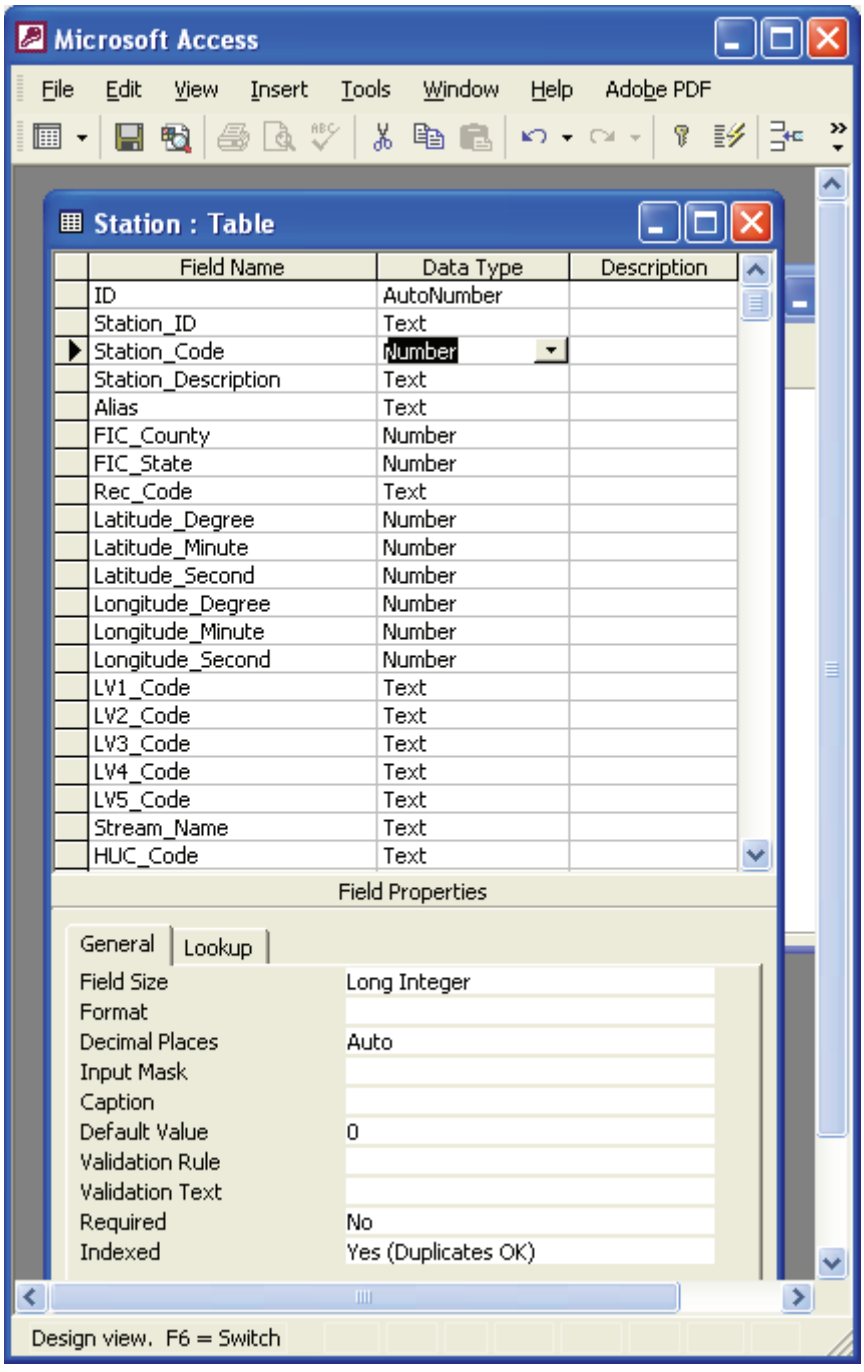


Delete these extra records.

There are also problems with importing null values "--" for FieldData DO_probe and others and in Stations for Strahler_rder and Shreve_Order as these are nulls.

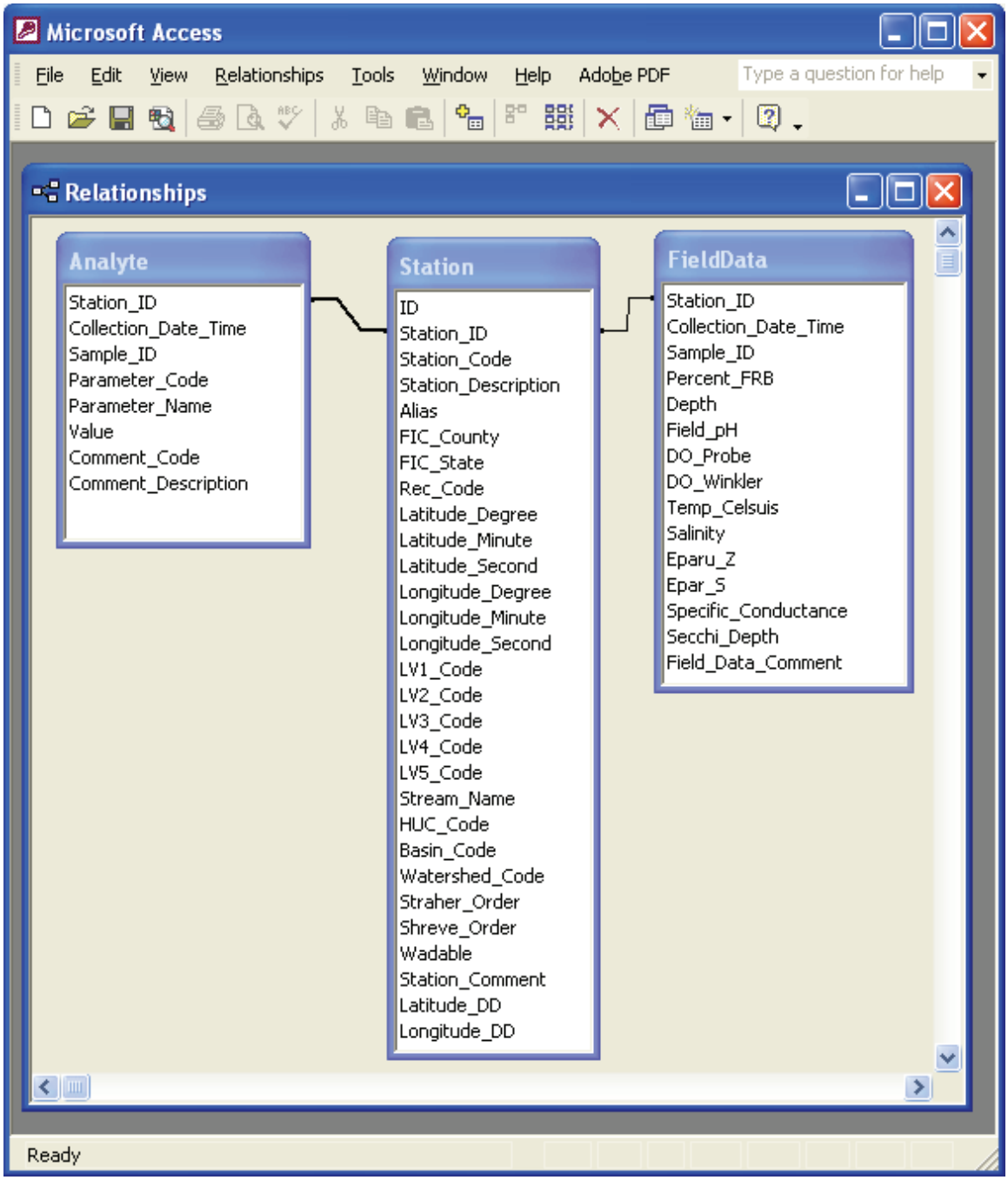
In preparation for Stagraphics, we need to have a number for the station. We can't use text values.

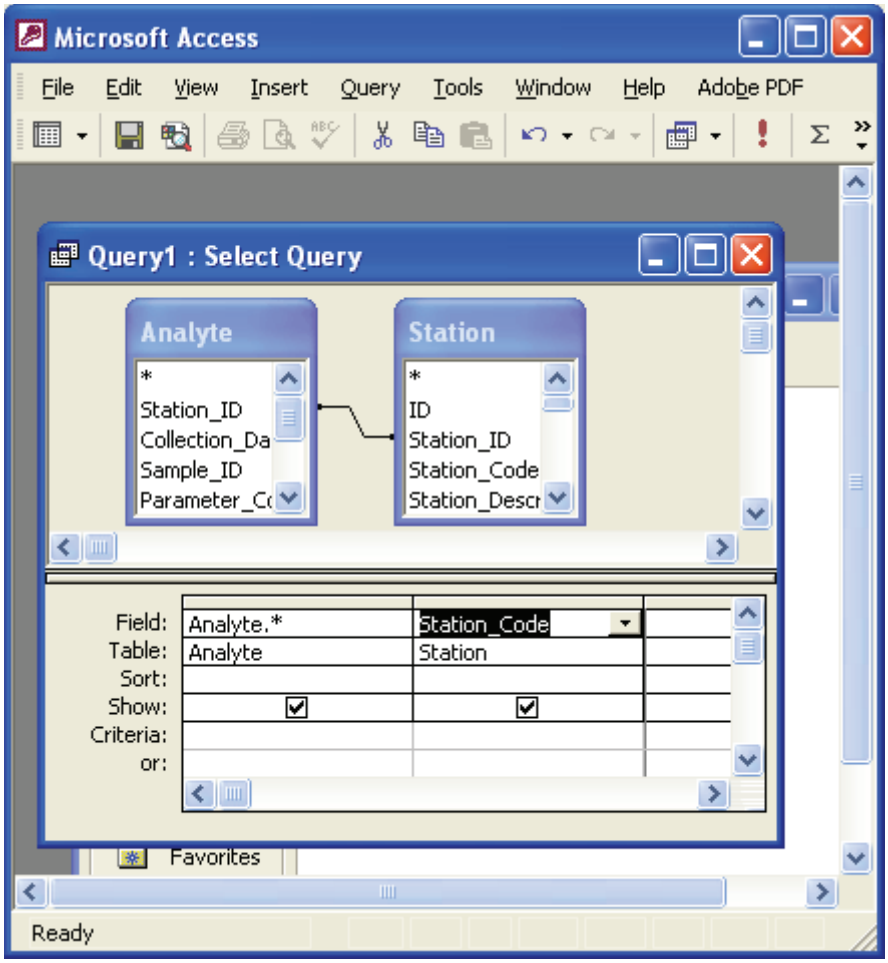
To address this, add a sequence number to the Station table



Populate the first few values and then using down arrow, the rest will fill in automatically.

No join Analyte to Station and "Make Table"


Microsoft Access
File Edit View Relationships Tools Window Help Adobe PDF
Type a question for help
Relationships
Analyte
Station_ID
Collection_Date_Time
Sample_ID
Parameter_Code
Parameter_Name
Value
Comment_Code
Comment_Description
Station
ID
Station_ID
Station_Code
Station_Description
Alias
FIC_County
FIC_State
Rec_Code
Latitude_Degree
Latitude_Minute
Latitude_Second
Longitude_Degree
Longitude_Minute
Longitude_Second
LV1_Code
LV2_Code
LV3_Code
LV4_Code
LV5_Code
Stream_Name
HUC_Code
Basin_Code
Watershed_Code
Straher_Order
Shreve_Order
Wadable
Station_Comment
Latitude_DD
Longitude_DD
FieldData
Station_ID
Collection_Date_Time
Sample_ID
Percent_FRB
Depth
Field_pH
DO_Probe
DO_Winkler
Temp_Celsuis
Salinity
Eparu_Z
Epar_S
Specific_Conductance
Secchi_Depth
Field_Data_Comment
Ready



Do similar for FieldData

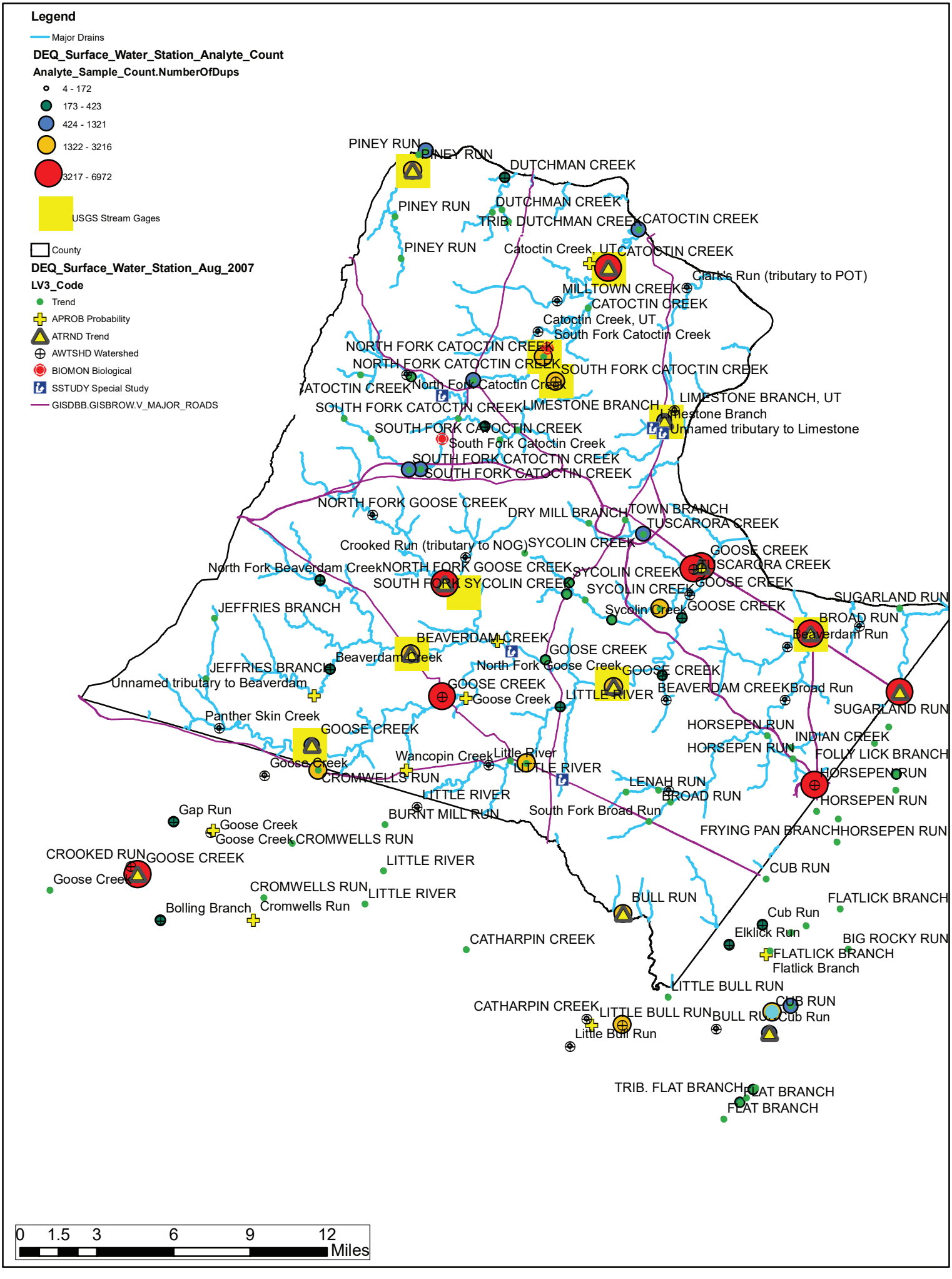
We now have Analyte and FieldData with a numerical field for Station_Code.

Status:

As of 1/23/2007, DEQ (Roger Stewart) indicated that preferred data type designations and definitions would not be forthcoming and that we should wait for the new Oracle-based system is developed.

Other Reference:

Separate memo will be created on relating time-series tables (similar to USGS Stream flow table relate).


Legend
Major Drains
DEQ_Surface_Water_Station_Analyte_Count
Analyte_Sample_Count.NumberOfDups
4 - 172
173 - 423
424 - 1321
1322 - 3216
3217 - 6972
USGS Stream Gages
County
DEQ_Surface_Water_Station_Aug_2007
LV3_Code
Trend
APROB Probability
ATRND Trend
AWTSHD Watershed
BIOMON Biological
SSTUDY Special Study
GISDBB.GISBROW.V_MAJOR_ROADS
PINEY RUN
DUTCHMAN CREEK
TRIB. DUTCHMAN CREEK
CATOCTIN CREEK
Catoctin Creek, UT
Clark's Run (tributary to POT)
MILLTOWN CREEK
South Fork Catoctin Creek
NORTH FORK CATOCTIN CREEK
SOUTH FORK CATOCTIN CREEK
North Fork Catoctin Creek
LIMESTONE BRANCH, UT
LIMESTONE BRANCH
Unnamed tributary to Limestone
NORTH FORK GOOSE CREEK
DRY MILL BRANCH
TOWN BRANCH
TUSCARORA CREEK
Crooked Run (tributary to NOG)
SYCOLIN CREEK
GOOSE CREEK
North Fork Beaverdam Creek
SOUTH FORK SYCOLIN CREEK
JEFFRIES BRANCH
SUGARLAND RUN
BROAD RUN
Beaverdam Run
BEAVERDAM CREEK
Beaverdam Creek
North Fork Goose Creek
Unnamed tributary to Beaverdam
Goose Creek
LITTLE RIVER
Broad Run
Panther Skin Creek
HORSEPEN RUN
INDIAN CREEK
FOLLY LICK BRANCH
Wancopin Creek
Little River
CROMWELLS RUN
LENAH RUN
BROAD RUN
Gap Run
BURNT MILL RUN
South Fork Broad Run
FRYING PAN BRANCH
CROOKED RUN
Cromwells Run
Bolling Branch
CUB RUN
BULL RUN
FLATLICK BRANCH
Cub Run
Elklick Run
BIG ROCKY RUN
CATHARPIN CREEK
Flatlick Branch
LITTLE BULL RUN
Little Bull Run
TRIB. FLAT BRANCH
FLAT BRANCH
0 1.5 3 6 9 12
Miles

Relating Data in USGS NAWQA

David Ward
December 8, 2006

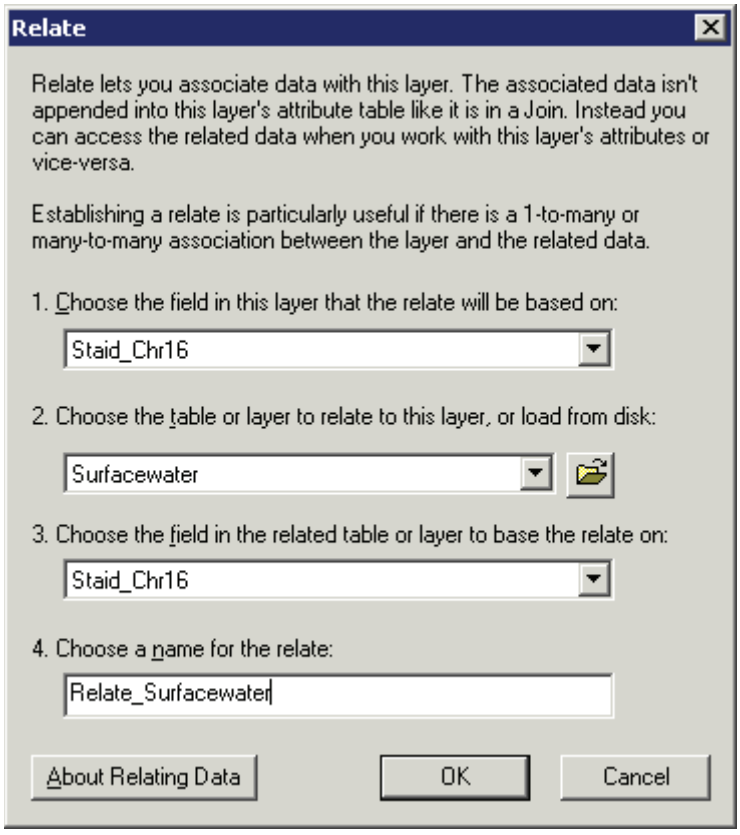
The station identification number from web query results in the field Staid being a Double. This first needs to be converted to a character string of length 16 in the feature class “Stations” and the two table of time series data “Surfacewater” and “Groundwater”.

Now these can be related in a one-to-many relationship. For each station there are numerous water chemistry measurements.

One can manually create the relate and store in the .mxd file, or one can use ArcToolBox to create a relationship class. If you create the relate in the .mxd, one needs to save as layer file such that others may use the data in the same way. Preferably the relate is stored as a relationship class in pgdb.

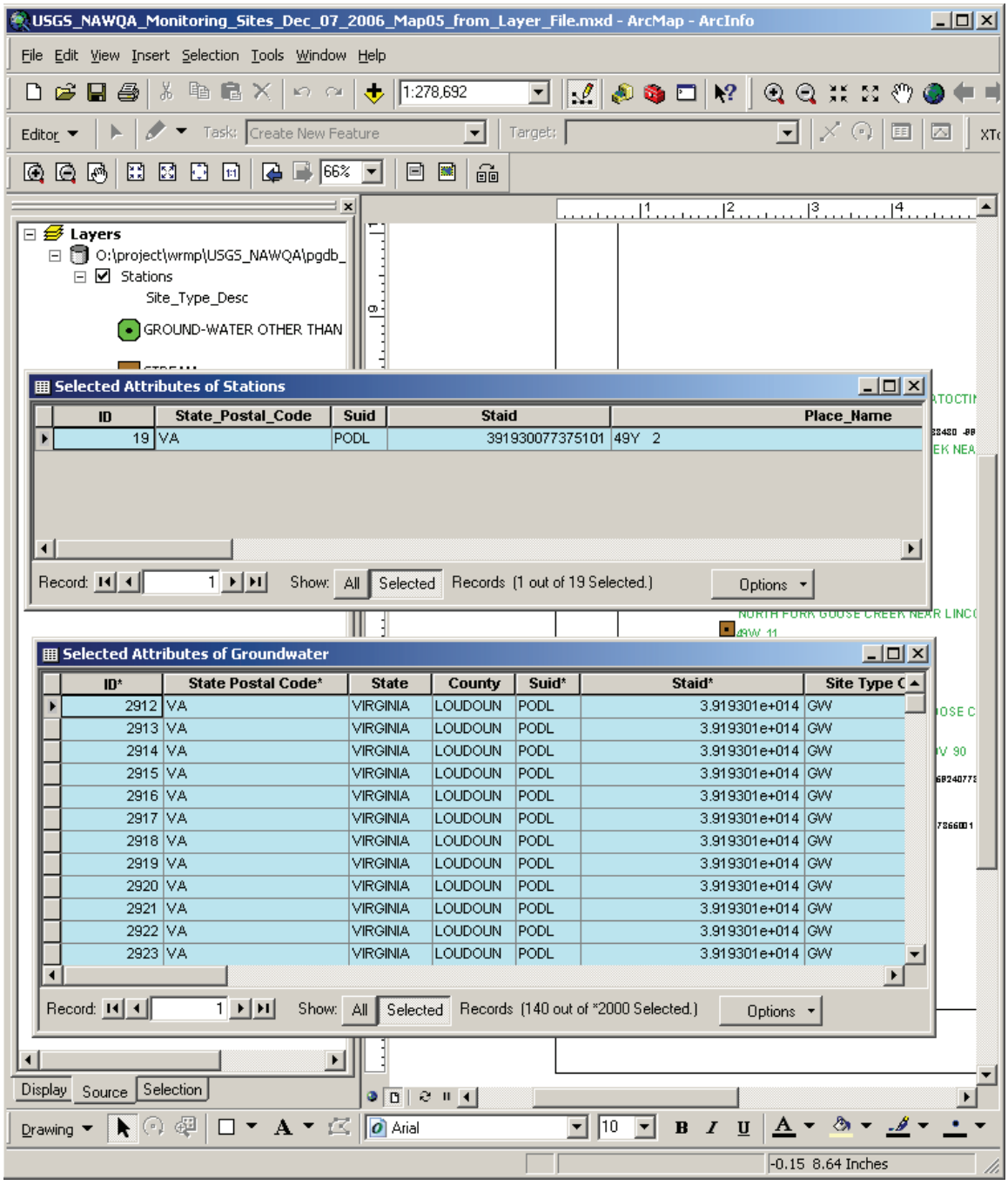
Step 1: First examine relating directly within ArcMap.

Select the “Stations” layer and create the Relate. One for Surface and one for Groundwater tables containing the time series data.

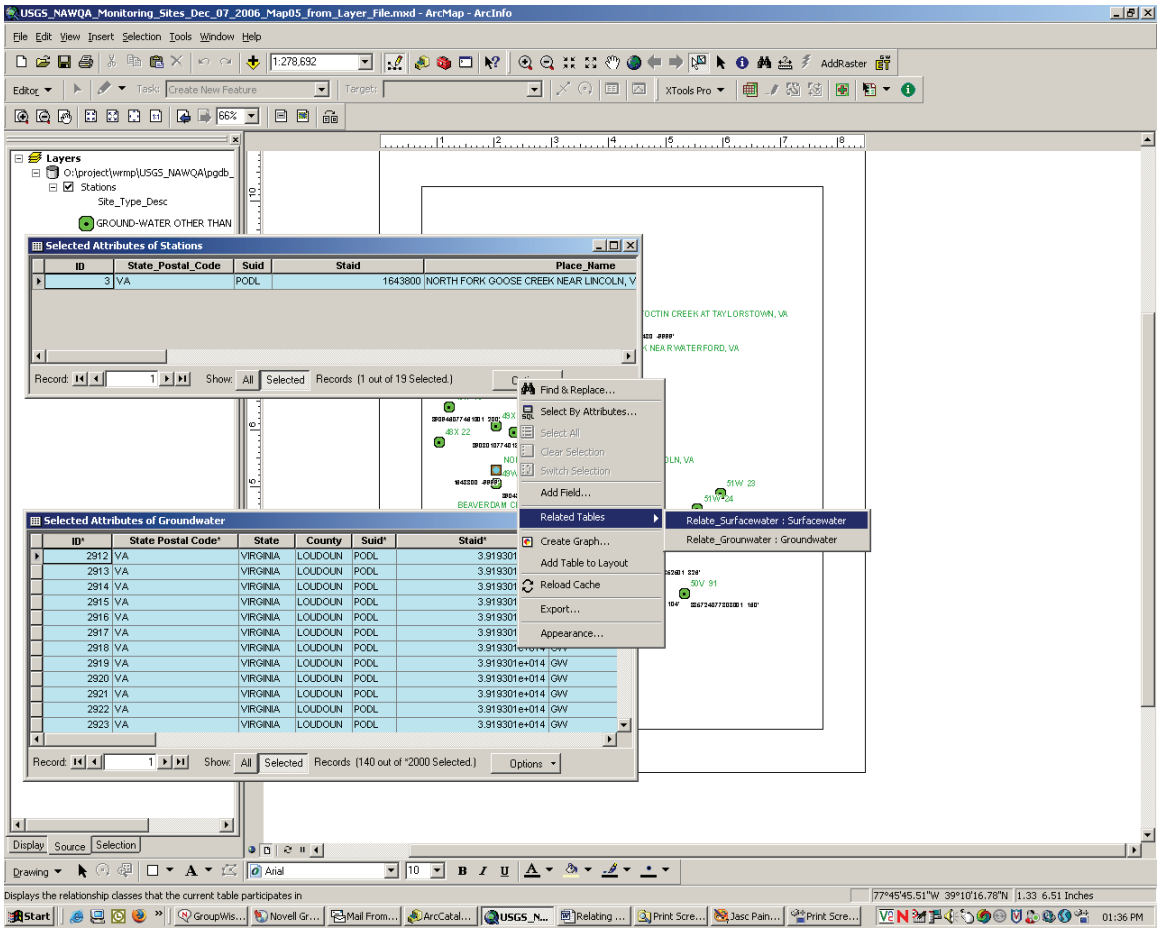


Sometimes this works, sometime the system simply crashes.

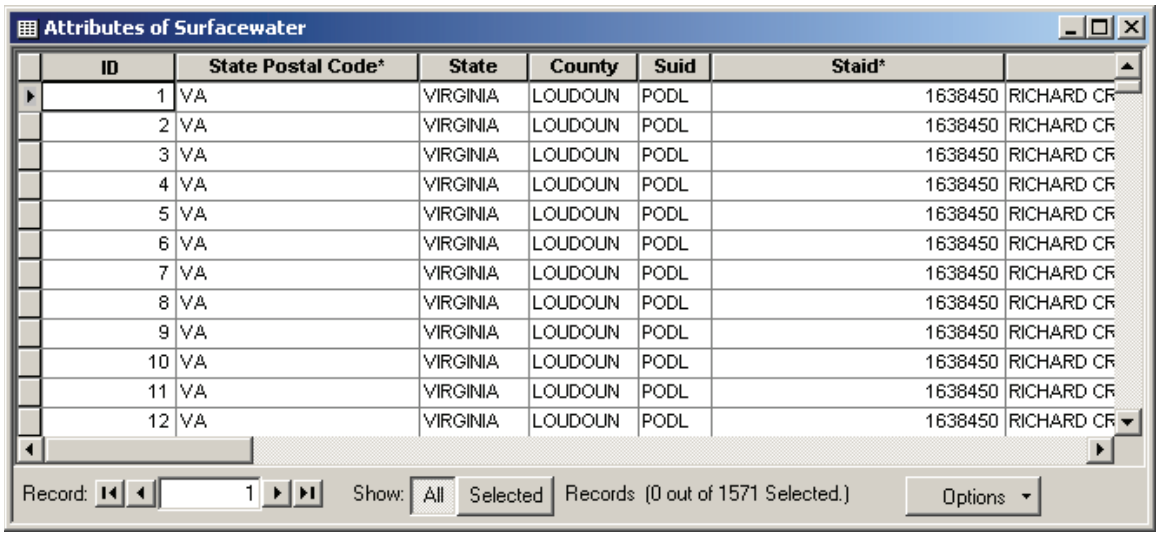
One can select one of the 19 stations and view the related 140 records with that one station, as shown below.



This is done by right clicking on Options on bottom right section of the table window.



You can't just open one of the related tables even though one of stations was selected. You'll find that none of the related records display



Attributes of Surfacewater

ID	State Postal Code*	State	County	Suid	Staid*	
1	VA	VIRGINIA	LOUDOUN	PODL	1638450	RICHARD CR
2	VA	VIRGINIA	LOUDOUN	PODL	1638450	RICHARD CR
3	VA	VIRGINIA	LOUDOUN	PODL	1638450	RICHARD CR
4	VA	VIRGINIA	LOUDOUN	PODL	1638450	RICHARD CR
5	VA	VIRGINIA	LOUDOUN	PODL	1638450	RICHARD CR
6	VA	VIRGINIA	LOUDOUN	PODL	1638450	RICHARD CR
7	VA	VIRGINIA	LOUDOUN	PODL	1638450	RICHARD CR
8	VA	VIRGINIA	LOUDOUN	PODL	1638450	RICHARD CR
9	VA	VIRGINIA	LOUDOUN	PODL	1638450	RICHARD CR
10	VA	VIRGINIA	LOUDOUN	PODL	1638450	RICHARD CR
11	VA	VIRGINIA	LOUDOUN	PODL	1638450	RICHARD CR
12	VA	VIRGINIA	LOUDOUN	PODL	1638450	RICHARD CR

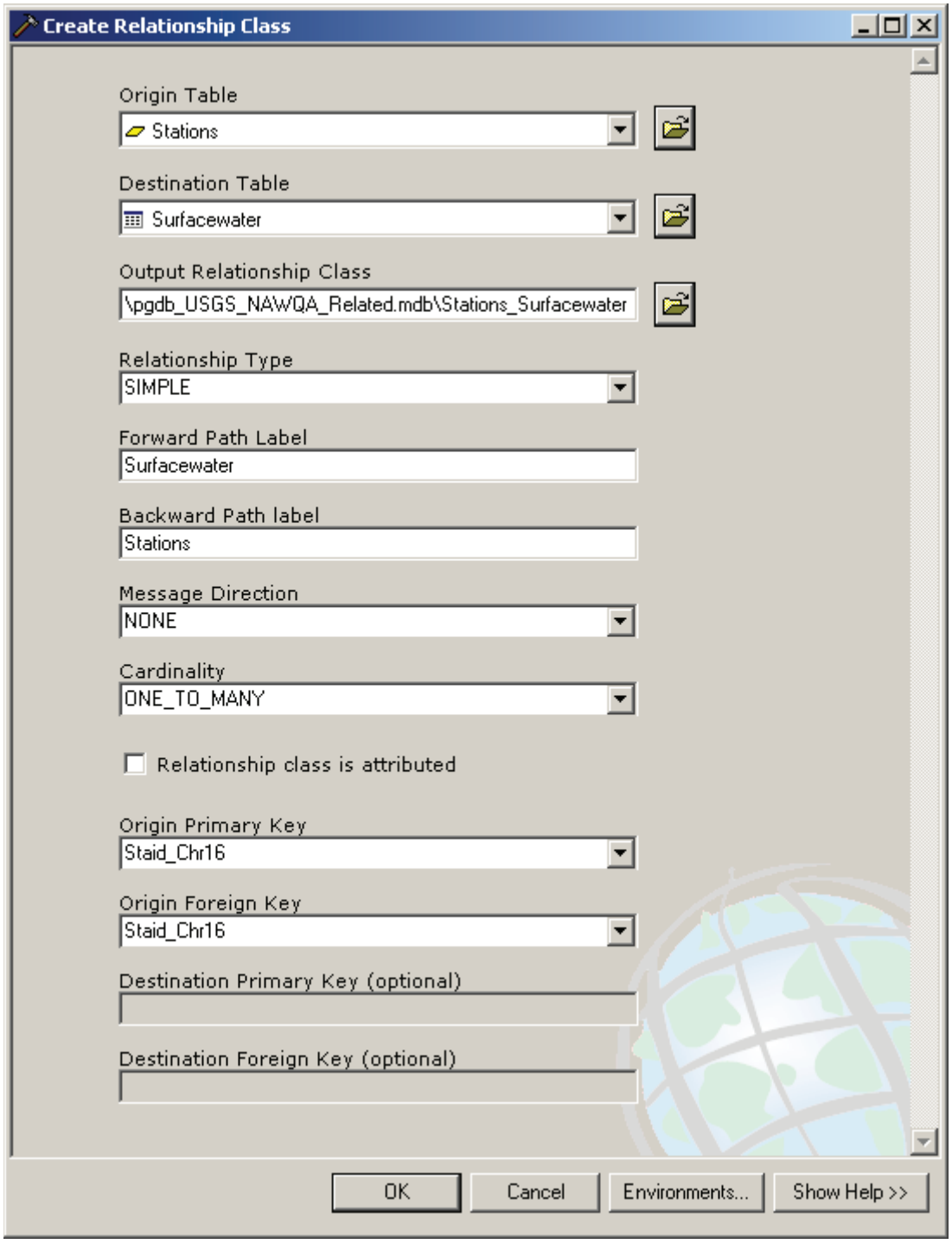
Record: 1 Show: All Selected Records (0 out of 1571 Selected.) Options

The relationship is saved with the .lyr file.

However, you need to be very careful not to save the relationship both in the .lyr (i.e. from manually realte in ArcMAP with a relationship class in pgdb. This will likely cause system crash.

Step 2: Now examine storing the relationship class in pgdb.

In ArcToolBox > Data Management > Create Relationship Class



This crashes on local ArcGIS installation and Citrix.

Summary and Conclusion:

Manually create the relations in ArcMap and save the feature class as .lyr file. When going to use the data, just add the station point file. To view the related data, do not add to TOC, rather, open the stations table and in lower right under options, select related tables. Now when you select a record, in stations, just the related table records are selected also.

Creating Time Averaged Values

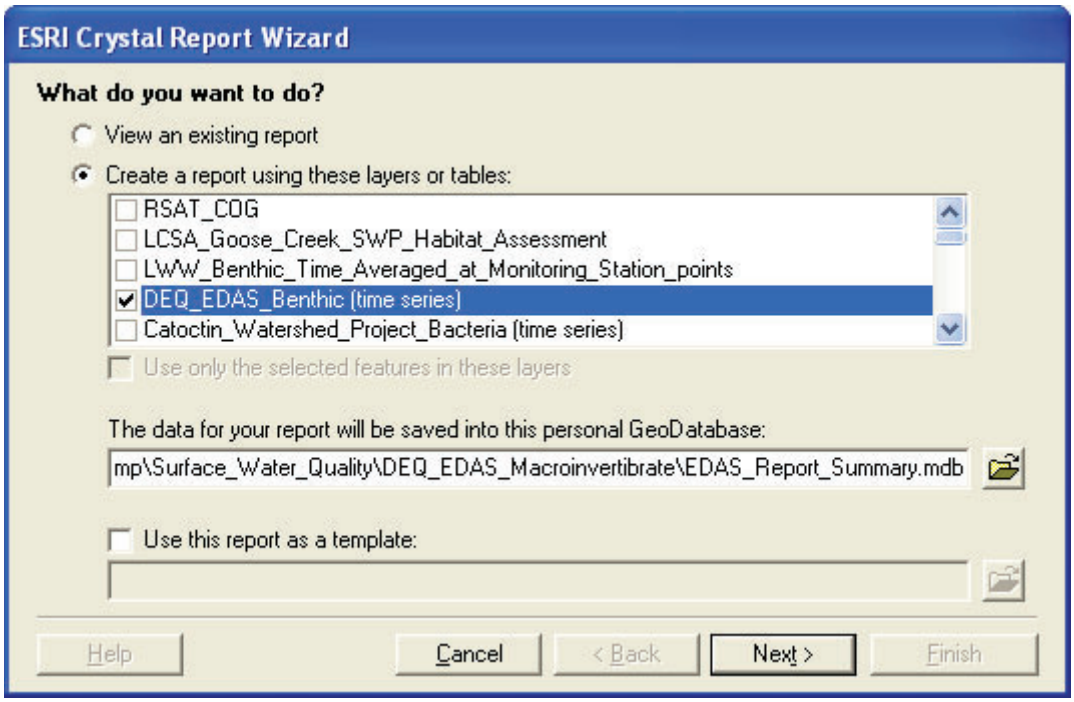
Background: Stream monitoring has been performed several times at locations and needs to be averaged. This memo describes one approach.

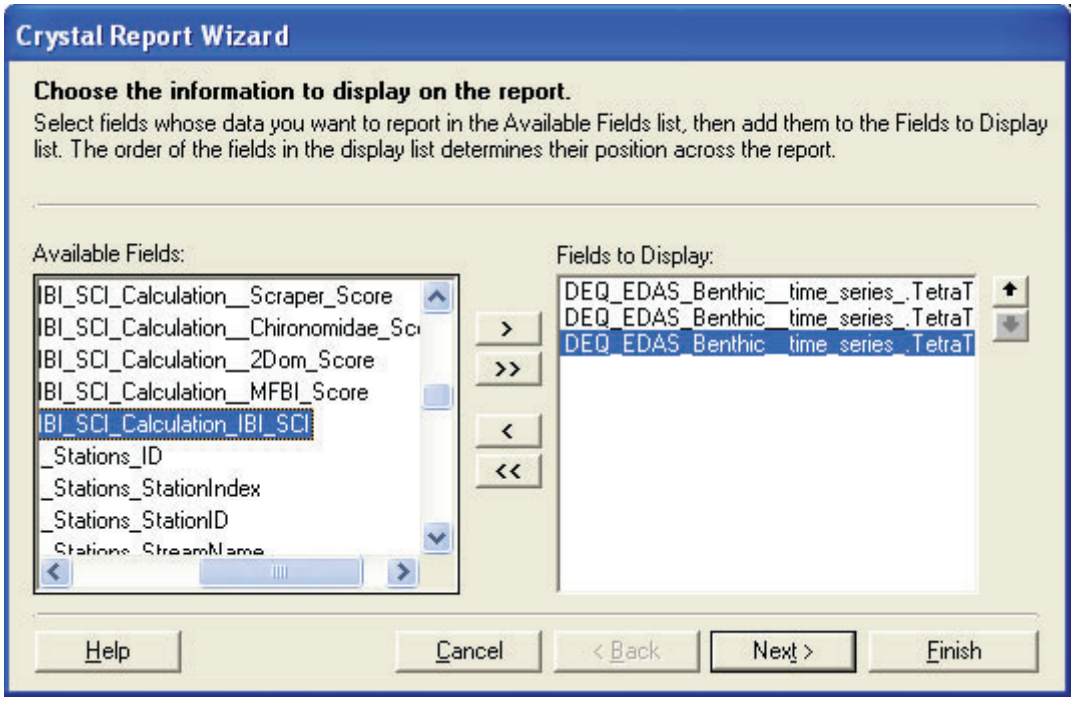
Approach:
A brute force approach is to create averages for each station by using ESRI report, summarizing using 'sum", cleaning-up the report export and then join this back to the stations point file.

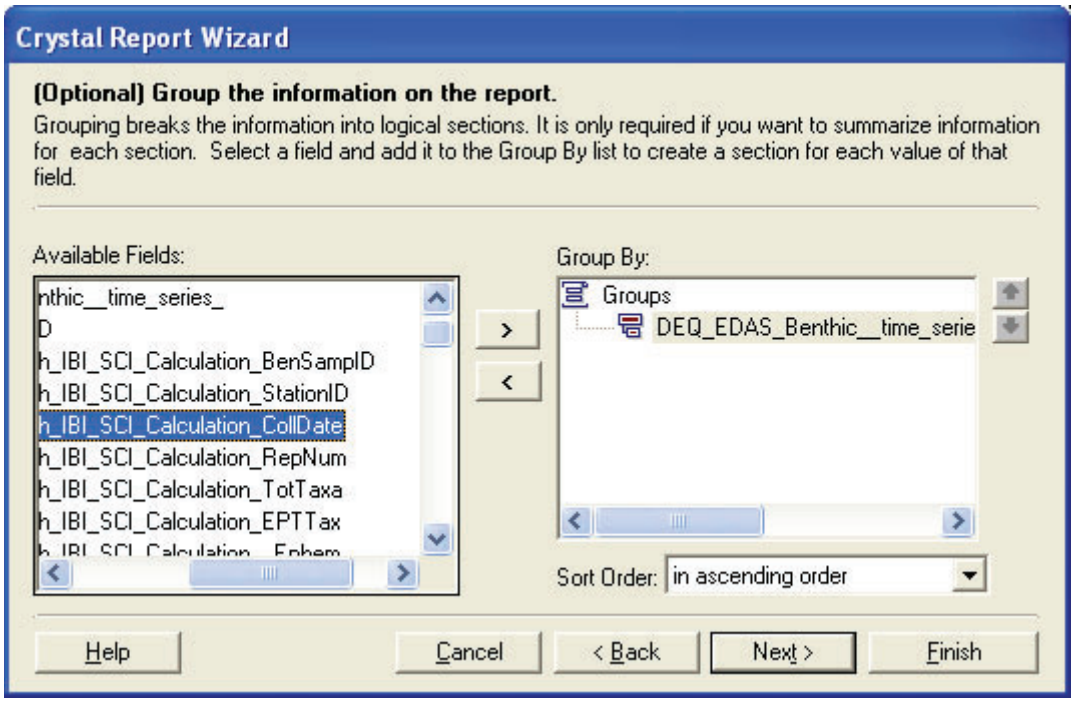
Creating a report for "sum":

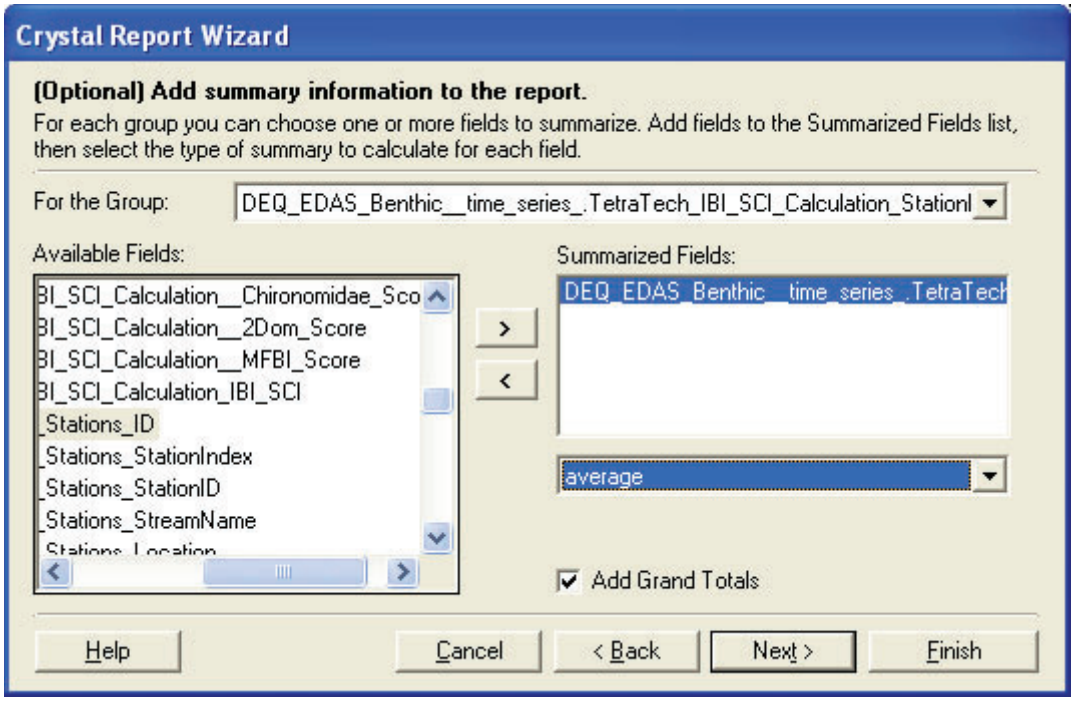
First add both the station feature class and time series data table. Now join the stations to the points. This creates a new feature class with "stacked" measurements for the stations. So for the 19 stations we now have a feature class of 75 records. "DEQ_EDAS_TetraTech_IBI_SCI_joined_to_Stations"

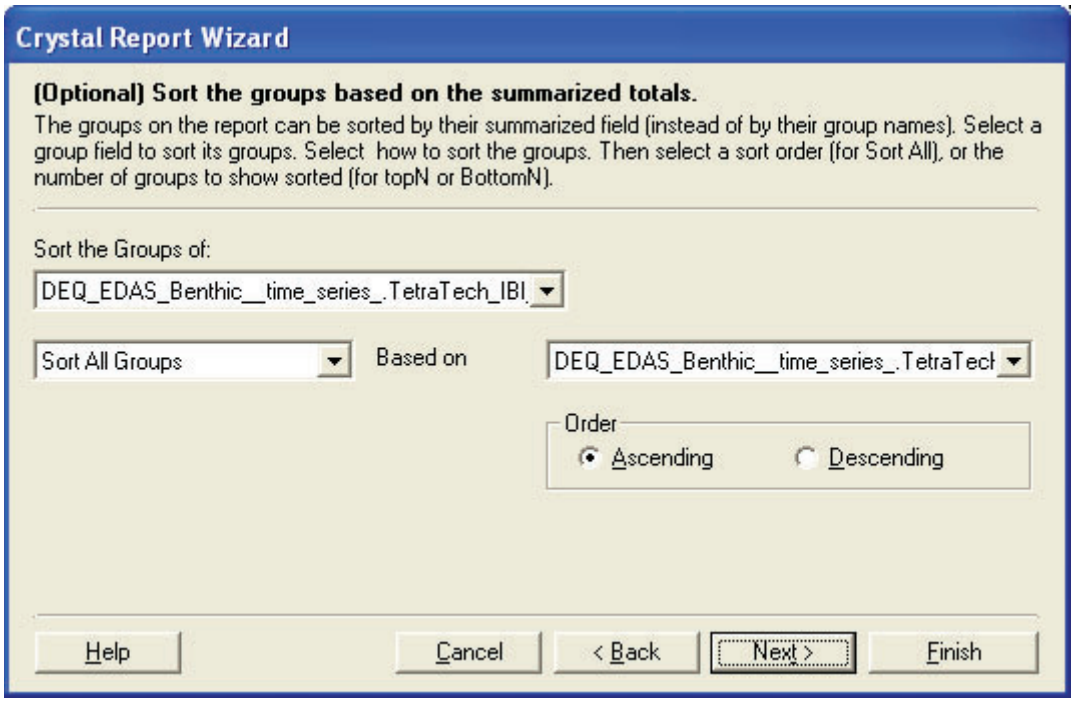
Using the time series, run a report in ArcMap:

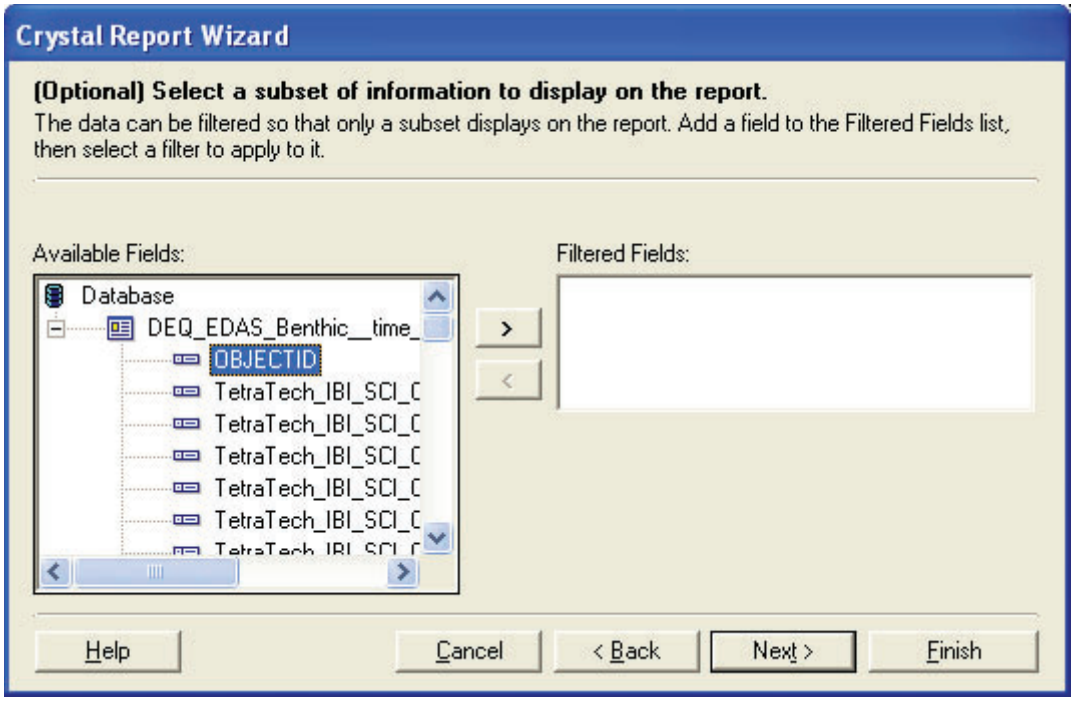


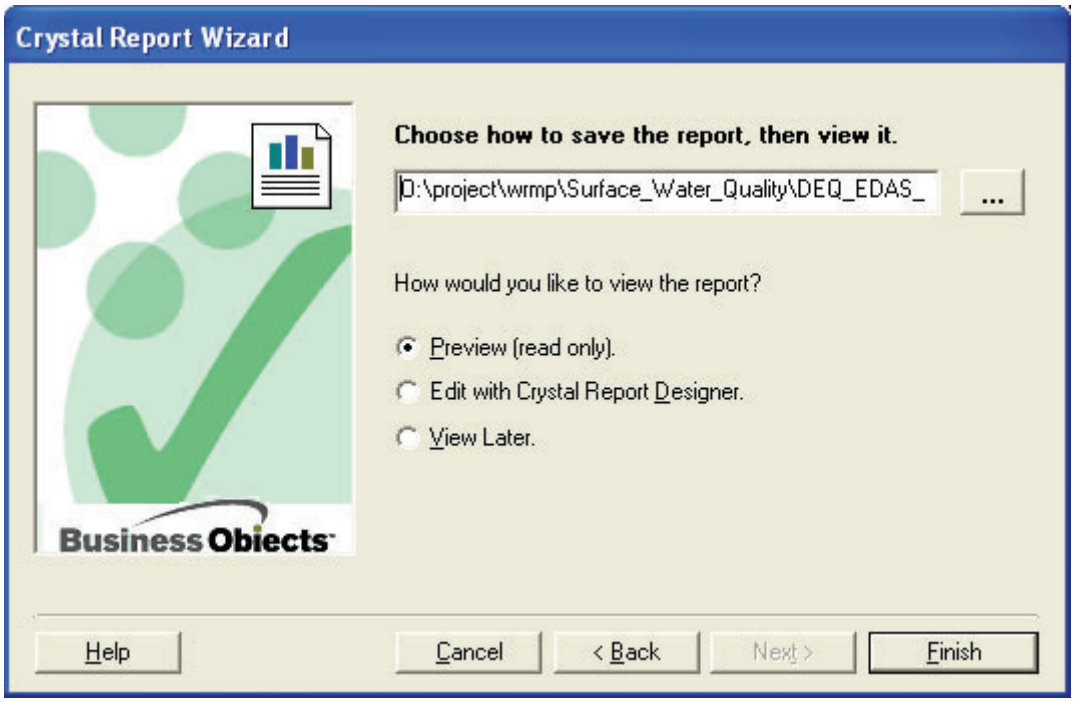

Crystal Report Wizard
Choose the information to display on the report.
Select fields whose data you want to report in the Available Fields list, then add them to the Fields to Display list. The order of the fields in the display list determines their position across the report.
Available Fields:
IBI_SCI_Calculation__Scraper_Score
IBI_SCI_Calculation__Chironomidae_Sc
IBI_SCI_Calculation__2Dom_Score
IBI_SCI_Calculation__MFBI_Score
IBI_SCI_Calculation_IBI_SCI
_Stations_ID
_Stations_StationIndex
_Stations_StationID
Fields to Display:
DEQ_EDAS_Benthic__time_series_.TetraT
DEQ_EDAS_Benthic__time_series_.TetraT
DEQ_EDAS_Benthic__time_series_.TetraT
Help
Cancel
< Back
Next >
Finish

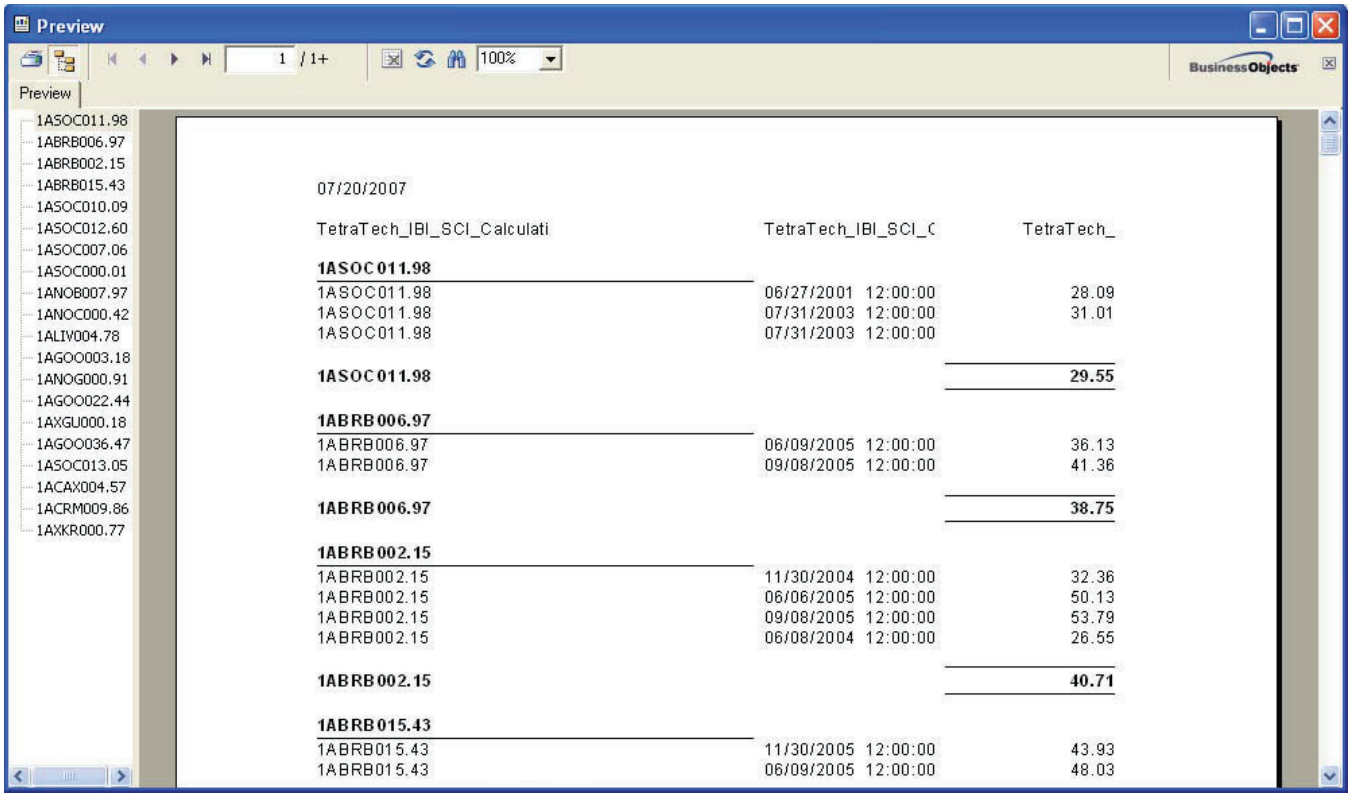

Crystal Report Wizard
(Optional) Group the information on the report.
Grouping breaks the information into logical sections. It is only required if you want to summarize information for each section. Select a field and add it to the Group By list to create a section for each value of that field.
Available Fields:
nthic__time_series_
D
h_IBI_SCI_Calculation_BenSampID
h_IBI_SCI_Calculation_StationID
h_IBI_SCI_Calculation_CollDate
h_IBI_SCI_Calculation_RepNum
h_IBI_SCI_Calculation_TotTaxa
h_IBI_SCI_Calculation_EPTTax
Group By:
Groups
DEQ_EDAS_Benthic__time_serie
Sort Order:
in ascending order
Help
Cancel
< Back
Next >
Finish


Crystal Report Wizard
(Optional) Add summary information to the report.
For each group you can choose one or more fields to summarize. Add fields to the Summarized Fields list, then select the type of summary to calculate for each field.
For the Group:
DEQ_EDAS_Benthic__time_series_.TetraTech_IBI_SCI_Calculation_StationI
Available Fields:
BI_SCI_Calculation__Chironomidae_Sco
BI_SCI_Calculation__2Dom_Score
BI_SCI_Calculation__MFBI_Score
BI_SCI_Calculation_IBI_SCI
_Stations_ID
_Stations_StationIndex
_Stations_StationID
_Stations_StreamName
Summarized Fields:
DEQ_EDAS_Benthic__time_series_.TetraTech
average
Add Grand Totals
Help
Cancel
< Back
Next >
Finish


Crystal Report Wizard
(Optional) Sort the groups based on the summarized totals.
The groups on the report can be sorted by their summarized field (instead of by their group names). Select a group field to sort its groups. Select how to sort the groups. Then select a sort order (for Sort All), or the number of groups to show sorted (for topN or BottomN).
Sort the Groups of:
DEQ_EDAS_Benthic__time_series_.TetraTech_IBI_
Sort All Groups
Based on
DEQ_EDAS_Benthic__time_series_.TetraTech
Order
Ascending
Descending
Help
Cancel
< Back
Next >
Finish

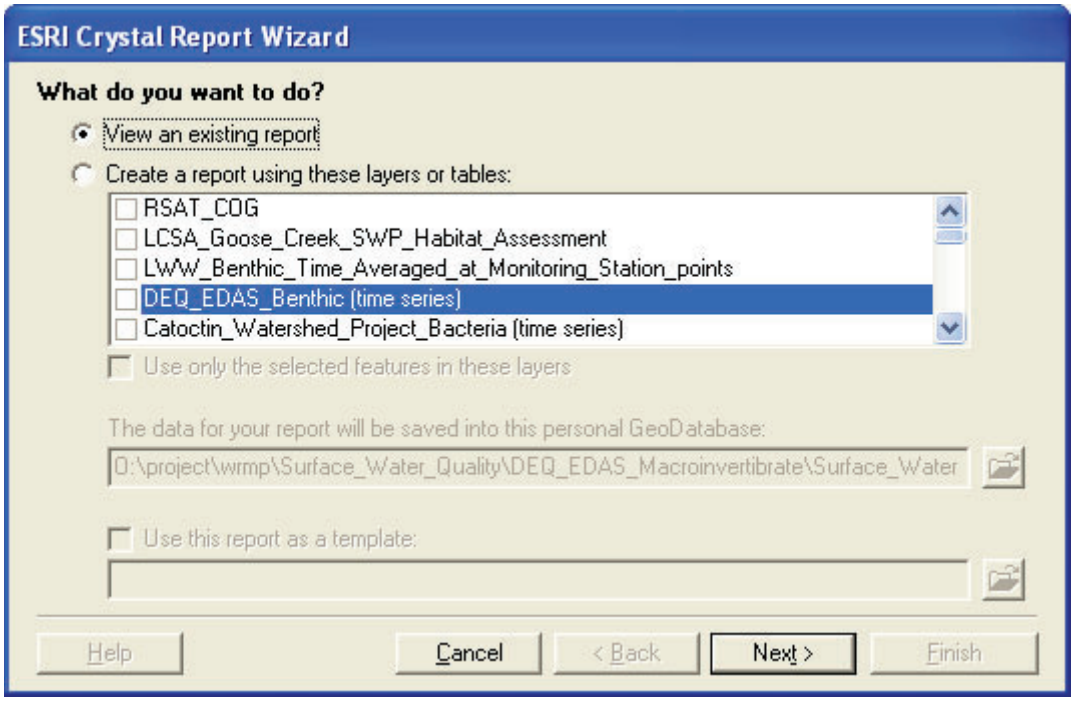

Crystal Report Wizard
(Optional) Select a subset of information to display on the report.
The data can be filtered so that only a subset displays on the report. Add a field to the Filtered Fields list, then select a filter to apply to it.
Available Fields:
Filtered Fields:
Database
DEQ_EDAS_Benthic__time_
OBJECTID
TetraTech_IBI_SCI_C
TetraTech_IBI_SCI_C
TetraTech_IBI_SCI_C
TetraTech_IBI_SCI_C
TetraTech_IBI_SCI_C
>
<
Help
Cancel
< Back
Next >
Finish

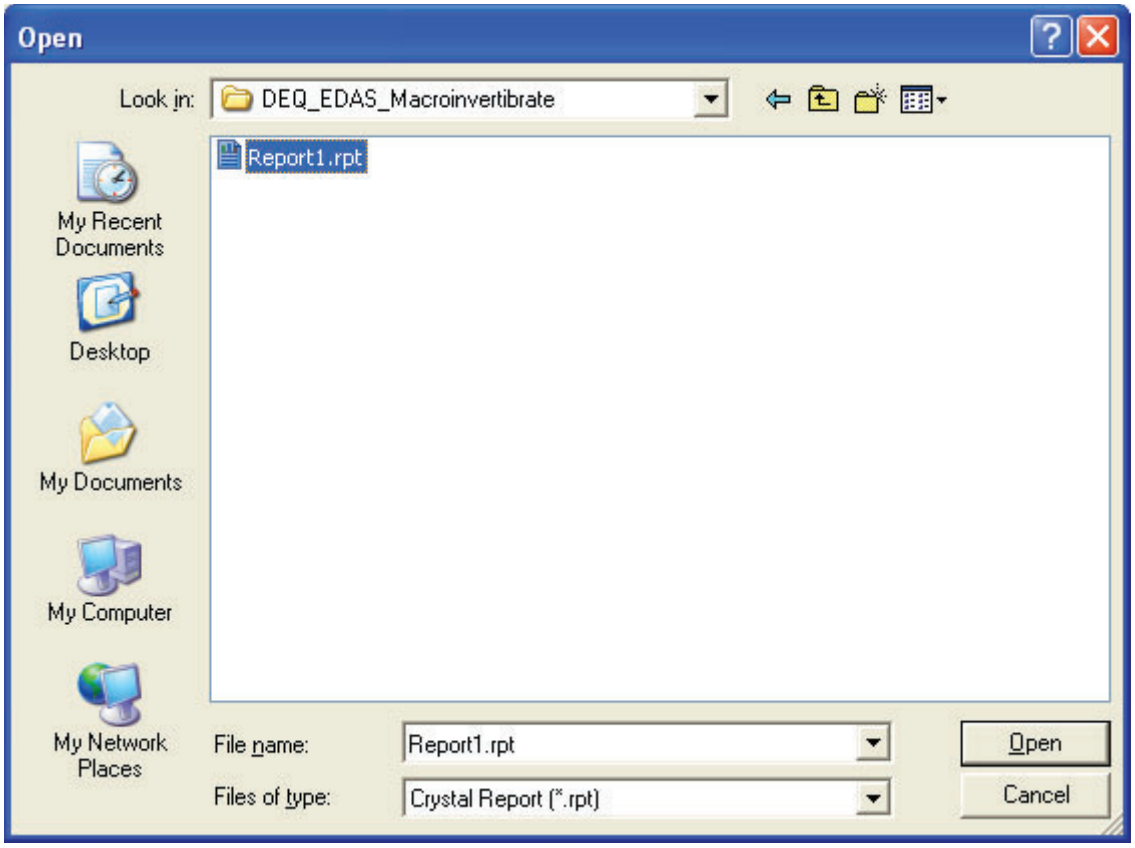

Crystal Report Wizard
Choose how to save the report, then view it.
D:\project\wrmp\Surface_Water_Quality\DEQ_EDAS_
...
How would you like to view the report?
Preview (read only).
Edit with Crystal Report Designer.
View Later.
Business Objects
Help
Cancel
< Back
Next >
Finish



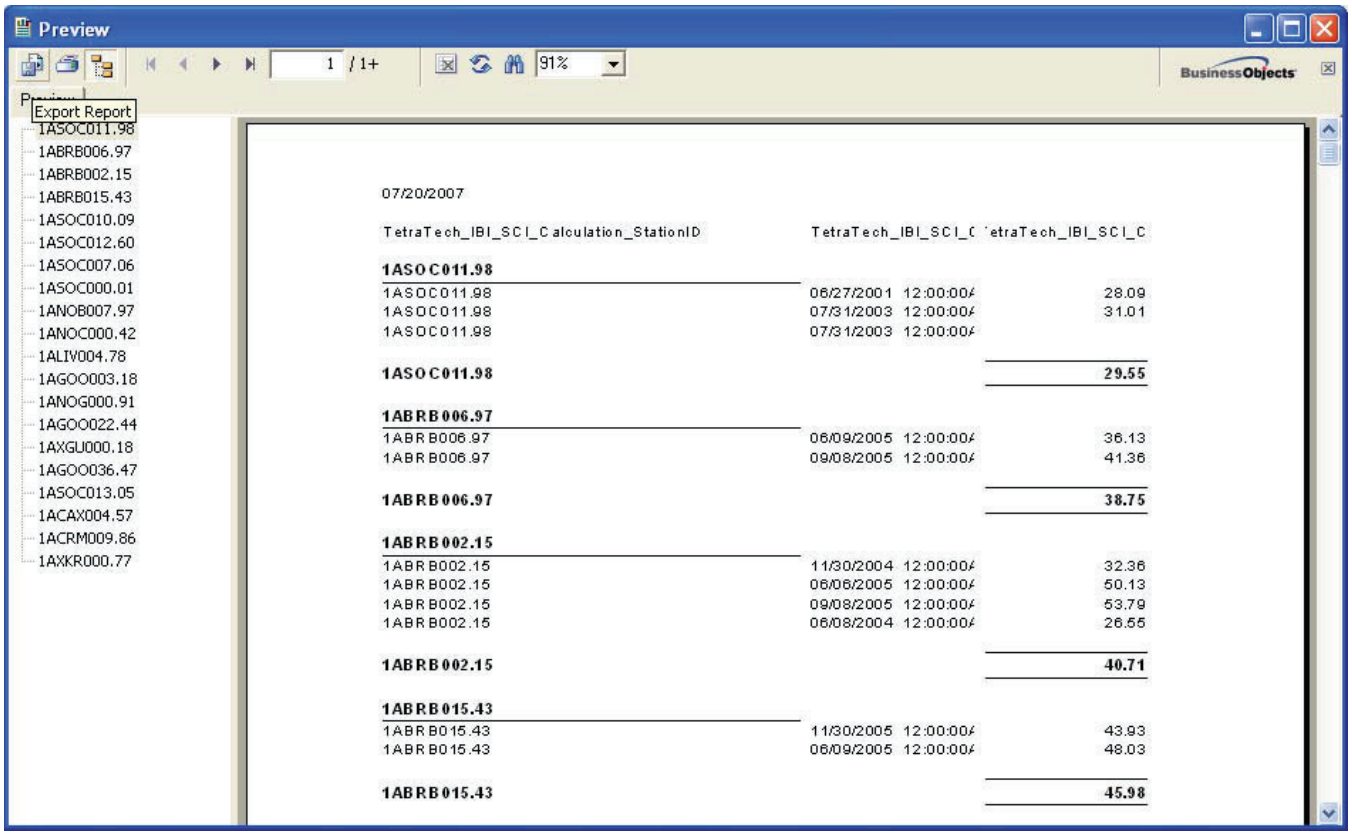
Now “Export”.

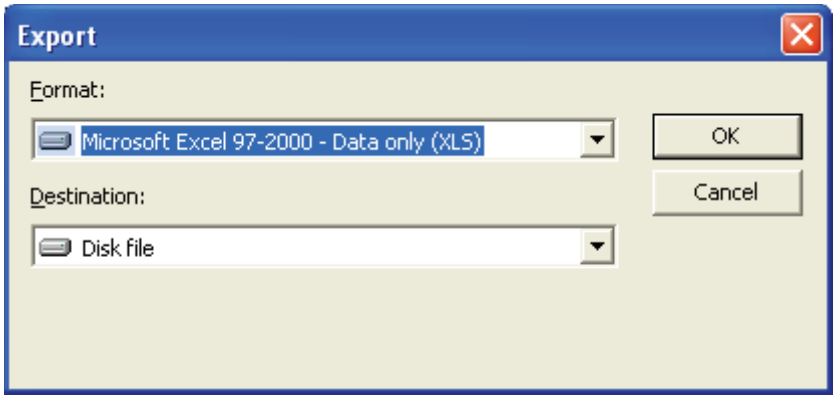
To do this go back and open existing report

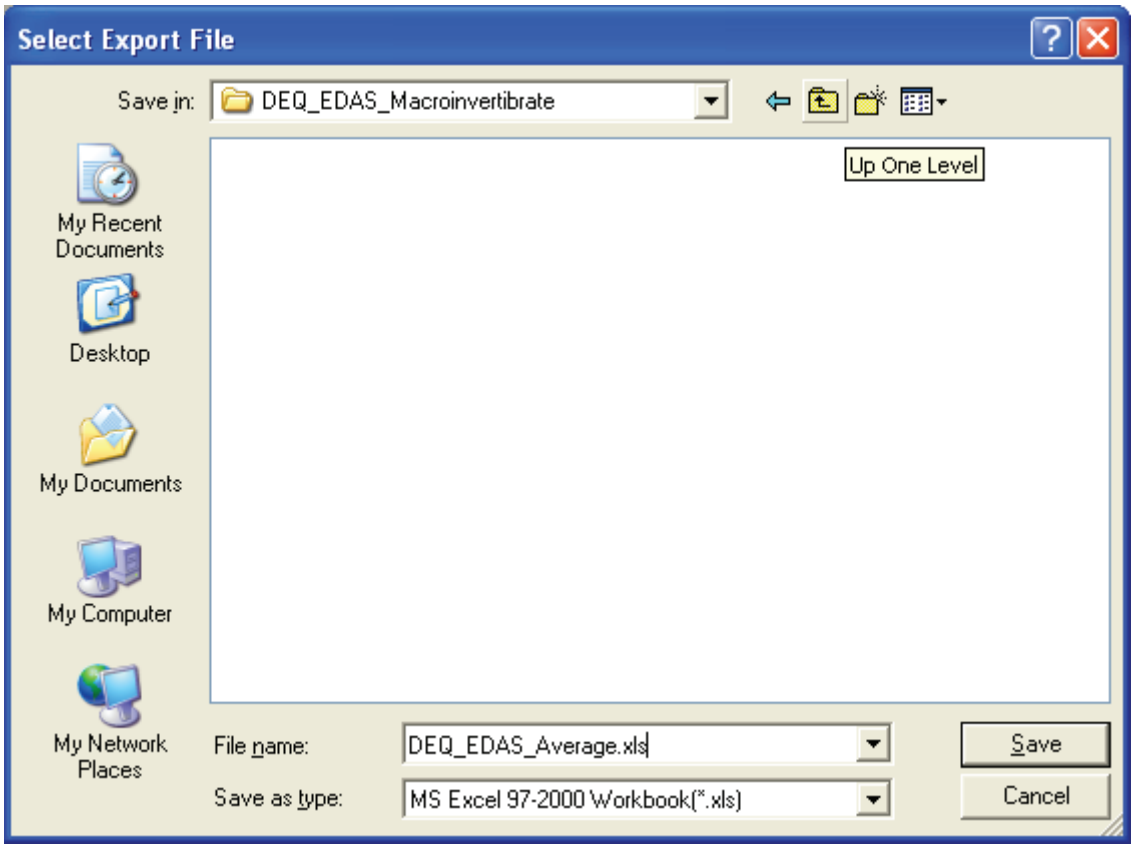




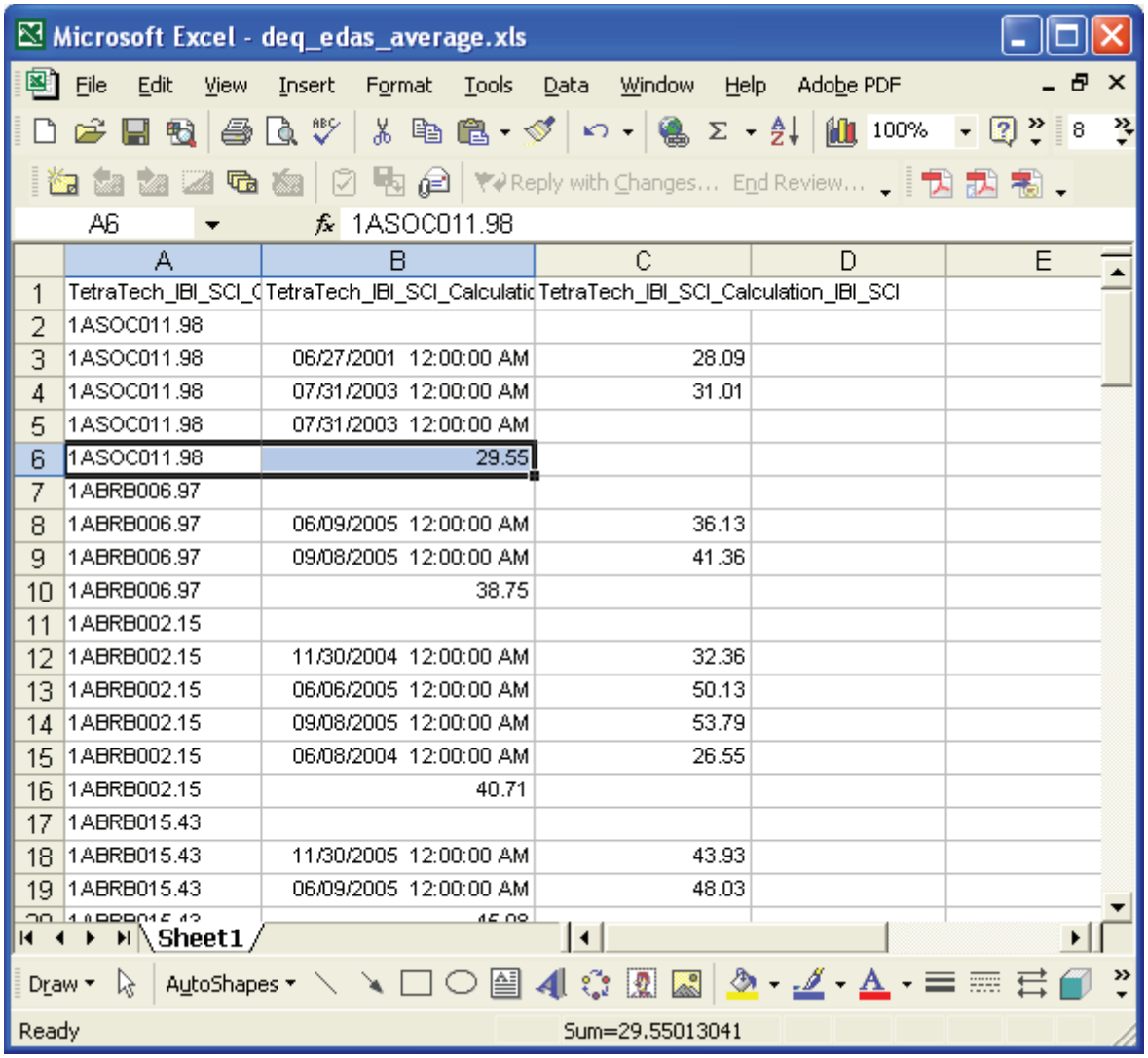
Now there is a “Export” button available





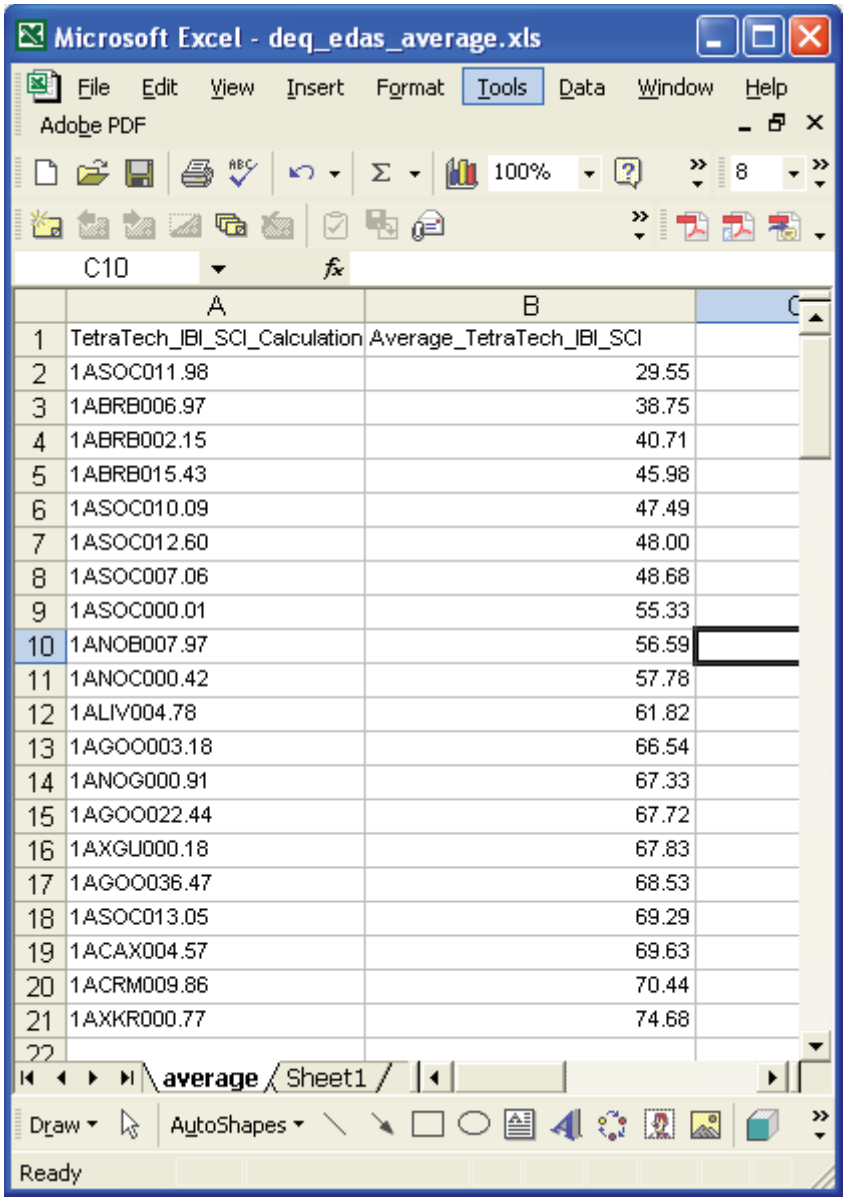


This is rather crude, but we can clean-up the file



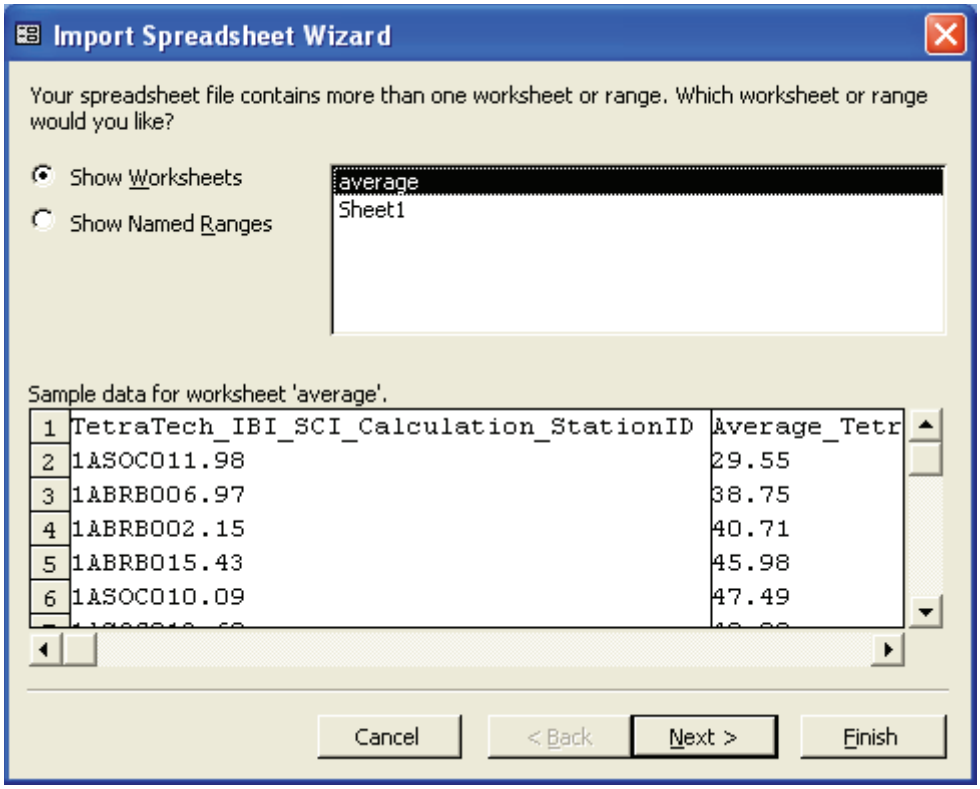
	A	B	C	D	E
1	TetraTech_IBI_SCI_C	TetraTech_IBI_SCI_Calculatic	TetraTech_IBI_SCI_Calculation_IBI_SCI		
2	1ASOC011.98				
3	1ASOC011.98	06/27/2001 12:00:00 AM	28.09		
4	1ASOC011.98	07/31/2003 12:00:00 AM	31.01		
5	1ASOC011.98	07/31/2003 12:00:00 AM			
6	1ASOC011.98	29.55			
7	1ABRB006.97				
8	1ABRB006.97	06/09/2005 12:00:00 AM	36.13		
9	1ABRB006.97	09/08/2005 12:00:00 AM	41.36		
10	1ABRB006.97	38.75			
11	1ABRB002.15				
12	1ABRB002.15	11/30/2004 12:00:00 AM	32.36		
13	1ABRB002.15	06/06/2005 12:00:00 AM	50.13		
14	1ABRB002.15	09/08/2005 12:00:00 AM	53.79		
15	1ABRB002.15	06/08/2004 12:00:00 AM	26.55		
16	1ABRB002.15	40.71			
17	1ABRB015.43				
18	1ABRB015.43	11/30/2005 12:00:00 AM	43.93		
19	1ABRB015.43	06/09/2005 12:00:00 AM	48.03		

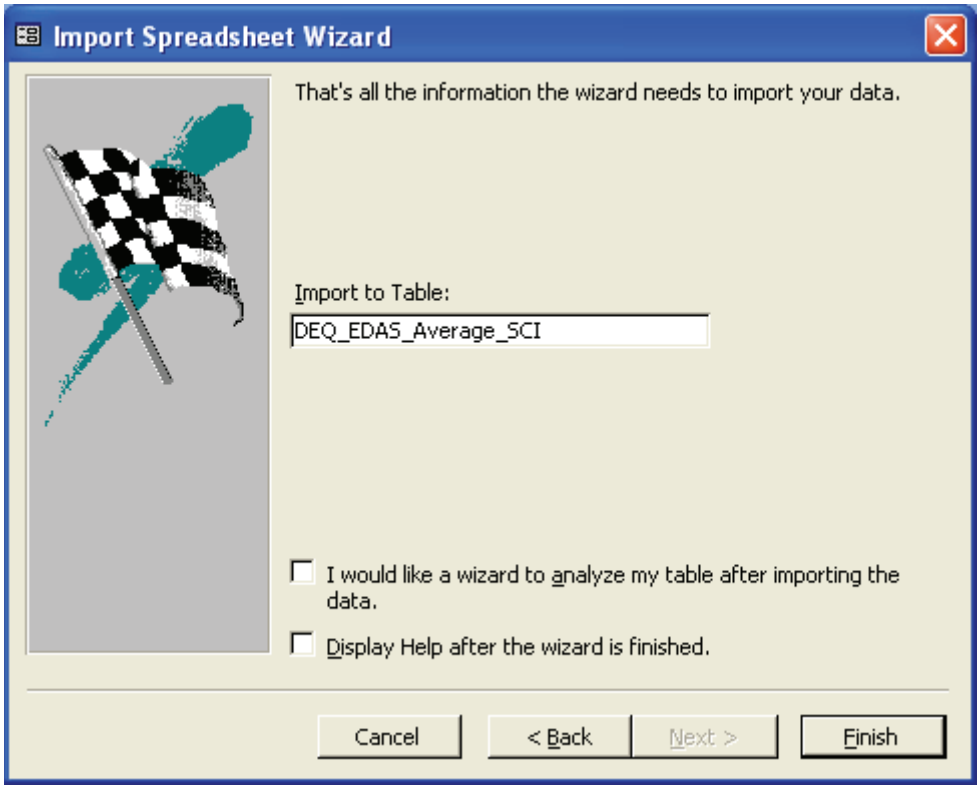
To be:



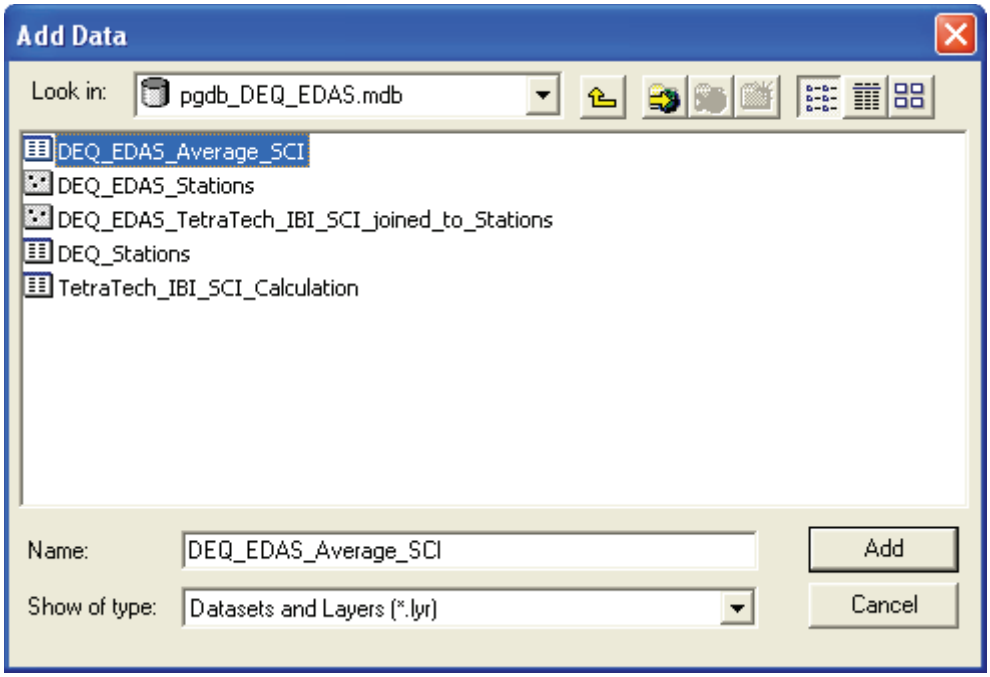
	A	B
1	TetraTech_IBI_SCI_Calculation	Average_TetraTech_IBI_SCI
2	1ASOC011.98	29.55
3	1ABRB006.97	38.75
4	1ABRB002.15	40.71
5	1ABRB015.43	45.98
6	1ASOC010.09	47.49
7	1ASOC012.60	48.00
8	1ASOC007.06	48.68
9	1ASOC000.01	55.33
10	1ANOB007.97	56.59
11	1ANOC000.42	57.78
12	1ALIV004.78	61.82
13	1AGOO003.18	66.54
14	1ANOG000.91	67.33
15	1AGOO022.44	67.72
16	1AXGU000.18	67.83
17	1AGOO036.47	68.53
18	1ASOC013.05	69.29
19	1ACAX004.57	69.63
20	1ACRM009.86	70.44
21	1AXKR000.77	74.68

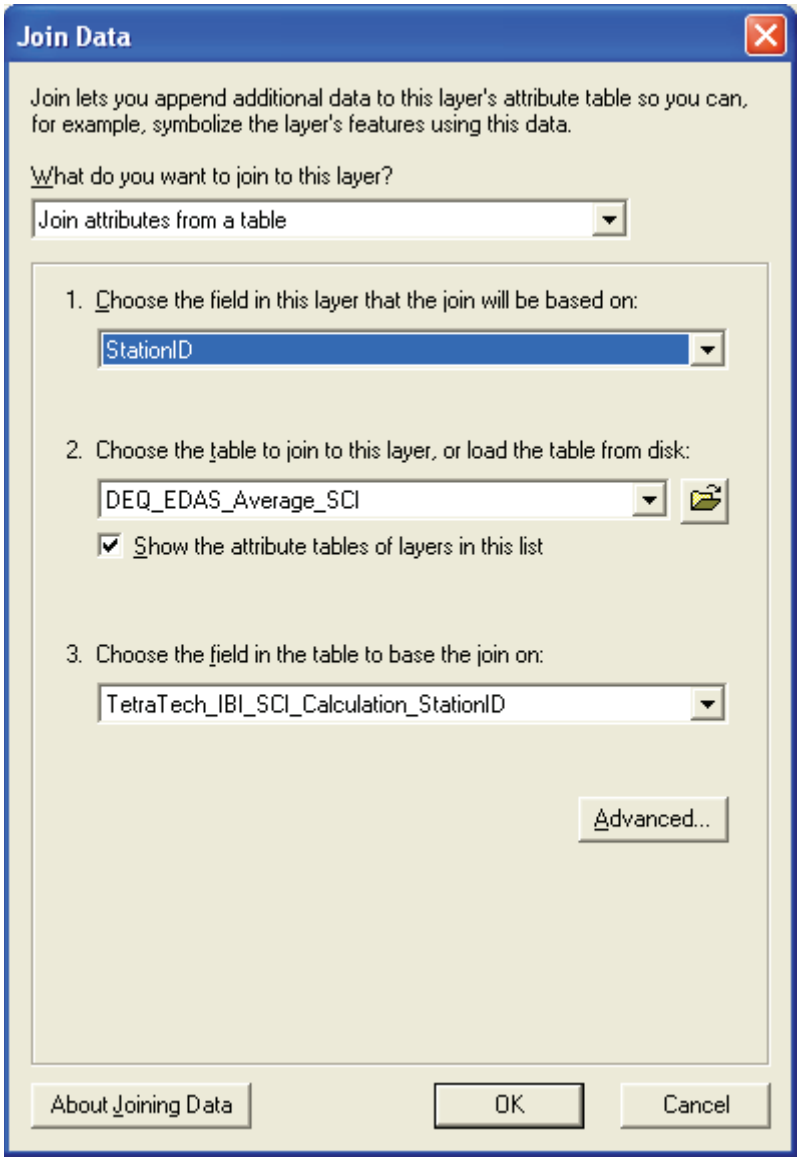
Now Import this back into pgdb, join stations to it and map it.





Now in ArcMap:


Add Data
Look in:
pgdb_DEQ_EDAS.mdb
DEQ_EDAS_Average_SCI
DEQ_EDAS_Stations
DEQ_EDAS_TetraTech_IBI_SCI_joined_to_Stations
DEQ_Stations
TetraTech_IBI_SCI_Calculation
Name:
DEQ_EDAS_Average_SCI
Add
Show of type:
Datasets and Layers (*.lyr)
Cancel


Join Data
Join lets you append additional data to this layer's attribute table so you can, for example, symbolize the layer's features using this data.
What do you want to join to this layer?
Join attributes from a table
1. Choose the field in this layer that the join will be based on:
StationID
2. Choose the table to join to this layer, or load the table from disk:
DEQ_EDAS_Average_SCI
Show the attribute tables of layers in this list
3. Choose the field in the table to base the join on:
TetraTech_IBI_SCI_Calculation_StationID
Advanced...
About Joining Data
OK
Cancel

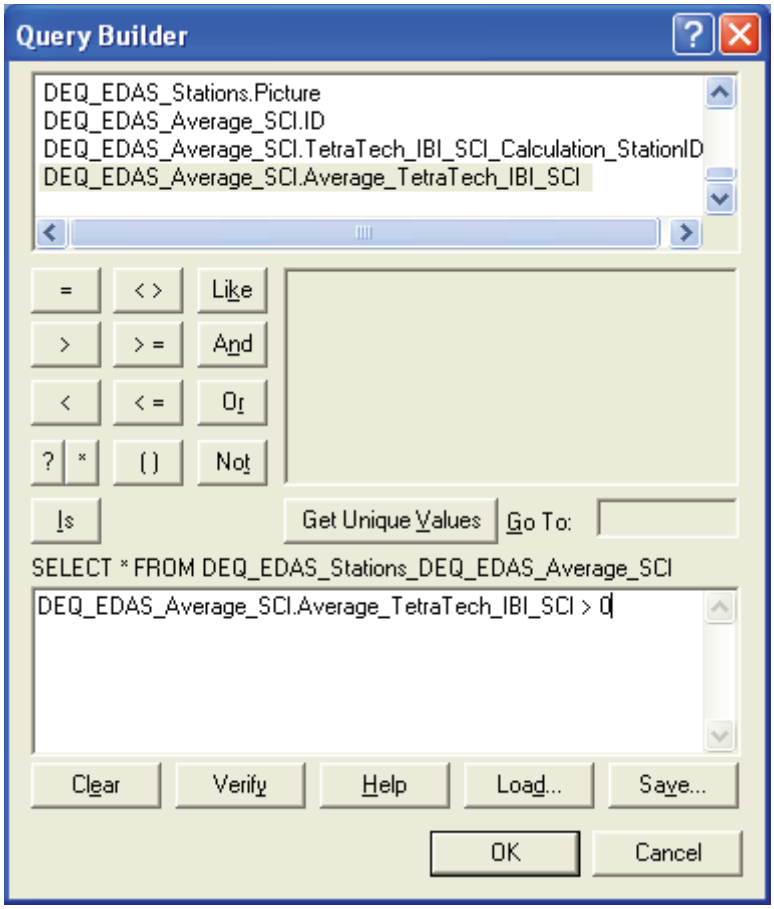
Now we see a good macth on the 20 stations in Loudoun area

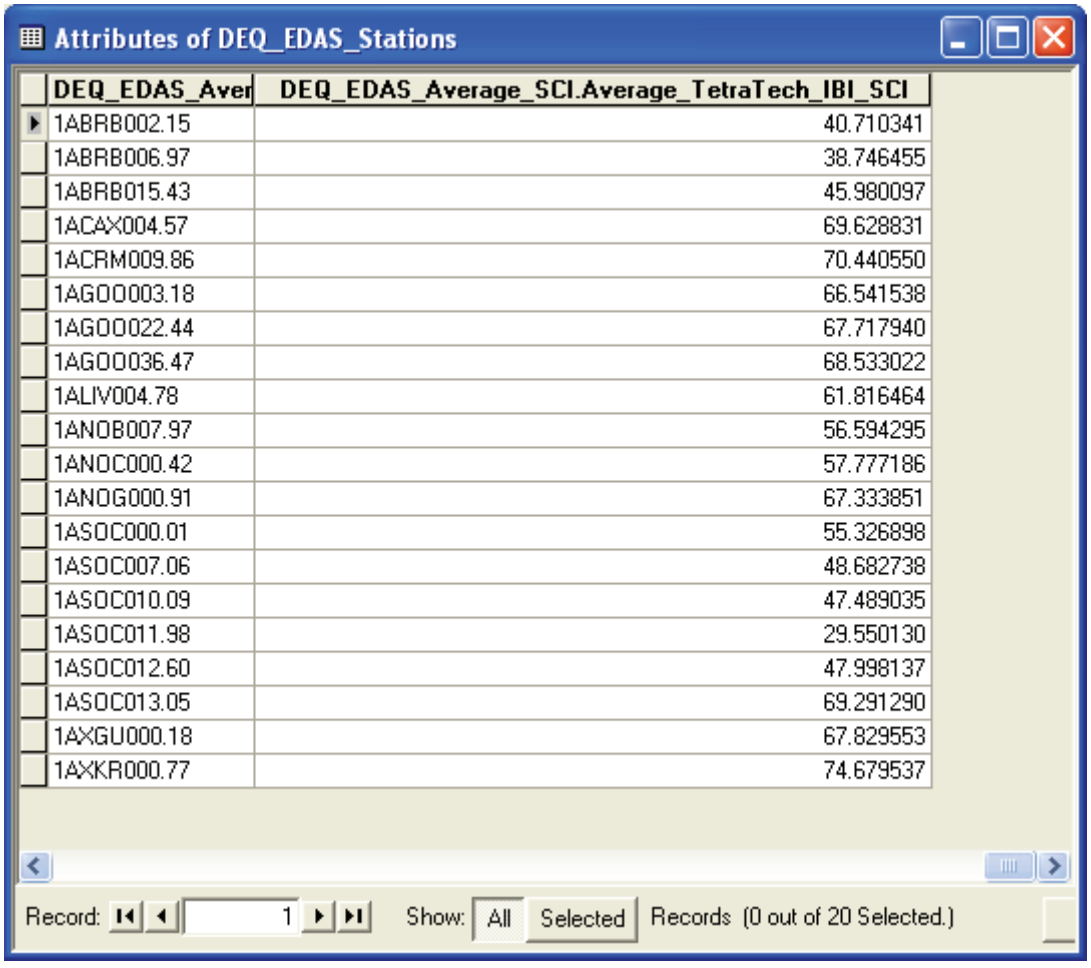
Attributes of DEQ_EDAS_Stations

Shape	DEQ_ED	DEQ_EDAS_Avera	DEQ_EDAS_Average_SCI.Average_TetraTech_IBI_SCI
Point	20	1AXKR000.77	74.679537
Point	19	1ACRM009.86	70.440550
Point	18	1ACAX004.57	69.628831
Point	17	1ASOC013.05	69.291290
Point	16	1AGOO036.47	68.533022
Point	15	1AXGU000.18	67.829553
Point	14	1AGOO022.44	67.717940
Point	13	1ANOG000.91	67.333851
Point	12	1AGOO003.18	66.541538
Point	11	1ALIV004.78	61.816464
Point	10	1ANOC000.42	57.777186
Point	9	1ANOB007.97	56.594295
Point	8	1ASOC000.01	55.326898
Point	7	1ASOC007.06	48.682738
Point	6	1ASOC012.60	47.998137
Point	5	1ASOC010.09	47.489035
Point	4	1ABRB015.43	45.980097
Point	3	1ABRB002.15	40.710341
Point	2	1ABRB006.97	38.746455
Point	1	1ASOC011.98	29.550130
Point	<Null>	<Null>	<Null>
Point	<Null>	<Null>	<Null>

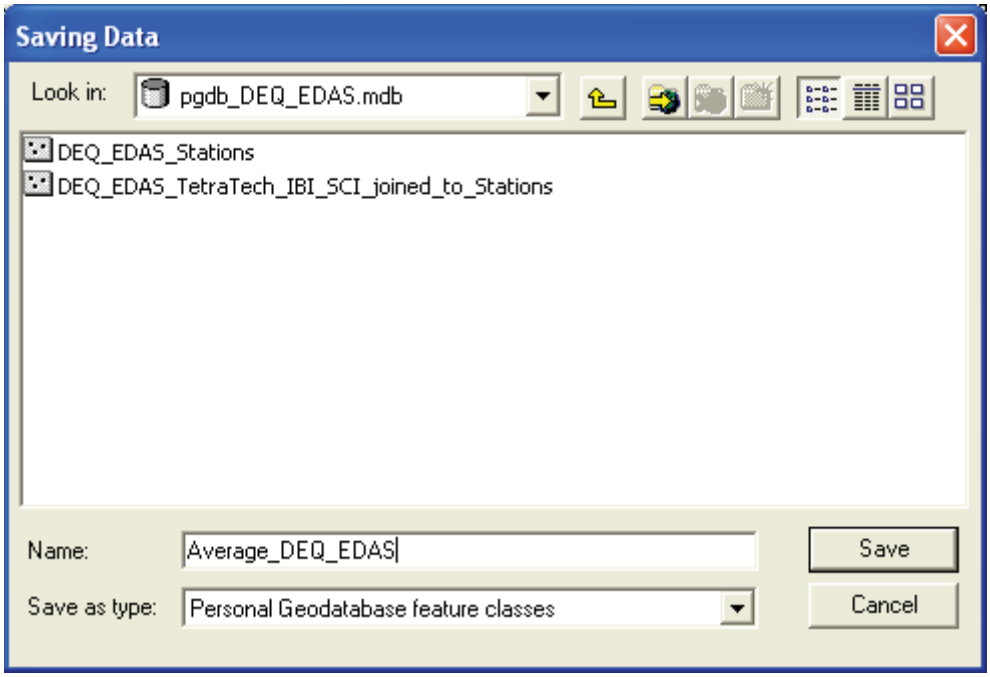
Record: 0 Show: All Selected Records (0 out of 1112 Selected.) Options

Lets' trim these 1,112 down to the 20 using Definition Query


Query Builder
DEQ_EDAS_Stations.Picture
DEQ_EDAS_Average_SCI.ID
DEQ_EDAS_Average_SCI.TetraTech_IBI_SCI_Calculation_StationID
DEQ_EDAS_Average_SCI.Average_TetraTech_IBI_SCI
=
< >
Like
>
> =
And
<
< =
Or
?
*
( )
Not
Is
Get Unique Values
Go To:
SELECT * FROM DEQ_EDAS_Stations_DEQ_EDAS_Average_SCI
DEQ_EDAS_Average_SCI.Average_TetraTech_IBI_SCI > 0
Clear
Verify
Help
Load...
Save...
OK
Cancel


Attributes of DEQ_EDAS_Stations
DEQ_EDAS_Aver
DEQ_EDAS_Average_SCI.Average_TetraTech_IBI_SCI
1ABRB002.15 40.710341
1ABRB006.97 38.746455
1ABRB015.43 45.980097
1ACAX004.57 69.628831
1ACRM009.86 70.440550
1AGOO003.18 66.541538
1AGOO022.44 67.717940
1AGOO036.47 68.533022
1ALIV004.78 61.816464
1ANOB007.97 56.594295
1ANOC000.42 57.777186
1ANOG000.91 67.333851
1ASOC000.01 55.326898
1ASOC007.06 48.682738
1ASOC010.09 47.489035
1ASOC011.98 29.550130
1ASOC012.60 47.998137
1ASOC013.05 69.291290
1AXGU000.18 67.829553
1AXKR000.77 74.679537
Record: 1
Show: All Selected
Records (0 out of 20 Selected.)

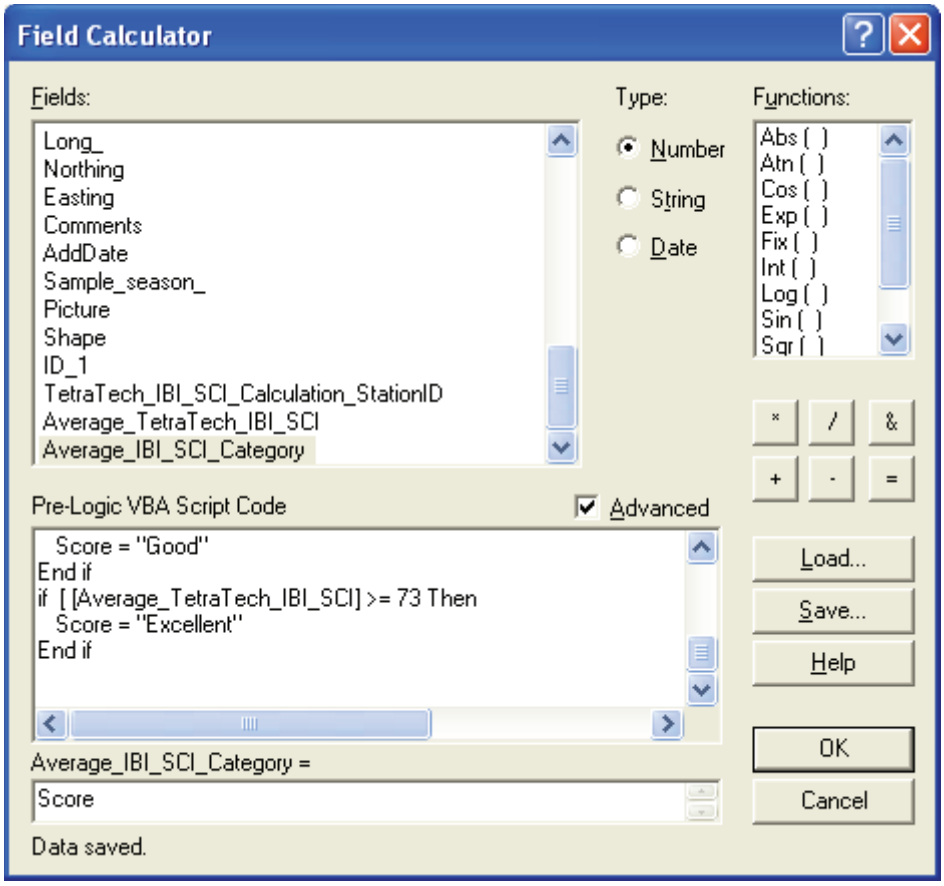
Now we need to add classification, but first save the joined table as a new feature class



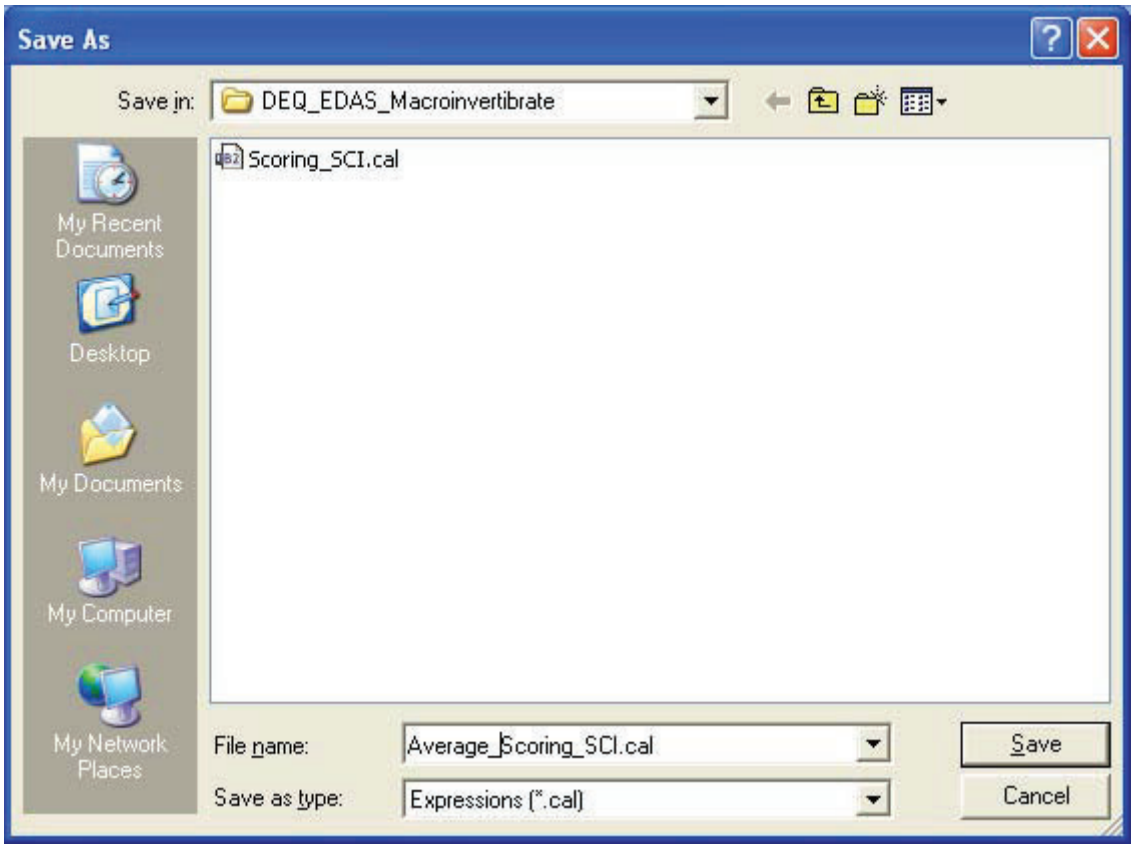
Now add a field for the text classification (string 25)

In Field Calculator

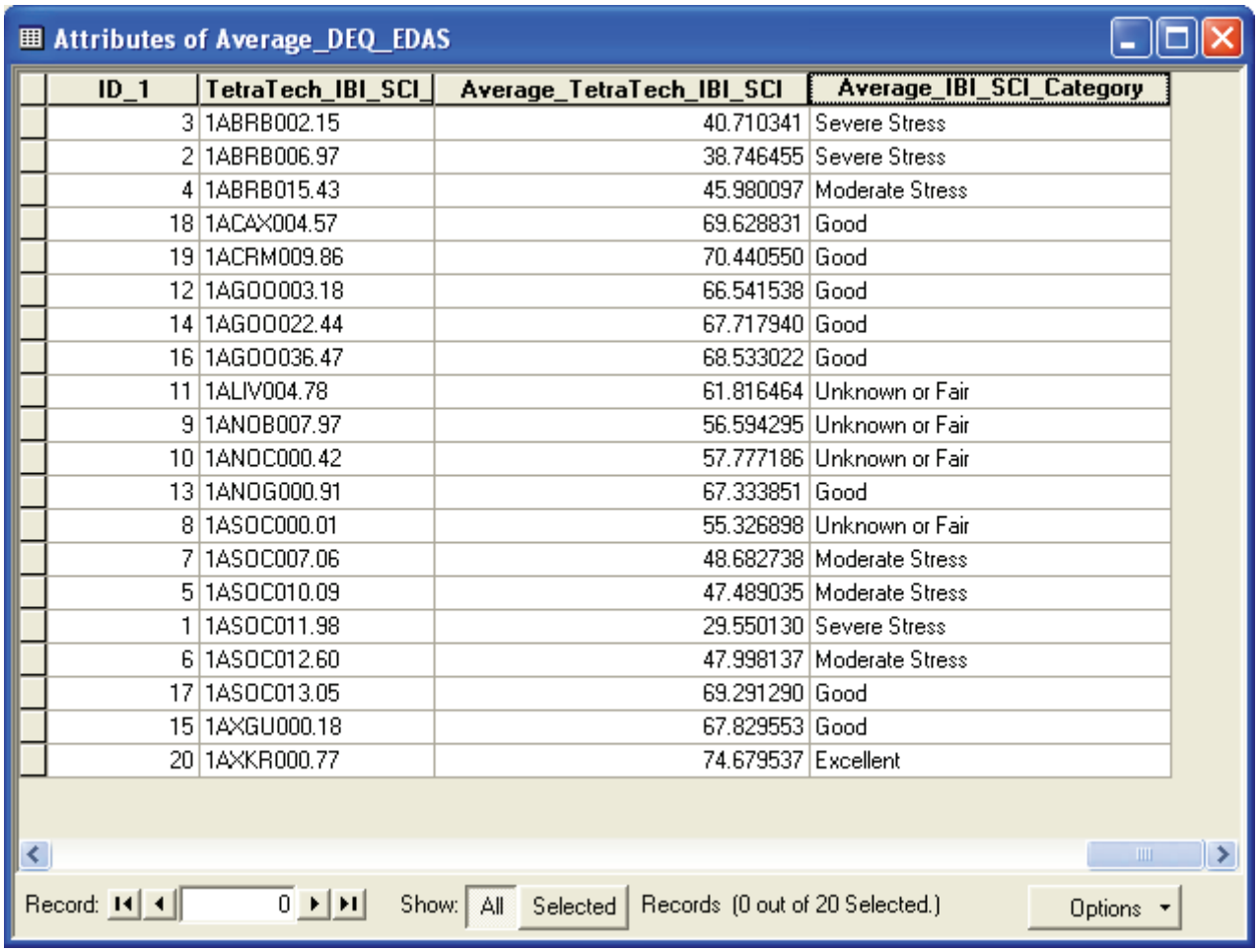
```
Dim Score as string
if  [Average_TetraTech_IBI_SCI] < 42 Then
   Score = "Severe Stress"
End if
if  [Average_TetraTech_IBI_SCI] >= 42 and
[Average_TetraTech_IBI_SCI] < 55 Then
   Score = "Moderate Stress"
End if
if  [Average_TetraTech_IBI_SCI] >= 55 and
[Average_TetraTech_IBI_SCI] < 63 Then
   Score = "Unknown or Fair"
End if
if  [Average_TetraTech_IBI_SCI] >= 63 and
[Average_TetraTech_IBI_SCI] < 73 Then
   Score = "Good"
End if
if  [Average_TetraTech_IBI_SCI] >= 73 Then
   Score = "Excellent"
End if
```



And save the calculation



So we now have:

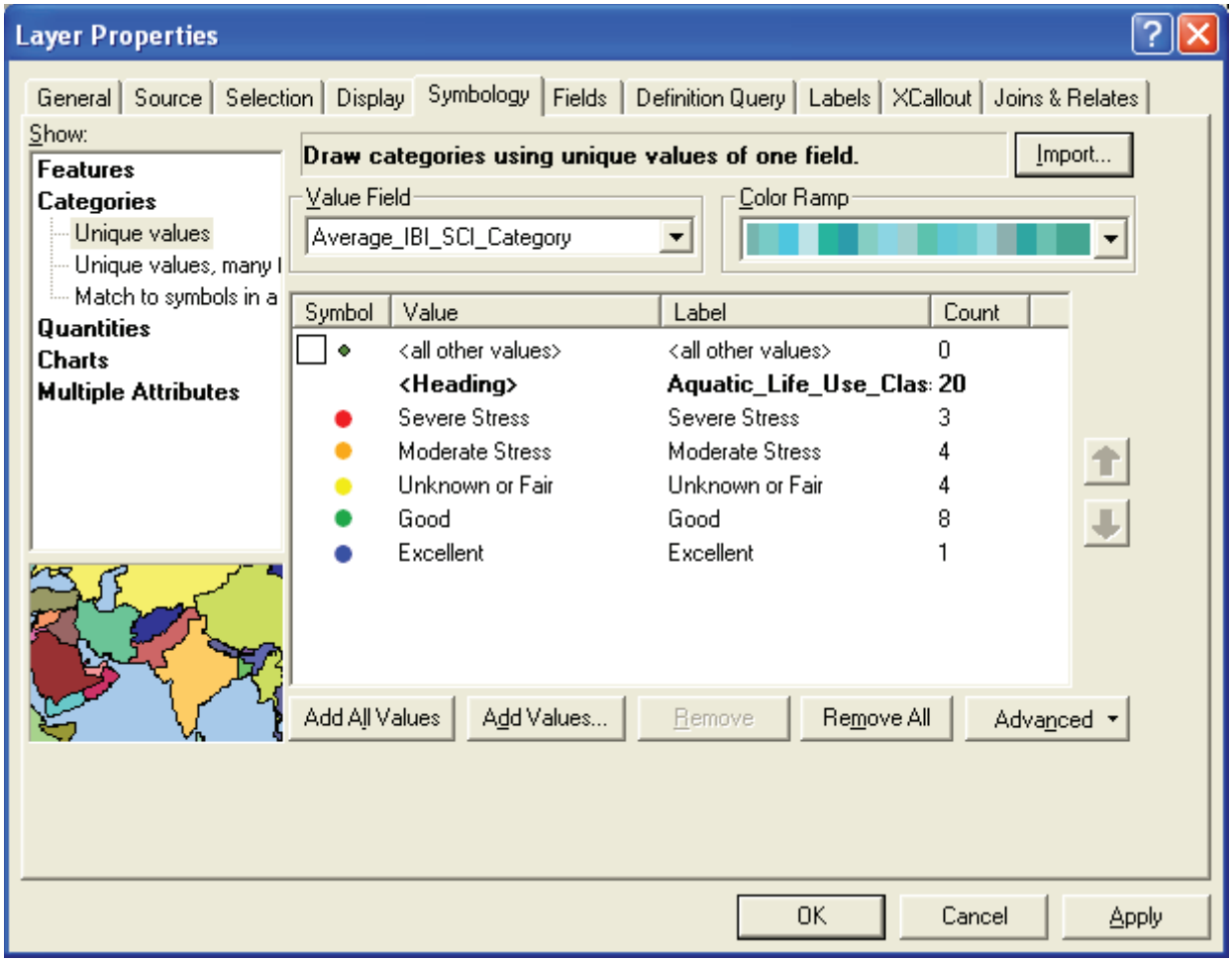


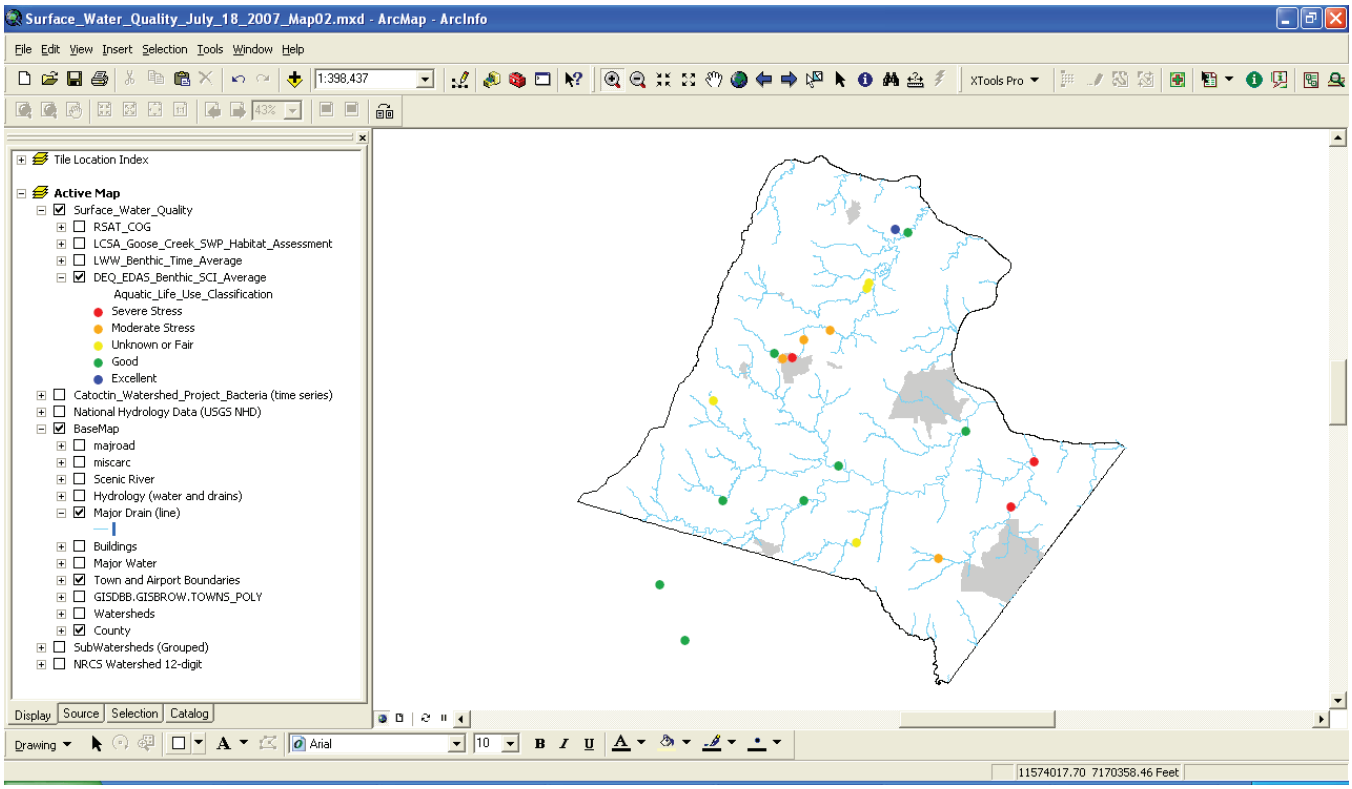
Attributes of Average_DEQ_EDAS

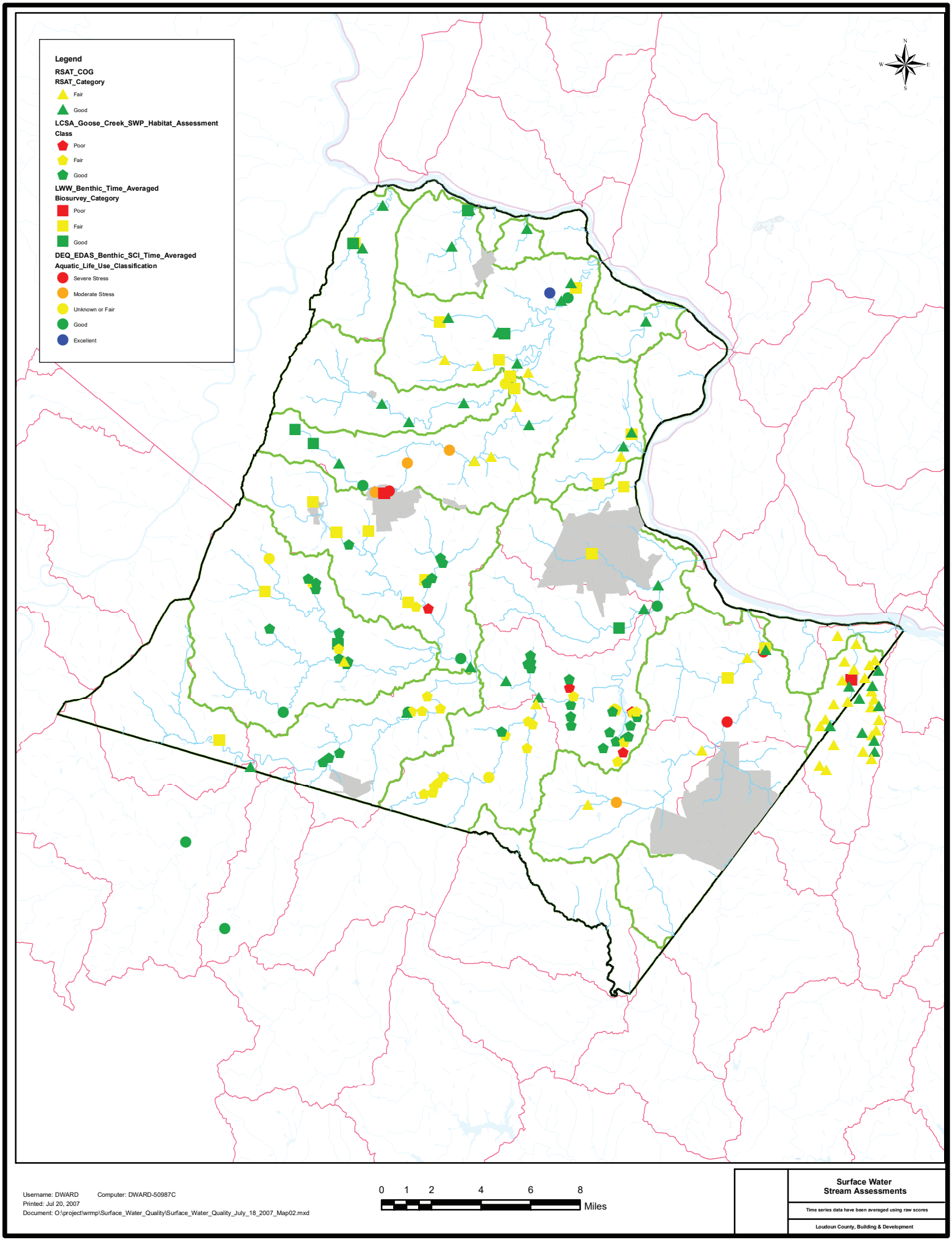
ID_1	TetraTech_IBI_SCI_	Average_TetraTech_IBI_SCI	Average_IBI_SCI_Category
3	1ABRB002.15	40.710341	Severe Stress
2	1ABRB006.97	38.746455	Severe Stress
4	1ABRB015.43	45.980097	Moderate Stress
18	1ACAX004.57	69.628831	Good
19	1ACRM009.86	70.440550	Good
12	1AGOO003.18	66.541538	Good
14	1AGOO022.44	67.717940	Good
16	1AGOO036.47	68.533022	Good
11	1ALIV004.78	61.816464	Unknown or Fair
9	1ANOB007.97	56.594295	Unknown or Fair
10	1ANOC000.42	57.777186	Unknown or Fair
13	1ANOG000.91	67.333851	Good
8	1ASOC000.01	55.326898	Unknown or Fair
7	1ASOC007.06	48.682738	Moderate Stress
5	1ASOC010.09	47.489035	Moderate Stress
1	1ASOC011.98	29.550130	Severe Stress
6	1ASOC012.60	47.998137	Moderate Stress
17	1ASOC013.05	69.291290	Good
15	1AXGU000.18	67.829553	Good
20	1AXKR000.77	74.679537	Excellent

Record: 0 Show: All Selected Records (0 out of 20 Selected.) Options

and can map this


Layer Properties
General
Source
Selection
Display
Symbology
Fields
Definition Query
Labels
XCallout
Joins & Relates
Show:
Features
Categories
Unique values
Unique values, many
Match to symbols in a
Quantities
Charts
Multiple Attributes
Draw categories using unique values of one field.
Import...
Value Field
Average_IBI_SCI_Category
Color Ramp
Symbol
Value
Label
Count
<all other values>
<all other values>
0
<Heading>
Aquatic_Life_Use_Clas
20
Severe Stress
Severe Stress
3
Moderate Stress
Moderate Stress
4
Unknown or Fair
Unknown or Fair
4
Good
Good
8
Excellent
Excellent
1
Add All Values
Add Values...
Remove
Remove All
Advanced
OK
Cancel
Apply


Surface_Water_Quality_July_18_2007_Map02.mxd - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
1:398,437
XTools Pro
Tile Location Index
Active Map
Surface_Water_Quality
RSAT_COG
LCSA_Goose_Creek_SWP_Habitat_Assessment
LWW_Benthic_Time_Average
DEQ_EDAS_Benthic_SCI_Average
Aquatic_Life_Use_Classification
Severe Stress
Moderate Stress
Unknown or Fair
Good
Excellent
Catoctin_Watershed_Project_Bacteria (time series)
National Hydrology Data (USGS NHD)
BaseMap
majroad
miscarc
Scenic River
Hydrology (water and drains)
Major Drain (line)
Buildings
Major Water
Town and Airport Boundaries
GISDBB.GISBROW.TOWNS_POLY
Watersheds
County
SubWatersheds (Grouped)
NRCS Watershed 12-digit
Display
Source
Selection
Catalog
Drawing
Arial
10
11574017.70 7170358.46 Feet


Legend
RSAT_COG
RSAT_Category
Fair
Good
LCSA_Goose_Creek_SWP_Habitat_Assessment
Class
Poor
Fair
Good
LWW_Benthic_Time_Averaged
Biosurvey_Category
Poor
Fair
Good
DEQ_EDAS_Benthic_SCI_Time_Averaged
Aquatic_Life_Use_Classification
Severe Stress
Moderate Stress
Unknown or Fair
Good
Excellent
N
W
E
S
0 1 2 4 6 8
Miles
Surface Water
Stream Assessments
Time series data have been averaged using raw scores
Loudoun County, Building & Development
Username: DWARD Computer: DWARD-50987C
Printed: Jul 20, 2007
Document: O:\project\wrmp\Surface_Water_Quality\Surface_Water_Quality_July_18_2007_Map02.mxd

Task B.3.5 Loudoun County Wells and Groundwater Quantity

B.3.5 Wells and Groundwater Quantity (using data sets 1.1, 1.2, 1.3, 1.5, and 3.1)

Data Set 1.1
Loudoun County Groundwater, Well, and Pollution Sources

Well construction and groundwater information in database (MS Access) with locations in GIS maintained by B&D and Health Department. Source of most data from paper files generated during Health Department well permitting process (e.g., GW2 well construction form). Subset of WellPoll database, which includes well data and pollution sources data. Data on ~18,500 wells dating from 1930 to present, with information of varying quality and completeness including: location (VA state plane coordinates), surface elevation (62% complete), well depth (70%), casing depth (65%), static water level (53%) {but of suspect accuracy}, total yield (60%), depth of primary yield zone (60%), and transmissivity (~250 values).

Also includes groundwater quality data. Water quality data for a limited number of parameters are entered in the database for some wells (~2,100) constructed and tested prior to 2002. Water quality data provided digitally to B&D by National Testing Labs started in 2002 and is available for approximately 2,250 wells. These data are considered level A quality and typically consist of 100 physical/chemical water quality parameters per well for a total of more than 200,000 individual analyses. NTL data linked to the groundwater database by Health Department Permit No.

Also includes data on potential pollution sources – primarily on-site sewage disposal systems (e.g., drainfields) but also other sites such as cemeteries, landfills, chemical storage sites, etc. Currently approximately 15,000 records with site ID numbers and corresponding points in GIS. Data in some of the old records may be obsolete. Currently, data are obtained primarily from the Health Department sewage disposal system permitting process.

Data Set 1.2
USGS Groundwater Wells

The USGS operates three real-time water level measurement wells within Loudoun County or contributing watersheds. One well is located on the ridge of Short Hill north of Hillsboro (1963 to present), one is located east of Leesburg (1977 to present), and the third is in Prince William County, just south of the Loudoun County line in the Bull Run watershed (1968 to present). Data is added to B&D databases through automated web queries.

Data Set 1.3
County Hydrogeologic Studies
These reports are valuable sources of high-quality groundwater data, including level data, geologic logs and aquifer testing data. The reports are required for most large subdivisions, as well as other developments with anticipated usage greater than 10,000 gal/day. The County has ~ 165 reports on file. However, these reports are largely paper files only, and need to be compiled electronically. Tasks (subcontract and in-house) are now underway to compile these into a new "enhanced" Loudoun County well database. Activities are expected to be completed by May 2007. This will replace the draft data now in the database.

Data Set 1.5
WRMP Monitoring Wells
B&D started monitoring groundwater levels in the county in 2003 and, with two wells added in December 2006, currently monitors eight wells (with the goal of establishing 17-20 wells by 2009). Water levels recorded by automatic data loggers several times per day and manually downloaded. Records are incomplete for some wells. (Water quality sampling from many of these wells is slated to begin in 2007.)

Data Set 3.1
Geology – USGS/Loudoun County
Surficial and bedrock geology GIS layers and printed maps developed through mapping efforts by USGS with assistance from Loudoun County's former Department of Natural Resources. Bedrock map data updated by USGS in 1999. Following minor corrections with data labeling after consulting with USGS, layers incorporated into Loudoun County GIS in 2003.

Task B.3.5 Wells and Groundwater Quantity

Section A) Statistical Comparisons and Summary Statistics of Wells from Hydrostudies and Wells from VDH.

1) Two sample comparison: Static Water Level from Hydrostudy wells to Static Water Level from VDH. Includes graphical comparison, summary statistics, comparison of means and comparison of medians.
2) Well Depth by year from VDH well data. This data set is used because it is more complete than the hydrostudy data.
3) Frequency diagram of Dry Holes (WWDH) by year. Issue is revisited below.
4) One way ANOVA of VDH static water level by Year Code. The years are grouped through 1999 to allow for larger sample sizes. The VDH data set is used instead of the Hydrostudy data set because it has a longer record. ANOVA shows which groups are stastically similar.
5) Two sample comparison: Hydrostudy well depth to VDH well depth.
6) Multiple variable analysis of Hydrostudy data; This analysis produces summary statistics for Well depth, bedrock depth, static water level, specific capacity, airlift yield, primary yield zone, secondary yield zone, median transmissivity and median storativity for all hydrostudy wells. Analysis includes, count, mean, median, standard deviation, minimum, maximum, range, upper and lower quartiles, interquartile range, standardized skewness and standardized kurtosis. The analysis also produced a correlation matrix for the above parameters.
7) Two sample comparison: VDH primary water zone and VDH secondary water zone.
8) Multiple Box and Whisker Plot of Specific Capacity vs Rock Class' Visual comparison of medians and distribution of specific capacity values by rock class.
9) Simple Regression: VDH base elevation vs BDH Well depth.
10) Simple Regression: VDH well depth vs Year.
11) Simple Regression: VDH static water level vs Year.
12) Simple Regression: VDH airlift yield vs year
13) Two Sample comparison: Hydrostudy Airlift Yield to VDH airlift yield.
14) Analysis of VDH static water level by year. Summary statistics of static water levels reported each year, beginning with 1975 to allow for larger sample populations.
15) Multiple sample comparison: Hydrostudy Well depth by Year.
16) Summary Statistic table for VDH static water level by Year.

Section B) Box and Whiskers plots for various comparisons. These plots allow visual inspections of distributions of data and comparisons of mean and median values. Other Box and Whiskers plots may be found within various analysis routines throughout this document, Plots provided include:

Hydrostudy Well Depth by Bedrock Class
Hydrostudy Airlift Yield by Bedrock Class
Hydrostudy Bedrock Depth by Bedrock Class
Hydrostudy Yield Zone Depth by Bedrock Class
Hydrostudy Airlift Yields by Year
Hydrostudy Well Depth by Year

Section C) Detailed statistical analysis of Hydrostudy data, including parameters calculated from pumping tests.

1) Analysis of Airlift Yield vs Year. Detailed analysis of airlift yield values dating back to 1985. Comparison of means and medians.
2) Comparison of Well Depth by major Watershed.
3) Comparison of Airlift Yield by major Watershed.
4) Comparison of Airlift Yield by Rock Class.
5) Comparison of Specific Capacity by Rock Class.
6) Comparison of Median Transmissivity by Rock Class.
7) Comparison of Median Storativity by Rock Class.
8) Comparison of Primary Yield Zone by Rock Class.
9) Summary Statistics table from Hydrostudy well data.
10) Correlation matrix produced for Hydrostudy parameters Well Depth, Bedrock Depth, Static Water Level, Specific Capacity, Airlift Yield, Primary Yield Zone, Secondary Yield Zone, Median Transmissivity, and Median Storativity.
11) Summary Statictics table for Hydrostudy well depths by Year.

Section D) Detailed analysis of VDH well data.

1) Analysis of VDH Casing depth by year (grouped).
2) Analysis of VDH Well depth by year (grouped).
3) Analysis of VDH Well Yield by year (grouped).
4) Analysis of VDH Static Water Level by year (grouped).
5) Summary statistics table for VDH Static Water Level by year (grouped).
6) Summary statistics table for VDH well parameters Well Depth, Bedrock Depth, Static Water Level, Airlift Yield, Primary Yield Zone and Secondary Yield Zone.

Section E) Analysis of dry hole data from VDH data set. Includes frequency histogram of reported dry holes by year, and frequency histogram of dry holes by year concurrent with total wells drilled by year. Also a table showing the number of dry holes for each rock class.

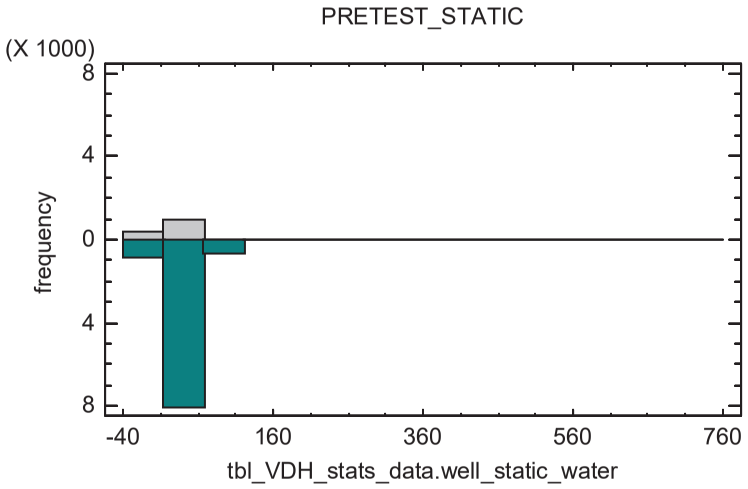
Section A) Statistical Comparisons and Summary Statistics of Wells from Hydrostudies and Wells from VDH.

1) Two-Sample Comparison – Static Water Level from Hydrostudy Data to VDH Static Water Level data

Sample 1: PRETEST_STATIC (hydrostudy)
Sample 2: tbl_VDH_stats_data.well_static_water

Sample 1: 1401 values ranging from 0.0 to 182.93
Sample 2: 9320 values ranging from 0.2 to 700.0

The StatAdvisor
This procedure is designed to compare two samples of data. It will calculate various statistics and graphs for each sample, and it will run several tests to determine whether there are statistically significant differences between the two samples.

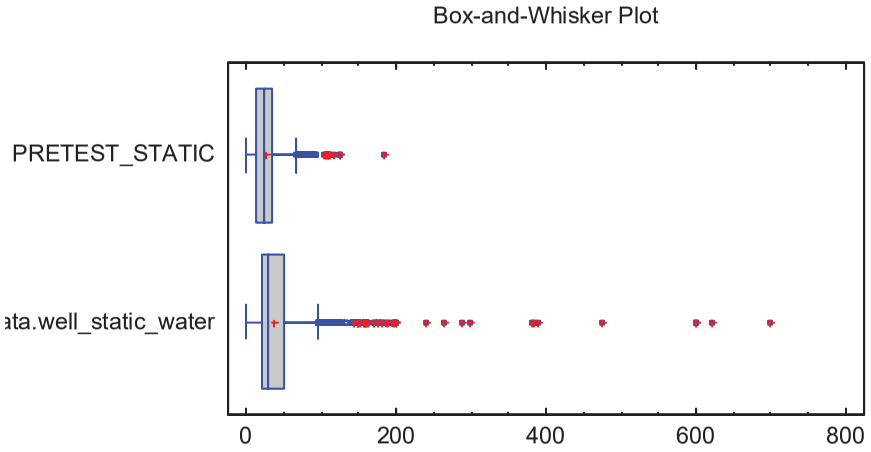


Summary Statistics

	PRETEST_STATIC (hydrostudies)	*tbl_VDH_stats_data.well_static_water*
Count	1401	9320
Average	25.6313	37.7393
Standard deviation	18.5542	26.0762
Coeff. of variation	72.3888%	69.0956%
Minimum	0.0	0.2
Maximum	182.93	700.0

Range	182.93	699.8
Stnd. skewness	26.4129	292.606
Stnd. kurtosis	51.6279	2754.27

The StatAdvisor
This table shows summary statistics for the two samples of data. Other tabular options within this analysis can be used to test whether differences between the statistics from the two samples are statistically significant. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the samples come from normal distributions. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate the tests which compare the standard deviations. **In this case, both samples have standardized skewness values outside the normal range. Both samples have standardized kurtosis values outside the normal range.**



Comparison of Means
95.0% confidence interval for mean of PRETEST_STATIC (hydrostudies): 25.6313 +/- 0.971563 [24.6597, 26.6028]
95.0% confidence interval for mean of tbl_VDH_stats_data.well_static_water: 37.7393 +/- 0.529402 [37.2099, 38.2687]
95.0% confidence interval for the difference between the means
assuming equal variances: -12.1081 +/- 1.41648 [-13.5246, -10.6916]

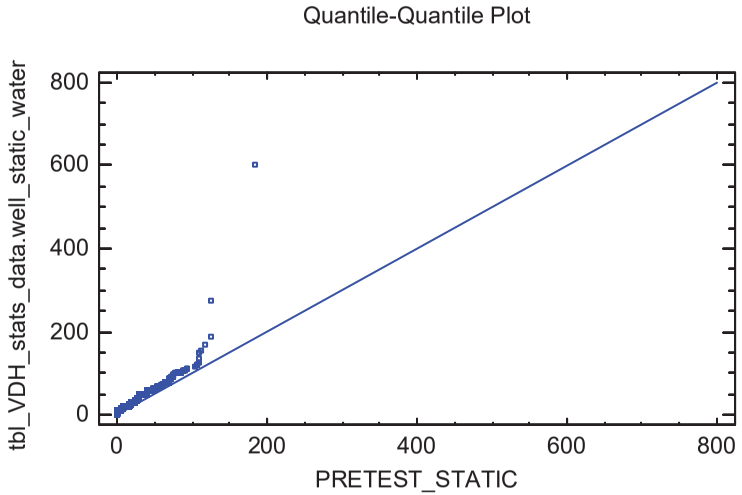
t test to compare means
Null hypothesis: mean1 = mean2
Alt. hypothesis: mean1 NE mean2
assuming equal variances: t = -16.7538 P-value = 0.0
Reject the null hypothesis for alpha = 0.05.

The StatAdvisor
This option runs a t-test to compare the means of the two samples. It also constructs confidence intervals or bounds for each mean and for the difference between the means. Of particular interest is

the confidence interval for the difference between the means, which extends from -13.5246 to -10.6916. Since the interval does not contain the value 0, **there is a statistically significant difference between the means of the two samples at the 95.0% confidence level.**

A t-test may also be used to test a specific hypothesis about the difference between the means of the populations from which the two samples come. In this case, the test has been constructed to determine whether the difference between the two means equals 0.0 versus the alternative hypothesis that the difference does not equal 0.0. Since the computed P-value is less than 0.05, we can reject the null hypothesis in favor of the alternative.

NOTE: these results assume that the variances of the two samples are equal. **In this case, that assumption is questionable since the results of an F-test to compare the standard deviations suggests that there may be a significant difference between them**. You can see the results of that test by selecting Comparison of Standard Deviations from the Tabular Options menu.



Comparison of Standard Deviations

	PRETEST_STATIC	*tbl_VDH_stats_data.well_static_water*
Standard deviation	18.5542	26.0762
Variance	344.257	679.969
Df	1400	9319

Ratio of Variances = 0.506283

95.0% Confidence Intervals
Standard deviation of PRETEST_STATIC (hydrostudies): [17.8917, 19.2679]
Standard deviation of tbl_VDH_stats_data.well_static_water: [25.7072, 26.4561]
Ratio of Variances: [0.470775, 0.545986]

F-test to Compare Standard Deviations
Null hypothesis: sigma1 = sigma2

Alt. hypothesis: sigma1 NE sigma2
F = 0.506283 P-value = 0.0
Reject the null hypothesis for alpha = 0.05.

The StatAdvisor
This option runs an F-test to compare the variances of the two samples. It also constructs confidence intervals or bounds for each standard deviation and for the ratio of the variances. Of particular interest is the confidence interval for the ratio of the variances, which extends from 0.470775 to 0.545986. Since the interval does not contain the value 1, there is a statistically significant difference between the standard deviations of the two samples at the 95.0% confidence level.

An F-test may also be used to test a specific hypothesis about the standard deviations of the populations from which the two samples come. In this case, the test has been constructed to determine whether the ratio of the standard deviations equals 1.0 versus the alternative hypothesis that the ratio does not equal 1.0. **Since the computed P-value is less than 0.05, we can reject the null hypothesis in favor of the alternative.**

IMPORTANT NOTE: the F-tests and confidence intervals shown here depend on the samples having come from normal distributions. To test this assumption, select Summary Statistics from the list of Tabular Options and check the standardized skewness and standardized kurtosis values. **(Summary Statistics shown above indicate non-normal distributions, therefore the F-test for comparison of variances is not adequate).**

SINCE THE DATA IS NON-NORMALLY DISTRIBUTED, THE COMPARISON OF MEDIANS IS MORE APPROPRIATE FOR COMPARING CENTRAL TENDANCY.

Comparison of Medians
Median of sample 1: 23.0
Median of sample 2: 30.0

Mann-Whitney (Wilcoxon) W test to compare medians
Null hypothesis: median1 = median2
Alt. hypothesis: median1 NE median2

Average rank of sample 1: 3723.8
Average rank of sample 2: 5607.11

W = 2.29371E6 P-value = 0.0
Reject the null hypothesis for alpha = 0.05. MEDIANS ARE NOT EQUAL, HYDROSTUDY STATIC WATER LEVELS SHOW SIGNIFICANT DIFFERENCE FROM VDH STATIC WATER LEVELS.

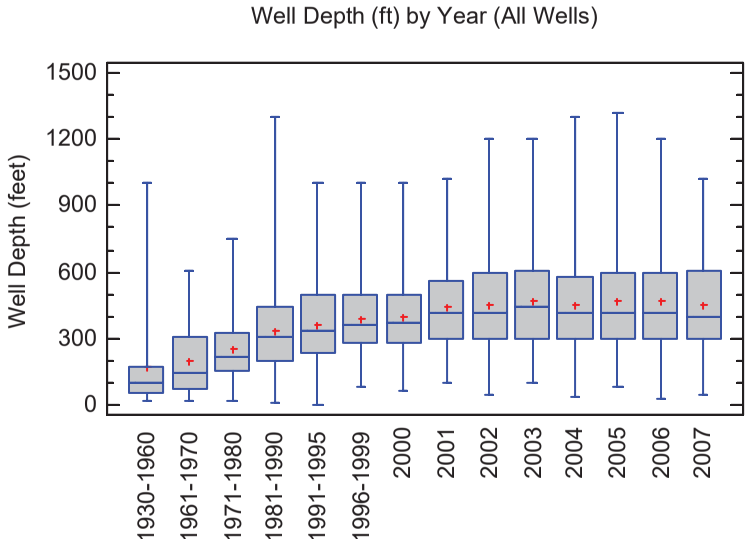
The StatAdvisor
This option runs a Mann-Whitney W test to compare the medians of the two samples. This test is constructed by combining the two samples, sorting the data from smallest to largest, and comparing the average ranks of the two samples in the combined data. **Since the P-value is less than 0.05, there is a statistically significant difference between the medians at the 95.0% confidence level.**

2) HEALTH DEPARTMENT WELL DATA: Well depth by Year
Multiple Box-and-Whisker Plot

Dependent variable: tbl_VDH_stats_data.well_depth
Factor: Year_Code

Number of observations: 12792
Number of levels: 14

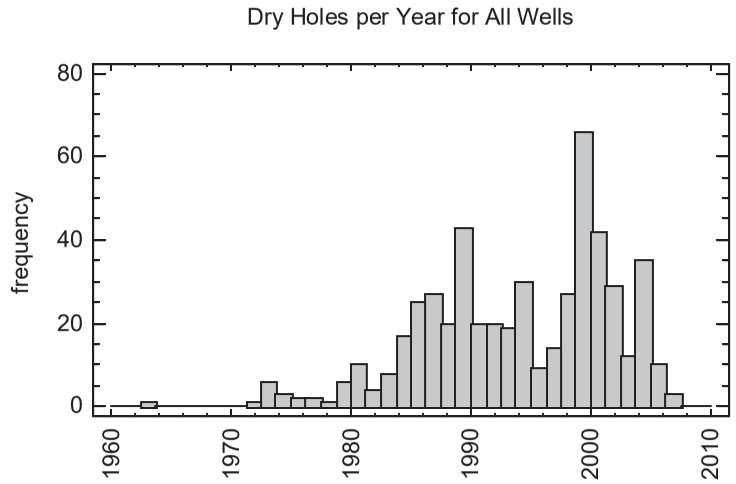
The StatAdvisor
This procedure constructs box-and-whisker plots to compare the 14 samples of tbl_VDH_stats_data.well_depth. For a detailed statistical analysis of this data, select Compare - Analysis of Variance - One-Way ANOVA from the main menu.



3) Frequency Histogram – Dry Holes (WWHD) from VDH by Year

Data variable: tbl_WWDH.WE_ID_YEAR
512 values ranging from 1963.0 to 2007.0

The StatAdvisor
This procedure displays a frequency histogram for a single column of data. You can create many other graphs and statistics for the data by selecting Describe - Numeric Data - One-Variable Analysis from the main menu.

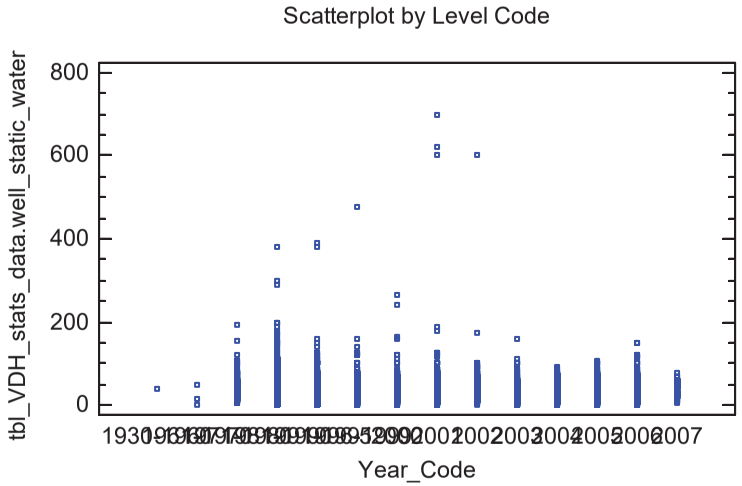


4) One-Way ANOVA – VDH static water level by Year_Code

Dependent variable: tbl_VDH_stats_data.well_static_water
Factor: Year_Code

Number of observations: 9320
Number of levels: 14

The StatAdvisor
This procedure performs a one-way analysis of variance for tbl_VDH_stats_data.well_static_water. It constructs various tests and graphs to compare the mean values of tbl_VDH_stats_data.well_static_water for the 14 different levels of Year_Code. **The F-test in the ANOVA table will test whether there are any significant differences amongst the means**. If there are, the Multiple Range Tests will tell you which means are significantly different from which others. **If you are worried about the presence of outliers, choose the Kruskal-Wallis Test which compares medians instead of means**. The various plots will help you judge the practical significance of the results, as well as allow you to look for possible violations of the assumptions underlying the analysis of variance.



ANOVA Table for tbl_VDH_stats_data.well_static_water by Year_Code

Source	*Sum of Squares*	*Df*	*Mean Square*	*F-Ratio*	*P-Value*
Between groups	79834.2	13	6141.09	9.13	0.0000
Within groups	6.2568E6	9306	672.34		
Total (Corr.)	6.33663E6	9319			

The StatAdvisor
The ANOVA table decomposes the variance of tbl_VDH_stats_data.well_static_water into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 9.13391, is a ratio of the between-group estimate to the within-group estimate**. Since the P-value of the F-test is less than 0.05, there is a statistically significant difference between**

the mean tbl_VDH_stats_data.well_static_water from one level of Year_Code to another at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

Multiple Range Tests for tbl_VDH_stats_data.well_static_water by Year_Code:

Method: 95.0 percent LSD

Year_Code	*Count*	*Mean*	*Homogeneous Groups*
1961-1970	3	21.6667	XXXXXX
2003	415	32.3687	X
2004	575	33.409	XX
2000	685	34.5902	XXX
2005	725	34.8428	XXX
1996-1999	1355	35.7791	XXX
2002	569	37.1511	XXX
2006	795	37.7434	XX
2001	677	39.4919	XX
1930-1960	1	40.0	XXXXXX
1981-1990	2178	40.2764	X
1971-1980	222	40.8626	XX
1991-1995	1024	41.5859	X
2007	96	44.6667	X

Contrast	*Sig.*	*Difference*	*+/- Limits*
1930-1960 - 1961-1970		18.3333	58.6831
1930-1960 - 1971-1980		-0.862613	50.9354
1930-1960 - 1981-1990		-0.2764	50.8327
1930-1960 - 1991-1995		-1.58594	50.8458
1930-1960 - 1996-1999		4.2209	50.8398
1930-1960 - 2000		5.40978	50.8581
1930-1960 - 2001		0.508124	50.8586
1930-1960 - 2002		2.84886	50.8657
1930-1960 - 2003		7.63133	50.8822
1930-1960 - 2004		6.59096	50.8652
1930-1960 - 2005		5.15724	50.8561
1930-1960 - 2006		2.2566	50.853
1930-1960 - 2007		-4.66667	51.085
1961-1970 - 1971-1980		-19.1959	29.5391
1961-1970 - 1981-1990		-18.6097	29.3617
1961-1970 - 1991-1995		-19.9193	29.3845
1961-1970 - 1996-1999		-14.1124	29.374
1961-1970 - 2000		-12.9236	29.4057
1961-1970 - 2001		-17.8252	29.4065
1961-1970 - 2002		-15.4845	29.4188

1961-1970 - 2003		-10.702	29.4474
1961-1970 - 2004		-11.7424	29.418
1961-1970 - 2005		-13.1761	29.4022
1961-1970 - 2006		-16.0767	29.3969
1961-1970 - 2007		-23.0	29.7965
1971-1980 - 1981-1990		0.586212	3.5805
1971-1980 - 1991-1995		-0.723325	3.7625
1971-1980 - 1996-1999	*	5.08351	3.67971
1971-1980 - 2000	*	6.27239	3.92487
1971-1980 - 2001		1.37074	3.93054
1971-1980 - 2002		3.71147	4.0216
1971-1980 - 2003	*	8.49394	4.22584
1971-1980 - 2004	*	7.45357	4.01571
1971-1980 - 2005	*	6.01985	3.89828
1971-1980 - 2006		3.11922	3.85784
1971-1980 - 2007		-3.80405	6.2079
1981-1990 - 1991-1995		-1.30954	1.92564
1981-1990 - 1996-1999	*	4.4973	1.7584
1981-1990 - 2000	*	5.68618	2.22628
1981-1990 - 2001		0.784524	2.23627
1981-1990 - 2002	*	3.12526	2.3927
1981-1990 - 2003	*	7.90773	2.72202
1981-1990 - 2004	*	6.86736	2.38278
1981-1990 - 2005	*	5.43364	2.17906
1981-1990 - 2006	*	2.533	2.10586
1981-1990 - 2007		-4.39027	5.29998
1991-1995 - 1996-1999	*	5.80684	2.10437
1991-1995 - 2000	*	6.99572	2.50853
1991-1995 - 2001		2.09406	2.5174
1991-1995 - 2002	*	4.4348	2.65733
1991-1995 - 2003	*	9.21726	2.95733
1991-1995 - 2004	*	8.17689	2.6484
1991-1995 - 2005	*	6.74318	2.46672
1991-1995 - 2006	*	3.84254	2.4023
1991-1995 - 2007		-3.08073	5.42459
1996-1999 - 2000		1.18888	2.38256
1996-1999 - 2001	*	-3.71278	2.39189
1996-1999 - 2002		-1.37204	2.53875
1996-1999 - 2003	*	3.41042	2.85126
1996-1999 - 2004		2.37006	2.52941
1996-1999 - 2005		0.936341	2.3385
1996-1999 - 2006		-1.9643	2.27044
1996-1999 - 2007	*	-8.88757	5.3675

2000 - 2001	*	-4.90166	2.75418
2000 - 2002		-2.56092	2.88264
2000 - 2003		2.22154	3.16134
2000 - 2004		1.18118	2.87442
2000 - 2005		-0.25254	2.70794
2000 - 2006	*	-3.15318	2.64939
2000 - 2007	*	-10.0764	5.53845
2001 - 2002		2.34073	2.89036
2001 - 2003	*	7.1232	3.16837
2001 - 2004	*	6.08283	2.88216
2001 - 2005	*	4.64912	2.71615
2001 - 2006		1.74848	2.65778
2001 - 2007		-5.17479	5.54247
2002 - 2003	*	4.78247	3.28066
2002 - 2004	*	3.7421	3.00515
2002 - 2005		2.30838	2.84633
2002 - 2006		-0.592254	2.79069
2002 - 2007	*	-7.51552	5.60741
2003 - 2004		-1.04037	3.27343
2003 - 2005		-2.47408	3.12826
2003 - 2006	*	-5.37472	3.07772
2003 - 2007	*	-12.298	5.75565
2004 - 2005		-1.43372	2.838
2004 - 2006	*	-4.33435	2.78219
2004 - 2007	*	-11.2576	5.60319
2005 - 2006	*	-2.90064	2.60983
2005 - 2007	*	-9.82391	5.51964
2006 - 2007	*	-6.92327	5.49115

* denotes a statistically significant difference.

The StatAdvisor

This table applies a multiple comparison procedure to determine which means are significantly different from which others. The bottom half of the output shows the estimated difference between each pair of means. **An asterisk has been placed next to 38 pairs, indicating that these pairs show statistically significant differences at the 95.0% confidence level. At the top of the page, 6 homogenous groups are identified using columns of X's**. Within each column, the levels containing X's form a group of means within which there are no statistically significant differences. The method currently being used to discriminate among the means is Fisher's least significant difference (LSD) procedure. With this method, there is a 5.0% risk of calling each pair of means significantly different when the actual difference equals 0.

Kruskal-Wallis Test for tbl_VDH_stats_data.well_static_water by Year_Code

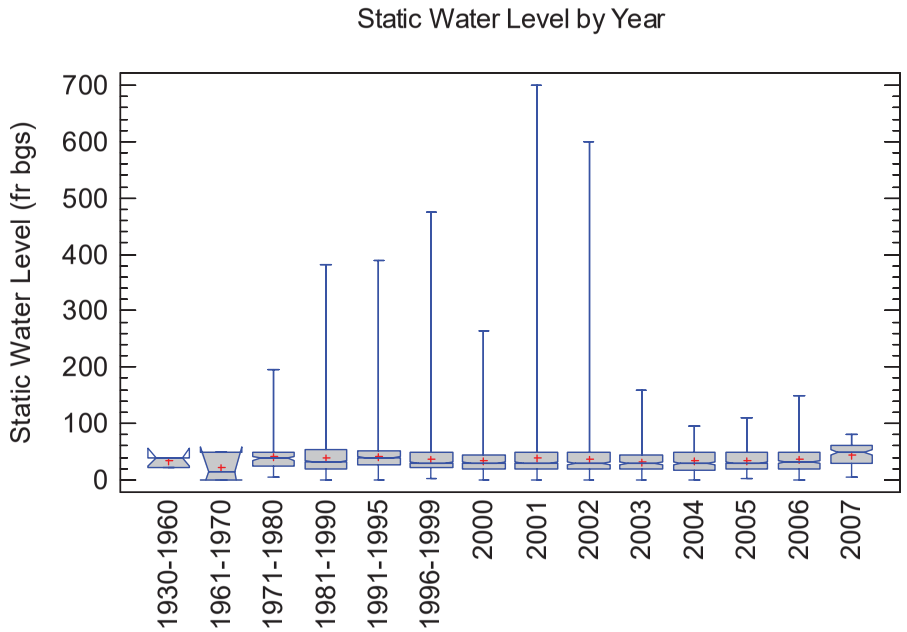
Year_Code	*Sample Size*	*Average Rank*
1930-1960	1	5559.0
1961-1970	3	2569.83
1971-1980	222	5105.67
1981-1990	2178	4863.09
1991-1995	1024	5222.64

1996-1999	1355	4547.38
2000	685	4253.54
2001	677	4589.77
2002	569	4571.98
2003	415	3989.26
2004	575	4186.2
2005	725	4328.04
2006	795	4774.27
2007	96	5929.59

Test statistic = 162.67 P-Value = 0.0

The StatAdvisor

The Kruskal-Wallis test tests the null hypothesis that the medians of tbl_VDH_stats_data.well_static_water within each of the 14 levels of Year_Code are the same. The data from all the levels is first combined and ranked from smallest to largest. The average rank is then computed for the data at each level. **Since the P-value is less than 0.05, there is a statistically significant difference amongst the medians at the 95.0% confidence level**. To determine which medians are significantly different from which others, select Box-and-Whisker Plot from the list of Graphical Options and select the median notch option.

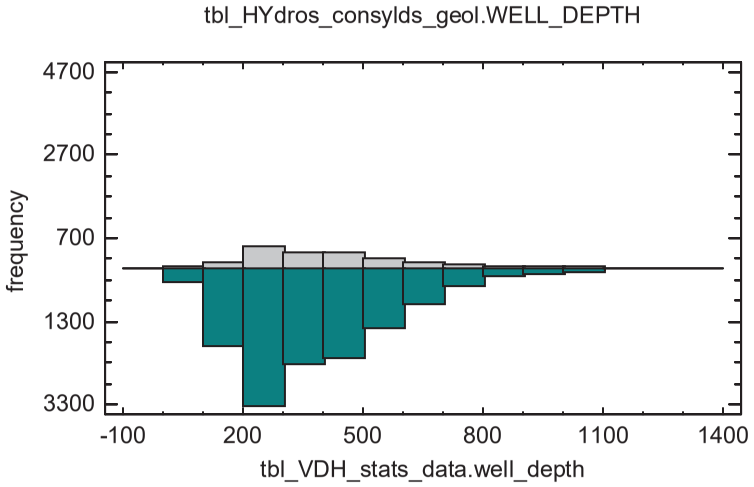


5) Two-Sample Comparison – Hydrostudies WELL_DEPTH & VDH well_depth

Sample 1: tbl_HYdros_consylds_geol.WELL_DEPTH (hydrostudies)
Sample 2: tbl_VDH_stats_data.well_depth (VDH)

Sample 1: 1817 values ranging from 50.0 to 1320.0
Sample 2: 12792 values ranging from 1.5 to 1320.0

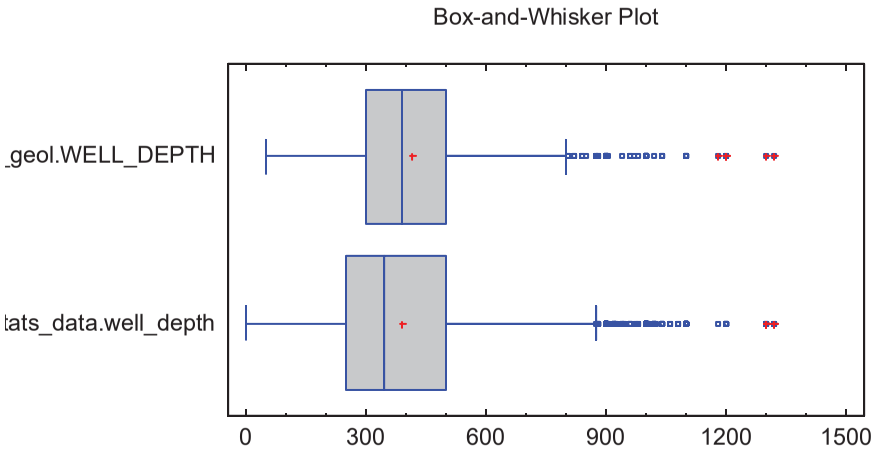
The StatAdvisor
This procedure is designed to compare two samples of data. It will calculate various statistics and graphs for each sample, and it will run several tests to determine whether there are statistically significant differences between the two samples.



Summary Statistics

	tbl_HYdros_consylds_geol.WELL_DEPTH	*tbl_VDH_stats_data.well_depth*
Count	1817	12792
Average	417.01	389.448
Standard deviation	182.455	191.342
Coeff. of variation	43.753%	49.1316%
Minimum	50.0	1.5
Maximum	1320.0	1320.0
Range	1270.0	1318.5
Stnd. skewness	18.8844	38.9927
Stnd. kurtosis	13.8639	17.7977

The StatAdvisor
This table shows summary statistics for the two samples of data. Other tabular options within this analysis can be used to test whether differences between the statistics from the two samples are statistically significant. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the samples come from normal distributions. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate the tests which compare the standard deviations. In this case, both samples have standardized skewness values outside the normal range. Both samples have standardized kurtosis values outside the normal range. **BOTH SAMPLES ARE NON-NORMALLY DISTRIBUTED. NON-PARAMETRIC TEST REQUIRED.**



Comparison of Standard Deviations

	tbl_HYdros_consylds_geol.WELL_DEPTH	*tbl_VDH_stats_data.well_depth*
Standard deviation	182.455	191.342
Variance	33289.7	36611.8
Df	1816	12791

Ratio of Variances = 0.909262
95.0% Confidence Intervals
Standard deviation of tbl_HYdros_consylds_geol.WELL_DEPTH: [176.709, 188.589]
Standard deviation of tbl_VDH_stats_data.well_depth: [189.026, 193.716]
Ratio of Variances: [0.852901, 0.971428]

F-test to Compare Standard Deviations
Null hypothesis: sigma1 = sigma2
Alt. hypothesis: sigma1 NE sigma2
F = 0.909262 P-value = 0.00825567
Reject the null hypothesis for alpha = 0.05. **STANDARD DEVIATIONS NOT EQUAL, SAMPLES SIGNIFICANTLY DIFFERENT**

The StatAdvisor
This option runs an F-test to compare the variances of the two samples. It also constructs confidence intervals or bounds for each standard deviation and for the ratio of the variances. Of particular interest is the confidence interval for the ratio of the variances, which extends from 0.852901 to 0.971428. Since the interval does not contain the value 1**, there is a statistically significant difference between the standard deviations of the two samples at the 95.0% confidence level**.
An F-test may also be used to test a specific hypothesis about the standard deviations of the populations from which the two samples come. In this case, the test has been constructed to determine whether the ratio of the standard deviations equals 1.0 versus the alternative hypothesis that the ratio does not equal 1.0. Since the computed P-value is less than 0.05, we can reject the null hypothesis in favor of the alternative.

IMPORTANT NOTE: the F-tests and confidence intervals shown here depend on the samples having come from normal distributions. To test this assumption, select Summary Statistics from the list of Tabular Options and check the standardized skewness and standardized kurtosis values. **Summary Statistics show that standard skewness and standard kurtosis are outside the limits of normally distributed data. Comparison of Medians (below) is a more appropriate comparison of central tendancy than comparison of means.**

Comparison of Medians
Median of sample 1: 390.0
Median of sample 2: 345.0

Mann-Whitney (Wilcoxon) W test to compare medians
Null hypothesis: median1 = median2
Alt. hypothesis: median1 NE median2

Average rank of sample 1: 7903.59
Average rank of sample 2: 7219.98

W = -1.08763E6 P-value = 9.70246E-11
Reject the null hypothesis for alpha = 0.05. MEDIANS NOT EQUAL, SAMPLES SHOW STATISTICALLY SIGNIFICANT DIFFERENCE (NOTE THAT HYDROSTUDY WELL_DEPTH MEDIAN IS HIGHER.)

The StatAdvisor
This option runs a Mann-Whitney W test to compare the medians of the two samples. This test is constructed by combining the two samples, sorting the data from smallest to largest, and comparing the average ranks of the two samples in the combined data. **Since the P-value is less than 0.05, there is a statistically significant difference between the medians at the 95.0% confidence level.**

6) Multiple-Variable Analysis HYDROSTUDY DATA

Data variables:

tbl_HYdros_consylds_geol.WELL_DEPTH
tbl_HYdros_consylds_geol.BEDROCK_DEPTH
PRETEST_STATIC
SPECIFIC_CAPACITY
AIRLIFT_YIELD
YIELD_ZONE
SECONDARY_WATER
Median_Trans
Median_Stor

All available data will be used in each calculation.

The StatAdvisor

This procedure is designed to summarize several columns of quantitative data. It will calculate various statistics, including correlations, covariances, and partial correlations. Also included in the procedure are a number of multivariate graphs, which give interesting views into the data. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

After this procedure, you may wish to select another procedure to build a statistical model for your data. Depending on your goal, one of several procedures may be appropriate. Following is a list of goals with an indication of which procedure would be appropriate:

GOAL: build a model for predicting one variable given values of one of more other variables.
PROCEDURE: Relate - Multiple Factors - Multiple Regression

Summary Statistics from Hydrostudy Wells

	Well Depth (ft TOC)	*Bedrock Depth (ft bgs)*	*Static Water Level (ft TOC)*	*Specific Capacity (gal/min/ft)*	*Airlift Yield (gal/min)*	*Primary Yield Zone (ft bgs)*	*Secondary Yield Zone (ft bgs)*	*Median Transmissivity (ft2/day)**	*Median Storativity**
Count	1817	1806	1401	1395	1812	1749	920	1092	767
Average	417	29	25.6	0.80	22	294	250	240	3.1E-04
Median	390	25	23	0.131	10	262	202	48	7.0E-05
Geometric mean	380.52	24.37	-	0.14	-	247.31	209.51	41.17	7.4E-05
Standard deviation	182.46	19.85	18.55	3.87	41.37	174.45	162.29	852.73	1.0E-03
Minimum	50	2	0	0.0005	0	25	20	0.000012	3.0E-08
Maximum	1320	305	183	75	650	1235	1200	16400	1.4E-02
Range	1270	303	183	74.9995	650	1210	1180	16400	1.4E-02
Lower quartile	300	16	13	0.044	5	160	135	13.1	2.8E-05
Upper quartile	500	40	34.94	0.42	25	380	317.5	160	2.0E-04
Interquartile range	200	24	21.94	0.38	20	220	182.5	146.9	1.7E-04

Stnd. skewness	18.9	62.1	26.4	204.9	120.0	22.2	23.0	155.1	98.3
Stnd. kurtosis	13.9	293.4	51.6	1632.8	638.6	20.5	30.7	1199.4	511.7

*Median of each test well calculated from multiple observation wells.

The StatAdvisor

This table shows summary statistics for each of the selected data variables. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate many of the statistical procedures normally applied to this data. In this case, the following variables show standardized skewness values outside the expected range: **THESE SAMPLES ARE NOT NORMALLY DISTRIBUTED**

tbl_HYdros_consylds_geol.WELL_DEPTH
tbl_HYdros_consylds_geol.BEDROCK_DEPTH
PRETEST_STATIC
SPECIFIC_CAPACITY
AIRLIFT_YIELD
YIELD_ZONE
SECONDARY_WATER
Median_Trans
Median_Stor

The following variables show standardized kurtosis values outside the expected range:

tbl_HYdros_consylds_geol.WELL_DEPTH
tbl_HYdros_consylds_geol.BEDROCK_DEPTH
PRETEST_STATIC
SPECIFIC_CAPACITY
AIRLIFT_YIELD
YIELD_ZONE
SECONDARY_WATER
Median_Trans
Median_Stor

To make the variables more normal, you might try a transformation such as LOG(Y), SQRT(Y), or 1/Y.

SEE CORRELATION MATRIX BELOW:

Matrix of Pearson Product Moment Correlations for Hydrostudy Well Data.

	Well Depth (ft bgs)	Bedrock Depth (ft bgs)	Static Water Level (ft TOC)	Specific Capacity (gal/min/ft)	Airlift Yield (gal/min)	Primary Yield Zone (ft bgs)	Secondary Yield Zone (ft bgs)	Median Transmissivity (ft2/day)	Median Storativity
Well Depth	Correlation (Sample Size) P-Value	-0.1212 -1803 0	0.0418 -1399 0.1181	-0.1609 -1393 0	-0.1641 -1807 0	0.6657 -1747 0	0.6314 -918 0	-0.1404 -1091 0	-0.0433 -766 0.2313
Bedrock Depth	-0.1212 -1803 0		0.096 -1391 0.0003	0.0696 -1385 0.0095	-0.0337 -1796 0.1529	-0.066 -1742 0.0058	0.0109 -916 0.7419	0.113 -1082 0.0002	0.0881 -760 0.0148
Static Water Level	0.0418 -1399 0.1181	0.096 -1391 0.0003		0.04 -1391 0.1359	-0.0014 -1396 0.9588	0.0887 -1387 0.0009	0.0787 -721 0.0343	-0.0047 -1089 0.8764	-0.0199 -765 0.5823
Specific Capacity	-0.1609 -1393 0	0.0696 -1385 0.0095	0.04 -1391 0.1359		0.3452 -1390 0	-0.1079 -1381 0.0001	-0.0521 -721 0.1622	0.3385 -1085 0	0.1437 -763 0.0001
Airlift Yield	-0.1641 -1807 0	-0.0337 -1796 0.1529	-0.0014 -1396 0.9588	0.3452 -1390 0		-0.1045 -1742 0	-0.0544 -915 0.0996	0.2234 -1089 0	0.009 -764 0.8034
Primary Yield Zone	0.6657 -1747 0	-0.066 -1742 0.0058	0.0887 -1387 0.0009	-0.1079 -1381 0.0001	-0.1045 -1742 0		0.205 -920 0	-0.1071 -1078 0.0004	-0.05 -758 0.1684
Secondary Yield Zone	0.6314 -918 0	0.0109 -916 0.7419	0.0787 -721 0.0343	-0.0521 -721 0.1622	-0.0544 -915 0.0996	0.205 -920 0		-0.0744 -561 0.0783	-0.0235 -391 0.643
Median Transmissivity	-0.1404 -1091 0	0.113 -1082 0.0002	-0.0047 -1089 0.8764	0.3385 -1085 0	0.2234 -1089 0	-0.1071 -1078 0.0004	-0.0744 -561 0.0783		0.2449 -758 0
Median Storativity	-0.0433 -766	0.0881 -760	-0.0199 -765	0.1437 -763	0.009 -764	-0.05 -758	-0.0235 -391	0.2449 -758	

	0.2313	0.0148	0.5823	0.0001	0.8034	0.1684	0.643	0

Statistically significant non-zero correlations at the 95.0% confidence level

No statistically significant non-zero correlations at the 95.0% confidence level

The StatAdvisor

This table shows Pearson product moment correlations between each pair of variables. These correlation coefficients range between -1 and +1 and measure the strength of the linear relationship between the variables. Also shown in parentheses is the number of pairs of data values used to compute each coefficient. The third number in each location of the table is a P-value which tests the statistical significance of the estimated correlations**. P-values below 0.05 indicate statistically significant non-zero correlations at the 95.0% confidence level.** The following pairs of variables have P-values below 0.05:

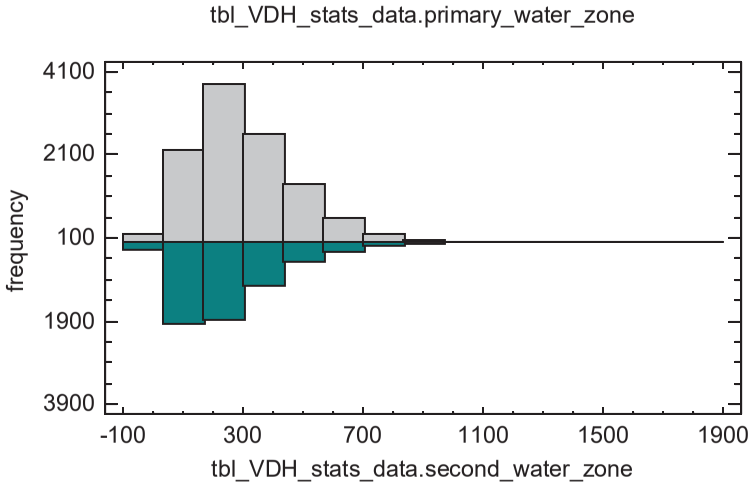
tbl_HYdros_consylds_geol.WELL_DEPTH and tbl_HYdros_consylds_geol.BEDROCK_DEPTH
tbl_HYdros_consylds_geol.WELL_DEPTH and SPECIFIC_CAPACITY
tbl_HYdros_consylds_geol.WELL_DEPTH and AIRLIFT_YIELD
tbl_HYdros_consylds_geol.WELL_DEPTH and YIELD_ZONE
tbl_HYdros_consylds_geol.WELL_DEPTH and SECONDARY_WATER
tbl_HYdros_consylds_geol.WELL_DEPTH and Median_Trans
tbl_HYdros_consylds_geol.BEDROCK_DEPTH and PRETEST_STATIC
tbl_HYdros_consylds_geol.BEDROCK_DEPTH and SPECIFIC_CAPACITY
tbl_HYdros_consylds_geol.BEDROCK_DEPTH and YIELD_ZONE
tbl_HYdros_consylds_geol.BEDROCK_DEPTH and Median_Trans
tbl_HYdros_consylds_geol.BEDROCK_DEPTH and Median_Stor
PRETEST_STATIC and YIELD_ZONE
PRETEST_STATIC and SECONDARY_WATER
SPECIFIC_CAPACITY and AIRLIFT_YIELD
SPECIFIC_CAPACITY and YIELD_ZONE
SPECIFIC_CAPACITY and Median_Trans
SPECIFIC_CAPACITY and Median_Stor
AIRLIFT_YIELD and YIELD_ZONE
AIRLIFT_YIELD and Median_Trans
YIELD_ZONE and SECONDARY_WATER
YIELD_ZONE and Median_Trans
Median_Trans and Median_Stor

7) Two-Sample Comparison - VDH_primary_water_zone & second_water_zone

Sample 1: tbl_VDH_stats_data.primary_water_zone
Sample 2: tbl_VDH_stats_data.second_water_zone

Sample 1: 11084 values ranging from 1.0 to 1609.0
Sample 2: 5586 values ranging from 0.42 to 1740.0

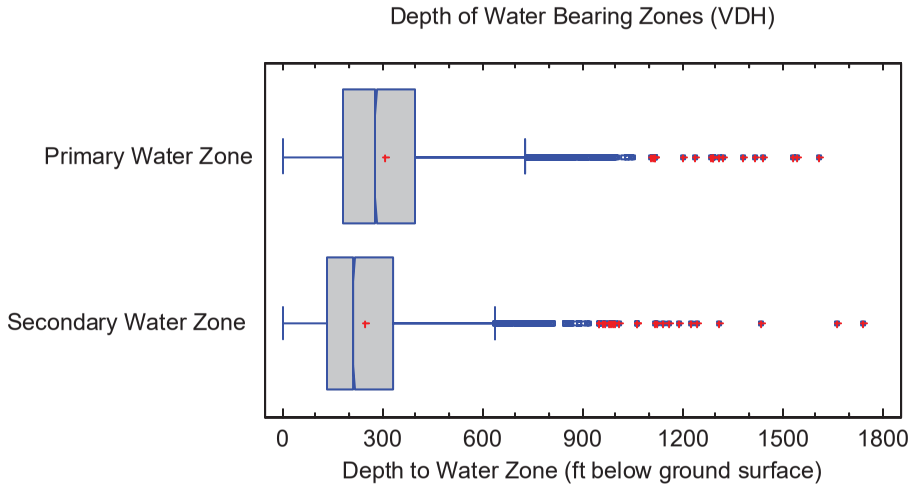
The StatAdvisor
This procedure is designed to compare two samples of data. It will calculate various statistics and graphs for each sample, and it will run several tests to determine whether there are statistically significant differences between the two samples.



Summary Statistics

	tbl_VDH_stats_data.primary_water_zone	*tbl_VDH_stats_data.second_water_zone*
Count	11084	5586
Average	306.71	250.923
Standard deviation	174.846	162.125
Coeff. of variation	57.0069%	64.6114%
Minimum	1.0	0.42
Maximum	1609.0	1740.0
Range	1608.0	1739.58
Stnd. skewness	48.1356	48.0232
Stnd. kurtosis	55.8449	81.7747

The StatAdvisor
This table shows summary statistics for the two samples of data. Other tabular options within this analysis can be used to test whether differences between the statistics from the two samples are statistically significant. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the samples come from normal distributions. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate the tests which compare the standard deviations. **In this case, both samples have standardized skewness values outside the normal range. Both samples have standardized kurtosis values outside the normal range. NON-NORMAL DISTRIBUTION.**



Comparison of Standard Deviations

	tbl_VDH_stats_data.primary_water_zone	*tbl_VDH_stats_data.second_water_zone*
Standard deviation	174.846	162.125
Variance	30571.1	26284.5
Df	11083	5585

Ratio of Variances = 1.16309

95.0% Confidence Intervals
Standard deviation of tbl_VDH_stats_data.primary_water_zone: [172.574, 177.179]
Standard deviation of tbl_VDH_stats_data.second_water_zone: [159.174, 165.189]
Ratio of Variances: [1.11207, 1.21809]

F-test to Compare Standard Deviations
Null hypothesis: sigma1 = sigma2
Alt. hypothesis: sigma1 NE sigma2
F = 1.16309 P-value = 1.11189E-10
Reject the null hypothesis for alpha = 0.05.

The StatAdvisor
This option runs an F-test to compare the variances of the two samples. It also constructs confidence intervals or bounds for each standard deviation and for the ratio of the variances. Of particular interest is the confidence interval for the ratio of the variances, which extends from 1.11207 to 1.21809. Since the interval does not contain the value 1, **there is a statistically significant difference between the standard deviations of the two samples at the 95.0% confidence level.**

An **F-test** may also be used to test a specific hypothesis about the standard deviations of the populations from which the two samples come. In this case, the test has been constructed to determine whether the ratio of the standard deviations equals 1.0 versus the alternative hypothesis that the ratio does not equal 1.0. **Since the computed P-value is less than 0.05, we can reject the null hypothesis in favor of the alternative.**

IMPORTANT NOTE: **the F-tests and confidence intervals shown here depend on the samples having come from normal distributions.** To test this assumption, select Summary Statistics from the list of Tabular Options and check the standardized skewness and standardized kurtosis values. **We already know that these samples are non-normally distributed, therefore we will use the non-parametric comparison of medians test below.**

Comparison of Medians
Median of sample 1: 280.0 (primary water zone)
Median of sample 2: 215.0 (secondary water zone)

Mann-Whitney (Wilcoxon) W test to compare medians
Null hypothesis: median1 = median2
Alt. hypothesis: median1 NE median2

Average rank of sample 1: 8920.15
Average rank of sample 2: 7175.41

W = -6.48027E6 P-value = 0.0
Reject the null hypothesis for alpha = 0.05.

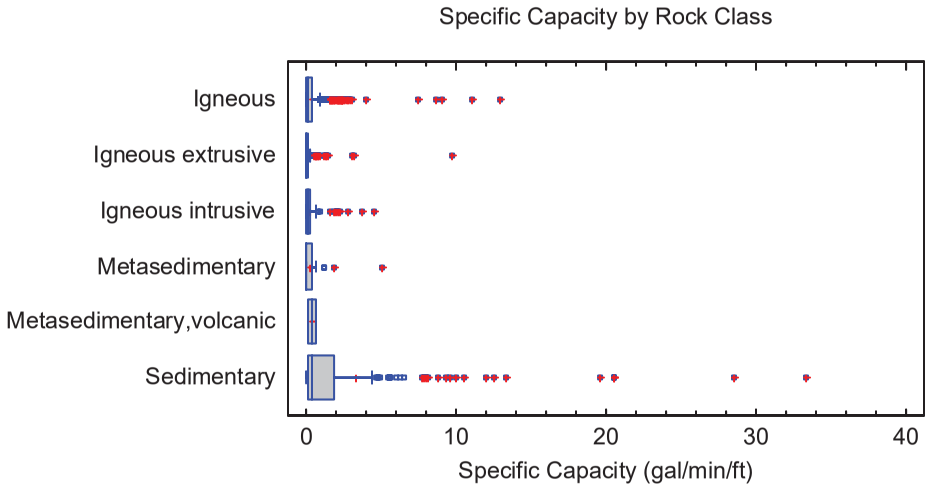
The StatAdvisor
This option runs a Mann-Whitney W test to compare the medians of the two samples. This test is constructed by combining the two samples, sorting the data from smallest to largest, and comparing the average ranks of the two samples in the combined data. Since the P-value is less than 0.05, **there is a statistically significant difference between the medians at the 95.0% confidence level.**
Note that Primary zone median is greater (deeper).

8) Multiple Box-and-Whisker Plot - SPECIFIC_CAPACITY by Rock Class

Dependent variable: SPECIFIC_CAPACITY
Factor: BE_ROCK_CL

Number of observations: 1395
Number of levels: 6

The StatAdvisor
This procedure constructs box-and-whisker plots to compare the 6 samples of SPECIFIC_CAPACITY. For a detailed statistical analysis of this data, select Compare - Analysis of Variance - One-Way ANOVA from the main menu.



9) Simple Regression - base_elevation vs. tbl_VDH_stats_data.well_depth

Dependent variable: base_elevation
Independent variable: tbl_VDH_stats_data.well_depth
Linear model: Y = a + b*X

Coefficients

	Least Squares	*Standard*	*T*	
Parameter	*Estimate*	*Error*	*Statistic*	*P-Value*
Intercept	451.428	1.8833	239.7	0.0000
Slope	0.0938746	0.00702086	13.3708	0.0000

Analysis of Variance

Source	*Sum of Squares*	*Df*	*Mean Square*	*F-Ratio*	*P-Value*
Model	4.041E6	1	4.041E6	178.78	0.0000
Residual	2.4267E8	10736	22603.4		
Total (Corr.)	2.46711E8	10737			

Correlation Coefficient = 0.127982
R-squared = 1.63795 percent
R-squared (adjusted for d.f.) = 1.62879 percent
Standard Error of Est. = 150.344
Mean absolute error = 103.853
Durbin-Watson statistic = 1.44737 (P=0.0000)
Lag 1 residual autocorrelation = 0.276205

The StatAdvisor
The output shows the results of fitting a linear model to describe the relationship between base_elevation and tbl_VDH_stats_data.well_depth. The equation of the fitted model is

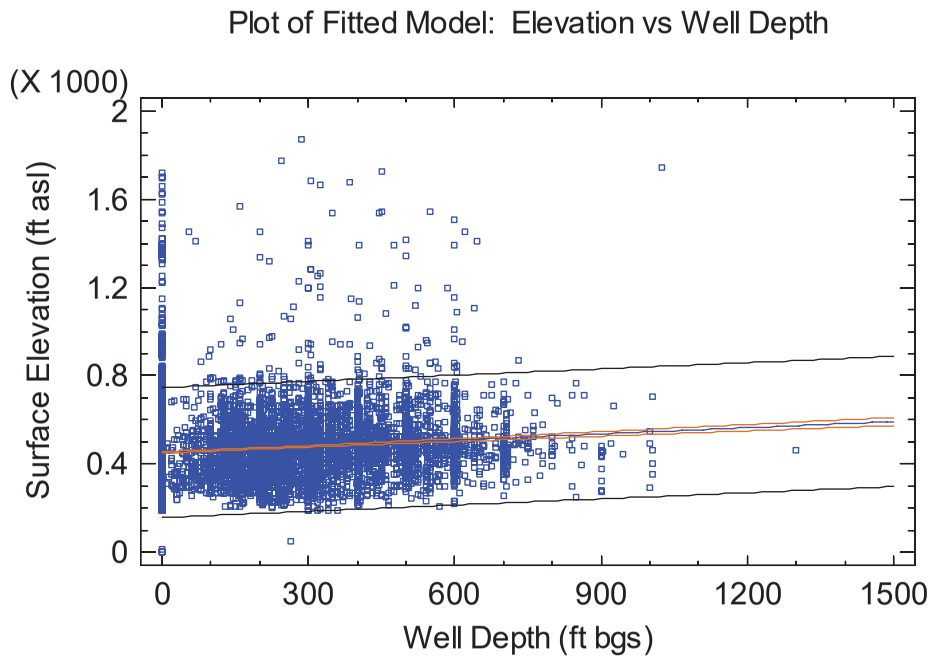
base_elevation = 451.428 + 0.0938746*VDH well_depth

Since the P-value in the ANOVA table is less than 0.05, **there is a statistically significant relationship between base_elevation and VDH_stats_well_depth at the 95.0% confidence level.**

The R-Squared statistic indicates that **the model as fitted explains 1.63795% of the variability in base_elevation**. The correlation coefficient equals 0.127982**, indicating a relatively weak relationship between the variables**. The standard error of the estimate shows the standard deviation of the residuals to be 150.344. This value can be used to construct prediction limits for new observations by selecting the Forecasts option from the text menu.

The mean absolute error (MAE) of 103.853 is the average value of the residuals. The Durbin-Watson (DW) statistic tests the residuals to determine if there is any significant correlation based on the order in which they occur in your data file. Since the P-value is less than 0.05, there is an indication of possible serial correlation at the 95.0% confidence level. Plot the residuals versus row order to see if there is any pattern that can be seen.

NONE NOTED.


Plot of Fitted Model: Elevation vs Well Depth
(X 1000)
Surface Elevation (ft asl)
2
1.6
1.2
0.8
0.4
0
0
300
600
900
1200
1500
Well Depth (ft bgs)

10) Simple Regression - tbl_VDH_well_depth vs. tbl_VDH_YEAR

Dependent variable: tbl_VDH_ well_depth
Independent variable: tbl_VDH_YEAR
Linear model: Y = a + b*X

Coefficients

	Least Squares	*Standard*	*T*	
Parameter	*Estimate*	*Error*	*Statistic*	*P-Value*
Intercept	-9721.53	167.795	-57.937	0.0000
Slope	5.0306	0.0843986	59.6053	0.0000

Analysis of Variance

Source	*Sum of Squares*	*Df*	*Mean Square*	*F-Ratio*	*P-Value*
Model	2.10625E8	1	2.10625E8	3552.79	0.0000
Residual	1.06344E9	17938	59284.2		
Total (Corr.)	1.27407E9	17939			

Correlation Coefficient = 0.406592
R-squared = 16.5317 percent
R-squared (adjusted for d.f.) = 16.527 percent
Standard Error of Est. = 243.484
Mean absolute error = 164.092
Durbin-Watson statistic = 1.2079 (P=0.0000)
Lag 1 residual autocorrelation = 0.387571

The StatAdvisor
The output shows the results of fitting a linear model to describe the relationship between tbl_VDH_well_depth and tbl_VDH_YEAR. The equation of the fitted model is

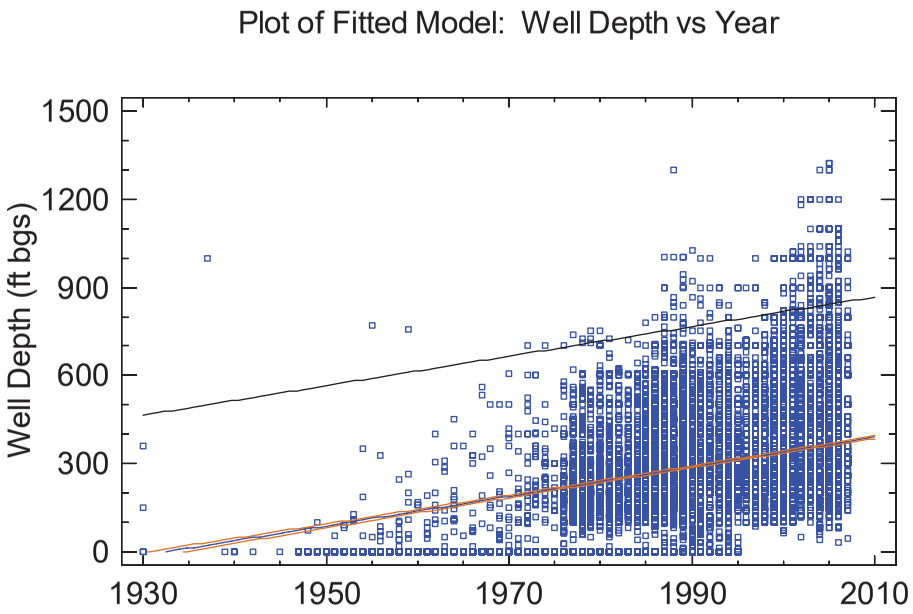
tbl_VDH_well_depth = -9721.53 + 5.0306*tbl_VDH_YEAR

Since the P-value in the ANOVA table is less than 0.05**, there is a statistically significant relationship between tbl_VDH_well_depth and tbl_VDH_YEAR at the 95.0% confidence level**.

The R-Squared statistic indicates that the model as fitted explains 16.5317% of the variability in tbl_VDH_well_depth. The correlation coefficient equals 0.406592, **indicating a relatively weak relationship between the variables**. The standard error of the estimate shows the standard deviation of the residuals to be 243.484. This value can be used to construct prediction limits for new observations by selecting the Forecasts option from the text menu.

The mean absolute error (MAE) of 164.092 is the average value of the residuals. The Durbin-Watson (DW) statistic tests the residuals to determine if there is any significant correlation based on the order in which they occur in your data file. Since the P-value is less than 0.05, there is an indication of possible serial correlation at the 95.0% confidence level. Plot the residuals versus row order to see if there is any pattern that can be seen.

NONE NOTED


Plot of Fitted Model: Well Depth vs Year
Well Depth (ft bgs)
1500
1200
900
600
300
0
1930
1950
1970
1990
2010

11) Simple Regression - tbl_VDH static_water vs. YEAR

Dependent variable: tbl_VDH_stats_data.well_static_water
Independent variable: tbl_VDH_stats_data.WE_ID_YEAR
Linear model: Y = a + b*X

Coefficients

	Least Squares	*Standard*	*T*	
Parameter	*Estimate*	*Error*	*Statistic*	*P-Value*
Intercept	-1854.2	25.5102	-72.6847	0.0000
Slope	0.94389	0.0128349	73.5409	0.0000

Analysis of Variance

Source	*Sum of Squares*	*Df*	*Mean Square*	*F-Ratio*	*P-Value*
Model	2.99842E6	1	2.99842E6	5408.26	0.0000
Residual	8.94769E6	16139	554.414		
Total (Corr.)	1.19461E7	16140			

Correlation Coefficient = 0.500994
R-squared = 25.0995 percent
R-squared (adjusted for d.f.) = 25.0949 percent
Standard Error of Est. = 23.546
Mean absolute error = 15.6154
Durbin-Watson statistic = 1.60538 (P=0.0000)
Lag 1 residual autocorrelation = 0.19725

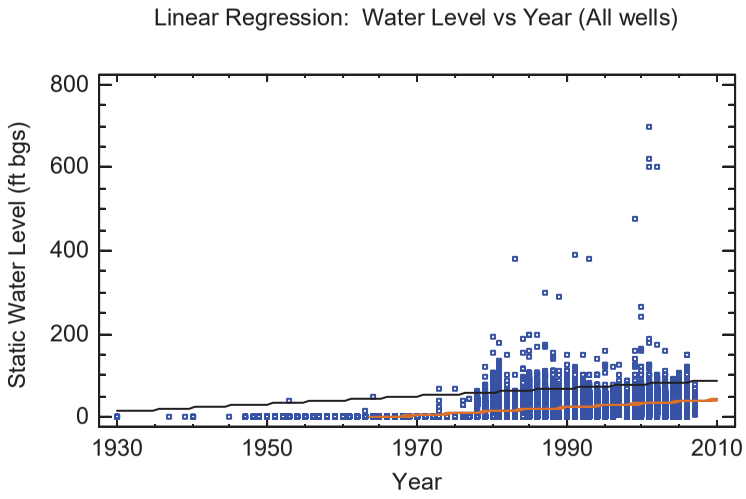
The StatAdvisor
The output shows the results of fitting a linear model to describe the relationship between tbl_VDH_stats_data.well_static_water and tbl_VDH_stats_data.WE_ID_YEAR. The equation of the fitted model is

tbl_VDH_stats_data.well_static_water = -1854.2 + 0.94389*tbl_VDH_stats_data.WE_ID_YEAR

Since the P-value in the ANOVA table is less than 0.05, **there is a statistically significant relationship between tbl_VDH_stats_data.well_static_water and tbl_VDH_stats_data.WE_ID_YEAR at the 95.0% confidence level**.

The R-Squared statistic indicates that the model as fitted **explains 25.0995% of the variability in tbl_VDH_stats_data.well_static_water.** The correlation coefficient equals 0.500994, **indicating a moderately strong relationship between the variables**. The standard error of the estimate shows the standard deviation of the residuals to be 23.546. This value can be used to construct prediction limits for new observations by selecting the Forecasts option from the text menu.

The mean absolute error (MAE) of 15.6154 is the average value of the residuals. The Durbin-Watson (DW) statistic tests the residuals to determine if there is any significant correlation based on the order in which they occur in your data file. Since the P-value is less than 0.05, there is an indication of possible serial correlation at the 95.0% confidence level. Plot the residuals versus row order to see if there is any pattern that can be seen.
NONE NOTED


Linear Regression: Water Level vs Year (All wells)
Static Water Level (ft bgs)
800
600
400
200
0
1930
1950
1970
1990
2010
Year

12) Simple Regression - tbl_VDH_airlift yield vs. YEAR

Dependent variable: tbl_VDH_stats_data.stablizied_discharge
Independent variable: tbl_VDH_stats_data.WE_ID_YEAR
Linear model: Y = a + b*X

Coefficients

	Least Squares	*Standard*	*T*	
Parameter	*Estimate*	*Error*	*Statistic*	*P-Value*
Intercept	676.57	267.345	2.5307	0.0114
Slope	-0.327672	0.133541	-2.45372	0.0141

Analysis of Variance

Source	*Sum of Squares*	*Df*	*Mean Square*	*F-Ratio*	*P-Value*
Model	7183.21	1	7183.21	6.02	0.0141
Residual	8.34439E6	6994	1193.08		
Total (Corr.)	8.35157E6	6995			

Correlation Coefficient = -0.0293275
R-squared = 0.0860103 percent
R-squared (adjusted for d.f.) = 0.0717246 percent
Standard Error of Est. = 34.541
Mean absolute error = 17.7965
Durbin-Watson statistic = 1.64874 (P=0.0000)
Lag 1 residual autocorrelation = 0.175497

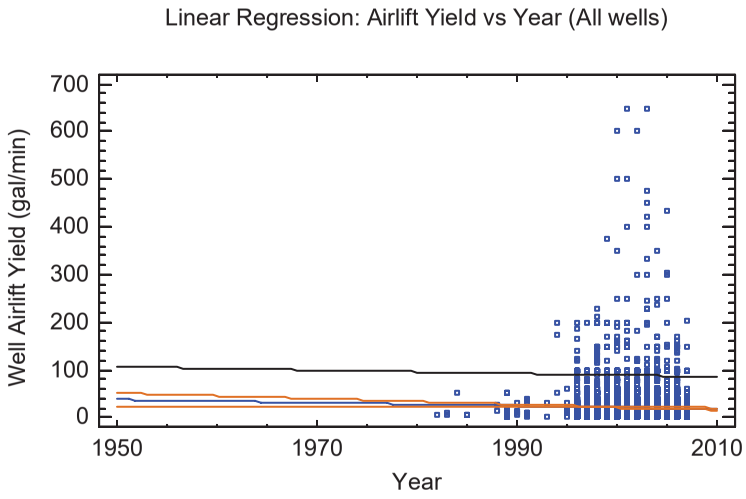
The StatAdvisor
The output shows the results of fitting a linear model to describe the relationship between tbl_VDH_stats_data.stablizied_discharge and tbl_VDH_stats_data.WE_ID_YEAR. The equation of the fitted model is

tbl_VDH_stats_data.stablizied_discharge = 676.57 - 0.327672*tbl_VDH_stats_data.WE_ID_YEAR

Since the P-value in the ANOVA table is less than 0.05, **there is a statistically significant relationship between tbl_VDH_stats_data.stablizied_discharge and tbl_VDH_stats_data.WE_ID_YEAR at the 95.0% confidence level**.

The R-Squared statistic indicates that the model as fitted explains 0.0860103% of the variability in tbl_VDH_stats_data.stablizied_discharge. The correlation coefficient equals -0.0293275, **indicating a relatively weak relationship between the variables.** The standard error of the estimate shows the standard deviation of the residuals to be 34.541. This value can be used to construct prediction limits for new observations by selecting the Forecasts option from the text menu.

The mean absolute error (MAE) of 17.7965 is the average value of the residuals. The Durbin-Watson (DW) statistic tests the residuals to determine if there is any significant correlation based on the order in which they occur in your data file. Since the P-value is less than 0.05, there is an indication of possible serial correlation at the 95.0% confidence level. Plot the residuals versus row order to see if there is any pattern that can be seen.
NONE NOTED

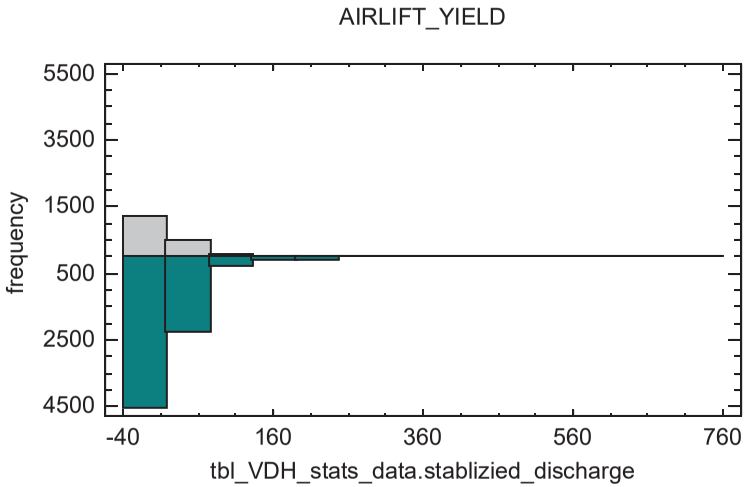

Linear Regression: Airlift Yield vs Year (All wells)
Well Airlift Yield (gal/min)
700
600
500
400
300
200
100
0
1950
1970
1990
2010
Year

13) Two-Sample Comparison - AIRLIFT_YIELD (Hydrostudies) & tbl_VDH_stablizied_discharge

Sample 1: AIRLIFT_YIELD
Sample 2: tbl_VDH_stablizied_discharge

Sample 1: 1812 values ranging from 0.0 to 650.0
Sample 2: 6997 values ranging from 0.0 to 650.0

The StatAdvisor
This procedure is designed to compare two samples of data. It will calculate various statistics and graphs for each sample, and it will run several tests to determine whether there are statistically significant differences between the two samples.

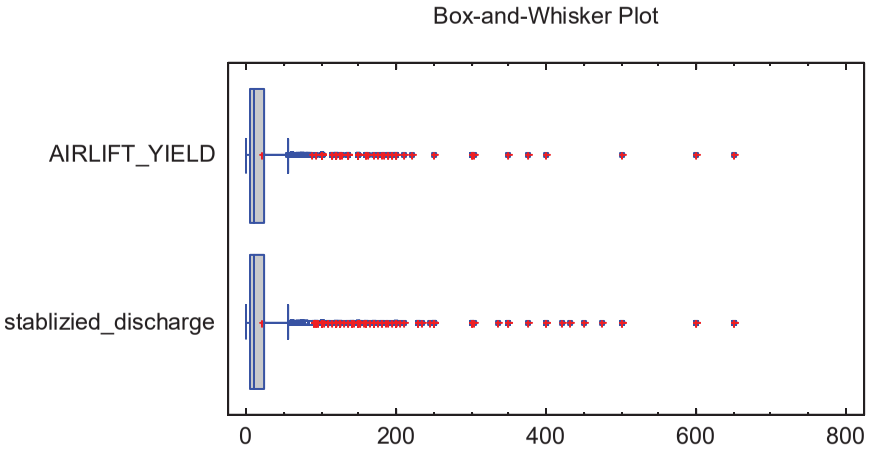


Summary Statistics

	AIRLIFT_YIELD	*tbl_VDH_stablizied_discharge*
Count	1812	6997
Average	22.4998	20.5776
Median	10.0	10.0
Geometric mean		
Standard deviation	41.3683	34.5516
Coeff. of variation	183.86%	167.909%
Minimum	0.0	0.0
Maximum	650.0	650.0
Range	650.0	650.0
Lower quartile	5.0	5.0

Upper quartile	25.0	25.0
Interquartile range	20.0	20.0
Stnd. skewness	**119.958**	**256.19**
Stnd. kurtosis	**638.571**	**1582.59**

The StatAdvisor
This table shows summary statistics for the two samples of data. Other tabular options within this analysis can be used to test whether differences between the statistics from the two samples are statistically significant. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the samples come from normal distributions. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate the tests which compare the standard deviations. In this case, both samples have standardized skewness values outside the normal range. Both samples have standardized kurtosis values outside the normal range.



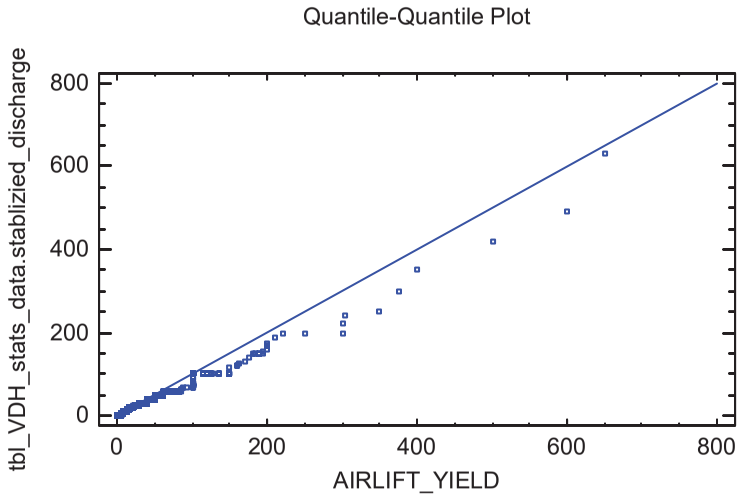
Comparison of Means
95.0% confidence interval for mean of AIRLIFT_YIELD: 22.4998 +/- 1.90475 [20.5951, 24.4046]
95.0% confidence interval for mean of tbl_VDH_stats_data.stablizied_discharge: 20.5776 +/- 0.809582 [19.768, 21.3872]
95.0% confidence interval for the difference between the means
assuming equal variances: 1.92222 +/- 1.86289 [0.0593334, 3.78511]

t test to compare means
Null hypothesis: mean1 = mean2
Alt. hypothesis: mean1 NE mean2
assuming equal variances: t = 2.02239 P-value = 0.0431355
Reject the null hypothesis for alpha = 0.05.

The StatAdvisor
This option runs a t-test to compare the means of the two samples. It also constructs confidence intervals or bounds for each mean and for the difference between the means. Of particular interest is the confidence interval for the difference between the means, which extends from 0.0593334 to 3.78511. Since the interval does not contain the value 0, there is **a statistically significant difference between the means of the two samples at the 95.0% confidence level**.

A t-test may also be used to test a specific hypothesis about the difference between the means of the populations from which the two samples come. In this case, the test has been constructed to determine whether the difference between the two means equals 0.0 versus the alternative hypothesis that the difference does not equal 0.0. Since the computed P-value is less than 0.05, we can reject the null hypothesis in favor of the alternative.

NOTE: these results assume that the variances of the two samples are equal. In this case, that assumption is questionable since the results of an F-test to compare the standard deviations suggests that there may be a significant difference between them. You can see the results of that test by selecting Comparison of Standard Deviations from the Tabular Options menu. **Samples are non-normally distributed**.



Comparison of Standard Deviations

	AIRLIFT_YIELD	*tbl_VDH_stats_data.stablizied_discharge*
Standard deviation	41.3683	34.5516
Variance	1711.34	1193.81
Df	1811	6996

Ratio of Variances = 1.43351

95.0% Confidence Intervals
Standard deviation of AIRLIFT_YIELD: [40.0639, 42.7611]
Standard deviation of tbl_VDH_stats_data.stablizied_discharge: [33.9885, 35.1338]
Ratio of Variances: [1.34453, 1.53166]

F-test to Compare Standard Deviations
Null hypothesis: sigma1 = sigma2
Alt. hypothesis: sigma1 NE sigma2
F = 1.43351 P-value = 0.0
Reject the null hypothesis for alpha = 0.05.

The StatAdvisor
This option runs an F-test to compare the variances of the two samples. It also constructs confidence intervals or bounds for each standard deviation and for the ratio of the variances. Of particular interest is the confidence interval for the ratio of the variances, which extends from 1.34453 to 1.53166. Since the interval does not contain the value 1, there is a **statistically significant difference between the standard deviations of the two samples at the 95.0% confidence level.**

An F-test may also be used to test a specific hypothesis about the standard deviations of the populations from which the two samples come. In this case, the test has been constructed to determine whether the ratio of the standard deviations equals 1.0 versus the alternative hypothesis that the ratio does not equal 1.0. Since the computed P-value is less than 0.05, we can reject the null hypothesis in favor of the alternative.

IMPORTANT NOTE: the F-tests and confidence intervals shown here depend on the samples having come from normal distributions. To test this assumption, select Summary Statistics from the list of Tabular Options and check the **standardized skewness and standardized kurtosis values**. **Samples are non-normally distributed**. Continue with comparison of medians below.
Comparison of Medians
Median of sample 1: 10.0
Median of sample 2: 10.0

Mann-Whitney (Wilcoxon) W test to compare medians
Null hypothesis: median1 = median2
Alt. hypothesis: median1 NE median2

Average rank of sample 1: 4384.78
Average rank of sample 2: 4410.24

W = 36644.5 P-value = 0.703676

Do not reject the null hypothesis for alpha = 0.05.

The StatAdvisor
This option runs a Mann-Whitney W test to compare the medians of the two samples. This test is constructed by combining the two samples, sorting the data from smallest to largest, and comparing the average ranks of the two samples in the combined data. Since the P-value is greater than or equal to 0.05, **there is not a statistically significant difference between the medians at the 95.0% confidence level.**

14) ANALYSIS OF VDH STATIC WATER LEVEL BY YEAR

ANALYSIS OF VDH STATIC WATER LEVEL BY YEAR

Summary Statistics for VDH Static Water Levels by Year

YEAR	Count	Average	Median	Geometric mean	Standard deviation	Coeff. of variation	Minimum	Maximum	Range	Lower quartile	Upper quartile	Interquartile range	Stnd. skewness	Stnd. kurtosis
1975	1	69.00	69.0	69.0		%	69	69	0	69	69	0		
1976	4	26.25	30.0	20.6	14.93	56.9%	5	40	35	17.5	35	17.5	-1.13	1.06
1977	2	46.00	46.0	46.0	1.41	3.1%	45	47	2	45	47	2		
1978	57	38.23	38.00	36.40	10.93	28.6%	10	62	52	30	45	15	-0.30	0.52
1979	68	38.70	34.50	33.97	20.69	53.5%	7	123	116	24.5	49.5	25	5.13	5.97
1980	84	45.12	38.50	37.44	31.00	68.7%	10	195	185	22.5	53.5	31	8.22	13.03
1981	97	49.06	40.00	37.92	34.66	70.7%	5	180	175	21	66	45	4.78	2.67
1982	76	32.61	29.00	24.83	23.50	72.1%	1	150	149	20	40	20	7.81	14.40
1983	54	37.14	26.00	24.92	51.56	138.8%	1	383	382	17.5	45	27.5	17.73	59.54
1984	100	45.56	40.0	37.8	29.71	65.2%	2.5	190	187.5	29	56.5	27.5	8.53	13.36
1985	155	51.76	48.0	42.1	32.95	63.7%	5	200	195	30	67	37	8.17	11.52
1986	205	38.95	30.00	31.60	27.29	70.1%	4	196	192	20	50	30	12.28	20.81
1987	307	35.02	25.00	29.00	27.34	78.1%	3	299	296	19	45	26	30.38	112.56
1988	403	39.27	31.00	33.64	22.62	57.6%	3	156	153	21	50	29	11.90	14.23
1989	490	38.85	36.00	31.48	23.00	59.2%	1	289	288	22	60	38	24.67	123.39
1990	291	42.28	40.00	34.57	22.88	54.1%	1	150	149	25	60	35	4.94	5.13
1991	207	51.09	50.00	44.13	31.50	61.7%	1	390	389	33	62	29	36.14	190.13
1992	192	41.58	43.00	32.68	22.76	54.7%	1	150	149	23	56.5	33.5	3.28	5.03
1993	203	38.63	33.00	31.74	30.62	79.3%	1	380	379	21	50	29	40.77	221.54
1994	225	38.82	37.00	33.50	19.69	50.7%	2	140	138	25	50	25	7.02	9.91
1995	197	37.81	35.00	32.11	21.70	57.4%	4	159	155	22	50	28	10.65	20.40
1996	178	38.01	40.00	33.34	16.46	43.3%	3	122	119	30	50	20	2.39	7.49
1997	295	36.47	30.00	32.66	16.65	45.7%	5	125	120	25	50	25	6.66	8.59
1998	366	33.63	30.00	29.44	15.93	47.4%	1.5	90	88.5	20	50	30	4.10	-0.05
1999	516	36.14	30.00	30.52	27.21	75.3%	2	475	473	20	50	30	80.46	612.42
2000	685	34.59	30.00	29.73	21.88	63.2%	0.3	264	263.7	20	45	25	42.61	168.96
2001	677	39.49	30.00	31.32	45.60	115.5%	1	700	699	20	50	30	111.18	724.61
2002	569	37.15	30.00	31.51	30.17	81.2%	0.2	600	599.8	20	50	30	114.48	1041.18
2003	415	32.37	30.00	27.14	19.00	58.7%	1	158	157	20	45	25	13.81	23.87
2004	575	33.41	30.00	27.92	18.56	55.5%	1.2	95	93.8	17	50	33	5.63	-2.64
2005	725	34.84	30.00	29.14	19.98	57.3%	2	109	107	20	50	30	8.37	-0.38

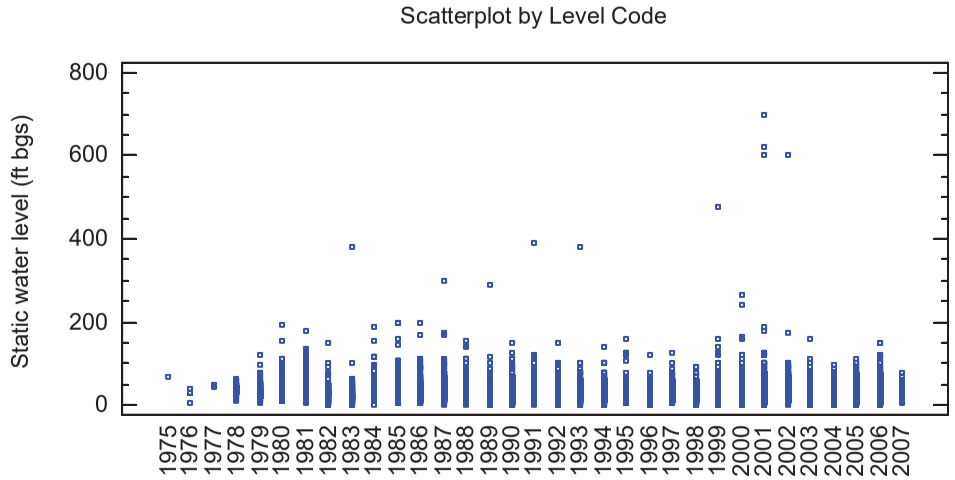
2006	795	37.74	32.00	32.42	20.09	53.2%	1	150	149	20	50	30	13.62	17.04
2007	96	44.67	50.00	40.20	17.15	38.4%	5	80	75	30	60	30	-1.82	-1.77

Indicates non-normal distribution

The StatAdvisor
The table above shows various statistics for each of the 33 columns of data. To test for significant differences amongst the column means, select Analysis of Variance from the list of Tabular Options. Select Means Plot from the list of Graphical Options to display the means graphically.

WARNING: There is more than a 3 to 1 difference between the smallest standard deviation and the largest. This may cause problems since the analysis of variance assumes that the standard deviations at all levels are equal. Select Variance Check from the list of Tabular Options to run a formal statistical test for differences among the sigmas. You may want to consider transforming the data to remove any dependence of the standard deviation on the mean.

WARNING: The standardized skewness and/or kurtosis is outside the range of -2 to +2 for 28 columns. This indicates some significant nonnormality in the data, which violates the assumption that the data come from normal distributions. You may wish to transform the data or use the Kruskal-Wallis test to compare the medians instead of the means.



ANOVA Table for tbl_VDH_stats_data.well_static_water by tbl_VDH_stats_data.WE_ID_YEAR

Source	*Sum of Squares*	*Df*	*Mean Square*	*F-Ratio*	*P-Value*
Between groups	158095.	32	4940.47	7.42	0.0000
Within groups	6.17453E6	9277	665.575		
Total (Corr.)	6.33263E6	9309			

The StatAdvisor

The ANOVA table decomposes the variance of the data into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 7.42286, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than 0.05, there is a statistically significant difference between the means of the 33 variables at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

Multiple Range Tests for tbl_VDH_stats_data.well_static_water by tbl_VDH_stats_data.WE_ID_YEAR

Method: 95.0 percent LSD

Level	*Count*	*Mean*	*Homogeneous Groups*
1976	4	26.25	XXXXXXXXXXXXX
2003	415	32.3687	X
1982	76	32.6118	XXXXX
2004	575	33.409	XX
1998	366	33.627	XX X
2000	685	34.5902	XXX X
2005	725	34.8428	XXX X
1987	307	35.0195	XXXXX
1999	516	36.1418	XXXXX
1997	295	36.4678	XXXXXX
1983	54	37.1389	XXXXXXXXXXX
2002	569	37.1511	XX XX
2006	795	37.7434	X XXX
1995	197	37.8122	XXXXXXX
1996	178	38.0112	XXXXXXX
1978	57	38.2281	XXXXXXXXXXX
1993	203	38.6305	XX XXXXX
1979	68	38.6985	XXXXXXXXXXX
1994	225	38.8178	X XXXXX
1989	490	38.8469	XXXX
1986	205	38.9488	X XXXXX
1988	403	39.273	XXXXX
2001	677	39.4919	XXXX
1992	192	41.5833	XXXX
1990	291	42.2766	XXX
2007	96	44.6667	XXX
1980	84	45.119	XXXX
1984	100	45.56	XXX
1977	2	46.0	XXXXXXXXXXXXX
1981	97	49.0619	XX
1991	207	51.087	X
1985	155	51.7613	X
1975	1	69.0	XXXXXXXXXXXXX

Contrast	*Sig.*	*Difference*	*+/- Limits*

1975 - 1976		42.75	56.533
1975 - 1977		23.0	61.9288
1975 - 1978		30.7719	51.0063
1975 - 1979		30.3015	50.9351
1975 - 1980		23.881	50.8648
1975 - 1981		19.9381	50.8247
1975 - 1982		36.3882	50.8963
1975 - 1983		31.8611	51.0307
1975 - 1984		23.44	50.8169
1975 - 1985		17.2387	50.7275
1975 - 1986		30.0512	50.6879
1975 - 1987		33.9805	50.647
1975 - 1988		29.727	50.6274
1975 - 1989		30.1531	50.6163
1975 - 1990		26.7234	50.6515
1975 - 1991		17.913	50.6867
1975 - 1992		27.4167	50.6962
1975 - 1993		30.3695	50.6891
1975 - 1994		30.1822	50.6769
1975 - 1995		31.1878	50.6929
1975 - 1996		30.9888	50.7065
1975 - 1997		32.5322	50.6503
1975 - 1998		35.373	50.6337
1975 - 1999		32.8582	50.6137
1975 - 2000		34.4098	50.6016
1975 - 2001		29.5081	50.602
1975 - 2002		31.8489	50.6091
1975 - 2003		36.6313	50.6256
1975 - 2004		35.591	50.6086
1975 - 2005		34.1572	50.5995
1975 - 2006		31.2566	50.5965
1975 - 2007		24.3333	50.8274
1976 - 1977		-19.75	43.7903
1976 - 1978		-11.9781	26.1544
1976 - 1979		-12.4485	26.0153
1976 - 1980		-18.869	25.8773
1976 - 1981		-22.8119	25.7984
1976 - 1982		-6.36184	25.9391
1976 - 1983		-10.8889	26.202
1976 - 1984		-19.31	25.783
1976 - 1985		-25.5113	25.6065
1976 - 1986		-12.6988	25.5278
1976 - 1987		-8.76954	25.4465

1976 - 1988		-13.023	25.4075
1976 - 1989		-12.5969	25.3853
1976 - 1990		-16.0266	25.4555
1976 - 1991		-24.837	25.5254
1976 - 1992		-15.3333	25.5443
1976 - 1993		-12.3805	25.5302
1976 - 1994		-12.5678	25.5061
1976 - 1995		-11.5622	25.5377
1976 - 1996		-11.7612	25.5648
1976 - 1997		-10.2178	25.4532
1976 - 1998		-7.37705	25.4201
1976 - 1999		-9.89182	25.3801
1976 - 2000		-8.34022	25.3561
1976 - 2001		-13.2419	25.3569
1976 - 2002		-10.9011	25.3711
1976 - 2003		-6.11867	25.4039
1976 - 2004		-7.15904	25.3701
1976 - 2005		-8.59276	25.352
1976 - 2006		-11.4934	25.3459
1976 - 2007		-18.4167	25.8037
1977 - 1978		7.77193	36.3765
1977 - 1979		7.30147	36.2766
1977 - 1980		0.880952	36.1778
1977 - 1981		-3.06186	36.1214
1977 - 1982		13.3882	36.222
1977 - 1983		8.86111	36.4107
1977 - 1984		0.44	36.1104
1977 - 1985		-5.76129	35.9846
1977 - 1986		7.05122	35.9286
1977 - 1987		10.9805	35.8709
1977 - 1988		6.72705	35.8432
1977 - 1989		7.15306	35.8275
1977 - 1990		3.72337	35.8773
1977 - 1991		-5.08696	35.9269
1977 - 1992		4.41667	35.9404
1977 - 1993		7.36946	35.9303
1977 - 1994		7.18222	35.9132
1977 - 1995		8.18782	35.9357
1977 - 1996		7.98876	35.9549
1977 - 1997		9.5322	35.8756
1977 - 1998		12.373	35.8522
1977 - 1999		9.85818	35.8239
1977 - 2000		11.4098	35.8068

1977 - 2001		6.50812	35.8074
1977 - 2002		8.84886	35.8174
1977 - 2003		13.6313	35.8407
1977 - 2004		12.591	35.8168
1977 - 2005		11.1572	35.8039
1977 - 2006		8.2566	35.7996
1977 - 2007		1.33333	36.1252
1978 - 1979		-0.470459	9.08051
1978 - 1980		-6.89098	8.6772
1978 - 1981	*	-10.8338	8.43887
1978 - 1982		5.61623	8.8599
1978 - 1983		1.08918	9.60228
1978 - 1984		-7.33193	8.39189
1978 - 1985	*	-13.5332	7.83271
1978 - 1986		-0.72071	7.57153
1978 - 1987		3.20853	7.29275
1978 - 1988		-1.04488	7.15544
1978 - 1989		-0.618869	7.07629
1978 - 1990		-4.04856	7.32408
1978 - 1991	*	-12.8589	7.56357
1978 - 1992		-3.35526	7.62709
1978 - 1993		-0.402472	7.57964
1978 - 1994		-0.589708	7.49796
1978 - 1995		0.415887	7.6049
1978 - 1996		0.216834	7.69545
1978 - 1997		1.76027	7.31594
1978 - 1998		4.60102	7.20012
1978 - 1999		2.08625	7.05769
1978 - 2000		3.63785	6.97054
1978 - 2001		-1.26381	6.9737
1978 - 2002		1.07693	7.02491
1978 - 2003		5.8594	7.14261
1978 - 2004		4.81903	7.02157
1978 - 2005		3.38531	6.95575
1978 - 2006		0.484674	6.9334
1978 - 2007		-6.4386	8.45512
1979 - 1980		-6.42052	8.2485
1979 - 1981	*	-10.3633	7.9974
1979 - 1982		6.08669	8.44048
1979 - 1983		1.55964	9.21671
1979 - 1984		-6.86147	7.94781
1979 - 1985	*	-13.0628	7.35494
1979 - 1986		-0.250251	7.07615

1979 - 1987		3.67899	6.77703
1979 - 1988		-0.574423	6.62904
1979 - 1989		-0.148409	6.54353
1979 - 1990		-3.5781	6.81073
1979 - 1991	*	-12.3884	7.06763
1979 - 1992		-2.8848	7.13557
1979 - 1993		0.0679875	7.08483
1979 - 1994		-0.119248	6.99738
1979 - 1995		0.886347	7.11185
1979 - 1996		0.687293	7.20859
1979 - 1997		2.23073	6.80198
1979 - 1998		5.07148	6.67724
1979 - 1999		2.55671	6.52341
1979 - 2000		4.10831	6.42902
1979 - 2001		-0.793347	6.43245
1979 - 2002		1.54739	6.48793
1979 - 2003		6.32985	6.61519
1979 - 2004		5.28949	6.48432
1979 - 2005		3.85577	6.41299
1979 - 2006		0.955133	6.38873
1979 - 2007		-5.96814	8.01455
1980 - 1981		-3.94281	7.53635
1980 - 1982	*	12.5072	8.00499
1980 - 1983		7.98016	8.81963
1980 - 1984		-0.440952	7.4837
1980 - 1985		-6.64224	6.85079
1980 - 1986		6.17027	6.55058
1980 - 1987	*	10.0995	6.22625
1980 - 1988		5.84609	6.06484
1980 - 1989	*	6.27211	5.97125
1980 - 1990		2.84242	6.26292
1980 - 1991		-5.96791	6.54137
1980 - 1992		3.53571	6.61472
1980 - 1993		6.48851	6.55995
1980 - 1994		6.30127	6.4654
1980 - 1995	*	7.30686	6.58912
1980 - 1996	*	7.10781	6.69342
1980 - 1997	*	8.65125	6.2534
1980 - 1998	*	11.492	6.11749
1980 - 1999	*	8.97723	5.9492
1980 - 2000	*	10.5288	5.84555
1980 - 2001		5.62717	5.84932
1980 - 2002	*	7.96791	5.91028

1980 - 2003	*	12.7504	6.0497
1980 - 2004	*	11.71	5.90631
1980 - 2005	*	10.2763	5.82791
1980 - 2006	*	7.37565	5.80121
1980 - 2007		0.452381	7.55454
1981 - 1982	*	16.45	7.746
1981 - 1983	*	11.923	8.58525
1981 - 1984		3.50186	7.206
1981 - 1985		-2.69943	6.5463
1981 - 1986	*	10.1131	6.23143
1981 - 1987	*	14.0423	5.88956
1981 - 1988	*	9.7889	5.71865
1981 - 1989	*	10.2149	5.6193
1981 - 1990	*	6.78522	5.92831
1981 - 1991		-2.0251	6.22176
1981 - 1992	*	7.47852	6.29883
1981 - 1993	*	10.4313	6.24128
1981 - 1994	*	10.2441	6.14183
1981 - 1995	*	11.2497	6.27194
1981 - 1996	*	11.0506	6.38143
1981 - 1997	*	12.5941	5.91825
1981 - 1998	*	15.4348	5.77446
1981 - 1999	*	12.92	5.59586
1981 - 2000	*	14.4716	5.48554
1981 - 2001	*	9.56998	5.48956
1981 - 2002	*	11.9107	5.55447
1981 - 2003	*	16.6932	5.70259
1981 - 2004	*	15.6528	5.55024
1981 - 2005	*	14.2191	5.46674
1981 - 2006	*	11.3185	5.43826
1981 - 2007		4.39519	7.27955
1982 - 1983		-4.52705	8.99944
1982 - 1984	*	-12.9482	7.69479
1982 - 1985	*	-19.1494	7.08077
1982 - 1986		-6.33694	6.79073
1982 - 1987		-2.4077	6.47844
1982 - 1988	*	-6.66111	6.32347
1982 - 1989	*	-6.2351	6.23377
1982 - 1990	*	-9.66479	6.51369
1982 - 1991	*	-18.4751	6.78186
1982 - 1992	*	-8.97149	6.85263
1982 - 1993		-6.0187	6.79978
1982 - 1994		-6.20594	6.70861

1982 - 1995		-5.20034	6.82792
1982 - 1996		-5.39939	6.92863
1982 - 1997		-3.85595	6.50454
1982 - 1998		-1.01521	6.37399
1982 - 1999		-3.52998	6.21264
1982 - 2000		-1.97838	6.11347
1982 - 2001	*	-6.88003	6.11707
1982 - 2002		-4.5393	6.17539
1982 - 2003		0.243167	6.30895
1982 - 2004		-0.797201	6.17159
1982 - 2005		-2.23092	6.0966
1982 - 2006		-5.13155	6.07108
1982 - 2007	*	-12.0548	7.76371
1983 - 1984		-8.42111	8.53907
1983 - 1985	*	-14.6224	7.9902
1983 - 1986		-1.80989	7.73434
1983 - 1987		2.11934	7.46165
1983 - 1988		-2.13406	7.3275
1983 - 1989		-1.70805	7.25023
1983 - 1990		-5.13774	7.49227
1983 - 1991	*	-13.9481	7.72655
1983 - 1992		-4.44444	7.78874
1983 - 1993		-1.49165	7.74228
1983 - 1994		-1.67889	7.66234
1983 - 1995		-0.673294	7.76701
1983 - 1996		-0.872347	7.85569
1983 - 1997		0.671092	7.48432
1983 - 1998		3.51184	7.37114
1983 - 1999		0.997067	7.23208
1983 - 2000		2.54867	7.14706
1983 - 2001		-2.35299	7.15014
1983 - 2002		-0.0122535	7.2001
1983 - 2003		4.77021	7.31497
1983 - 2004		3.72985	7.19684
1983 - 2005		2.29613	7.13264
1983 - 2006		-0.604507	7.11084
1983 - 2007		-7.52778	8.60123
1984 - 1985		-6.20129	6.48562
1984 - 1986	*	6.61122	6.16766
1984 - 1987	*	10.5405	5.82204
1984 - 1988	*	6.28705	5.64909
1984 - 1989	*	6.71306	5.5485
1984 - 1990		3.28337	5.86124

1984 - 1991		-5.52696	6.15788
1984 - 1992		3.97667	6.23574
1984 - 1993	*	6.92946	6.17761
1984 - 1994	*	6.74222	6.07712
1984 - 1995	*	7.74782	6.20858
1984 - 1996	*	7.54876	6.31916
1984 - 1997	*	9.0922	5.85106
1984 - 1998	*	11.933	5.70558
1984 - 1999	*	9.41818	5.52475
1984 - 2000	*	10.9698	5.41298
1984 - 2001	*	6.06812	5.41706
1984 - 2002	*	8.40886	5.48282
1984 - 2003	*	13.1913	5.63283
1984 - 2004	*	12.151	5.47855
1984 - 2005	*	10.7172	5.39393
1984 - 2006	*	7.8166	5.36507
1984 - 2007		0.893333	7.22503
1985 - 1986	*	12.8125	5.38215
1985 - 1987	*	16.7417	4.98234
1985 - 1988	*	12.4883	4.7791
1985 - 1989	*	12.9144	4.65976
1985 - 1990	*	9.48466	5.02808
1985 - 1991		0.674334	5.37094
1985 - 1992	*	10.178	5.46004
1985 - 1993	*	13.1307	5.39355
1985 - 1994	*	12.9435	5.27815
1985 - 1995	*	13.9491	5.429
1985 - 1996	*	13.7501	5.55512
1985 - 1997	*	15.2935	5.01622
1985 - 1998	*	18.1342	4.84574
1985 - 1999	*	15.6195	4.63146
1985 - 2000	*	17.1711	4.49755
1985 - 2001	*	12.2694	4.50245
1985 - 2002	*	14.6101	4.58136
1985 - 2003	*	19.3926	4.75987
1985 - 2004	*	18.3522	4.57624
1985 - 2005	*	16.9185	4.4746
1985 - 2006	*	14.0179	4.43976
1985 - 2007	*	7.09462	6.56724
1986 - 1987		3.92924	4.56075
1986 - 1988		-0.324172	4.3378
1986 - 1989		0.101842	4.20596
1986 - 1990		-3.32785	4.61068

1986 - 1991	*	-12.1382	4.98234
1986 - 1992		-2.63455	5.07826
1986 - 1993		0.318239	5.00671
1986 - 1994		0.131003	4.88217
1986 - 1995		1.1366	5.04487
1986 - 1996		0.937545	5.18036
1986 - 1997		2.48098	4.59774
1986 - 1998	*	5.32173	4.41111
1986 - 1999		2.80696	4.17458
1986 - 2000	*	4.35856	4.0255
1986 - 2001		-0.543095	4.03098
1986 - 2002		1.79764	4.11893
1986 - 2003	*	6.58011	4.3166
1986 - 2004	*	5.53974	4.11324
1986 - 2005	*	4.10602	3.99984
1986 - 2006		1.20538	3.96084
1986 - 2007		-5.71789	6.25343
1987 - 1988	*	-4.25341	3.83049
1987 - 1989	*	-3.82739	3.68052
1987 - 1990	*	-7.25709	4.13697
1987 - 1991	*	-16.0674	4.54752
1987 - 1992	*	-6.56379	4.65241
1987 - 1993		-3.611	4.5742
1987 - 1994		-3.79823	4.43754
1987 - 1995		-2.79264	4.61594
1987 - 1996		-2.99169	4.76364
1987 - 1997		-1.44825	4.12254
1987 - 1998		1.39249	3.91332
1987 - 1999		-1.12228	3.64463
1987 - 2000		0.429325	3.47287
1987 - 2001	*	-4.47233	3.47922
1987 - 2002		-2.1316	3.58075
1987 - 2003		2.65087	3.80647
1987 - 2004		1.6105	3.5742
1987 - 2005		0.176785	3.44309
1987 - 2006		-2.72385	3.3977
1987 - 2007	*	-9.64712	5.91282
1988 - 1989		0.426014	3.40034
1988 - 1990		-3.00368	3.88981
1988 - 1991	*	-11.814	4.32389
1988 - 1992		-2.31038	4.43407
1988 - 1993		0.642411	4.35194
1988 - 1994		0.455175	4.20807

1988 - 1995		1.46077	4.39579
1988 - 1996		1.26172	4.55064
1988 - 1997		2.80516	3.87446
1988 - 1998	*	5.6459	3.65105
1988 - 1999		3.13113	3.36146
1988 - 2000	*	4.68273	3.17442
1988 - 2001		-0.218923	3.18136
1988 - 2002		2.12181	3.29209
1988 - 2003	*	6.90428	3.53629
1988 - 2004	*	5.86391	3.28496
1988 - 2005	*	4.43019	3.14181
1988 - 2006		1.52956	3.092
1988 - 2007		-5.39371	5.74261
1989 - 1990		-3.42969	3.74221
1989 - 1991	*	-12.24	4.19161
1989 - 1992		-2.73639	4.30517
1989 - 1993		0.216397	4.22054
1989 - 1994		0.029161	4.07203
1989 - 1995		1.03476	4.26574
1989 - 1996		0.835703	4.42514
1989 - 1997		2.37914	3.72626
1989 - 1998	*	5.21989	3.49338
1989 - 1999		2.70512	3.18951
1989 - 2000	*	4.25672	2.99173
1989 - 2001		-0.644937	2.9991
1989 - 2002		1.6958	3.11631
1989 - 2003	*	6.47826	3.37326
1989 - 2004	*	5.4379	3.10878
1989 - 2005	*	4.00418	2.95712
1989 - 2006		1.10354	2.90414
1989 - 2007	*	-5.81973	5.64368
1990 - 1991	*	-8.81032	4.59759
1990 - 1992		0.693299	4.70136
1990 - 1993		3.64609	4.62398
1990 - 1994		3.45885	4.48884
1990 - 1995		4.46445	4.66528
1990 - 1996		4.2654	4.81146
1990 - 1997	*	5.80884	4.17771
1990 - 1998	*	8.64958	3.97139
1990 - 1999	*	6.13481	3.70692
1990 - 2000	*	7.68641	3.53818
1990 - 2001		2.78476	3.54441
1990 - 2002	*	5.12549	3.64413

1990 - 2003	*	9.90796	3.86615
1990 - 2004	*	8.86759	3.63769
1990 - 2005	*	7.43387	3.50896
1990 - 2006	*	4.53324	3.46443
1990 - 2007		-2.39003	5.95142
1991 - 1992	*	9.50362	5.06638
1991 - 1993	*	12.4564	4.99466
1991 - 1994	*	12.2692	4.86982
1991 - 1995	*	13.2748	5.03292
1991 - 1996	*	13.0757	5.16871
1991 - 1997	*	14.6192	4.58462
1991 - 1998	*	17.4599	4.39743
1991 - 1999	*	14.9451	4.16013
1991 - 2000	*	16.4967	4.01051
1991 - 2001	*	11.5951	4.016
1991 - 2002	*	13.9358	4.10428
1991 - 2003	*	18.7183	4.30262
1991 - 2004	*	17.6779	4.09856
1991 - 2005	*	16.2442	3.98475
1991 - 2006	*	13.3436	3.94559
1991 - 2007	*	6.42029	6.24378
1992 - 1993		2.95279	5.09034
1992 - 1994		2.76556	4.96791
1992 - 1995		3.77115	5.12789
1992 - 1996		3.5721	5.26123
1992 - 1997	*	5.11554	4.68868
1992 - 1998	*	7.95628	4.50581
1992 - 1999	*	5.44151	4.27453
1992 - 2000	*	6.99311	4.12906
1992 - 2001		2.09146	4.1344
1992 - 2002	*	4.43219	4.2202
1992 - 2003	*	9.21466	4.41334
1992 - 2004	*	8.17429	4.21464
1992 - 2005	*	6.74057	4.10405
1992 - 2006		3.83994	4.06604
1992 - 2007		-3.08333	6.32059
1993 - 1994		-0.187236	4.89474
1993 - 1995		0.818359	5.05704
1993 - 1996		0.619306	5.1922
1993 - 1997		2.16275	4.61108
1993 - 1998	*	5.00349	4.42502
1993 - 1999		2.48872	4.18927
1993 - 2000		4.04032	4.04074

1993 - 2001		-0.861334	4.04619
1993 - 2002		1.4794	4.13382
1993 - 2003	*	6.26187	4.33081
1993 - 2004	*	5.2215	4.12815
1993 - 2005		3.78778	4.01517
1993 - 2006		0.887146	3.97632
1993 - 2007		-6.03612	6.26324
1994 - 1995		1.0056	4.93377
1994 - 1996		0.806542	5.07223
1994 - 1997		2.34998	4.47555
1994 - 1998	*	5.19073	4.2836
1994 - 1999		2.67596	4.03962
1994 - 2000	*	4.22756	3.88536
1994 - 2001		-0.674098	3.89103
1994 - 2002		1.66664	3.98208
1994 - 2003	*	6.4491	4.18622
1994 - 2004	*	5.40873	3.97619
1994 - 2005	*	3.97502	3.85877
1994 - 2006		1.07438	3.81832
1994 - 2007		-5.84889	6.16415
1995 - 1996		-0.199053	5.22901
1995 - 1997		1.34439	4.65249
1995 - 1998		4.18513	4.46815
1995 - 1999		1.67036	4.23481
1995 - 2000		3.22196	4.08793
1995 - 2001		-1.67969	4.09332
1995 - 2002		0.66104	4.17996
1995 - 2003	*	5.44351	4.37488
1995 - 2004	*	4.40314	4.17435
1995 - 2005		2.96942	4.06266
1995 - 2006		0.0687865	4.02426
1995 - 2007	*	-6.85448	6.29379
1996 - 1997		1.54344	4.79907
1996 - 1998		4.38419	4.62058
1996 - 1999		1.86941	4.39534
1996 - 2000		3.42102	4.254
1996 - 2001		-1.48064	4.25918
1996 - 2002		0.860094	4.34252
1996 - 2003	*	5.64256	4.53044
1996 - 2004	*	4.60219	4.33711
1996 - 2005		3.16848	4.22973
1996 - 2006		0.26784	4.19286
1996 - 2007	*	-6.65543	6.4029

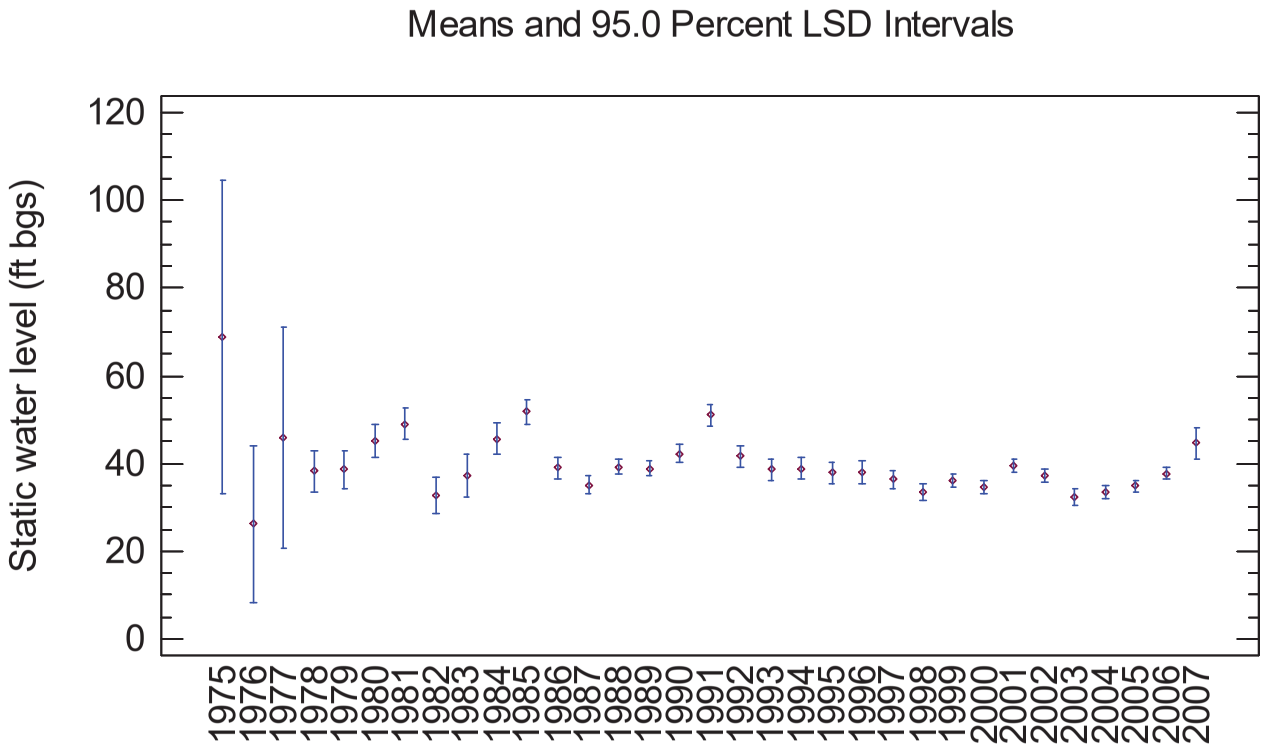
1997 - 1998		2.84075	3.95637
1997 - 1999		0.325975	3.69081
1997 - 2000		1.87758	3.52131
1997 - 2001		-3.02408	3.52757
1997 - 2002		-0.683346	3.62775
1997 - 2003	*	4.09912	3.85072
1997 - 2004		3.05875	3.62128
1997 - 2005		1.62504	3.49194
1997 - 2006		-1.2756	3.4472
1997 - 2007	*	-8.19887	5.9414
1998 - 1999		-2.51477	3.45554
1998 - 2000		-0.96317	3.27388
1998 - 2001	*	-5.86483	3.28061
1998 - 2002	*	-3.52409	3.3881
1998 - 2003		1.25837	3.62584
1998 - 2004		0.218006	3.38117
1998 - 2005		-1.21571	3.24228
1998 - 2006	*	-4.11635	3.19403
1998 - 2007	*	-11.0396	5.79819
1999 - 2000		1.5516	2.94746
1999 - 2001	*	-3.35005	2.95494
1999 - 2002		-1.00932	3.07384
1999 - 2003	*	3.77315	3.33406
1999 - 2004		2.73278	3.0662
1999 - 2005		1.29906	2.91232
1999 - 2006		-1.60157	2.85851
1999 - 2007	*	-8.52484	5.62034
2000 - 2001	*	-4.90166	2.74029
2000 - 2002		-2.56092	2.8681
2000 - 2003		2.22154	3.14539
2000 - 2004		1.18118	2.85992
2000 - 2005		-0.25254	2.69428
2000 - 2006	*	-3.15318	2.63602
2000 - 2007	*	-10.0764	5.51051
2001 - 2002		2.34073	2.87578
2001 - 2003	*	7.1232	3.15239
2001 - 2004	*	6.08283	2.86762
2001 - 2005	*	4.64912	2.70245
2001 - 2006		1.74848	2.64438
2001 - 2007		-5.17479	5.51451
2002 - 2003	*	4.78247	3.26411
2002 - 2004	*	3.7421	2.98999
2002 - 2005		2.30838	2.83197

2002 - 2006		-0.592254	2.77661
2002 - 2007	*	-7.51552	5.57913
2003 - 2004		-1.04037	3.25692
2003 - 2005		-2.47408	3.11248
2003 - 2006	*	-5.37472	3.06219
2003 - 2007	*	-12.298	5.72662
2004 - 2005		-1.43372	2.82368
2004 - 2006	*	-4.33435	2.76815
2004 - 2007	*	-11.2576	5.57492
2005 - 2006	*	-2.90064	2.59667
2005 - 2007	*	-9.82391	5.49179
2006 - 2007	*	-6.92327	5.46345

* denotes a statistically significant difference.

The StatAdvisor

This table applies a multiple comparison procedure to determine which means are significantly different from which others. The bottom half of the output shows the estimated difference between each pair of means. An asterisk has been placed next to 191 pairs, indicating that these pairs show statistically significant differences at the 95.0% confidence level. At the top of the page, 13 homogenous groups are identified using columns of X's. Within each column, the levels containing X's form a group of means within which there are no statistically significant differences. The method currently being used to discriminate among the means is Fisher's least significant difference (LSD) procedure. With this method, there is a 5.0% risk of calling each pair of means significantly different when the actual difference equals 0.



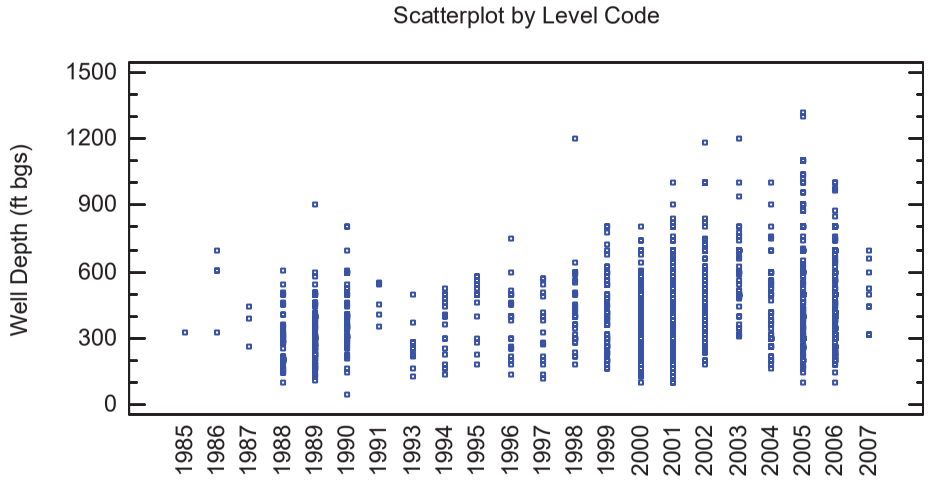
The dataset for the graph above was truncated due to insufficient data during years prior to 1975.

15) Multiple-Sample Comparison (Hydros Well Depth by YEAR_COMPLETED>1985)

Dependent variable: tbl_HYdros_consylds_geol.WELL_DEPTH
Factor: YEAR_COMPLETED
Selection variable: YEAR_COMPLETED>1985

Number of observations: 1816
Number of levels: 22

The StatAdvisor
This procedure compares the data in 22 columns of the current data file. It constructs various statistical tests and graphs to compare the samples. The F-test in the ANOVA table will test whether there are any significant differences amongst the means. If there are, the Multiple Range Tests will tell you which means are significantly different from which others. If you are worried about the presence of outliers, choose the Kruskal-Wallis Test which compares medians instead of means. The various plots will help you judge the practical significance of the results, as well as allow you to look for possible violations of the assumptions underlying the analysis of variance.



Summary Statistics Hydrostudies Well Depth by Year

YEAR	Count	Average	Median	Geometric mean	Standard deviation	Coeff. of variation	Minimum	Maximum	Range	Lower quartile	Upper quartile	Interquartile range	Stnd. skewness	Stnd. kurtosis
1985	1	330.00	330.0	330.0		%	330	330	0	330	330	0		
1986	4	558.75	605.0	537.2	162.14	29.0%	325	700	375	465	652.5	187.5	-1.24581	1.16861
1987	3	365.00	385.0	356.7	91.65	25.1%	265	445	180	265	445	180	-0.6613	
1988	58	281.60	285.00	261.15	113.60	40.3%	102	605	503	200	330	130	2.85886	0.438964
1989	109	316.22	300.00	294.54	122.47	38.7%	110	900	790	230	400	170	5.21719	7.67813
1990	64	392.66	360.00	364.22	144.45	36.8%	50	805	755	305	480	175	2.3512	1.62554
1991	5	459.00	450.00	452.38	86.20	18.8%	350	550	200	405	540	135	-0.0999003	-0.951049
1993	13	267.46	250.00	253.61	92.71	34.7%	125	500	375	225	280	55	1.72756	2.07126
1994	19	352.63	400.00	325.00	131.83	37.4%	140	520	380	225	480	255	-0.590737	-1.2611
1995	16	451.25	500.0	428.2	130.61	28.9%	185	580	395	350	540	190	-1.69312	-0.273183
1996	25	392.32	400.0	364.1	145.34	37.0%	140	750	610	260	500	240	0.485358	0.0407322
1997	16	350.63	352.50	314.26	155.48	44.3%	120	570	450	210	495	285	0.0637809	-1.14854
1998	38	418.82	400.00	390.48	178.38	42.6%	180	1200	1020	300	500	200	5.86061	11.2853
1999	88	397.50	380.00	365.80	163.90	41.2%	160	800	640	260	500	240	2.73375	-0.343667
2000	302	369.09	350.00	345.69	132.87	36.0%	100	800	700	266	440	174	4.51824	-0.0527422
2001	283	420.47	400.00	389.30	160.32	38.1%	100	1000	900	300	520	220	3.6125	0.00231144
2002	130	479.04	430.00	441.64	196.40	41.0%	180	1180	1000	300	600	300	4.0905	1.92606
2003	57	596.58	600.00	573.02	172.19	28.9%	310	1200	890	490	700	210	2.52916	2.65463
2004	63	432.54	380.00	396.09	185.47	42.9%	160	1000	840	300	550	250	2.77287	0.705955
2005	213	491.29	430.00	436.02	247.70	50.4%	100	1320	1220	300	600	300	6.16369	1.65399
2006	299	429.87	380.00	394.95	181.95	42.3%	100	1000	900	300	520	220	6.24439	0.383794
2007	10	482.00	470.00	463.46	140.30	29.1%	320	700	380	320	600	280	0.311699	-0.79001
Total	**1816**	**417.17**	**390.00**	**380.75**	**182.38**	**43.7%**	**50**	**1320**	**1270**	**300**	**500**	**200**	**18.9058**	**13.8854**

Indicates non-normal distribution.

The StatAdvisor

This table shows various statistics for each of the 22 columns of data. To test for significant differences amongst the column means, select Analysis of Variance from the list of Tabular Options. Select Means Plot from the list of Graphical Options to display the means graphically.

WARNING: There is more than a 3 to 1 difference between the smallest standard deviation and the largest. This may cause problems since the analysis of variance assumes that the standard deviations at all levels are equal. Select Variance Check from the list of Tabular Options to run a formal statistical test for differences among the sigmas. You may want to consider transforming the data to remove any dependence of the standard deviation on the mean.

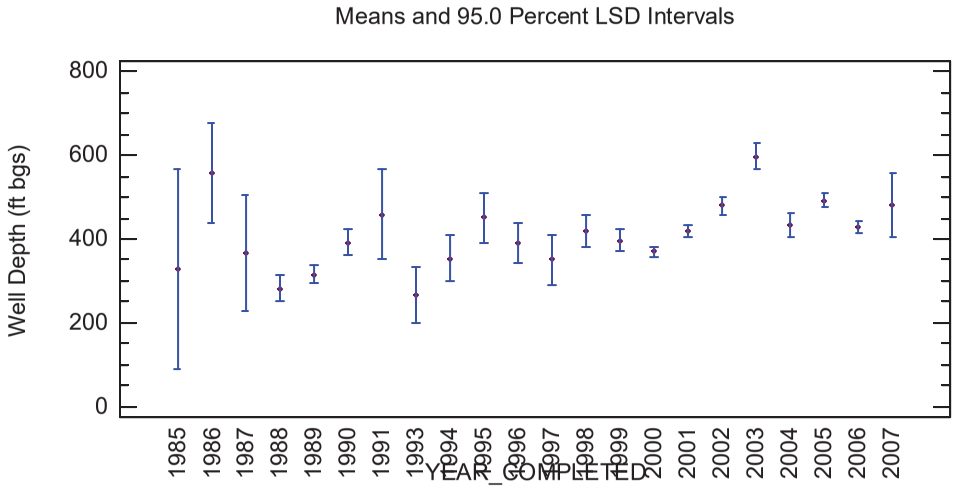
WARNING: The standardized skewness and/or kurtosis is outside the range of -2 to +2 for 13 columns. This indicates some significant **non-normality** in the data, which violates the assumption that the data come from normal distributions. You may wish to transform the data or **use the Kruskal-Wallis test to compare the medians instead of the means**.

ANOVA Table for tbl_HYdros_consylds_geol.WELL_DEPTH by YEAR_COMPLETED

Source	*Sum of Squares*	*Df*	*Mean Square*	*F-Ratio*	*P-Value*
Between groups	7.13832E6	21	339920.	11.46	0.0000
Within groups	5.32322E7	1794	29672.3		
Total (Corr.)	6.03705E7	1815			

The StatAdvisor

The ANOVA table decomposes the variance of the data into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 11.4558, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than 0.05, there is a statistically significant difference between the means of the 22 variables at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.



The StatAdvisor

This table shows the mean for each sample. It also shows the standard error of each mean, which is a measure of its sampling variability. The standard error is formed by dividing the pooled standard deviation by the square root of the number of observations at each level. The table also displays an interval around each mean. The intervals currently displayed are based on Fisher's least significant difference (LSD) procedure. They are constructed in such a way that if two means are the same, their intervals will overlap 95.0% of the time. You can display the intervals graphically by selecting Means Plot from the list of Graphical Options. In the Multiple Range Tests, these intervals are used to determine which means are significantly different from which others.

Multiple Range Tests for tbl_HYdros_consylds_geol.WELL_DEPTH by YEAR_COMPLETED

Method: 95.0 percent LSD

YEAR_COMPLETED	*Count*	*Mean*	*Homogeneous Groups*
1993	13	267.462	X
1988	58	281.603	X
1989	109	316.22	XX
1985	1	330.0	XXXXXXXX
1997	16	350.625	XXXX
1994	19	352.632	XXXX
1987	3	365.0	XXXXXXX
2000	302	369.088	X
1996	25	392.32	XX X
1990	64	392.656	XX X
1999	88	397.5	XX X
1998	38	418.816	XXX X
2001	283	420.473	X X
2006	299	429.866	X X
2004	63	432.54	XX X
1995	16	451.25	XXXXX
1991	5	459.0	XXXXXXX
2002	130	479.038	XX
2007	10	482.0	XXXXX
2005	213	491.291	X
1986	4	558.75	XXXX
2003	57	596.579	X

The StatAdvisor

This table applies a multiple comparison procedure to determine which means are significantly different from which others. At the top of the page, 8 homogenous groups are identified using columns of X's. Within each column, the levels containing X's form a group of means within which there are no statistically significant differences. The method currently being used to discriminate among the means is Fisher's least significant difference (LSD) procedure. With this method, there is a 5.0% risk of calling each pair of means significantly different when the actual difference equals 0.

Kruskal-Wallis Test for tbl_HYdros_consylds_geol.WELL_DEPTH by YEAR_COMPLETED

YEAR_COMPLETED	*Sample Size*	*Average Rank*
1985	1	754.5
1986	4	1404.5
1987	3	804.5
1988	58	481.397
1989	109	601.67
1990	64	890.391
1991	5	1167.1
1993	13	386.885

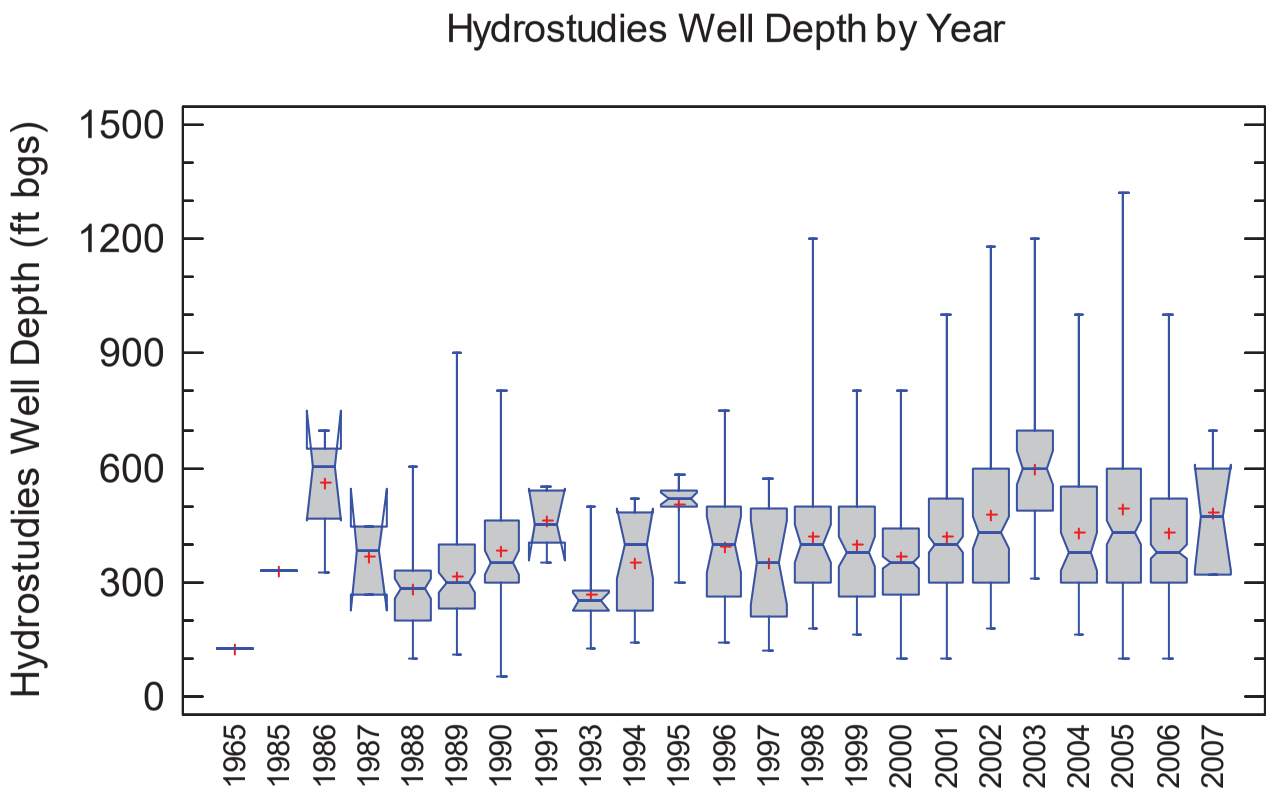
1994	19	754.368
1995	16	1082.34
1996	25	866.56
1997	16	735.938
1998	38	927.079
1999	88	853.17
2000	302	790.323
2001	283	947.265
2002	130	1079.22
2003	57	1416.04
2004	63	953.659
2005	213	1043.11
2006	299	944.311
2007	10	1192.15

Test statistic = 203.589 P-Value = 0.0

The StatAdvisor

The Kruskal-Wallis test tests the null hypothesis that the medians within each of the 22 columns is the same. The data from all the columns is first combined and ranked from smallest to largest. The average rank is then computed for the data in each column. Since the P-value is less than 0.05, **there is a statistically significant difference amongst the medians at the 95.0% confidence level**.

To determine which medians are significantly different from which others, select Box-and-Whisker Plot from the list of Graphical Options and select the median notch option.


Hydrostudies Well Depth by Year
Hydrostudies Well Depth (ft bgs)
1500
1200
900
600
300
0
1965
1985
1986
1987
1988
1989
1990
1991
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007

Note: The year 1965 not included in statistical analysis due to insufficient data.

Mood's Median Test for tbl_HYdros_consylds_geol.WELL_DEPTH by YEAR_COMPLETED

Total n = 1816

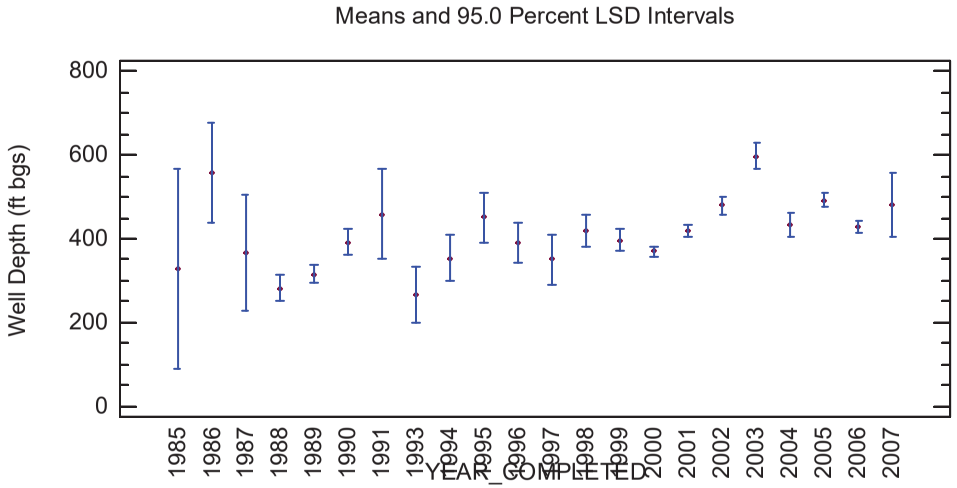
Grand median = 390.0

YEAR_COMPLETED	*Sample Size*	*n<=*	*n>*	*Median*	*95.0% lower CL*	*95.0% upper CL*
1985	1	1	0	330.0		
1986	4	1	3	605.0		
1987	3	2	1	385.0		
1988	58	48	10	285.0	205.0	305.0
1989	109	80	29	300.0	270.0	321.209
1990	64	37	27	360.0	335.855	401.829
1991	5	1	4	450.0		
1993	13	12	1	250.0	183.664	338.32
1994	19	9	10	400.0	212.765	486.118
1995	16	4	12	500.0	292.759	549.655
1996	25	10	15	400.0	264.166	500.0
1997	16	9	7	352.5	190.345	524.31
1998	38	17	21	400.0	300.0	445.825
1999	88	47	41	380.0	300.0	420.0
2000	302	178	124	350.0	320.0	380.0
2001	283	132	151	400.0	360.0	425.0
2002	130	44	86	430.0	420.0	500.0
2003	57	6	51	600.0	500.0	700.0
2004	63	32	31	380.0	300.0	500.0
2005	213	89	124	430.0	400.0	500.0
2006	299	151	148	380.0	340.0	420.0
2007	10	3	7	470.0	320.0	687.022

Test statistic = 137.268 P-Value = 0.0

The StatAdvisor

Mood's median test tests the hypothesis that the medians of all 22 samples are equal. It does so by counting the number of observations in each sample on either side of the grand median, which equals 390.0. Since the P-value for the chi-squared test is less than 0.05, **the medians of the samples are significantly different at the 95.0% confidence level**. Also included (if available) are 95.0% confidence intervals for each median based on the order statistics of each sample.


Means and 95.0 Percent LSD Intervals
Well Depth (ft bgs)
800
600
400
200
0
1985
1986
1987
1988
1989
1990
1991
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
YEAR_COMPLETED

ANALYSIS OF VDH STATIC WATER LEVEL BY YEAR

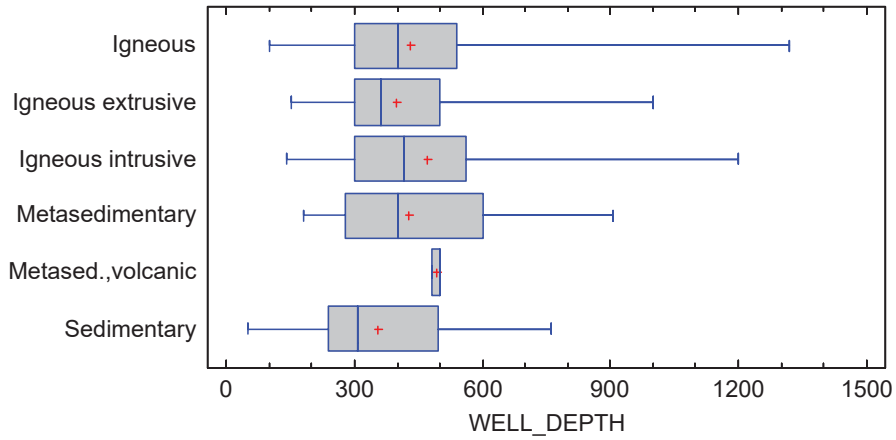
Summary Statistics for VDH Static Water Levels by Year

YEAR	*Count*	*Average*	*Median*	*Geometric mean*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
1975	1	69.00	69.0	69.0		%	69	69	0	69	69	0		
1976	4	26.25	30.0	20.6	14.93	56.9%	5	40	35	17.5	35	17.5	-1.13	1.06
1977	2	46.00	46.0	46.0	1.41	3.1%	45	47	2	45	47	2		
1978	57	38.23	38.00	36.40	10.93	28.6%	10	62	52	30	45	15	-0.30	0.52
1979	68	38.70	34.50	33.97	20.69	53.5%	7	123	116	24.5	49.5	25	5.13	5.97
1980	84	45.12	38.50	37.44	31.00	68.7%	10	195	185	22.5	53.5	31	8.22	13.03
1981	97	49.06	40.00	37.92	34.66	70.7%	5	180	175	21	66	45	4.78	2.67
1982	76	32.61	29.00	24.83	23.50	72.1%	1	150	149	20	40	20	7.81	14.40
1983	54	37.14	26.00	24.92	51.56	138.8%	1	383	382	17.5	45	27.5	17.73	59.54
1984	100	45.56	40.0	37.8	29.71	65.2%	2.5	190	187.5	29	56.5	27.5	8.53	13.36
1985	155	51.76	48.0	42.1	32.95	63.7%	5	200	195	30	67	37	8.17	11.52
1986	205	38.95	30.00	31.60	27.29	70.1%	4	196	192	20	50	30	12.28	20.81
1987	307	35.02	25.00	29.00	27.34	78.1%	3	299	296	19	45	26	30.38	112.56
1988	403	39.27	31.00	33.64	22.62	57.6%	3	156	153	21	50	29	11.90	14.23
1989	490	38.85	36.00	31.48	23.00	59.2%	1	289	288	22	60	38	24.67	123.39
1990	291	42.28	40.00	34.57	22.88	54.1%	1	150	149	25	60	35	4.94	5.13
1991	207	51.09	50.00	44.13	31.50	61.7%	1	390	389	33	62	29	36.14	190.13
1992	192	41.58	43.00	32.68	22.76	54.7%	1	150	149	23	56.5	33.5	3.28	5.03
1993	203	38.63	33.00	31.74	30.62	79.3%	1	380	379	21	50	29	40.77	221.54
1994	225	38.82	37.00	33.50	19.69	50.7%	2	140	138	25	50	25	7.02	9.91
1995	197	37.81	35.00	32.11	21.70	57.4%	4	159	155	22	50	28	10.65	20.40
1996	178	38.01	40.00	33.34	16.46	43.3%	3	122	119	30	50	20	2.39	7.49
1997	295	36.47	30.00	32.66	16.65	45.7%	5	125	120	25	50	25	6.66	8.59
1998	366	33.63	30.00	29.44	15.93	47.4%	1.5	90	88.5	20	50	30	4.10	-0.05
1999	516	36.14	30.00	30.52	27.21	75.3%	2	475	473	20	50	30	80.46	612.42
2000	685	34.59	30.00	29.73	21.88	63.2%	0.3	264	263.7	20	45	25	42.61	168.96
2001	677	39.49	30.00	31.32	45.60	115.5%	1	700	699	20	50	30	111.18	724.61
2002	569	37.15	30.00	31.51	30.17	81.2%	0.2	600	599.8	20	50	30	114.48	1041.18
2003	415	32.37	30.00	27.14	19.00	58.7%	1	158	157	20	45	25	13.81	23.87
2004	575	33.41	30.00	27.92	18.56	55.5%	1.2	95	93.8	17	50	33	5.63	-2.64
2005	725	34.84	30.00	29.14	19.98	57.3%	2	109	107	20	50	30	8.37	-0.38
2006	795	37.74	32.00	32.42	20.09	53.2%	1	150	149	20	50	30	13.62	17.04
2007	96	44.67	50.00	40.20	17.15	38.4%	5	80	75	30	60	30	-1.82	-1.77

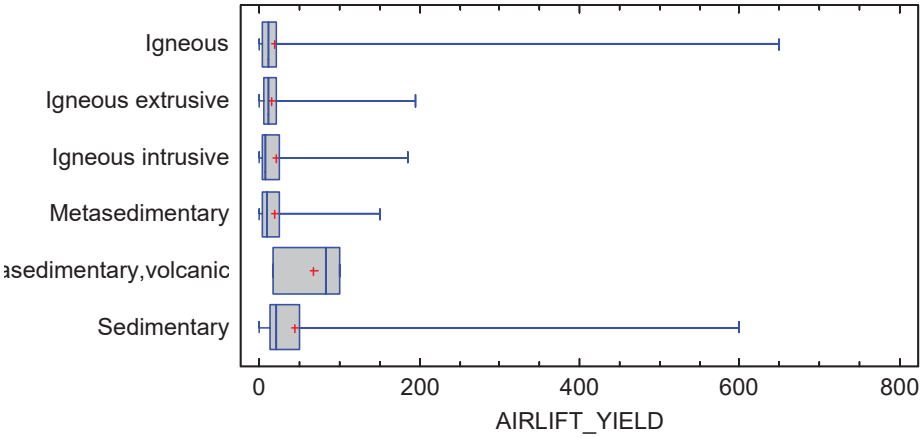
Indicates non-normal distribution

Section B) Box and Whiskers plots for various comparisons. These plots allow visual inspections of distributions of data and comparisons of mean and median values.

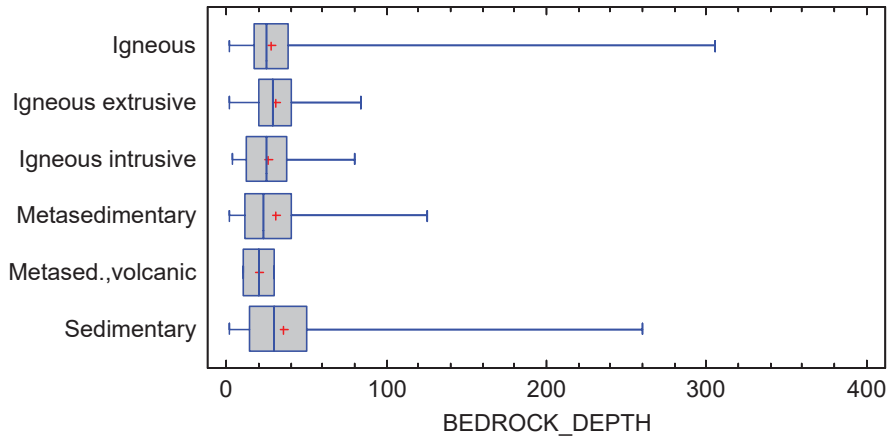
Well Depth by Bedrock Class

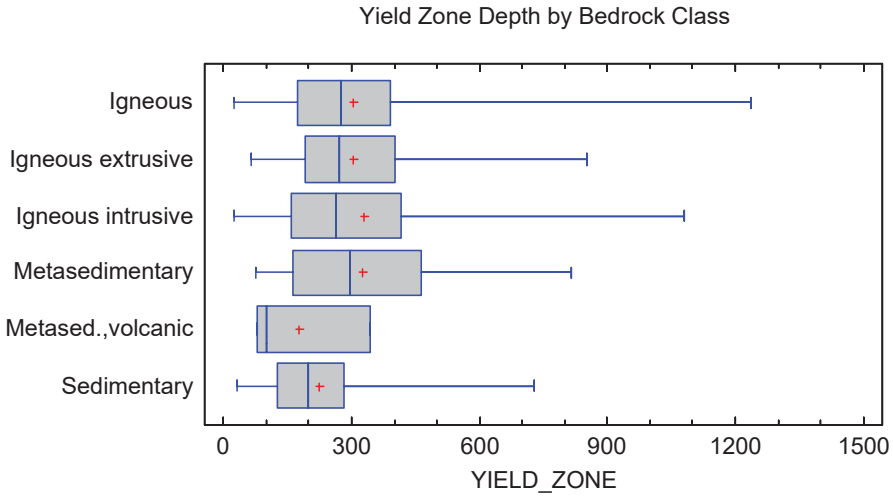


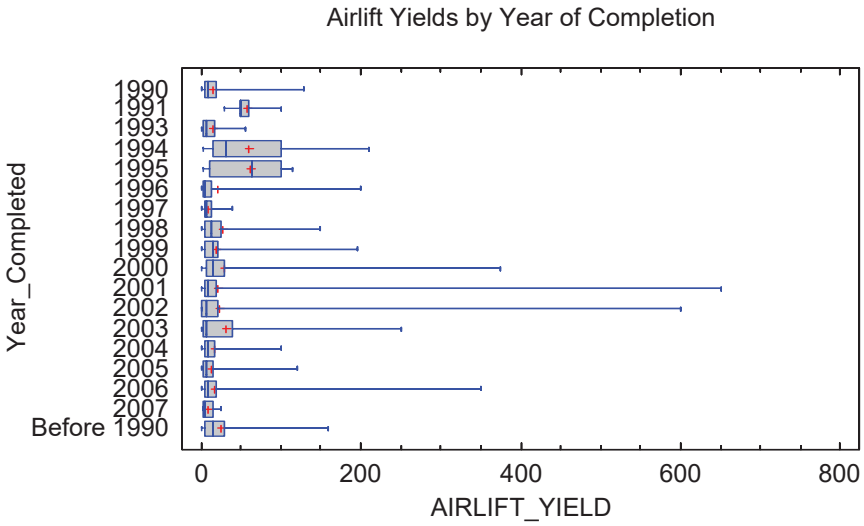
Hydrostudy Airlift Yields by Bedrock Class

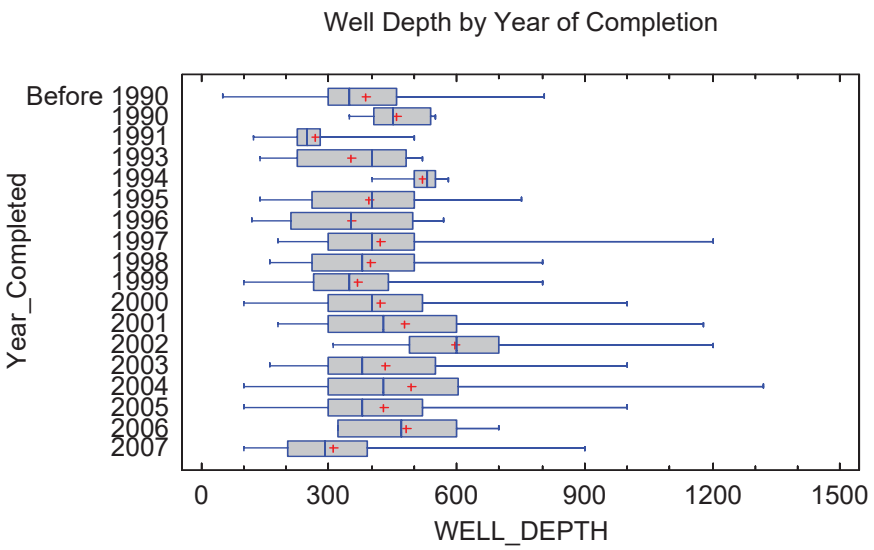


Bedrock Depth by Bedrock Class




Yield Zone Depth by Bedrock Class
Igneous
Igneous extrusive
Igneous intrusive
Metasedimentary
Metased.,volcanic
Sedimentary
0
300
600
900
1200
1500
YIELD_ZONE


Airlift Yields by Year of Completion
Year_Completed
1990
1991
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Before 1990
0
200
400
600
800
AIRLIFT_YIELD


Well Depth by Year of Completion
Year_Completed
Before 1990
1990
1991
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
0
300
600
900
1200
1500
WELL_DEPTH

Section C) Detailed statistical analysis of Hydrostudy data, including parameters calculated from pumping tests.

ANALYSIS OF AIRLIFT YIELD (HYDROS) VS YEAR COMPLETED

Summary Statistics for AIRLIFT_YIELD

YEAR_COMPLETED	*Count*	*Average*	*Median*	*Geometric mean*	*Standard deviation*	*Coeff. of variation*	*Minimum*
1985	1	0.0	0.0			%	0.0
1986	4	7.75	5.5		8.65544	111.683%	0.0
1987	3	24.3333	25.0	23.811	6.02771	24.7714%	18.0
1988	55	24.6364	12.0		30.4156	123.458%	0.0
1989	110	26.0582	15.0		32.5877	125.057%	0.0
1990	63	15.5317	8.0		20.5789	132.496%	0.0
1991	5	58.0	50.0	53.7827	25.8844	44.6282%	30.0
1993	13	14.2731	6.0	6.73628	17.1736	120.322%	0.25
1994	19	60.7895	32.0	36.9294	57.3387	94.3235%	3.0
1995	16	49.25	35.0	26.3449	44.5159	90.3876%	2.0
1996	25	20.68	4.0	6.1995	43.6759	211.199%	0.25
1997	16	10.0313	7.75	7.28633	9.22581	91.9707%	1.0
1998	38	26.4474	13.0	11.4269	36.7794	139.067%	0.5
1999	88	20.1597	15.0		27.53	136.56%	0.0
2000	302	28.6846	15.0	14.7102	42.0343	146.539%	0.25
2001	282	22.0846	10.0		48.7932	220.938%	0.0
2002	131	22.9008	6.0		63.4494	277.062%	0.0
2003	56	31.4196	8.0		51.9462	165.33%	0.0
2004	63	17.5333	10.0	9.52158	23.081	131.641%	1.0
2005	212	17.1509	8.0		45.4419	264.953%	0.0
2006	299	17.0635	10.0		26.9276	157.808%	0.0
2007	10	8.3	5.0	5.83165	7.86059	94.7059%	2.0
Total	1811	22.504	10.0		41.3793	183.876%	0.0

YEAR_COMPLETED	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*
1985	0.0	0.0	0.0	0.0	0.0	
1986	20.0	20.0	2.0	13.5	11.5	1.10776
1987	30.0	12.0	18.0	30.0	12.0	-0.347623
1988	150.0	150.0	5.0	40.0	35.0	6.2814
1989	160.0	160.0	4.5	30.0	25.5	8.95609
1990	128.0	128.0	4.0	20.0	16.0	10.3667
1991	100.0	70.0	50.0	60.0	10.0	1.12118
1993	56.0	55.75	3.0	16.8	13.8	2.4322
1994	210.0	207.0	15.0	100.0	85.0	2.14901
1995	115.0	113.0	11.0	100.0	89.0	0.628159
1996	200.0	199.75	2.0	14.0	12.0	6.94395
1997	40.0	39.0	4.5	13.25	8.75	4.04653
1998	150.0	149.5	5.0	25.0	20.0	5.33493
1999	195.0	195.0	4.25	21.0	16.75	14.2905
2000	375.0	374.75	8.0	30.0	22.0	29.5222
2001	650.0	650.0	5.0	20.0	15.0	59.8838
2002	600.0	600.0	1.5	21.0	19.5	32.0966
2003	250.0	250.0	2.5	40.0	37.5	7.95387
2004	100.0	99.0	5.0	18.0	13.0	7.71673
2005	500.0	500.0	3.0	16.5	13.5	51.6823
2006	350.0	350.0	5.5	20.0	14.5	54.5007
2007	26.0	24.0	3.0	15.0	12.0	1.97367
Total	650.0	650.0	5.0	25.0	20.0	119.89

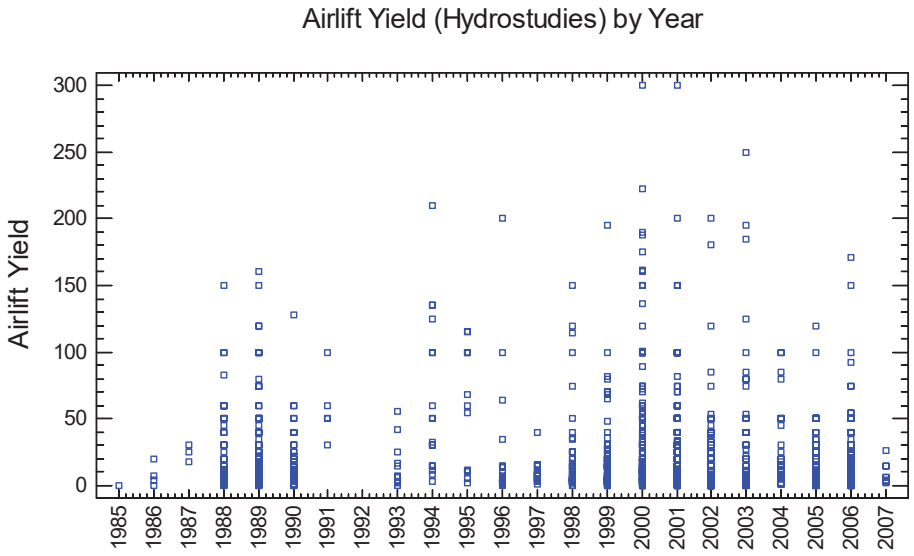
YEAR_COMPLETED	*Stnd. kurtosis*
1985	
1986	0.871335
1987	
1988	7.48114

1989	9.51572
1990	22.5996
1991	1.09508
1993	1.49035
1994	0.776674
1995	-1.39278
1996	12.7093
1997	6.21642
1998	4.82177
1999	36.2511
2000	83.5845
2001	348.7
2002	130.877
2003	10.8844
2004	8.53843
2005	249.311
2006	294.686
2007	1.12972
Total	638.029

The StatAdvisor
This table shows various statistics for each of the 22 columns of data. To test for significant differences amongst the column means, select Analysis of Variance from the list of Tabular Options. Select Means Plot from the list of Graphical Options to display the means graphically.

WARNING: There is more than a 3 to 1 difference between the smallest standard deviation and the largest. This may cause problems since the analysis of variance assumes that the standard deviations at all levels are equal. Select Variance Check from the list of Tabular Options to run a formal statistical test for differences among the sigmas. You may want to consider transforming the data to remove any dependence of the standard deviation on the mean.

WARNING: The standardized skewness and/or kurtosis is outside the range of -2 to +2 for 16 columns. This indicates some significant nonnormality in the data, which violates the assumption that the data come from normal distributions. You may wish to transform the data or use the Kruskal-Wallis test to compare the medians instead of the means.



ANOVA Table for AIRLIFT_YIELD by YEAR_COMPLETED

Source	*Sum of Squares*	*Df*	*Mean Square*	*F-Ratio*	*P-Value*
Between groups	90769.1	21	4322.34	2.57	0.0001
Within groups	3.0084E6	1789	1681.61		
Total (Corr.)	3.09917E6	1810			

The StatAdvisor

The ANOVA table decomposes the variance of the data into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 2.57035, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than 0.05, there is a statistically significant difference between the means of the 22 variables at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.

Multiple Range Tests for AIRLIFT_YIELD by YEAR_COMPLETED

Method: 95.0 percent LSD

YEAR_COMPLETED	*Count*	*Mean*	*Homogeneous Groups*
1985	1	0.0	XXXXXXX
1986	4	7.75	XXXXXX
2007	10	8.3	XXXX
1997	16	10.0313	XXXX
1993	13	14.2731	XXXX
1990	63	15.5317	XX
2006	299	17.0635	X
2005	212	17.1509	XX
2004	63	17.5333	XX X
1999	88	20.1597	XXXX
1996	25	20.68	XXXX X
2001	282	22.0846	XXXX X
2002	131	22.9008	XXXX X
1987	3	24.3333	XXXXXXX
1988	55	24.6364	XXXX X
1989	110	26.0582	XXX X
1998	38	26.4474	XXXXXX
2000	302	28.6846	X XX
2003	56	31.4196	XXXX
1995	16	49.25	X X
1991	5	58.0	XXX
1994	19	60.7895	X

Contrast	*Sig.*	*Difference*	*+/- Limits*
1985 - 1986		-7.75	89.8601
1985 - 1987		-24.3333	92.8071
1985 - 1988		-24.6364	81.1007
1985 - 1989		-26.0582	80.7378
1985 - 1990		-15.5317	81.0087
1985 - 1991		-58.0	88.0446
1985 - 1993		-14.2731	83.4073
1985 - 1994		-60.7895	82.4613
1985 - 1995		-49.25	82.8469
1985 - 1996		-20.68	81.965
1985 - 1997		-10.0313	82.8469
1985 - 1998		-26.4474	81.424
1985 - 1999		-20.1597	80.8287
1985 - 2000		-28.6846	80.5063
1985 - 2001		-22.0846	80.5157
1985 - 2002		-22.9008	80.6795
1985 - 2003		-31.4196	81.0878
1985 - 2004		-17.5333	81.0087

1985 - 2005		-17.1509	80.5626
1985 - 2006		-17.0635	80.5076
1985 - 2007		-8.3	84.2962
1986 - 1987		-16.5833	61.3861
1986 - 1988		-16.8864	41.6223
1986 - 1989		-18.3082	40.9108
1986 - 1990		-7.78175	41.4428
1986 - 1991		-50.25	53.9161
1986 - 1993		-6.52308	45.9552
1986 - 1994	*	-53.0395	44.2149
1986 - 1995		-41.5	44.93
1986 - 1996		-12.93	43.2824
1986 - 1997		-2.28125	44.93
1986 - 1998		-18.6974	42.2488
1986 - 1999		-12.4097	41.0898
1986 - 2000		-20.9346	40.4519
1986 - 2001		-14.3346	40.4707
1986 - 2002		-15.1508	40.7956
1986 - 2003		-23.6696	41.5971
1986 - 2004		-9.78333	41.4428
1986 - 2005		-9.40094	40.564
1986 - 2006		-9.31355	40.4546
1986 - 2007		-0.55	47.5495
1987 - 1988		-0.30303	47.6523
1987 - 1989		-1.72485	47.0321
1987 - 1990		8.80159	47.4956
1987 - 1991		-33.6667	58.6964
1987 - 1993		10.0603	51.4801
1987 - 1994		-36.4561	49.9328
1987 - 1995		-24.9167	50.5671
1987 - 1996		3.65333	49.1089
1987 - 1997		14.3021	50.5671
1987 - 1998		-2.11404	48.2005
1987 - 1999		4.17367	47.1879
1987 - 2000		-4.35127	46.6335
1987 - 2001		2.24876	46.6497
1987 - 2002		1.43257	46.9319
1987 - 2003		-7.08631	47.6303
1987 - 2004		6.8	47.4956
1987 - 2005		7.18239	46.7307
1987 - 2006		7.26979	46.6358
1987 - 2007		16.0333	52.9082
1988 - 1989		-1.42182	13.2732
1988 - 1990		9.10462	14.8321
1988 - 1991		-33.3636	37.5423
1988 - 1993		10.3633	24.7864
1988 - 1994	*	-36.1531	21.388
1988 - 1995	*	-24.6136	22.8297
1988 - 1996		3.95636	19.3868
1988 - 1997		14.6051	22.8297
1988 - 1998		-1.811	16.9543
1988 - 1999		4.4767	13.8152
1988 - 2000		-4.04824	11.7831
1988 - 2001		2.55179	11.8473
1988 - 2002		1.7356	12.9137
1988 - 2003		-6.78328	15.258
1988 - 2004		7.10303	14.8321
1988 - 2005		7.48542	12.1624

1988 - 2006		7.57282	11.7922
1988 - 2007		16.3364	27.6304
1989 - 1990		10.5264	12.699
1989 - 1991		-31.9418	36.7519
1989 - 1993		11.7851	23.572
1989 - 1994	*	-34.7313	19.968
1989 - 1995	*	-23.1918	21.5051
1989 - 1996		5.37818	17.8079
1989 - 1997		16.0269	21.5051
1989 - 1998		-0.389187	15.1236
1989 - 1999		5.89852	11.4949
1989 - 2000		-2.62642	8.95078
1989 - 2001		3.97361	9.03512
1989 - 2002		3.15742	10.3941
1989 - 2003		-5.36146	13.194
1989 - 2004		8.52485	12.699
1989 - 2005		8.90724	9.44443
1989 - 2006	*	8.99464	8.96276
1989 - 2007		17.7582	26.5464
1990 - 1991	*	-42.4683	37.3432
1990 - 1993		1.25867	24.4837
1990 - 1994	*	-45.2577	21.0364
1990 - 1995	*	-33.7183	22.5007
1990 - 1996		-5.14825	18.9982
1990 - 1997		5.5005	22.5007
1990 - 1998		-10.9156	16.5086
1990 - 1999		-4.62791	13.2644
1990 - 2000	*	-13.1529	11.1323
1990 - 2001		-6.55283	11.2002
1990 - 2002		-7.36902	12.3227
1990 - 2003	*	-15.8879	14.7612
1990 - 2004		-2.00159	14.3204
1990 - 2005		-1.6192	11.5329
1990 - 2006		-1.5318	11.1419
1990 - 2007		7.23175	27.3592
1991 - 1993	*	43.7269	42.2952
1991 - 1994		-2.78947	40.3976
1991 - 1995		8.75	41.1791
1991 - 1996		37.32	39.3747
1991 - 1997	*	47.9688	41.1791
1991 - 1998		31.5526	38.2357
1991 - 1999	*	37.8403	36.9511
1991 - 2000		29.3154	36.2404
1991 - 2001		35.9154	36.2613
1991 - 2002		35.0992	36.6236
1991 - 2003		26.5804	37.5144
1991 - 2004	*	40.4667	37.3432
1991 - 2005	*	40.8491	36.3654
1991 - 2006	*	40.9365	36.2433
1991 - 2007	*	49.7	44.0223
1993 - 1994	*	-46.5164	28.9293
1993 - 1995	*	-34.9769	30.0109
1993 - 1996		-6.40692	27.4829
1993 - 1997		4.24183	30.0109
1993 - 1998		-12.1743	25.8246
1993 - 1999		-5.88658	23.8814
1993 - 2000		-14.4115	22.7663
1993 - 2001		-7.8115	22.7996

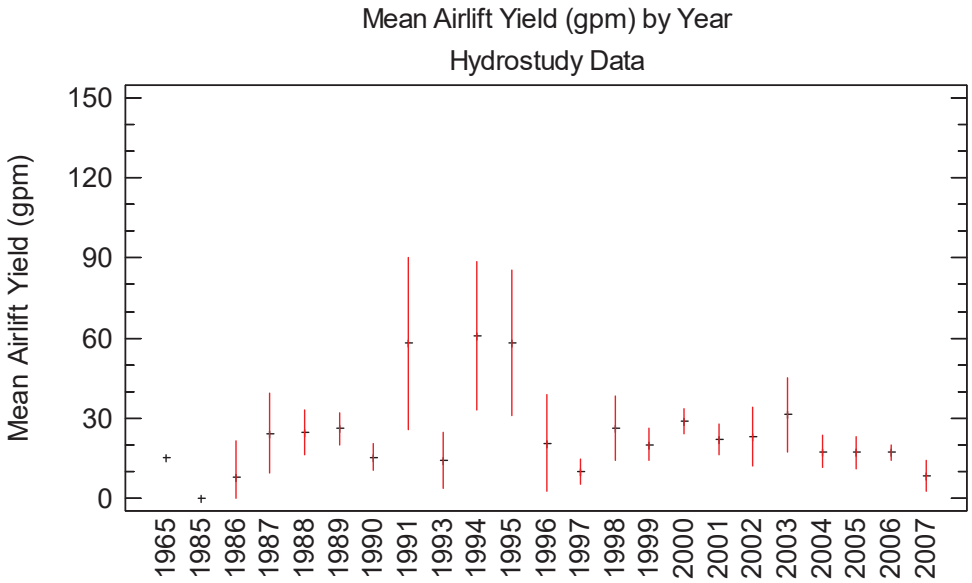
1993 - 2002		-8.62769	23.3715
1993 - 2003		-17.1466	24.744
1993 - 2004		-3.26026	24.4837
1993 - 2005		-2.87787	22.9648
1993 - 2006		-2.79047	22.771
1993 - 2007		5.97308	33.8068
1994 - 1995		11.5395	27.2715
1994 - 1996	*	40.1095	24.462
1994 - 1997	*	50.7582	27.2715
1994 - 1998	*	34.3421	22.583
1994 - 1999	*	40.6298	20.3323
1994 - 2000	*	32.1049	19.0101
1994 - 2001	*	38.7049	19.0499
1994 - 2002	*	37.8887	19.7308
1994 - 2003	*	29.3698	21.3389
1994 - 2004	*	43.2561	21.0364
1994 - 2005	*	43.6385	19.2474
1994 - 2006	*	43.7259	19.0157
1994 - 2007	*	52.4895	31.4003
1995 - 1996	*	28.57	25.732
1995 - 1997	*	39.2188	28.4163
1995 - 1998		22.8026	23.9528
1995 - 1999	*	29.0903	21.8438
1995 - 2000		20.5654	20.6187
1995 - 2001	*	27.1654	20.6555
1995 - 2002	*	26.3492	21.2851
1995 - 2003		17.8304	22.7837
1995 - 2004	*	31.7167	22.5007
1995 - 2005	*	32.0991	20.8378
1995 - 2006	*	32.1865	20.6239
1995 - 2007	*	40.95	32.3995
1996 - 1997		10.6488	25.732
1996 - 1998		-5.76737	20.6976
1996 - 1999		0.520341	18.2154
1996 - 2000		-8.0046	16.7268
1996 - 2001		-1.40457	16.7721
1996 - 2002		-2.22076	17.5416
1996 - 2003		-10.7396	19.3326
1996 - 2004		3.14667	18.9982
1996 - 2005		3.52906	16.9961
1996 - 2006		3.61645	16.7332
1996 - 2007		12.38	30.0729
1997 - 1998		-16.4161	23.9528
1997 - 1999		-10.1284	21.8438
1997 - 2000		-18.6534	20.6187
1997 - 2001		-12.0533	20.6555
1997 - 2002		-12.8695	21.2851
1997 - 2003		-21.3884	22.7837
1997 - 2004		-7.50208	22.5007
1997 - 2005		-7.11969	20.8378
1997 - 2006		-7.0323	20.6239
1997 - 2007		1.73125	32.3995
1998 - 1999		6.28771	15.6014
1998 - 2000		-2.23723	13.8343
1998 - 2001		4.36279	13.889
1998 - 2002		3.54661	14.8091
1998 - 2003		-4.97227	16.8923
1998 - 2004		8.91404	16.5086

1998 - 2005		9.29643	14.1587
1998 - 2006		9.38382	13.842
1998 - 2007		18.1474	28.5654
1999 - 2000		-8.52494	9.73642
1999 - 2001		-1.92492	9.81402
1999 - 2002		-2.7411	11.0779
1999 - 2003		-11.26	13.7391
1999 - 2004		2.62633	13.2644
1999 - 2005		3.00872	10.1921
1999 - 2006		3.09611	9.74744
1999 - 2007		11.8597	26.8215
2000 - 2001		6.60003	6.65565
2000 - 2002		5.78384	8.40846
2000 - 2003		-2.73504	11.6938
2000 - 2004	*	11.1513	11.1323
2000 - 2005	*	11.5337	7.20148
2000 - 2006	*	11.6211	6.55707
2000 - 2007		20.3846	25.8336
2001 - 2002		-0.816189	8.49819
2001 - 2003		-9.33507	11.7585
2001 - 2004		4.55124	11.2002
2001 - 2005		4.93363	7.30605
2001 - 2006		5.02103	6.67175
2001 - 2007		13.7846	25.863
2002 - 2003		-8.51888	12.8323
2002 - 2004		5.36743	12.3227
2002 - 2005		5.74982	8.93214
2002 - 2006		5.83722	8.42122
2002 - 2007		14.6008	26.3685
2003 - 2004		13.8863	14.7612
2003 - 2005	*	14.2687	12.0758
2003 - 2006	*	14.3561	11.703
2003 - 2007		23.1196	27.5924
2004 - 2005		0.38239	11.5329
2004 - 2006		0.469788	11.1419
2004 - 2007		9.23333	27.3592
2005 - 2006		0.0873982	7.21637
2005 - 2007		8.85094	26.0088
2006 - 2007		8.76355	25.8378

* denotes a statistically significant difference.

The StatAdvisor

This table applies a multiple comparison procedure to determine which means are significantly different from which others. The bottom half of the output shows the estimated difference between each pair of means. An asterisk has been placed next to 46 pairs, indicating that these pairs show statistically significant differences at the 95.0% confidence level. At the top of the page, 7 homogenous groups are identified using columns of X's. Within each column, the levels containing X's form a group of means within which there are no statistically significant differences. The method currently being used to discriminate among the means is Fisher's least significant difference (LSD) procedure. With this method, there is a 5.0% risk of calling each pair of means significantly different when the actual difference equals 0.



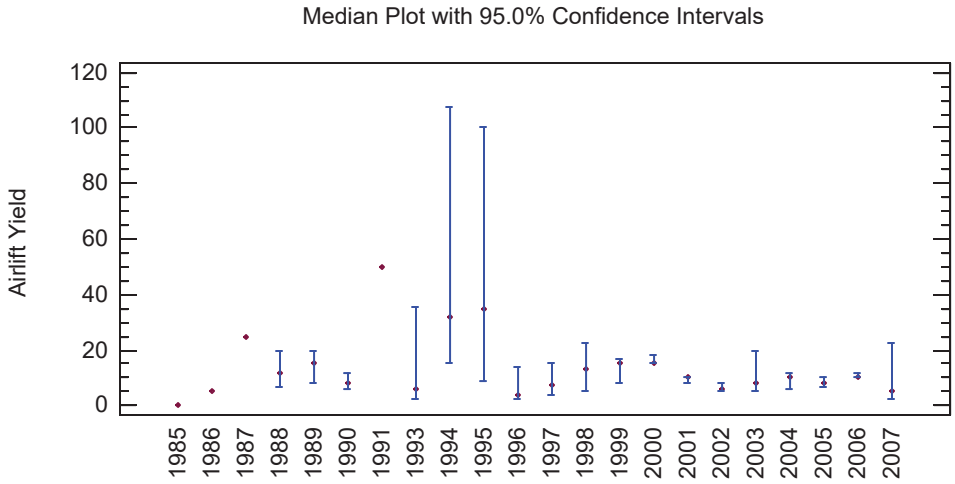
Kruskal-Wallis Test for AIRLIFT_YIELD by YEAR_COMPLETED

YEAR_COMPLETED	*Sample Size*	*Average Rank*
1985	1	16.5
1986	4	591.125
1987	3	1349.5
1988	55	964.545
1989	110	988.491
1990	63	814.833
1991	5	1624.8
1993	13	770.308
1994	19	1409.58
1995	16	1257.22
1996	25	678.34
1997	16	736.969
1998	38	949.671
1999	88	932.466
2000	302	1070.72
2001	282	874.239
2002	131	732.408
2003	56	867.098
2004	63	859.952
2005	212	777.231
2006	299	901.57
2007	10	637.2

Test statistic = 115.937 P-Value = 0.0

The StatAdvisor

The Kruskal-Wallis test tests the null hypothesis that the medians within each of the 22 columns is the same. The data from all the columns is first combined and ranked from smallest to largest. The average rank is then computed for the data in each column. Since the P-value is less than 0.05, there is a statistically significant difference amongst the medians at the 95.0% confidence level. To determine which medians are significantly different from which others, select Box-and-Whisker Plot from the list of Graphical Options and select the median notch option.



Mood's Median Test for AIRLIFT_YIELD by YEAR_COMPLETED
Total n = 1811
Grand median = 10.0

YEAR_COMPLETED	*Sample Size*	*n<=*	*n>*	*Median*	*95.0% lower CL*	*95.0% upper CL*
1985	1	1	0	0.0		
1986	4	3	1	5.5		
1987	3	0	3	25.0		
1988	55	26	29	12.0	7.0	20.0
1989	110	46	64	15.0	8.42236	20.0
1990	63	36	27	8.0	6.0	12.0
1991	5	0	5	50.0		
1993	13	8	5	6.0	2.39441	35.2951
1994	19	2	17	32.0	15.0	107.647
1995	16	4	12	35.0	8.55176	100.0
1996	25	16	9	4.0	2.10416	14.0
1997	16	11	5	7.75	3.75863	15.2241
1998	38	18	20	13.0	5.0	22.9127
1999	88	37	51	15.0	8.0	17.0
2000	302	110	192	15.0	15.0	18.0
2001	282	165	117	10.0	8.0	10.0
2002	131	87	44	6.0	5.0	8.44918
2003	56	32	24	8.0	5.0	20.0
2004	63	37	26	10.0	6.0	12.0
2005	212	141	71	8.0	6.6115	10.0
2006	299	161	138	10.0	10.0	12.0
2007	10	7	3	5.0	2.32444	22.4311

Test statistic = 107.815 P-Value = 0.0

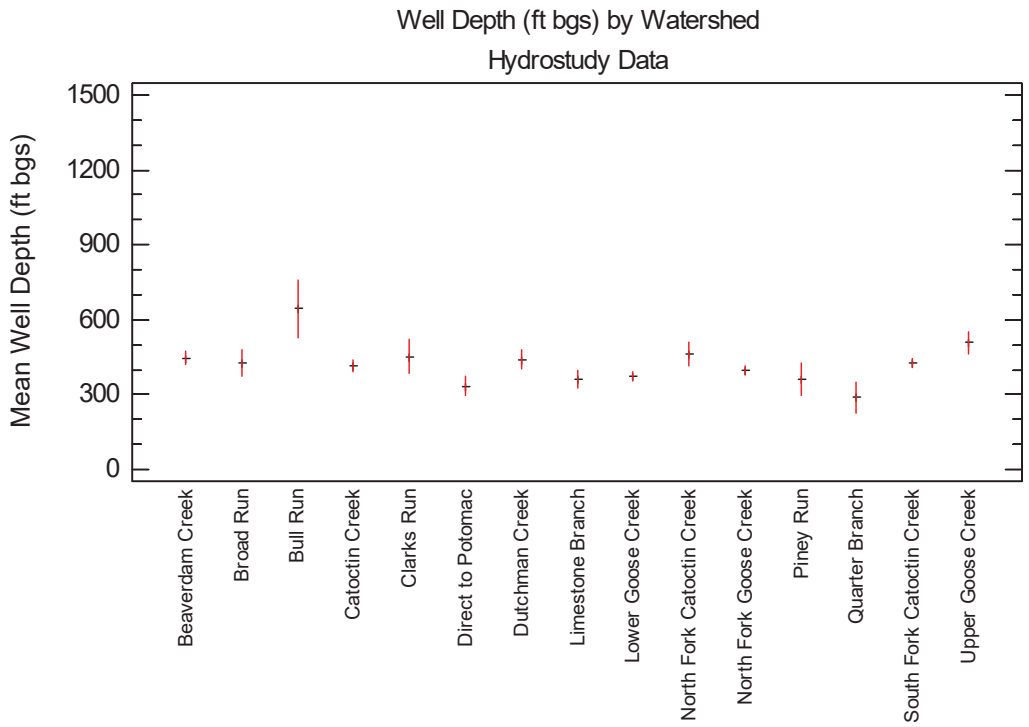
The StatAdvisor
Mood's median test tests the hypothesis that the medians of all 22 samples are equal. It does so by counting the number of observations in each sample on either side of the grand median, which equals 10.0. Since the P-value for the chi-squared test is less than 0.05, the medians of the samples are significantly different at the 95.0% confidence level. Also included (if available) are 95.0% confidence intervals for each median based on the order statistics of each sample.

Multiple-Sample Comparison Well Depth (hydros) by Watershed

Dependent variable: Hydros WELL_DEPTH
Factor: Watershed

Number of observations: 1817
Number of levels: 15

The StatAdvisor
This procedure compares the data in 15 columns of the current data file. It constructs various statistical tests and graphs to compare the samples. The F-test in the ANOVA table will test whether there are any significant differences amongst the means. If there are, the Multiple Range Tests will tell you which means are significantly different from which others. If you are worried about the presence of outliers, choose the Kruskal-Wallis Test which compares medians instead of means. The various plots will help you judge the practical significance of the results, as well as allow you to look for possible violations of the assumptions underlying the analysis of variance.



Summary Statistics for Hydros Well Depth

Watershed	*Count*	*Average*	*Median*	*Geometric mean*	*Standard deviation*
Beaverdam Creek	232	446.392	400.0	407.06	195.45
Broad Run	35	426.857	460.0	400.984	148.656
Bull Run	33	643.758	430.0	563.896	323.448
Catoctin Creek	234	412.701	350.0	377.245	179.435
Clarks Run	29	451.724	500.0	412.18	177.725
Direct to Potomac	55	332.455	300.0	304.373	143.103
Dutchman Creek	101	439.911	400.0	394.401	198.596
Limestone Branch	82	363.232	302.5	326.669	162.114
Lower Goose Creek	283	375.097	320.0	345.991	153.836
North Fork Catoctin Creek	104	461.442	390.0	403.412	243.524
North Fork Goose Creek	220	396.75	380.0	374.164	139.451
Piney Run	15	363.0	300.0	349.742	116.952
Quarter Branch	16	289.688	262.5	270.32	117.239
South Fork Catoctin Creek	334	424.766	400.0	393.229	168.628
Upper Goose Creek	44	509.273	509.0	485.824	148.217
Total	1817	417.01	390.0	380.523	182.455

Watershed	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*
Beaverdam Creek	43.7844%	100.0	1300.0	1200.0	300.0	555.0
Broad Run	34.8257%	160.0	960.0	800.0	360.0	500.0
Bull Run	50.2437%	220.0	1100.0	880.0	430.0	960.0
Catoctin Creek	43.4783%	140.0	1180.0	1040.0	280.0	550.0
Clarks Run	39.3437%	160.0	900.0	740.0	300.0	580.0
Direct to Potomac	43.0445%	140.0	760.0	620.0	220.0	450.0
Dutchman Creek	45.1445%	120.0	800.0	680.0	300.0	600.0
Limestone Branch	44.6311%	50.0	800.0	750.0	230.0	500.0
Lower Goose Creek	41.0122%	100.0	1200.0	1100.0	280.0	480.0
North Fork Catoctin Creek	52.7744%	100.0	1320.0	1220.0	300.0	612.5
North Fork Goose Creek	35.1484%	140.0	980.0	840.0	300.0	455.0
Piney Run	32.2183%	300.0	700.0	400.0	300.0	400.0
Quarter Branch	40.4707%	140.0	600.0	460.0	200.0	340.0
South Fork Catoctin Creek	39.699%	125.0	1000.0	875.0	300.0	540.0
Upper Goose Creek	29.1037%	250.0	760.0	510.0	370.0	610.0
Total	43.753%	50.0	1320.0	1270.0	300.0	500.0

Watershed	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
Beaverdam Creek	255.0	6.40076	4.16395
Broad Run	140.0	2.17225	4.55505
Bull Run	530.0	0.720565	-1.97231
Catoctin Creek	270.0	5.82615	2.60973
Clarks Run	280.0	-0.0174521	-0.130231
Direct to Potomac	230.0	2.34213	-0.0872207
Dutchman Creek	300.0	1.7373	-1.9488
Limestone Branch	270.0	1.99098	-1.02962
Lower Goose Creek	200.0	8.40328	10.8927
North Fork Catoctin Creek	312.5	4.39481	2.05973
North Fork Goose Creek	155.0	6.65857	6.69862
Piney Run	100.0	3.34663	3.40598
Quarter Branch	140.0	2.08898	1.66946
South Fork Catoctin Creek	240.0	6.15227	1.82544
Upper Goose Creek	240.0	-0.628545	-1.53574
Total	200.0	18.8844	13.8639

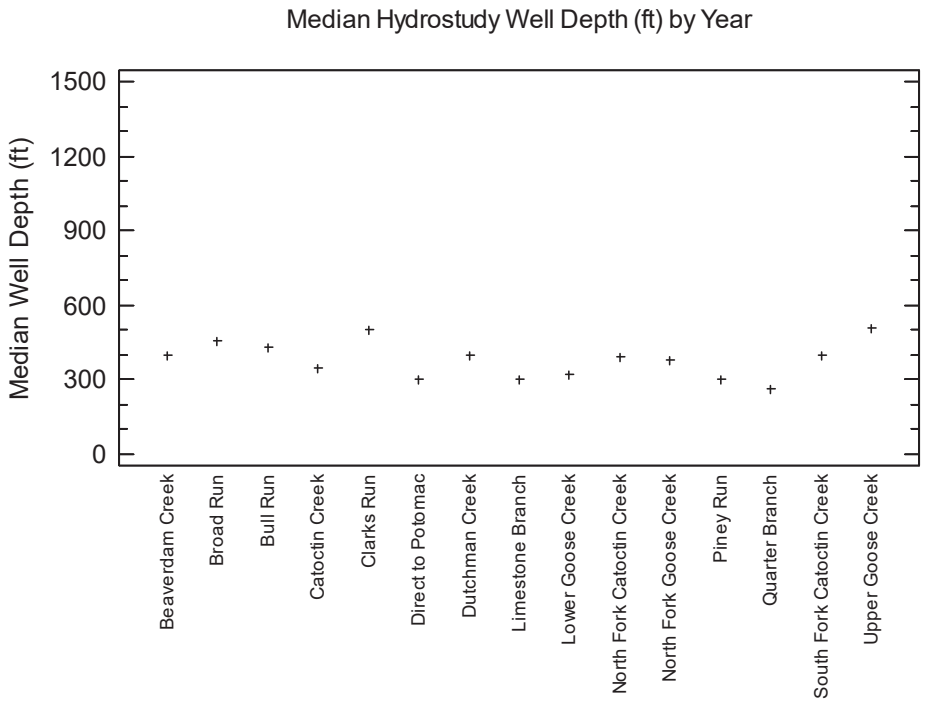
The StatAdvisor
This table shows various statistics for each of the 15 columns of data. To test for significant differences amongst the column means, select Analysis of Variance from the list of Tabular Options. Select Means Plot from the list of Graphical Options to display the means graphically.

WARNING: The standardized skewness and/or kurtosis is outside the range of -2 to +2 for 10 columns. This indicates some significant nonnormality in the data, which violates the assumption that the data come from normal distributions. You may wish to transform the data or use the Kruskal-Wallis test to compare the medians instead of the means.

ANOVA Table for Hydros Well Depth by Watershed

Source	*Sum of Squares*	*Df*	*Mean Square*	*F-Ratio*	*P-Value*
Between groups	4.11354E6	14	293824.	9.40	0.0000
Within groups	5.63405E7	1802	31265.5		
Total (Corr.)	6.04541E7	1816			

The StatAdvisor
The ANOVA table decomposes the variance of the data into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 9.39771, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than 0.05, there is a statistically significant difference between the means of the 15 variables at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.



Multiple Range Tests for Hydros Well Depth by Watershed

Method: 95.0 percent LSD

Level	*Count*	*Mean*	*Homogeneous Groups*
Quarter Branch	16	289.688	X
Direct to Potomac	55	332.455	X
Piney Run	15	363.0	XXXXX
Limestone Branch	82	363.232	XX
Lower Goose Creek	283	375.097	XX
North Fork Goose Creek	220	396.75	XX
Catoctin Creek	234	412.701	XX
South Fork Catoctin Creek	334	424.766	XXXX
Broad Run	35	426.857	XXXXX
Dutchman Creek	101	439.911	XXX
Beaverdam Creek	232	446.392	XX
Clarks Run	29	451.724	XXXXX
North Fork Catoctin Creek	104	461.442	XX
Upper Goose Creek	44	509.273	X
Bull Run	33	643.758	X

Contrast	*Sig.*	*Difference*	*+/- Limits*
Beaverdam Creek - Broad Run		19.5351	62.8434
Beaverdam Creek - Bull Run	*	-197.365	64.4769
Beaverdam Creek - Catoctin Creek	*	33.6914	32.1087
Beaverdam Creek - Clarks Run		-5.3319	68.2589
Beaverdam Creek - Direct to Potomac	*	113.938	51.9754
Beaverdam Creek - Dutchman Creek		6.48135	41.3142
Beaverdam Creek - Limestone Branch	*	83.1605	44.5242
Beaverdam Creek - Lower Goose Creek	*	71.2951	30.6936
Beaverdam Creek - North Fork Catoctin Creek		-15.0501	40.8969
Beaverdam Creek - North Fork Goose Creek	*	49.6422	32.6134
Beaverdam Creek - Piney Run		83.3922	92.3296
Beaverdam Creek - Quarter Branch	*	156.705	89.5785
Beaverdam Creek - South Fork Catoctin Creek		21.6258	29.6192
Beaverdam Creek - Upper Goose Creek	*	-62.8805	56.9857
Broad Run - Bull Run	*	-216.9	84.0902
Broad Run - Catoctin Creek		14.1563	62.8082
Broad Run - Clarks Run		-24.867	87.024
Broad Run - Direct to Potomac	*	94.4026	74.9355
Broad Run - Dutchman Creek		-13.0537	67.9762
Broad Run - Limestone Branch		63.6254	69.9735
Broad Run - Lower Goose Creek		51.76	62.0967
Broad Run - North Fork Catoctin Creek		-34.5852	67.7234
Broad Run - North Fork Goose Creek		30.1071	63.0676
Broad Run - Piney Run		63.8571	106.952
Broad Run - Quarter Branch	*	137.17	104.586
Broad Run - South Fork Catoctin Creek		2.09068	61.5727
Broad Run - Upper Goose Creek	*	-82.4156	78.4938
Bull Run - Catoctin Creek	*	231.057	64.4425
Bull Run - Clarks Run	*	192.033	88.2108
Bull Run - Direct to Potomac	*	311.303	76.3106
Bull Run - Dutchman Creek	*	203.847	69.4891
Bull Run - Limestone Branch	*	280.526	71.4442
Bull Run - Lower Goose Creek	*	268.66	63.7493
Bull Run - North Fork Catoctin Creek	*	182.315	69.2418
Bull Run - North Fork Goose Creek	*	247.008	64.6955
Bull Run - Piney Run	*	280.758	107.92
Bull Run - Quarter Branch	*	354.07	105.575
Bull Run - South Fork Catoctin Creek	*	218.991	63.239
Bull Run - Upper Goose Creek	*	134.485	79.8075
Catoctin Creek - Clarks Run		-39.0233	68.2265
Catoctin Creek - Direct to Potomac	*	80.2463	51.9328
Catoctin Creek - Dutchman Creek		-27.21	41.2606
Catoctin Creek - Limestone Branch	*	49.4691	44.4745
Catoctin Creek - Lower Goose Creek	*	37.6037	30.6215
Catoctin Creek - North Fork Catoctin Creek	*	-48.7415	40.8428
Catoctin Creek - North Fork Goose Creek		15.9509	32.5455
Catoctin Creek - Piney Run		49.7009	92.3056
Catoctin Creek - Quarter Branch	*	123.013	89.5538
Catoctin Creek - South Fork Catoctin Creek		-12.0656	29.5444
Catoctin Creek - Upper Goose Creek	*	-96.5719	56.9469
Clarks Run - Direct to Potomac	*	119.27	79.5319
Clarks Run - Dutchman Creek		11.8132	73.0119
Clarks Run - Limestone Branch	*	88.4924	74.8751
Clarks Run - Lower Goose Creek	*	76.627	67.572
Clarks Run - North Fork Catoctin Creek		-9.71817	72.7767
Clarks Run - North Fork Goose Creek		54.9741	68.4654
Clarks Run - Piney Run		88.7241	110.221

Clarks Run - Quarter Branch	*	162.037	107.927
Clarks Run - South Fork Catoctin Creek		26.9577	67.0908
Clarks Run - Upper Goose Creek		-57.5486	82.893
Direct to Potomac - Dutchman Creek	*	-107.456	58.0767
Direct to Potomac - Limestone Branch		-30.7772	60.4024
Direct to Potomac - Lower Goose Creek		-42.6426	51.07
Direct to Potomac - North Fork Catoctin Creek	*	-128.988	57.7807
Direct to Potomac - North Fork Goose Creek	*	-64.2955	52.2463
Direct to Potomac - Piney Run		-30.5455	100.949
Direct to Potomac - Quarter Branch		42.767	98.4396
Direct to Potomac - South Fork Catoctin Creek	*	-92.3119	50.4315
Direct to Potomac - Upper Goose Creek	*	-176.818	70.0958
Dutchman Creek - Limestone Branch	*	76.6792	51.5157
Dutchman Creek - Lower Goose Creek	*	64.8137	40.1692
Dutchman Creek - North Fork Catoctin Creek		-21.5314	48.4152
Dutchman Creek - North Fork Goose Creek	*	43.1609	41.6545
Dutchman Creek - Piney Run		76.9109	95.8969
Dutchman Creek - Quarter Branch	*	150.223	93.2511
Dutchman Creek - South Fork Catoctin Creek		15.1444	39.3543
Dutchman Creek - Upper Goose Creek	*	-69.3618	62.6007
Limestone Branch - Lower Goose Creek		-11.8655	43.4639
Limestone Branch - North Fork Catoctin Creek	*	-98.2106	51.1817
Limestone Branch - North Fork Goose Creek		-33.5183	44.8402
Limestone Branch - Piney Run		0.231707	97.3229
Limestone Branch - Quarter Branch		73.5442	94.717
Limestone Branch - South Fork Catoctin Creek	*	-61.5348	42.7119
Limestone Branch - Upper Goose Creek	*	-146.041	64.764
Lower Goose Creek - North Fork Catoctin Creek	*	-86.3451	39.74
Lower Goose Creek - North Fork Goose Creek		-21.6528	31.1502
Lower Goose Creek - Piney Run		12.0972	91.8229
Lower Goose Creek - Quarter Branch		85.4097	89.0562
Lower Goose Creek - South Fork Catoctin Creek	*	-49.6693	28.0
Lower Goose Creek - Upper Goose Creek	*	-134.176	56.1612
North Fork Catoctin Creek - North Fork Goose Creek	*	64.6923	41.2407
North Fork Catoctin Creek - Piney Run	*	98.4423	95.7179
North Fork Catoctin Creek - Quarter Branch	*	171.755	93.067
North Fork Catoctin Creek - South Fork Catoctin Creek		36.6758	38.9161
North Fork Catoctin Creek - Upper Goose Creek		-47.8304	62.3261
North Fork Goose Creek - Piney Run		33.75	92.4824
North Fork Goose Creek - Quarter Branch	*	107.063	89.736
North Fork Goose Creek - South Fork Catoctin Creek		-28.0165	30.0921
North Fork Goose Creek - Upper Goose Creek	*	-112.523	57.233
Piney Run - Quarter Branch		73.3125	124.554
Piney Run - South Fork Catoctin Creek		-61.7665	91.4694
Piney Run - Upper Goose Creek	*	-146.273	103.618
Quarter Branch - South Fork Catoctin Creek	*	-135.079	88.6916
Quarter Branch - Upper Goose Creek	*	-219.585	101.175
South Fork Catoctin Creek - Upper Goose Creek	*	-84.5063	55.5812

* denotes a statistically significant difference.

The StatAdvisor

This table applies a multiple comparison procedure to determine which means are significantly different from which others. The bottom half of the output shows the estimated difference between each pair of means. An asterisk has been placed next to 59 pairs, indicating that these pairs show statistically significant differences at the 95.0% confidence level. At the top of the page, 8 homogenous groups are identified using columns of X's. Within each column, the levels containing X's form a group of means within which there are no statistically significant differences. The method currently being used to discriminate among the means is Fisher's least significant difference (LSD) procedure. With this method, there is a 5.0% risk of calling each pair of means significantly different when the actual difference equals 0.

Kruskal-Wallis Test for Hydros Well Depth by Watershed

Watershed	*Sample Size*	*Average Rank*
Beaverdam Creek	232	991.412
Broad Run	35	986.8
Bull Run	33	1264.92
Catoctin Creek	234	888.788
Clarks Run	29	1036.19
Direct to Potomac	55	643.0
Dutchman Creek	101	961.901
Limestone Branch	82	747.024
Lower Goose Creek	283	795.318
North Fork Catoctin Creek	104	971.288
North Fork Goose Creek	220	890.47
Piney Run	15	774.733
Quarter Branch	16	502.25
South Fork Catoctin Creek	334	951.799
Upper Goose Creek	44	1227.63

Test statistic = 91.0751 P-Value = 0.0

The StatAdvisor

The Kruskal-Wallis test tests the null hypothesis that the medians within each of the 15 columns is the same. The data from all the columns is first combined and ranked from smallest to largest. The average rank is then computed for the data in each column. Since the P-value is less than 0.05, there is a statistically significant difference amongst the medians at the 95.0% confidence level. To determine which medians are significantly different from which others, select Box-and-Whisker Plot from the list of Graphical Options and select the median notch option.

Mood's Median Test for Hydros Well Depth by Watershed

Total n = 1817

Grand median = 390.0

Watershed	*Sample Size*	*n<=*	*n>*	*Median*	*95.0% lower CL*	*95.0% upper CL*
Beaverdam Creek	232	103	129	400.0	387.785	420.0
Broad Run	35	11	24	460.0	383.723	500.0
Bull Run	33	6	27	430.0	430.0	900.0
Catoctin Creek	234	125	109	350.0	300.0	400.0
Clarks Run	29	10	19	500.0	300.0	580.0
Direct to Potomac	55	34	21	300.0	240.0	409.315
Dutchman Creek	101	47	54	400.0	320.0	500.0
Limestone Branch	82	51	31	302.5	266.007	389.981
Lower Goose Creek	283	165	118	320.0	300.0	362.506
North Fork Catoctin Creek	104	52	52	390.0	312.211	500.0
North Fork Goose Creek	220	112	108	380.0	360.0	400.0
Piney Run	15	11	4	300.0	300.0	482.183
Quarter Branch	16	14	2	262.5	190.345	372.069
South Fork Catoctin Creek	334	160	174	400.0	360.0	420.0
Upper Goose Creek	44	13	31	509.0	480.0	600.0

Test statistic = 61.4602 P-Value = 6.4953E-8

The StatAdvisor

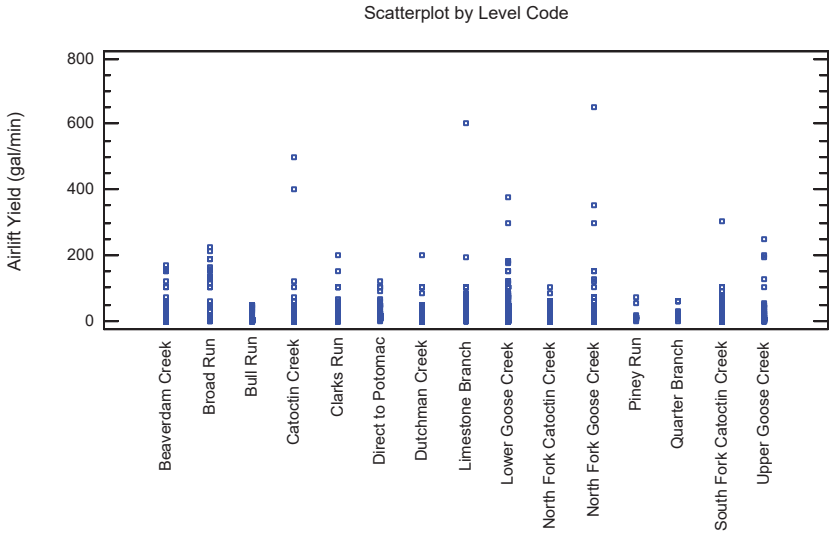
Mood's median test tests the hypothesis that the medians of all 15 samples are equal. It does so by counting the number of observations in each sample on either side of the grand median, which equals 390.0. Since the P-value for the chi-squared test is less than 0.05, the medians of the samples are significantly different at the 95.0% confidence level. Also included (if available) are 95.0% confidence intervals for each median based on the order statistics of each sample.

Multiple-Sample Comparison Hydros Airlift Yield by Watershed

Dependent variable: AIRLIFT_YIELD
Factor: Watershed

Number of observations: 1812
Number of levels: 15

The StatAdvisor
This procedure compares the data in 15 columns of the current data file. It constructs various statistical tests and graphs to compare the samples. The F-test in the ANOVA table will test whether there are any significant differences amongst the means. If there are, the Multiple Range Tests will tell you which means are significantly different from which others. If you are worried about the presence of outliers, choose the Kruskal-Wallis Test which compares medians instead of means. The various plots will help you judge the practical significance of the results, as well as allow you to look for possible violations of the assumptions underlying the analysis of variance.



Summary Statistics for AIRLIFT_YIELD

Watershed	*Count*	*Average*	*Median*	*Geometric mean*	*Standard deviation*
Beaverdam Creek	231	15.6963	8.0		25.2612
Broad Run	35	79.25	51.0	40.1741	68.9867
Bull Run	33	11.697	3.0	3.93431	16.9132
Catoctin Creek	232	16.8922	8.0		43.5915
Clarks Run	29	37.5431	7.0		52.3938
Direct to Potomac	55	28.0364	20.0	18.2307	28.1365
Dutchman Creek	102	15.1127	8.0		26.0795
Limestone Branch	81	42.1049	27.0	22.9715	70.7297
Lower Goose Creek	284	28.1688	15.0	13.8524	41.2147
North Fork Catoctin Creek	104	13.7841	8.0	7.26389	17.7479
North Fork Goose Creek	217	24.0668	12.0		56.6691
Piney Run	15	15.6667	10.0	9.73426	19.6311
Quarter Branch	16	23.125	17.5	15.5674	19.8053
South Fork Catoctin Creek	334	17.0714	10.0		23.7122
Upper Goose Creek	44	34.5341	13.5		55.9689
Total	1812	22.4998	10.0		41.3683

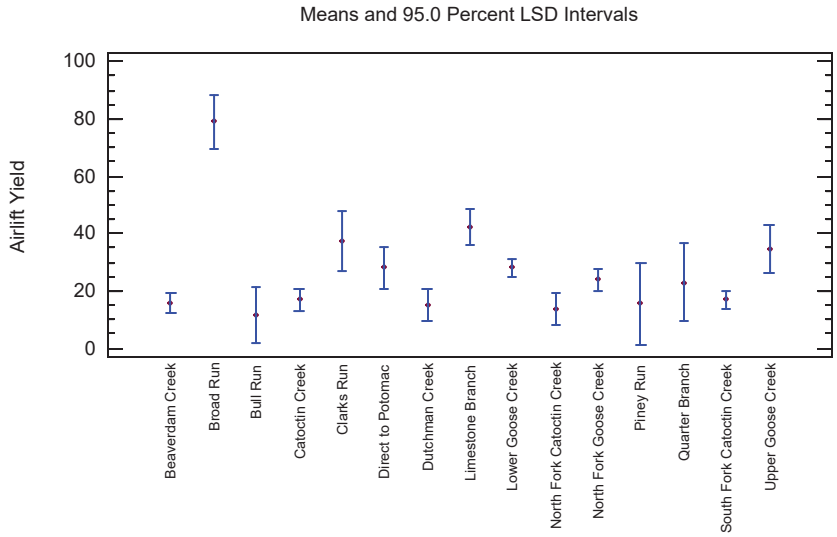
Watershed	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*
Beaverdam Creek	160.937%	0.0	171.0	171.0	3.5	15.0
Broad Run	87.0495%	0.25	222.0	221.75	14.0	135.0
Bull Run	144.595%	0.25	50.0	49.75	1.5	10.0
Catoctin Creek	258.056%	0.0	500.0	500.0	3.5	20.0
Clarks Run	139.556%	0.0	200.0	200.0	1.0	60.0
Direct to Potomac	100.357%	2.0	120.0	118.0	10.0	35.0
Dutchman Creek	172.566%	0.0	200.0	200.0	4.0	12.0
Limestone Branch	167.984%	1.0	600.0	599.0	15.0	50.0
Lower Goose Creek	146.313%	0.15	375.0	374.85	6.0	30.0
North Fork Catoctin Creek	128.756%	1.0	100.0	99.0	2.75	15.0
North Fork Goose Creek	235.466%	0.0	650.0	650.0	5.0	20.0
Piney Run	125.305%	1.0	72.0	71.0	6.0	12.0
Quarter Branch	85.6446%	1.0	60.0	59.0	10.0	27.5
South Fork Catoctin Creek	138.9%	0.0	304.0	304.0	5.0	20.0
Upper Goose Creek	162.069%	0.0	250.0	250.0	4.0	40.0
Total	183.86%	0.0	650.0	650.0	5.0	25.0

Watershed	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
Beaverdam Creek	11.5	24.4647	55.9083
Broad Run	121.0	1.29423	-1.26573
Bull Run	8.5	3.46035	0.678109
Catoctin Creek	16.5	56.0513	282.083
Clarks Run	59.0	3.52368	2.41329
Direct to Potomac	25.0	5.42356	3.95973
Dutchman Creek	8.0	18.7965	54.6745
Limestone Branch	35.0	23.6109	90.7452
Lower Goose Creek	24.0	28.5497	86.4911
North Fork Catoctin Creek	12.25	10.6766	15.3773
North Fork Goose Creek	15.0	47.4493	228.69
Piney Run	6.0	3.83202	4.10161
Quarter Branch	17.5	1.95824	0.169154
South Fork Catoctin Creek	15.0	45.8533	241.875
Upper Goose Creek	36.0	7.17196	9.19207
Total	20.0	119.958	638.571

The StatAdvisor
This table shows various statistics for each of the 15 columns of data. To test for significant differences amongst the column means, select Analysis of Variance from the list of Tabular Options. Select Means Plot from the list of Graphical Options to display the means graphically.

WARNING: There is more than a 3 to 1 difference between the smallest standard deviation and the largest. This may cause problems since the analysis of variance assumes that the standard deviations at all levels are equal. Select Variance Check from the list of Tabular Options to run a formal statistical test for differences among the sigmas. You may want to consider transforming the data to remove any dependence of the standard deviation on the mean.

WARNING: The standardized skewness and/or kurtosis is outside the range of -2 to +2 for 13 columns. This indicates some significant nonnormality in the data, which violates the assumption that the data come from normal distributions. You may wish to transform the data or use the Kruskal-Wallis test to compare the medians instead of the means.

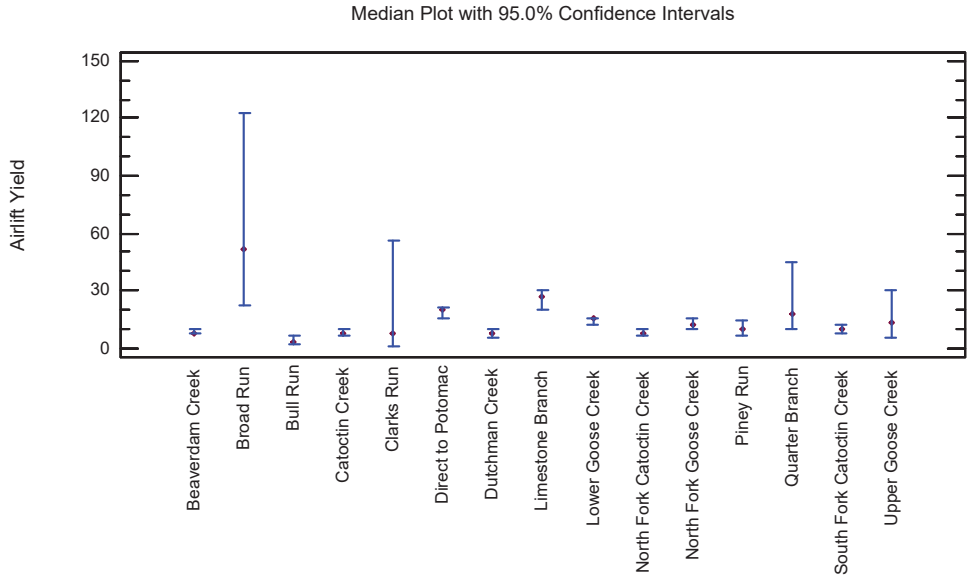


ANOVA Table for AIRLIFT_YIELD by Watershed

Source	*Sum of Squares*	*Df*	*Mean Square*	*F-Ratio*	*P-Value*
Between groups	213988.	14	15284.9	9.52	0.0000
Within groups	2.88524E6	1797	1605.59		
Total (Corr.)	3.09923E6	1811			

The StatAdvisor

The ANOVA table decomposes the variance of the data into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 9.5198, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than 0.05, there is a statistically significant difference between the means of the 15 variables at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.



Multiple Range Tests for AIRLIFT_YIELD by Watershed

Method: 95.0 percent LSD

Level	*Count*	*Mean*	*Homogeneous Groups*
Bull Run	33	11.697	XXX
North Fork Catoctin Creek	104	13.7841	X
Dutchman Creek	102	15.1127	XXX
Piney Run	15	15.6667	XXXX
Beaverdam Creek	231	15.6963	X
Catoctin Creek	232	16.8922	XXX
South Fork Catoctin Creek	334	17.0714	X X
Quarter Branch	16	23.125	XXXXX
North Fork Goose Creek	217	24.0668	X X
Direct to Potomac	55	28.0364	XXX
Lower Goose Creek	284	28.1688	X
Upper Goose Creek	44	34.5341	XX
Clarks Run	29	37.5431	XX
Limestone Branch	81	42.1049	X
Broad Run	35	79.25	X

Contrast	*Sig.*	*Difference*	*+/- Limits*
Beaverdam Creek - Broad Run	*	-63.5537	14.2451
Beaverdam Creek - Bull Run		3.99935	14.6152
Beaverdam Creek - Catoctin Creek		-1.19592	7.29972
Beaverdam Creek - Clarks Run	*	-21.8468	15.472
Beaverdam Creek - Direct to Potomac	*	-12.34	11.7832
Beaverdam Creek - Dutchman Creek		0.583575	9.33646
Beaverdam Creek - Limestone Branch	*	-26.4086	10.1413
Beaverdam Creek - Lower Goose Creek	*	-12.4725	6.95832
Beaverdam Creek - North Fork Catoctin Creek		1.91219	9.27397
Beaverdam Creek - North Fork Goose Creek	*	-8.3705	7.42453
Beaverdam Creek - Piney Run		0.0296537	20.9258
Beaverdam Creek - Quarter Branch		-7.42868	20.3025
Beaverdam Creek - South Fork Catoctin Creek		-1.37509	6.72065
Beaverdam Creek - Upper Goose Creek	*	-18.8378	12.9181
Broad Run - Bull Run	*	67.553	19.0559
Broad Run - Catoctin Creek	*	62.3578	14.2411
Broad Run - Clarks Run	*	41.7069	19.7207
Broad Run - Direct to Potomac	*	51.2136	16.9813
Broad Run - Dutchman Creek	*	64.1373	15.3848
Broad Run - Limestone Branch	*	37.1451	15.8861
Broad Run - Lower Goose Creek	*	51.0812	14.0692
Broad Run - North Fork Catoctin Creek	*	65.4659	15.347
Broad Run - North Fork Goose Creek	*	55.1832	14.3055
Broad Run - Piney Run	*	63.5833	24.2366
Broad Run - Quarter Branch	*	56.125	23.7005
Broad Run - South Fork Catoctin Creek	*	62.1786	13.9531
Broad Run - Upper Goose Creek	*	44.7159	17.7877
Bull Run - Catoctin Creek		-5.19527	14.6113
Bull Run - Clarks Run	*	-25.8461	19.9897
Bull Run - Direct to Potomac		-16.3394	17.2929
Bull Run - Dutchman Creek		-3.41578	15.7281
Bull Run - Limestone Branch	*	-30.408	16.2188
Bull Run - Lower Goose Creek	*	-16.4719	14.4437
Bull Run - North Fork Catoctin Creek		-2.08716	15.6911
Bull Run - North Fork Goose Creek		-12.3699	14.674
Bull Run - Piney Run		-3.9697	24.4559

Bull Run - Quarter Branch		-11.428	23.9247
Bull Run - South Fork Catoctin Creek		-5.37444	14.3307
Bull Run - Upper Goose Creek	*	-22.8371	18.0854
Catoctin Creek - Clarks Run	*	-20.6509	15.4683
Catoctin Creek - Direct to Potomac		-11.1441	11.7783
Catoctin Creek - Dutchman Creek		1.7795	9.33029
Catoctin Creek - Limestone Branch	*	-25.2127	10.1357
Catoctin Creek - Lower Goose Creek	*	-11.2766	6.95005
Catoctin Creek - North Fork Catoctin Creek		3.10811	9.26776
Catoctin Creek - North Fork Goose Creek		-7.17458	7.41678
Catoctin Creek - Piney Run		1.22557	20.923
Catoctin Creek - Quarter Branch		-6.23276	20.2996
Catoctin Creek - South Fork Catoctin Creek		-0.179166	6.71208
Catoctin Creek - Upper Goose Creek	*	-17.6418	12.9137
Clarks Run - Direct to Potomac		9.50674	18.0229
Clarks Run - Dutchman Creek	*	22.4304	16.5273
Clarks Run - Limestone Branch		-4.56183	16.995
Clarks Run - Lower Goose Creek		9.37427	15.3102
Clarks Run - North Fork Catoctin Creek	*	23.759	16.4921
Clarks Run - North Fork Goose Creek		13.4763	15.5276
Clarks Run - Piney Run		21.8764	24.9774
Clarks Run - Quarter Branch		14.4181	24.4576
Clarks Run - South Fork Catoctin Creek	*	20.4717	15.2036
Clarks Run - Upper Goose Creek		3.00901	18.7846
Direct to Potomac - Dutchman Creek		12.9236	13.1382
Direct to Potomac - Limestone Branch	*	-14.0686	13.7218
Direct to Potomac - Lower Goose Creek		-0.132474	11.5698
Direct to Potomac - North Fork Catoctin Creek	*	14.2522	13.0938
Direct to Potomac - North Fork Goose Creek		3.96954	11.856
Direct to Potomac - Piney Run		12.3697	22.8764
Direct to Potomac - Quarter Branch		4.91136	22.3076
Direct to Potomac - South Fork Catoctin Creek		10.965	11.4284
Direct to Potomac - Upper Goose Creek		-6.49773	15.8846
Dutchman Creek - Limestone Branch	*	-26.9922	11.6882
Dutchman Creek - Lower Goose Creek	*	-13.0561	9.06568
Dutchman Creek - North Fork Catoctin Creek		1.32861	10.9442
Dutchman Creek - North Fork Goose Creek		-8.95408	9.42826
Dutchman Creek - Piney Run		-0.553922	21.7177
Dutchman Creek - Quarter Branch		-8.01225	21.1177
Dutchman Creek - South Fork Catoctin Creek		-1.95866	8.88456
Dutchman Creek - Upper Goose Creek	*	-19.4213	14.165
Limestone Branch - Lower Goose Creek	*	13.9361	9.89261
Limestone Branch - North Fork Catoctin Creek	*	28.3208	11.6384
Limestone Branch - North Fork Goose Creek	*	18.0381	10.2259
Limestone Branch - Piney Run	*	26.4383	22.0756
Limestone Branch - Quarter Branch		18.9799	21.4857
Limestone Branch - South Fork Catoctin Creek	*	25.0335	9.7269
Limestone Branch - Upper Goose Creek		7.57085	14.7079
Lower Goose Creek - North Fork Catoctin Creek	*	14.3847	9.00132
Lower Goose Creek - North Fork Goose Creek		4.10202	7.08102
Lower Goose Creek - Piney Run		12.5022	20.8064
Lower Goose Creek - Quarter Branch		5.04384	20.1794
Lower Goose Creek - South Fork Catoctin Creek	*	11.0974	6.3391
Lower Goose Creek - Upper Goose Creek		-6.36525	12.7238
North Fork Catoctin Creek - North Fork Goose Creek	*	-10.2827	9.36638
North Fork Catoctin Creek - Piney Run		-1.88253	21.6909
North Fork Catoctin Creek - Quarter Branch		-9.34087	21.0902
North Fork Catoctin Creek - South Fork Catoctin Creek		-3.28727	8.81887

North Fork Catoctin Creek - Upper Goose Creek	*	-20.75	14.1239
North Fork Goose Creek - Piney Run		8.40015	20.9669
North Fork Goose Creek - Quarter Branch		0.94182	20.3448
North Fork Goose Creek - South Fork Catoctin Creek	*	6.99541	6.8476
North Fork Goose Creek - Upper Goose Creek		-10.4673	12.9846
Piney Run - Quarter Branch		-7.45833	28.2255
Piney Run - South Fork Catoctin Creek		-1.40474	20.7281
Piney Run - Upper Goose Creek		-18.8674	23.4812
Quarter Branch - South Fork Catoctin Creek		6.05359	20.0986
Quarter Branch - Upper Goose Creek		-11.4091	22.9274
South Fork Catoctin Creek - Upper Goose Creek	*	-17.4627	12.5954

* denotes a statistically significant difference.

The StatAdvisor
This table applies a multiple comparison procedure to determine which means are significantly different from which others. The bottom half of the output shows the estimated difference between each pair of means. An asterisk has been placed next to 47 pairs, indicating that these pairs show statistically significant differences at the 95.0% confidence level. At the top of the page, 6 homogenous groups are identified using columns of X's. Within each column, the levels containing X's form a group of means within which there are no statistically significant differences. The method currently being used to discriminate among the means is Fisher's least significant difference (LSD) procedure. With this method, there is a 5.0% risk of calling each pair of means significantly different when the actual difference equals 0.

Kruskal-Wallis Test for AIRLIFT_YIELD by Watershed

Watershed	*Sample Size*	*Average Rank*
Beaverdam Creek	231	783.411
Broad Run	35	1409.99
Bull Run	33	581.773
Catoctin Creek	232	788.776
Clarks Run	29	860.69
Direct to Potomac	55	1159.6
Dutchman Creek	102	753.039
Limestone Branch	81	1261.51
Lower Goose Creek	284	1034.97
North Fork Catoctin Creek	104	768.096
North Fork Goose Creek	217	936.493
Piney Run	15	865.8
Quarter Branch	16	1115.69
South Fork Catoctin Creek	334	873.626
Upper Goose Creek	44	969.898

Test statistic = 158.909 P-Value = 0.0

The StatAdvisor
The Kruskal-Wallis test tests the null hypothesis that the medians within each of the 15 columns is the same. The data from all the columns is first combined and ranked from smallest to largest. The average rank is then computed for the data in each column. Since the P-value is less than 0.05, there is a statistically significant difference amongst the medians at the 95.0% confidence level. To determine which medians are significantly different from which others, select Box-and-Whisker Plot from the list of Graphical Options and select the median notch option.

Mood's Median Test for AIRLIFT_YIELD by Watershed
Total n = 1812
Grand median = 10.0

Watershed	*Sample Size*	*n<=*	*n>*	*Median*	*95.0% lower CL*	*95.0% upper CL*
Beaverdam Creek	231	154	77	8.0	7.0	10.0
Broad Run	35	5	30	51.0	21.8613	123.139
Bull Run	33	25	8	3.0	2.0	6.0
Catoctin Creek	232	140	92	8.0	6.0	10.0
Clarks Run	29	15	14	7.0	1.0	56.5316
Direct to Potomac	55	17	38	20.0	15.0	21.4382
Dutchman Creek	102	72	30	8.0	5.28954	10.0
Limestone Branch	81	15	66	27.0	20.0	30.0
Lower Goose Creek	284	118	166	15.0	12.0	15.0
North Fork Catoctin Creek	104	70	34	8.0	6.0	10.0
North Fork Goose Creek	217	105	112	12.0	10.0	15.0
Piney Run	15	11	4	10.0	6.0	14.4655
Quarter Branch	16	7	9	17.5	10.0	44.4824
South Fork Catoctin Creek	334	176	158	10.0	8.0	12.0
Upper Goose Creek	44	18	26	13.5	5.0	30.0

Test statistic = 142.825 P-Value = 0.0

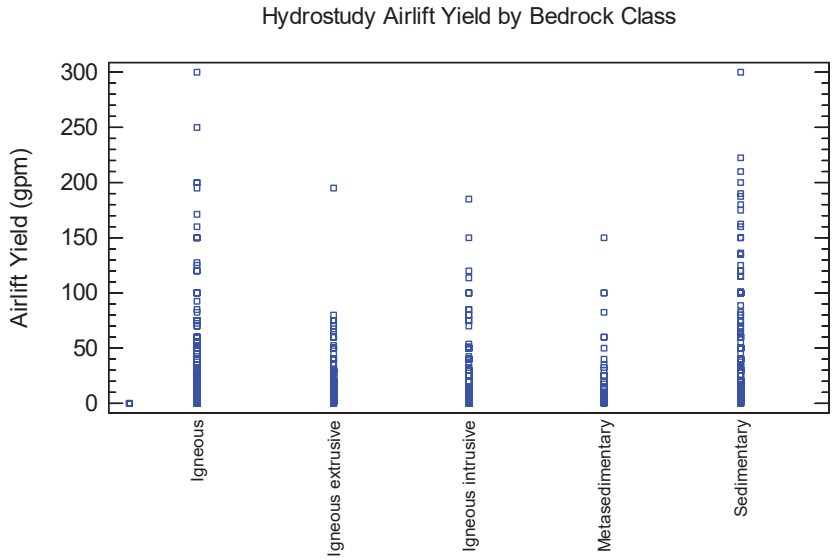
The StatAdvisor
Mood's median test tests the hypothesis that the medians of all 15 samples are equal. It does so by counting the number of observations in each sample on either side of the grand median, which equals 10.0. Since the P-value for the chi-squared test is less than 0.05, the medians of the samples are significantly different at the 95.0% confidence level. Also included (if available) are 95.0% confidence intervals for each median based on the order statistics of each sample.

Multiple-Sample Comparison Airlift Yield (hydros) by Rock Class

Dependent variable: AIRLIFT_YIELD_1
Factor: BE_ROCK_CLASS

Number of observations: 1812
Number of levels: 5

The StatAdvisor
This procedure compares the data in 5 columns of the current data file. It constructs various statistical tests and graphs to compare the samples. The F-test in the ANOVA table will test whether there are any significant differences amongst the means. If there are, the Multiple Range Tests will tell you which means are significantly different from which others. If you are worried about the presence of outliers, choose the Kruskal-Wallis Test which compares medians instead of means. The various plots will help you judge the practical significance of the results, as well as allow you to look for possible violations of the assumptions underlying the analysis of variance.



Summary Statistics for AIRLIFT_YIELD_1

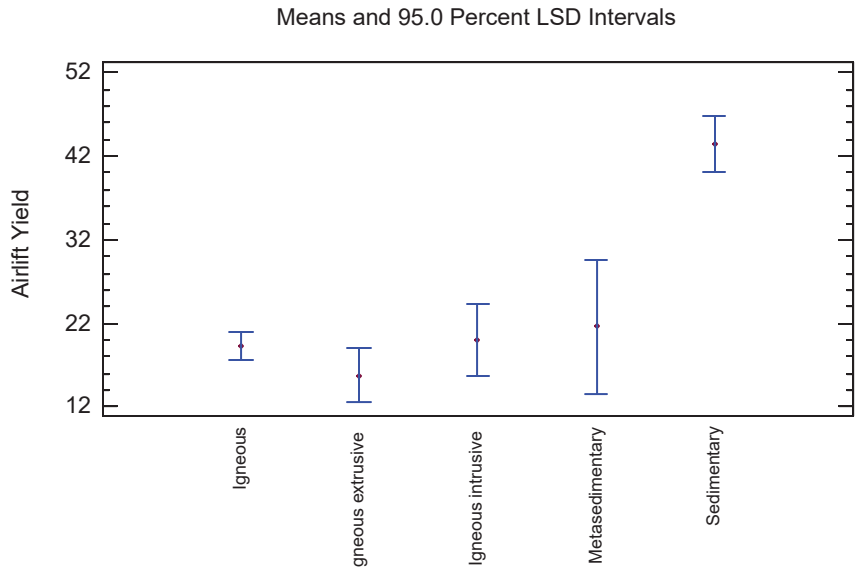
ROCK CLASS	*Count*	*Average*	*Median*	*Geometric mean*	*Standard deviation*	*Coeff. of variation*	*Minimum*
Igneous	1020	19.267	10.0		40.4258	209.819%	0.0
Igneous extrusive	306	15.7698	10.0		18.204	115.436%	0.0
Igneous intrusive	161	19.963	8.0		30.0662	150.609%	0.0
Metasedimentary	49	21.5969	10.0		30.8257	142.732%	0.0
Sedimentary	276	43.5489	20.0		60.1433	138.105%	0.0
Total	1812	22.4998	10.0		41.3683	183.86%	0.0

ROCK CLASS	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
Igneous	650.0	650.0	4.0	20.0	16.0	107.987	622.926
Igneous extrusive	195.0	195.0	5.0	20.0	15.0	29.812	112.896
Igneous intrusive	185.0	185.0	3.0	25.0	22.0	13.7476	21.5365
Metasedimentary	150.0	150.0	3.0	25.0	22.0	6.97674	9.20988
Sedimentary	600.0	600.0	12.0	50.0	38.0	29.6214	103.027
Total	650.0	650.0	5.0	25.0	20.0	119.958	638.571

The StatAdvisor
This table shows various statistics for each of the 5 columns of data. To test for significant differences amongst the column means, select Analysis of Variance from the list of Tabular Options. Select Means Plot from the list of Graphical Options to display the means graphically.

WARNING: There is more than a 3 to 1 difference between the smallest standard deviation and the largest. This may cause problems since the analysis of variance assumes that the standard deviations at all levels are equal. Select Variance Check from the list of Tabular Options to run a formal statistical test for differences among the sigmas. You may want to consider transforming the data to remove any dependence of the standard deviation on the mean.

WARNING: The standardized skewness and/or kurtosis is outside the range of -2 to +2 for 5 columns. This indicates some significant nonnormality in the data, which violates the assumption that the data come from normal distributions. You may wish to transform the data or use the Kruskal-Wallis test to compare the medians instead of the means.

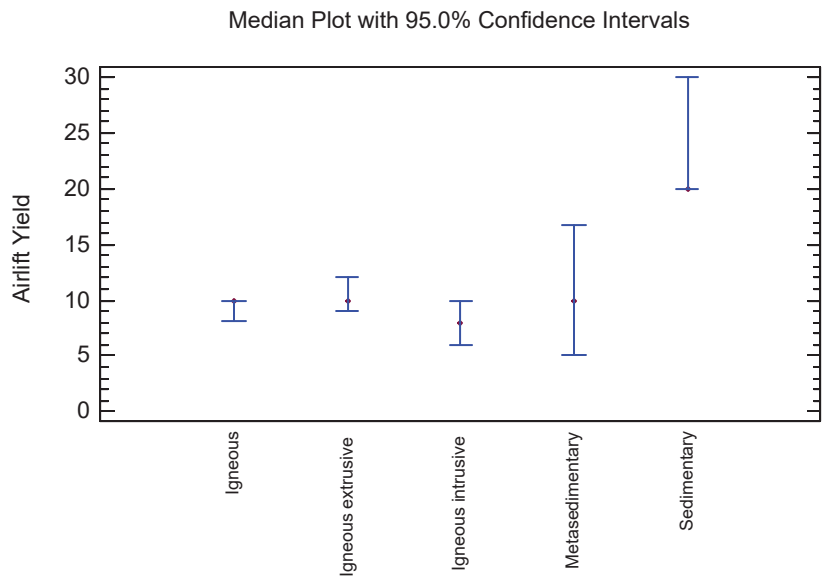


ANOVA Table for AIRLIFT_YIELD_1 by ROCK CLASS

Source	*Sum of Squares*	*Df*	*Mean Square*	*F-Ratio*	*P-Value*
Between groups	147882.	4	36970.4	22.64	0.0000
Within groups	2.95135E6	1807	1633.29		
Total (Corr.)	3.09923E6	1811			

The StatAdvisor

The ANOVA table decomposes the variance of the data into two components: a between-group component and a within-group component. The F-ratio, which in this case equals 22.6356, is a ratio of the between-group estimate to the within-group estimate. Since the P-value of the F-test is less than 0.05, there is a statistically significant difference between the means of the 5 variables at the 95.0% confidence level. To determine which means are significantly different from which others, select Multiple Range Tests from the list of Tabular Options.



Multiple Range Tests for AIRLIFT_YIELD_1 by Rock Class

Method: 95.0 percent LSD

ROCK CLASS	*Count*	*Mean*	*Homogeneous Groups*
Igneous extrusive	306	15.7698	X
Igneous	1020	19.267	X
Igneous intrusive	161	19.963	X
Metasedimentary	49	21.5969	X
Sedimentary	276	43.5489	X

Contrast	*Sig.*	*Difference*	*+/- Limits*
Igneous - Igneous extrusive		3.49724	5.16287
Igneous - Igneous intrusive		-0.696034	6.71726
Igneous - Metasedimentary		-2.32993	11.5843
Igneous - Sedimentary	*	-24.2819	5.37437
Igneous extrusive - Igneous intrusive		-4.19327	7.71196
Igneous extrusive - Metasedimentary		-5.82717	12.1881
Igneous extrusive - Sedimentary	*	-27.7791	6.57546
Igneous intrusive - Metasedimentary		-1.6339	12.9235
Igneous intrusive - Sedimentary	*	-23.5859	7.85513
Metasedimentary - Sedimentary	*	-21.952	12.2792

* denotes a statistically significant difference.

The StatAdvisor

This table applies a multiple comparison procedure to determine which means are significantly different from which others. The bottom half of the output shows the estimated difference between each pair of means. An asterisk has been placed next to 4 pairs, indicating that these pairs show statistically significant differences at the 95.0% confidence level. At the top of the page, 2 homogenous groups are identified using columns of X's. Within each column, the levels containing X's form a group of means within which there are no statistically significant differences. The method currently being used to discriminate among the means is Fisher's least significant difference (LSD) procedure. With this method, there is a 5.0% risk of calling each pair of means significantly different when the actual difference equals 0.

Kruskal-Wallis Test for AIRLIFT YIELD by ROCK CLASS

ROCK CLASS	*Sample Size*	*Average Rank*
Igneous	1020	847.18
Igneous extrusive	306	884.203
Igneous intrusive	161	804.109
Metasedimentary	49	862.449
Sedimentary	276	1217.99

Test statistic = 118.284 P-Value = 0.0

The StatAdvisor

The Kruskal-Wallis test tests the null hypothesis that the medians within each of the 5 columns is the same. The data from all the columns is first combined and ranked from smallest to largest. The average rank is then computed for the data in each column. Since the P-value is less than 0.05, there is a statistically significant difference amongst the medians at the 95.0% confidence level. To determine which medians are significantly different from which others, select Box-and-Whisker Plot from the list of Graphical Options and select the median notch option.

Mood's Median Test for AIRLIFT YIELD by ROCK CLASS

Total n = 1812

Grand median = 10.0

ROCK CLASS	*Sample Size*	*n<=*	*n>*	*Median*	*95.0% lower CL*	*95.0% upper CL*
Igneous	1020	586	434	10.0	8.09959	10.0
Igneous extrusive	306	163	143	10.0	9.0	12.0
Igneous intrusive	161	103	58	8.0	6.0	10.0
Metasedimentary	49	28	21	10.0	5.0	16.7264
Sedimentary	276	68	208	20.0	20.0	30.0

Test statistic = 104.882 P-Value = 0.0

The StatAdvisor

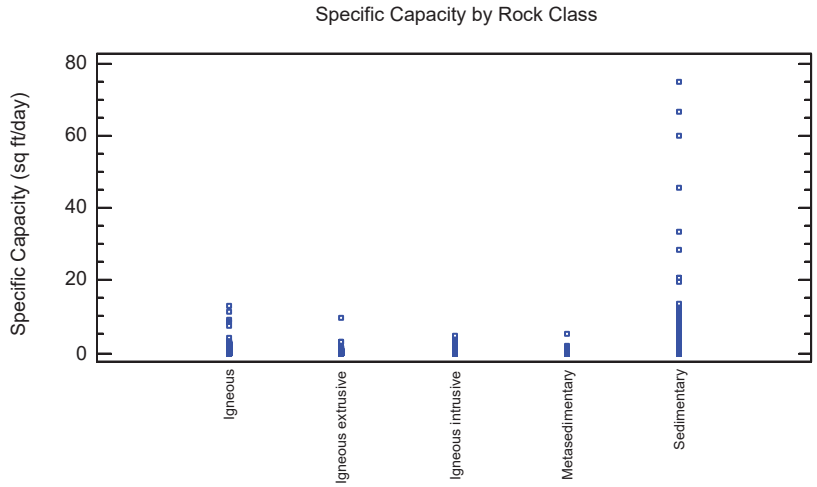
Mood's median test tests the hypothesis that the medians of all 5 samples are equal. It does so by counting the number of observations in each sample on either side of the grand median, which equals 10.0. Since the P-value for the chi-squared test is less than 0.05, the medians of the samples are significantly different at the 95.0% confidence level. Also included (if available) are 95.0% confidence intervals for each median based on the order statistics of each sample.

Multiple-Sample Comparison of Specific Capacity (hydros) by Rock Class

Dependent variable: SPECIFIC CAPACITY
Factor: BE_ROCK_CL_1

Number of observations: 1395
Number of levels: 5

The StatAdvisor
This procedure compares the data in 5 columns of the current data file. It constructs various statistical tests and graphs to compare the samples. The F-test in the ANOVA table will test whether there are any significant differences amongst the means. If there are, the Multiple Range Tests will tell you which means are significantly different from which others. If you are worried about the presence of outliers, choose the Kruskal-Wallis Test which compares medians instead of means. The various plots will help you judge the practical significance of the results, as well as allow you to look for possible violations of the assumptions underlying the analysis of variance.



Summary Statistics for SPECIFIC_CAPACITY_1

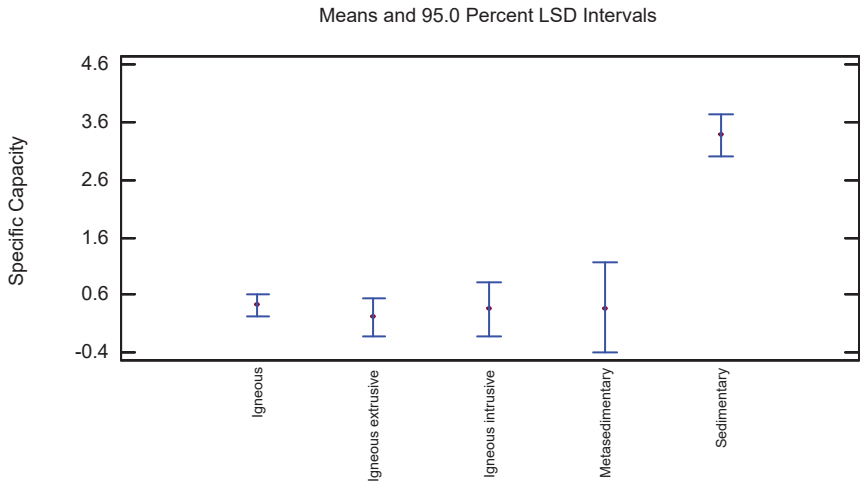
ROCK CLASS	*Count*	*Average*	*Median*	*Geometric mean*	*Standard deviation*	*Coeff. of variation*	*Minimum*
Igneous	793	0.428007	0.13	0.134046	0.953394	222.752%	0.00286369
Igneous extrusive	245	0.214567	0.0851064	0.0834826	0.708801	330.34%	0.005
Igneous intrusive	115	0.352562	0.123	0.101758	0.713225	202.298%	0.0005
Metasedimentary	45	0.383236	0.091	0.11331	0.823945	214.997%	0.00685714
Sedimentary	197	3.38564	0.501567	0.500396	9.69331	286.306%	0.008
Total	1395	0.800531	0.131	0.144444	3.87096	483.549%	0.0005

ROCK CLASS	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
Igneous	12.9762	12.9733	0.043	0.42	0.377	85.2911	436.548
Igneous extrusive	9.83607	9.83107	0.038	0.17	0.132	70.3869	454.49
Igneous intrusive	4.61538	4.61488	0.0267755	0.32967	0.302895	16.9316	36.8684
Metasedimentary	5.15152	5.14466	0.0388098	0.406667	0.367857	13.0549	36.1099
Sedimentary	75.0	74.992	0.126	1.93182	1.80582	30.2821	88.9679
Total	75.0	74.9995	0.044	0.420402	0.376402	204.924	1632.8

The StatAdvisor
This table shows various statistics for each of the 5 columns of data. To test for significant differences amongst the column means, select Analysis of Variance from the list of Tabular Options. Select Means Plot from the list of Graphical Options to display the means graphically.

WARNING: There is more than a 3 to 1 difference between the smallest standard deviation and the largest. This may cause problems since the analysis of variance assumes that the standard deviations at all levels are equal. Select Variance Check from the list of Tabular Options to run a formal statistical test for differences among the sigmas. You may want to consider transforming the data to remove any dependence of the standard deviation on the mean.

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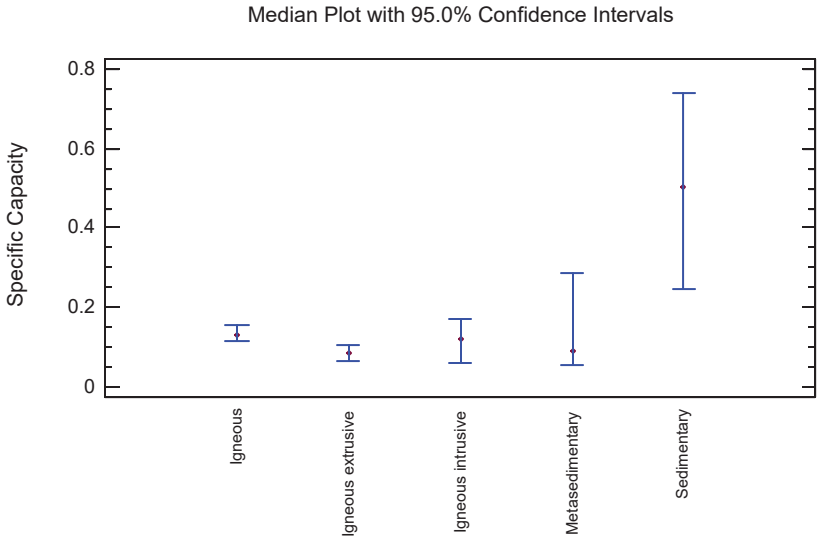
Multiple Range Tests for SPECIFIC CAPACITY by ROCK CLASS
Method: 95.0 percent LSD

ROCK CLASS	*Count*	*Mean*	*Homogeneous Groups*
Igneous extrusive	245	0.214567	X
Igneous intrusive	115	0.352562	X
Metasedimentary	45	0.383236	X
Igneous	793	0.428007	X
Sedimentary	197	3.38564	X

Contrast	*Sig.*	*Difference*	*+/- Limits*
Igneous - Igneous extrusive		0.21344	0.534469
Igneous - Igneous intrusive		0.0754453	0.729627
Igneous - Metasedimentary		0.0447711	1.12053
Igneous - Sedimentary	*	-2.95764	0.582092
Igneous extrusive - Igneous intrusive		-0.137994	0.826538
Igneous extrusive - Metasedimentary		-0.168669	1.18591
Igneous extrusive - Sedimentary	*	-3.17108	0.699743
Igneous intrusive - Metasedimentary		-0.0306743	1.28573
Igneous intrusive - Sedimentary	*	-3.03308	0.858102
Metasedimentary - Sedimentary	*	-3.00241	1.20812

* denotes a statistically significant difference.

The StatAdvisor
This table applies a multiple comparison procedure to determine which means are significantly different from which others. The bottom half of the output shows the estimated difference between each pair of means. An asterisk has been placed next to 4 pairs, indicating that these pairs show statistically significant differences at the 95.0% confidence level. At the top of the page, 2 homogenous groups are identified using columns of X's. Within each column, the levels containing X's form a group of means within which there are no statistically significant differences. The method currently being used to discriminate among the means is Fisher's least significant difference (LSD) procedure. With this method, there is a 5.0% risk of calling each pair of means significantly different when the actual difference equals 0.



Kruskal-Wallis Test for SPECIFIC_CAPACITY by ROCK CLASS

ROCK CLASS	*Sample Size*	*Average Rank*
Igneous	793	691.479
Igneous extrusive	245	562.637
Igneous intrusive	115	630.13
Metasedimentary	45	648.344
Sedimentary	197	943.556

Test statistic = 105.015 P-Value = 0.0

The StatAdvisor

The Kruskal-Wallis test tests the null hypothesis that the medians within each of the 5 columns is the same. The data from all the columns is first combined and ranked from smallest to largest. The average rank is then computed for the data in each column. Since the P-value is less than 0.05, there is a statistically significant difference amongst the medians at the 95.0% confidence level. To determine which medians are significantly different from which others, select Box-and-Whisker Plot from the list of Graphical Options and select the median notch option.

Mood's Median Test for SPECIFIC_CAPACITY by ROCK CLASS

Total n = 1395

Grand median = 0.131

ROCK CLASS	*Sample Size*	*n<=*	*n>*	*Median*	*95.0% lower CL*	*95.0% upper CL*
Igneous	793	399	394	0.13	0.116458	0.15842
Igneous extrusive	245	161	84	0.0851064	0.0677611	0.105328
Igneous intrusive	115	59	56	0.123	0.0616488	0.173932
Metasedimentary	45	26	19	0.091	0.0579183	0.286109
Sedimentary	197	53	144	0.501567	0.244951	0.736606

Test statistic = 67.4335 P-Value = 0.0

The StatAdvisor

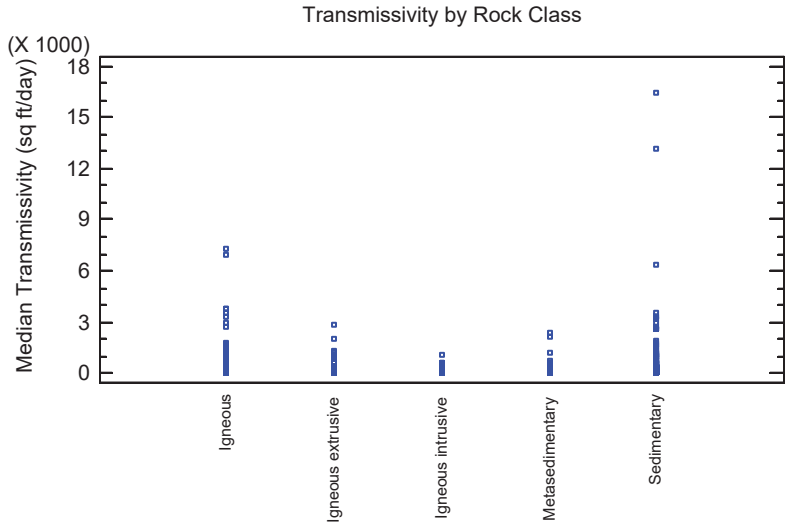
Mood's median test tests the hypothesis that the medians of all 5 samples are equal. It does so by counting the number of observations in each sample on either side of the grand median, which equals 0.131. Since the P-value for the chi-squared test is less than 0.05, the medians of the samples are significantly different at the 95.0% confidence level. Also included (if available) are 95.0% confidence intervals for each median based on the order statistics of each sample.

Multiple-Sample Comparison; Median Transmissivity by Rock Class

Dependent variable: Median_Trans
Factor: ROCK CLASS

Number of observations: 1092
Number of levels: 5

The StatAdvisor
This procedure compares the data in 5 columns of the current data file. It constructs various statistical tests and graphs to compare the samples. The F-test in the ANOVA table will test whether there are any significant differences amongst the means. If there are, the Multiple Range Tests will tell you which means are significantly different from which others. If you are worried about the presence of outliers, choose the Kruskal-Wallis Test which compares medians instead of means. The various plots will help you judge the practical significance of the results, as well as allow you to look for possible violations of the assumptions underlying the analysis of variance.



Summary Statistics for Median_Trans

ROCK CLASS	*Count*	*Average*	*Median*	*Geometric mean*	*Standard deviation*	*Coeff. of variation*	*Minimum*
Igneous	632	181.451	45.975	36.563	554.242	305.449%	0.0000117
Igneous extrusive	173	126.165	31.11	28.7736	318.81	252.693%	0.19
Igneous intrusive	82	110.087	43.75	31.4694	174.959	158.927%	0.0000227
Metasedimentary	42	223.927	25.475	28.3367	521.41	232.848%	0.4
Sedimentary	163	656.796	130.75	120.212	1816.0	276.494%	0.54
Total	1092	239.921	48.0	41.1685	852.727	355.42%	0.0000117

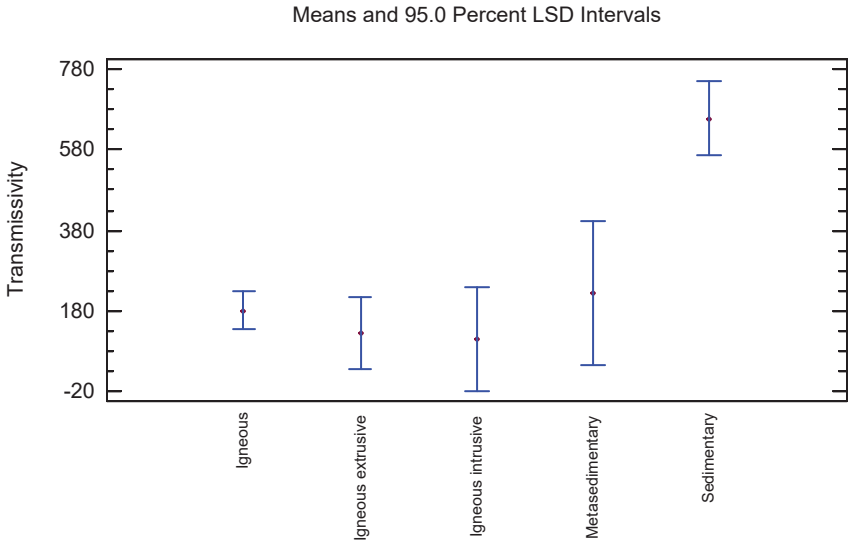
ROCK CLASS	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
Igneous	7280.0	7280.0	13.0	139.25	126.25	86.366	455.116
Igneous extrusive	2810.0	2809.81	9.9	93.0	83.1	30.0509	101.946
Igneous intrusive	1080.0	1080.0	16.0	123.0	107.0	11.6208	22.7719
Metasedimentary	2425.9	2425.5	6.7	86.0	79.3	8.60944	14.2043
Sedimentary	16400.0	16399.5	35.2	521.5	486.3	33.5705	126.474
Total	16400.0	16400.0	13.1	160.0	146.9	155.068	1199.41

The StatAdvisor
This table shows various statistics for each of the 5 columns of data. To test for significant differences amongst the column means, select Analysis of Variance from the list of Tabular Options. Select Means Plot from the list of Graphical Options to display the means graphically.

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formal statistical test for differences among the sigmas. You may want to consider transforming the data to remove any dependence of the standard deviation on the mean.

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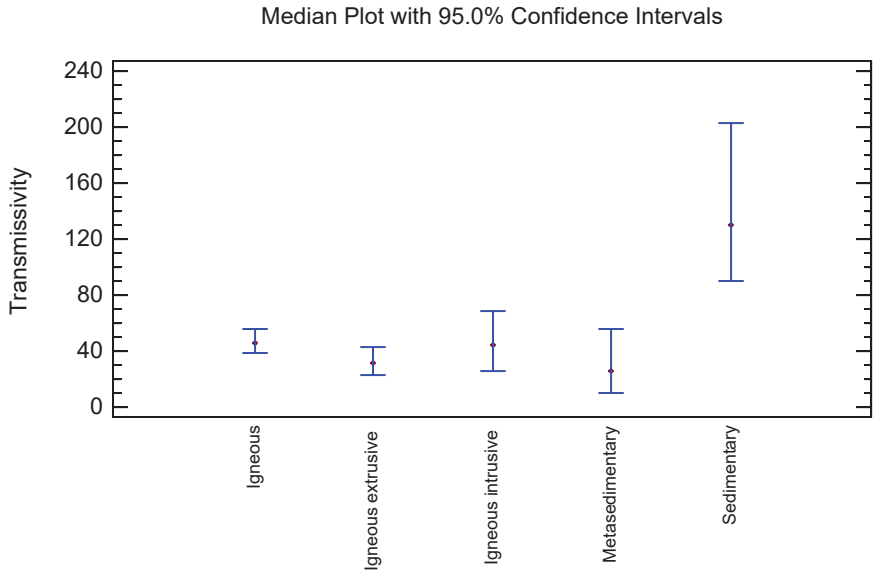
Multiple Range Tests for Median_Trans by ROCK CLASS
Method: 95.0 percent LSD

ROCK CLASS	*Count*	*Mean*	*Homogeneous Groups*
Igneous intrusive	82	110.087	X
Igneous extrusive	173	126.165	X
Igneous	632	181.451	X
Metasedimentary	42	223.927	X
Sedimentary	163	656.796	X

Contrast	*Sig.*	*Difference*	*+/- Limits*
Igneous - Igneous extrusive		55.2862	140.549
Igneous - Igneous intrusive		71.364	192.262
Igneous - Metasedimentary		-42.4755	261.01
Igneous - Sedimentary	*	-475.344	143.894
Igneous extrusive - Igneous intrusive		16.0779	219.609
Igneous extrusive - Metasedimentary		-97.7617	281.762
Igneous extrusive - Sedimentary	*	-530.631	178.798
Igneous intrusive - Metasedimentary		-113.84	310.806
Igneous intrusive - Sedimentary	*	-546.708	221.765
Metasedimentary - Sedimentary	*	-432.869	283.445

* denotes a statistically significant difference.

The StatAdvisor
This table applies a multiple comparison procedure to determine which means are significantly different from which others. The bottom half of the output shows the estimated difference between each pair of means. An asterisk has been placed next to 4 pairs, indicating that these pairs show statistically significant differences at the 95.0% conf. level. At the top of the page, 2 homogenous groups are identified using columns of X's. Within each column, levels containing X's form a group of means within which there are no statistically significant differences. The method currently being used to discriminate among the means is Fisher's least significant difference (LSD) procedure. With this method, there is a 5.0% risk of calling each pair of means significantly different when the actual difference equals 0.



Kruskal-Wallis Test for Median_Trans by ROCK CLASS

ROCK CLASS	*Sample Size*	*Average Rank*
Igneous	632	534.491
Igneous extrusive	173	472.202
Igneous intrusive	82	522.921
Metasedimentary	42	466.333
Sedimentary	163	704.436

Test statistic = 54.5683 P-Value = 4.00118E-11

The StatAdvisor

The Kruskal-Wallis test tests the null hypothesis that the medians within each of the 5 columns is the same. The data from all the columns is first combined and ranked from smallest to largest. The average rank is then computed for the data in each column. Since the P-value is less than 0.05, there is a statistically significant difference amongst the medians at the 95.0% confidence level. To determine which medians are significantly different from which others, select Box-and-Whisker Plot from the list of Graphical Options and select the median notch option.

Mood's Median Test for Median_Trans by ROCK CLASS

Total n = 1092

Grand median = 48.0

ROCK CLASS	*Sample Size*	*n<=*	*n>*	*Median*	*95.0% lower CL*	*95.0% upper CL*
Igneous	632	322	310	45.975	37.9592	55.0
Igneous extrusive	173	105	68	31.11	22.5556	42.8147
Igneous intrusive	82	44	38	43.75	26.0601	68.1541
Metasedimentary	42	26	16	25.475	9.1392	54.9282
Sedimentary	163	50	113	130.75	89.8729	203.933

Test statistic = 35.3073 P-Value = 4.01687E-7

The StatAdvisor

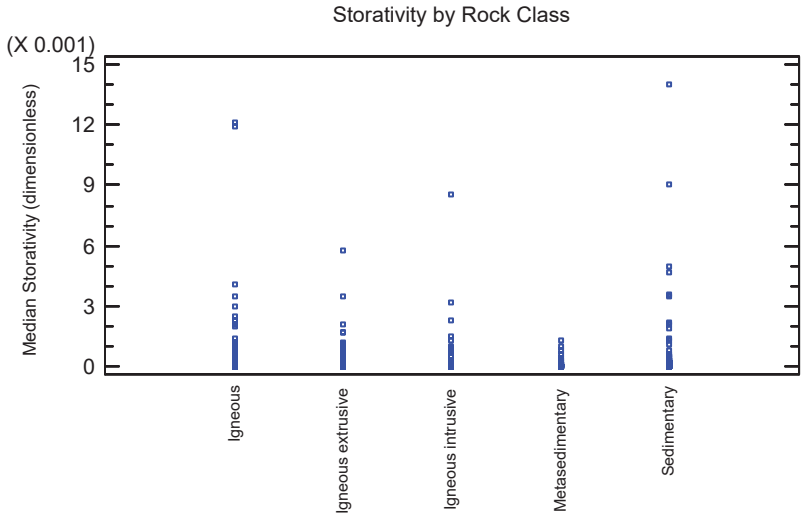
Mood's median test tests the hypothesis that the medians of all 5 samples are equal. It does so by counting the number of observations in each sample on either side of the grand median, which equals 48.0. Since the P-value for the chi-squared test is less than 0.05, the medians of the samples are significantly different at the 95.0% confidence level. Also included (if available) are 95.0% confidence intervals for each median based on the order statistics of each sample.

Multiple-Sample Comparison; Median Storativity by Rock Class

Dependent variable: Median_Stor
Factor: ROCK CLASS

Number of observations: 767
Number of levels: 5

The StatAdvisor
This procedure compares the data in 5 columns of the current data file. It constructs various statistical tests and graphs to compare the samples. The F-test in the ANOVA table will test whether there are any significant differences amongst the means. If there are, the Multiple Range Tests will tell you which means are significantly different from which others. If you are worried about the presence of outliers, choose the Kruskal-Wallis Test which compares medians instead of means. The various plots will help you judge the practical significance of the results, as well as allow you to look for possible violations of the assumptions underlying the analysis of variance.



Summary Statistics for Median_Stor

ROCK CLASS	*Count*	*Average*	*Median*	*Geometric mean*	*Standard deviation*	*Coeff. of variation*
Igneous	465	0.000239295	0.00007	0.000069474	0.000874162	365.307%
Igneous extrusive	119	0.000272933	0.00005965	0.0000690543	0.000681237	249.598%
Igneous intrusive	64	0.000436303	0.00008935	0.0000897812	0.00116879	267.884%
Metasedimentary	23	0.00021188	0.000046	0.0000515208	0.000346386	163.482%
Sedimentary	96	0.00062815	0.0000788	0.000104135	0.00186885	297.516%
Total	767	0.000308801	0.00007	0.0000739287	0.00104923	339.775%

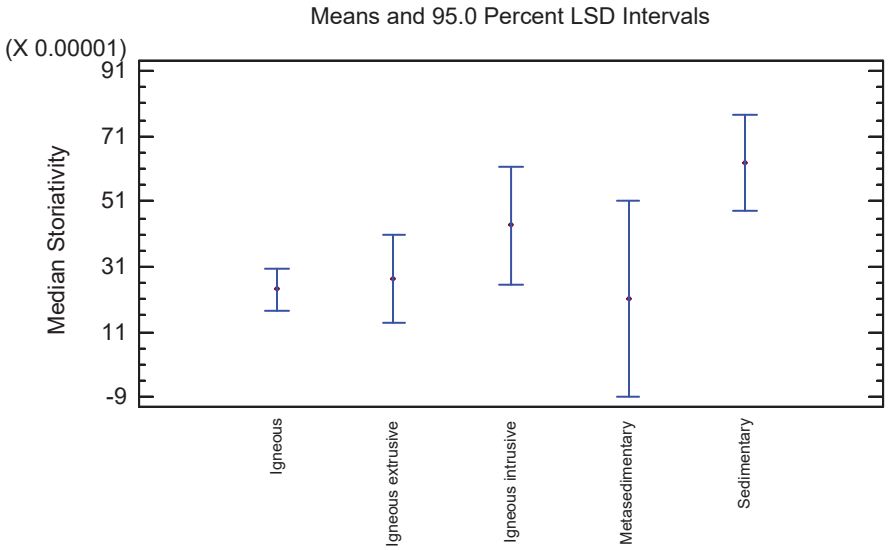
ROCK CLASS	*Minimum*	*Maximum*	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*
Igneous	3.E-8	0.0121485	0.0121485	0.0000275	0.00018	0.0001525
Igneous extrusive	0.00000117	0.005755	0.00575383	0.000029255	0.0002145	0.000185245
Igneous intrusive	0.00000211	0.0085495	0.00854739	0.0000175	0.0003875	0.00037
Metasedimentary	0.00000203	0.00125	0.00124797	0.000016	0.00029	0.000274
Sedimentary	4.1E-7	0.014	0.0139996	0.00003385	0.000253	0.00021915
Total	3.E-8	0.014	0.014	0.000028	0.0002	0.000172

ROCK CLASS	*Stnd. skewness*	*Stnd. kurtosis*
Igneous	98.553	636.344
Igneous extrusive	25.3256	87.3148
Igneous intrusive	18.7972	62.1627
Metasedimentary	3.87195	3.09473
Sedimentary	20.9057	63.0742
Total	98.3006	511.728

The StatAdvisor
This table shows various statistics for each of the 5 columns of data. To test for significant differences amongst the column means, select Analysis of Variance from the list of Tabular Options. Select Means Plot from the list of Graphical Options to display the means graphically.

WARNING: There is more than a 3 to 1 difference between the smallest standard deviation and the largest. This may cause problems since the analysis of variance assumes that the standard deviations at all levels are equal. Select Variance Check from the list of Tabular Options to run a formal statistical test for differences among the sigmas. You may want to consider transforming the data to remove any dependence of the standard deviation on the mean.

WARNING: The standardized skewness and/or kurtosis is outside the range of -2 to +2 for 5 columns. This indicates some significant nonnormality in the data, which violates the assumption that the data come from normal distributions. You may wish to transform the data or use the Kruskal-Wallis test to compare the medians instead of the means.



Multiple Range Tests for Median_Stor by ROCK CLASS

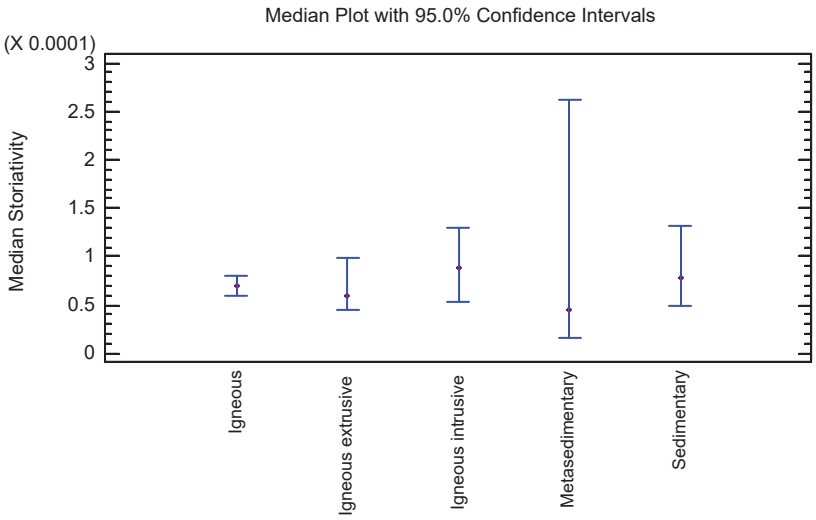
Method: 95.0 percent LSD

ROCK CLASS	*Count*	*Mean*	*Homogeneous Groups*
Metasedimentary	23	0.00021188	XX
Igneous	465	0.000239295	X
Igneous extrusive	119	0.000272933	X
Igneous intrusive	64	0.000436303	XX
Sedimentary	96	0.00062815	X

Contrast	*Sig.*	*Difference*	*+/- Limits*
Igneous - Igneous extrusive		-0.0000336381	0.000210122
Igneous - Igneous intrusive		-0.000197008	0.000272695
Igneous - Metasedimentary		0.0000274151	0.000436903
Igneous - Sedimentary	*	-0.000388855	0.00022929
Igneous extrusive - Igneous intrusive		-0.000163369	0.00031705
Igneous extrusive - Metasedimentary		0.0000610532	0.000465878
Igneous extrusive - Sedimentary	*	-0.000355217	0.000280592
Igneous intrusive - Metasedimentary		0.000224423	0.000497246
Igneous intrusive - Sedimentary		-0.000191848	0.000330065
Metasedimentary - Sedimentary		-0.00041627	0.000474832

* denotes a statistically significant difference.

The StatAdvisor
This table applies a multiple comparison procedure to determine which means are significantly different from which others. The bottom half of the output shows the estimated difference between each pair of means. An asterisk has been placed next to 2 pairs, indicating that these pairs show statistically significant differences at the 95.0% confidence level. At the top of the page, 2 homogenous groups are identified using columns of X's. Within each column, the levels containing X's form a group of means within which there are no statistically significant differences. The method currently being used to discriminate among the means is Fisher's least significant difference (LSD) procedure. With this method, there is a 5.0% risk of calling each pair of means significantly different when the actual difference equals 0.



Kruskal-Wallis Test for Median_Stor by ROCK CLASS

ROCK CLASS	*Sample Size*	*Average Rank*
Igneous	465	377.477
Igneous extrusive	119	378.697
Igneous intrusive	64	406.672
Metasedimentary	23	330.891
Sedimentary	96	419.776

Test statistic = 4.96603 P-Value = 0.2908

The StatAdvisor
The Kruskal-Wallis test tests the null hypothesis that the medians within each of the 5 columns is the same. The data from all the columns is first combined and ranked from smallest to largest. The average rank is then computed for the data in each column. Since the P-value is greater than or equal to 0.05, there is not a statistically significant difference amongst the medians at the 95.0% confidence level.

Mood's Median Test for Median_Stor by ROCK CLASS
Total n = 767
Grand median = 0.00007

ROCK CLASS	*Sample Size*	*n<=*	*n>*	*Median*	*95.0% lower CL*	*95.0% upper CL*
Igneous	465	234	231	0.00007	0.0000599343	0.0000809131
Igneous extrusive	119	65	54	0.00005965	0.0000453384	0.0000984152
Igneous intrusive	64	26	38	0.00008935	0.0000537879	0.000130274
Metasedimentary	23	15	8	0.000046	0.0000162619	0.000261187
Sedimentary	96	44	52	0.0000788	0.00005	0.000131735

Test statistic = 6.08197 P-Value = 0.19311

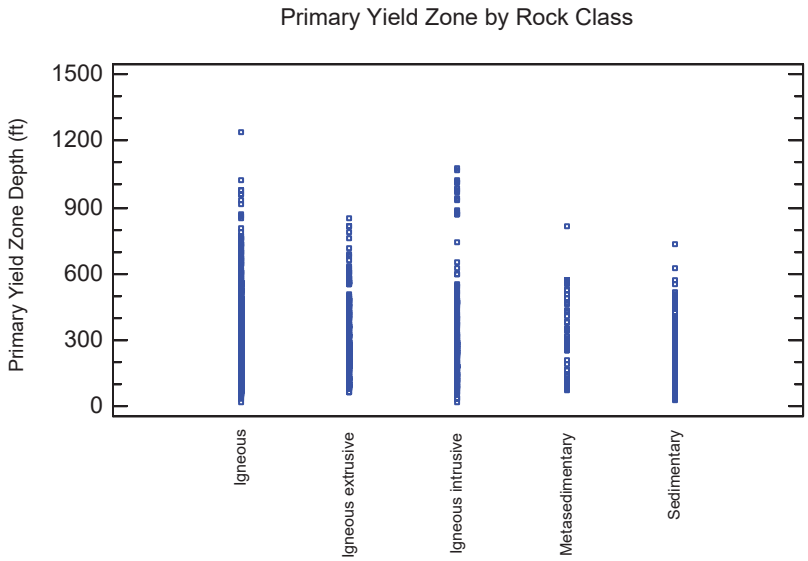
The StatAdvisor
Mood's median test tests the hypothesis that the medians of all 5 samples are equal. It does so by counting the number of observations in each sample on either side of the grand median, which equals 0.00007. Since the P-value for the chi-squared test is greater than or equal to 0.05, the medians of the samples are not significantly different at the 95.0% confidence level. Also included (if available) are 95.0% confidence intervals for each median based on the order statistics of each sample.

Multiple-Sample Comparison; PRIMARY YIELD ZONE BY ROCK CLASS

Dependent variable: YIELD_ZONE
Factor: ROCK CLASS

Number of observations: 1749
Number of levels: 5

The StatAdvisor
This procedure compares the data in 5 columns of the current data file. It constructs various statistical tests and graphs to compare the samples. The F-test in the ANOVA table will test whether there are any significant differences amongst the means. If there are, the Multiple Range Tests will tell you which means are significantly different from which others. If you are worried about the presence of outliers, choose the Kruskal-Wallis Test which compares medians instead of means. The various plots will help you judge the practical significance of the results, as well as allow you to look for possible violations of the assumptions underlying the analysis of variance.



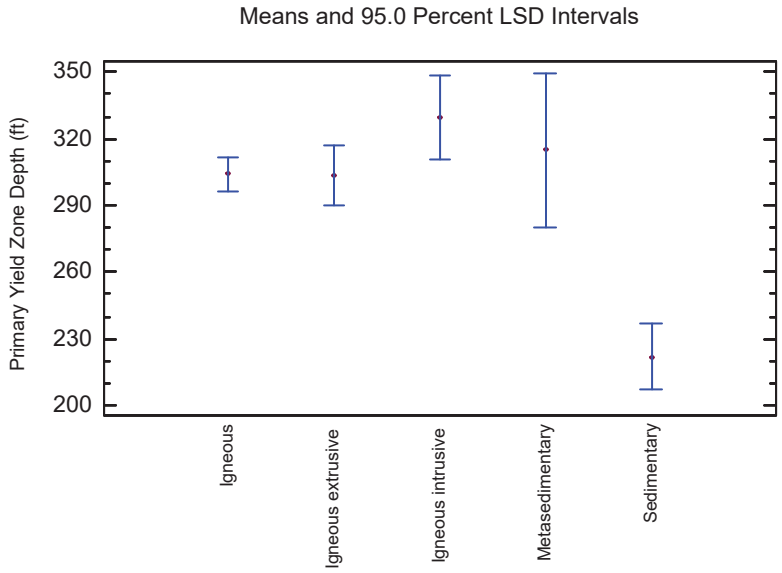
Summary Statistics for YIELD_ZONE

ROCK CLASS	*Count*	*Average*	*Median*	*Geometric mean*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*
Igneous	973	304.198	275.0	257.469	172.825	56.8134%	25.0	1235.0
Igneous extrusive	306	303.359	270.5	264.586	156.861	51.708%	65.0	850.0
Igneous intrusive	159	329.528	262.0	254.436	247.545	75.121%	25.0	1080.0
Metasedimentary	47	314.787	295.0	262.5	176.172	55.9655%	75.0	815.0
Sedimentary	264	222.087	197.0	191.785	120.772	54.3804%	32.0	730.0
Total	1749	294.244	262.0	247.313	174.45	59.2876%	25.0	1235.0

ROCK CLASS	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
Igneous	1210.0	172.0	390.0	218.0	14.1436	11.5475
Igneous extrusive	785.0	190.0	403.0	213.0	6.5652	2.24671
Igneous intrusive	1055.0	160.0	415.0	255.0	7.74612	4.351
Metasedimentary	740.0	150.0	461.0	311.0	1.44092	-0.34036
Sedimentary	698.0	126.0	280.5	154.5	6.88593	3.42209
Total	1210.0	160.0	380.0	220.0	22.2179	20.5297

The StatAdvisor
This table shows various statistics for each of the 5 columns of data. To test for significant differences amongst the column means, select Analysis of Variance from the list of Tabular Options. Select Means Plot from the list of Graphical Options to display the means graphically.

WARNING: The standardized skewness and/or kurtosis is outside the range of -2 to +2 for 4 columns. This indicates some significant nonnormality in the data, which violates the assumption that the data come from normal distributions. You may wish to transform the data or use the Kruskal-Wallis test to compare the medians instead of the means.



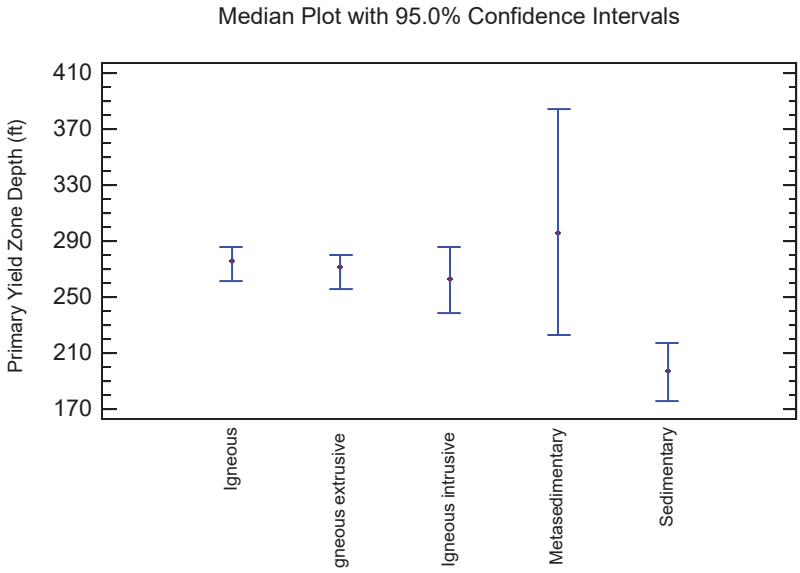
Multiple Range Tests for YIELD_ZONE by ROCK CLASS
Method: 95.0 percent LSD

ROCK CLASS	*Count*	*Mean*	*Homogeneous Groups*
Sedimentary	264	222.087	X
Igneous extrusive	306	303.359	X
Igneous	973	304.198	X
Metasedimentary	47	314.787	X
Igneous intrusive	159	329.528	X

Contrast	*Sig.*	*Difference*	*+/- Limits*
Igneous - Igneous extrusive		0.838365	22.0711
Igneous - Igneous intrusive		-25.3305	28.8054
Igneous - Metasedimentary		-10.5894	50.2922
Igneous - Sedimentary	*	82.1107	23.3686
Igneous extrusive - Igneous intrusive		-26.1688	32.921
Igneous extrusive - Metasedimentary		-11.4278	52.7575
Igneous extrusive - Sedimentary	*	81.2724	28.2866
Igneous intrusive - Metasedimentary		14.7411	55.9104
Igneous intrusive - Sedimentary	*	107.441	33.8046
Metasedimentary - Sedimentary	*	92.7001	53.3133

* denotes a statistically significant difference.

The StatAdvisor
This table applies a multiple comparison procedure to determine which means are significantly different from which others. The bottom half of the output shows the estimated difference between each pair of means. An asterisk has been placed next to 4 pairs, indicating that these pairs show statistically significant differences at the 95.0% confidence level. At the top of the page, 2 homogenous groups are identified using columns of X's. Within each column, the levels containing X's form a group of means within which there are no statistically significant differences. The method currently being used to discriminate among the means is Fisher's least significant difference (LSD) procedure. With this method, there is a 5.0% risk of calling each pair of means significantly different when the actual difference equals 0.



Kruskal-Wallis Test for YIELD_ZONE by ROCK CLASS

ROCK CLASS	*Sample Size*	*Average Rank*
Igneous	973	911.32
Igneous extrusive	306	925.652
Igneous intrusive	159	891.513
Metasedimentary	47	944.351
Sedimentary	264	660.136

Test statistic = 56.9536 P-Value = 1.2652E-11

The StatAdvisor

The Kruskal-Wallis test tests the null hypothesis that the medians within each of the 5 columns is the same. The data from all the columns is first combined and ranked from smallest to largest. The average rank is then computed for the data in each column. Since the P-value is less than 0.05, there is a statistically significant difference amongst the medians at the 95.0% confidence level. To determine which medians are significantly different from which others, select Box-and-Whisker Plot from the list of Graphical Options and select the median notch option.

Mood's Median Test for YIELD_ZONE by ROCK CLASS

Total n = 1749

Grand median = 262.0

ROCK CLASS	*Sample Size*	*n<=*	*n>*	*Median*	*95.0% lower CL*	*95.0% upper CL*
Igneous	973	457	516	275.0	260.847	285.0
Igneous extrusive	306	144	162	270.5	255.0	280.0
Igneous intrusive	159	80	79	262.0	238.128	285.0
Metasedimentary	47	20	27	295.0	222.769	384.229
Sedimentary	264	181	83	197.0	175.0	217.19

Test statistic = 41.9385 P-Value = 1.71786E-8

The StatAdvisor

Mood's median test tests the hypothesis that the medians of all 5 samples are equal. It does so by counting the number of observations in each sample on either side of the grand median, which equals 262.0. Since the P-value for the chi-squared test is less than 0.05, the medians of the samples are significantly different at the 95.0% confidence level. Also included (if available) are 95.0% confidence intervals for each median based on the order statistics of each sample.

Summary Statistics from Hydrostudy Wells

	Well Depth (ft TOC)	*Bedrock Depth (ft bgs)*	*Static Water Level (ft TOC)*	*Specific Capacity (gal/min/ft)*	*Airlift Yield (gal/min)*	*Primary Yield Zone (ft bgs)*	*Secondary Yield Zone (ft bgs)*	*Median Transmissivity (ft2/day)**	*Median Storativity**
Count	1817	1806	1401	1395	1812	1749	920	1092	767
Average	417	29	25.6	0.80	22	294	250	240	3.1E-04
Median	390	25	23	0.131	10	262	202	48	7.0E-05
Geometric mean	380.52	24.37	-	0.14	-	247.31	209.51	41.17	7.4E-05
Standard deviation	182.46	19.85	18.55	3.87	41.37	174.45	162.29	852.73	1.0E-03
Minimum	50	2	0	0.0005	0	25	20	0.000012	3.0E-08
Maximum	1320	305	183	75	650	1235	1200	16400	1.4E-02
Range	1270	303	183	74.9995	650	1210	1180	16400	1.4E-02
Lower quartile	300	16	13	0.044	5	160	135	13.1	2.8E-05
Upper quartile	500	40	34.94	0.42	25	380	317.5	160	2.0E-04
Interquartile range	200	24	21.94	0.38	20	220	182.5	146.9	1.7E-04
Stnd. skewness	18.9	62.1	26.4	204.9	120.0	22.2	23.0	155.1	98.3
Stnd. kurtosis	13.9	293.4	51.6	1632.8	638.6	20.5	30.7	1199.4	511.7

*Median of each test well calculated from multiple observation wells.

Matrix of Pearson Product Moment Correlations for Hydrostudy Well Data.

	Well Depth (ft bgs)	Bedrock Depth (ft bgs)	Static Water Level (ft TOC)	Specific Capacity (gal/min/ft)	Airlift Yield (gal/min)	Primary Yield Zone (ft bgs)	Secondary Yield Zone (ft bgs)	Median Transmissivity (ft2/day)	Median Storativity
Well Depth	Correlation	-0.1212	0.0418	-0.1609	-0.1641	0.6657	0.6314	-0.1404	-0.0433
	(Sample Size)	-1803	-1399	-1393	-1807	-1747	-918	-1091	-766
	P-Value	0	0.1181	0	0	0	0	0	0.2313
Bedrock Depth	-0.1212		0.096	0.0696	-0.0337	-0.066	0.0109	0.113	0.0881
	-1803		-1391	-1385	-1796	-1742	-916	-1082	-760
	0		0.0003	0.0095	0.1529	0.0058	0.7419	0.0002	0.0148
Static Water Level	0.0418	0.096		0.04	-0.0014	0.0887	0.0787	-0.0047	-0.0199
	-1399	-1391		-1391	-1396	-1387	-721	-1089	-765
	0.1181	0.0003		0.1359	0.9588	0.0009	0.0343	0.8764	0.5823
Specific Capacity	-0.1609	0.0696	0.04		0.3452	-0.1079	-0.0521	0.3385	0.1437
	-1393	-1385	-1391		-1390	-1381	-721	-1085	-763
	0	0.0095	0.1359		0	0.0001	0.1622	0	0.0001
Airlift Yield	-0.1641	-0.0337	-0.0014	0.3452		-0.1045	-0.0544	0.2234	0.009
	-1807	-1796	-1396	-1390		-1742	-915	-1089	-764
	0	0.1529	0.9588	0		0	0.0996	0	0.8034
Primary Yield Zone	0.6657	-0.066	0.0887	-0.1079	-0.1045		0.205	-0.1071	-0.05
	-1747	-1742	-1387	-1381	-1742		-920	-1078	-758
	0	0.0058	0.0009	0.0001	0		0	0.0004	0.1684
Secondary Yield Zone	0.6314	0.0109	0.0787	-0.0521	-0.0544	0.205		-0.0744	-0.0235
	-918	-916	-721	-721	-915	-920		-561	-391
	0	0.7419	0.0343	0.1622	0.0996	0		0.0783	0.643
Median Transmissivity	-0.1404	0.113	-0.0047	0.3385	0.2234	-0.1071	-0.0744		0.2449
	-1091	-1082	-1089	-1085	-1089	-1078	-561		-758
	0	0.0002	0.8764	0	0	0.0004	0.0783		0
Median Storativity	-0.0433	0.0881	-0.0199	0.1437	0.009	-0.05	-0.0235	0.2449	
	-766	-760	-765	-763	-764	-758	-391	-758	
	0.2313	0.0148	0.5823	0.0001	0.8034	0.1684	0.643	0	

Statistically significant non-zero correlations at the 95.0% confidence level

No statistically significant non-zero correlations at the 95.0% confidence level

Summary Statistics for Hydrostudies Well Depths (ft bgs) by Year

YEAR	Count	Average	Median	Geometric mean	Standard deviation	Coeff. of variation	Minimum	Maximum	Range	Lower quartile	Upper quartile	Interquartile range	Stnd. skewness	Stnd. kurtosis
1985	1	330.00	330.0	330.0		%	330	330	0	330	330	0		
1986	4	558.75	605.0	537.2	162.14	29.0%	325	700	375	465	652.5	187.5	-1.24581	1.16861
1987	3	365.00	385.0	356.7	91.65	25.1%	265	445	180	265	445	180	-0.6613	
1988	58	281.60	285.00	261.15	113.60	40.3%	102	605	503	200	330	130	2.85886	0.438964
1989	109	316.22	300.00	294.54	122.47	38.7%	110	900	790	230	400	170	5.21719	7.67813
1990	64	392.66	360.00	364.22	144.45	36.8%	50	805	755	305	480	175	2.3512	1.62554
1991	5	459.00	450.00	452.38	86.20	18.8%	350	550	200	405	540	135	-0.0999003	-0.951049
1993	13	267.46	250.00	253.61	92.71	34.7%	125	500	375	225	280	55	1.72756	2.07126
1994	19	352.63	400.00	325.00	131.83	37.4%	140	520	380	225	480	255	-0.590737	-1.2611
1995	16	451.25	500.0	428.2	130.61	28.9%	185	580	395	350	540	190	-1.69312	-0.273183
1996	25	392.32	400.0	364.1	145.34	37.0%	140	750	610	260	500	240	0.485358	0.0407322
1997	16	350.63	352.50	314.26	155.48	44.3%	120	570	450	210	495	285	0.0637809	-1.14854
1998	38	418.82	400.00	390.48	178.38	42.6%	180	1200	1020	300	500	200	5.86061	11.2853
1999	88	397.50	380.00	365.80	163.90	41.2%	160	800	640	260	500	240	2.73375	-0.343667
2000	302	369.09	350.00	345.69	132.87	36.0%	100	800	700	266	440	174	4.51824	-0.0527422
2001	283	420.47	400.00	389.30	160.32	38.1%	100	1000	900	300	520	220	3.6125	0.00231144
2002	130	479.04	430.00	441.64	196.40	41.0%	180	1180	1000	300	600	300	4.0905	1.92606
2003	57	596.58	600.00	573.02	172.19	28.9%	310	1200	890	490	700	210	2.52916	2.65463
2004	63	432.54	380.00	396.09	185.47	42.9%	160	1000	840	300	550	250	2.77287	0.705955
2005	213	491.29	430.00	436.02	247.70	50.4%	100	1320	1220	300	600	300	6.16369	1.65399
2006	299	429.87	380.00	394.95	181.95	42.3%	100	1000	900	300	520	220	6.24439	0.383794
2007	10	482.00	470.00	463.46	140.30	29.1%	320	700	380	320	600	280	0.311699	-0.79001
Total	**1816**	**417.17**	**390.00**	**380.75**	**182.38**	**43.7%**	**50**	**1320**	**1270**	**300**	**500**	**200**	**18.9058**	**13.8854**

Indicates non-normal distribution.

Section D) Detailed analysis of VDH well data.

Subset Analysis

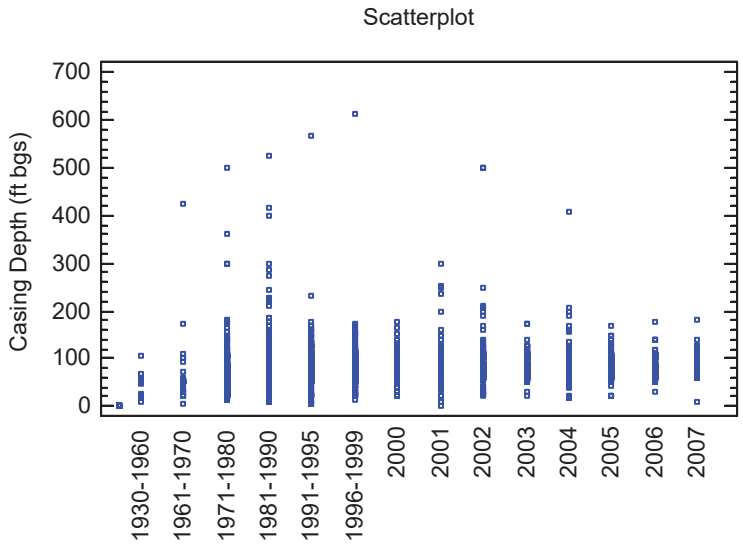
Data variable: casing_depth_b
Code variable: Year_Code

Subset Analysis VDH Casing Depth by Year

Data variable: casing_depth_b
Code variable: Year_Code

Number of observations: 17953
Number of levels: 14

The StatAdvisor
This procedure calculates summary statistics for the values of casing_depth_b corresponding to each of the 14 levels of Year_Code. It also creates a variety of plots and allows you to save the calculated statistics. Further analyses can be performed on the data using the Oneway Analysis of Variance procedure under Compare on the main menu.

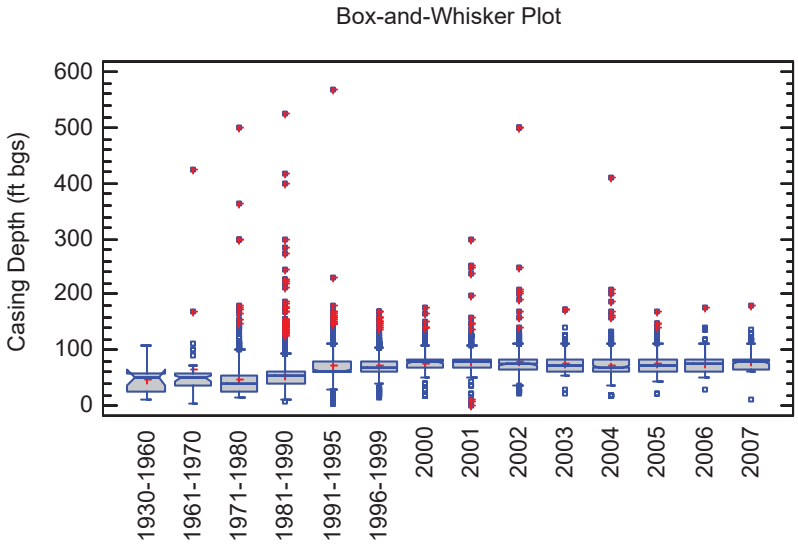


Summary Statistics
Data variable: casing_depth_b

				Standard	*Coefficient*				*Lower*	*Upper*
Year_Code	*Count*	*Average*	*Median*	*Deviation*	*of variation*	*Minimum*	*Maximum*	*Range*	*Quartile*	*Quartile*
1930-1960	13	47.8077	50.0	25.4587	53.2524%	9.5	107.0	97.5	25.0	58.0
1961-1970	36	63.9236	50.0	68.9968	107.936%	4.0	425.0	421.0	34.5	56.5
1971-1980	833	46.2114	40.0	33.7496	73.033%	15.0	500.0	485.0	25.0	55.0
1981-1990	3121	55.8998	55.0	27.8888	49.8907%	8.0	525.0	517.0	41.0	62.0
1991-1995	1117	71.2632	63.0	25.987	36.4663%	5.0	569.0	564.0	60.0	80.0
1996-1999	1491	71.563	68.0	20.7226	28.9571%	15.0	614.0	599.0	63.0	80.0
2000	848	76.5165	78.0	14.6208	19.1081%	20.0	176.0	156.0	68.0	84.0
2001	813	78.9594	80.0	20.8129	26.3589%	0.0	300.0	300.0	68.0	84.0
2002	607	78.4745	75.0	31.1835	39.7372%	21.0	500.0	479.0	65.0	83.0
2003	447	75.6957	72.0	16.7498	22.1279%	21.0	173.0	152.0	63.0	82.5
2004	671	73.7317	70.0	21.4937	29.1512%	18.0	410.0	392.0	63.0	82.0
2005	889	74.6665	73.0	12.652	16.9447%	21.0	170.0	149.0	63.0	82.0
2006	968	74.8701	75.5	11.9411	15.9491%	29.6	178.0	148.4	63.0	82.5
2007	119	80.105	78.0	21.0624	26.2935%	10.0	181.0	171.0	64.0	84.0
Total	11973	67.7016	65.0	26.0053	38.4116%	0.0	614.0	614.0	59.0	80.0

	Interquartile	*Standardized*	*Standardized*
Year_Code	*Range*	*Skewness*	*Kurtosis*
1930-1960	33.0	0.941206	1.007
1961-1970	22.0	10.7754	27.4639
1971-1980	30.0	66.0098	329.161
1981-1990	21.0	99.9625	560.508
1991-1995	20.0	99.4634	835.901
1996-1999	17.0	200.036	2494.45
2000	16.0	13.9554	44.8053
2001	16.0	45.1279	186.711
2002	18.0	89.9455	562.712
2003	19.5	15.4865	25.9778
2004	19.0	73.27	502.469
2005	19.0	19.9213	51.4012
2006	19.5	19.9976	51.5812
2007	20.0	6.01504	10.5378
Total	21.0	210.964	1589.21

The StatAdvisor
This table shows sample statistics for the 14 levels of Year_Code.

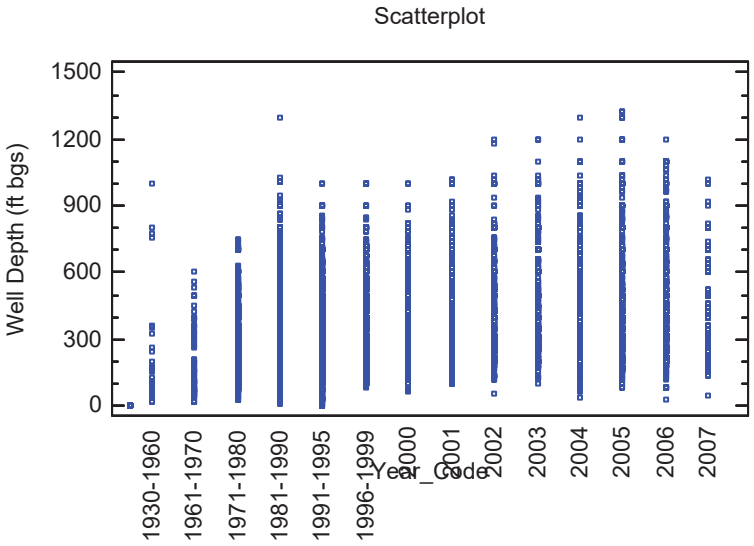


Subset Analysis

Data variable: well_depth
Code variable: Year_Code

Number of observations: 17953
Number of levels: 14

The StatAdvisor
This procedure calculates summary statistics for the values of well_depth corresponding to each of the 14 levels of Year_Code. It also creates a variety of plots and allows you to save the calculated statistics. Further analyses can be performed on the data using the Oneway Analysis of Variance procedure under Compare on the main menu.



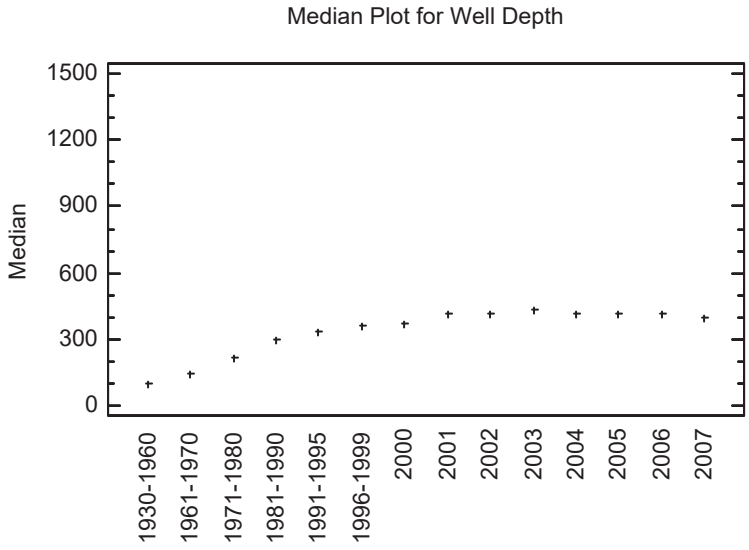
Summary Statistics
Data variable: well_depth

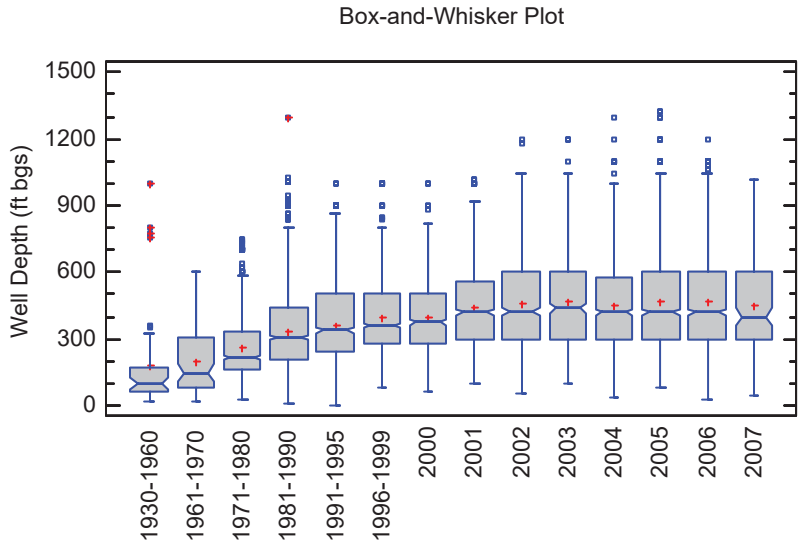
				Standard	*Coefficient*				*Lower*	*Upper*
Year_Code	*Count*	*Average*	*Median*	*Deviation*	*of variation*	*Minimum*	*Maximum*	*Range*	*Quartile*	*Quartile*
1930-1960	46	179.348	100.0	221.284	123.382%	19.0	999.0	980.0	60.0	170.0
1961-1970	80	197.488	147.0	149.814	75.8602%	20.0	605.0	585.0	77.5	308.5
1971-1980	896	258.86	220.0	139.078	53.7272%	25.0	750.0	725.0	160.0	330.0
1981-1990	3343	336.841	305.0	158.956	47.1902%	10.0	1300.0	1290.0	205.0	445.0
1991-1995	1276	363.888	340.0	171.255	47.0625%	1.0	1000.0	999.0	240.0	500.0
1996-1999	1571	393.841	360.0	162.1	41.1587%	85.0	1000.0	915.0	280.0	500.0
2000	892	396.64	375.0	165.785	41.7974%	65.0	1000.0	935.0	280.0	500.0
2001	861	441.713	420.0	182.68	41.3571%	100.0	1020.0	920.0	300.0	560.0
2002	648	457.307	420.0	201.089	43.9723%	52.0	1200.0	1148.0	300.0	600.0
2003	471	471.52	440.0	208.74	44.2696%	100.0	1200.0	1100.0	300.0	605.0
2004	709	452.042	420.0	206.385	45.6562%	40.0	1300.0	1260.0	300.0	580.0
2005	905	472.158	420.0	231.338	48.9958%	80.0	1320.0	1240.0	300.0	600.0
2006	982	471.72	420.0	216.595	45.9159%	30.0	1200.0	1170.0	300.0	600.0
2007	120	452.767	400.0	214.648	47.4081%	45.0	1020.0	975.0	300.0	604.0
Total	12800	389.296	345.0	191.481	49.1864%	1.0	1320.0	1319.0	250.0	500.0

	Interquartile	*Standardized*	*Standardized*
Year_Code	*Range*	*Skewness*	*Kurtosis*
1930-1960	110.0	6.8891	7.89639
1961-1970	231.0	3.43785	-0.190725
1971-1980	170.0	13.2625	5.32472

1981-1990	240.0	16.9479	6.45154
1991-1995	260.0	6.96885	0.429393
1996-1999	220.0	8.81099	-1.42541
2000	220.0	8.21711	0.00178978
2001	260.0	6.78826	-0.244684
2002	300.0	6.5911	0.180076
2003	305.0	6.85206	0.866627
2004	280.0	8.71778	3.0259
2005	300.0	10.9914	2.64949
2006	300.0	10.4209	0.683612
2007	304.0	2.89914	-0.694039
Total	250.0	38.8975	17.7287

The StatAdvisor
This table shows sample statistics for the 14 levels of Year_Code.



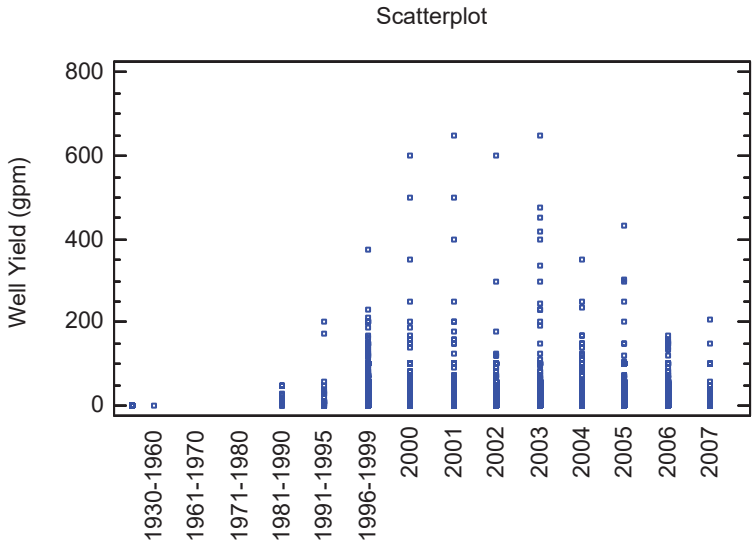


Subset Analysis VDH Well Yield by Year group

Data variable: stablizied_discharge
Code variable: Year_Code

Number of observations: 17953
Number of levels: 14

The StatAdvisor
This procedure calculates summary statistics for the values of stablizied_discharge corresponding to each of the 14 levels of Year_Code. It also creates a variety of plots and allows you to save the calculated statistics. Further analyses can be performed on the data using the Oneway Analysis of Variance procedure under Compare on the main menu.



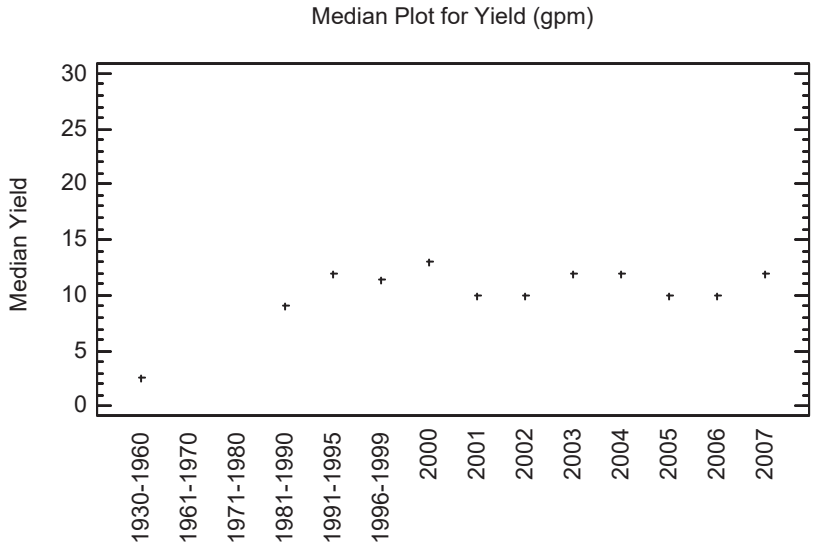
Summary Statistics
Data variable: stablizied_discharge

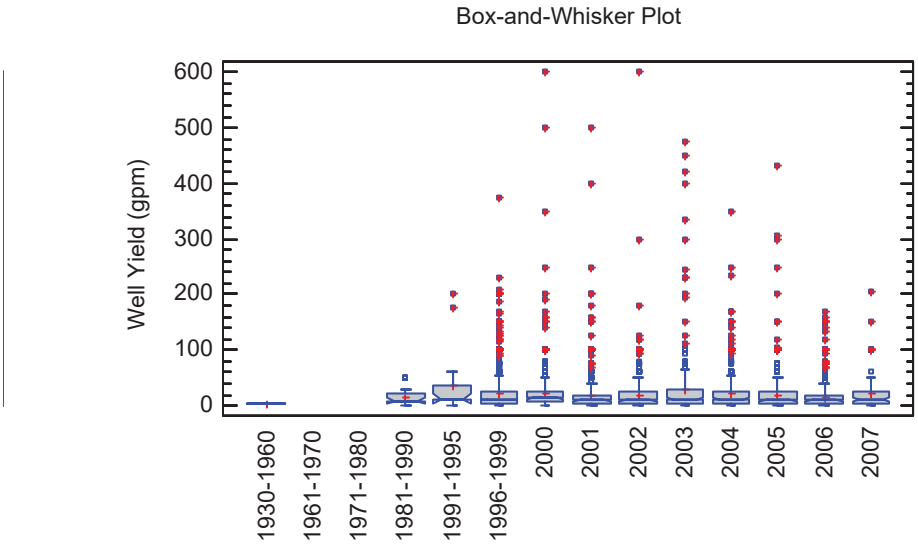
				Standard	*Coefficient*				*Lower*	*Upper*
Year_Code	*Count*	*Average*	*Median*	*Deviation*	*of variation*	*Minimum*	*Maximum*	*Range*	*Quartile*	*Quartile*
1930-1960	1	2.5	2.5		%	2.5	2.5	0.0	2.5	2.5
1961-1970	0				%					
1971-1980	0				%					
1981-1990	20	16.4	9.0	16.2486	99.0766%	1.0	50.0	49.0	5.75	21.5
1991-1995	21	35.5357	12.0	53.3128	150.026%	0.25	200.0	199.75	10.0	35.0
1996-1999	1510	20.8041	11.5	29.5032	141.814%	0.0	375.0	375.0	5.0	25.0
2000	858	22.2244	13.0	37.4788	168.639%	0.0	600.0	600.0	6.0	25.0
2001	828	19.6327	10.0	39.9902	203.692%	0.0	650.0	650.0	5.0	20.0
2002	627	19.9112	10.0	34.254	172.034%	0.0	600.0	600.0	4.0	25.0
2003	460	28.4837	12.0	60.3058	211.721%	0.0	650.0	650.0	5.0	30.0
2004	689	22.0976	12.0	30.7529	139.169%	0.0	350.0	350.0	5.0	25.0
2005	899	19.4513	10.0	30.4629	156.611%	0.0	432.0	432.0	5.0	25.0
2006	968	15.8527	10.0	20.2949	128.022%	0.0	171.0	171.0	5.0	20.0
2007	116	21.7414	12.0	29.7904	137.022%	0.5	205.0	204.5	5.0	25.0
Total	6997	20.5776	10.0	34.5516	167.909%	0.0	650.0	650.0	5.0	25.0

	Interquartile	*Standardized*	*Standardized*
Year_Code	*Range*	*Skewness*	*Kurtosis*
1930-1960	0.0		
1961-1970			
1971-1980			

1981-1990	15.75	2.51951	0.615754
1991-1995	25.0	4.70851	5.46741
1996-1999	20.0	62.9183	196.182
2000	19.0	101.333	630.549
2001	15.0	104.026	653.993
2002	21.0	95.1929	709.743
2003	25.0	52.8647	195.183
2004	20.0	45.4759	154.495
2005	20.0	74.2514	360.648
2006	15.0	45.9904	115.314
2007	20.0	14.9587	33.1808
Total	20.0	256.19	1582.59

The StatAdvisor
This table shows sample statistics for the 14 levels of Year_Code.



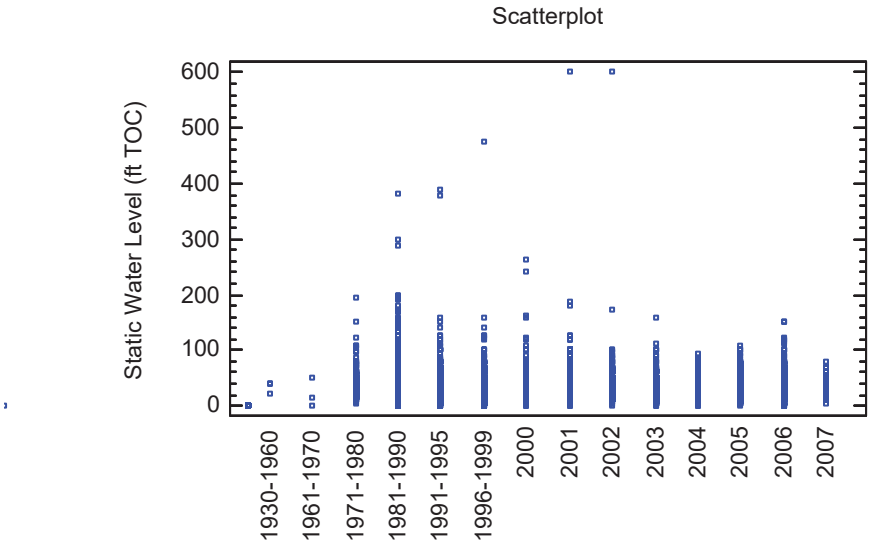


Subset Analysis

Data variable: well_static_water
Code variable: Year_Code

Number of observations: 17953
Number of levels: 14

The StatAdvisor
This procedure calculates summary statistics for the values of well_static_water corresponding to each of the 14 levels of Year_Code. It also creates a variety of plots and allows you to save the calculated statistics. Further analyses can be performed on the data using the Oneway Analysis of Variance procedure under Compare on the main menu.



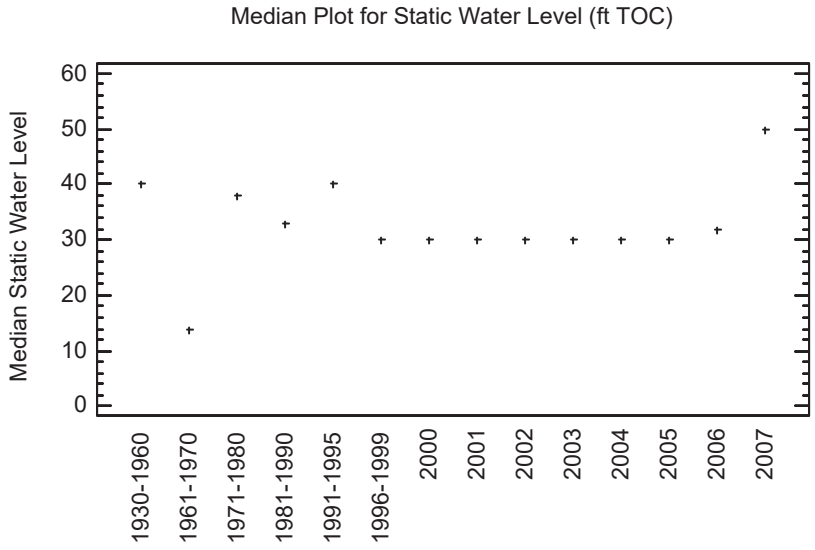
Summary Statistics
Data variable: well_static_water

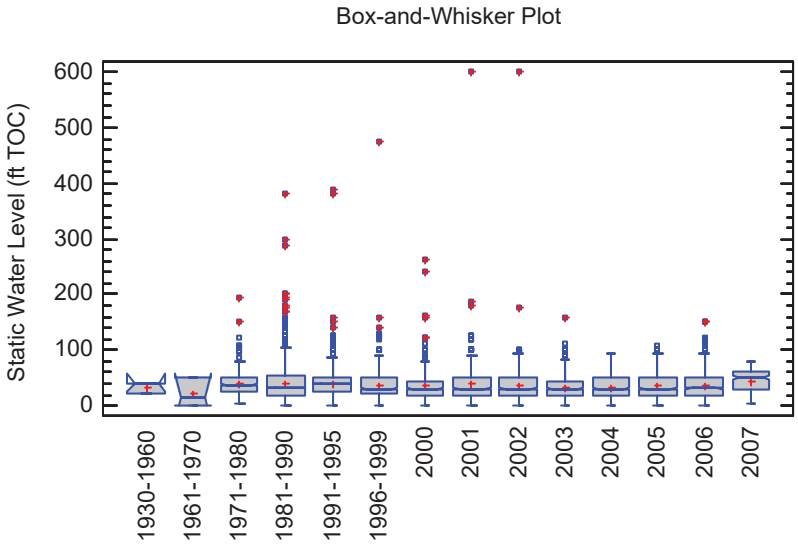
				Standard	*Coefficient*				*Lower*	*Upper*
Year_Code	*Count*	*Average*	*Median*	*Deviation*	*of variation*	*Minimum*	*Maximum*	*Range*	*Quartile*	*Quartile*
1930-1960	3	34.0	40.0	10.3923	30.5656%	22.0	40.0	18.0	22.0	40.0
1961-1970	3	21.6667	14.0	25.3837	117.156%	1.0	50.0	49.0	1.0	50.0
1971-1980	222	40.8626	38.0	23.4861	57.4758%	5.0	195.0	190.0	25.0	50.0
1981-1990	2178	40.2764	33.0	27.0766	67.227%	1.0	383.0	382.0	20.0	55.0
1991-1995	1024	41.5859	40.0	26.0994	62.7603%	1.0	390.0	389.0	26.0	52.0
1996-1999	1355	35.7791	30.0	21.1582	59.1357%	1.5	475.0	473.5	22.0	50.0
2000	685	34.5902	30.0	21.8772	63.2468%	0.3	264.0	263.7	20.0	45.0
2001	677	39.4919	30.0	45.5984	115.463%	1.0	700.0	699.0	20.0	50.0
2002	569	37.1511	30.0	30.1658	81.1974%	0.2	600.0	599.8	20.0	50.0
2003	415	32.3687	30.0	19.0026	58.7067%	1.0	158.0	157.0	20.0	45.0
2004	575	33.409	30.0	18.5581	55.5482%	1.2	95.0	93.8	17.0	50.0
2005	725	34.8428	30.0	19.9806	57.345%	2.0	109.0	107.0	20.0	50.0
2006	795	37.7434	32.0	20.0945	53.2399%	1.0	150.0	149.0	20.0	50.0
2007	96	44.6667	50.0	17.1505	38.3967%	5.0	80.0	75.0	30.0	60.0
Total	9322	37.7379	30.0	26.0739	69.0922%	0.2	700.0	699.8	20.0	50.0

	Interquartile	*Standardized*	*Standardized*
Year_Code	*Range*	*Skewness*	*Kurtosis*
1930-1960	18.0	-1.22474	
1961-1970	49.0	0.873386	
1971-1980	25.0	14.8638	32.2361

1981-1990	35.0	55.4206	207.011
1991-1995	26.0	64.0095	381.139
1996-1999	28.0	108.379	1036.8
2000	25.0	42.6095	168.955
2001	30.0	111.175	724.608
2002	30.0	114.477	1041.18
2003	25.0	13.8147	23.8693
2004	33.0	5.63093	-2.64391
2005	30.0	8.36892	-0.377262
2006	30.0	13.6211	17.0386
2007	30.0	-1.82041	-1.7703
Total	30.0	292.657	2754.98

The StatAdvisor
This table shows sample statistics for the 14 levels of Year_Code.





Summary Statistics for Health Department Static Water Level by Year.

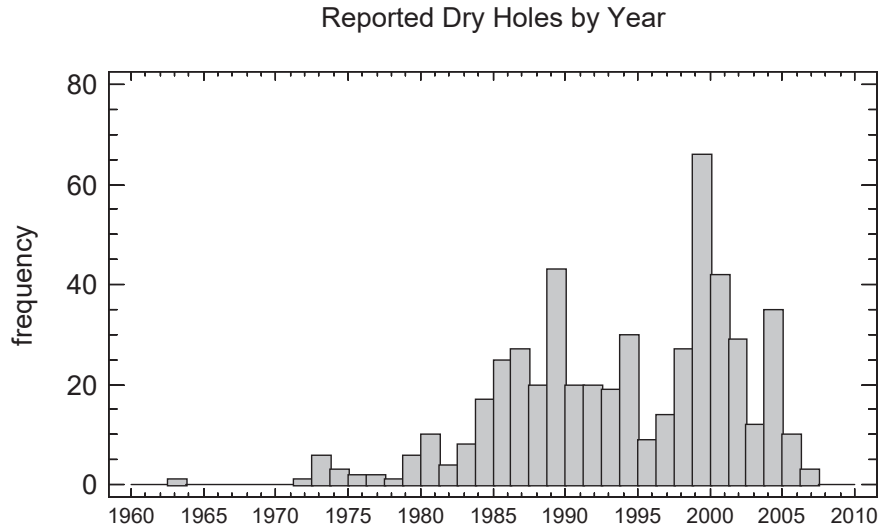
Year	*Count*	*Average*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*	*Stnd. skewness*	*Stnd. kurtosis*
1930-1960	1	40		%	40	40	0		
1961-1970	3	22	25.4	1.17	1	50	49.00	1	
1971-1980	222	40.8626	23.4861	0.574758	5	195	190	14.8638	32.2361
1981-1990	2178.00	40.28	27.08	0.67	1.00	383.00	382.00	55.42	207.01
1991-1995	1024.00	41.59	26.10	0.63	1.00	390.00	389.00	64.01	381.14
1996-1999	1355	35.7791	21.1582	0.591357	1.5	475	473.5	108.379	1036.8
2000	685	34.5902	22	0.632468	0.3	264	263.7	42.6095	168.955
2001	677	39.4919	46	1	1	700	699	111.175	724.608
2002	569	37.1511	30.1658	0.811974	0.2	600	599.8	114.477	1041.18
2003	415	32.3687	19.0026	0.587067	1	158	157	13.8147	23.8693
2004	575	33.409	18.5581	0.555482	1.2	95	93.8	5.63093	-2.64391
2005	725.0	34.8	20.0	0.6	2.0	109.0	107.0	8.4	-0.4
2006	795.0	37.7	20.1	0.5	1.0	150.0	149.0	13.6	17.0
2007	96.0	44.7	17.2	0.4	5.0	80.0	75.0	-1.8	-1.8

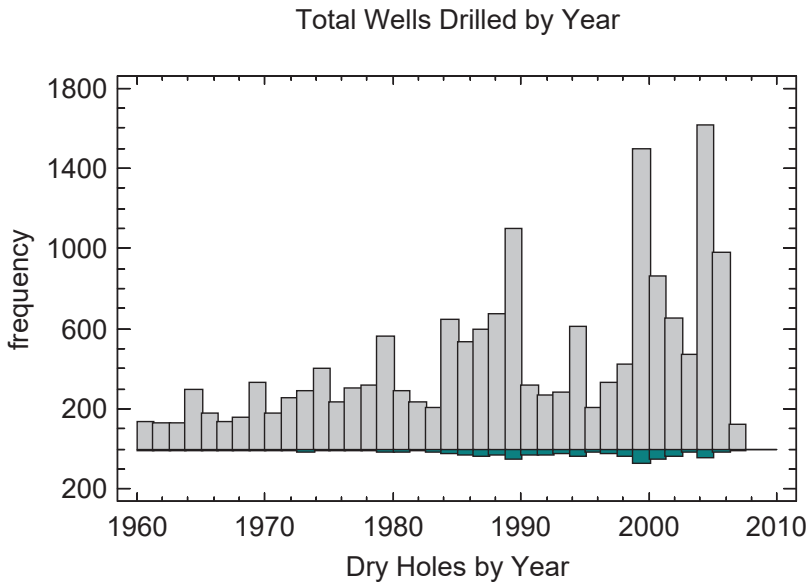
Summary Statistics from Health Department Wells

	Well Depth (ft TOC)	*Bedrock Depth (ft bgs)*	*Static Water Level (ft TOC)*	*Airlift Yield (gal/min)*	*Primary Yield Zone (ft bgs)*	*Secondary Yield Zone (ft bgs)*
Count	12792	12311	9320	6996	11084	5586
Average	389	25	37.7	20.58	307	251
Median	345	20	30	10	280	215
Geometric mean	341.64	-	31.48	-	252.56	199.52
Standard deviation	191.34	19.26	26.08	34.55	174.85	162.13
Minimum	1.5	0	0.2	0	1	0.42
Maximum	1320	500	700	650	1609	1740
Range	1318.5	500	700	650	1608	1739.58
Lower quartile	250	12	20	5	180	132
Upper quartile	500	35	50	25	400	335
Interquartile range	250	23	30	20	220	203
Stnd. skewness	39.0	139.8	292.6	256.2	48.1	48.0
Stnd. kurtosis	17.8	899.2	2754.3	1582.3	55.8	81.8

Section E) Analysis of dry hole data from VDH data set. Includes frequency histogram of reported dry holes by year, and frequency histogram of dry holes by year concurrent with total wells drilled by year. Also a table showing the number of dry holes for each rock class.

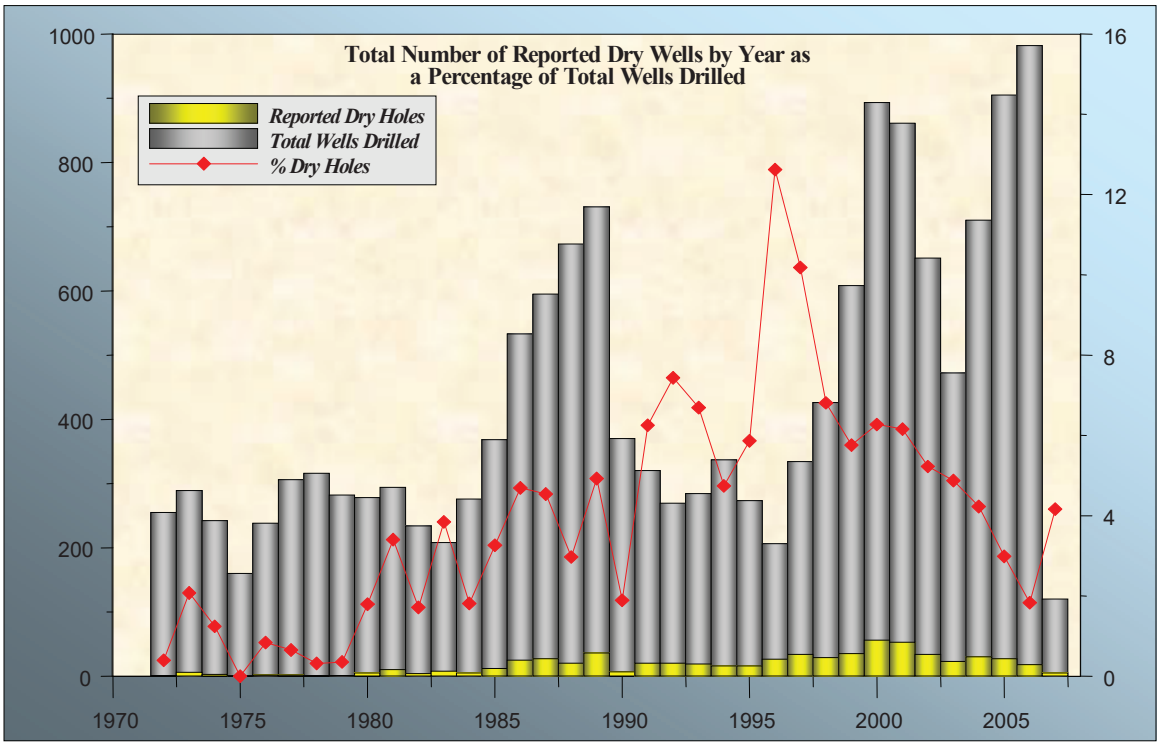
Graphical Analysis of Dry Holes (WWDH wells) from VDH data set.

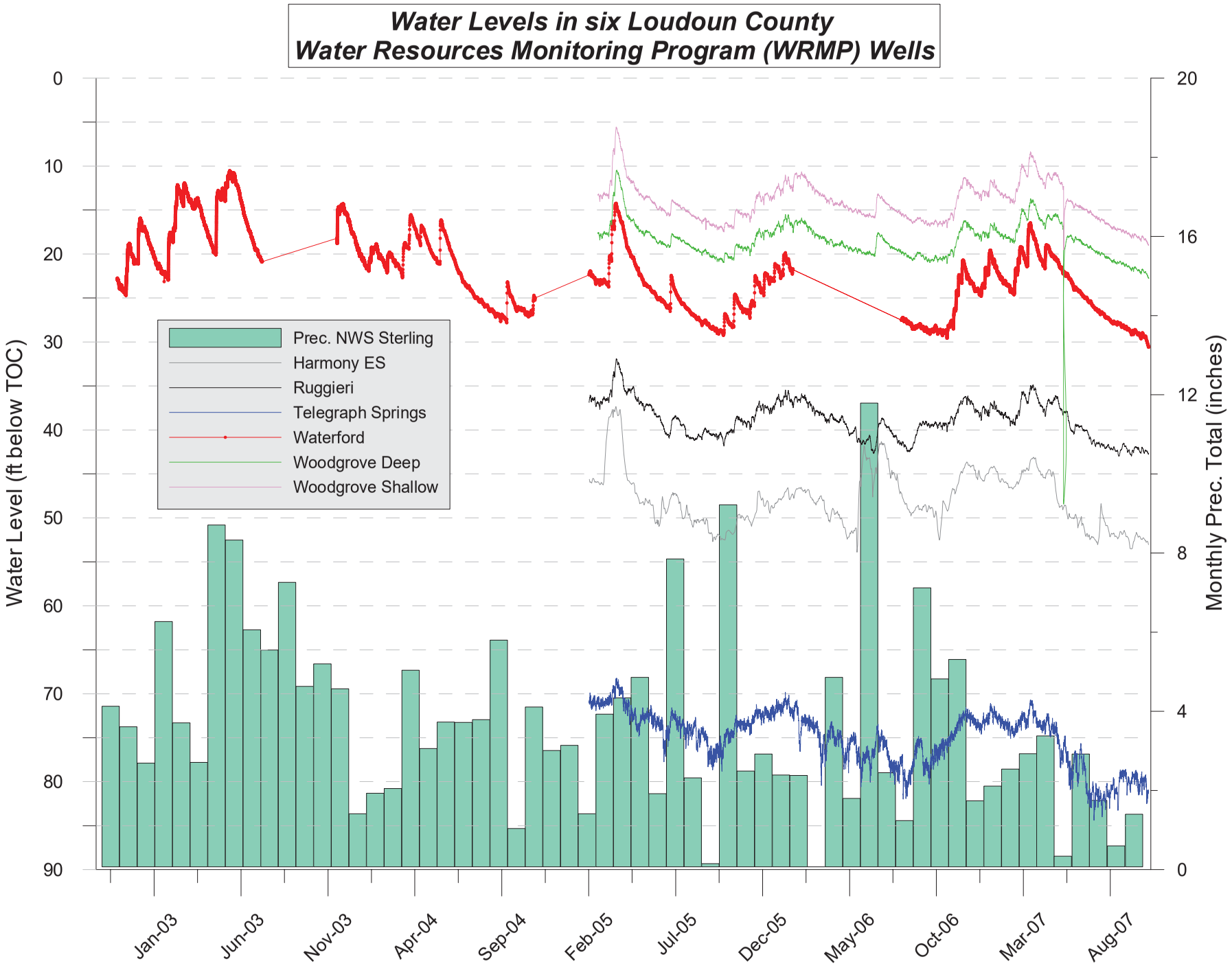


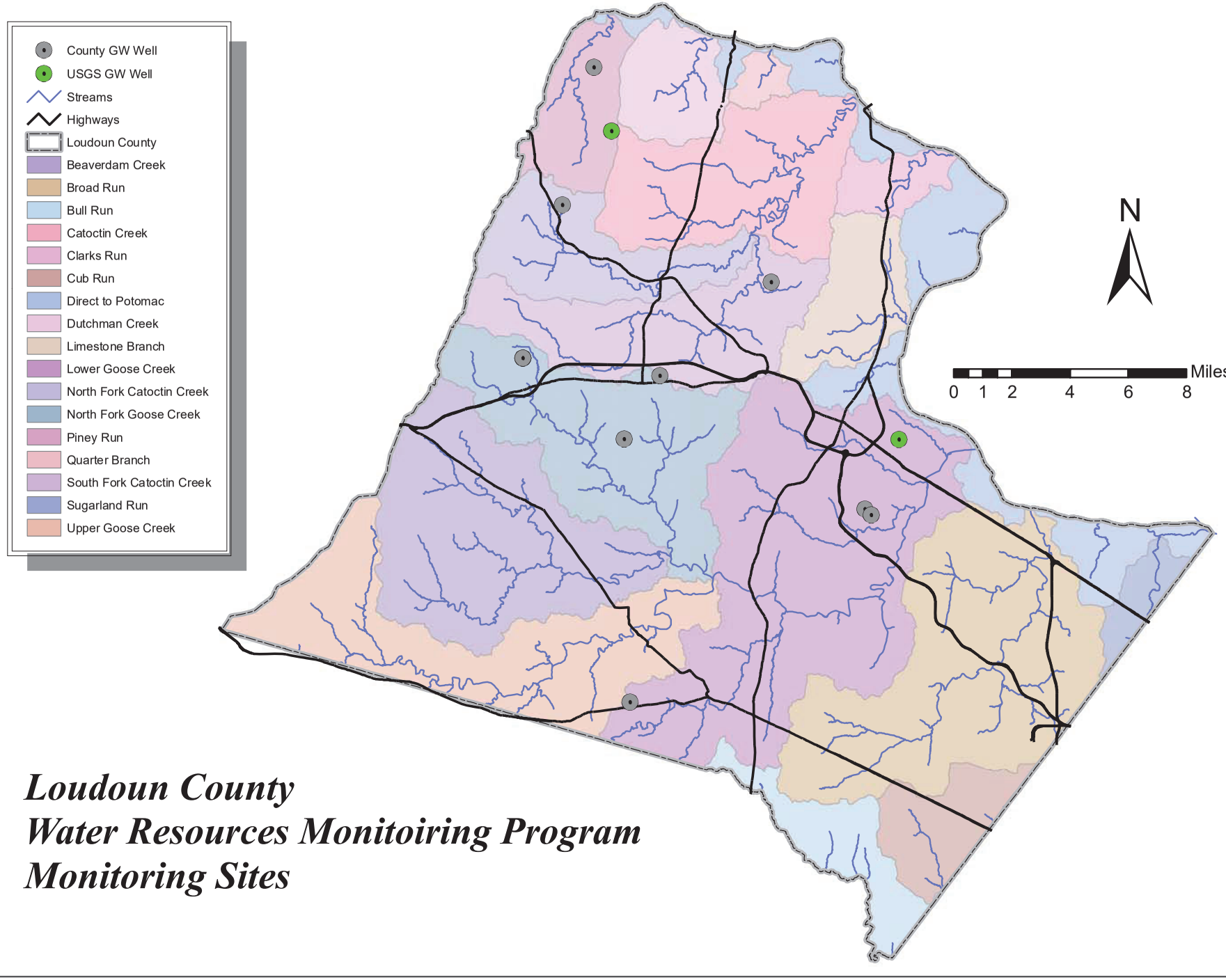


Summary Statistics
Dry Holes (reported by VDH as WWDH) by Bedrock Classification

BE_ROCK_CL	*Count*
Igneous	325
Igneous extrusive	87
Igneous intrusive	97
Metasedimentary	47
Sedimentary	88
Total	644


Total Number of Reported Dry Wells by Year as
a Percentage of Total Wells Drilled
Reported Dry Holes
Total Wells Drilled
% Dry Holes
1000
800
600
400
200
0
16
12
8
4
0
1970
1975
1980
1985
1990
1995
2000
2005


Water Levels in six Loudoun County
Water Resources Monitoring Program (WRMP) Wells
Water Level (ft below TOC)
Monthly Prec. Total (inches)
0
10
20
30
40
50
60
70
80
90
20
16
12
8
4
0
Prec. NWS Sterling
Harmony ES
Ruggieri
Telegraph Springs
Waterford
Woodgrove Deep
Woodgrove Shallow
Jan-03
Jun-03
Nov-03
Apr-04
Sep-04
Feb-05
Jul-05
Dec-05
May-06
Oct-06
Mar-07
Aug-07



Loudoun County
Water Resources Monitoiring Program
Monitoring Sites

B.3.5 Wells and groundwater quantity (using data sets 1.1, 1.2, 1.3, 1.5, and 3.1)

Hydrostudy Database

USGS Web Download

USGS Groundwater Web Download

This spreadsheet contains hyperlink to execute web queries from USGS NWIS web sites for the groundwater well in Loudoun and one in Prince William. The process includes a complete download of all **daily** data, approved and provisional. There is both field (historic) and daily min/max (more recent values).

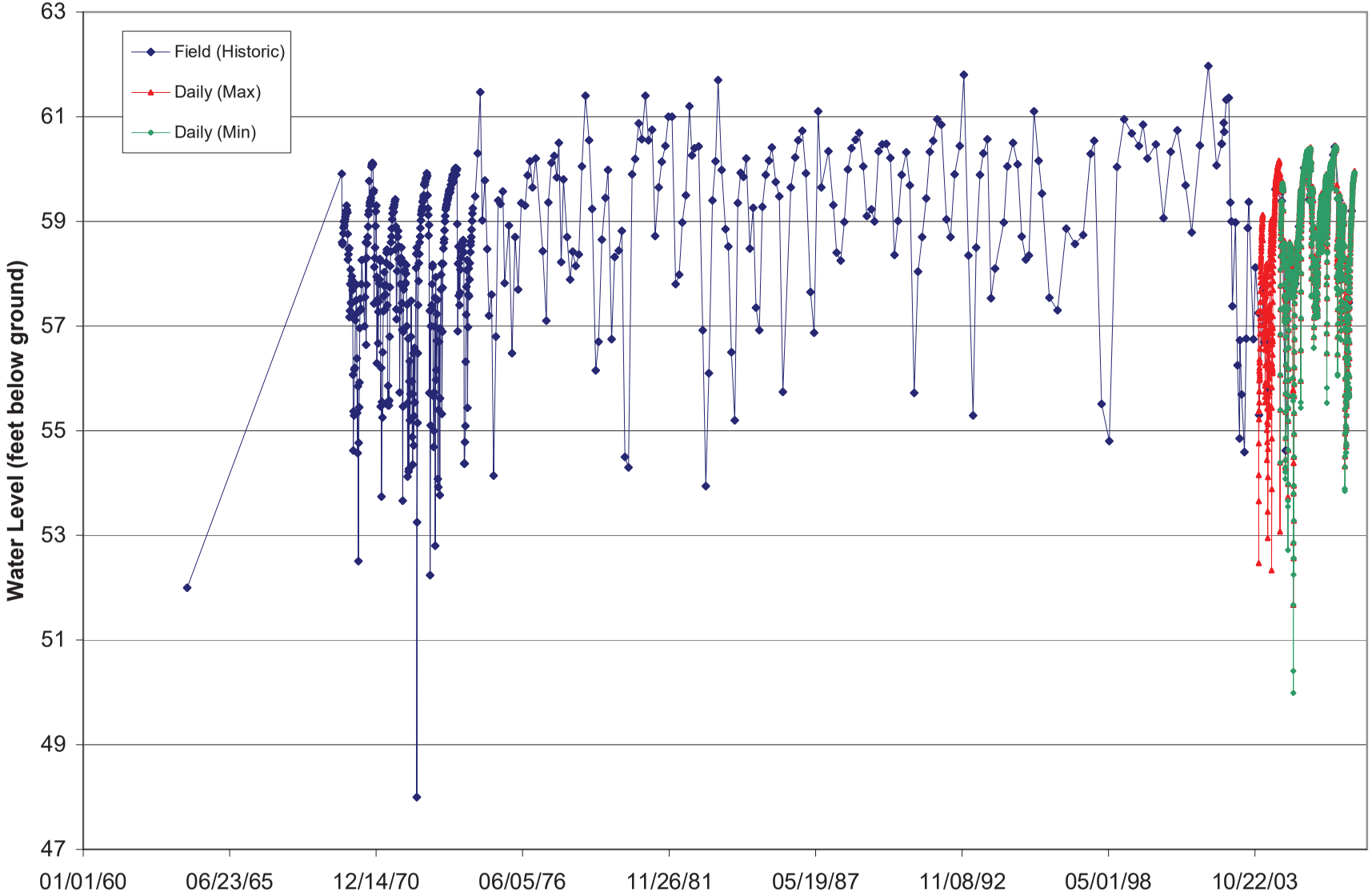
The spreadsheet offers the option to uses data "as is" from last update or update all stations. The update process will takes several minutes to process.

To ensure that data is updated correctly, 3 charts are linked to the data downloads.

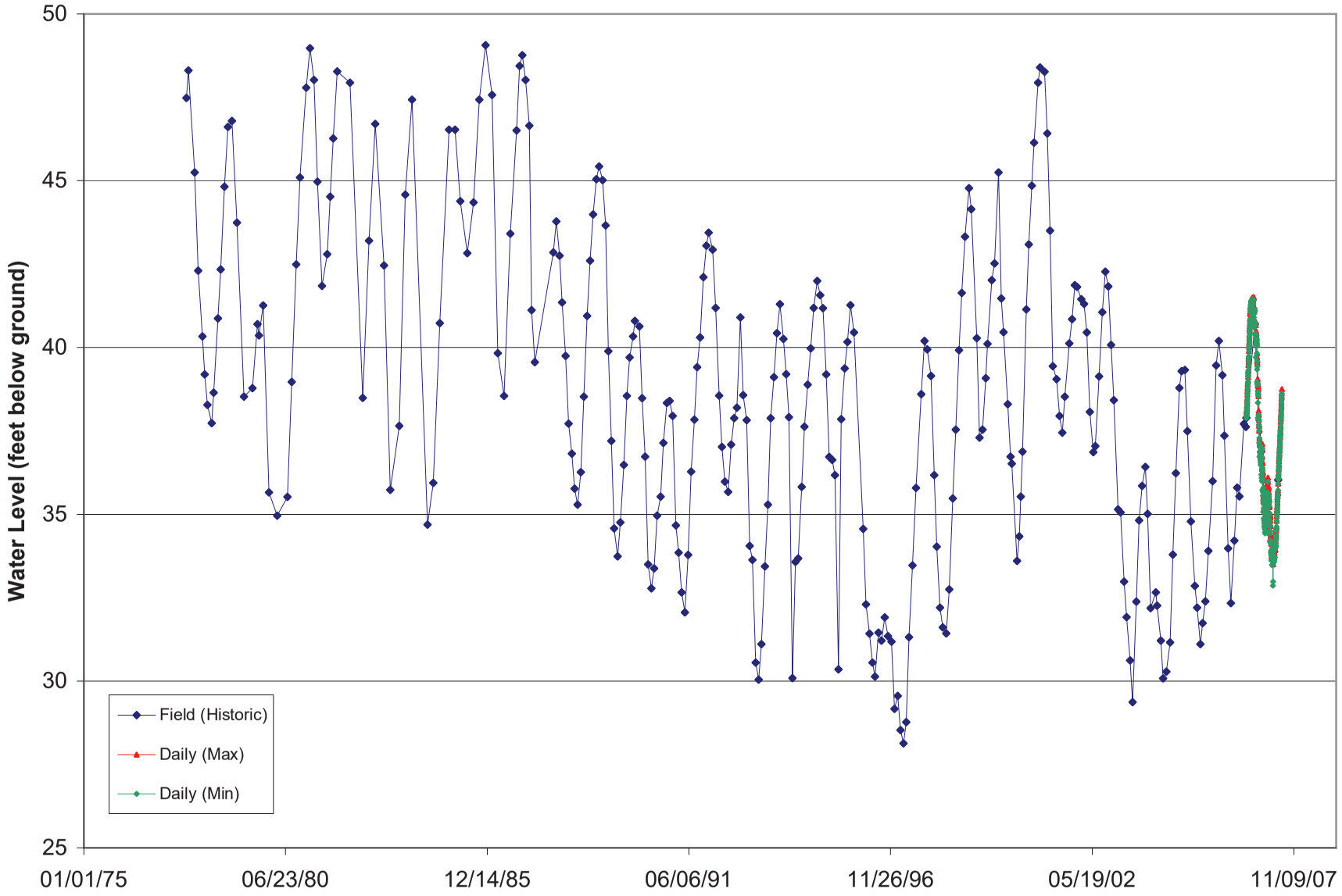
To prepare data for GIS, currently 6 tabs are manuall merged into one tab for loading to pgdb. (To be automated later possibly)

D Ward 7/13/2007

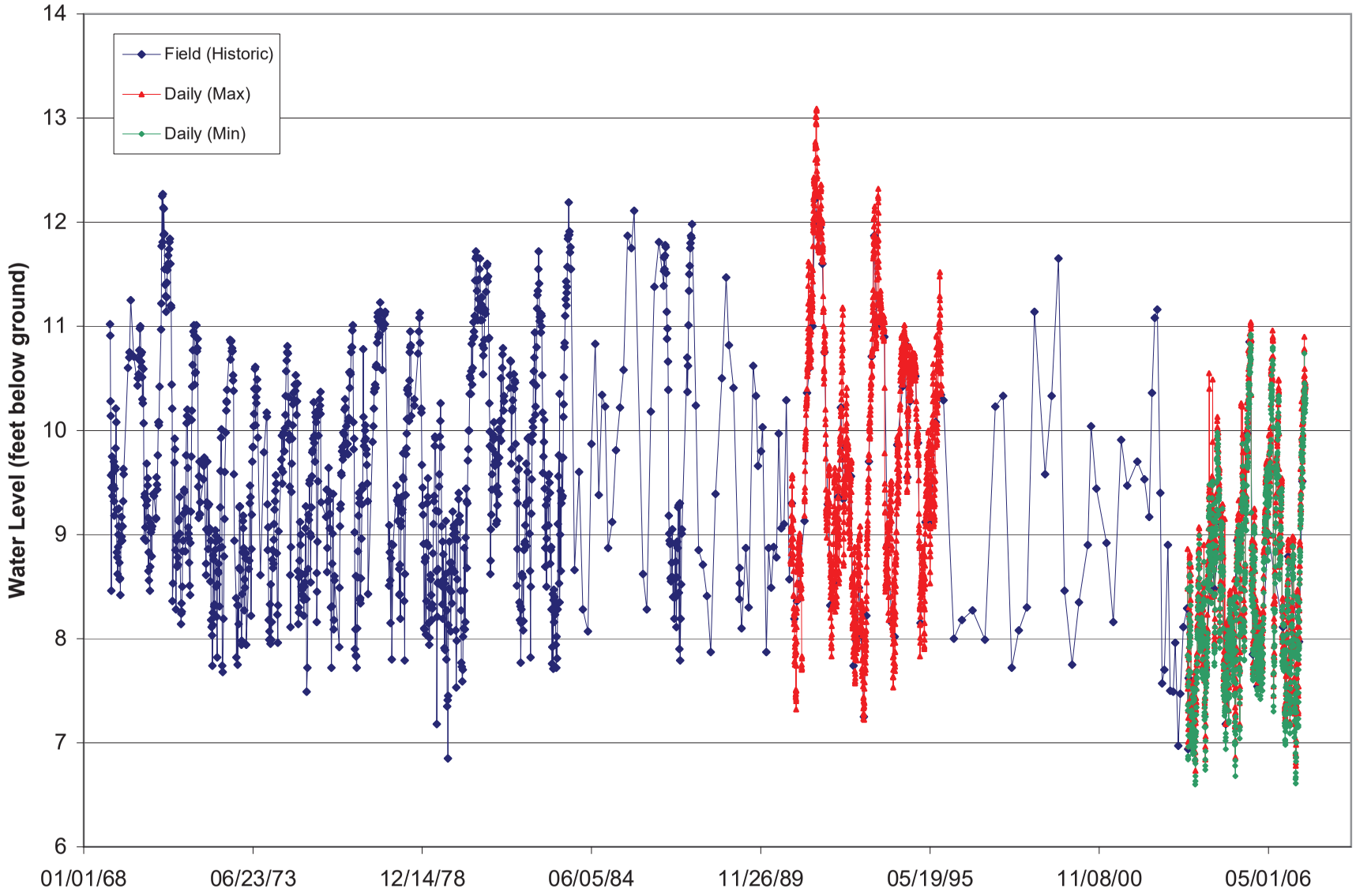
Well: USGS 391542077423801 - 49Y 1 SOW 022 - ATT



Well: USGS 390623077314201 50W 4C - Leesburg



Well: USGS 385607077381101 49V 1 - Bull Run



Task B.3.6 Analysis of groundwater quality data (National Testing Labs data set).

B.3.6 Groundwater Quality (using data sets 1.1, 1.4, 1.6)

Data Set 1.1
Loudoun County Groundwater, Well, and Pollution Sources

Well construction and groundwater information in database (MS Access) with locations in GIS maintained by B&D and Health Department. Source of most data from paper files generated during Health Department well permitting process (e.g., GW2 well construction form). Subset of WellPoll database, which includes well data and pollution sources data. Data on ~18,500 wells dating from 1930 to present, with information of varying quality and completeness including: location (VA state plane coordinates), surface elevation (62% complete), well depth (70%), casing depth (65%), static water level (53%) {but of suspect accuracy}, total yield (60%), depth of primary yield zone (60%), and transmissivity (~250 values).

Also includes groundwater quality data. Water quality data for a limited number of parameters are entered in the database for some wells (~2,100) constructed and tested prior to 2002. Water quality data provided digitally to B&D by National Testing Labs started in 2002 and is available for approximately 2,250 wells. These data are considered level A quality and typically consist of 100 physical/chemical water quality parameters per well for a total of more than 200,000 individual analyses. NTL data linked to the groundwater database by Health Department Permit No.

Also includes data on potential pollution sources – primarily on-site sewage disposal systems (e.g., drainfields) but also other sites such as cemeteries, landfills, chemical storage sites, etc. Currently approximately 15,000 records with site ID numbers and corresponding points in GIS. Data in some of the old records may be obsolete. Currently, data are obtained primarily from the Health Department sewage disposal system permitting process.

Data Set 1.4
USGS NAWQA Wells

As part of the USGS National Water-Quality Assessment Program (NAWQA) program, fourteen wells in Loudoun County were sampled between 1994 and 2004 for a broad range of chemicals. Data are compiled in a personal geodatabase format with related time series table. As many as 140 analyses per sample were analyzed including pesticides, radionuclides and volatile organic compounds. Two well sites in Purcellville were sampled in 2003 and 2004 with over 500 analyses each and showed little change over time. The total number of water quality analyses reported exceeds 3,000.

Data Set 1.6
Water Quality Data from LCSA and VADH Public Water Supplies

These data are collected by state and local agencies to monitor public water supply wells. WRMP has yet to receive data other than well locations. **{Restricted distribution}**

Section A) Basic statistics for all 98 anlalytes reported by National Testing Labs to VDH as part of the well permitting program. Most of these analytes have no record of detection within the county samples.

Summary of Results from National Testing Labs for All Analytes

PARAM_NAME	ANALYT_MET	MDL	# Analyses	# above MDL	% above MDL
Hexachlorobenzene	505	0.0005	1632	0	0.0
Alachlor	505	0.001	1632	0	0.0
Aldrin	505	0.002	1632	0	0.0
Atrazine	505	0.002	1632	0	0.0
Chlordane	505	0.001	1632	0	0.0
Dichloran	505	0.002	1632	0	0.0
Dieldrin	505	0.001	1632	0	0.0
Endrin	505	0.0001	1632	0	0.0
1,1,1,2-Tetrachloroethane	524.2	0.002	1631	0	0.0
Heptachlor Epoxide	505	0.0001	1632	0	0.0
Hexachlorocyclopentadiene	505	0.001	1632	0	0.0
Lindane	505	0.0002	1632	0	0.0
Methoxychlor	505	0.002	1632	0	0.0
PCBs	505	0.0005	1632	0	0.0
Pentachloronitrobenzene	505	0.002	1632	0	0.0
Simazine	505	0.002	1632	0	0.0
Toxaphene	505	0.001	1632	0	0.0
Trifluralin	505	0.002	1632	0	0.0
2,4-D	515.2	0.010	1632	0	0.0
Silvex(2,4,5-TP)	515.2	0.005	1632	0	0.0
Heptachlor	505	0.0004	1632	0	0.0
Mercury	200.8	0.001	1632	0	0.0
Selenium	200.8	0.020	1632	0	0.0
Silver	200.8	0.002	1632	0	0.0
Cadmium	200.8	0.002	1632	0	0.0
Chloroethane	524.2	0.002	1632	0	0.0
Chloromethane	524.2	0.002	1632	0	0.0
Dibromochloropropane (DBCP)	524.2	0.001	1632	0	0.0
Dibromomethane	524.2	0.002	1632	0	0.0
Ethylenedibromide (EDB)	524.2	0.001	1632	0	0.0
Chlorobenzene	524.2	0.001	1632	0	0.0
cis-1,2-Dichloroethene	524.2	0.002	1632	0	0.0
Trans-1,2-Dichloroethene	524.2	0.002	1632	0	0.0
Vinyl Chloride	524.2	0.001	1632	0	0.0
1,1,1-Trichloroethane	524.2	0.001	1296	0	0.0
cis-1,3-Dichloropropene	524.2	0.002	1632	0	0.0
trans-1,3-Dichloropropene	524.2	0.002	1632	0	0.0
1,1,2,2-Tetrachloroethane	524.2	0.002	1632	0	0.0
1,1-Dichloroethane	524.2	0.002	1632	0	0.0
1,1-Dichloroethene	524.2	0.001	1632	0	0.0
1,1-Dichloropropene	524.2	0.002	1632	0	0.0
1,2,3-Trichlorobenzene	524.2	0.002	1632	0	0.0
1,2,3-Trichloropropane	524.2	0.002	1632	0	0.0
Iron	200.7	0.020	1886	1836	97.3
Turbidity (Turbidity Units)	2130B	0.1	1888	1849	97.9
Hardness (as CaCO3)	2340B	10	1888	1864	98.7
Calcium	200.7	2.0	1551	1544	99.5
1,2,4-Trichlorobenzene	524.2	0.002	1632	0	0
1,2-Dichlorobenzene	524.2	0.001	1632	0	0
1,2-Dichloropropane	524.2	0.002	1632	0	0
1,3-Dichlorobenzene	524.2	0.001	1632	0	0
1,4-Dichlorobenzene	524.2	0.001	1632	0	0
2,2-Dichloropropane	524.2	0.002	1632	0	0
2-Chlorotoluene	524.2	0.001	1632	0	0
4-Chlorotoluene	524.2	0.001	1632	0	0
Bromobenzene	524.2	0.002	1632	0	0
Bromomethane	524.2	0.002	1632	0	0
Carbon Tetrachloride	524.2	0.001	1632	0	0
1,3-Dichloropropane	524.2	0.002	1632	0	0
Dichlorodifluoromethane	524.2	0.002	1632	1	0.1
Trichlorofluoromethane	524.2	0.002	1632	1	0.1
1,1,2-Trichloroethane	524.2	0.002	1632	1	0.1
Bromoform	524.2	0.004	1632	1	0.1
Trichloroethene (TCE)	524.2	0.001	1632	2	0.1
Dibromochloromethane	524.2	0.004	1632	3	0.2
Dichloromethane	524.2	0.002	1632	3	0.2
1,2-Dichloroethane	524.2	0.001	1632	3	0.2
Benzene	524.2	0.001	1632	4	0.2
Ethylbenzene	524.2	0.001	1632	4	0.2
Nitrite as N	300.0	0.5	1632	5	0.3
Methyl-Tert-Butyl-Ether	524.2	0.004	1632	5	0.3
Bromodichloromethane	524.2	0.002	1632	7	0.4
Nickel	200.8	0.02	1632	8	0.5
Foaming Agents	5540C	0.1	1632	9	0.6
Arsenic	200.8	0.005	1632	13	0.8
Tetrachloroethene (PCE)	524.2	0.002	1632	13	0.8
Xylene	524.2	0.001	1632	15	0.9
Chromium	200.8	0.010	1632	22	1.3
Chloroform	524.2	0.002	1632	30	1.8
Total THMs	524.2	0.002	1632	31	1.9
Barium	200.8	0.30	1632	35	2.1
Styrene	524.2	0.001	1632	57	3.5
Fluoride	300.0	0.5	1888	197	10.4
Toluene	524.2	0.001	1885	227	12.0
Lead	200.8	0.002	1888	252	13.3
Nitrate as N	300.0	0.5	1888	473	25.1
Copper	200.8	0.004	1883	501	26.6
Aluminum	200.7	0.1	1888	553	29.3
Zinc	200.8	0.004	1890	839	44.4
Chloride	300.0	5.0	1888	859	45.4
Sulfate	300.0	5.0	1888	1486	78.7
Iron	200.7	0.020	1886	1836	97.3
Turbidity (Turbidity Units)	2130B	0.1	1888	1849	97.9
Hardness (as CaCO3)	2340B	10	1888	1864	98.7
Manganese	200.8	0.004	1888	1783	94.4
Alkalinity	2320B	20	1888	1878	99.5
Magnesium	200.7	0.10	1551	1546	99.7
Total Dissolved Solids	1030F	20	1888	1881	99.6
Sodium	200.7	1	1888	1883	99.7
Corrosivity	2330B	---	1889	1887	99.9
pH (Standard Units)	150.1	---	1889	1888	99.9

Summary of Results from National Testing Labs for All Analytes with <1% Detections

PARAM_NAME	ANALYT_MET	MDL	# Analyses	# above MDL	% above MDL
Hexachlorobenzene	505	0.0005	1632	0	0.0
Alachlor	505	0.001	1632	0	0.0
Aldrin	505	0.002	1632	0	0.0
Atrazine	505	0.002	1632	0	0.0
Chlordane	505	0.001	1632	0	0.0
Dichloran	505	0.002	1632	0	0.0
Dieldrin	505	0.001	1632	0	0.0
Endrin	505	0.0001	1632	0	0.0
1,1,1,2-Tetrachloroethane	524.2	0.002	1631	0	0.0
Heptachlor Epoxide	505	0.0001	1632	0	0.0
Hexachlorocyclopentadiene	505	0.001	1632	0	0.0
Lindane	505	0.0002	1632	0	0.0
Methoxychlor	505	0.002	1632	0	0.0
PCBs	505	0.0005	1632	0	0.0
Pentachloronitrobenzene	505	0.002	1632	0	0.0
Simazine	505	0.002	1632	0	0.0
Toxaphene	505	0.001	1632	0	0.0
Trifluralin	505	0.002	1632	0	0.0
2,4-D	515.2	0.01	1632	0	0.0
Silvex(2,4,5-TP)	515.2	0.005	1632	0	0.0
Heptachlor	505	0.0004	1632	0	0.0
Mercury	200.8	0.001	1632	0	0.0
Selenium	200.8	0.02	1632	0	0.0
Silver	200.8	0.002	1632	0	0.0
Cadmium	200.8	0.002	1632	0	0.0
Chloroethane	524.2	0.002	1632	0	0.0
Chloromethane	524.2	0.002	1632	0	0.0
Dibromochloropropane (DBCP)	524.2	0.001	1632	0	0.0
Dibromomethane	524.2	0.002	1632	0	0.0
Ethylenedibromide (EDB)	524.2	0.001	1632	0	0.0
Chlorobenzene	524.2	0.001	1632	0	0.0
cis-1,2-Dichloroethene	524.2	0.002	1632	0	0.0
Trans-1,2-Dichloroethene	524.2	0.002	1632	0	0.0
Vinyl Chloride	524.2	0.001	1632	0	0.0
1,1,1-Trichloroethane	524.2	0.001	1296	0	0.0
cis-1,3-Dichloropropene	524.2	0.002	1632	0	0.0
trans-1,3-Dichloropropene	524.2	0.002	1632	0	0.0

PARAM_NAME	ANALYT_MET	MDL	# Analyses	# above MDL	% above MDL
1,1,2,2-Tetrachloroethane	524.2	0.002	1632	0	0.0
1,1-Dichloroethane	524.2	0.002	1632	0	0.0
1,1-Dichloroethene	524.2	0.001	1632	0	0.0
1,1-Dichloropropene	524.2	0.002	1632	0	0.0
1,2,3-Trichlorobenzene	524.2	0.002	1632	0	0.0
1,2,3-Trichloropropane	524.2	0.002	1632	0	0.0
1,2,4-Trichlorobenzene	524.2	0.002	1632	0	0.0
1,2-Dichlorobenzene	524.2	0.001	1632	0	0.0
1,2-Dichloropropane	524.2	0.002	1632	0	0.0
1,3-Dichlorobenzene	524.2	0.001	1632	0	0.0
1,4-Dichlorobenzene	524.2	0.001	1632	0	0.0
2,2-Dichloropropane	524.2	0.002	1632	0	0.0
2-Chlorotoluene	524.2	0.001	1632	0	0.0
4-Chlorotoluene	524.2	0.001	1632	0	0.0
Bromobenzene	524.2	0.002	1632	0	0.0
Bromomethane	524.2	0.002	1632	0	0.0
Carbon Tetrachloride	524.2	0.001	1632	0	0.0
1,3-Dichloropropane	524.2	0.002	1632	0	0.0
Dichlorodifluoromethane	524.2	0.002	1632	1	0.1
Trichlorofluoromethane	524.2	0.002	1632	1	0.1
1,1,2-Trichloroethane	524.2	0.002	1632	1	0.1
Bromoform	524.2	0.004	1632	1	0.1
Trichloroethene (TCE)	524.2	0.001	1632	2	0.1
Dibromochloromethane	524.2	0.004	1632	3	0.2
Dichloromethane	524.2	0.002	1632	3	0.2
1,2-Dichloroethane	524.2	0.001	1632	3	0.2
Benzene	524.2	0.001	1632	4	0.2
Ethylbenzene	524.2	0.001	1632	4	0.2
Nitrite as N	300.0	0.5	1632	5	0.3
Methyl-Tert-Butyl-Ether	524.2	0.004	1632	5	0.3
Bromodichloromethane	524.2	0.002	1632	7	0.4
Nickel	200.8	0.02	1632	8	0.5
Foaming Agents	5540C	0.1	1632	9	0.6
Arsenic	200.8	0.005	1632	13	0.8
Tetrachloroethene (PCE)	524.2	0.002	1632	13	0.8
Xylene	524.2	0.001	1632	15	0.9

Summary of Results from National Testing Labs for All Analytes with >1% Detections

PARAM_NAME	ANALYT_MET	MDL	# Analyses	# above MDL	% above MDL
Chromium	200.8	0.010	1632	22	1.3
Chloroform	524.2	0.002	1632	30	1.8
Total THMs	524.2	0.002	1632	31	1.9
Barium	200.8	0.30	1632	35	2.1
Styrene	524.2	0.001	1632	57	3.5
Fluoride	300.0	0.5	1632	161	9.9
Toluene	524.2	0.001	1632	210	12.9
Lead	200.8	0.002	1632	234	14.3
Nitrate as N	300.0	0.5	1632	395	24.2
Copper	200.8	0.004	1632	449	27.5
Aluminum	200.7	0.1	1632	479	29.4
Zinc	200.8	0.004	1641	719	43.8
Chloride	300.0	5.0	1632	746	45.5
Sulfate	300.0	5.0	1632	1293	79.2
Manganese	200.8	0.004	1632	1539	94.3
Iron	200.7	0.020	1632	1587	97.2
Turbidity (Turbidity Units)	2130B	0.1	1632	1596	97.8
Hardness (as CaCO3)	2340B	10	1632	1609	98.6
Calcium	200.7	2.0	1296	1288	99.4
Alkalinity (Total as CaCO3)	2320B	20	1632	1622	99.4
Magnesium	200.7	0.10	1296	1290	99.5
Total Dissolved Solids	1030F	20	1632	1625	99.6
Sodium	200.7	1	1632	1629	99.8
Corrosivity	2330B	---	1632	1630	99.9
pH (Standard Units)	150.1	---	1633	1633	100.0

Correlation Matrix for Water Quality Data from National Testing Labs (Pearson Product Moment Correlation)

		pH	Ca	Cl	Al	F	Fe	Mg	Mn	NO3	SO4	TDS	Turb	Zn	Na	Cu
pH	Correlation		0.0938	-0.1504	0.0616	0.2509	-0.1116	-0.2042	-0.2605	-0.1679	0.0363	0.1112	-0.0236	-0.0045	0.3239	-0.0164
	(Sample Size)		-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432
	P-Value		0.0004	0	0.0197	0	0	0	0	0	0.1691	0	0.373	0.8652	0	0.5346
Ca	0.0938			0.3376	-0.0114	-0.0179	-0.0634	0.4062	0.1279	0.1216	0.4563	0.8871	-0.0108	0.0133	0.1062	-0.0038
	-1432			-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432
	0.0004			0	0.6663	0.4986	0.0164	0	0	0	0	0	0.6828	0.6158	0.0001	0.8864
Cl	-0.1504	0.3376			-0.0101	-0.0023	0.0796	0.4391	0.436	0.0585	0.094	0.4539	0.0563	0.035	0.1589	0.0368
	-1432	-1432			-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432
	0	0			0.7037	0.9309	0.0025	0	0	0.0268	0.0004	0	0.0329	0.1856	0	0.1632
Al	0.0616	-0.0114	-0.0101			0.0474	0.1672	0.0271	-0.0098	0.1227	0.1035	0.1135	0.262	0.0017	0.3288	0.0687
	-1432	-1432	-1432			-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432
	0.0197	0.6663	0.7037			0.0724	0	0.3045	0.7112	0	0.0001	0	0	0.9497	0	0.0093
F	0.2509	-0.0179	-0.0023	0.0474			-0.0136	-0.1507	-0.0861	-0.0447	-0.0128	0.0411	0.0064	-0.0155	0.3737	-0.0051
	-1432	-1432	-1432	-1432			-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432
	0	0.4986	0.9309	0.0724			0.6067	0	0.0011	0.0908	0.6284	0.12	0.8092	0.5588	0	0.8461
Fe	-0.1116	-0.0634	0.0796	0.1672	-0.0136			0.0462	0.4656	-0.0292	0.03	0.0199	0.4756	0.0272	0.0281	0.0241
	-1432	-1432	-1432	-1432	-1432			-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432
	0	0.0164	0.0025	0	0.6067			0.08	0	0.2701	0.2566	0.4522	0	0.304	0.2874	0.3616
Mg	-0.2042	0.4062	0.4391	0.0271	-0.1507	0.0462			0.2023	0.1606	0.3452	0.5865	0.0131	0.0067	-0.0379	0.0711
	-1432	-1432	-1432	-1432	-1432	-1432			-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432
	0	0	0	0.3045	0	0.08			0	0	0	0	0.6215	0.7986	0.1517	0.007
Mn	-0.2605	0.1279	0.436	-0.0098	-0.0861	0.4656	0.2023			-0.1467	0.0629	0.1697	0.2666	0.064	-0.0629	-0.0136
	-1432	-1432	-1432	-1432	-1432	-1432	-1432			-1432	-1432	-1432	-1432	-1432	-1432	-1432
	0	0	0	0.7112	0.0011	0	0			0	0.0171	0	0	0.0153	0.0171	0.6068
NO3	-0.1679	0.1216	0.0585	0.1227	-0.0447	-0.0292	0.1606	-0.1467			0.0197	0.0902	-0.0206	-0.0072	-0.0482	-0.0121
	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432			-1432	-1432	-1432	-1432	-1432	-1432
	0	0	0.0268	0	0.0908	0.2701	0	0			0.4563	0.0006	0.4361	0.785	0.068	0.647
SO4	0.0363	0.4563	0.094	0.1035	-0.0128	0.03	0.3452	0.0629	0.0197			0.648	0.0265	0.004	0.3829	-0.0089
	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432			-1432	-1432	-1432	-1432	-1432
	0.1691	0	0.0004	0.0001	0.6284	0.2566	0	0.0171	0.4563			0	0.3154	0.8788	0	0.7351
TDS	0.1112	0.8871	0.4539	0.1135	0.0411	0.0199	0.5865	0.1697	0.0902	0.648			0.0453	0.0248	0.3799	0.013
	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432			-1432	-1432	-1432	-1432
	0	0	0	0	0.12	0.4522	0	0	0.0006	0			0.0862	0.3476	0	0.6223
Turb	-0.0236	-0.0108	0.0563	0.262	0.0064	0.4756	0.0131	0.2666	-0.0206	0.0265	0.0453			0.0144	0.0992	0.0019
	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432			-1432	-1432	-1432
	0.373	0.6828	0.0329	0	0.8092	0	0.6215	0	0.4361	0.3154	0.0862			0.5865	0.0002	0.9432
Zn	-0.0045	0.0133	0.035	0.0017	-0.0155	0.0272	0.0067	0.064	-0.0072	0.004	0.0248	0.0144			0.0189	0.0233
	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432			-1432	-1432
	0.8652	0.6158	0.1856	0.9497	0.5588	0.304	0.7986	0.0153	0.785	0.8788	0.3476	0.5865			0.4742	0.3784
Na	0.3239	0.1062	0.1589	0.3288	0.3737	0.0281	-0.0379	-0.0629	-0.0482	0.3829	0.3799	0.0992	0.0189			-0.0084
	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432			-1432
	0	0.0001	0	0	0	0.2874	0.1517	0.0171	0.068	0	0	0.0002	0.4742			0.7518
Cu	-0.0164	-0.0038	0.0368	0.0687	-0.0051	0.0241	0.0711	-0.0136	-0.0121	-0.0089	0.013	0.0019	0.0233	-0.0084		
	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432	-1432		
	0.5346	0.8864	0.1632	0.0093	0.8461	0.3616	0.007	0.6068	0.647	0.7351	0.6223	0.9432	0.3784	0.7518		

Statistically significant non-zero correlations at the 95.0% confidence level

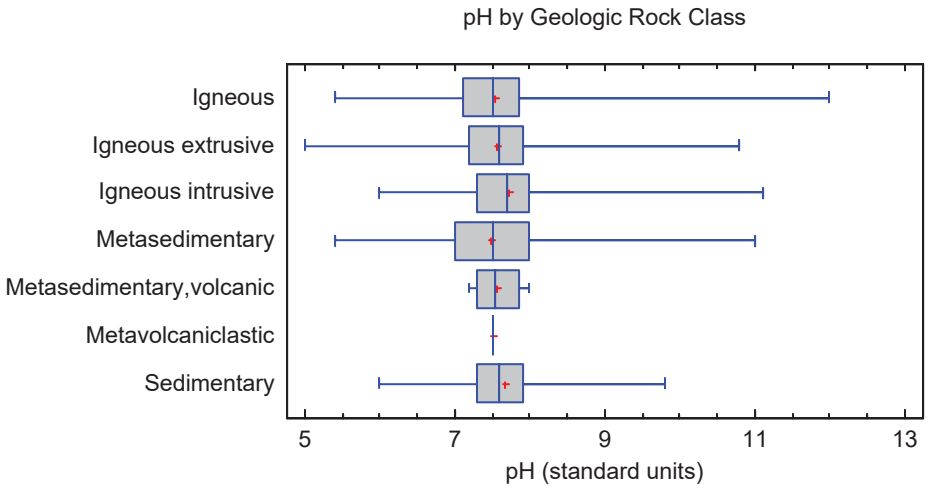
No statistically significant non-zero correlations at the 95.0% confidence level

Multiple Box-and-Whisker Plot - RESULTS_pH by BE_ROCK_CLASS

Dependent variable: RESULTS_pH
Factor: BE_ROCK_CLASS

Number of observations: 1799
Number of levels: 7

The StatAdvisor
This procedure constructs box-and-whisker plots to compare the 7 samples of RESULTS_pH. For a detailed statistical analysis of this data, select Compare - Analysis of Variance - One-Way ANOVA from the main menu.

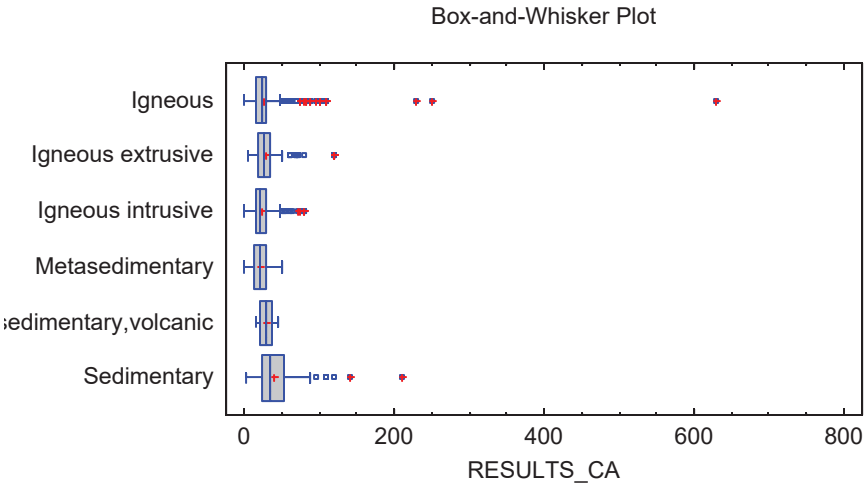


Multiple Box-and-Whisker Plot - RESULTS_CA by BE_ROCK_CLASS

Dependent variable: RESULTS_CA
Factor: BE_ROCK_CLASS

Number of observations: 1475
Number of levels: 6

The StatAdvisor
This procedure constructs box-and-whisker plots to compare the 6 samples of RESULTS_CA. For a detailed statistical analysis of this data, select Compare - Analysis of Variance - One-Way ANOVA from the main menu.

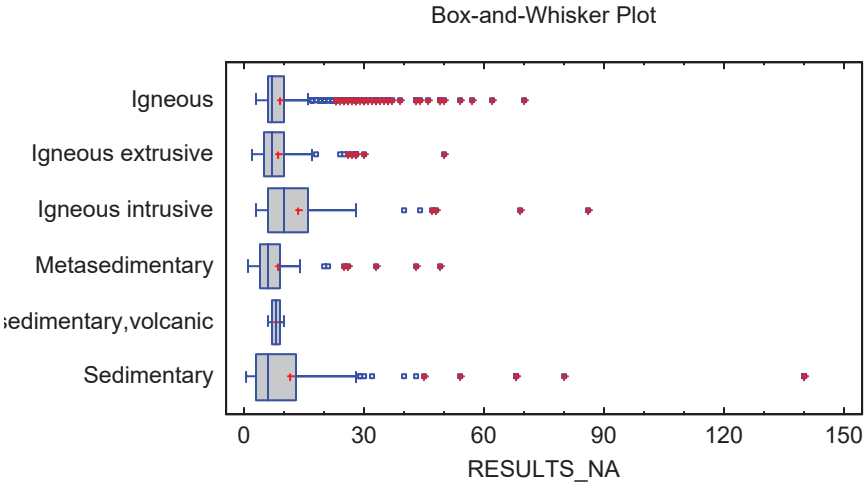


Multiple Box-and-Whisker Plot - RESULTS_NA by BE_ROCK_CLASS

Dependent variable: RESULTS_NA
Factor: BE_ROCK_CLASS

Number of observations: 1474
Number of levels: 6

The StatAdvisor
This procedure constructs box-and-whisker plots to compare the 6 samples of RESULTS_NA. For a detailed statistical analysis of this data, select Compare - Analysis of Variance - One-Way ANOVA from the main menu.

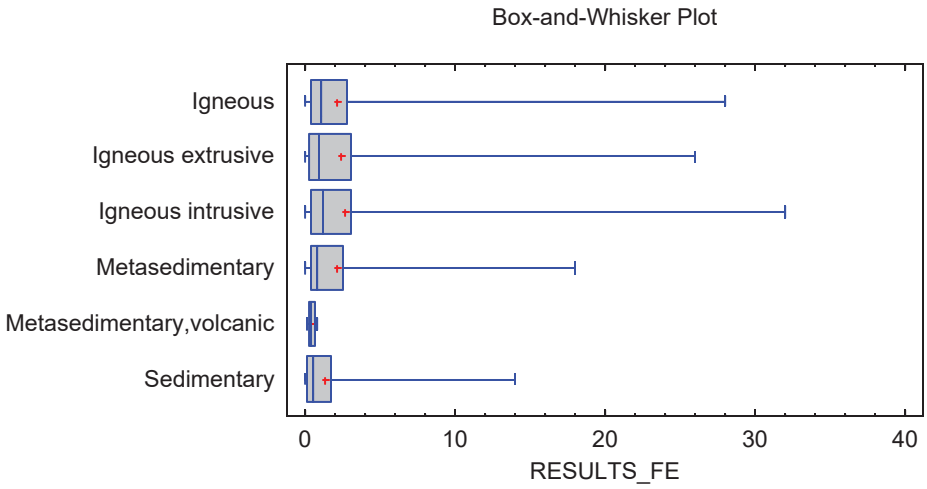


Multiple Box-and-Whisker Plot - RESULTS_FE by BE_ROCK_CLASS

Dependent variable: RESULTS_FE
Factor: BE_ROCK_CLASS

Number of observations: 1460
Number of levels: 6

The StatAdvisor
This procedure constructs box-and-whisker plots to compare the 6 samples of RESULTS_FE. For a detailed statistical analysis of this data, select Compare - Analysis of Variance - One-Way ANOVA from the main menu.



Summary Statistics

	Count	*Average*	*Standard deviation*	*Coeff. of variation*	*Minimum*	*Maximum*	*Range*
RESULTS_pH	1799	7.57571	0.695308	9.17812%	5.0	12.0	7.0
RESULTS_ALK	1800	106.362	53.3769	50.1841%	6.2	1100.0	1093.8
RESULTS_CA	1475	28.1109	24.3293	86.5475%	1.0	630.0	629.0
RESULTS_CL	1800	8.12667	16.2553	200.025%	2.5	440.0	437.5
RESULTS_AL	1795	0.188903	0.487477	258.058%	0.05	9.7	9.65
RESULTS_FL	1795	0.329833	0.370505	112.331%	0.25	8.3	8.05
RESULTS_FE	1460	2.13308	3.12572	146.535%	0.01	32.0	31.99
RESULTS_MG	1475	8.47816	5.63749	66.4943%	0.002	56.0	55.998
RESULTS_MN	1458	0.138788	0.147395	106.202%	0.002	2.0	1.998
RESULTS_NO3	1474	0.895929	1.93516	215.995%	0.25	29.0	28.75
RESULTS_SO3	1475	13.3471	27.1333	203.29%	2.5	660.0	657.5
RESULTS_PB	1793	0.00225711	0.0110246	488.44%	0.001	0.26	0.259
RESULTS_TDS	1793	132.574	77.8413	58.7154%	2.0	1600.0	1598.0
RESULTS_TURB	1789	16.2949	43.3089	265.782%	0.05	1000.0	999.95
RESULTS_HARD	1796	104.247	70.2967	67.4327%	5.0	1600.0	1595.0
RESULTS_ZN	1793	0.0139381	0.103182	740.291%	0.002	3.6	3.598
RESULTS_NA	1474	9.56479	9.64506	100.839%	0.5	140.0	139.5
RESULTS_CU	1794	0.0105819	0.0949785	897.553%	0.002	3.3	3.298
Total	30038	25.5398	53.2031	208.315%	0.001	1600.0	1600.0

	Stnd. skewness	*Stnd. kurtosis*
RESULTS_pH	15.392	36.0362
RESULTS_ALK	95.8145	717.587
RESULTS_CA	189.115	2071.77
RESULTS_CL	228.024	2538.41
RESULTS_AL	159.916	1085.66
RESULTS_FL	199.121	1691.53
RESULTS_FE	55.3281	145.676
RESULTS_MG	36.6896	78.1361
RESULTS_MN	51.5105	182.337
RESULTS_NO3	101.944	523.736

RESULTS_SO3	245.289	2431.15
RESULTS_PB	319.916	3232.52
RESULTS_TDS	116.277	809.305
RESULTS_TURB	187.884	1589.77
RESULTS_HARD	125.904	1079.77
RESULTS_ZN	456.326	7315.99
RESULTS_NA	91.6741	437.663
RESULTS_CU	478.519	7589.63
Total	384.276	2937.07

The StatAdvisor
This table shows various statistics for each of the 18 columns of data. To test for significant differences amongst the column means, select Analysis of Variance from the list of Tabular Options. Select Means Plot from the list of Graphical Options to display the means graphically.

WARNING: There is more than a 3 to 1 difference between the smallest standard deviation and the largest. This may cause problems since the analysis of variance assumes that the standard deviations at all levels are equal. Select Variance Check from the list of Tabular Options to run a formal statistical test for differences among the sigmas. You may want to consider transforming the data to remove any dependence of the standard deviation on the mean.

WARNING: The standardized skewness and/or kurtosis is outside the range of -2 to +2 for 18 columns. This indicates some significant nonnormality in the data, which violates the assumption that the data come from normal distributions. You may wish to transform the data or use the Kruskal-Wallis test to compare the medians instead of the means.

Multiple-Variable Analysis

Data variables:
- RESULTS_pH
- RESULTS_CA
- RESULTS_CL
- RESULTS_AL
- RESULTS_FL
- RESULTS_FE
- RESULTS_MG
- RESULTS_MN
- RESULTS_NO3
- RESULTS_SO3
- RESULTS_TDS
- RESULTS_TURB
- RESULTS_ZN
- RESULTS_NA
- RESULTS_CU

There are 1432 complete cases for use in the calculations.

The StatAdvisor
This procedure is designed to summarize several columns of quantitative data. It will calculate various statistics, including correlations, covariances, and partial correlations. Also included in the procedure are a number of multivariate graphs, which give interesting views into the data. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

After this procedure, you may wish to select another procedure to build a statistical model for your data. Depending on your goal, one of several procedures may be appropriate. Following is a list of goals with an indication of which procedure would be appropriate:

GOAL: build a model for predicting one variable given values of one of more other variables.
PROCEDURE: Relate - Multiple Factors - Multiple Regression

GOAL: group rows of data with similar characteristics.

PROCEDURE: Describe - Multivariate Methods - Cluster Analysis

GOAL: develop a method for predicting which of several groups new rows belong to.
PROCEDURE: Relate - Classification Methods - Discriminant Analysis

GOAL: reduce the number of columns to a small set of meaningful measures.
PROCEDURE: Describe - Multivariate Methods - Factor Analysis

GOAL: determine which combinations of the columns determine most of the variability in your data.
PROCEDURE: Describe - Multivariate Methods - Principal Components

GOAL: find combinations of the columns which are strongly related to each other.
PROCEDURE: Describe - Multivariate Methods - Canonical Correlations

Correlations

	RESULTS_pH	RESULTS_CA	RESULTS_CL	RESULTS_AL	RESULTS_FL	RESULTS_FE
RESULTS_pH		0.0938	-0.1504	0.0616	0.2509	-0.1116
		(1432)	(1432)	(1432)	(1432)	(1432)
		0.0004	0.0000	0.0197	0.0000	0.0000
RESULTS_CA	0.0938		0.3376	-0.0114	-0.0179	-0.0634
	(1432)		(1432)	(1432)	(1432)	(1432)
	0.0004		0.0000	0.6663	0.4986	0.0164
RESULTS_CL	-0.1504	0.3376		-0.0101	-0.0023	0.0796
	(1432)	(1432)		(1432)	(1432)	(1432)
	0.0000	0.0000		0.7037	0.9309	0.0025
RESULTS_AL	0.0616	-0.0114	-0.0101		0.0474	0.1672
	(1432)	(1432)	(1432)		(1432)	(1432)
	0.0197	0.6663	0.7037		0.0724	0.0000
RESULTS_FL	0.2509	-0.0179	-0.0023	0.0474		-0.0136
	(1432)	(1432)	(1432)	(1432)		(1432)
	0.0000	0.4986	0.9309	0.0724		0.6067
RESULTS_FE	-0.1116	-0.0634	0.0796	0.1672	-0.0136	
	(1432)	(1432)	(1432)	(1432)	(1432)	
	0.0000	0.0164	0.0025	0.0000	0.6067	
RESULTS_MG	-0.2042	0.4062	0.4391	0.0271	-0.1507	0.0462
	(1432)	(1432)	(1432)	(1432)	(1432)	(1432)
	0.0000	0.0000	0.0000	0.3045	0.0000	0.0800
RESULTS_MN	-0.2605	0.1279	0.4360	-0.0098	-0.0861	0.4656
	(1432)	(1432)	(1432)	(1432)	(1432)	(1432)
	0.0000	0.0000	0.0000	0.7112	0.0011	0.0000
RESULTS_NO3	-0.1679	0.1216	0.0585	0.1227	-0.0447	-0.0292
	(1432)	(1432)	(1432)	(1432)	(1432)	(1432)
	0.0000	0.0000	0.0268	0.0000	0.0908	0.2701
RESULTS_SO3	0.0363	0.4563	0.0940	0.1035	-0.0128	0.0300
	(1432)	(1432)	(1432)	(1432)	(1432)	(1432)
	0.1691	0.0000	0.0004	0.0001	0.6284	0.2566
RESULTS_TDS	0.1112	0.8871	0.4539	0.1135	0.0411	0.0199
	(1432)	(1432)	(1432)	(1432)	(1432)	(1432)
	0.0000	0.0000	0.0000	0.0000	0.1200	0.4522
RESULTS_TURB	-0.0236	-0.0108	0.0563	0.2620	0.0064	0.4756
	(1432)	(1432)	(1432)	(1432)	(1432)	(1432)
	0.3730	0.6828	0.0329	0.0000	0.8092	0.0000
RESULTS_ZN	-0.0045	0.0133	0.0350	0.0017	-0.0155	0.0272
	(1432)	(1432)	(1432)	(1432)	(1432)	(1432)
	0.8652	0.6158	0.1856	0.9497	0.5588	0.3040
RESULTS_NA	0.3239	0.1062	0.1589	0.3288	0.3737	0.0281
	(1432)	(1432)	(1432)	(1432)	(1432)	(1432)
	0.0000	0.0001	0.0000	0.0000	0.0000	0.2874
RESULTS_CU	-0.0164	-0.0038	0.0368	0.0687	-0.0051	0.0241

	(1432)	(1432)	(1432)	(1432)	(1432)	(1432)
	0.5346	0.8864	0.1632	0.0093	0.8461	0.3616

	RESULTS_MG	RESULTS_MN	RESULTS_NO3	RESULTS_SO3	RESULTS_TDS
RESULTS_pH	-0.2042	-0.2605	-0.1679	0.0363	0.1112
	(1432)	(1432)	(1432)	(1432)	(1432)
	0.0000	0.0000	0.0000	0.1691	0.0000
RESULTS_CA	0.4062	0.1279	0.1216	0.4563	0.8871
	(1432)	(1432)	(1432)	(1432)	(1432)
	0.0000	0.0000	0.0000	0.0000	0.0000
RESULTS_CL	0.4391	0.4360	0.0585	0.0940	0.4539
	(1432)	(1432)	(1432)	(1432)	(1432)
	0.0000	0.0000	0.0268	0.0004	0.0000
RESULTS_AL	0.0271	-0.0098	0.1227	0.1035	0.1135
	(1432)	(1432)	(1432)	(1432)	(1432)
	0.3045	0.7112	0.0000	0.0001	0.0000
RESULTS_FL	-0.1507	-0.0861	-0.0447	-0.0128	0.0411
	(1432)	(1432)	(1432)	(1432)	(1432)
	0.0000	0.0011	0.0908	0.6284	0.1200
RESULTS_FE	0.0462	0.4656	-0.0292	0.0300	0.0199
	(1432)	(1432)	(1432)	(1432)	(1432)
	0.0800	0.0000	0.2701	0.2566	0.4522
RESULTS_MG		0.2023	0.1606	0.3452	0.5865
		(1432)	(1432)	(1432)	(1432)
		0.0000	0.0000	0.0000	0.0000
RESULTS_MN	0.2023		-0.1467	0.0629	0.1697
	(1432)		(1432)	(1432)	(1432)
	0.0000		0.0000	0.0171	0.0000
RESULTS_NO3	0.1606	-0.1467		0.0197	0.0902
	(1432)	(1432)		(1432)	(1432)
	0.0000	0.0000		0.4563	0.0006
RESULTS_SO3	0.3452	0.0629	0.0197		0.6480
	(1432)	(1432)	(1432)		(1432)
	0.0000	0.0171	0.4563		0.0000
RESULTS_TDS	0.5865	0.1697	0.0902	0.6480	
	(1432)	(1432)	(1432)	(1432)	
	0.0000	0.0000	0.0006	0.0000	
RESULTS_TURB	0.0131	0.2666	-0.0206	0.0265	0.0453
	(1432)	(1432)	(1432)	(1432)	(1432)
	0.6215	0.0000	0.4361	0.3154	0.0862
RESULTS_ZN	0.0067	0.0640	-0.0072	0.0040	0.0248
	(1432)	(1432)	(1432)	(1432)	(1432)
	0.7986	0.0153	0.7850	0.8788	0.3476
RESULTS_NA	-0.0379	-0.0629	-0.0482	0.3829	0.3799
	(1432)	(1432)	(1432)	(1432)	(1432)
	0.1517	0.0171	0.0680	0.0000	0.0000
RESULTS_CU	0.0711	-0.0136	-0.0121	-0.0089	0.0130
	(1432)	(1432)	(1432)	(1432)	(1432)
	0.0070	0.6068	0.6470	0.7351	0.6223

	RESULTS_TURB	RESULTS_ZN	RESULTS_NA	RESULTS_CU
RESULTS_pH	-0.0236	-0.0045	0.3239	-0.0164
	(1432)	(1432)	(1432)	(1432)
	0.3730	0.8652	0.0000	0.5346
RESULTS_CA	-0.0108	0.0133	0.1062	-0.0038
	(1432)	(1432)	(1432)	(1432)
	0.6828	0.6158	0.0001	0.8864
RESULTS_CL	0.0563	0.0350	0.1589	0.0368

	(1432)	(1432)	(1432)	(1432)
	0.0329	0.1856	0.0000	0.1632
RESULTS_AL	0.2620	0.0017	0.3288	0.0687
	(1432)	(1432)	(1432)	(1432)
	0.0000	0.9497	0.0000	0.0093
RESULTS_FL	0.0064	-0.0155	0.3737	-0.0051
	(1432)	(1432)	(1432)	(1432)
	0.8092	0.5588	0.0000	0.8461
RESULTS_FE	0.4756	0.0272	0.0281	0.0241
	(1432)	(1432)	(1432)	(1432)
	0.0000	0.3040	0.2874	0.3616
RESULTS_MG	0.0131	0.0067	-0.0379	0.0711
	(1432)	(1432)	(1432)	(1432)
	0.6215	0.7986	0.1517	0.0070
RESULTS_MN	0.2666	0.0640	-0.0629	-0.0136
	(1432)	(1432)	(1432)	(1432)
	0.0000	0.0153	0.0171	0.6068
RESULTS_NO3	-0.0206	-0.0072	-0.0482	-0.0121
	(1432)	(1432)	(1432)	(1432)
	0.4361	0.7850	0.0680	0.6470
RESULTS_SO3	0.0265	0.0040	0.3829	-0.0089
	(1432)	(1432)	(1432)	(1432)
	0.3154	0.8788	0.0000	0.7351
RESULTS_TDS	0.0453	0.0248	0.3799	0.0130
	(1432)	(1432)	(1432)	(1432)
	0.0862	0.3476	0.0000	0.6223
RESULTS_TURB		0.0144	0.0992	0.0019
		(1432)	(1432)	(1432)
		0.5865	0.0002	0.9432
RESULTS_ZN	0.0144		0.0189	0.0233
	(1432)		(1432)	(1432)
	0.5865		0.4742	0.3784
RESULTS_NA	0.0992	0.0189		-0.0084
	(1432)	(1432)		(1432)
	0.0002	0.4742		0.7518
RESULTS_CU	0.0019	0.0233	-0.0084	
	(1432)	(1432)	(1432)	
	0.9432	0.3784	0.7518	

Correlation
(Sample Size)
P-Value

The StatAdvisor

This table shows Pearson product moment correlations between each pair of variables. These correlation coefficients range between -1 and +1 and measure the strength of the linear relationship between the variables. Also shown in parentheses is the number of pairs of data values used to compute each coefficient. The third number in each location of the table is a P-value which tests the statistical significance of the estimated correlations. P-values below 0.05 indicate statistically significant non-zero correlations at the 95.0% confidence level. The following pairs of variables have P-values below 0.05:

RESULTS_pH and RESULTS_CA
RESULTS_pH and RESULTS_CL
RESULTS_pH and RESULTS_AL
RESULTS_pH and RESULTS_FL
RESULTS_pH and RESULTS_FE
RESULTS_pH and RESULTS_MG
RESULTS_pH and RESULTS_MN
RESULTS_pH and RESULTS_NO3
RESULTS_pH and RESULTS_TDS
RESULTS_pH and RESULTS_NA

RESULTS_CA and RESULTS_CL
RESULTS_CA and RESULTS_FE
RESULTS_CA and RESULTS_MG
RESULTS_CA and RESULTS_MN
RESULTS_CA and RESULTS_NO3
RESULTS_CA and RESULTS_SO3
RESULTS_CA and RESULTS_TDS
RESULTS_CA and RESULTS_NA
RESULTS_CL and RESULTS_FE
RESULTS_CL and RESULTS_MG
RESULTS_CL and RESULTS_MN
RESULTS_CL and RESULTS_NO3
RESULTS_CL and RESULTS_SO3
RESULTS_CL and RESULTS_TDS
RESULTS_CL and RESULTS_TURB
RESULTS_CL and RESULTS_NA
RESULTS_AL and RESULTS_FE
RESULTS_AL and RESULTS_NO3
RESULTS_AL and RESULTS_SO3
RESULTS_AL and RESULTS_TDS
RESULTS_AL and RESULTS_TURB
RESULTS_AL and RESULTS_NA
RESULTS_AL and RESULTS_CU
RESULTS_FL and RESULTS_MG
RESULTS_FL and RESULTS_MN
RESULTS_FL and RESULTS_NA
RESULTS_FE and RESULTS_MN
RESULTS_FE and RESULTS_TURB
RESULTS_MG and RESULTS_MN
RESULTS_MG and RESULTS_NO3
RESULTS_MG and RESULTS_SO3
RESULTS_MG and RESULTS_TDS
RESULTS_MG and RESULTS_CU
RESULTS_MN and RESULTS_NO3
RESULTS_MN and RESULTS_SO3
RESULTS_MN and RESULTS_TDS
RESULTS_MN and RESULTS_TURB
RESULTS_MN and RESULTS_ZN
RESULTS_MN and RESULTS_NA
RESULTS_NO3 and RESULTS_TDS
RESULTS_SO3 and RESULTS_TDS
RESULTS_SO3 and RESULTS_NA
RESULTS_TDS and RESULTS_NA
RESULTS_TURB and RESULTS_NA

Summary Statistics

	Count	*Average*	*Median*	*Geometric mean*	*Standard deviation*	*Coeff. of variation*	*Minimum*
RESULTS_pH	1799	7.57571	7.6	7.54482	0.695308	9.17812%	5.0
RESULTS_ALK	1800	106.362	100.0	96.4602	53.3769	50.1841%	6.2
RESULTS_CA	1475	28.1109	25.0	23.3852	24.3293	86.5475%	1.0
RESULTS_CL	1800	8.12667	2.5	4.84347	16.2553	200.025%	2.5
RESULTS_AL	1795	0.188903	0.05	0.0859776	0.487477	258.058%	0.05
RESULTS_FL	1795	0.329833	0.25	0.284405	0.370505	112.331%	0.25
RESULTS_FE	1460	2.13308	0.98	0.844674	3.12572	146.535%	0.01
RESULTS_MG	1475	8.47816	7.1	6.83632	5.63749	66.4943%	0.002
RESULTS_MN	1458	0.138788	0.11	0.0739129	0.147395	106.202%	0.002
RESULTS_NO3	1474	0.895929	0.25	0.416293	1.93516	215.995%	0.25
RESULTS_SO3	1475	13.3471	10.0	8.7761	27.1333	203.29%	2.5
RESULTS_TDS	1793	132.574	120.0	119.168	77.8413	58.7154%	2.0
RESULTS_TURB	1789	16.2949	5.0	4.79057	43.3089	265.782%	0.05
RESULTS_ZN	1793	0.0139381	0.002	0.00420239	0.103182	740.291%	0.002

RESULTS_NA	1474	9.56479	7.0	7.57374	9.64506	100.839%	0.5
RESULTS_CU	1794	0.0105819	0.002	0.00320993	0.0949785	897.553%	0.002
Total	26449	21.9264	2.9	1.33478	49.0037	223.491%	0.002

	Maximum	*Range*	*Lower quartile*	*Upper quartile*	*Interquartile range*	*Stnd. skewness*	*Stnd. kurtosis*
RESULTS_pH	12.0	7.0	7.2	7.9	0.7	15.392	36.0362
RESULTS_ALK	1100.0	1093.8	76.0	120.0	44.0	95.8145	717.587
RESULTS_CA	630.0	629.0	18.0	33.0	15.0	189.115	2071.77
RESULTS_CL	440.0	437.5	2.5	8.0	5.5	228.024	2538.41
RESULTS_AL	9.7	9.65	0.05	0.1	0.05	159.916	1085.66
RESULTS_FL	8.3	8.05	0.25	0.25	0.0	199.121	1691.53
RESULTS_FE	32.0	31.99	0.34	2.7	2.36	55.3281	145.676
RESULTS_MG	56.0	55.998	5.3	10.0	4.7	36.6896	78.1361
RESULTS_MN	2.0	1.998	0.039	0.18	0.141	51.5105	182.337
RESULTS_NO3	29.0	28.75	0.25	0.25	0.0	101.944	523.736
RESULTS_SO3	660.0	657.5	5.0	16.0	11.0	245.289	2431.15
RESULTS_TDS	1600.0	1598.0	96.0	150.0	54.0	116.277	809.305
RESULTS_TURB	1000.0	999.95	1.8	15.0	13.2	187.884	1589.77
RESULTS_ZN	3.6	3.598	0.002	0.007	0.005	456.326	7315.99
RESULTS_NA	140.0	139.5	5.0	10.0	5.0	91.6741	437.663
RESULTS_CU	3.3	3.298	0.002	0.004	0.002	478.519	7589.63
Total	1600.0	1600.0	0.21	13.0	12.79	379.374	2848.07

The StatAdvisor
This table shows various statistics for each of the 16 columns of data. To test for significant differences amongst the column means, select Analysis of Variance from the list of Tabular Options. Select Means Plot from the list of Graphical Options to display the means graphically.

WARNING: There is more than a 3 to 1 difference between the smallest standard deviation and the largest. This may cause problems since the analysis of variance assumes that the standard deviations at all levels are equal. Select Variance Check from the list of Tabular Options to run a formal statistical test for differences among the sigmas. You may want to consider transforming the data to remove any dependence of the standard deviation on the mean.

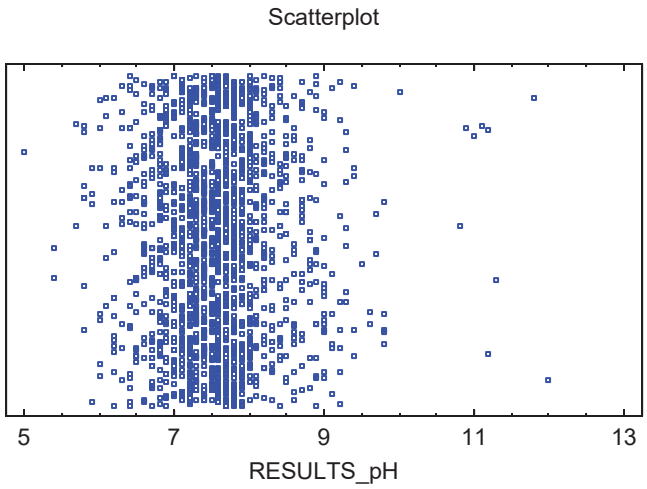
WARNING: The standardized skewness and/or kurtosis is outside the range of -2 to +2 for 16 columns. This indicates some significant nonnormality in the data, which violates the assumption that the data come from normal distributions. You may wish to transform the data or use the Kruskal-Wallis test to compare the medians instead of the means.

Section B) Analysis of individual analytes reported by National Testing Labs.

One-Variable Analysis - RESULTS_pH

Data variable: RESULTS_pH
1799 values ranging from 5.0 to 12.0

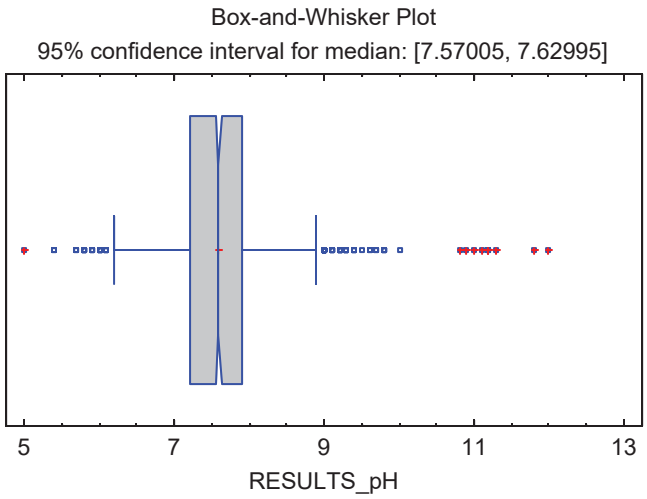
The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.



Summary Statistics for RESULTS_pH

Count	1799
Average	7.57571
Standard deviation	0.695308
Coeff. of variation	9.17812%
Minimum	5.0
Maximum	12.0
Range	7.0
Stnd. skewness	15.392
Stnd. kurtosis	36.0362

The StatAdvisor
This table shows summary statistics for RESULTS_pH. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for RESULTS_pH

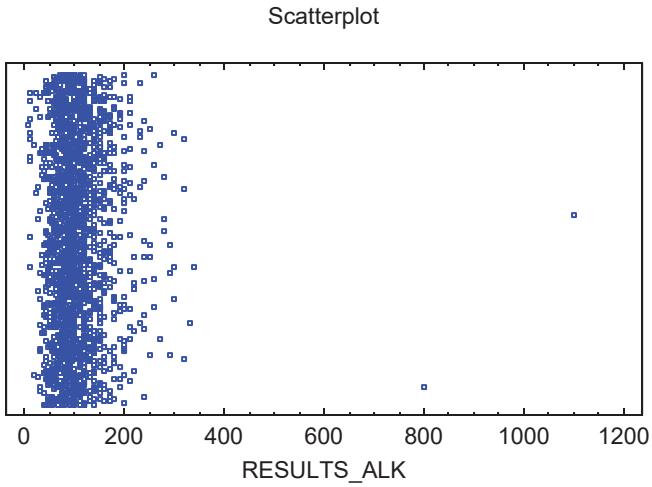
	Percentiles
1.0%	6.0
5.0%	6.5
10.0%	6.8
25.0%	7.2
50.0%	7.6
75.0%	7.9
90.0%	8.4
95.0%	8.8
99.0%	9.6

The StatAdvisor
This pane shows sample percentiles for RESULTS_pH. The percentiles are values below which specific percentages of the data are found. You can see the percentiles graphically by selecting Quantile Plot from the list of Graphical Options.

One-Variable Analysis - RESULTS_ALK

Data variable: RESULTS_ALK
1800 values ranging from 6.2 to 1100.0

The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

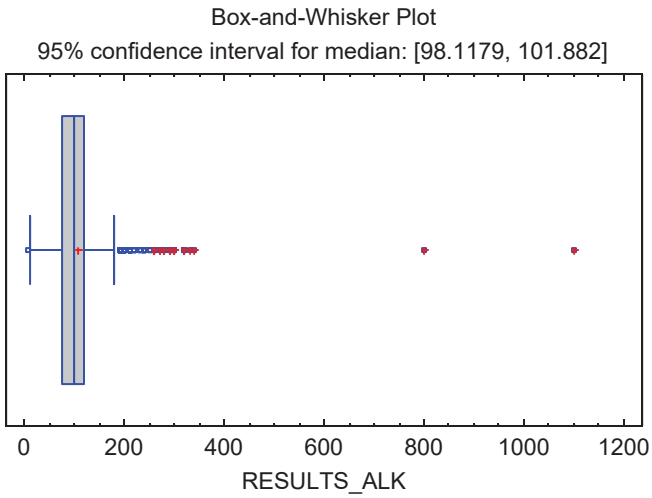


Summary Statistics for RESULTS_ALK

Count	1800
Average	106.362
Standard deviation	53.3769
Coeff. of variation	50.1841%
Minimum	6.2
Maximum	1100.0
Range	1093.8
Stnd. skewness	95.8145
Stnd. kurtosis	717.587

The StatAdvisor

This table shows summary statistics for RESULTS_ALK. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for RESULTS_ALK

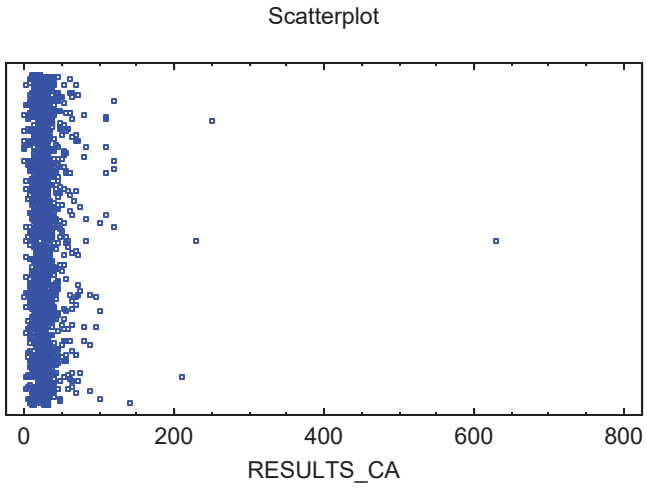
	Percentiles
1.0%	28.0
5.0%	46.0
10.0%	58.0
25.0%	76.0
50.0%	100.0
75.0%	120.0
90.0%	160.0
95.0%	190.0
99.0%	260.0

The StatAdvisor
This pane shows sample percentiles for RESULTS_ALK. The percentiles are values below which specific percentages of the data are found. You can see the percentiles graphically by selecting Quantile Plot from the list of Graphical Options.

One-Variable Analysis - RESULTS_CA

Data variable: RESULTS_CA
1475 values ranging from 1.0 to 630.0

The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

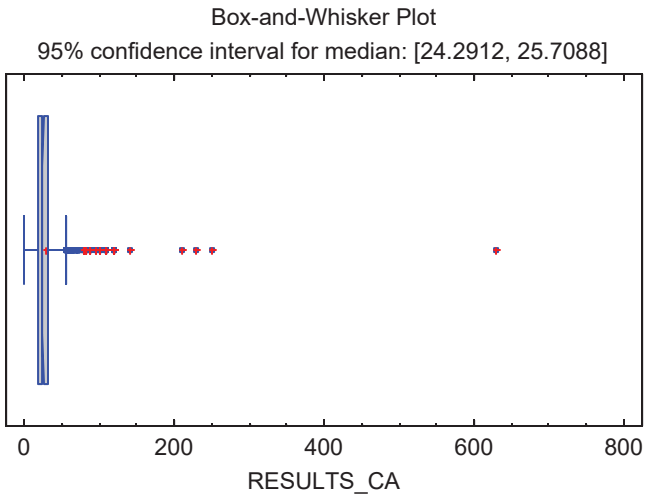


Summary Statistics for RESULTS_CA

Count	1475
Average	28.1109
Standard deviation	24.3293
Coeff. of variation	86.5475%
Minimum	1.0
Maximum	630.0
Range	629.0
Stnd. skewness	189.115
Stnd. kurtosis	2071.77

The StatAdvisor

This table shows summary statistics for RESULTS_CA. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for RESULTS_CA

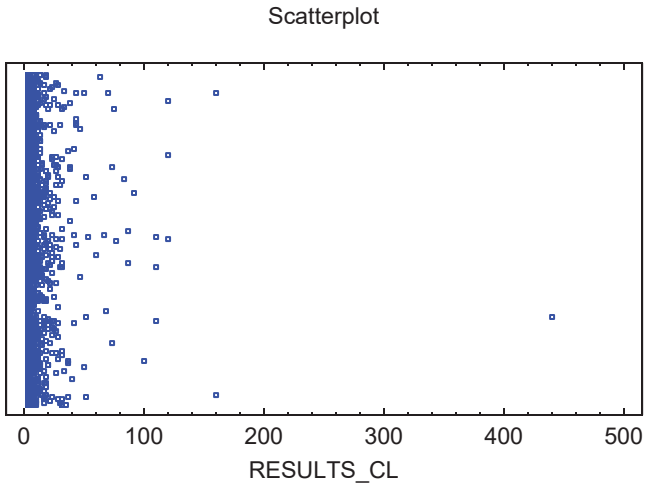
	Percentiles
1.0%	3.3
5.0%	8.4
10.0%	11.0
25.0%	18.0
50.0%	25.0
75.0%	33.0
90.0%	45.0
95.0%	59.0
99.0%	100.0

The StatAdvisor
This pane shows sample percentiles for RESULTS_CA. The percentiles are values below which specific percentages of the data are found. You can see the percentiles graphically by selecting Quantile Plot from the list of Graphical Options.

One-Variable Analysis - RESULTS_CL

Data variable: RESULTS_CL
1800 values ranging from 2.5 to 440.0

The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

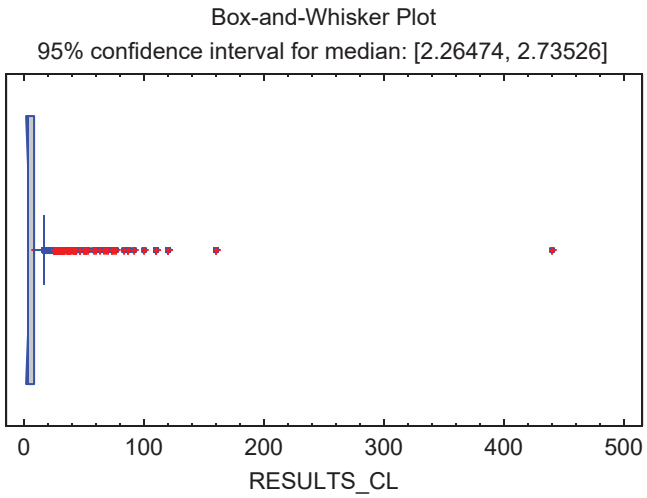


Summary Statistics for RESULTS_CL

Count	1800
Average	8.12667
Standard deviation	16.2553
Coeff. of variation	200.025%
Minimum	2.5
Maximum	440.0
Range	437.5
Stnd. skewness	228.024
Stnd. kurtosis	2538.41

The StatAdvisor

This table shows summary statistics for RESULTS_CL. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for RESULTS_CL

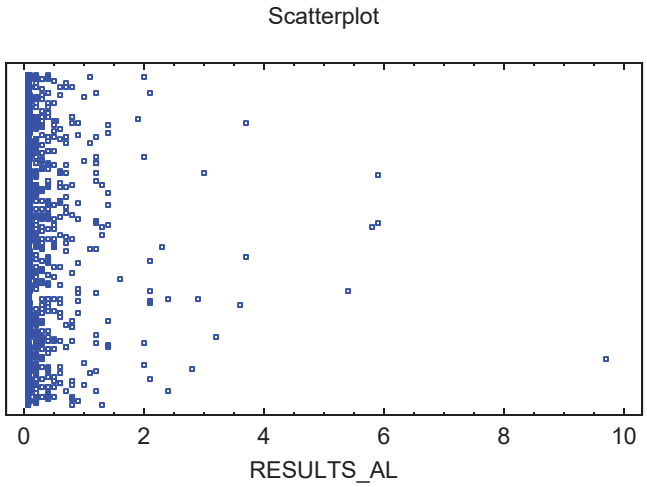
	Percentiles
1.0%	2.5
5.0%	2.5
10.0%	2.5
25.0%	2.5
50.0%	2.5
75.0%	8.0
90.0%	17.0
95.0%	26.0
99.0%	70.0

The StatAdvisor
This pane shows sample percentiles for RESULTS_CL. The percentiles are values below which specific percentages of the data are found. You can see the percentiles graphically by selecting Quantile Plot from the list of Graphical Options.

One-Variable Analysis - RESULTS_AL

Data variable: RESULTS_AL
1795 values ranging from 0.05 to 9.7

The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

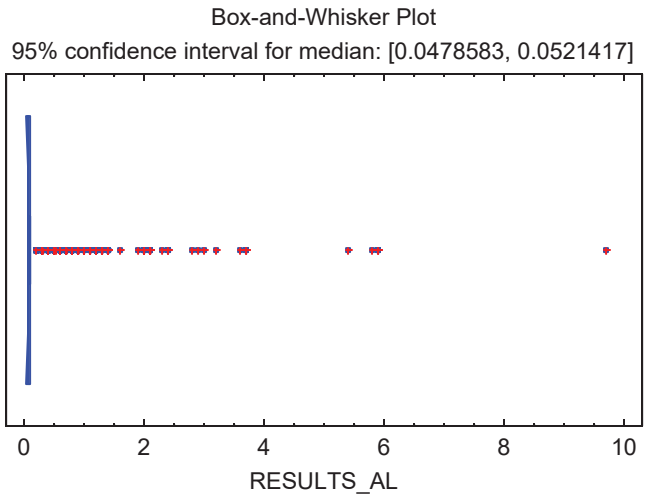


Summary Statistics for RESULTS_AL

Count	1795
Average	0.188903
Standard deviation	0.487477
Coeff. of variation	258.058%
Minimum	0.05
Maximum	9.7
Range	9.65
Stnd. skewness	159.916
Stnd. kurtosis	1085.66

The StatAdvisor

This table shows summary statistics for RESULTS_AL. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for RESULTS_AL

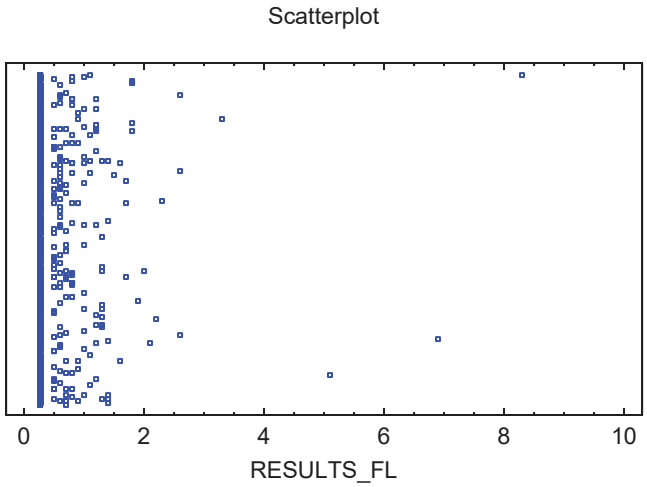
	Percentiles
1.0%	0.05
5.0%	0.05
10.0%	0.05
25.0%	0.05
50.0%	0.05
75.0%	0.1
90.0%	0.4
95.0%	0.7
99.0%	2.1

The StatAdvisor
This pane shows sample percentiles for RESULTS_AL. The percentiles are values below which specific percentages of the data are found. You can see the percentiles graphically by selecting Quantile Plot from the list of Graphical Options.

One-Variable Analysis - RESULTS_FL

Data variable: RESULTS_FL
1795 values ranging from 0.25 to 8.3

The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

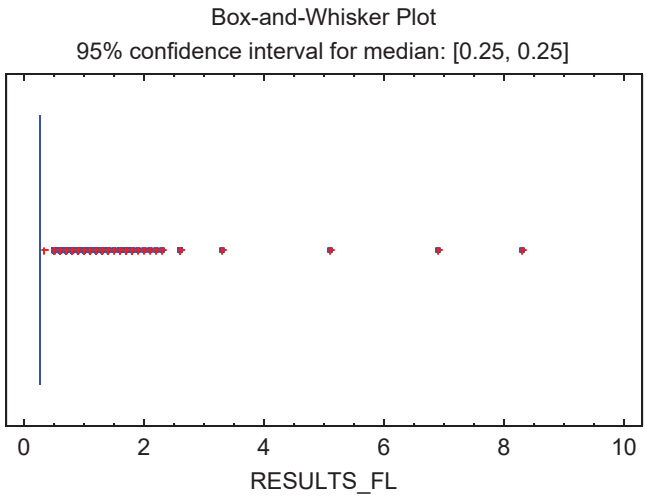


Summary Statistics for RESULTS_FL

Count	1795
Average	0.329833
Standard deviation	0.370505
Coeff. of variation	112.331%
Minimum	0.25
Maximum	8.3
Range	8.05
Stnd. skewness	199.121
Stnd. kurtosis	1691.53

The StatAdvisor

This table shows summary statistics for RESULTS_FL. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for RESULTS_FL

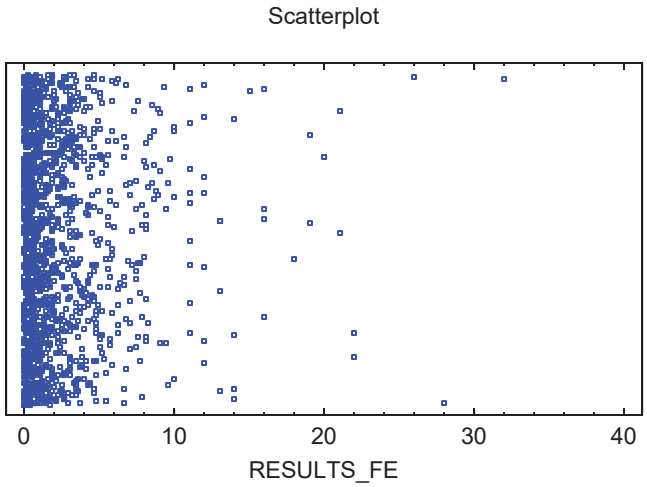
	Percentiles
1.0%	0.25
5.0%	0.25
10.0%	0.25
25.0%	0.25
50.0%	0.25
75.0%	0.25
90.0%	0.5
95.0%	0.8
99.0%	1.7

The StatAdvisor
This pane shows sample percentiles for RESULTS_FL. The percentiles are values below which specific percentages of the data are found. You can see the percentiles graphically by selecting Quantile Plot from the list of Graphical Options.

One-Variable Analysis - RESULTS_FE

Data variable: RESULTS_FE
1460 values ranging from 0.01 to 32.0

The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

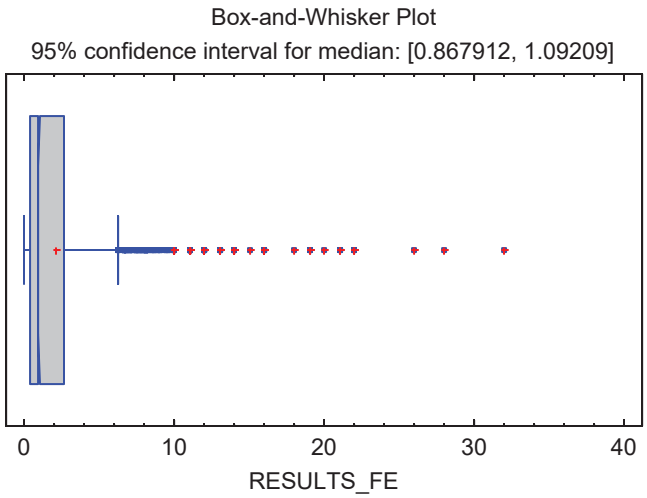


Summary Statistics for RESULTS_FE

Count	1460
Average	2.13308
Standard deviation	3.12572
Coeff. of variation	146.535%
Minimum	0.01
Maximum	32.0
Range	31.99
Stnd. skewness	55.3281
Stnd. kurtosis	145.676

The StatAdvisor

This table shows summary statistics for RESULTS_FE. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for RESULTS_FE

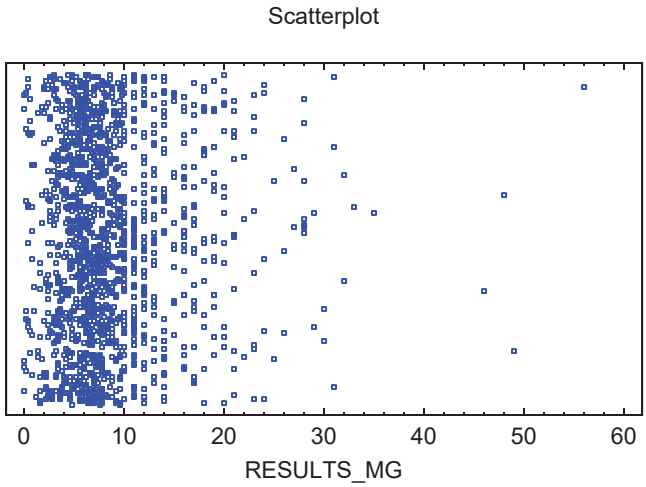
	Percentiles
1.0%	0.01
5.0%	0.045
10.0%	0.1
25.0%	0.34
50.0%	0.98
75.0%	2.7
90.0%	5.25
95.0%	8.0
99.0%	16.0

The StatAdvisor
This pane shows sample percentiles for RESULTS_FE. The percentiles are values below which specific percentages of the data are found. You can see the percentiles graphically by selecting Quantile Plot from the list of Graphical Options.

One-Variable Analysis - RESULTS_MG

Data variable: RESULTS_MG
1475 values ranging from 0.002 to 56.0

The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

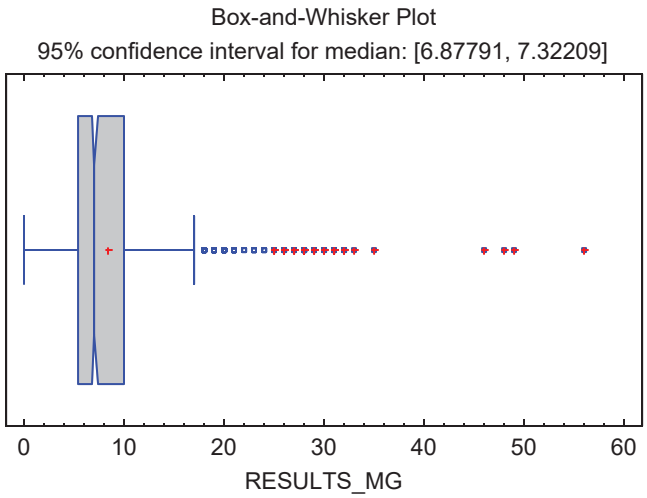


Summary Statistics for RESULTS_MG

Count	1475
Average	8.47816
Standard deviation	5.63749
Coeff. of variation	66.4943%
Minimum	0.002
Maximum	56.0
Range	55.998
Stnd. skewness	36.6896
Stnd. kurtosis	78.1361

The StatAdvisor

This table shows summary statistics for RESULTS_MG. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for RESULTS_MG

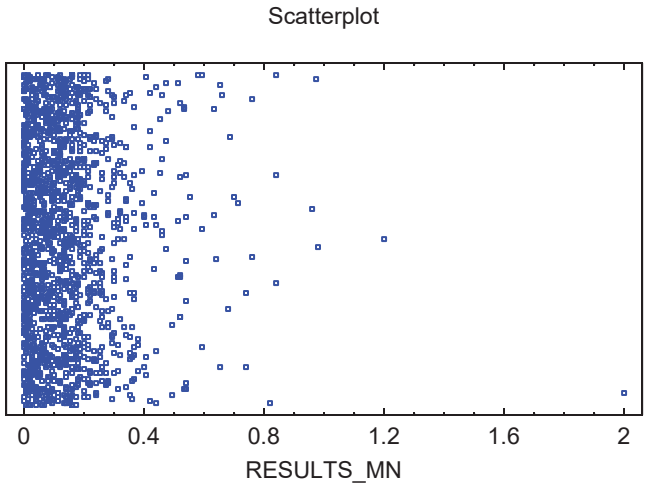
	Percentiles
1.0%	0.39
5.0%	2.3
10.0%	3.3
25.0%	5.3
50.0%	7.1
75.0%	10.0
90.0%	16.0
95.0%	19.0
99.0%	29.0

The StatAdvisor
This pane shows sample percentiles for RESULTS_MG. The percentiles are values below which specific percentages of the data are found. You can see the percentiles graphically by selecting Quantile Plot from the list of Graphical Options.

One-Variable Analysis - RESULTS_MN

Data variable: RESULTS_MN
1458 values ranging from 0.002 to 2.0

The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

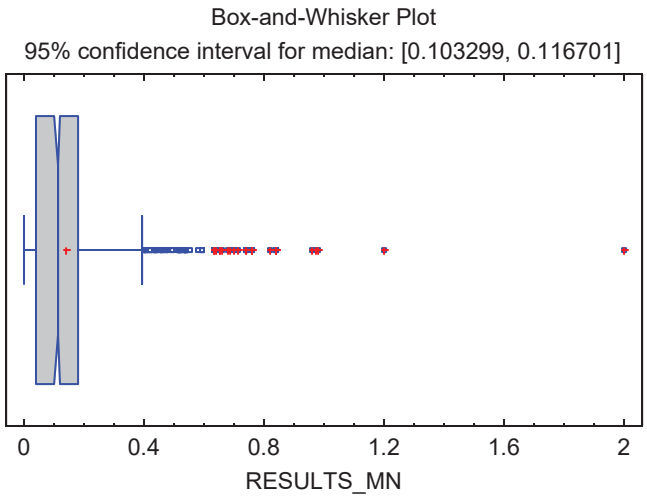


Summary Statistics for RESULTS_MN

Count	1458
Average	0.138788
Standard deviation	0.147395
Coeff. of variation	106.202%
Minimum	0.002
Maximum	2.0
Range	1.998
Stnd. skewness	51.5105
Stnd. kurtosis	182.337

The StatAdvisor

This table shows summary statistics for RESULTS_MN. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for RESULTS_MN

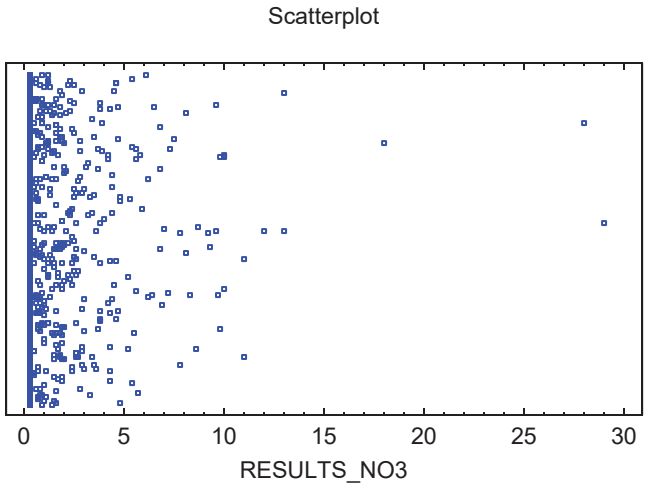
	Percentiles
1.0%	0.002
5.0%	0.002
10.0%	0.01
25.0%	0.039
50.0%	0.11
75.0%	0.18
90.0%	0.3
95.0%	0.41
99.0%	0.7

The StatAdvisor
This pane shows sample percentiles for RESULTS_MN. The percentiles are values below which specific percentages of the data are found. You can see the percentiles graphically by selecting Quantile Plot from the list of Graphical Options.

One-Variable Analysis - RESULTS_NO3

Data variable: RESULTS_NO3
1474 values ranging from 0.25 to 29.0

The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

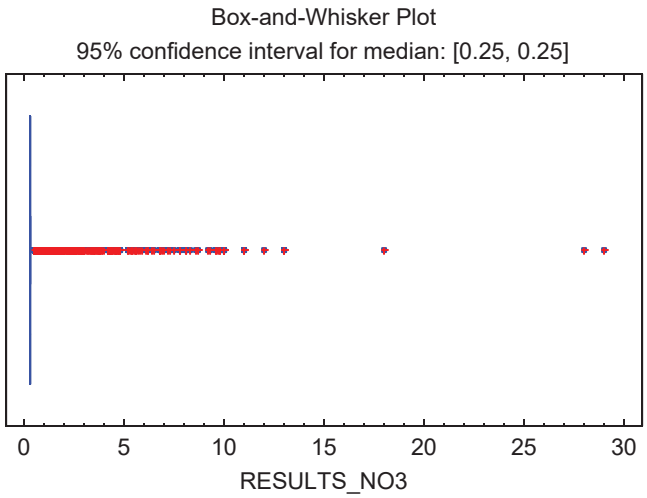


Summary Statistics for RESULTS_NO3

Count	1474
Average	0.895929
Standard deviation	1.93516
Coeff. of variation	215.995%
Minimum	0.25
Maximum	29.0
Range	28.75
Stnd. skewness	101.944
Stnd. kurtosis	523.736

The StatAdvisor

This table shows summary statistics for RESULTS_NO3. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for RESULTS_NO3

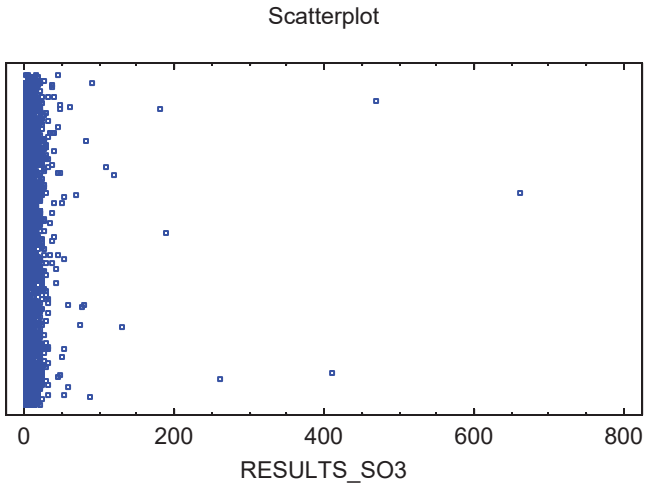
	Percentiles
1.0%	0.25
5.0%	0.25
10.0%	0.25
25.0%	0.25
50.0%	0.25
75.0%	0.25
90.0%	2.3
95.0%	4.2
99.0%	9.6

The StatAdvisor
This pane shows sample percentiles for RESULTS_NO3. The percentiles are values below which specific percentages of the data are found. You can see the percentiles graphically by selecting Quantile Plot from the list of Graphical Options.

One-Variable Analysis - RESULTS_SO3

Data variable: RESULTS_SO3
1475 values ranging from 2.5 to 660.0

The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

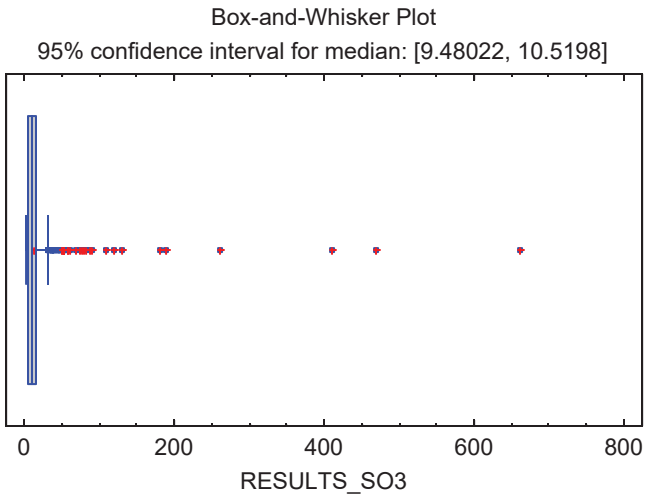


Summary Statistics for RESULTS_SO3

Count	1475
Average	13.3471
Standard deviation	27.1333
Coeff. of variation	203.29%
Minimum	2.5
Maximum	660.0
Range	657.5
Stnd. skewness	245.289
Stnd. kurtosis	2431.15

The StatAdvisor

This table shows summary statistics for RESULTS_SO3. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for RESULTS_SO3

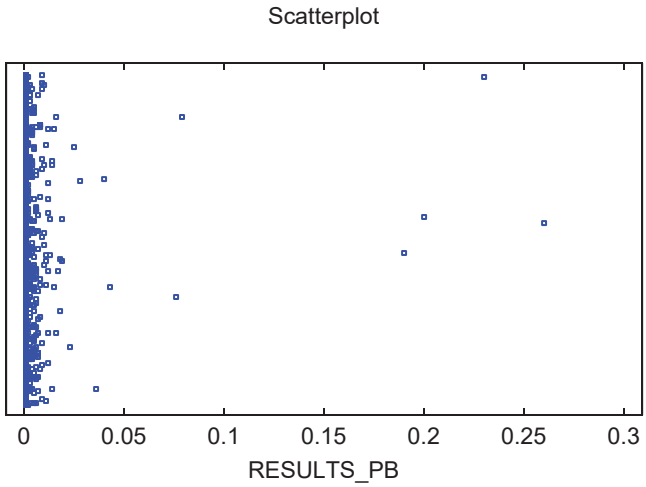
	Percentiles
1.0%	2.5
5.0%	2.5
10.0%	2.5
25.0%	5.0
50.0%	10.0
75.0%	16.0
90.0%	22.0
95.0%	29.0
99.0%	74.0

The StatAdvisor
This pane shows sample percentiles for RESULTS_SO3. The percentiles are values below which specific percentages of the data are found. You can see the percentiles graphically by selecting Quantile Plot from the list of Graphical Options.

One-Variable Analysis - RESULTS_PB

Data variable: RESULTS_PB
1793 values ranging from 0.001 to 0.26

The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

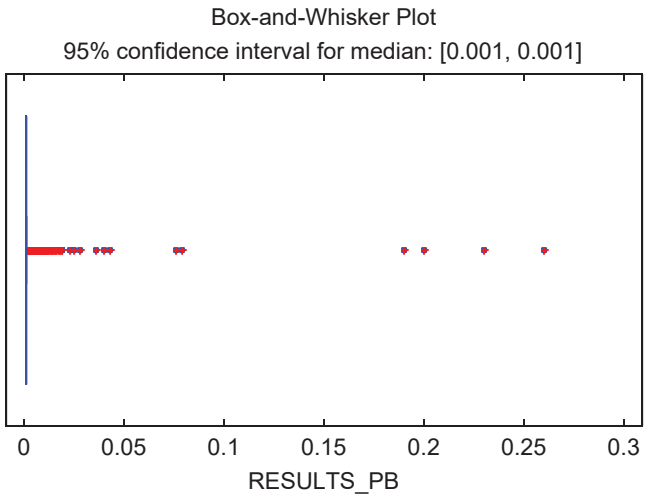


Summary Statistics for RESULTS_PB

Count	1793
Average	0.00225711
Standard deviation	0.0110246
Coeff. of variation	488.44%
Minimum	0.001
Maximum	0.26
Range	0.259
Stnd. skewness	319.916
Stnd. kurtosis	3232.52

The StatAdvisor

This table shows summary statistics for RESULTS_PB. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for RESULTS_PB

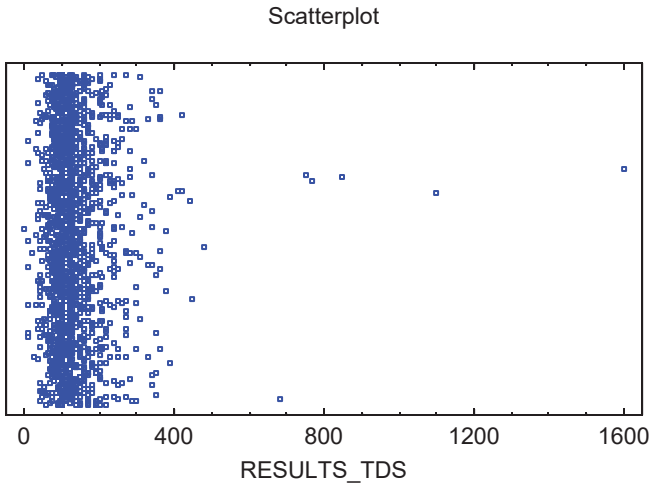
	Percentiles
1.0%	0.001
5.0%	0.001
10.0%	0.001
25.0%	0.001
50.0%	0.001
75.0%	0.001
90.0%	0.003
95.0%	0.006
99.0%	0.016

The StatAdvisor
This pane shows sample percentiles for RESULTS_PB. The percentiles are values below which specific percentages of the data are found. You can see the percentiles graphically by selecting Quantile Plot from the list of Graphical Options.

One-Variable Analysis - RESULTS_TDS

Data variable: RESULTS_TDS
1793 values ranging from 2.0 to 1600.0

The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

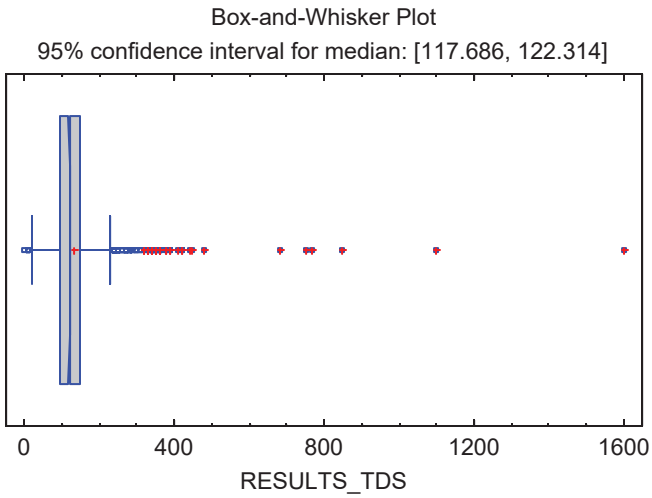


Summary Statistics for RESULTS_TDS

Count	1793
Average	132.574
Standard deviation	77.8413
Coeff. of variation	58.7154%
Minimum	2.0
Maximum	1600.0
Range	1598.0
Stnd. skewness	116.277
Stnd. kurtosis	809.305

The StatAdvisor

This table shows summary statistics for RESULTS_TDS. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for RESULTS_TDS

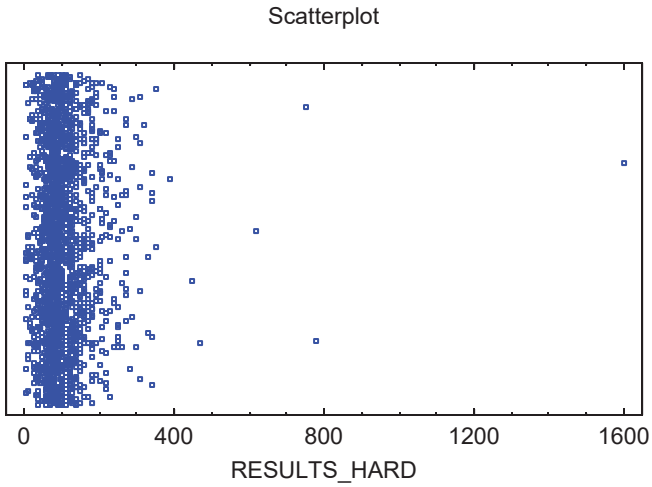
	Percentiles
1.0%	38.0
5.0%	63.0
10.0%	75.0
25.0%	96.0
50.0%	120.0
75.0%	150.0
90.0%	200.0
95.0%	250.0
99.0%	360.0

The StatAdvisor
This pane shows sample percentiles for RESULTS_TDS. The percentiles are values below which specific percentages of the data are found. You can see the percentiles graphically by selecting Quantile Plot from the list of Graphical Options.

One-Variable Analysis - RESULTS_HARD

Data variable: RESULTS_HARD
1796 values ranging from 5.0 to 1600.0

The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

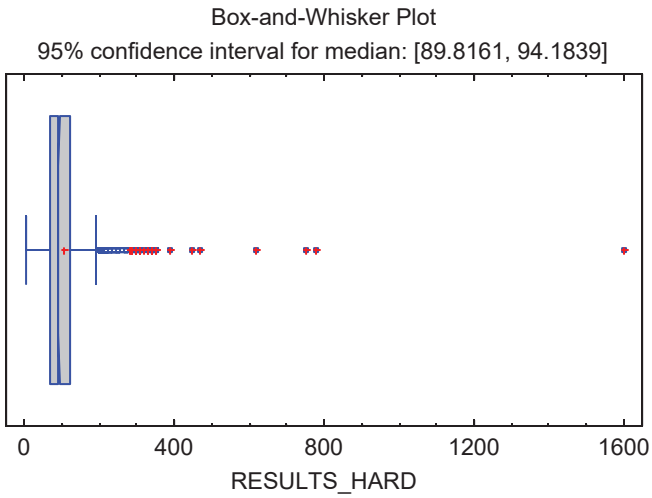


Summary Statistics for RESULTS_HARD

Count	1796
Average	104.247
Standard deviation	70.2967
Coeff. of variation	67.4327%
Minimum	5.0
Maximum	1600.0
Range	1595.0
Stnd. skewness	125.904
Stnd. kurtosis	1079.77

The StatAdvisor

This table shows summary statistics for RESULTS_HARD. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for RESULTS_HARD

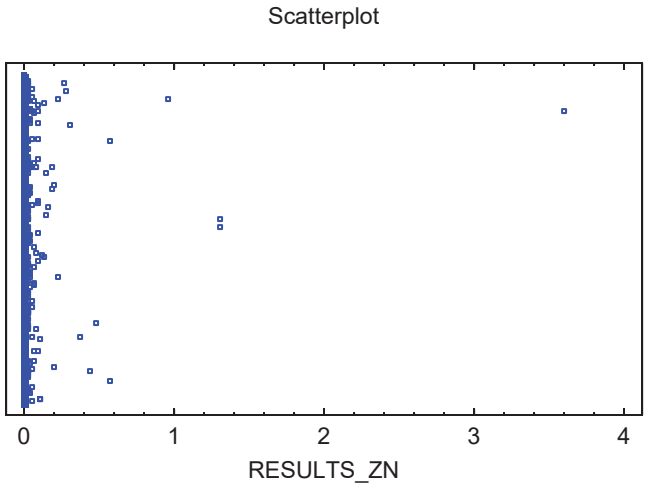
	Percentiles
1.0%	10.0
5.0%	34.0
10.0%	47.0
25.0%	69.0
50.0%	92.0
75.0%	120.0
90.0%	170.0
95.0%	210.0
99.0%	310.0

The StatAdvisor
This pane shows sample percentiles for RESULTS_HARD. The percentiles are values below which specific percentages of the data are found. You can see the percentiles graphically by selecting Quantile Plot from the list of Graphical Options.

One-Variable Analysis - RESULTS_ZN

Data variable: RESULTS_ZN
1793 values ranging from 0.002 to 3.6

The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

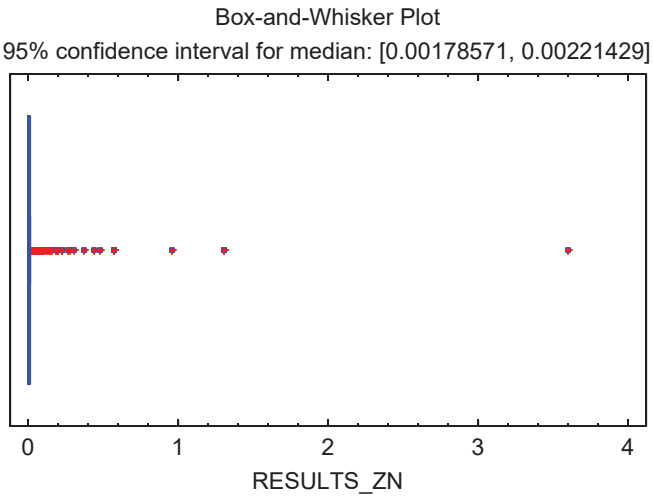


Summary Statistics for RESULTS_ZN

Count	1793
Average	0.0139381
Standard deviation	0.103182
Coeff. of variation	740.291%
Minimum	0.002
Maximum	3.6
Range	3.598
Stnd. skewness	456.326
Stnd. kurtosis	7315.99

The StatAdvisor

This table shows summary statistics for RESULTS_ZN. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for RESULTS_ZN

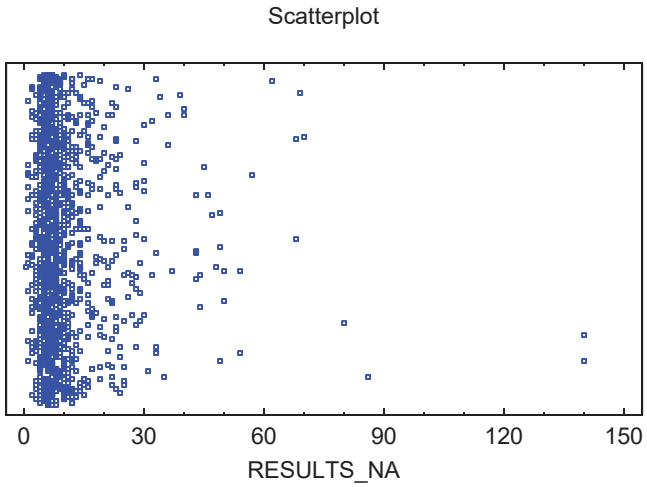
	Percentiles
1.0%	0.002
5.0%	0.002
10.0%	0.002
25.0%	0.002
50.0%	0.002
75.0%	0.007
90.0%	0.017
95.0%	0.029
99.0%	0.18

The StatAdvisor
This pane shows sample percentiles for RESULTS_ZN. The percentiles are values below which specific percentages of the data are found. You can see the percentiles graphically by selecting Quantile Plot from the list of Graphical Options.

One-Variable Analysis - RESULTS_NA

Data variable: RESULTS_NA
1474 values ranging from 0.5 to 140.0

The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

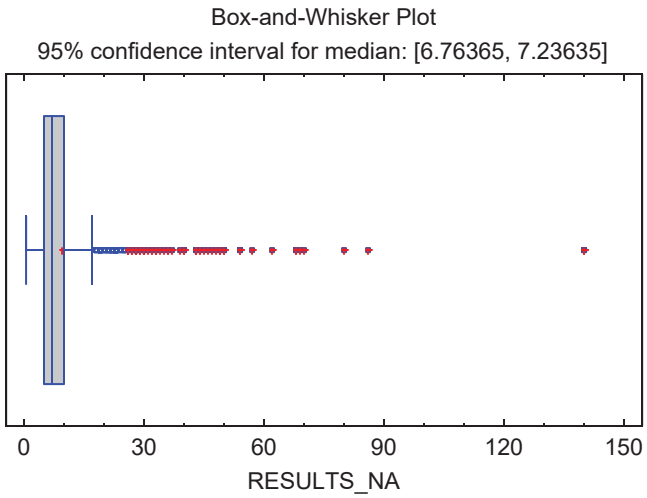


Summary Statistics for RESULTS_NA

Count	1474
Average	9.56479
Standard deviation	9.64506
Coeff. of variation	100.839%
Minimum	0.5
Maximum	140.0
Range	139.5
Stnd. skewness	91.6741
Stnd. kurtosis	437.663

The StatAdvisor

This table shows summary statistics for RESULTS_NA. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for RESULTS_NA

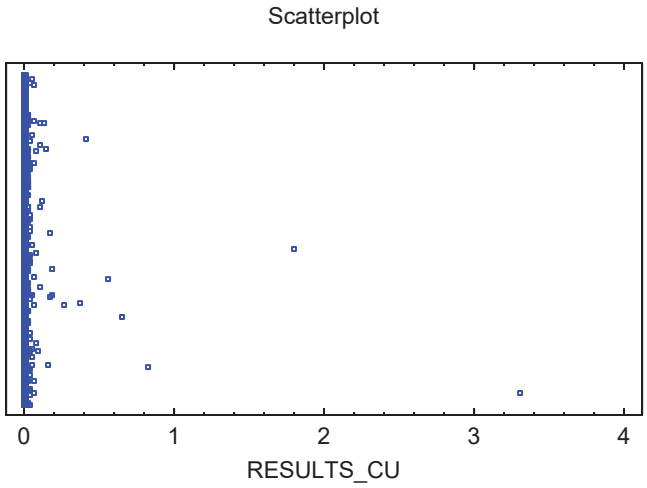
	Percentiles
1.0%	2.0
5.0%	3.0
10.0%	4.0
25.0%	5.0
50.0%	7.0
75.0%	10.0
90.0%	17.0
95.0%	25.0
99.0%	49.0

The StatAdvisor
This pane shows sample percentiles for RESULTS_NA. The percentiles are values below which specific percentages of the data are found. You can see the percentiles graphically by selecting Quantile Plot from the list of Graphical Options.

One-Variable Analysis - RESULTS_CU

Data variable: RESULTS_CU
1794 values ranging from 0.002 to 3.3

The StatAdvisor
This procedure is designed to summarize a single sample of data. It will calculate various statistics and graphs. Also included in the procedure are confidence intervals and hypothesis tests. Use the Tabular Options and Graphical Options buttons on the analysis toolbar to access these different procedures.

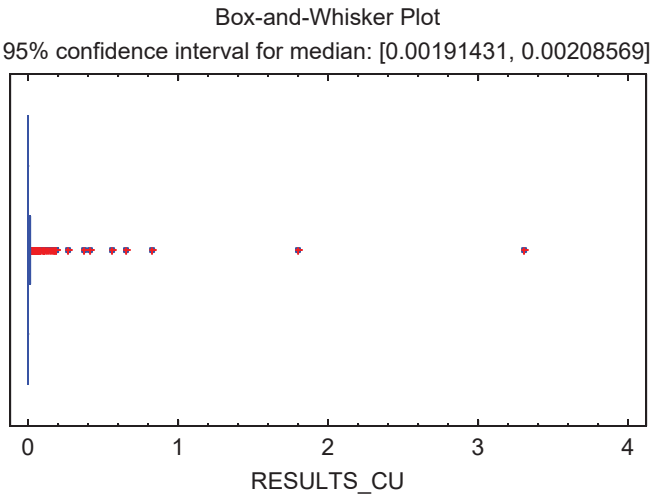


Summary Statistics for RESULTS_CU

Count	1794
Average	0.0105819
Standard deviation	0.0949785
Coeff. of variation	897.553%
Minimum	0.002
Maximum	3.3
Range	3.298
Stnd. skewness	478.519
Stnd. kurtosis	7589.63

The StatAdvisor

This table shows summary statistics for RESULTS_CU. It includes measures of central tendency, measures of variability, and measures of shape. Of particular interest here are the standardized skewness and standardized kurtosis, which can be used to determine whether the sample comes from a normal distribution. Values of these statistics outside the range of -2 to +2 indicate significant departures from normality, which would tend to invalidate any statistical test regarding the standard deviation. In this case, the standardized skewness value is not within the range expected for data from a normal distribution. The standardized kurtosis value is not within the range expected for data from a normal distribution.



Percentiles for RESULTS_CU

	Percentiles
1.0%	0.002
5.0%	0.002
10.0%	0.002
25.0%	0.002
50.0%	0.002
75.0%	0.004
90.0%	0.012
95.0%	0.024
99.0%	0.1

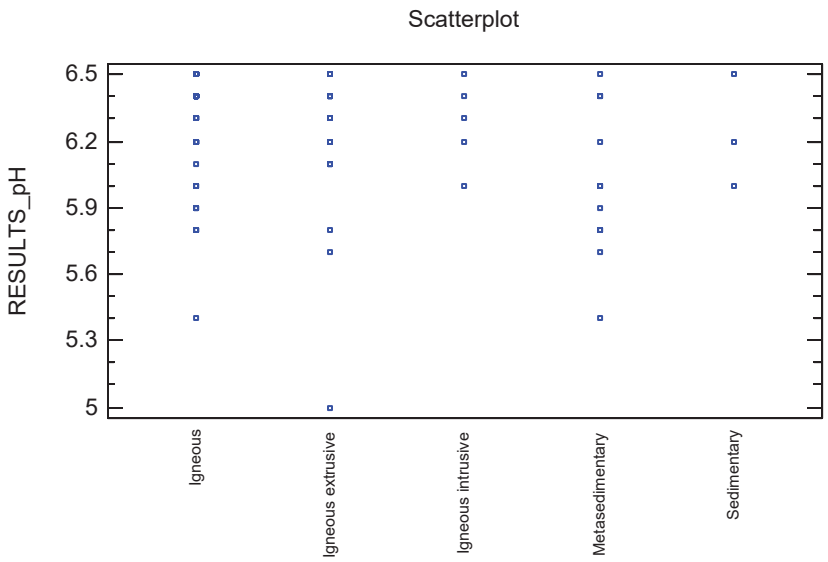
The StatAdvisor
This pane shows sample percentiles for RESULTS_CU. The percentiles are values below which specific percentages of the data are found. You can see the percentiles graphically by selecting Quantile Plot from the list of Graphical Options.

Subset Analysis (RESULTS_pH<=6.5)

Data variable: RESULTS_pH
Code variable: BE_ROCK_CLASS
Selection variable: RESULTS_pH<=6.5

Number of observations: 96
Number of levels: 5

The StatAdvisor
This procedure calculates summary statistics for the values of RESULTS_pH corresponding to each of the 5 levels of BE_ROCK_CLASS. It also creates a variety of plots and allows you to save the calculated statistics. Further analyses can be performed on the data using the Oneway Analysis of Variance procedure under Compare on the main menu.

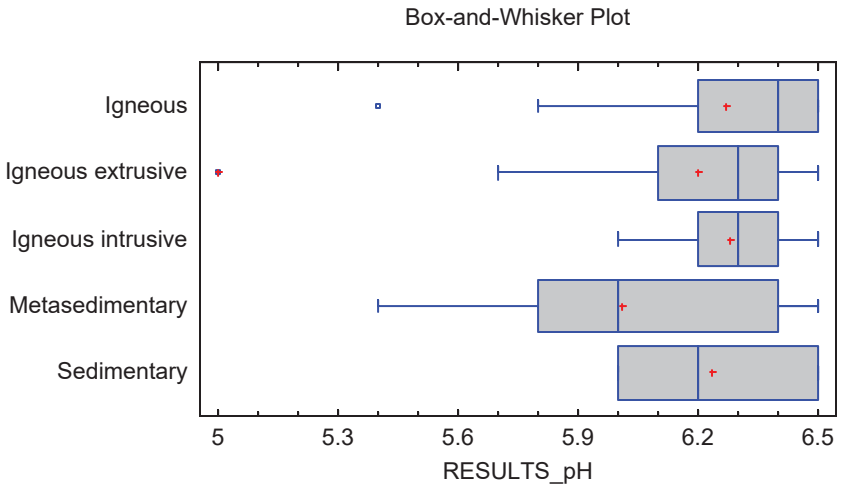


Summary Statistics
Data variable: RESULTS_pH

				Standard	*Coefficient*				*Lower*
BE_ROCK_CLASS	*Count*	*Average*	*Median*	*Deviation*	*of variation*	*Minimum*	*Maximum*	*Range*	*Quartile*
Igneous	55	6.26909	6.4	0.249349	3.97744%	5.4	6.5	1.1	6.2
Igneous extrusive	22	6.2	6.3	0.342261	5.52034%	5.0	6.5	1.5	6.1
Igneous intrusive	5	6.28	6.3	0.192354	3.06296%	6.0	6.5	0.5	6.2
Metasedimentary	11	6.00909	6.0	0.338982	5.64116%	5.4	6.5	1.1	5.8
Sedimentary	3	6.23333	6.2	0.251661	4.03734%	6.0	6.5	0.5	6.0
Total	96	6.22292	6.3	0.288181	4.63096%	5.0	6.5	1.5	6.1

	Upper	*Interquartile*	*Standardized*	*Standardized*
BE_ROCK_CLASS	*Quartile*	*Range*	*Skewness*	*Kurtosis*
Igneous	6.5	0.3	-4.02336	2.35154
Igneous extrusive	6.4	0.3	-4.45803	6.38986
Igneous intrusive	6.4	0.2	-0.538711	-0.0100022
Metasedimentary	6.4	0.6	-0.128931	-0.406635
Sedimentary	6.5	0.5	0.41407	
Total	6.4	0.3	-6.11171	5.95295

The StatAdvisor
This table shows sample statistics for the 5 levels of BE_ROCK_CLASS.

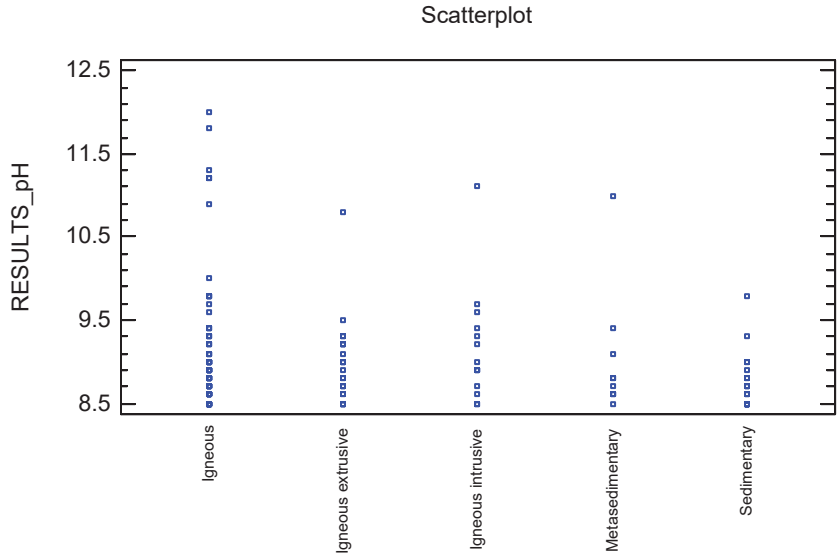


Subset Analysis (RESULTS_pH>=8.5)

Data variable: RESULTS_pH
Code variable: BE_ROCK_CLASS
Selection variable: RESULTS_pH>=8.5

Number of observations: 160
Number of levels: 5

The StatAdvisor
This procedure calculates summary statistics for the values of RESULTS_pH corresponding to each of the 5 levels of BE_ROCK_CLASS. It also creates a variety of plots and allows you to save the calculated statistics. Further analyses can be performed on the data using the Oneway Analysis of Variance procedure under Compare on the main menu.



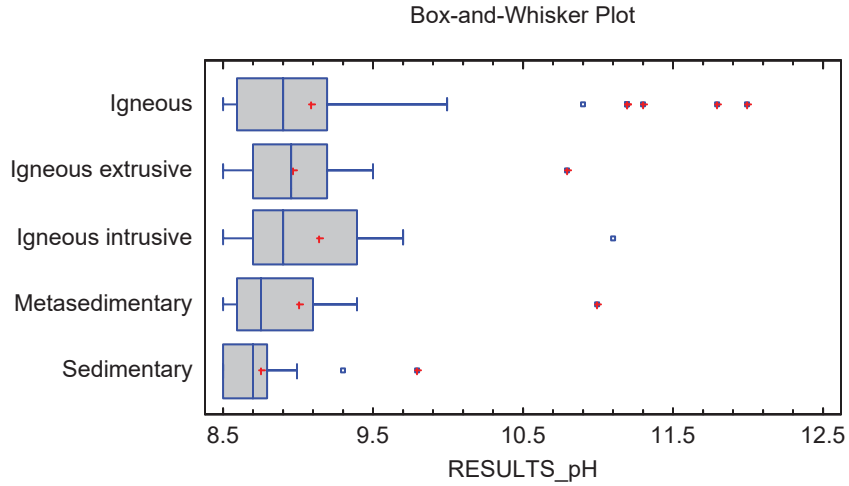
Summary Statistics
Data variable: RESULTS_pH

				Standard	*Coefficient*				*Lower*
BE_ROCK_CLASS	*Count*	*Average*	*Median*	*Deviation*	*of variation*	*Minimum*	*Maximum*	*Range*	*Quartile*

Igneous	86	9.08488	8.9	0.73557	8.09663%	8.5	12.0	3.5	8.6
Igneous extrusive	28	8.96429	8.95	0.458027	5.10946%	8.5	10.8	2.3	8.7
Igneous intrusive	15	9.14667	8.9	0.655599	7.16762%	8.5	11.1	2.6	8.7
Metasedimentary	10	9.01	8.75	0.750481	8.32943%	8.5	11.0	2.5	8.6
Sedimentary	21	8.75714	8.7	0.31713	3.62139%	8.5	9.8	1.3	8.5
Total	160	9.02188	8.8	0.648624	7.18946%	8.5	12.0	3.5	8.6

	Upper	*Interquartile*	*Standardized*	*Standardized*
BE_ROCK_CLASS	*Quartile*	*Range*	*Skewness*	*Kurtosis*
Igneous	9.2	0.6	9.05018	10.908
Igneous extrusive	9.2	0.5	5.26563	9.67766
Igneous intrusive	9.4	0.7	3.1813	4.16492
Metasedimentary	9.1	0.5	3.20396	4.24764
Sedimentary	8.8	0.3	3.92642	4.87027
Total	9.15	0.55	13.0584	18.1031

The StatAdvisor
This table shows sample statistics for the 5 levels of BE_ROCK_CLASS.



Subset Analysis (RESULTS_CL>=250)

Data variable: RESULTS_CL
Code variable: BE_ROCK_CLASS
Selection variable: RESULTS_CL>=250

Number of observations: 1
Number of levels: 1

The StatAdvisor
This procedure calculates summary statistics for the values of RESULTS_CL corresponding to each of the 1 levels of BE_ROCK_CLASS. It also creates a variety of plots and allows you to save the calculated statistics. Further analyses can be performed on the data using the Oneway Analysis of Variance procedure under Compare on the main menu.

Summary Statistics
Data variable: RESULTS_CL

				Standard	*Coefficient*				*Lower*
BE_ROCK_CLASS	*Count*	*Average*	*Median*	*Deviation*	*of variation*	*Minimum*	*Maximum*	*Range*	*Quartile*
Igneous	1	440.0	440.0		%	440.0	440.0	0.0	440.0

Total	1	440.0	440.0		%	440.0	440.0	0.0	440.0

	Upper	*Interquartile*	*Standardized*	*Standardized*
BE_ROCK_CLASS	*Quartile*	*Range*	*Skewness*	*Kurtosis*
Igneous	440.0	0.0		
Total	440.0	0.0		

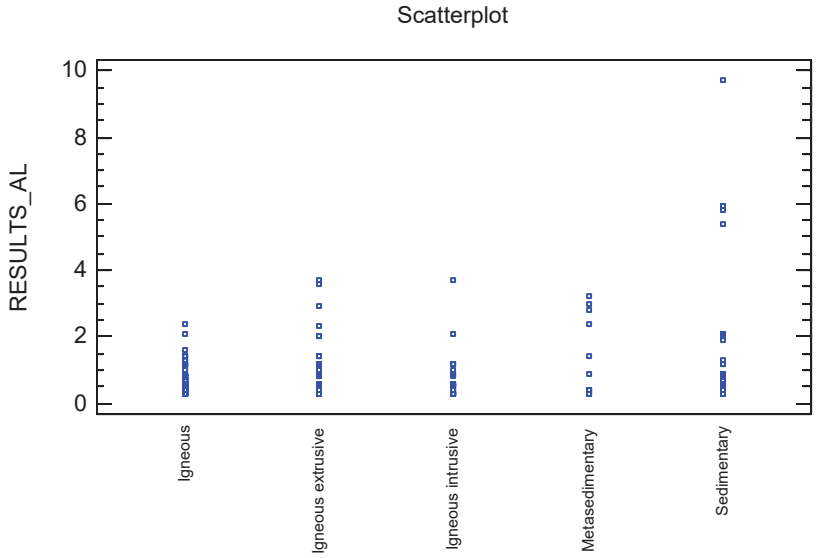
The StatAdvisor
This table shows sample statistics for the 1 levels of BE_ROCK_CLASS.

Subset Analysis (RESULTS_AL>0.2)

Data variable: RESULTS_AL
Code variable: BE_ROCK_CLASS
Selection variable: RESULTS_AL>0.2

Number of observations: 288
Number of levels: 5

The StatAdvisor
This procedure calculates summary statistics for the values of RESULTS_AL corresponding to each of the 5 levels of BE_ROCK_CLASS. It also creates a variety of plots and allows you to save the calculated statistics. Further analyses can be performed on the data using the Oneway Analysis of Variance procedure under Compare on the main menu.



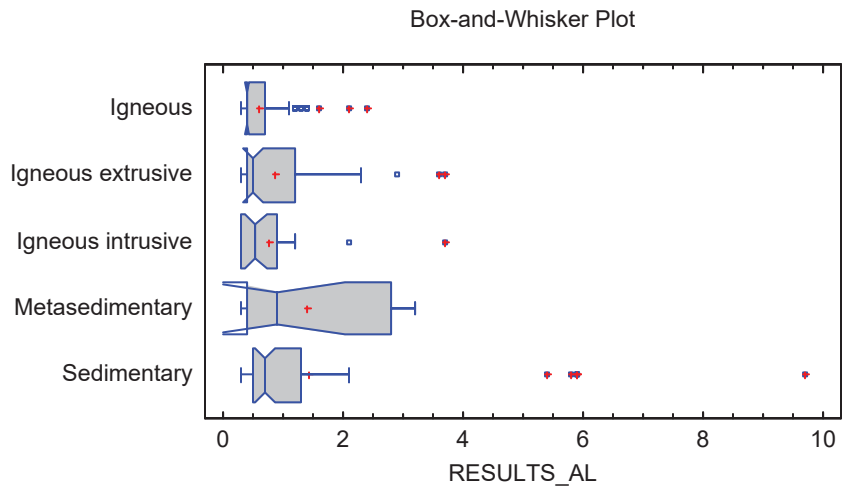
Summary Statistics
Data variable: RESULTS_AL

				Standard	*Coefficient*				*Lower*
BE_ROCK_CLASS	*Count*	*Average*	*Median*	*Deviation*	*of variation*	*Minimum*	*Maximum*	*Range*	*Quartile*
Igneous	147	0.588639	0.4	0.356024	60.4825%	0.3	2.4	2.1	0.4
Igneous extrusive	55	0.861818	0.5	0.786575	91.2693%	0.3	3.7	3.4	0.4
Igneous intrusive	26	0.776923	0.55	0.729004	93.8321%	0.3	3.7	3.4	0.3
Metasedimentary	11	1.40909	0.9	1.20121	85.2473%	0.3	3.2	2.9	0.4
Sedimentary	49	1.42245	0.7	1.89838	133.459%	0.3	9.7	9.4	0.5
Total	288	0.831007	0.5	0.991595	119.325%	0.3	9.7	9.4	0.4

	Upper	*Interquartile*	*Standardized*	*Standardized*
BE_ROCK_CLASS	*Quartile*	*Range*	*Skewness*	*Kurtosis*
Igneous	0.7	0.3	10.8506	15.2056

Igneous extrusive	1.2	0.8	6.54568	7.32682
Igneous intrusive	0.9	0.6	6.17662	10.827
Metasedimentary	2.8	2.4	0.715286	-1.17524
Sedimentary	1.3	0.8	7.8957	11.3831
Total	0.85	0.45	32.4843	102.762

The StatAdvisor
This table shows sample statistics for the 5 levels of BE_ROCK_CLASS.



Subset Analysis (RESULTS_FL>4)

Data variable: RESULTS_FL
Code variable: BE_ROCK_CLASS
Selection variable: RESULTS_FL>4

Number of observations: 3
Number of levels: 2

The StatAdvisor
This procedure calculates summary statistics for the values of RESULTS_FL corresponding to each of the 2 levels of BE_ROCK_CLASS. It also creates a variety of plots and allows you to save the calculated statistics. Further analyses can be performed on the data using the Oneway Analysis of Variance procedure under Compare on the main menu.

Summary Statistics
Data variable: RESULTS_FL

				Standard	*Coefficient*				*Lower*
BE_ROCK_CLASS	*Count*	*Average*	*Median*	*Deviation*	*of variation*	*Minimum*	*Maximum*	*Range*	*Quartile*
Igneous	2	6.7	6.7	2.26274	33.7723%	5.1	8.3	3.2	5.1
Igneous intrusive	1	6.9	6.9		%	6.9	6.9	0.0	6.9
Total	3	6.76667	6.9	1.60416	23.7068%	5.1	8.3	3.2	5.1

	Upper	*Interquartile*	*Standardized*	*Standardized*
BE_ROCK_CLASS	*Quartile*	*Range*	*Skewness*	*Kurtosis*
Igneous	8.3	3.2		
Igneous intrusive	6.9	0.0		
Total	8.3	3.2	-0.26265	

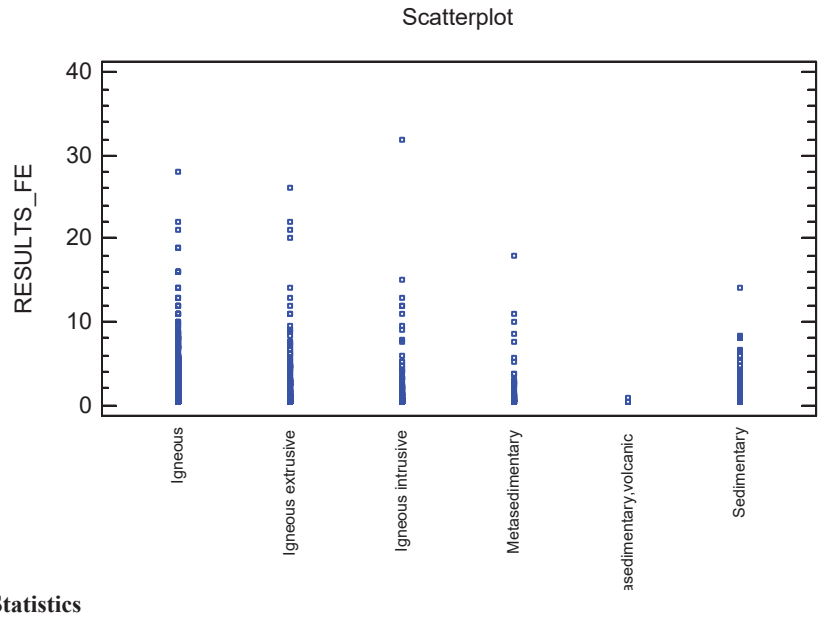
The StatAdvisor
This table shows sample statistics for the 2 levels of BE_ROCK_CLASS.

Subset Analysis (RESULTS_FE>0.3)

Data variable: RESULTS_FE
Code variable: BE_ROCK_CLASS
Selection variable: RESULTS_FE>0.3

Number of observations: 1127
Number of levels: 6

The StatAdvisor
This procedure calculates summary statistics for the values of RESULTS_FE corresponding to each of the 6 levels of BE_ROCK_CLASS. It also creates a variety of plots and allows you to save the calculated statistics. Further analyses can be performed on the data using the Oneway Analysis of Variance procedure under Compare on the main menu.



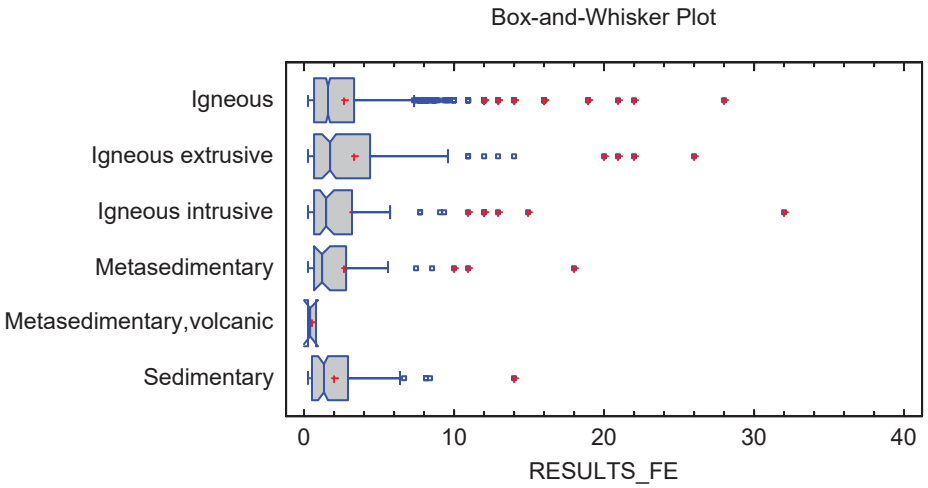
Summary Statistics
Data variable: RESULTS_FE

				Standard	*Coefficient*			
BE_ROCK_CLASS	*Count*	*Average*	*Median*	*Deviation*	*of variation*	*Minimum*	*Maximum*	*Range*
Igneous	726	2.65875	1.6	3.08077	115.873%	0.31	28.0	27.69
Igneous extrusive	160	3.33206	1.7	4.16255	124.924%	0.31	26.0	25.69
Igneous intrusive	78	3.18628	1.55	4.66069	146.273%	0.31	32.0	31.69
Metasedimentary	43	2.71977	1.2	3.52742	129.696%	0.33	18.0	17.67
Metasedimentary,volcanic	3	0.533333	0.45	0.265016	49.6904%	0.32	0.83	0.51
Sedimentary	117	2.05547	1.3	2.16656	105.405%	0.32	14.0	13.68
Total	1127	2.72489	1.5	3.33471	122.38%	0.31	32.0	31.69

	Lower	*Upper*	*Interquartile*	*Standardized*	*Standardized*
BE_ROCK_CLASS	*Quartile*	*Quartile*	*Range*	*Skewness*	*Kurtosis*
Igneous	0.74	3.4	2.66	33.9043	76.6018
Igneous extrusive	0.74	4.45	3.71	14.6721	26.1208
Igneous intrusive	0.7	3.2	2.5	13.4984	34.017
Metasedimentary	0.69	2.8	2.11	7.12275	10.9204
Metasedimentary,volcanic	0.32	0.83	0.51	0.901631	
Sedimentary	0.56	2.9	2.34	10.4894	17.6859
Total	0.72	3.4	2.68	45.3901	110.441

The StatAdvisor

This table shows sample statistics for the 6 levels of BE_ROCK_CLASS.

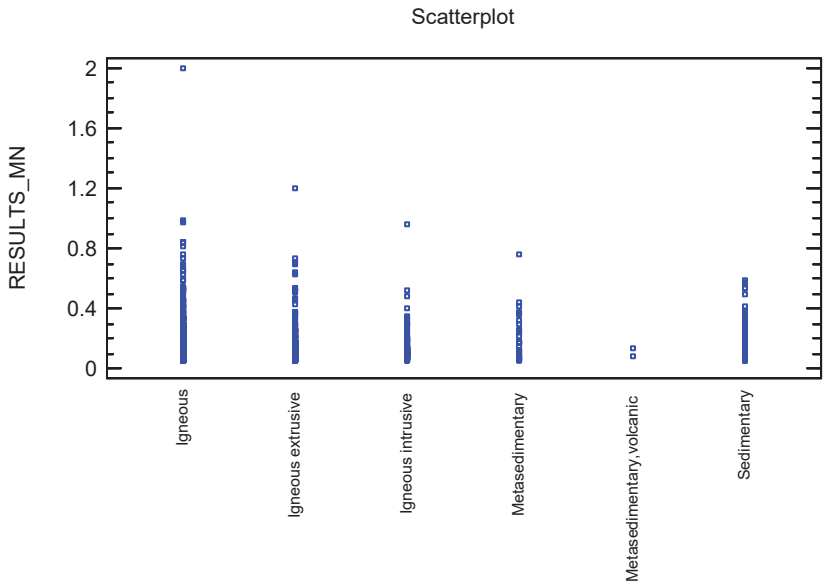


Subset Analysis (RESULTS_MN>0.05)

Data variable: RESULTS_MN
Code variable: BE_ROCK_CLASS
Selection variable: RESULTS_MN>0.05

Number of observations: 1027
Number of levels: 6

The StatAdvisor
This procedure calculates summary statistics for the values of RESULTS_MN corresponding to each of the 6 levels of BE_ROCK_CLASS. It also creates a variety of plots and allows you to save the calculated statistics. Further analyses can be performed on the data using the Oneway Analysis of Variance procedure under Compare on the main menu.

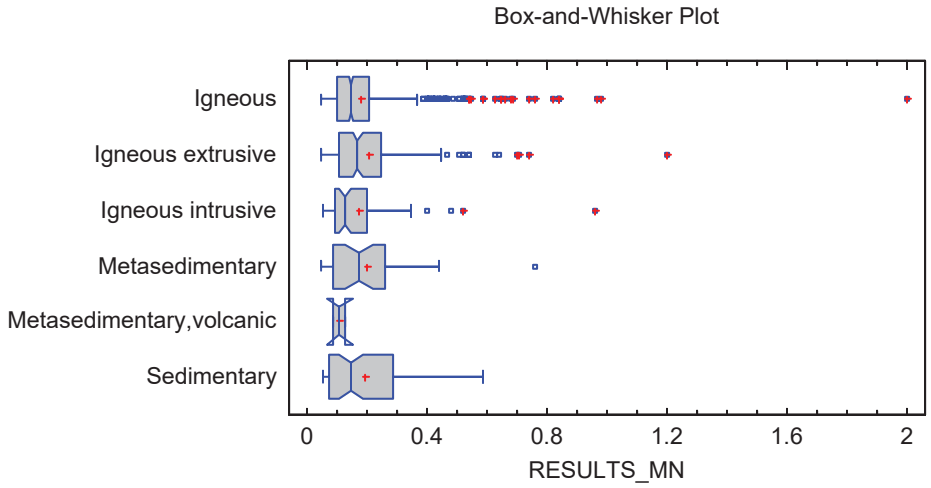


Summary Statistics
Data variable: RESULTS_MN

				Standard	*Coefficient*			
BE_ROCK_CLASS	*Count*	*Average*	*Median*	*Deviation*	*of variation*	*Minimum*	*Maximum*	*Range*
Igneous	724	0.18437	0.15	0.147198	79.8384%	0.051	2.0	1.949
Igneous extrusive	138	0.210935	0.17	0.168346	79.8096%	0.051	1.2	1.149
Igneous intrusive	69	0.173913	0.13	0.138687	79.7452%	0.055	0.96	0.905
Metasedimentary	30	0.203	0.175	0.154128	75.9252%	0.051	0.76	0.709
Metasedimentary,volcanic	2	0.1095	0.1095	0.0289914	26.4761%	0.089	0.13	0.041
Sedimentary	64	0.197563	0.145	0.144616	73.1999%	0.053	0.59	0.537
Total	1027	0.188458	0.15	0.149671	79.4189%	0.051	2.0	1.949

	Lower	*Upper*	*Interquartile*	*Standardized*	*Standardized*
BE_ROCK_CLASS	*Quartile*	*Quartile*	*Range*	*Skewness*	*Kurtosis*
Igneous	0.1	0.21	0.11	47.4232	199.521
Igneous extrusive	0.11	0.25	0.14	12.1055	22.1935
Igneous intrusive	0.095	0.2	0.105	10.9252	25.096
Metasedimentary	0.086	0.26	0.174	4.16696	5.22286
Metasedimentary,volcanic	0.089	0.13	0.041		
Sedimentary	0.077	0.285	0.208	3.71552	0.937836
Total	0.1	0.22	0.12	47.993	173.791

The StatAdvisor
This table shows sample statistics for the 6 levels of BE_ROCK_CLASS.

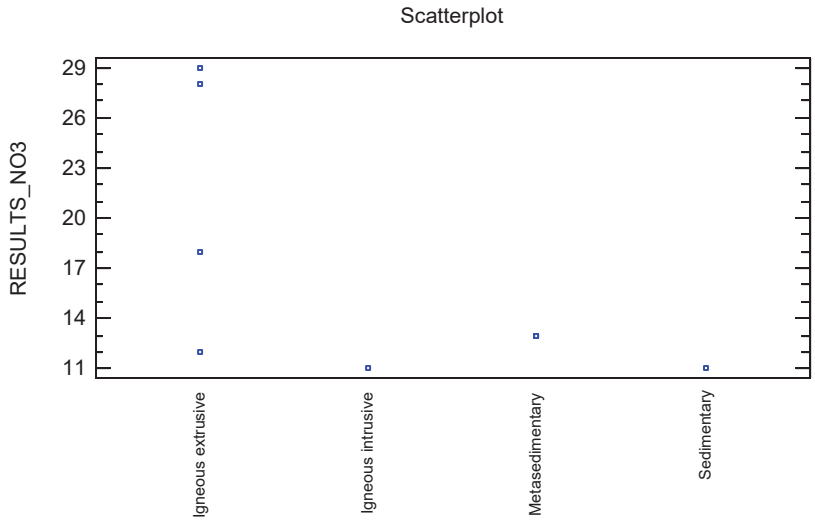


Subset Analysis (RESULTS_NO3>10)

Data variable: RESULTS_NO3
Code variable: BE_ROCK_CLASS
Selection variable: RESULTS_NO3>10

Number of observations: 8
Number of levels: 4

The StatAdvisor
This procedure calculates summary statistics for the values of RESULTS_NO3 corresponding to each of the 4 levels of BE_ROCK_CLASS. It also creates a variety of plots and allows you to save the calculated statistics. Further analyses can be performed on the data using the Oneway Analysis of Variance procedure under Compare on the main menu.



Summary Statistics
Data variable: RESULTS_NO3

				Standard	*Coefficient*				*Lower*
BE_ROCK_CLASS	*Count*	*Average*	*Median*	*Deviation*	*of variation*	*Minimum*	*Maximum*	*Range*	*Quartile*
Igneous extrusive	4	21.75	23.0	8.18026	37.6104%	12.0	29.0	17.0	15.0
Igneous intrusive	1	11.0	11.0		%	11.0	11.0	0.0	11.0
Metasedimentary	2	13.0	13.0	0.0	0.0%	13.0	13.0	0.0	13.0
Sedimentary	1	11.0	11.0		%	11.0	11.0	0.0	11.0
Total	8	16.875	13.0	7.51071	44.5079%	11.0	29.0	18.0	11.5

	Upper	*Interquartile*	*Standardized*	*Standardized*
BE_ROCK_CLASS	*Quartile*	*Range*	*Skewness*	*Kurtosis*
Igneous extrusive	28.5	13.5	-0.352391	-1.40158
Igneous intrusive	11.0	0.0		
Metasedimentary	13.0	0.0		
Sedimentary	11.0	0.0		
Total	23.0	11.5	1.30979	-0.32017

The StatAdvisor
This table shows sample statistics for the 4 levels of BE_ROCK_CLASS.

Subset Analysis (RESULTS_SO3>250)

Data variable: RESULTS_SO3
Code variable: BE_ROCK_CLASS
Selection variable: RESULTS_SO3>250

Number of observations: 4
Number of levels: 2

The StatAdvisor
This procedure calculates summary statistics for the values of RESULTS_SO3 corresponding to each of the 2 levels of BE_ROCK_CLASS. It also creates a variety of plots and allows you to save the calculated statistics. Further analyses can be performed on the data using the Oneway Analysis of Variance procedure under Compare on the main menu.

Summary Statistics
Data variable: RESULTS_SO3

				Standard	*Coefficient*				*Lower*

BE_ROCK_CLASS	*Count*	*Average*	*Median*	*Deviation*	*of variation*	*Minimum*	*Maximum*	*Range*	*Quartile*
Igneous	1	260.0	260.0		%	260.0	260.0	0.0	260.0
Sedimentary	3	513.333	470.0	130.512	25.4244%	410.0	660.0	250.0	410.0
Total	4	450.0	440.0	165.529	36.7843%	260.0	660.0	400.0	335.0

	Upper	*Interquartile*	*Standardized*	*Standardized*
BE_ROCK_CLASS	*Quartile*	*Range*	*Skewness*	*Kurtosis*
Igneous	260.0	0.0		
Sedimentary	660.0	250.0	0.940031	
Total	565.0	230.0	0.281556	0.38094

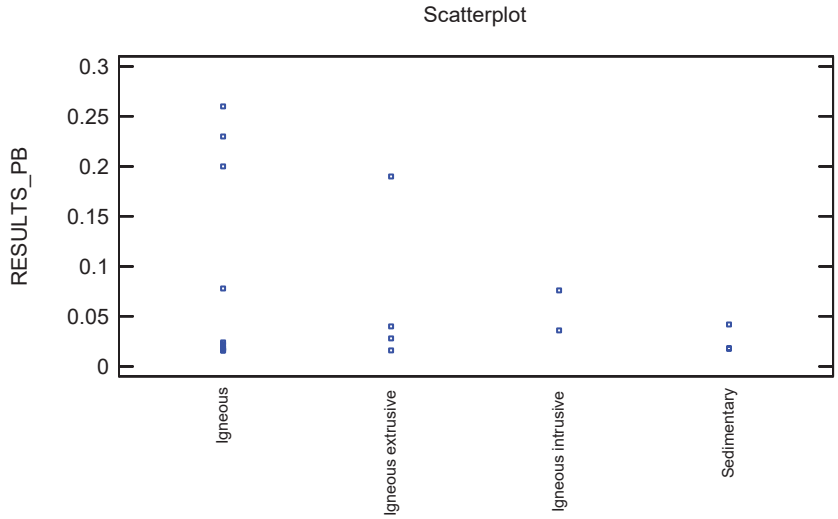
The StatAdvisor
This table shows sample statistics for the 2 levels of BE_ROCK_CLASS.

Subset Analysis (RESULTS_PB>0.015)

Data variable: RESULTS_PB
Code variable: BE_ROCK_CLASS
Selection variable: RESULTS_PB>0.015

Number of observations: 19
Number of levels: 4

The StatAdvisor
This procedure calculates summary statistics for the values of RESULTS_PB corresponding to each of the 4 levels of BE_ROCK_CLASS. It also creates a variety of plots and allows you to save the calculated statistics. Further analyses can be performed on the data using the Oneway Analysis of Variance procedure under Compare on the main menu.



Summary Statistics
Data variable: RESULTS_PB

				Standard	*Coefficient*				*Lower*
BE_ROCK_CLASS	*Count*	*Average*	*Median*	*Deviation*	*of variation*	*Minimum*	*Maximum*	*Range*	*Quartile*
Igneous	10	0.0887	0.024	0.100249	113.02%	0.016	0.26	0.244	0.018
Igneous extrusive	4	0.0685	0.034	0.0815904	119.11%	0.016	0.19	0.174	0.022
Igneous intrusive	2	0.056	0.056	0.0282843	50.5076%	0.036	0.076	0.04	0.036
Sedimentary	3	0.0266667	0.019	0.0141539	53.0772%	0.018	0.043	0.025	0.018
Total	19	0.0712105	0.028	0.0820309	115.195%	0.016	0.26	0.244	0.018

	Upper	*Interquartile*	*Standardized*	*Standardized*
BE_ROCK_CLASS	*Quartile*	*Range*	*Skewness*	*Kurtosis*
Igneous	0.2	0.182	1.28829	-0.637243
Igneous extrusive	0.115	0.093	1.56273	1.51673
Igneous intrusive	0.076	0.04		
Sedimentary	0.043	0.025	1.21787	
Total	0.079	0.061	2.61738	0.564582

The StatAdvisor
This table shows sample statistics for the 4 levels of BE_ROCK_CLASS.

Subset Analysis (RESULTS_TDS>500)

Data variable: RESULTS_TDS
Code variable: BE_ROCK_CLASS
Selection variable: RESULTS_TDS>500

Number of observations: 6
Number of levels: 2

The StatAdvisor
This procedure calculates summary statistics for the values of RESULTS_TDS corresponding to each of the 2 levels of BE_ROCK_CLASS. It also creates a variety of plots and allows you to save the calculated statistics. Further analyses can be performed on the data using the Oneway Analysis of Variance procedure under Compare on the main menu.

Summary Statistics
Data variable: RESULTS_TDS

				Standard	*Coefficient*				*Lower*
BE_ROCK_CLASS	*Count*	*Average*	*Median*	*Deviation*	*of variation*	*Minimum*	*Maximum*	*Range*	*Quartile*
Igneous	3	1073.33	850.0	457.857	42.6575%	770.0	1600.0	830.0	770.0
Sedimentary	3	843.333	750.0	225.019	26.682%	680.0	1100.0	420.0	680.0
Total	6	958.333	810.0	346.376	36.1436%	680.0	1600.0	920.0	750.0

	Upper	*Interquartile*	*Standardized*	*Standardized*
BE_ROCK_CLASS	*Quartile*	*Range*	*Skewness*	*Kurtosis*
Igneous	1600.0	830.0	1.18281	
Sedimentary	1100.0	420.0	1.09276	
Total	1100.0	350.0	1.64943	1.23251

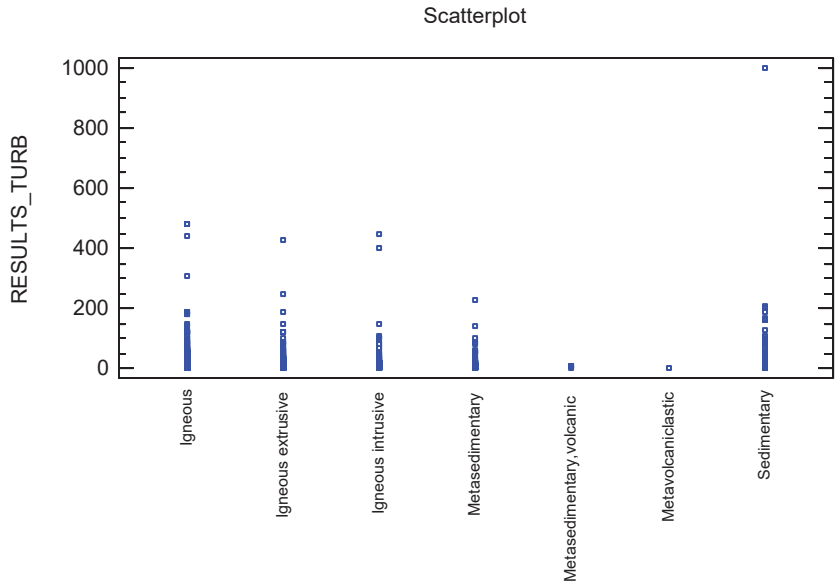
The StatAdvisor
This table shows sample statistics for the 2 levels of BE_ROCK_CLASS.

Subset Analysis (RESULTS_TURB>1)

Data variable: RESULTS_TURB
Code variable: BE_ROCK_CLASS
Selection variable: RESULTS_TURB>1

Number of observations: 1480
Number of levels: 7

The StatAdvisor
This procedure calculates summary statistics for the values of RESULTS_TURB corresponding to each of the 7 levels of BE_ROCK_CLASS. It also creates a variety of plots and allows you to save the calculated statistics. Further analyses can be performed on the data using the Oneway Analysis of Variance procedure under Compare on the main menu.

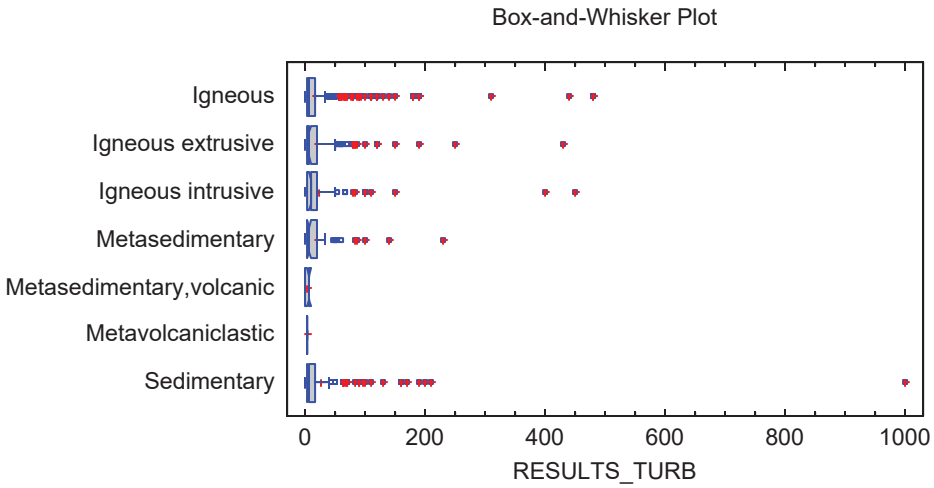


Summary Statistics
Data variable: RESULTS_TURB

				Standard	*Coefficient*				*Lower*
BE_ROCK_CLASS	*Count*	*Average*	*Median*	*Deviation*	*of variation*	*Minimum*	*Maximum*	*Range*	*Quartile*
Igneous	893	17.104	7.0	36.3334	212.426%	1.1	480.0	478.9	3.3
Igneous extrusive	250	20.0388	7.95	38.8412	193.83%	1.1	430.0	428.9	3.1
Igneous intrusive	110	25.4982	9.45	60.2465	236.277%	1.1	450.0	448.9	4.0
Metasedimentary	66	21.4788	7.3	37.0078	172.299%	1.2	230.0	228.8	3.4
Metasedimentary,volcanic	3	5.06667	6.5	2.48261	48.9988%	2.2	6.5	4.3	2.2
Metavolcaniclastic	1	5.0	5.0		%	5.0	5.0	0.0	5.0
Sedimentary	157	28.4949	6.2	87.6896	307.738%	1.1	1000.0	998.9	2.5
Total	1480	19.5945	7.1	46.9514	239.615%	1.1	1000.0	998.9	3.2

	Upper	*Interquartile*	*Standardized*	*Standardized*
BE_ROCK_CLASS	*Quartile*	*Range*	*Skewness*	*Kurtosis*
Igneous	16.0	12.7	96.7583	520.486
Igneous extrusive	22.0	18.9	41.1537	179.999
Igneous intrusive	22.0	18.0	24.2111	76.1517
Metasedimentary	20.0	16.6	12.1301	27.1202
Metasedimentary,volcanic	6.5	4.3	-1.22474	
Metavolcaniclastic	5.0	0.0		
Sedimentary	18.0	15.5	46.3656	250.0
Total	18.0	14.8	158.986	1240.82

The StatAdvisor
This table shows sample statistics for the 7 levels of BE_ROCK_CLASS.



Subset Analysis (RESULTS_CU>1.3)

Data variable: RESULTS_CU
Code variable: BE_ROCK_CLASS
Selection variable: RESULTS_CU>1.3

Number of observations: 2
Number of levels: 2

The StatAdvisor
This procedure calculates summary statistics for the values of RESULTS_CU corresponding to each of the 2 levels of BE_ROCK_CLASS. It also creates a variety of plots and allows you to save the calculated statistics. Further analyses can be performed on the data using the Oneway Analysis of Variance procedure under Compare on the main menu.

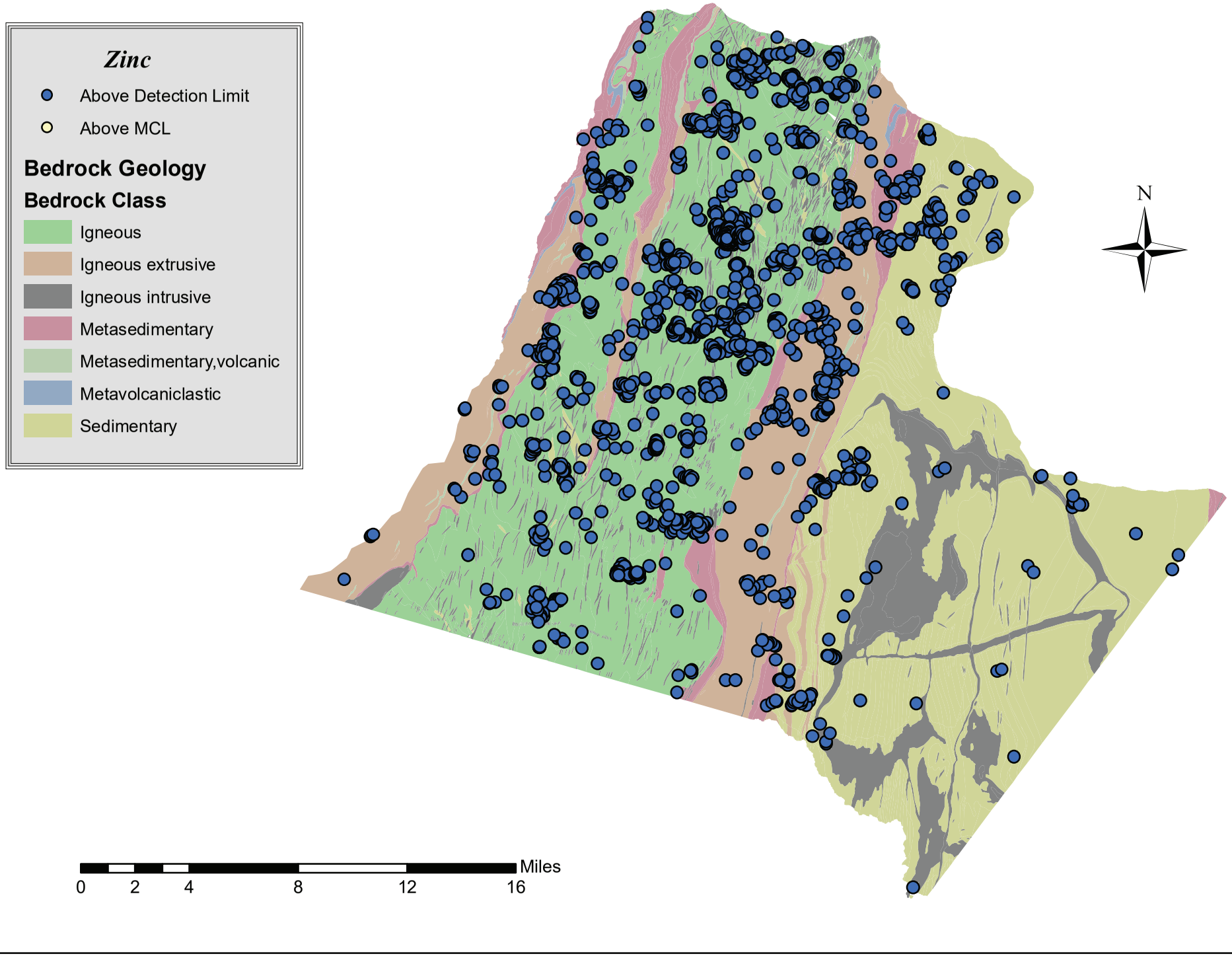
Summary Statistics
Data variable: RESULTS_CU

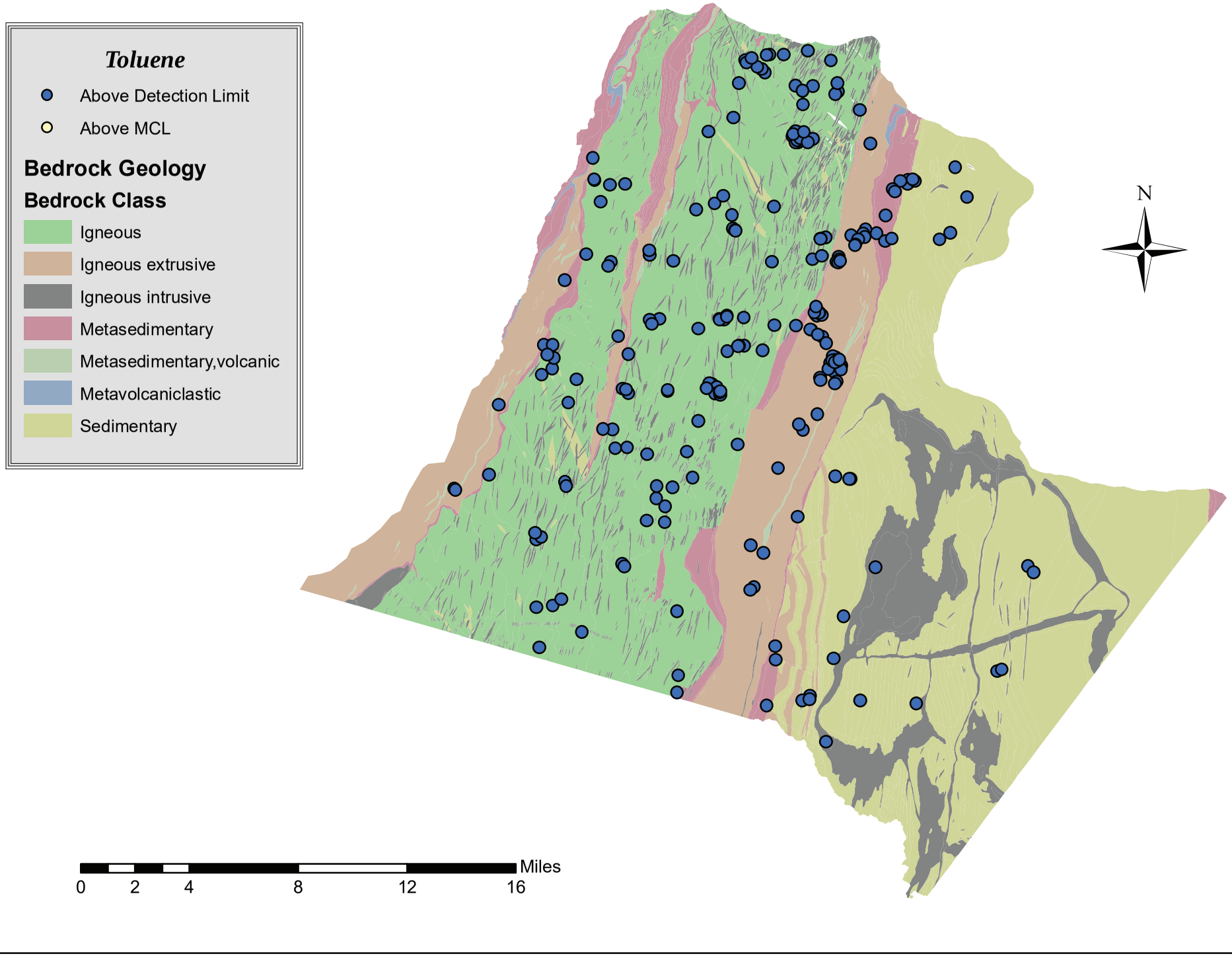
				Standard	*Coefficient*				*Lower*
BE_ROCK_CLASS	*Count*	*Average*	*Median*	*Deviation*	*of variation*	*Minimum*	*Maximum*	*Range*	*Quartile*
Igneous	1	3.3	3.3		%	3.3	3.3	0.0	3.3
Igneous extrusive	1	1.8	1.8		%	1.8	1.8	0.0	1.8
Total	2	2.55	2.55	1.06066	41.5945%	1.8	3.3	1.5	1.8

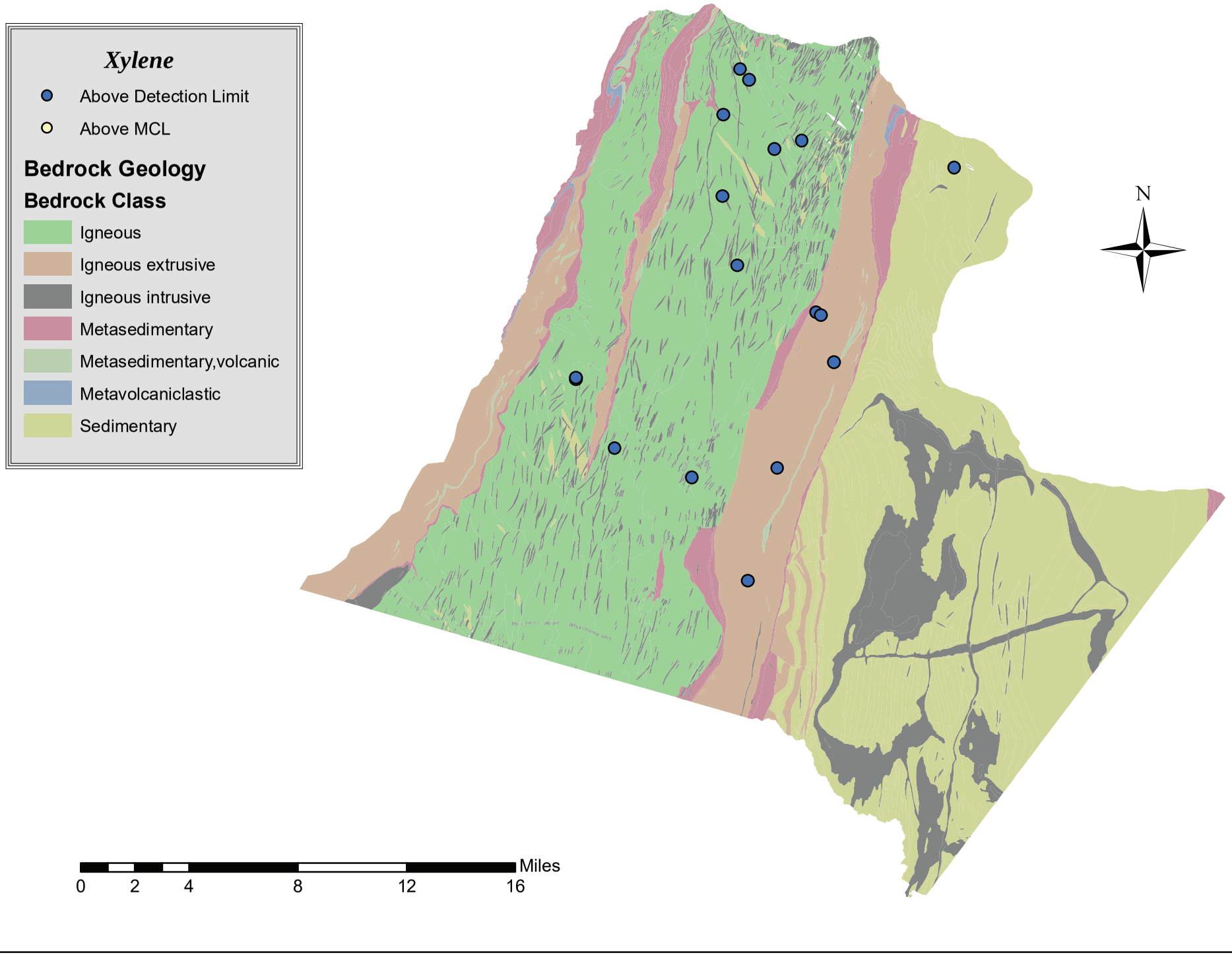
	Upper	*Interquartile*	*Standardized*	*Standardized*
BE_ROCK_CLASS	*Quartile*	*Range*	*Skewness*	*Kurtosis*
Igneous	3.3	0.0		
Igneous extrusive	1.8	0.0		
Total	3.3	1.5		

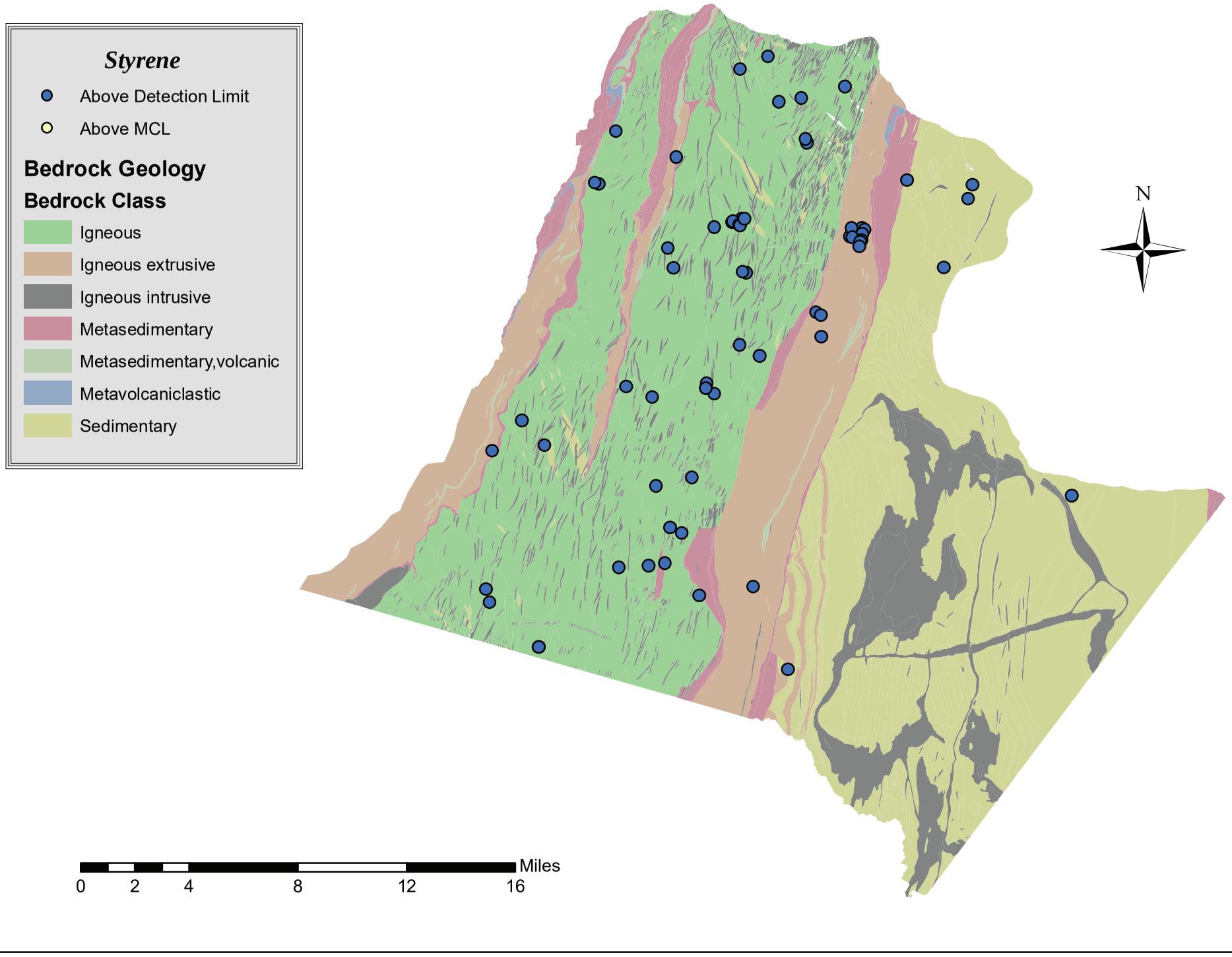
The StatAdvisor
This table shows sample statistics for the 2 levels of BE_ROCK_CLASS.

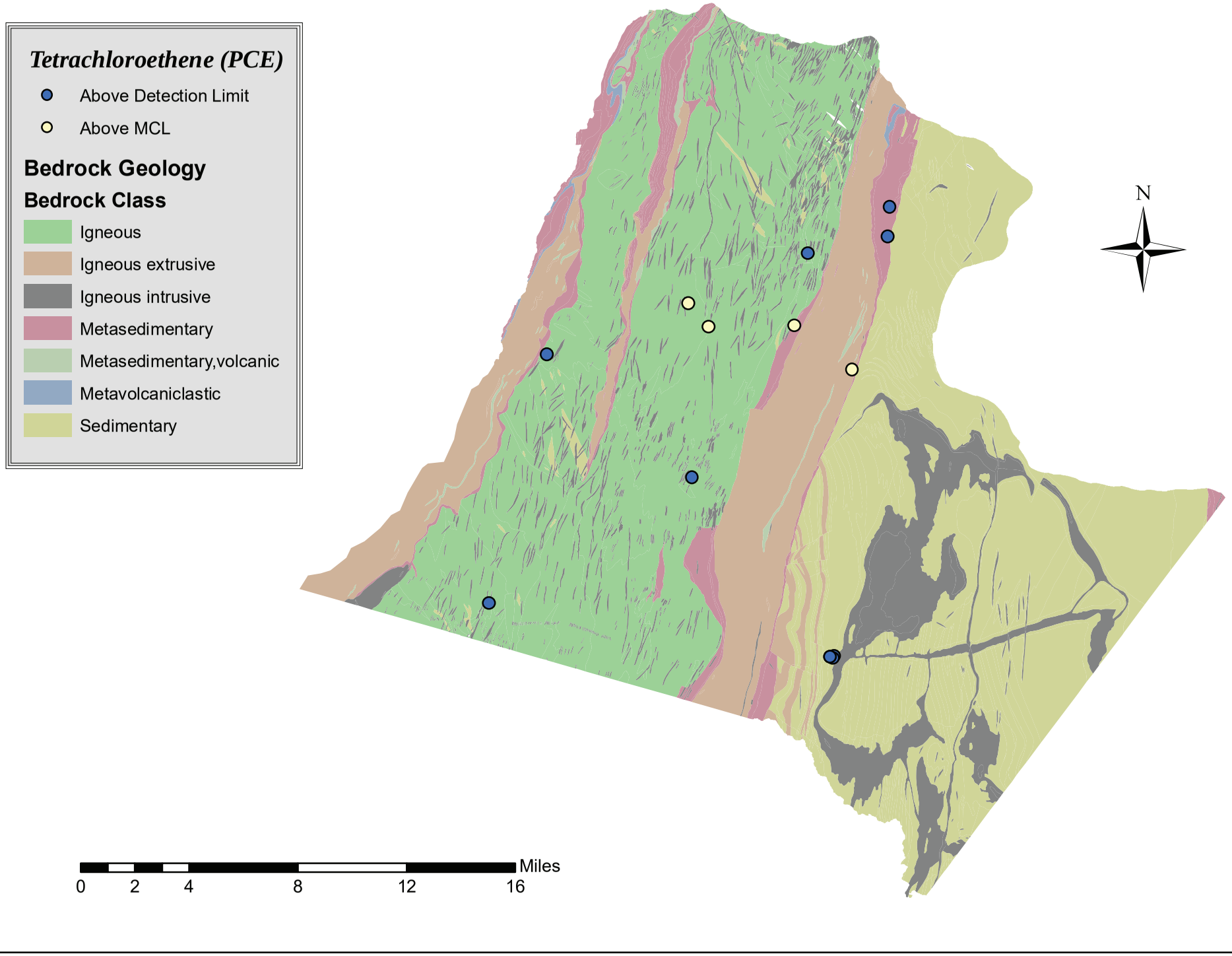
Section C) GIS maps showing spatial distribution of various analytes showing sites with results above detection limits and sites with results above EPA MCLs or SMCLs.

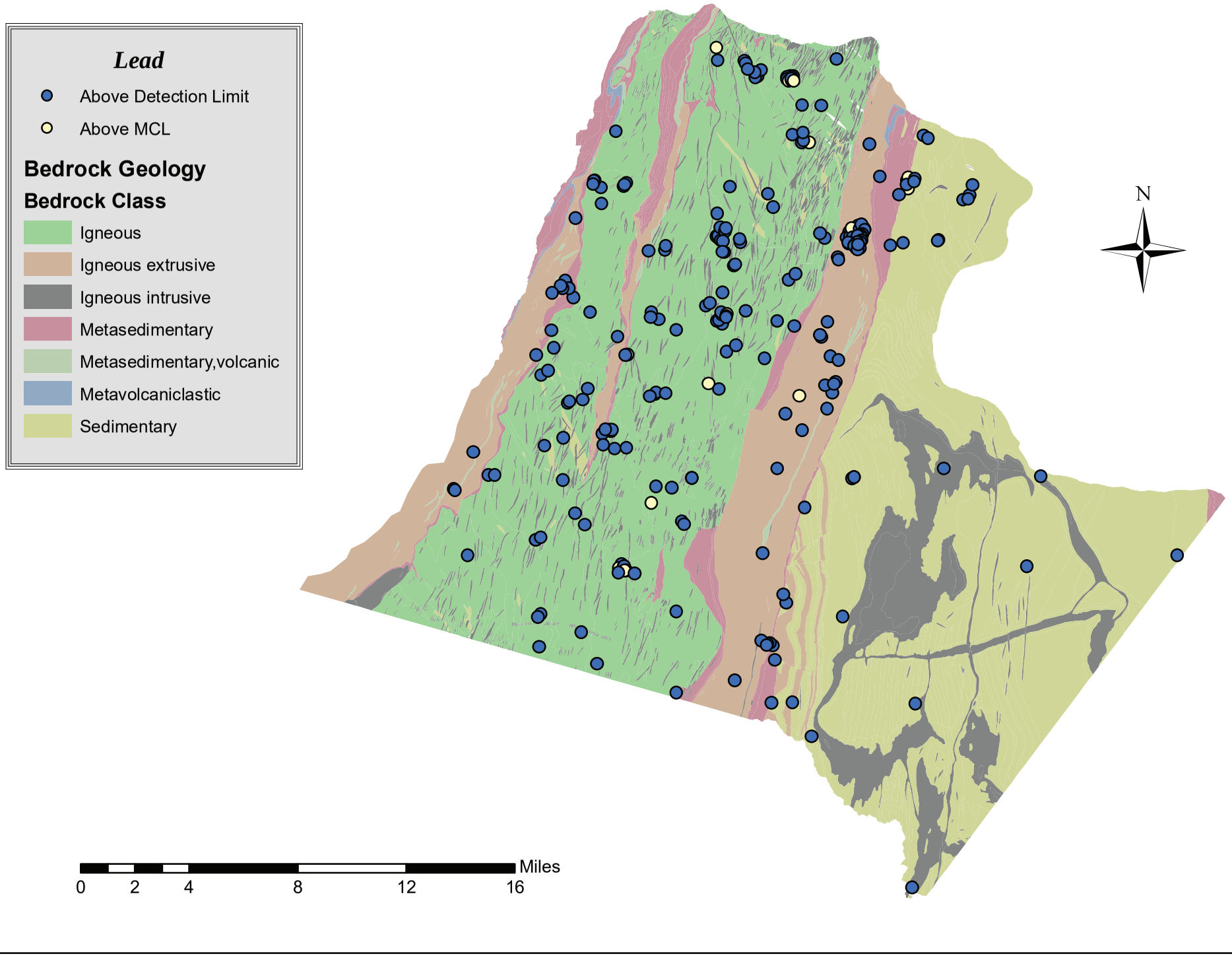

Zinc
Above Detection Limit
Above MCL
Bedrock Geology
Bedrock Class
Igneous
Igneous extrusive
Igneous intrusive
Metasedimentary
Metasedimentary,volcanic
Metavolcaniclastic
Sedimentary
N
Miles
0
2
4
8
12
16

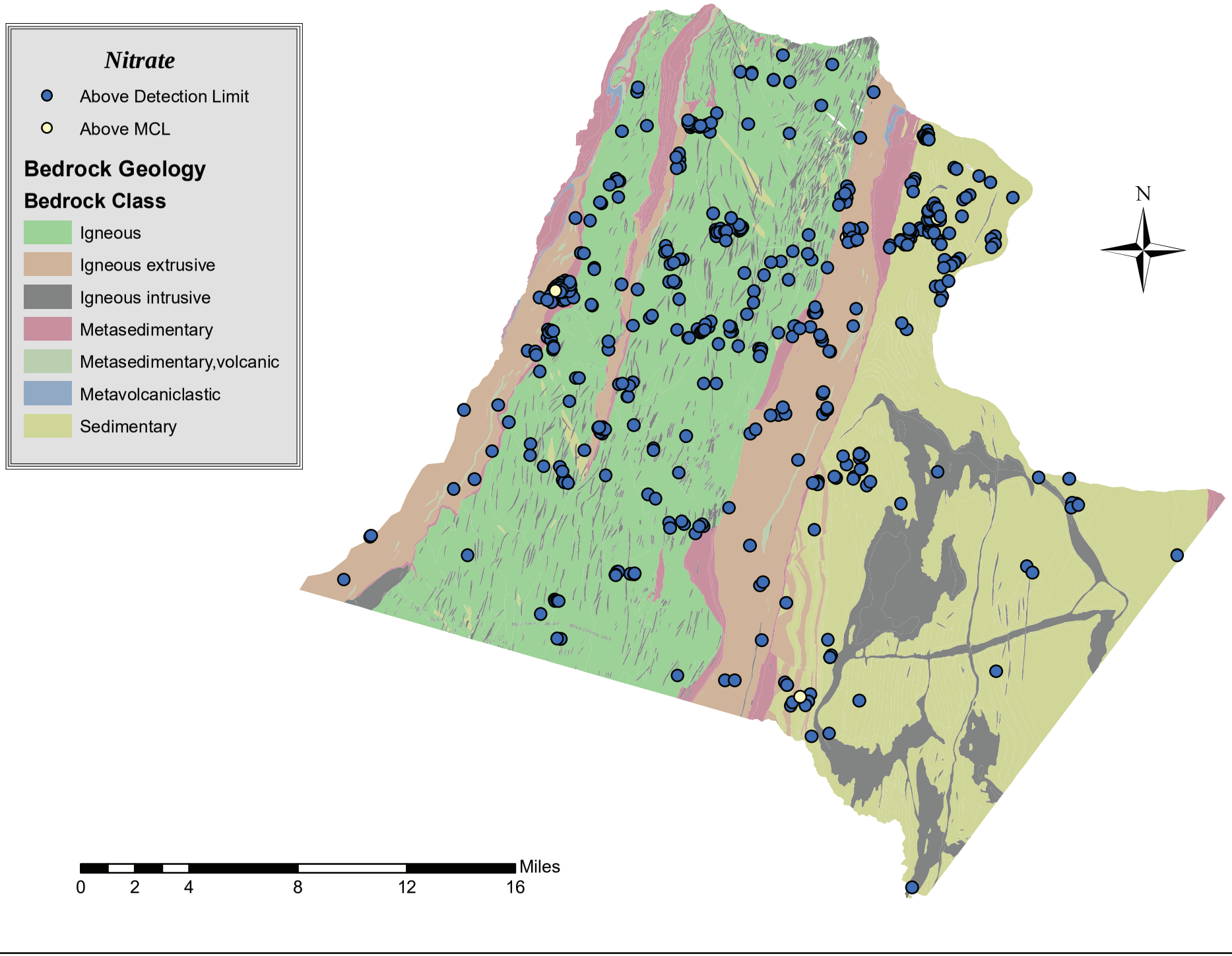

Toluene
Above Detection Limit
Above MCL
Bedrock Geology
Bedrock Class
Igneous
Igneous extrusive
Igneous intrusive
Metasedimentary
Metasedimentary,volcanic
Metavolcaniclastic
Sedimentary
N
0
2
4
8
12
16
Miles

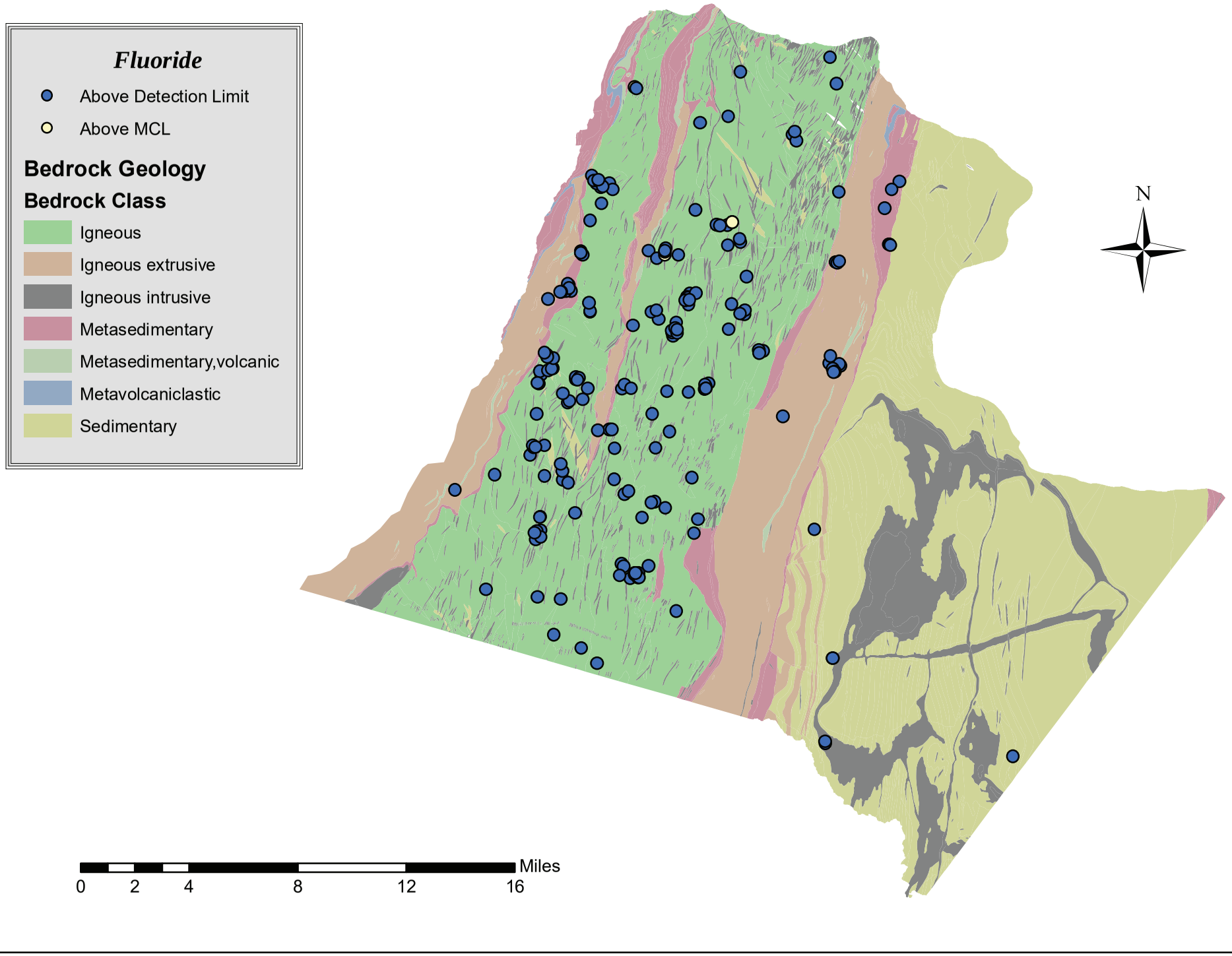

Xylene
Above Detection Limit
Above MCL
Bedrock Geology
Bedrock Class
Igneous
Igneous extrusive
Igneous intrusive
Metasedimentary
Metasedimentary,volcanic
Metavolcaniclastic
Sedimentary
N
0
2
4
8
12
16
Miles

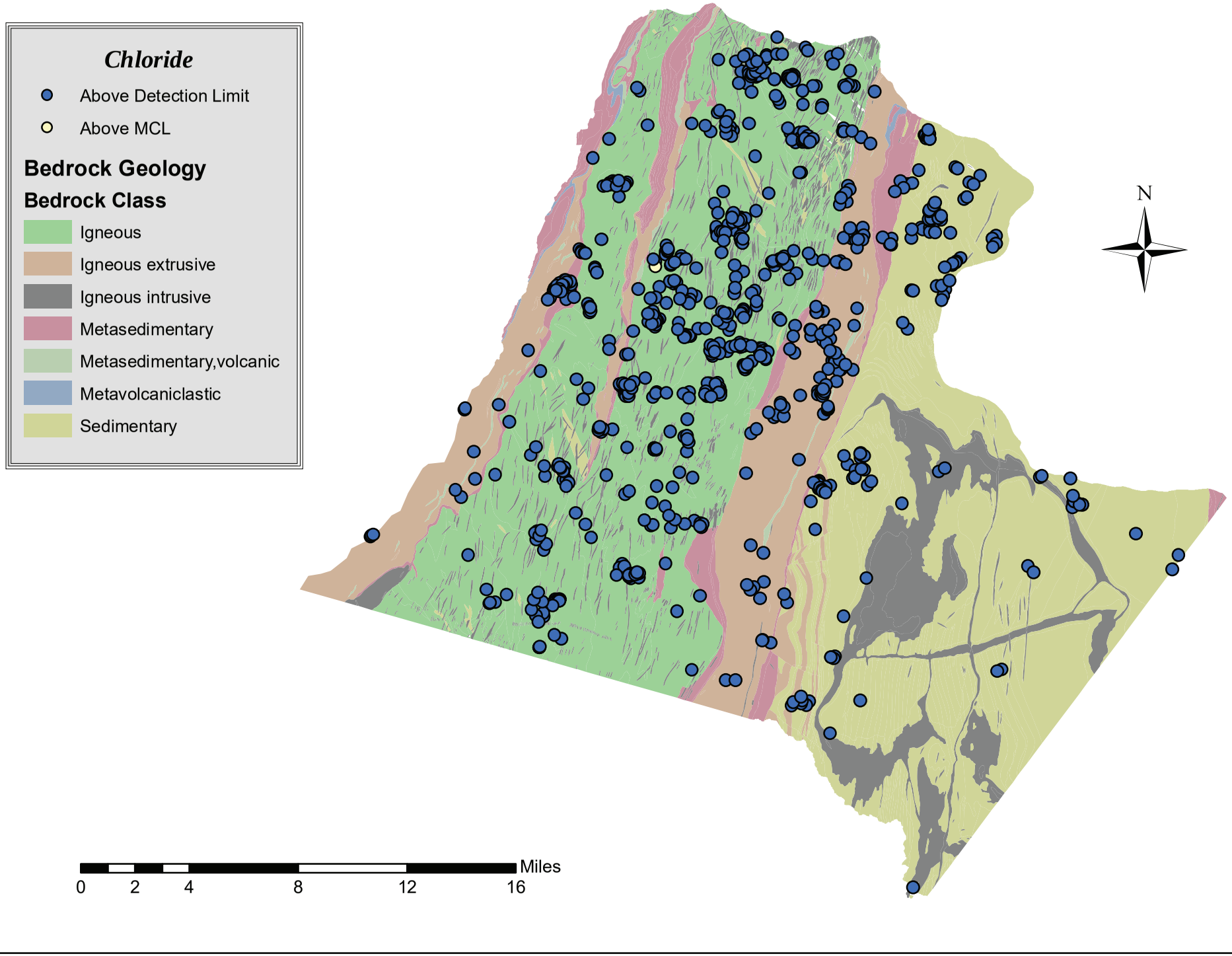

Styrene
Above Detection Limit
Above MCL
Bedrock Geology
Bedrock Class
Igneous
Igneous extrusive
Igneous intrusive
Metasedimentary
Metasedimentary,volcanic
Metavolcaniclastic
Sedimentary
N
0
2
4
8
12
16
Miles

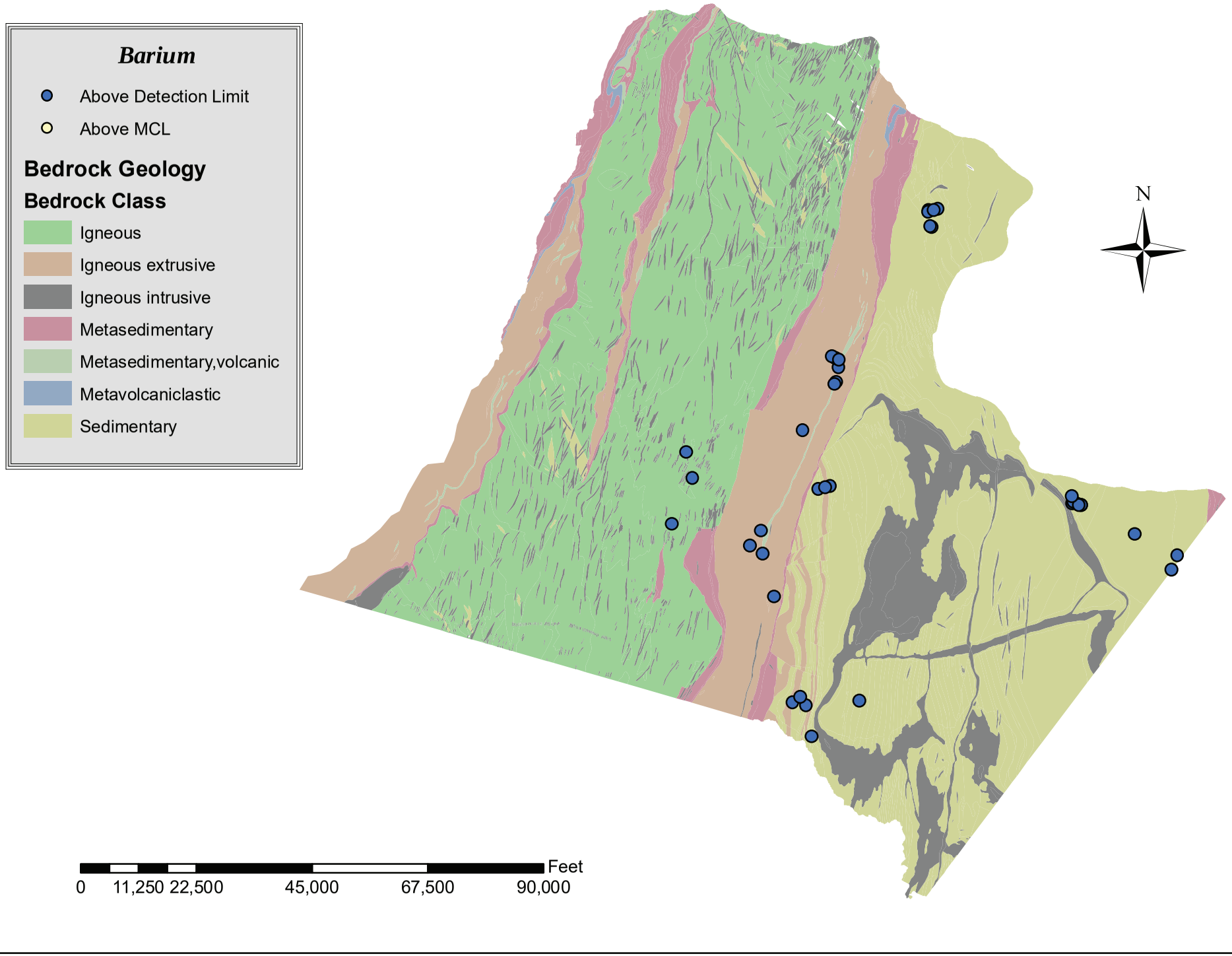

Tetrachloroethene (PCE)
Above Detection Limit
Above MCL
Bedrock Geology
Bedrock Class
Igneous
Igneous extrusive
Igneous intrusive
Metasedimentary
Metasedimentary,volcanic
Metavolcaniclastic
Sedimentary
N
0
2
4
8
12
16
Miles

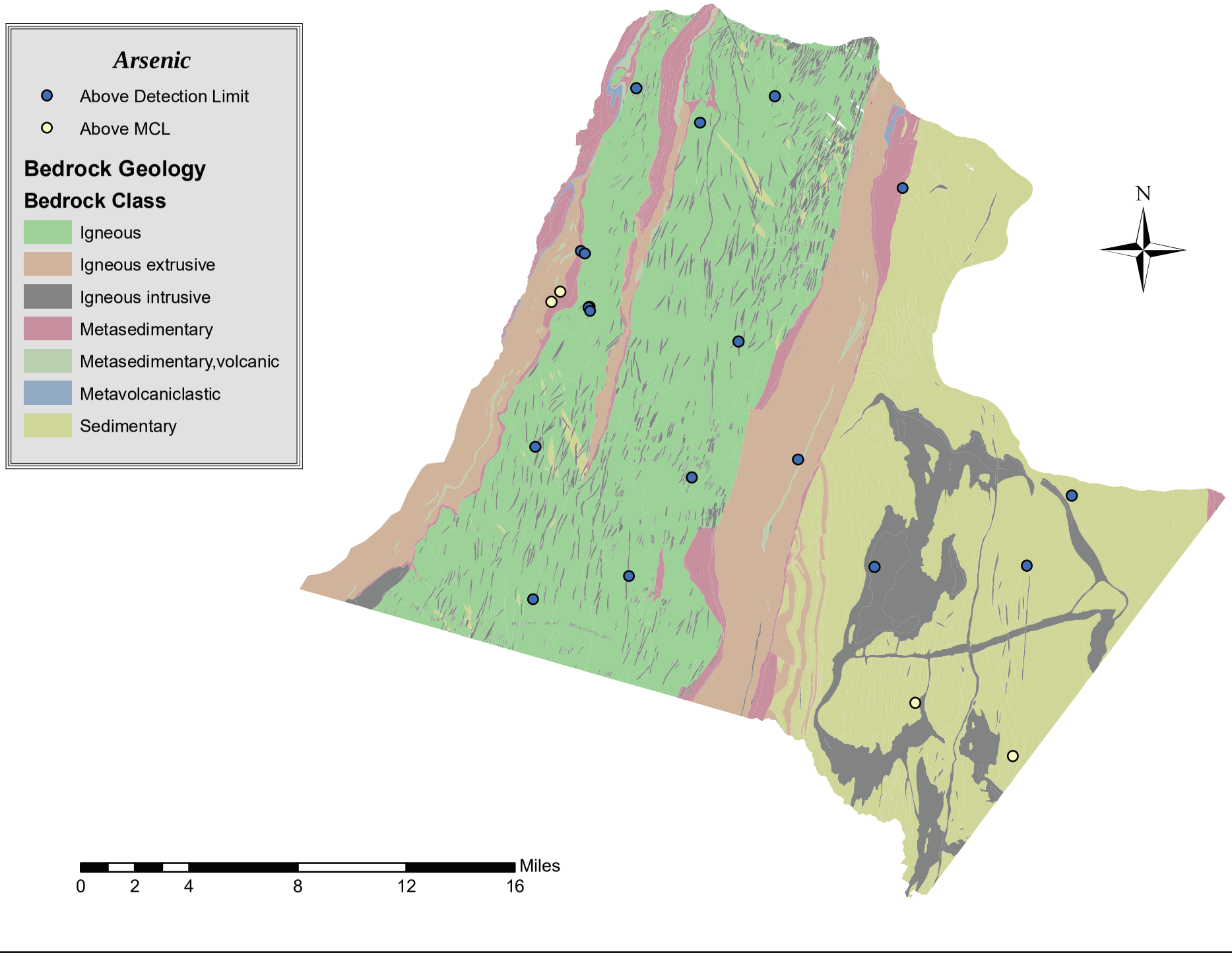

Lead
Above Detection Limit
Above MCL
Bedrock Geology
Bedrock Class
Igneous
Igneous extrusive
Igneous intrusive
Metasedimentary
Metasedimentary,volcanic
Metavolcaniclastic
Sedimentary
N
Miles
0
2
4
8
12
16

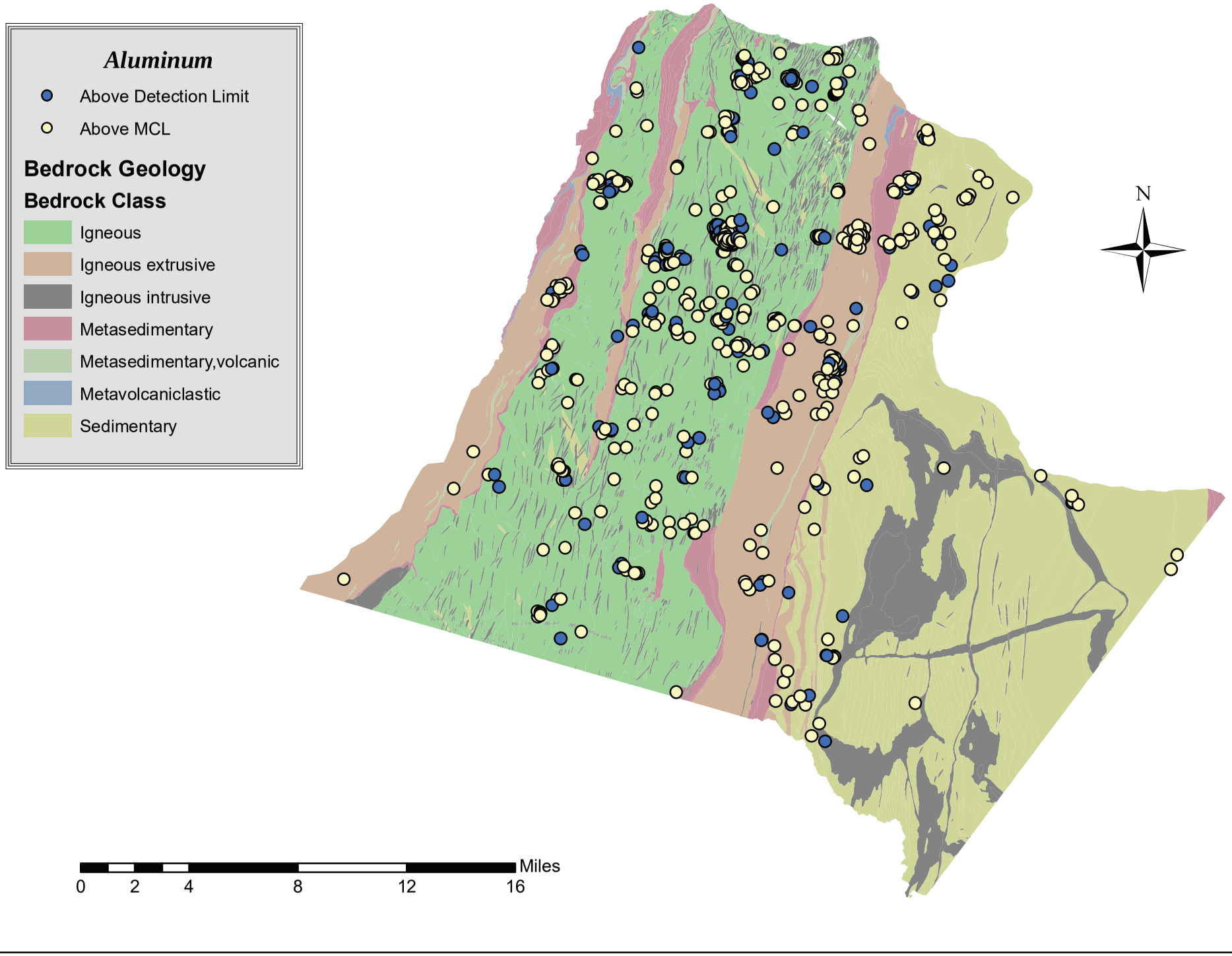

Nitrate
Above Detection Limit
Above MCL
Bedrock Geology
Bedrock Class
Igneous
Igneous extrusive
Igneous intrusive
Metasedimentary
Metasedimentary,volcanic
Metavolcaniclastic
Sedimentary
N
Miles
0
2
4
8
12
16

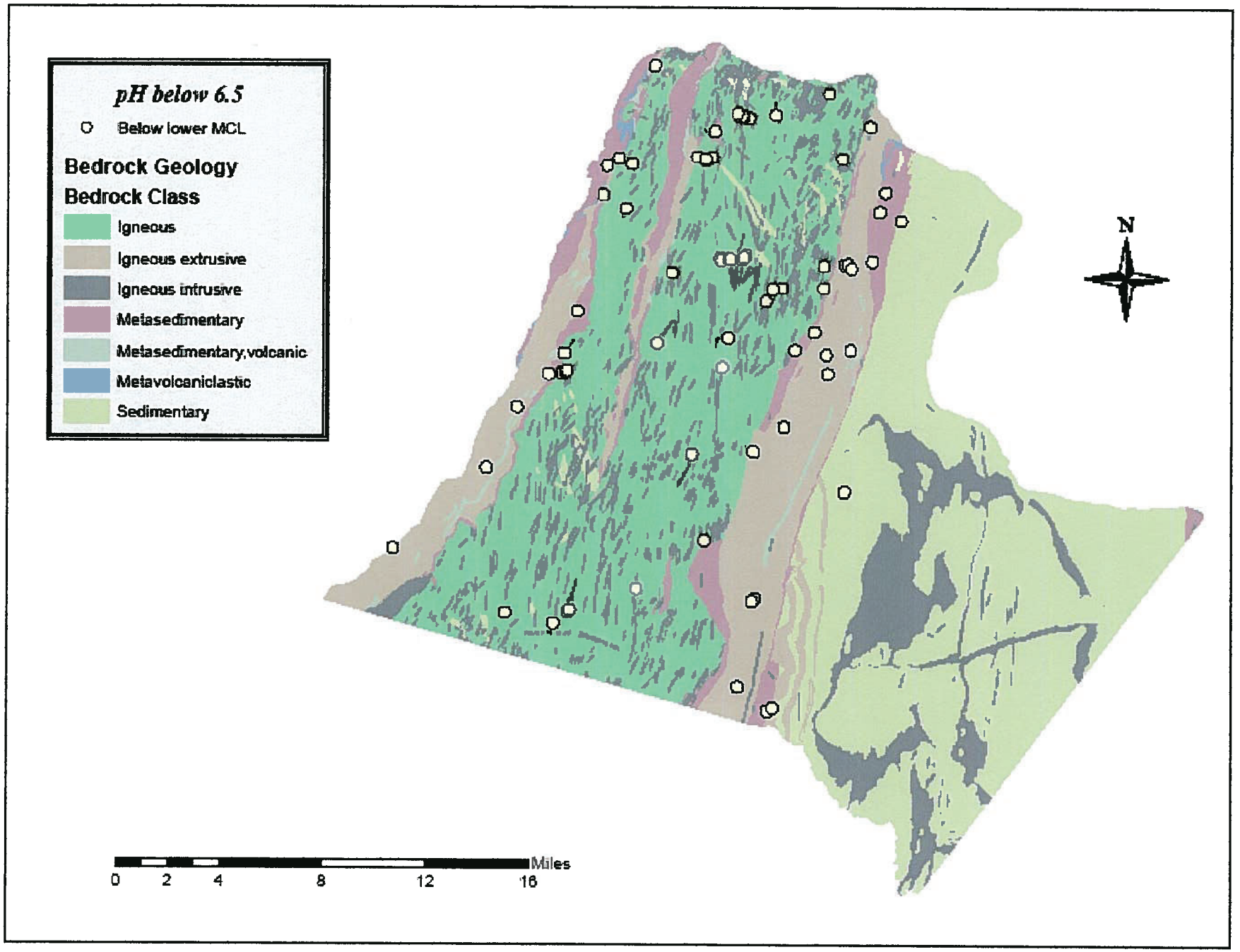

Fluoride
Above Detection Limit
Above MCL
Bedrock Geology
Bedrock Class
Igneous
Igneous extrusive
Igneous intrusive
Metasedimentary
Metasedimentary,volcanic
Metavolcaniclastic
Sedimentary
N
0
2
4
8
12
16
Miles

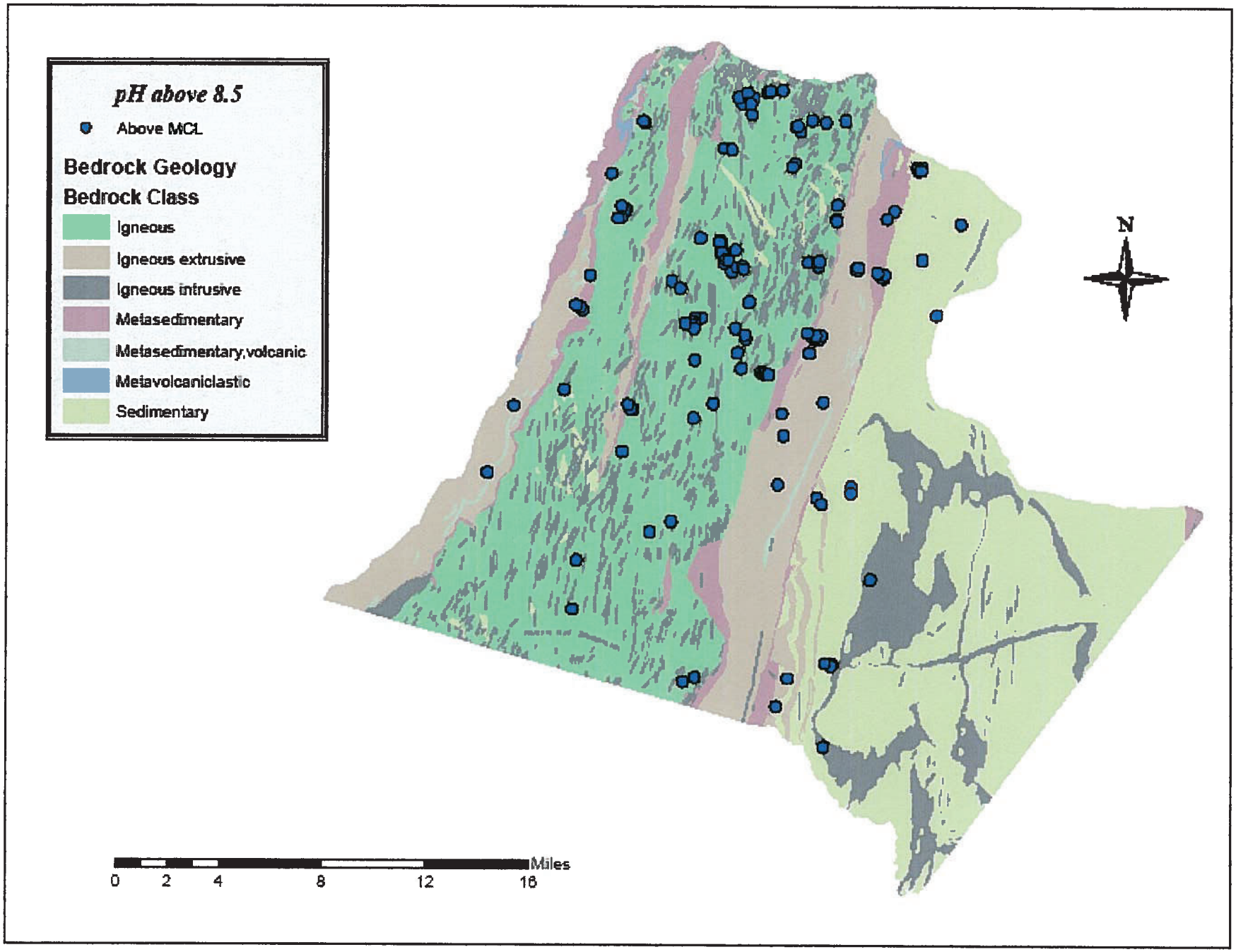

Chloride
Above Detection Limit
Above MCL
Bedrock Geology
Bedrock Class
Igneous
Igneous extrusive
Igneous intrusive
Metasedimentary
Metasedimentary,volcanic
Metavolcaniclastic
Sedimentary
N
0
2
4
8
12
16
Miles


Barium
Above Detection Limit
Above MCL
Bedrock Geology
Bedrock Class
Igneous
Igneous extrusive
Igneous intrusive
Metasedimentary
Metasedimentary,volcanic
Metavolcaniclastic
Sedimentary
N
Feet
0
11,250
22,500
45,000
67,500
90,000


Arsenic
Above Detection Limit
Above MCL
Bedrock Geology
Bedrock Class
Igneous
Igneous extrusive
Igneous intrusive
Metasedimentary
Metasedimentary,volcanic
Metavolcaniclastic
Sedimentary
N
0
2
4
8
12
16
Miles

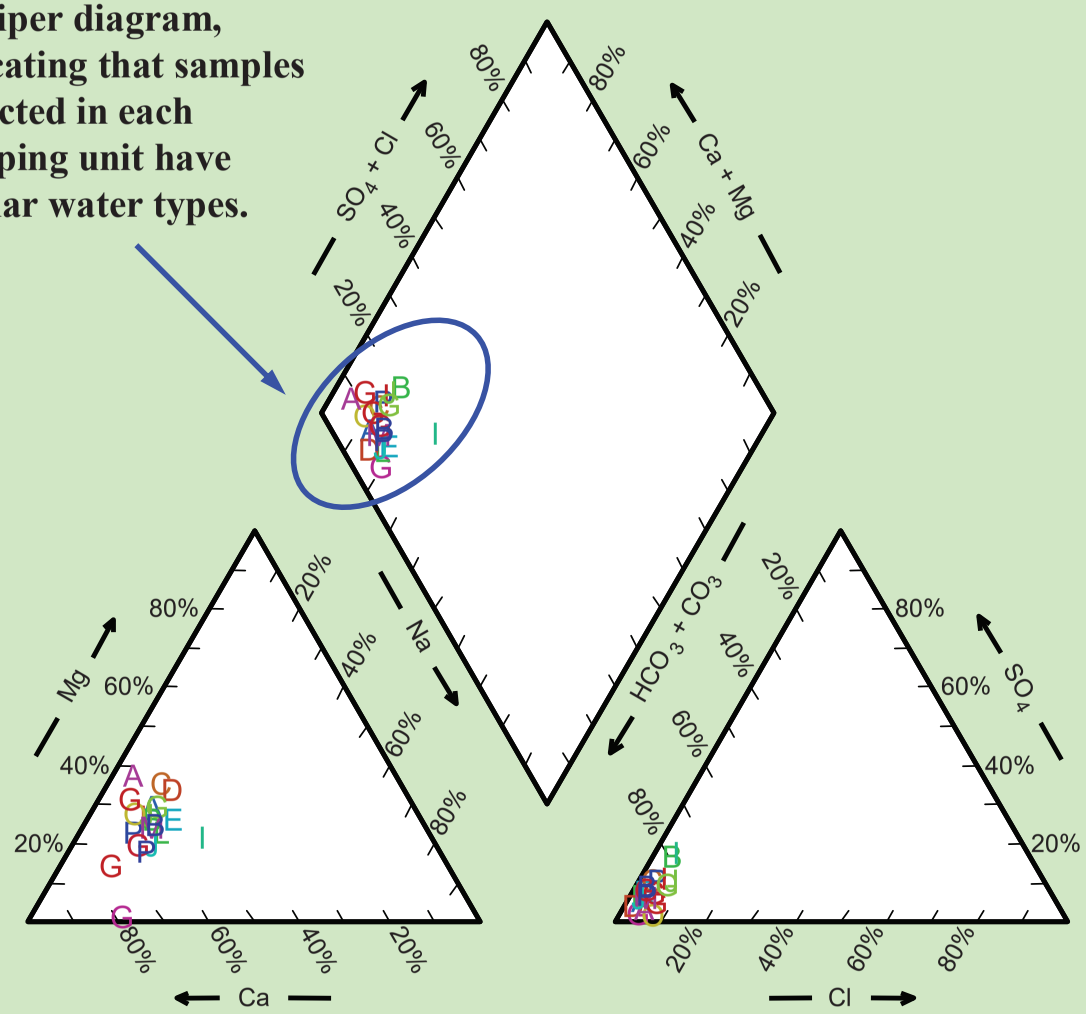

Aluminum
Above Detection Limit
Above MCL
Bedrock Geology
Bedrock Class
Igneous
Igneous extrusive
Igneous intrusive
Metasedimentary
Metasedimentary,volcanic
Metavolcaniclastic
Sedimentary
N
Miles
0
2
4
8
12
16


pH below 6.5
Below lower MCL
Bedrock Geology
Bedrock Class
Igneous
Igneous extrusive
Igneous intrusive
Metasedimentary
Metasedimentary,volcanic
Metavolcaniclastic
Sedimentary
N
0
2
4
8
12
16
Miles


pH above 8.5
Above MCL
Bedrock Geology
Bedrock Class
Igneous
Igneous extrusive
Igneous intrusive
Metasedimentary
Metasedimentary,volcanic
Metavolcaniclastic
Sedimentary
N
0
2
4
8
12
16
Miles

Section D) Identification and graphical representation of water quality types using Durov and Piper diagrams.

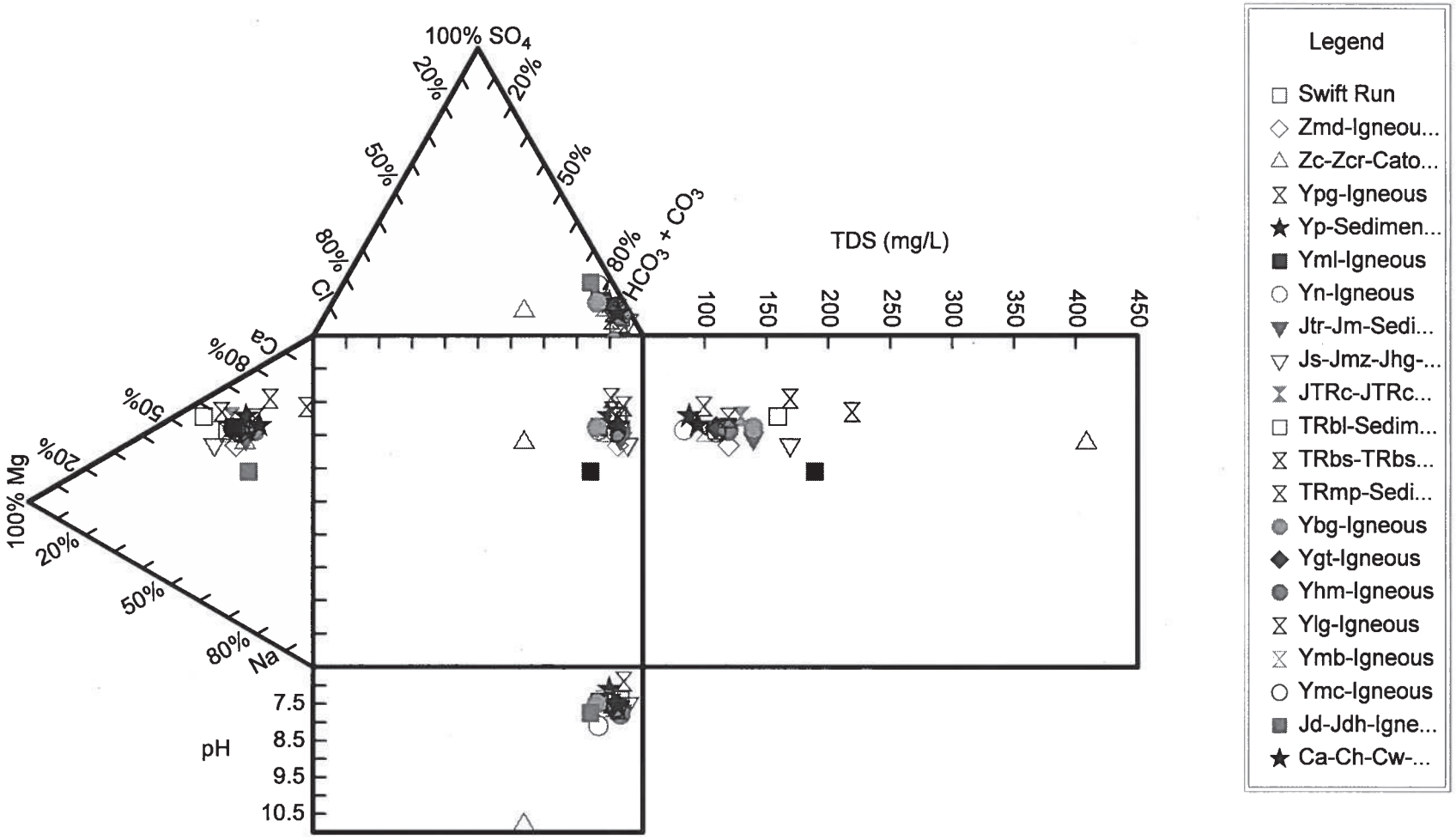
Symbols for each mapping unit plot closely on Piper diagram, indicating that samples collected in each mapping unit have similar water types.



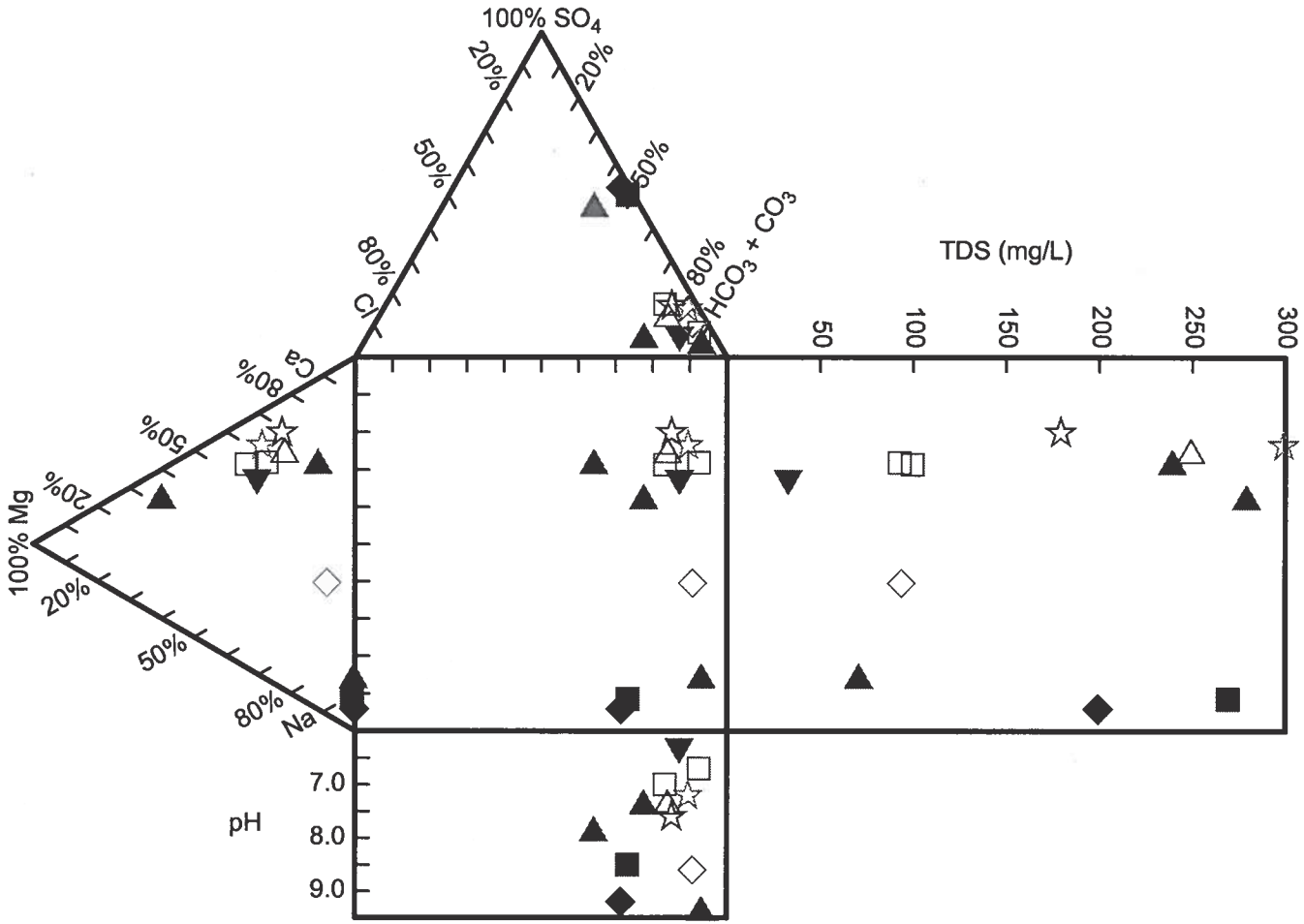
Legend

- A Swift Run
- E Zmd-Igneou...
- C Zc-Zcr-Cato...
- G Ypg-Igneous
- P Yp-Sedimen...
- I Yml-Igneous
- B Yn-Igneous
- L Jtr-Jm-Sedi...
- D Js-Jmz-Jhg-...
- O JTRc-JTRcg...
- A TRbl-Sedim...
- G TRbs-TRbsh...
- G TRmp-Sedi...
- J Ybg-Igneous
- M Ygt-Igneous
- J Yhm-Igneous
- G Ylg-Igneous
- G Ymb-Igneous
- B Ymc-Igneous
- I Jd-Jdh-Igne...
- P Ca-Ch-Cw-...

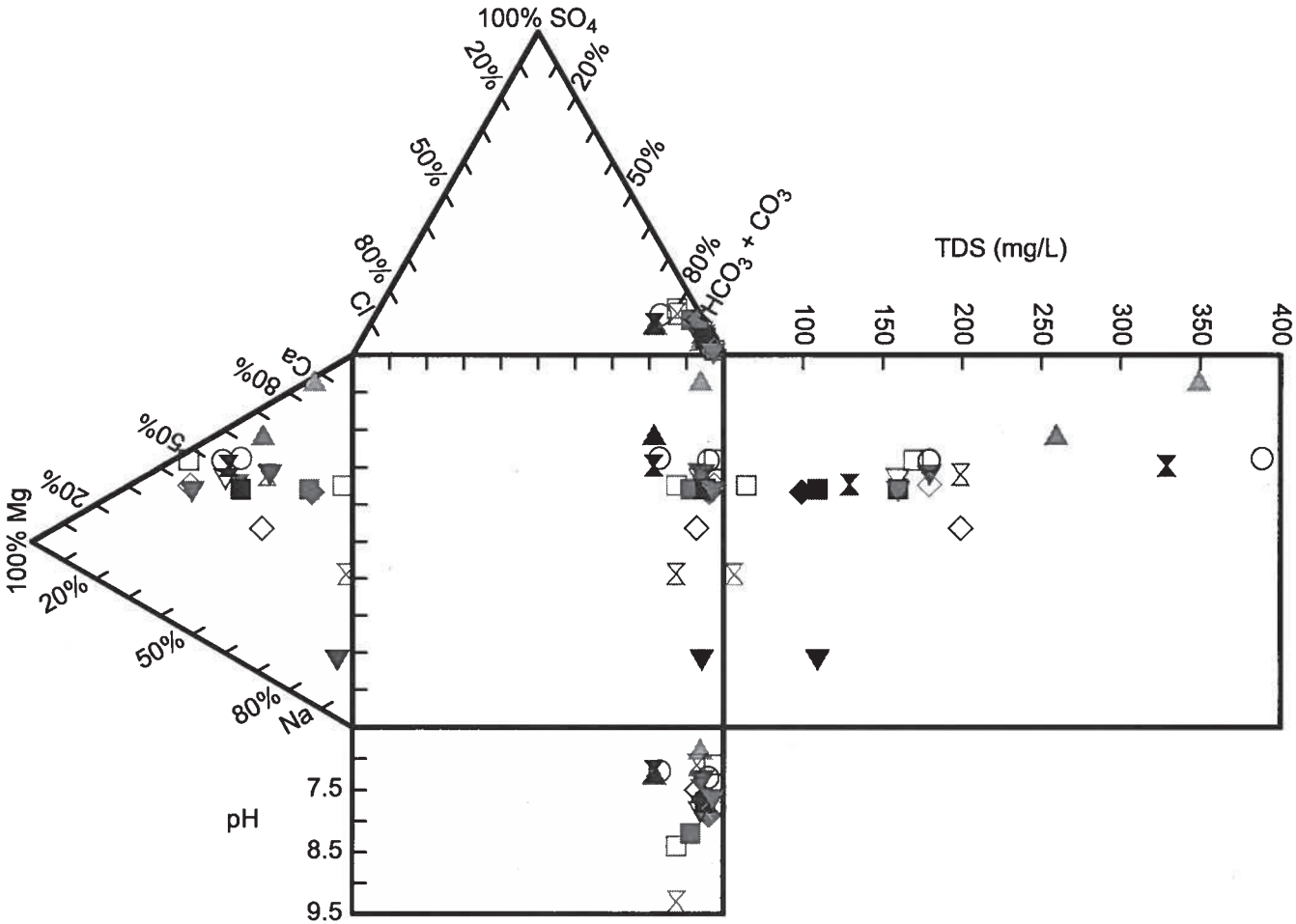
Median Values by Rock Unit



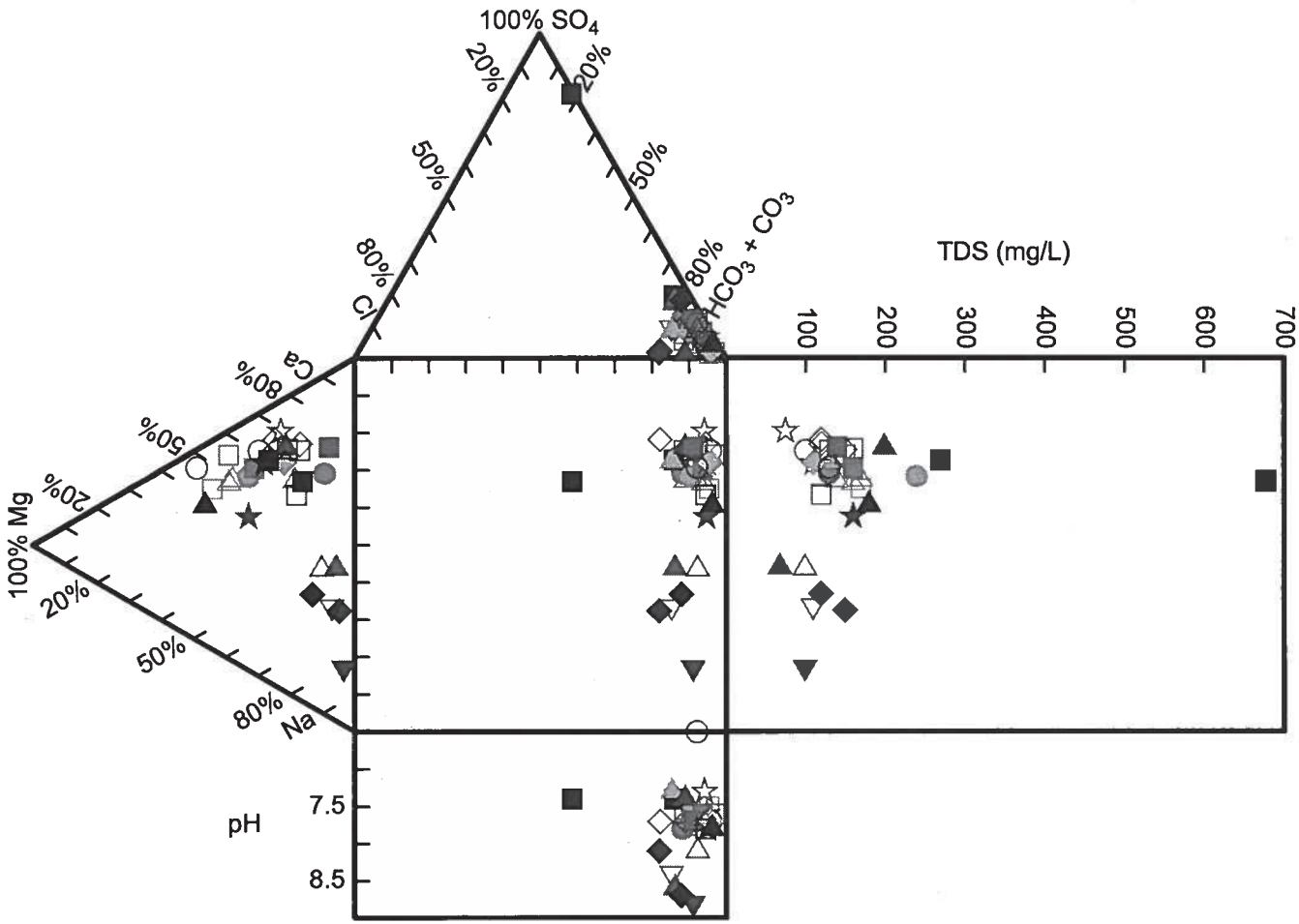
Jd-Jdh Jurassic Diabase



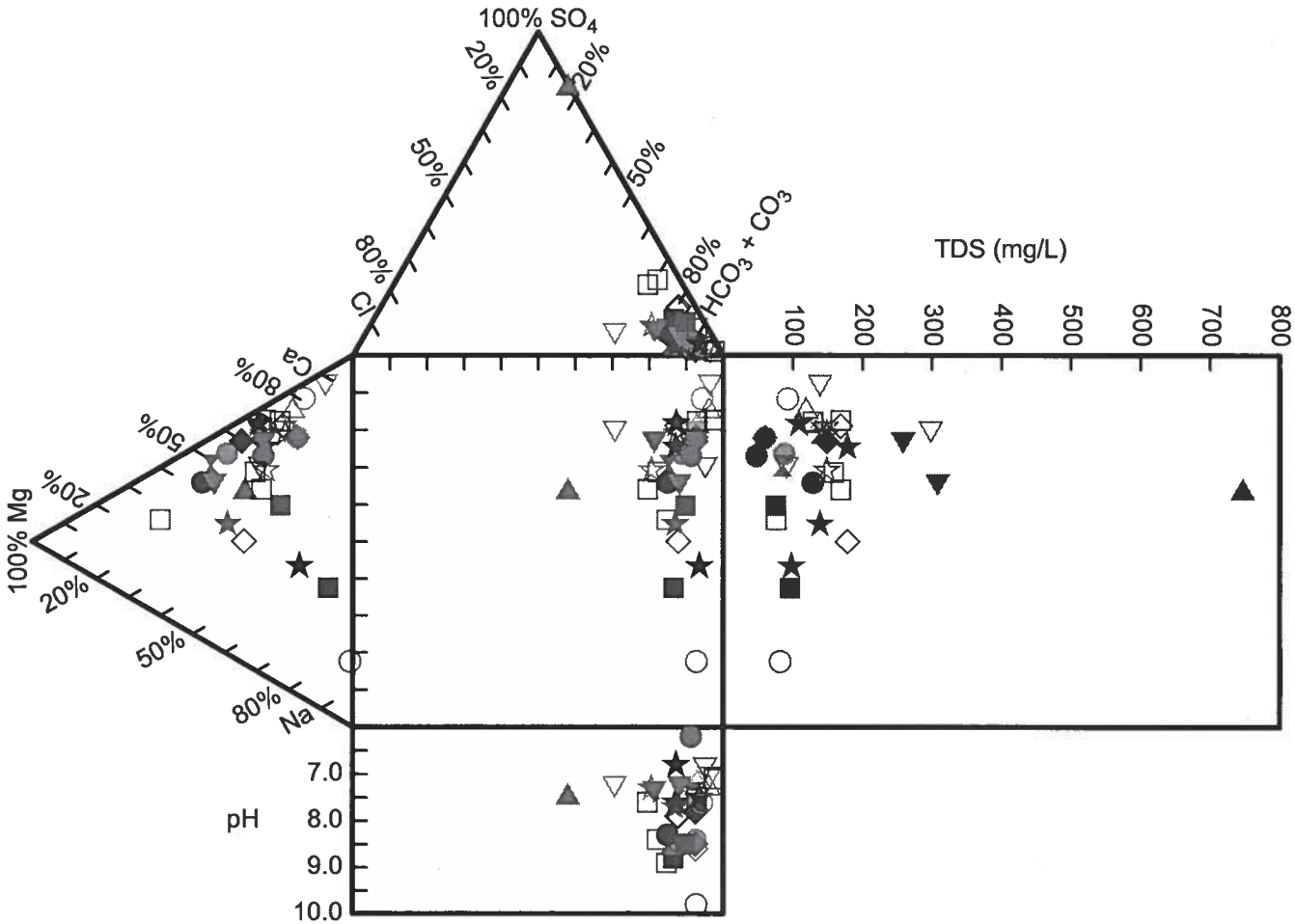
Jss-Jmz-Jhg Jurassic Basalts



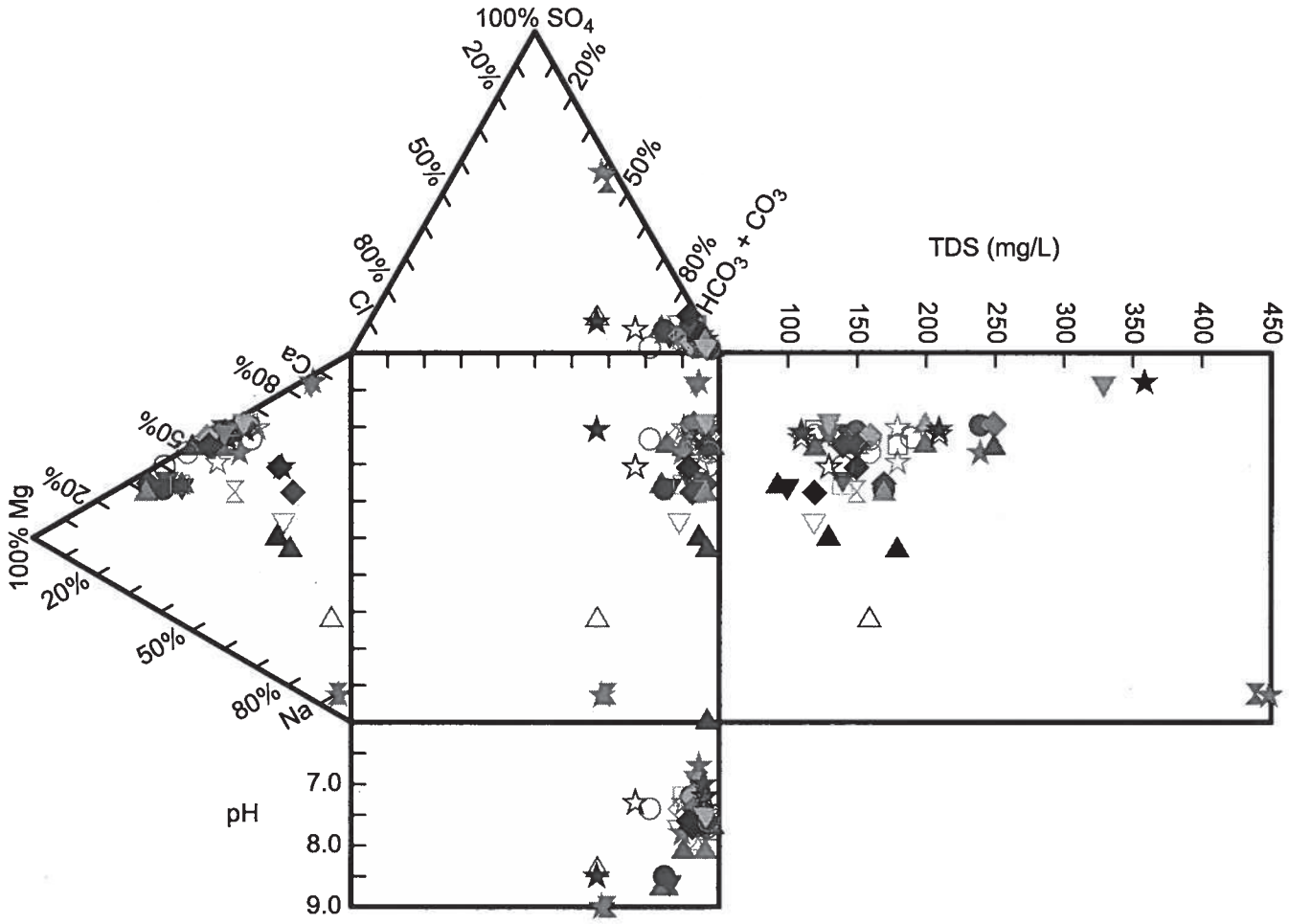
Jtr-Jm Sedimentary



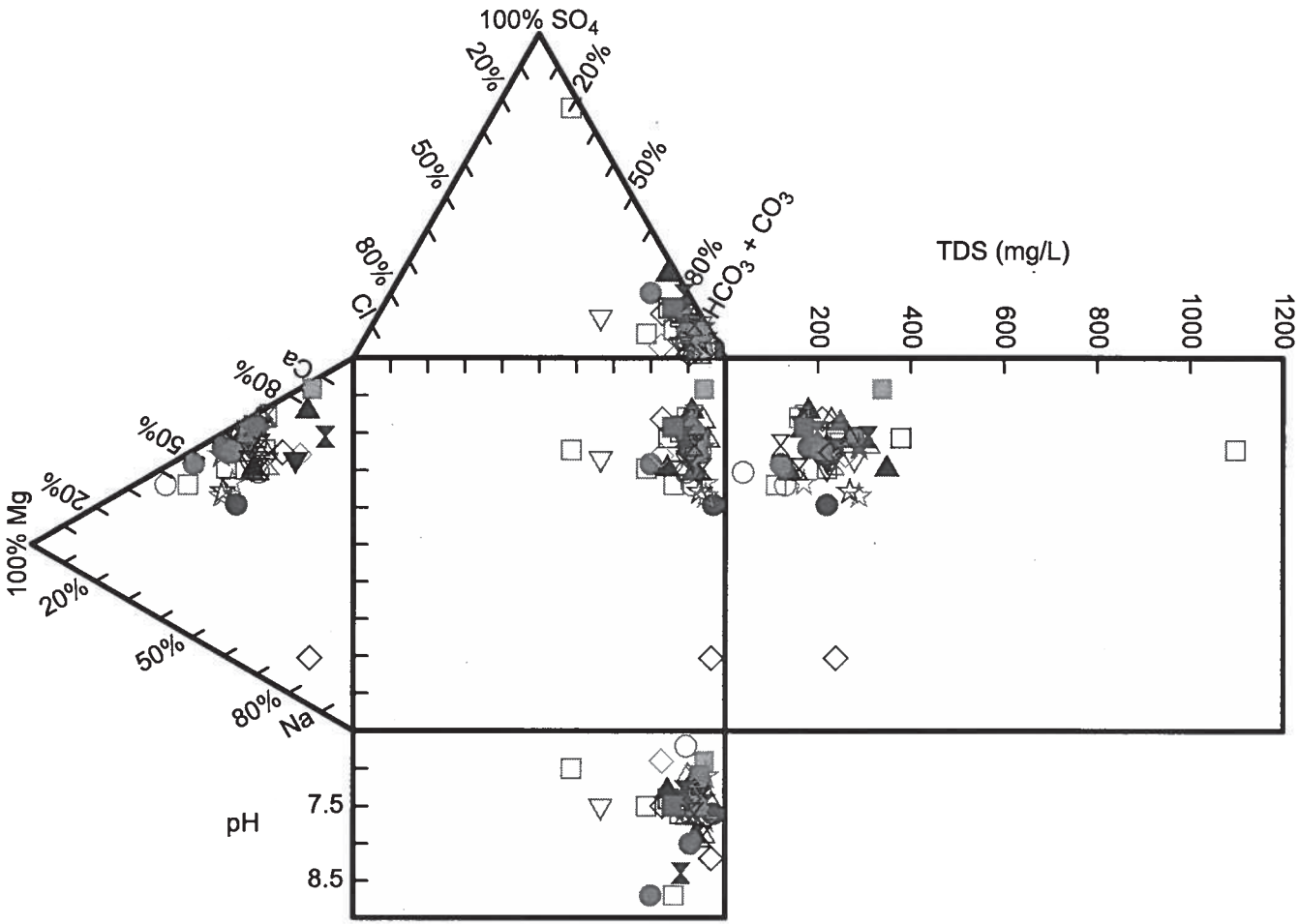
JTRtm-JTRc-JTRcg Sedimentary



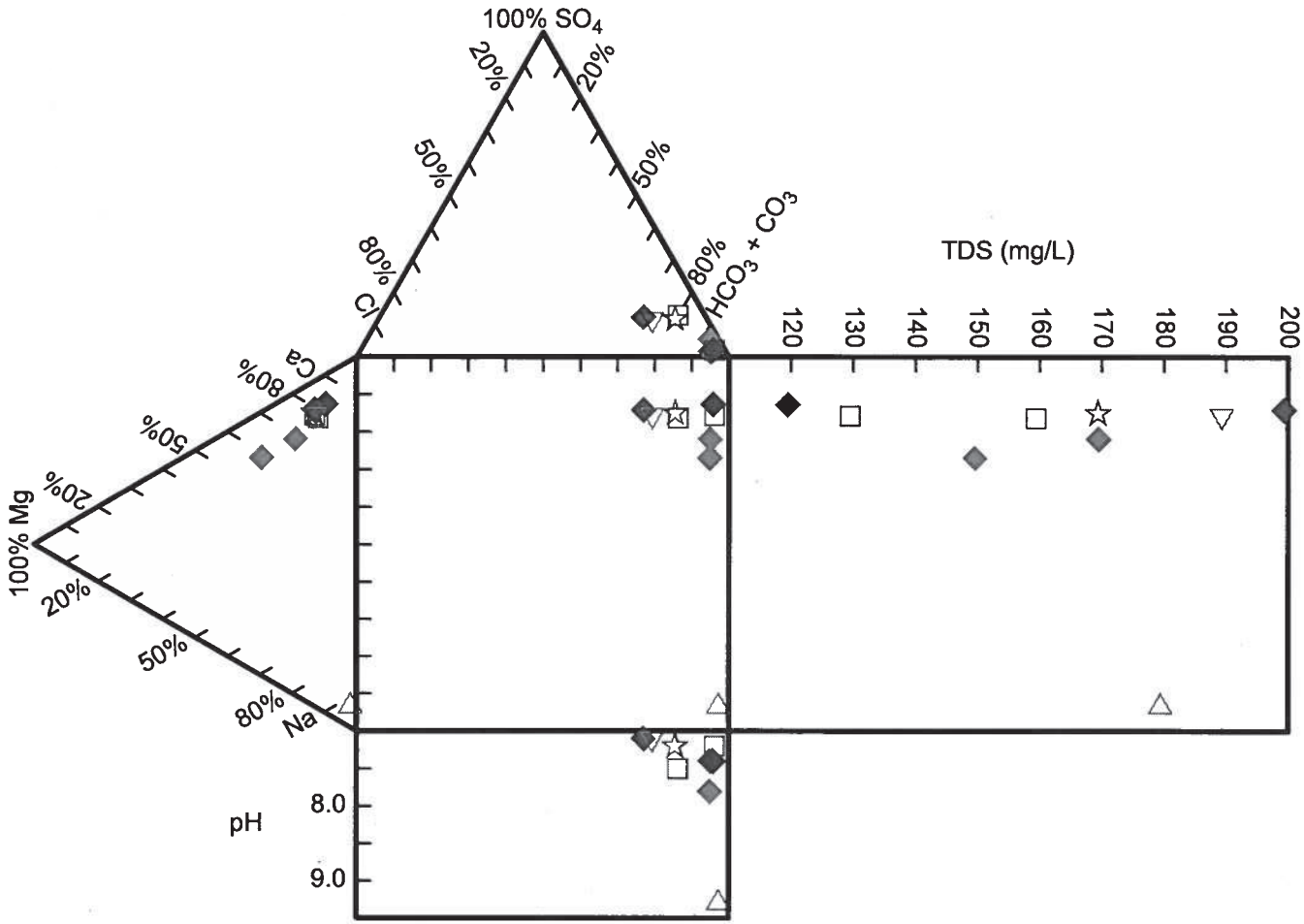
TRbl Conglomerate



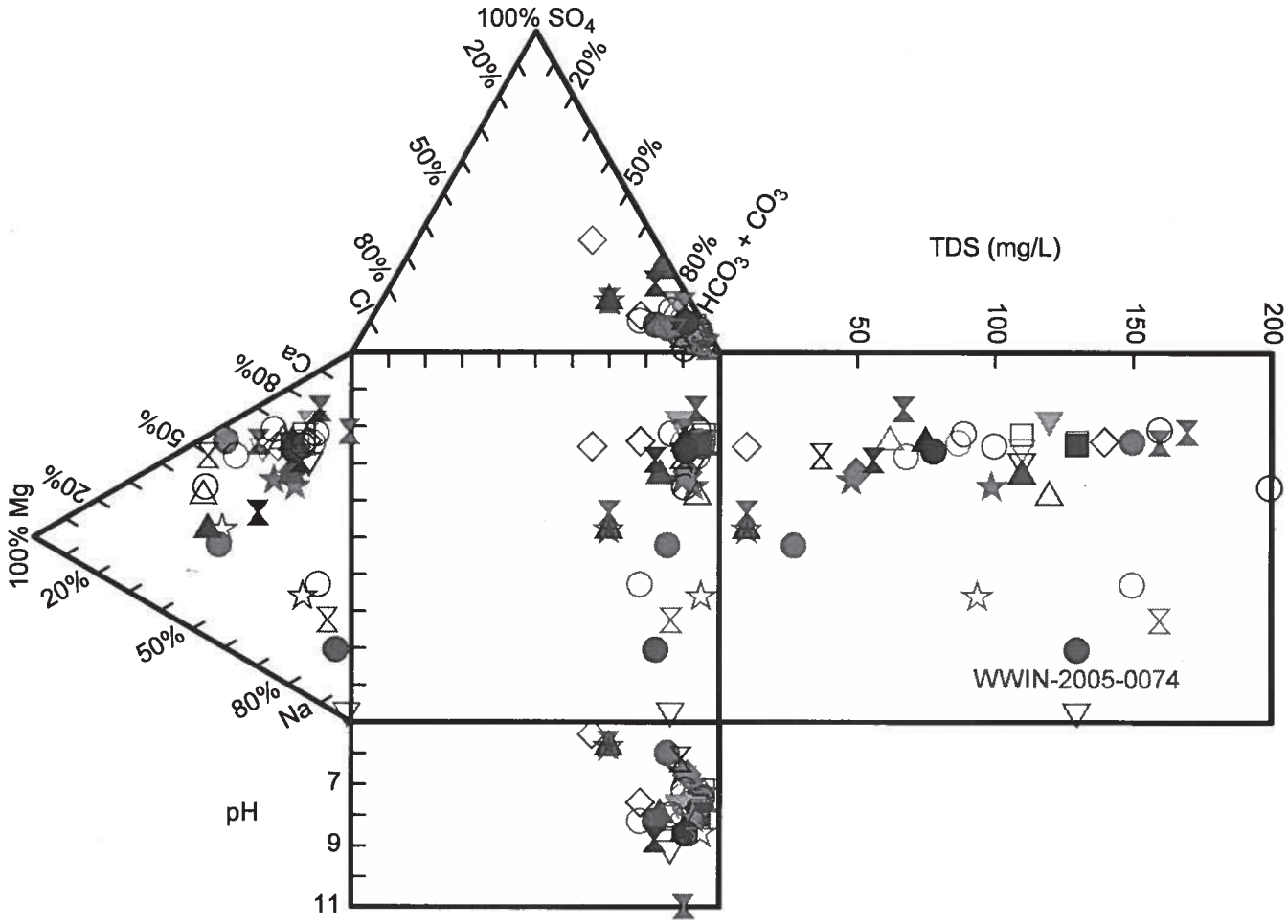
TRbs-TRbsh Sedimentary



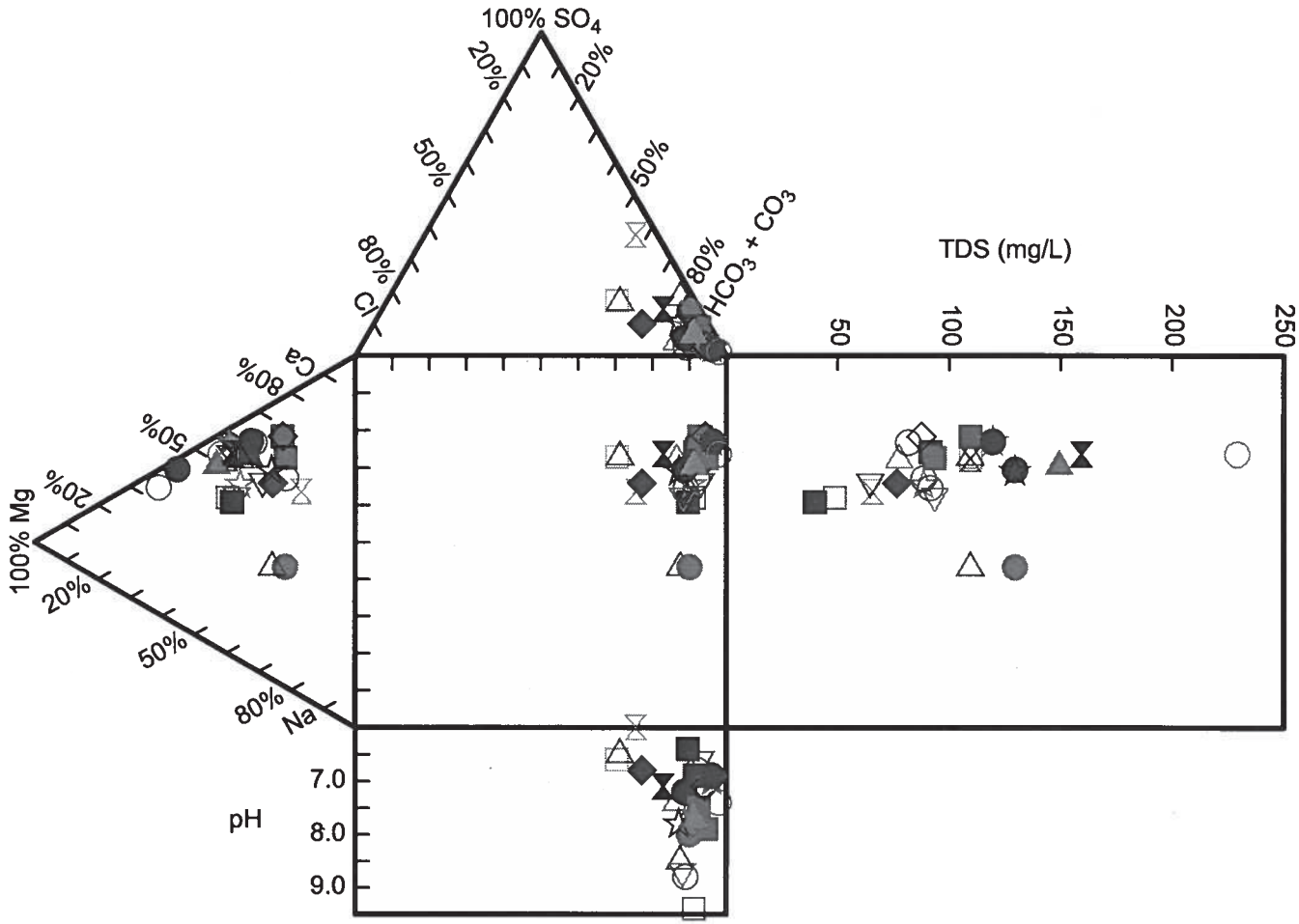
TRmp Sedimentary



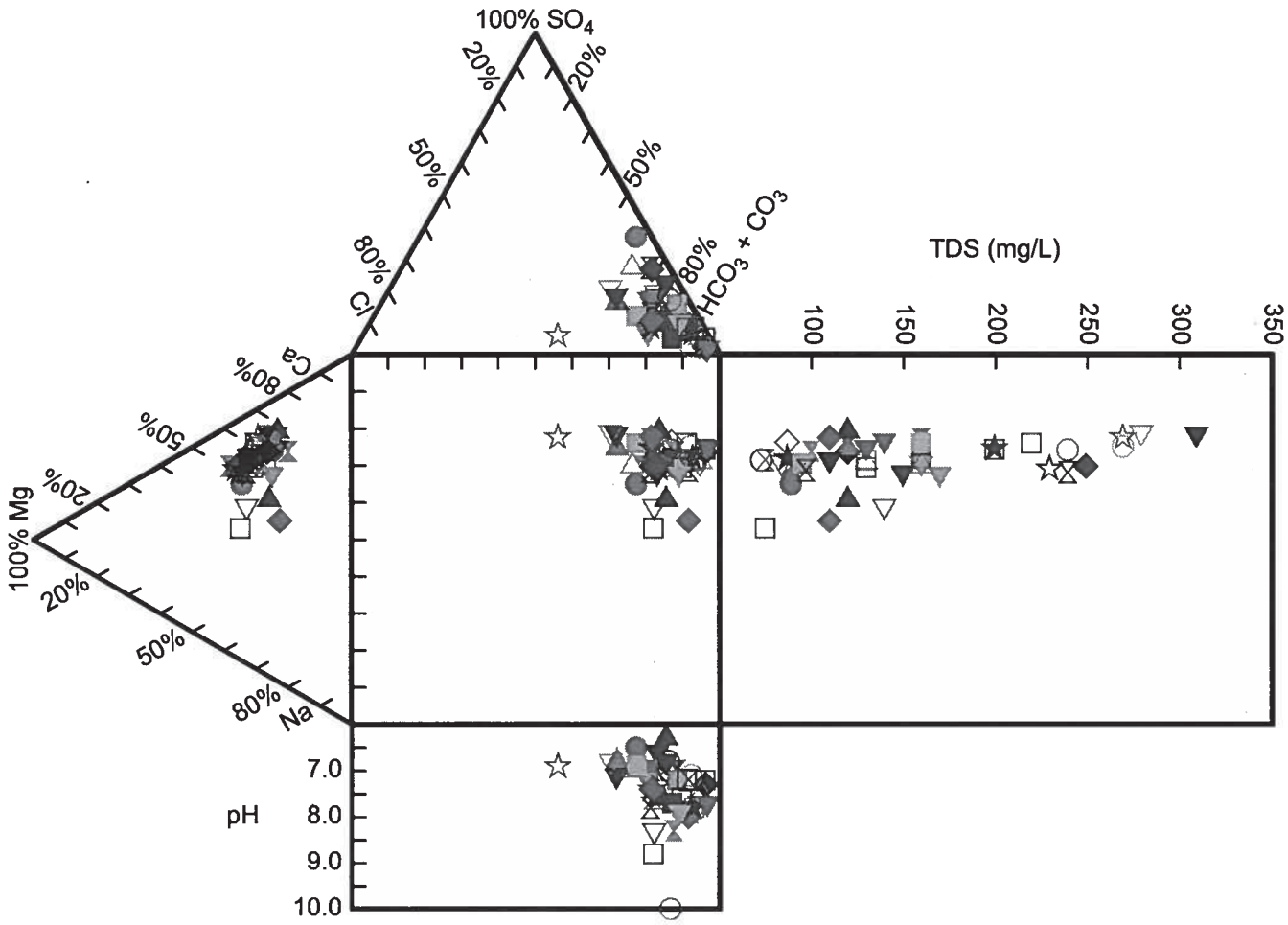
Cw-Ch Metasedimentary



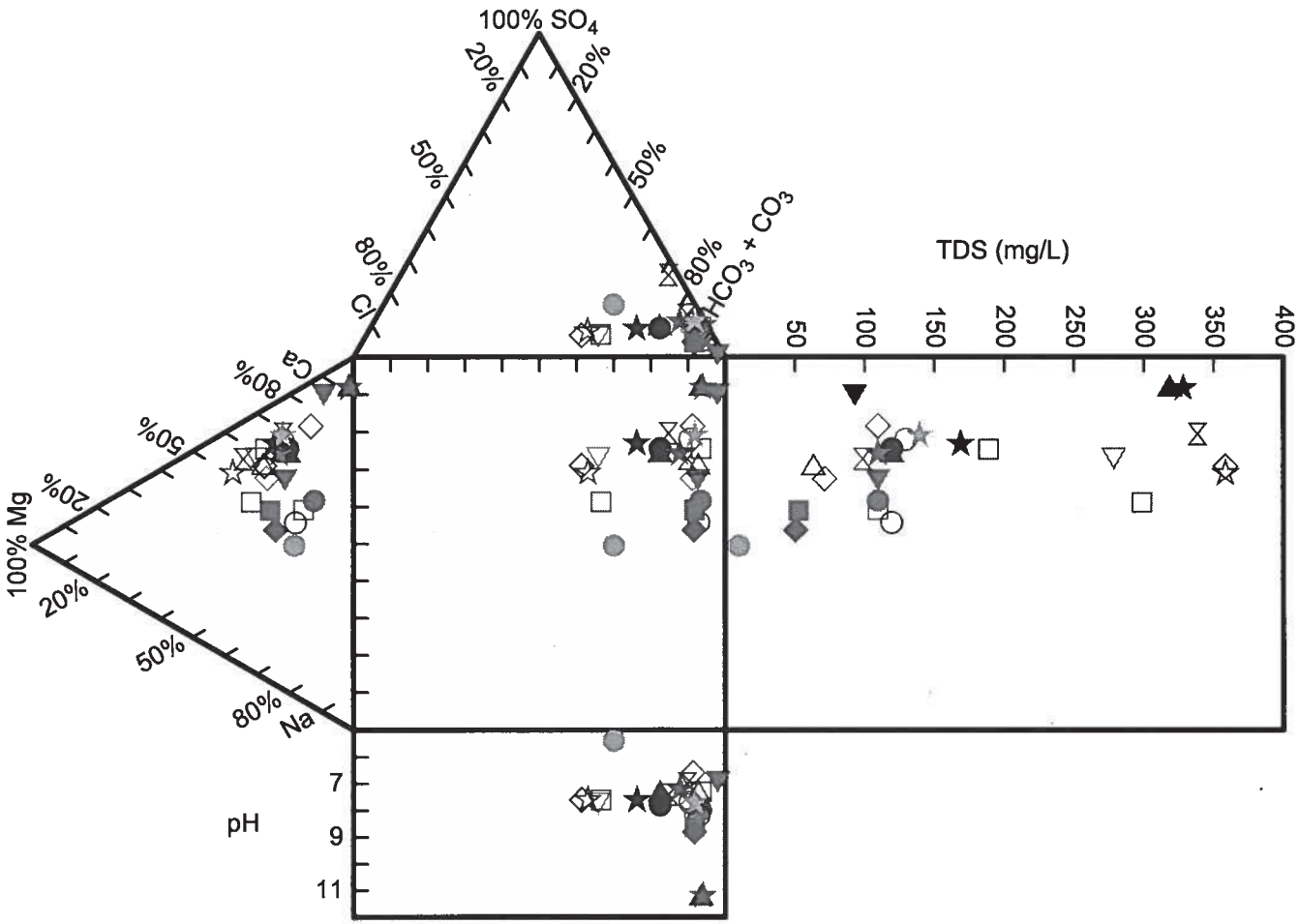
Zss-Zsp Swift Run Metasedimentary



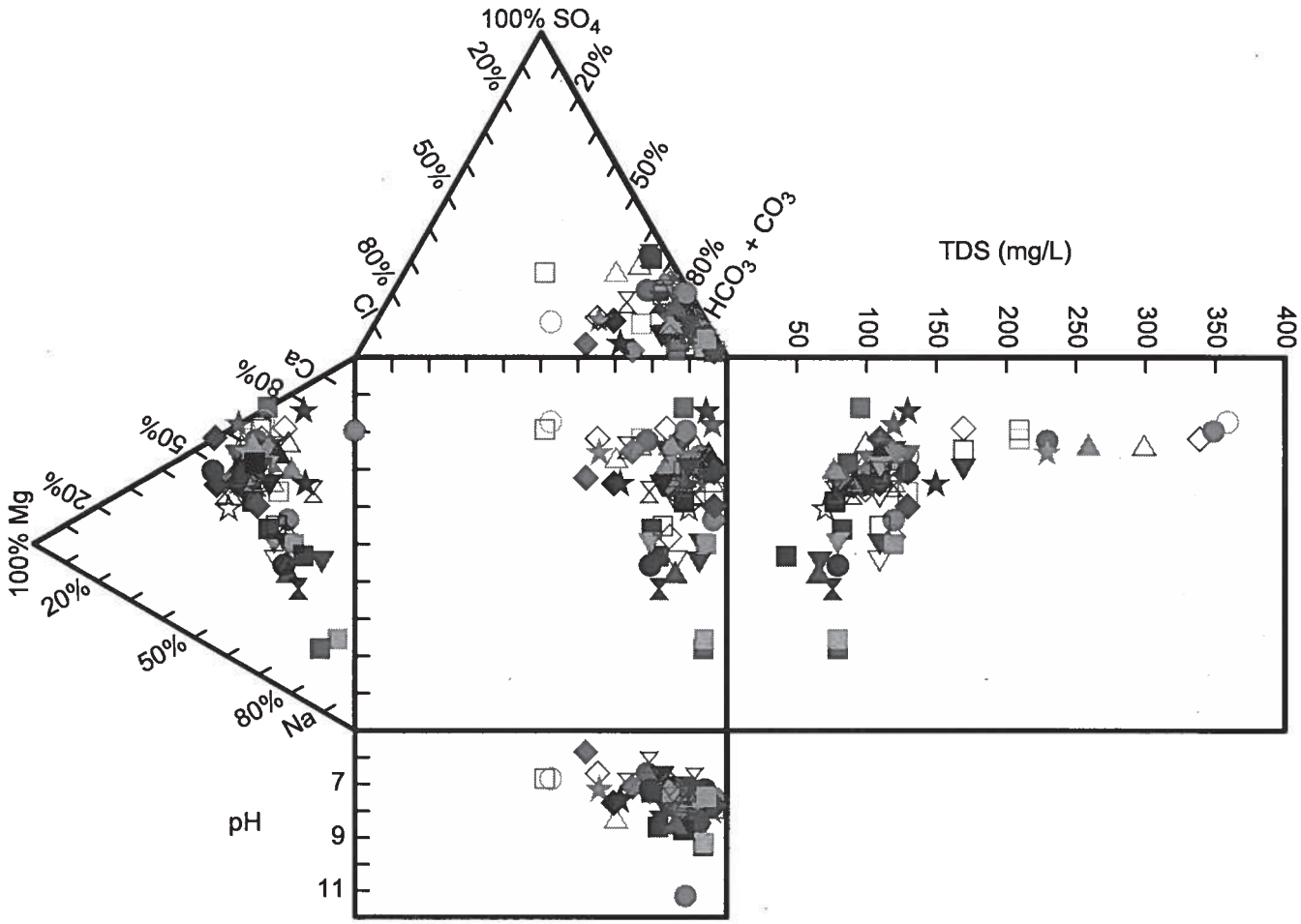
Ybg Igneous


100% SO4
20%
50%
80%
HCO3 + CO3
Cl
Ca
Mg
Na
TDS (mg/L)
100
150
200
250
300
350
pH
7.0
8.0
9.0
10.0

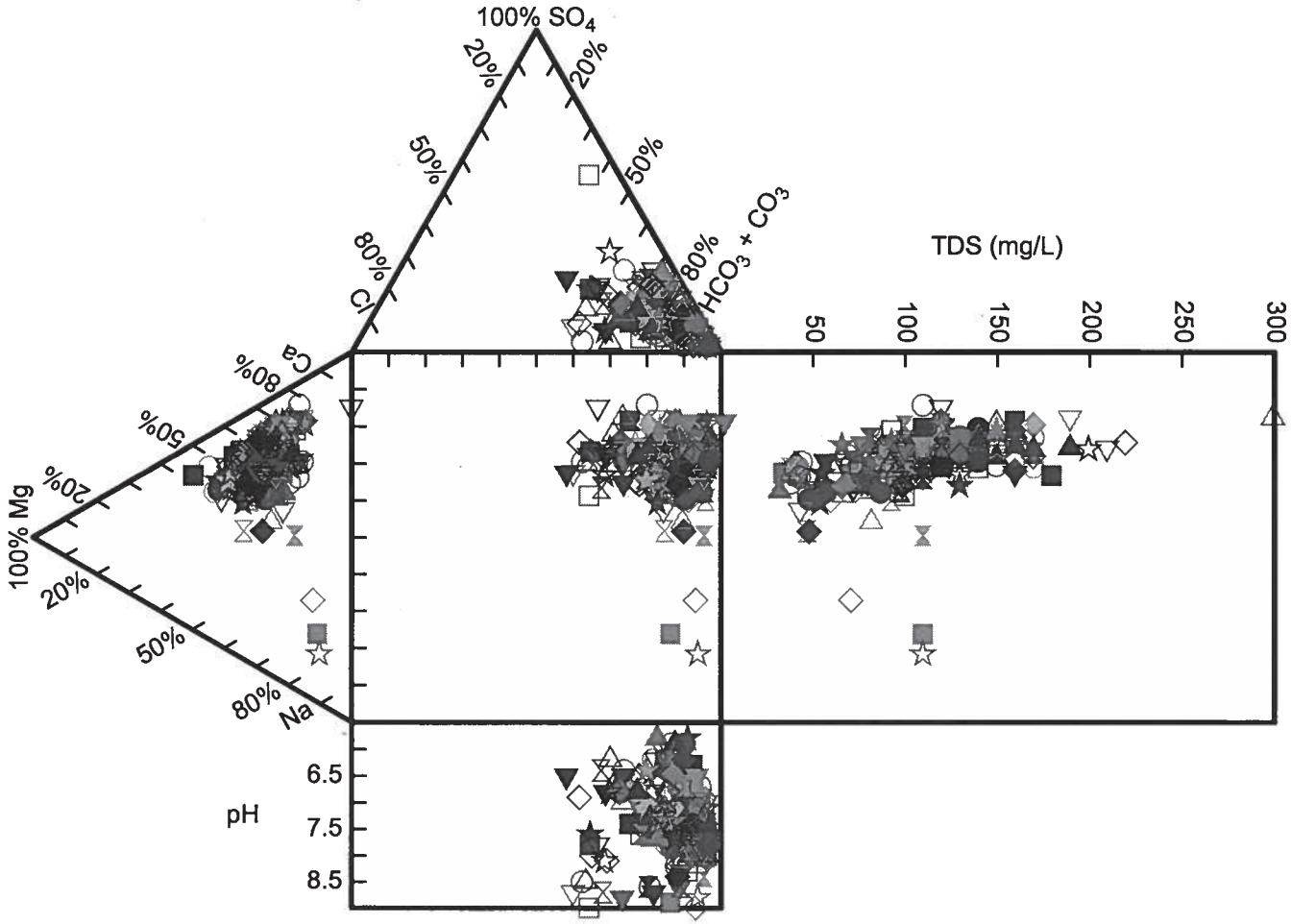
Yc Igneous


100% SO4
20%
20%
50%
50%
80%
80%
Cl
HCO3 + CO3
TDS (mg/L)
50
100
150
200
250
300
350
400
Ca
80%
50%
20%
100% Mg
20%
50%
80%
Na
pH
7
9
11

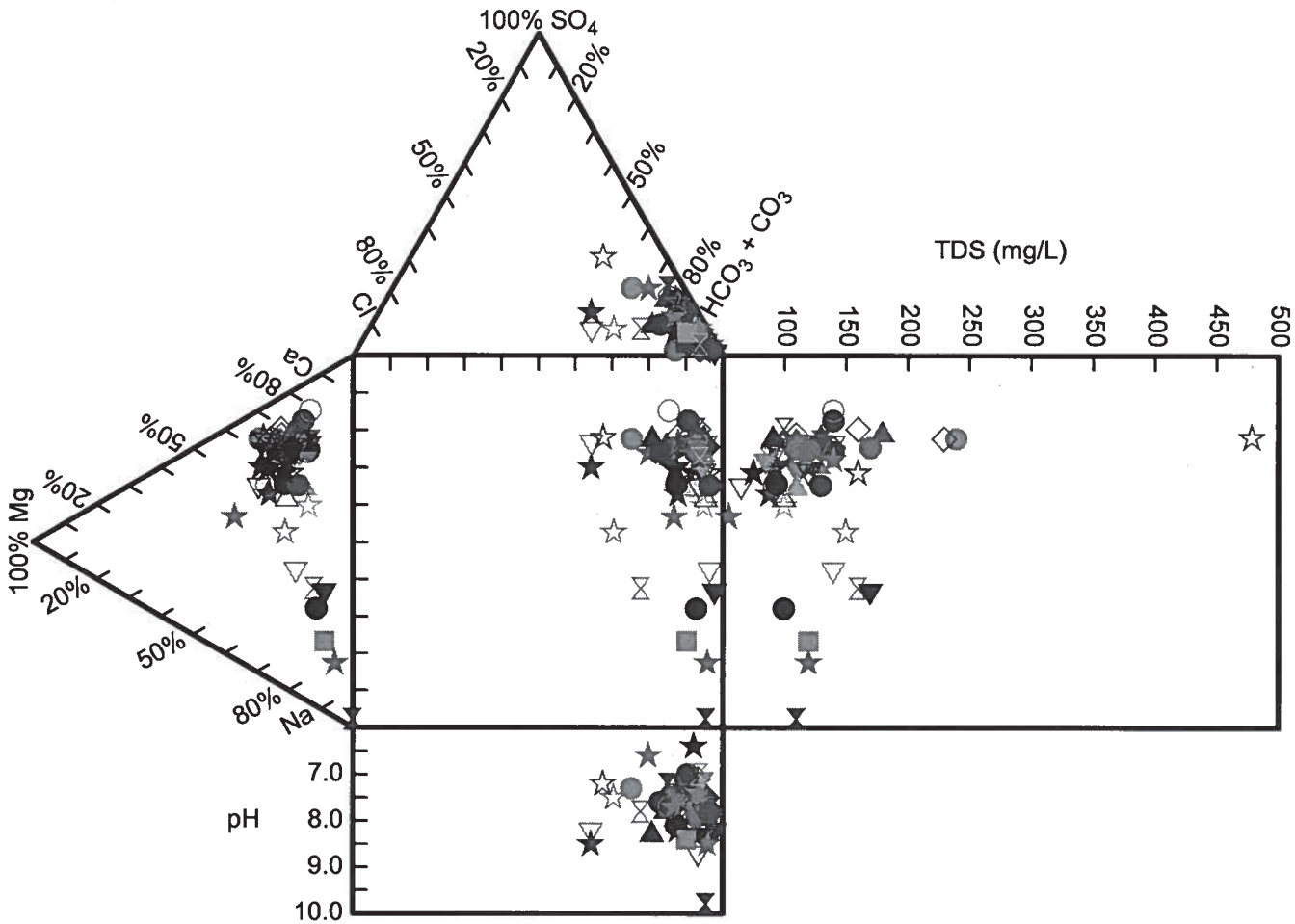
Yg Igneous


100% SO4
20%
50%
80%
HCO3 + CO3
Cl
Ca
100% Mg
Na
TDS (mg/L)
50
100
150
200
250
300
350
400
pH
7
9
11

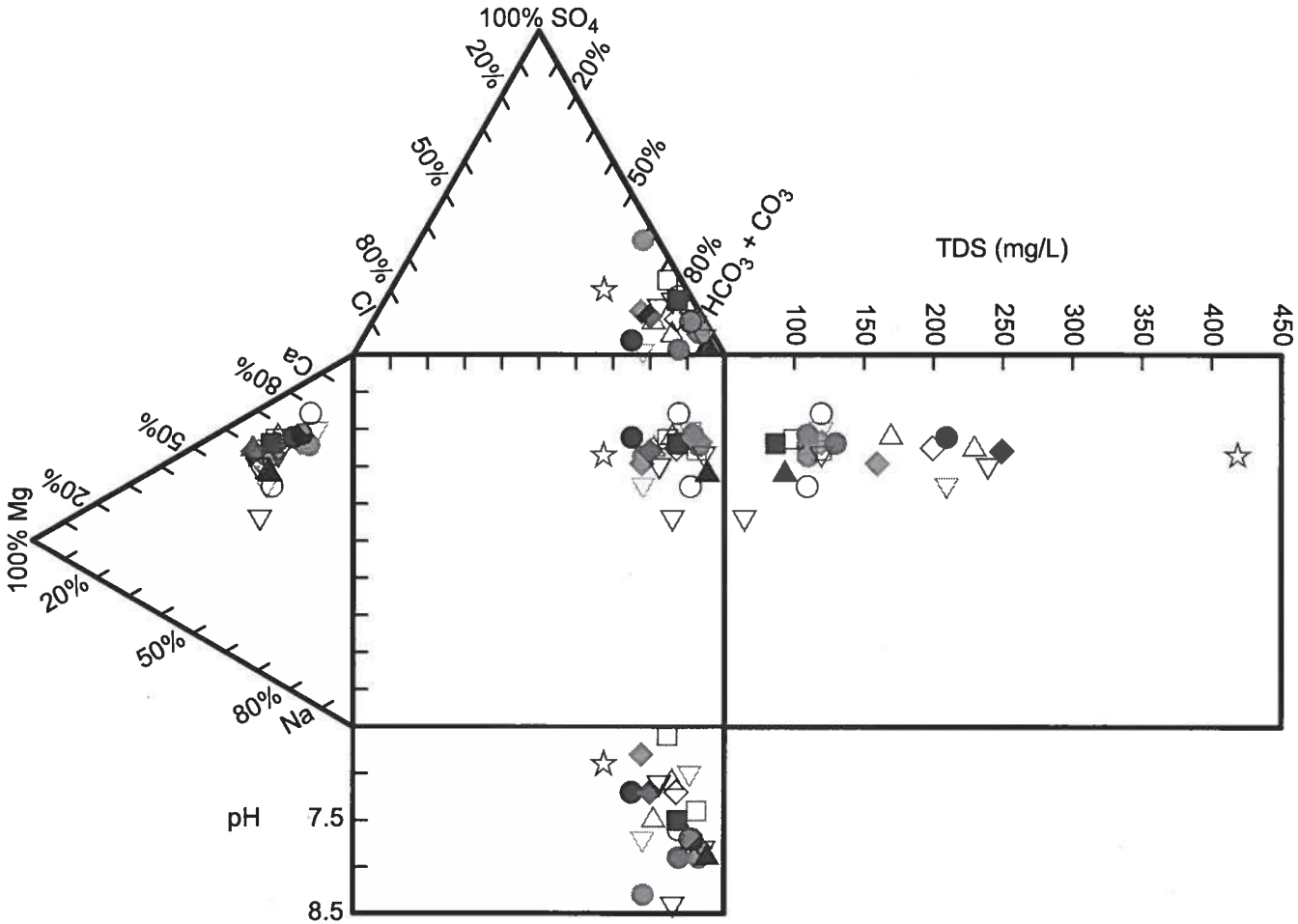
Ygt Igneous


100% SO4
20%
50%
80%
Cl
100% Mg
20%
50%
80%
Ca
100% Na
20%
50%
80%
HCO3 + CO3
TDS (mg/L)
50
100
150
200
250
300
pH
6.5
7.5
8.5

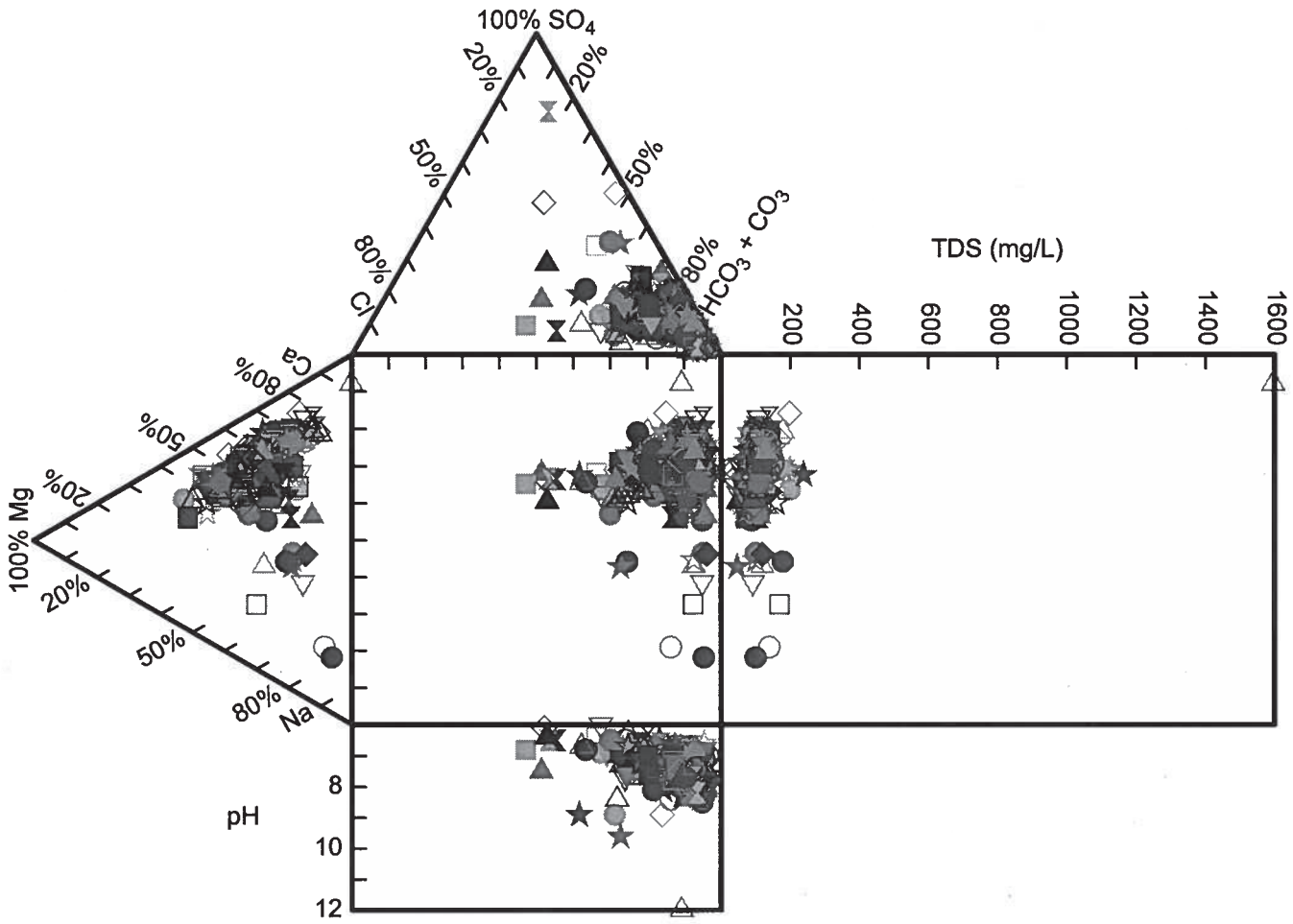
Yhm Igneous


100% SO4
20%
50%
80%
Cl
80%
50%
20%
100% Mg
20%
50%
80%
Na
80%
50%
20%
Ca
HCO3 + CO3
TDS (mg/L)
100
150
200
250
300
350
400
450
500
pH
7.0
8.0
9.0
10.0

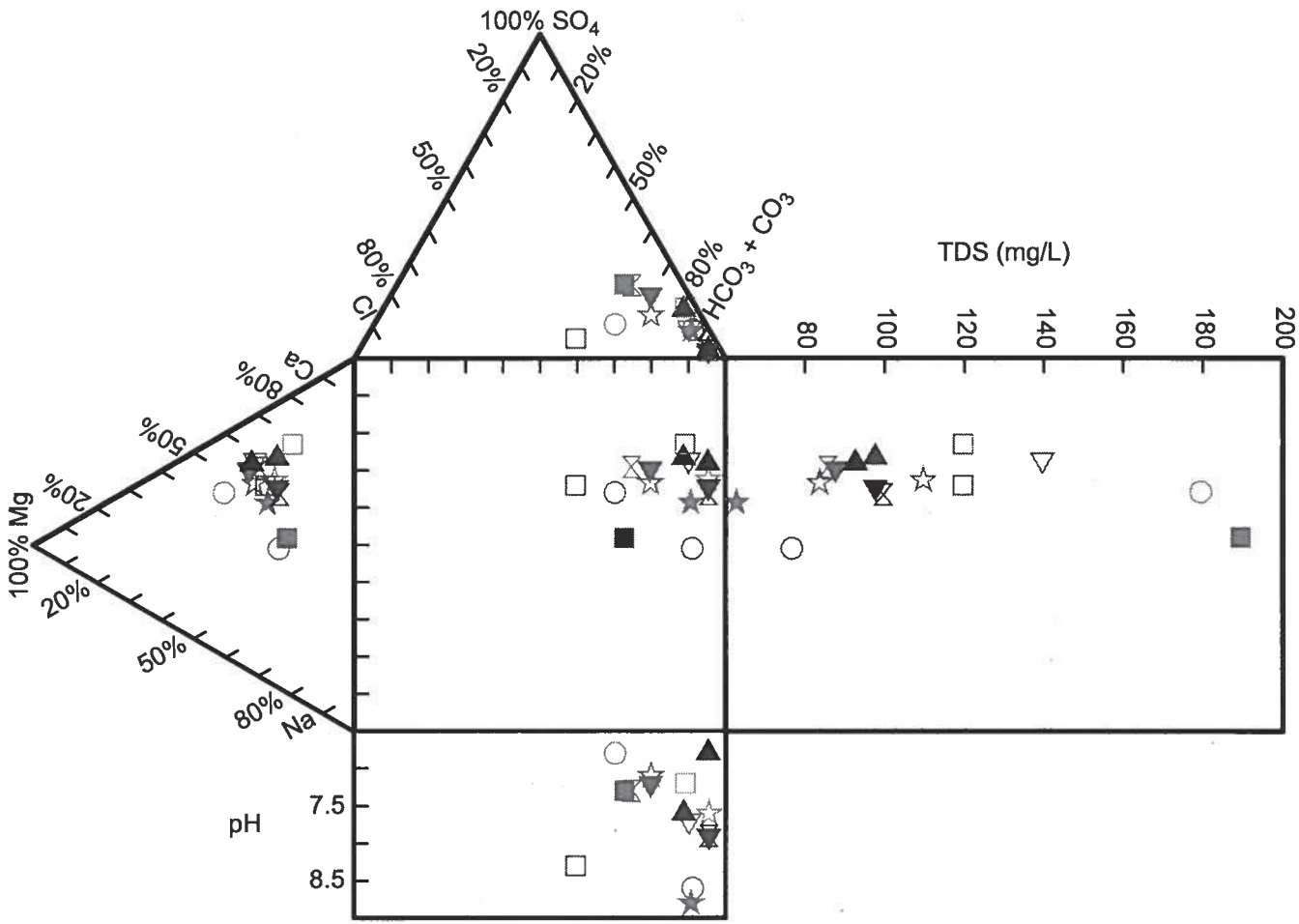
Ylg Igneous


100% SO4
20%
50%
80%
Cl
80%
50%
20%
100% Mg
20%
50%
80%
Na
80%
50%
20%
Ca
100% HCO3 + CO3
TDS (mg/L)
100
150
200
250
300
350
400
450
pH
7.5
8.5

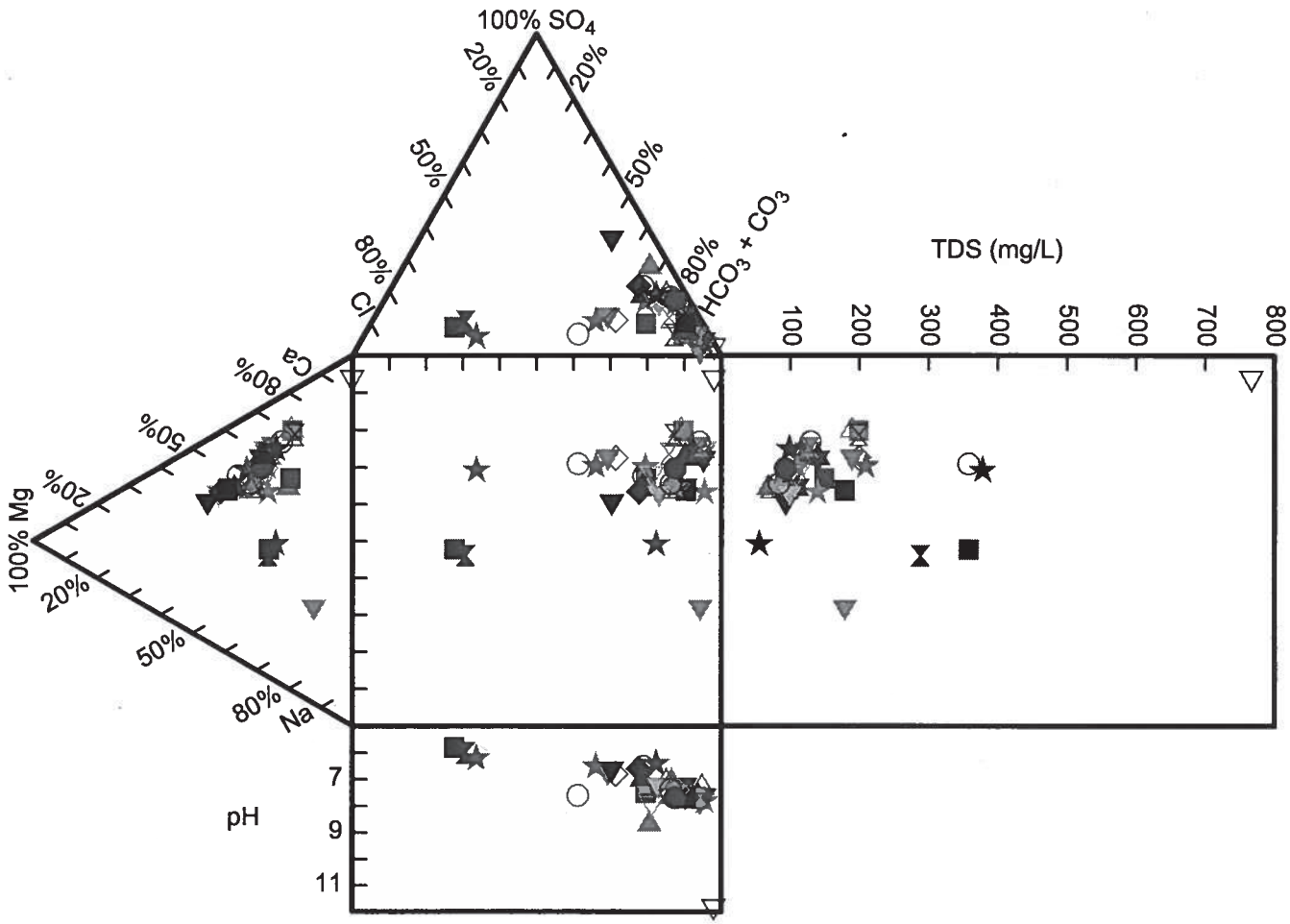
Ymb Igneous


100% SO4
20%
50%
80%
Cl
80%
50%
20%
HCO3 + CO3
TDS (mg/L)
200
400
600
800
1000
1200
1400
1600
Ca
80%
50%
20%
100% Mg
20%
50%
80%
Na
pH
8
10
12

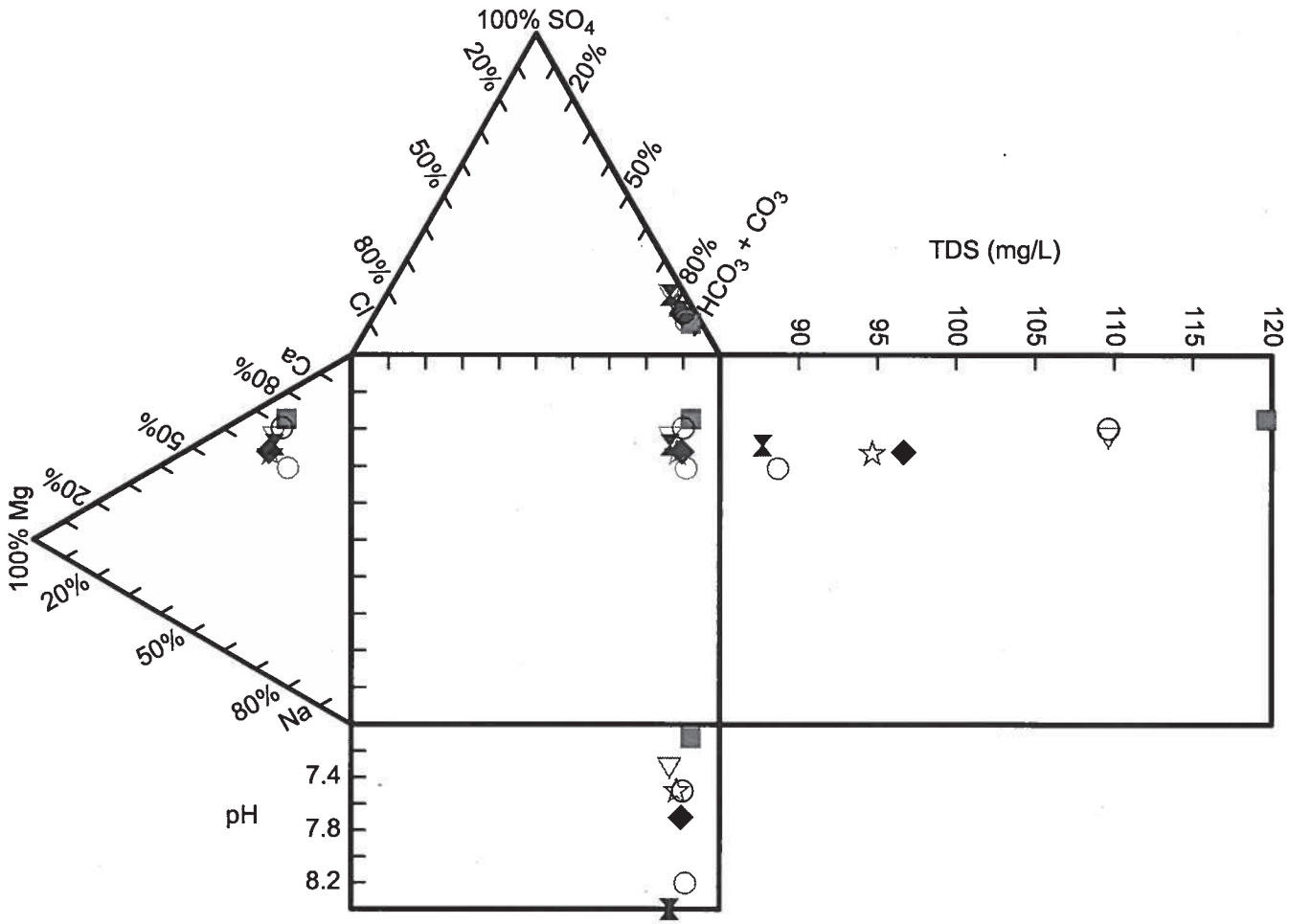
Ymc Igneous


100% SO4
20%
20%
50%
50%
80%
80%
Cl
HCO3 + CO3
TDS (mg/L)
80
100
120
140
160
180
200
Ca
80%
50%
20%
100% Mg
20%
50%
80%
Na
pH
7.5
8.5

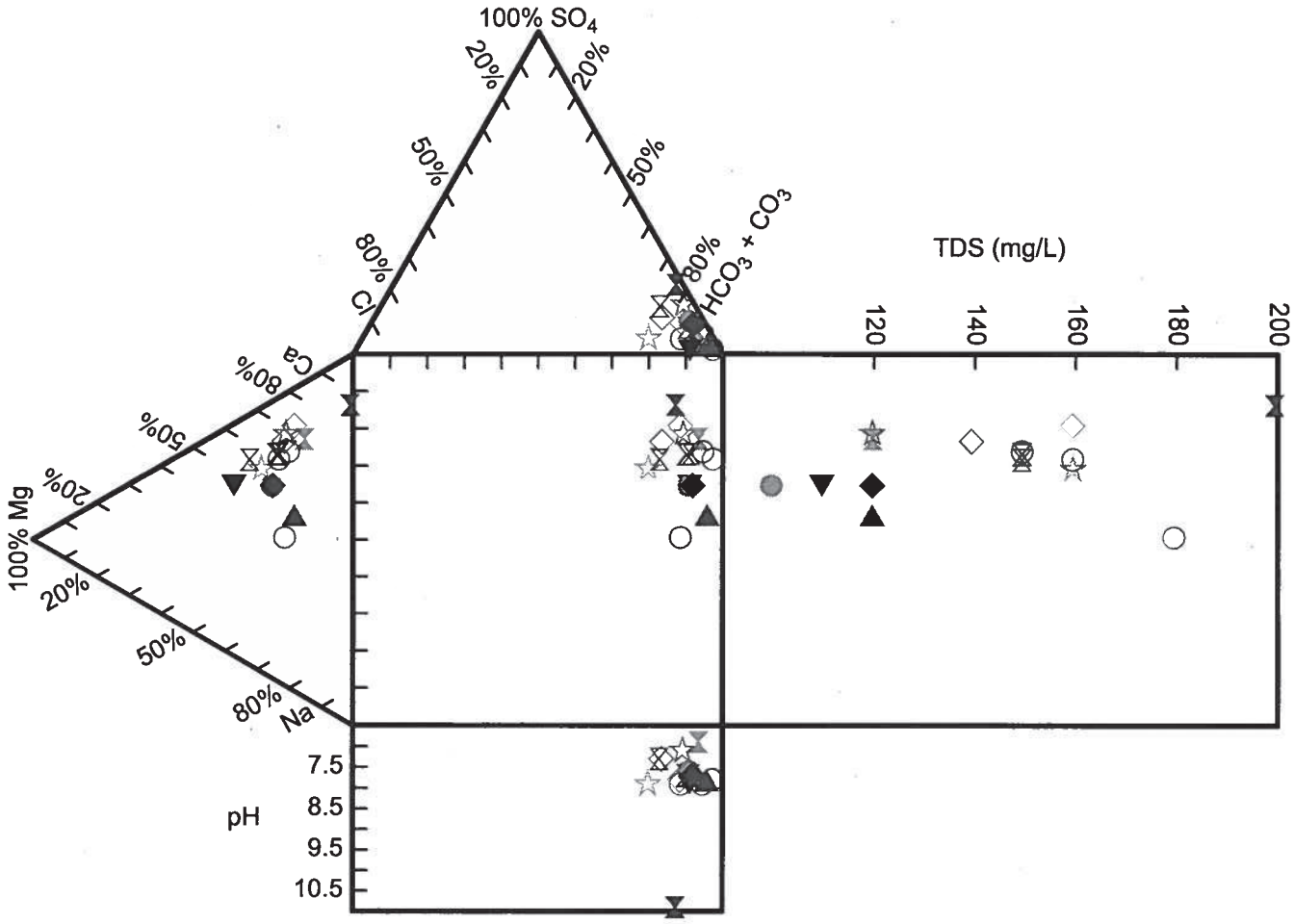
Yml Igenous


100% SO_4
20%
20%
50%
50%
80%
80%
Cl
$HCO_3 + CO_3$
TDS (mg/L)
100
200
300
400
500
600
700
800
Ca
80%
50%
20%
100% Mg
20%
50%
80%
Na
pH
7
9
11

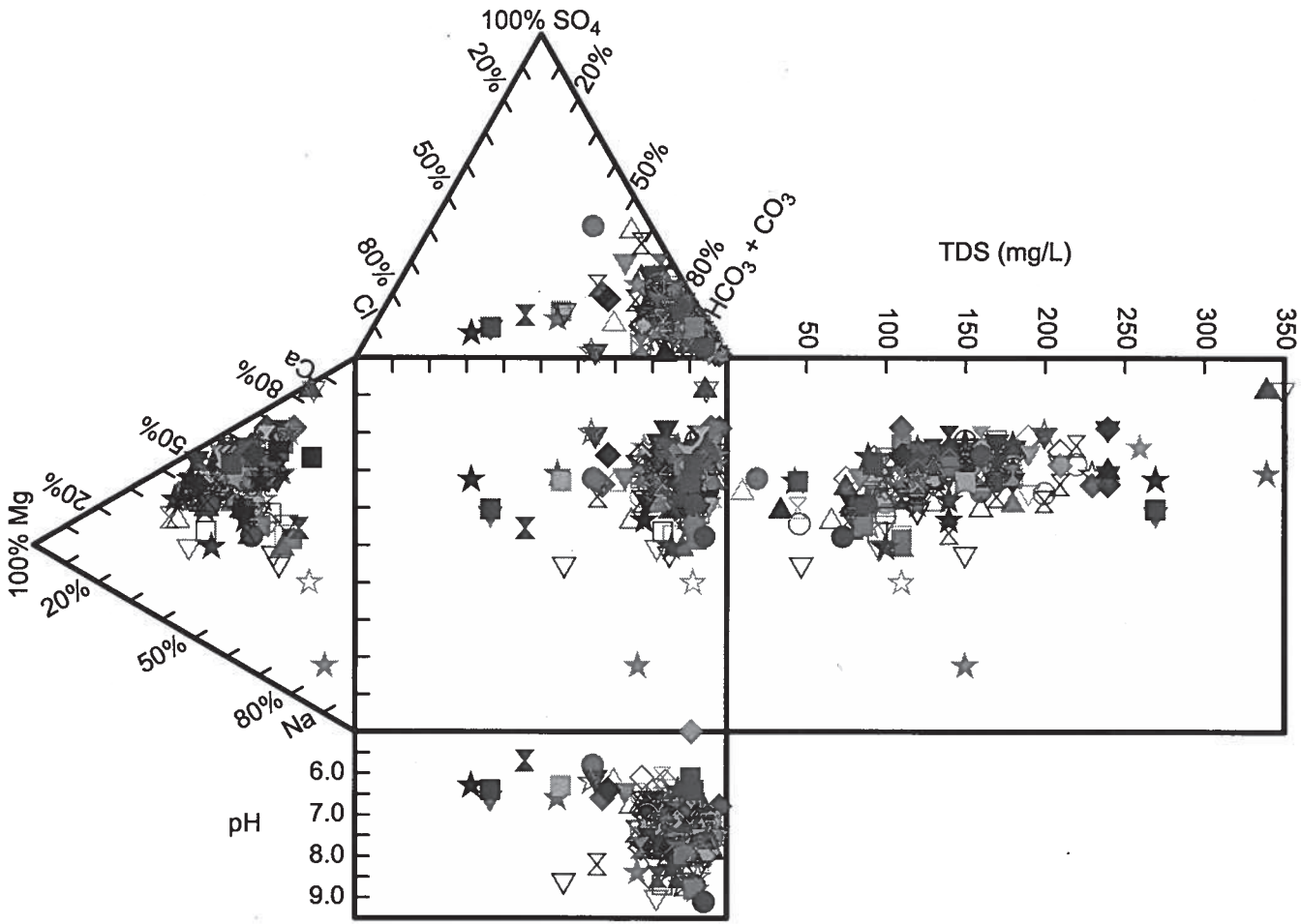
Yp Sedimentary



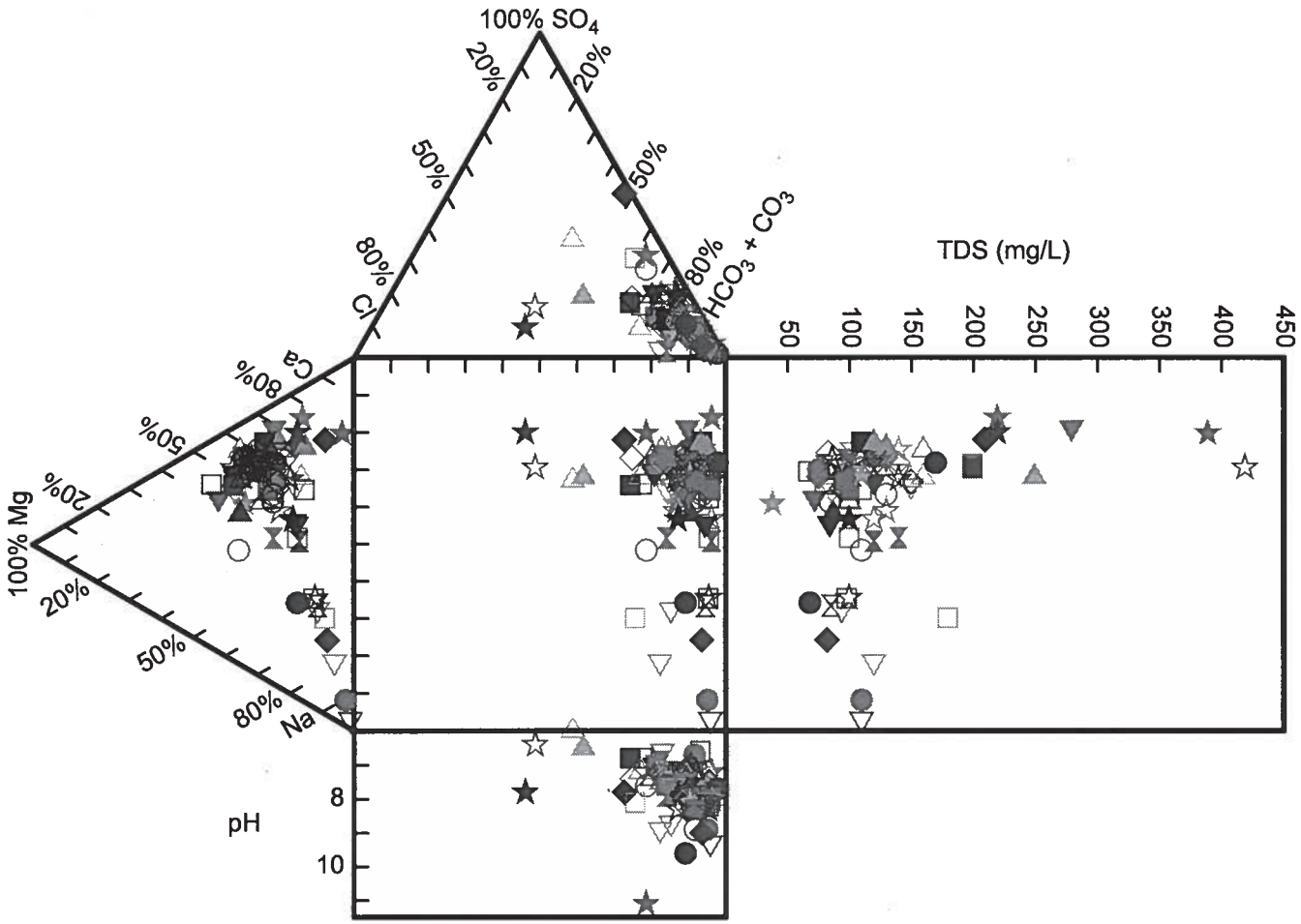
Ypg Igneous


100% SO4
20%
20%
50%
50%
80%
80%
Cl
HCO3 + CO3
TDS (mg/L)
120
140
160
180
200
Ca
80%
50%
20%
100% Mg
20%
50%
80%
Na
pH
7.5
8.5
9.5
10.5

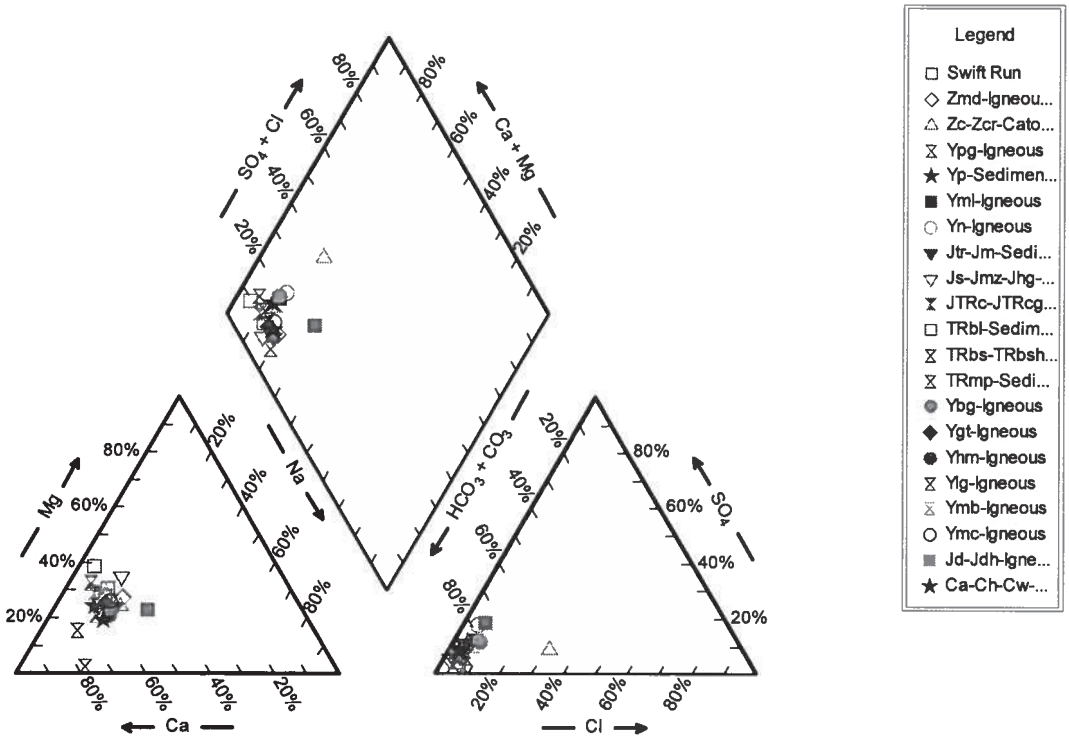
Zc-Zr Igneous Extrusives



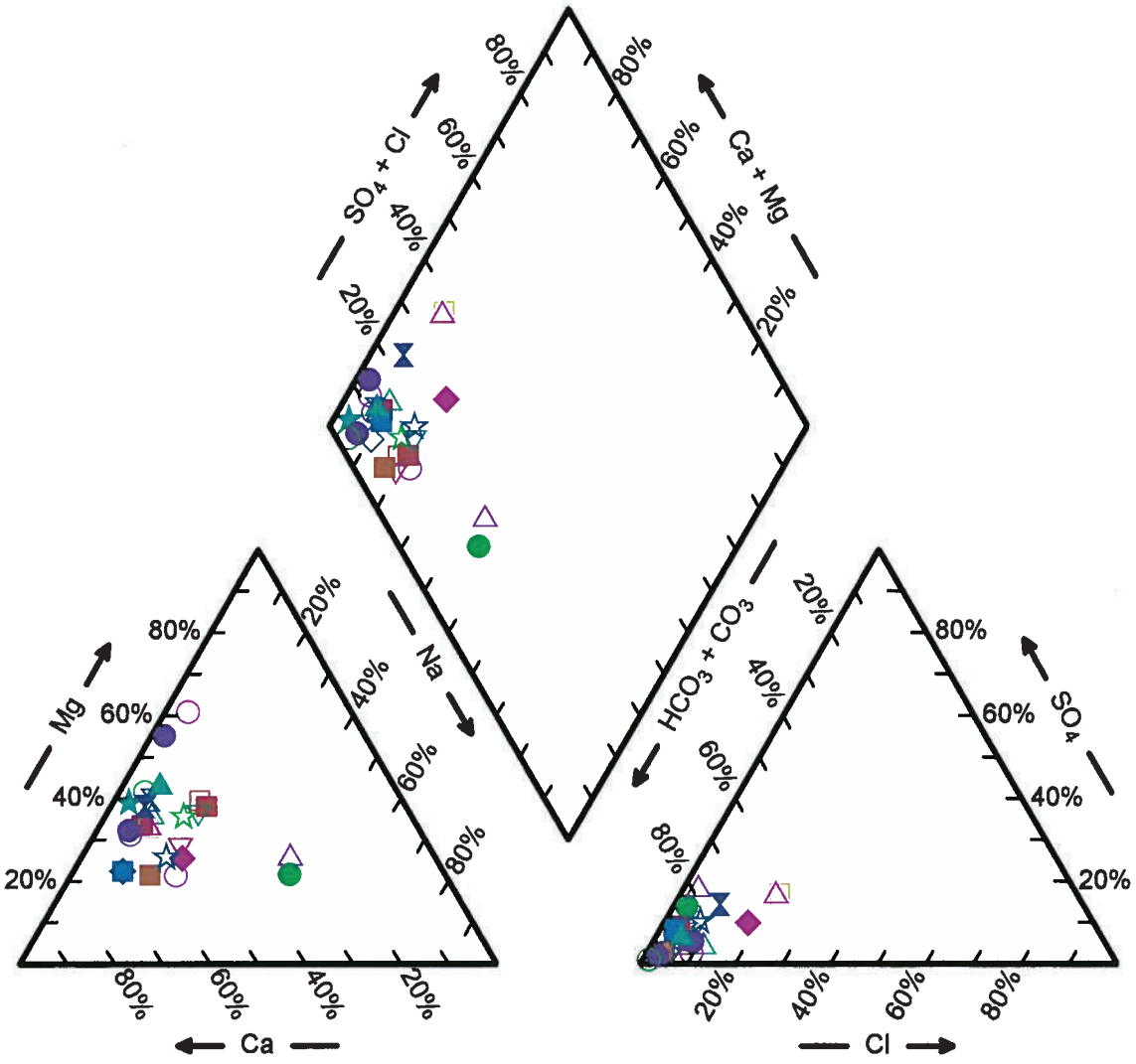
Zmd Igneous Intrusives



Piper Diagram



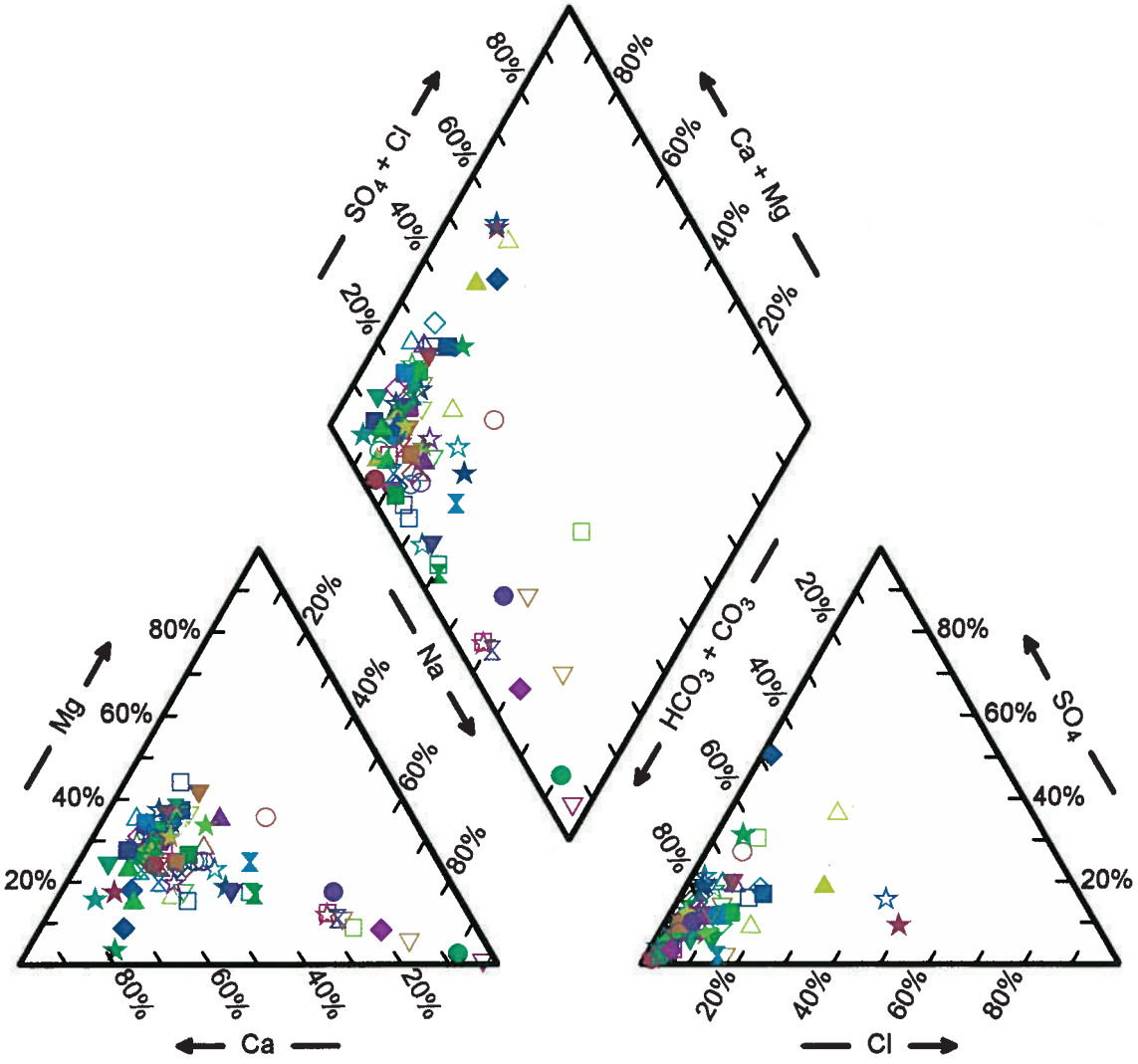
Zss Swift Run



Legend

- WWIN-200...
- WWIN-200...
- WWIN-200...
- WWIN-200...
- WWIN-200...
- WWIN-200...
- WWIN-200...
- WWIN-200...
- WWIN-200...
- WWIN-200...
- WWIN-200...
- WWTS-200...
- WWIN-200...
- WWIN-200...
- WWIN-200...
- WWIN-200...
- WWIN-200...
- WWTS-200...
- WWTS-200...
- WWIN-200...
- WWIN-200...
- WWTS-200...
- WWIN-200...
- WWIN-200...
- WWIN-200...

Zmd Igneous

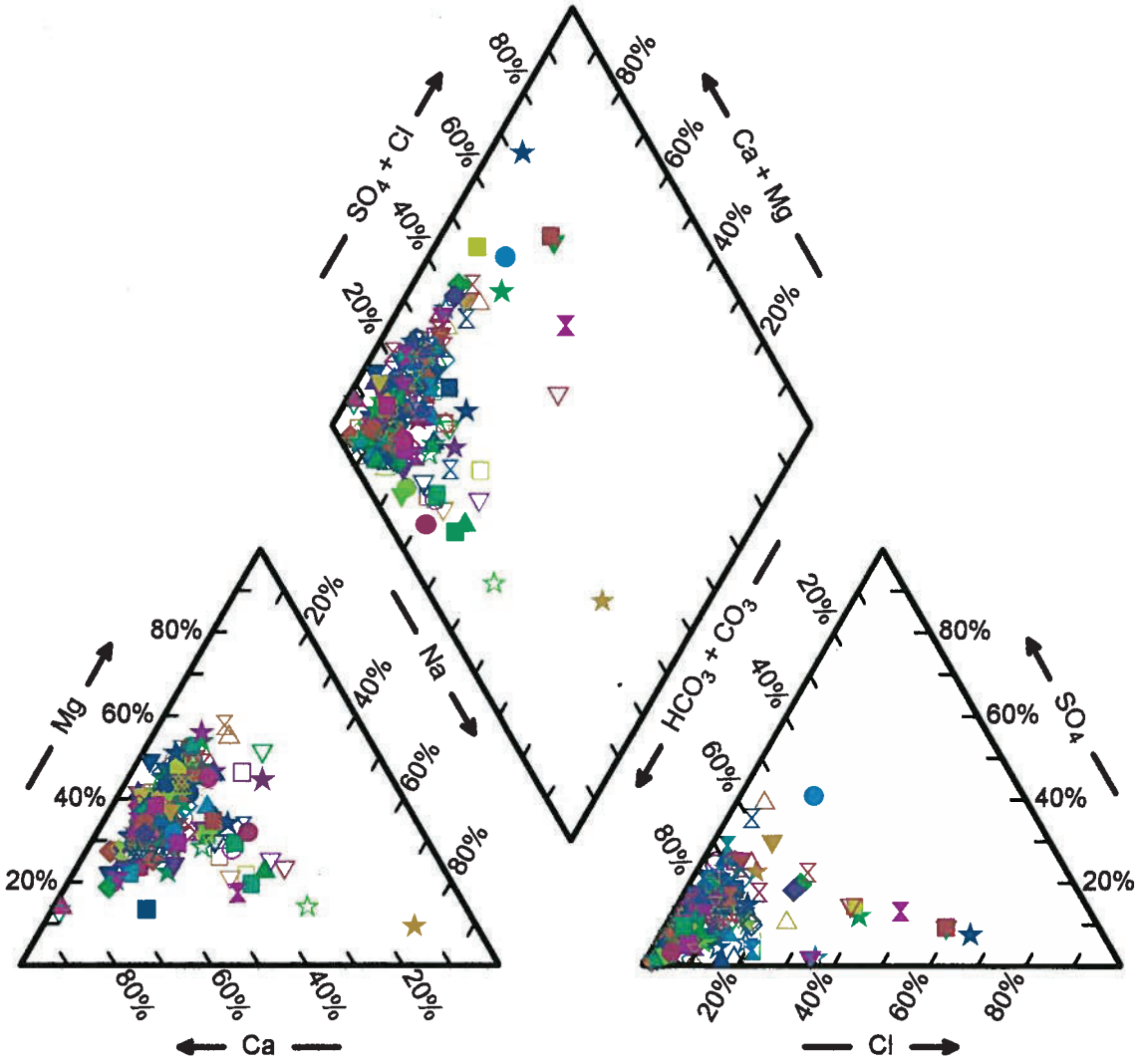


Legend

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56 More...

Zr Zc Catoctin

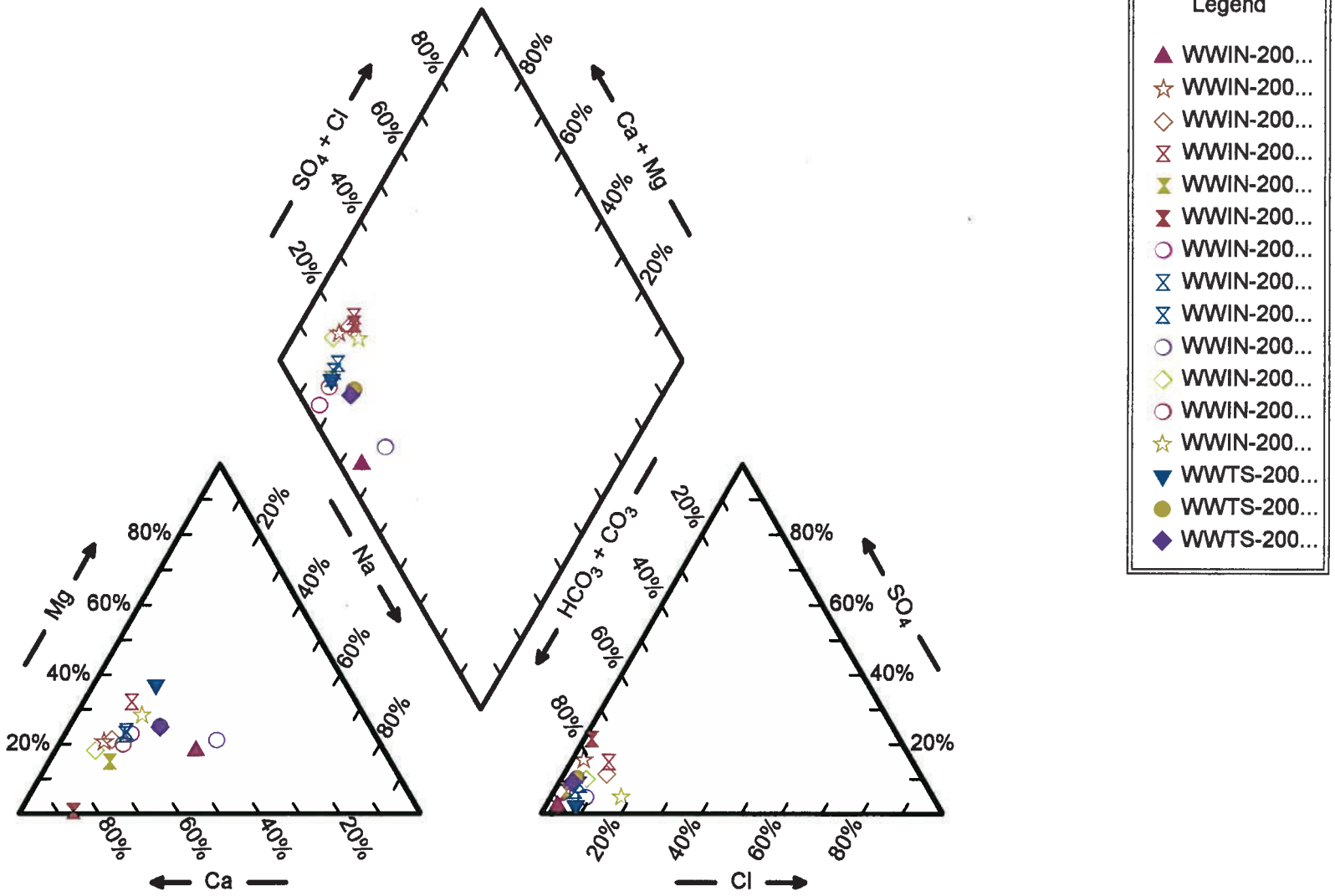


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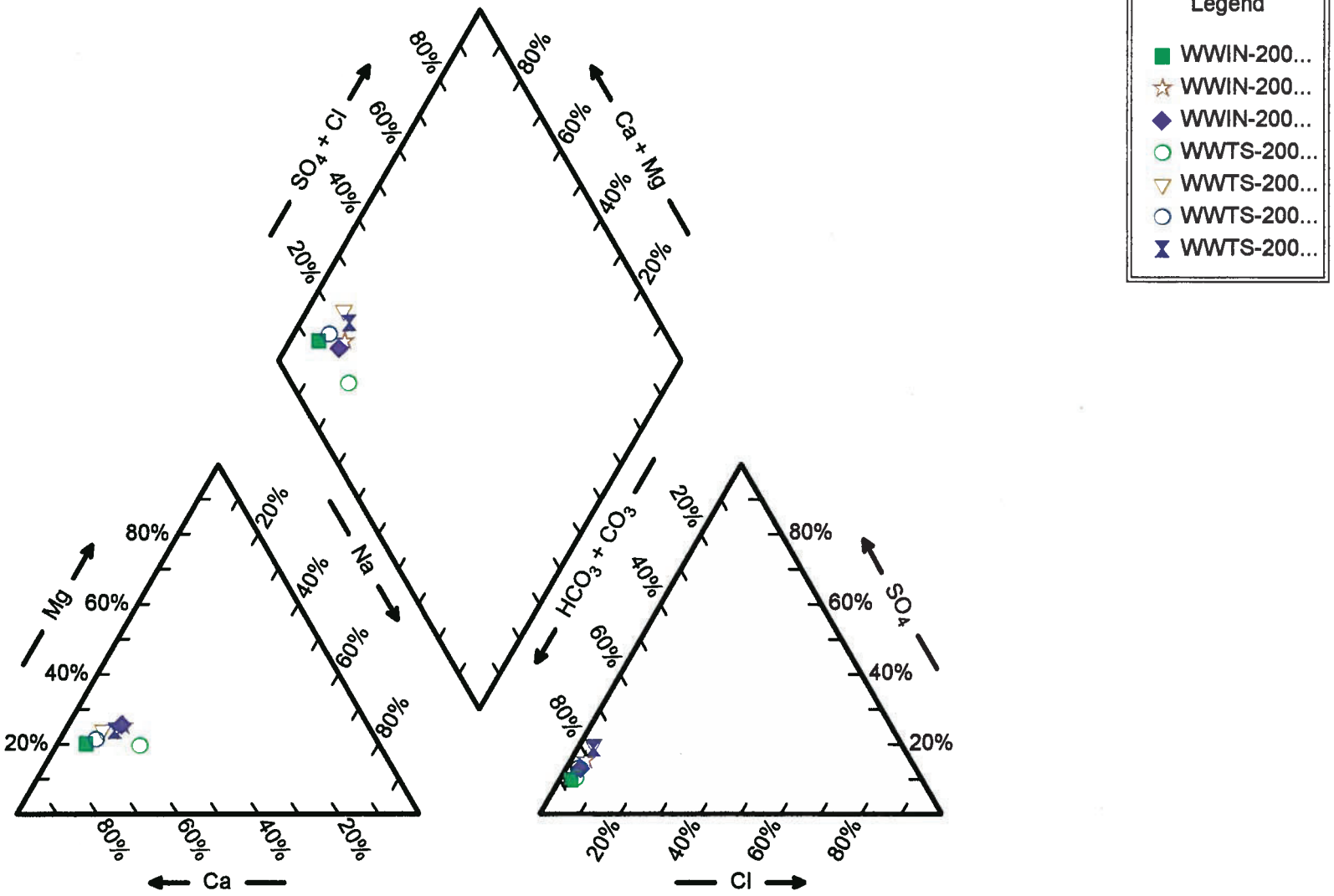
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179 More...

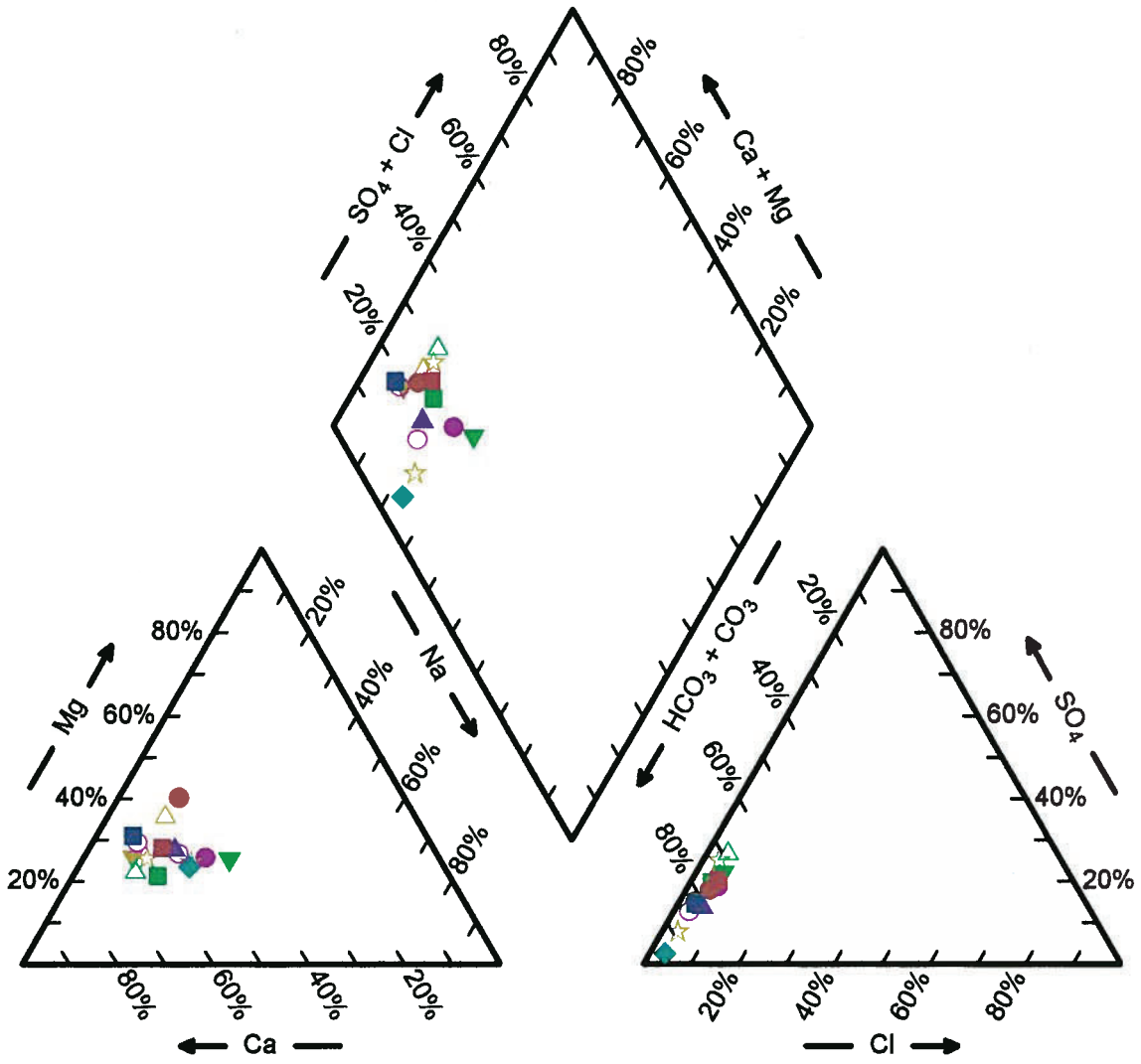
Ypg Igneous


Legend
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WWIN-200...
WWTS-200...
WWTS-200...
WWTS-200...
SO4 + Cl
Ca + Mg
Na
HCO3 + CO3
Mg
Ca
Cl
SO4
20%
40%
60%
80%

Yp Sedimentary



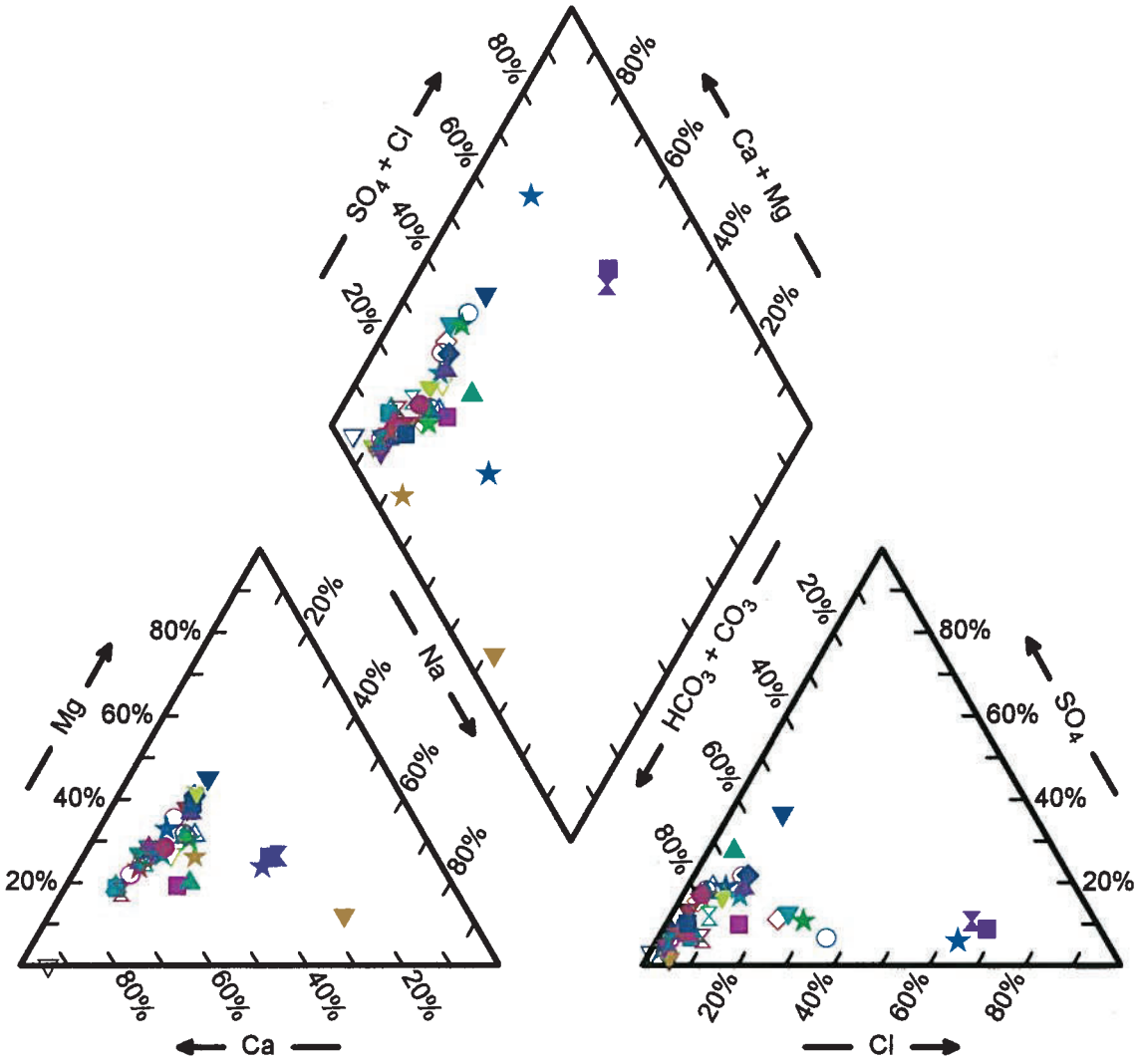
Yn Igneous



Legend

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Yml Igneous

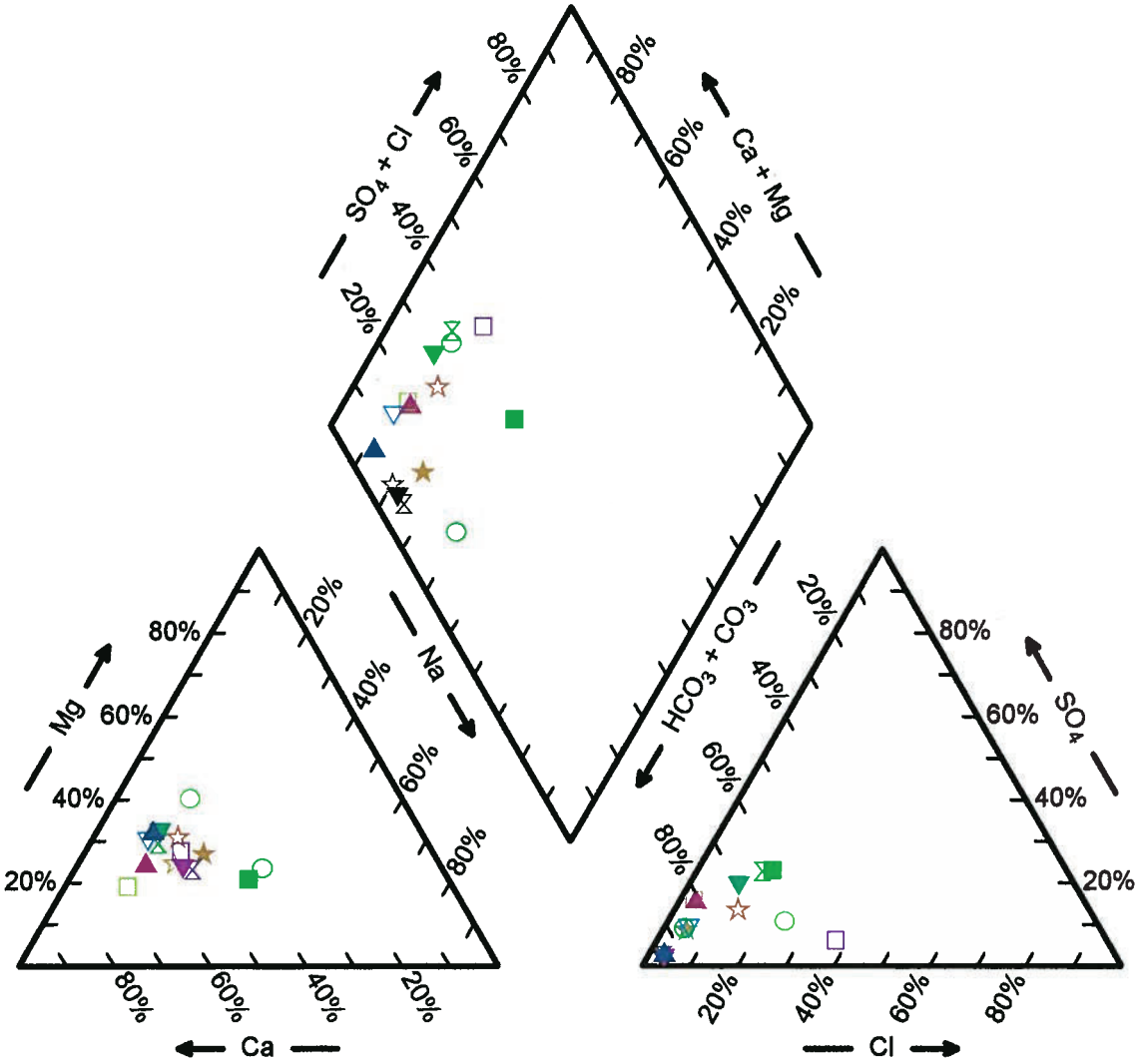


Legend

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14 More...

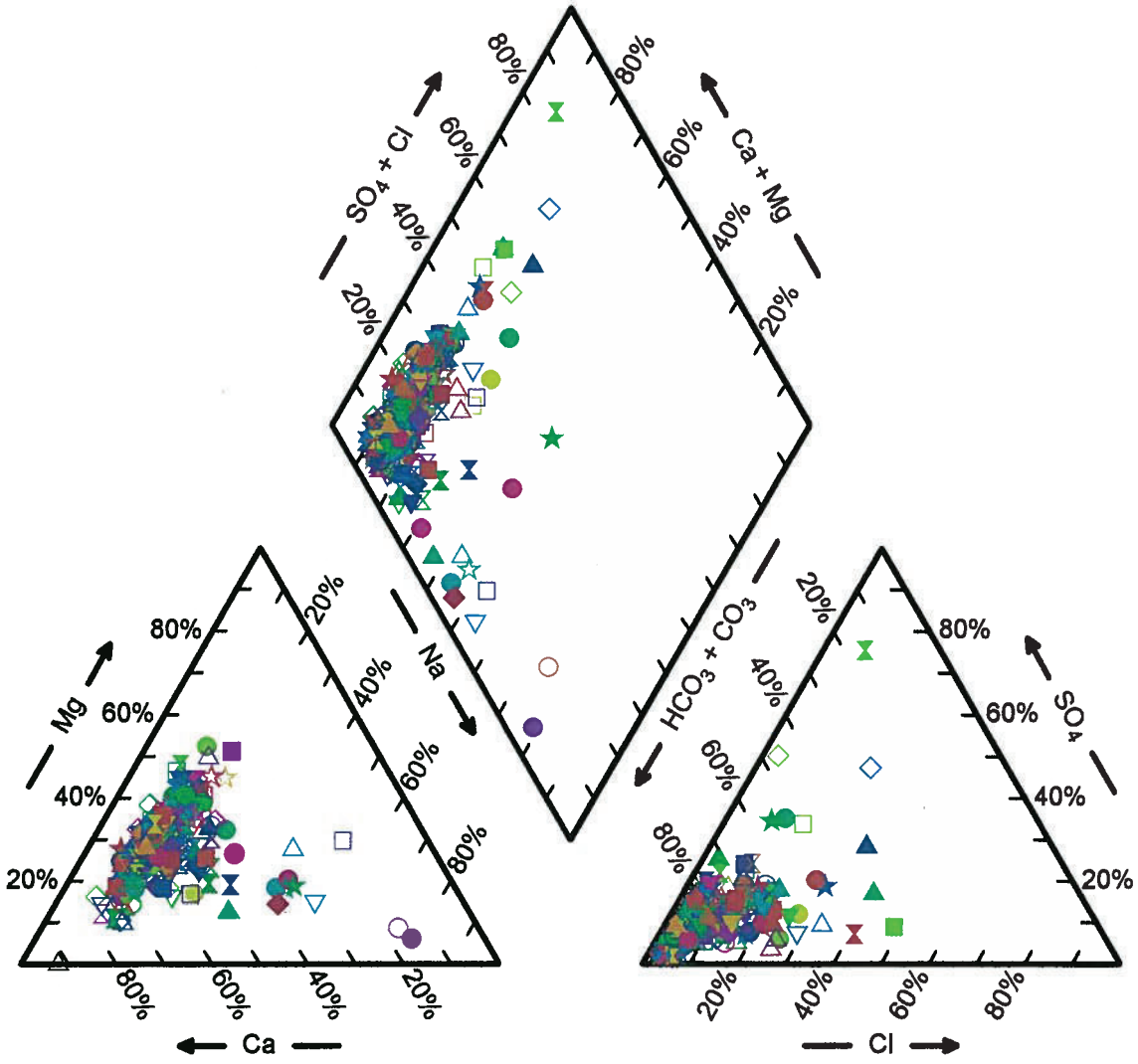
Ymc Igneous



Legend

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Ymb Igneous

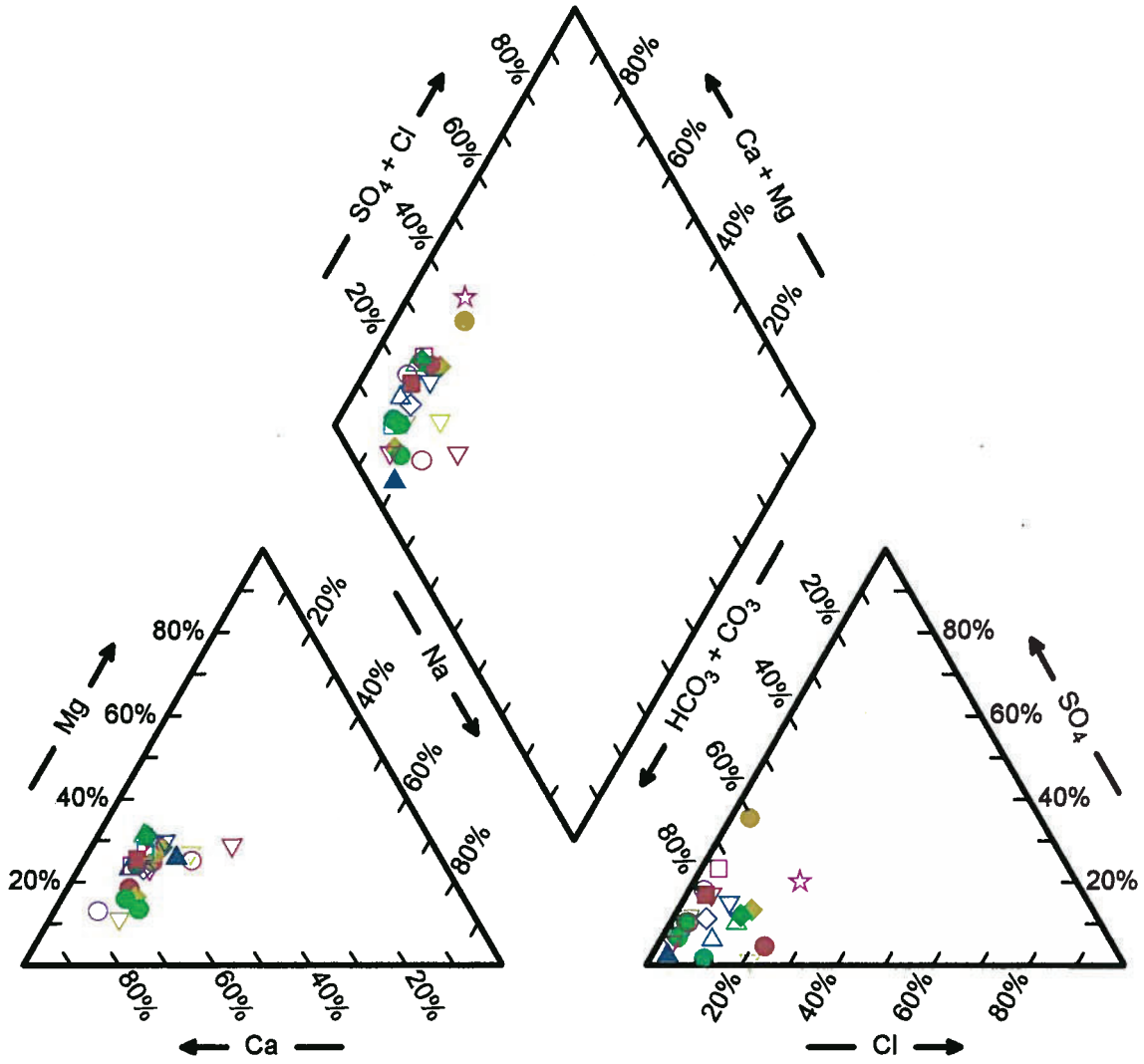


Legend

- WWIN-200...
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- WWTS-200...
- WWIN-200...

228 More...

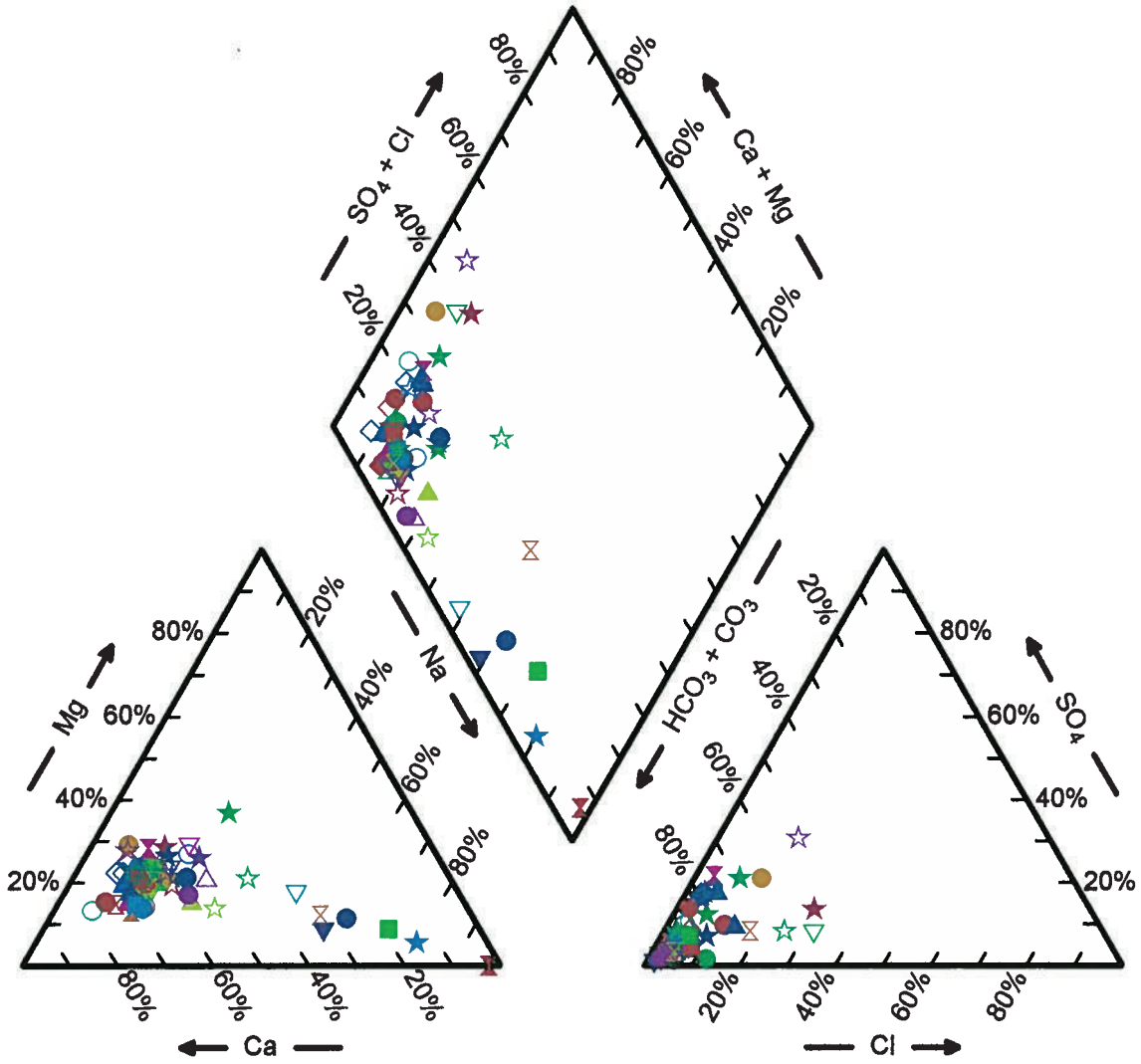
Ylg Igneous



Legend

- WWCO-200...
- WWIN-200...
- WWIN-200...
- WWIN-200...
- WWIN-200...
- WWIN-200...
- WWIN-200...
- WWIR-200...
- WWTS-200...
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Yhm Igneous

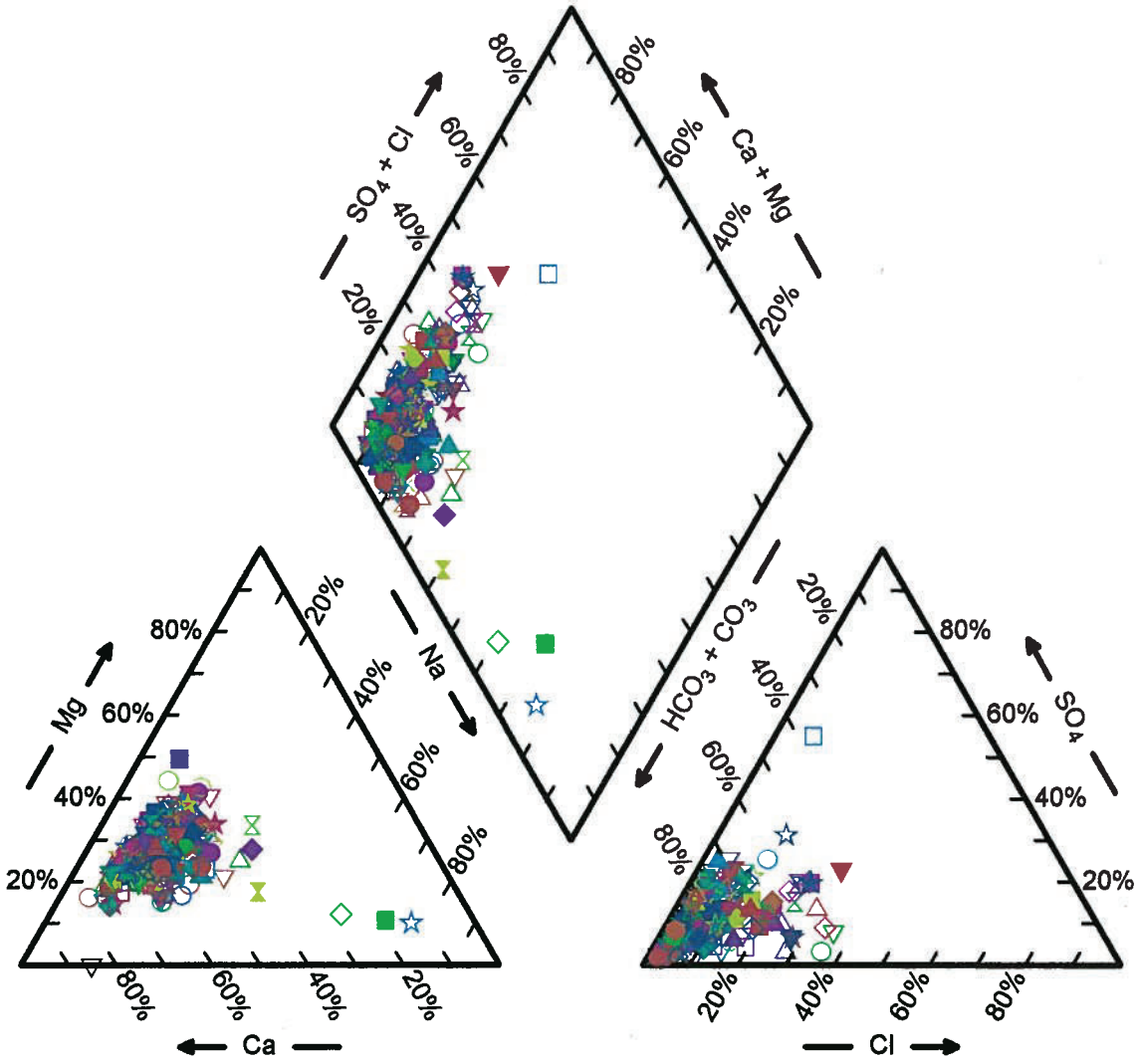


Legend

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- WWTS-200...

34 More...

Ygt Igneous

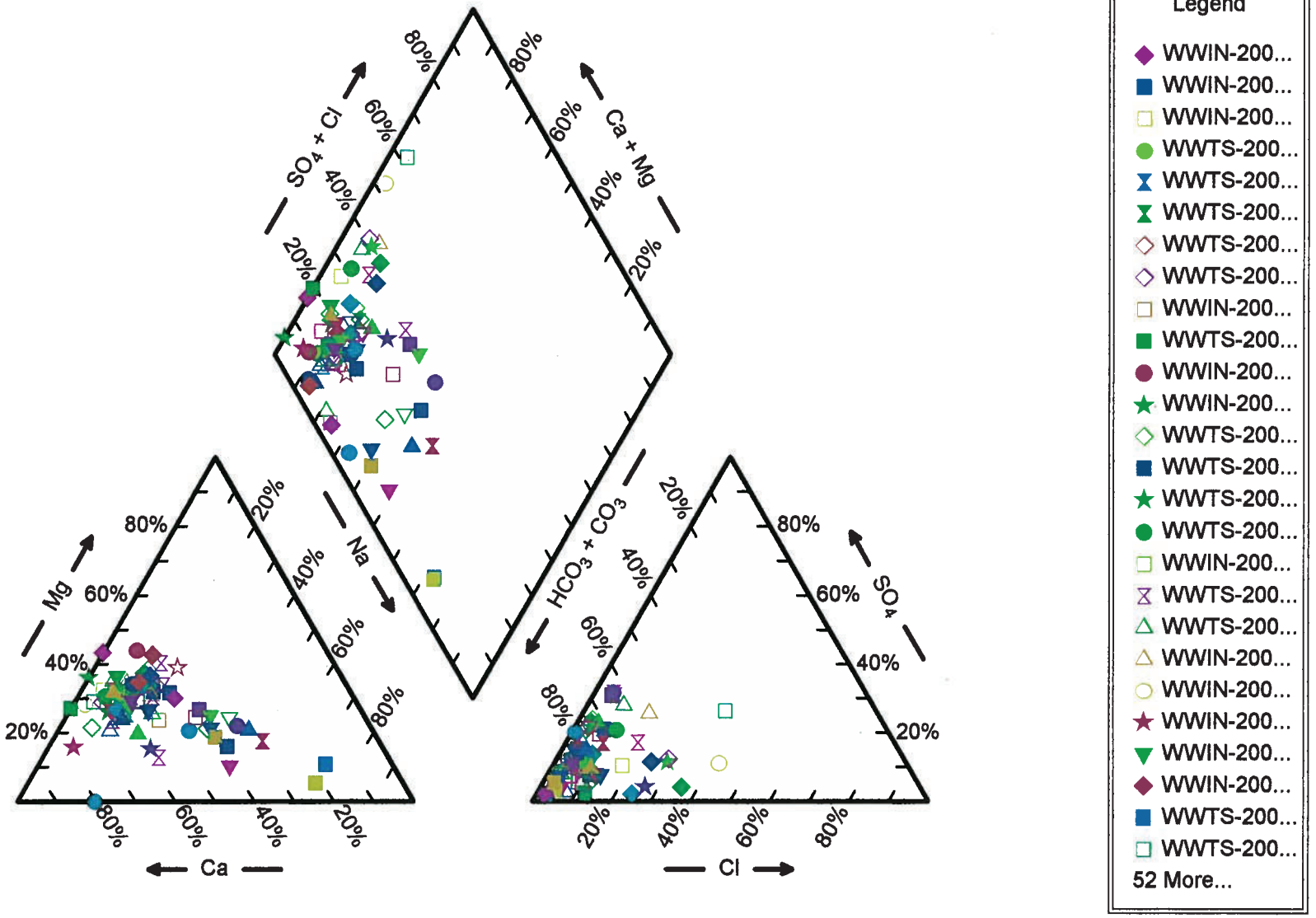


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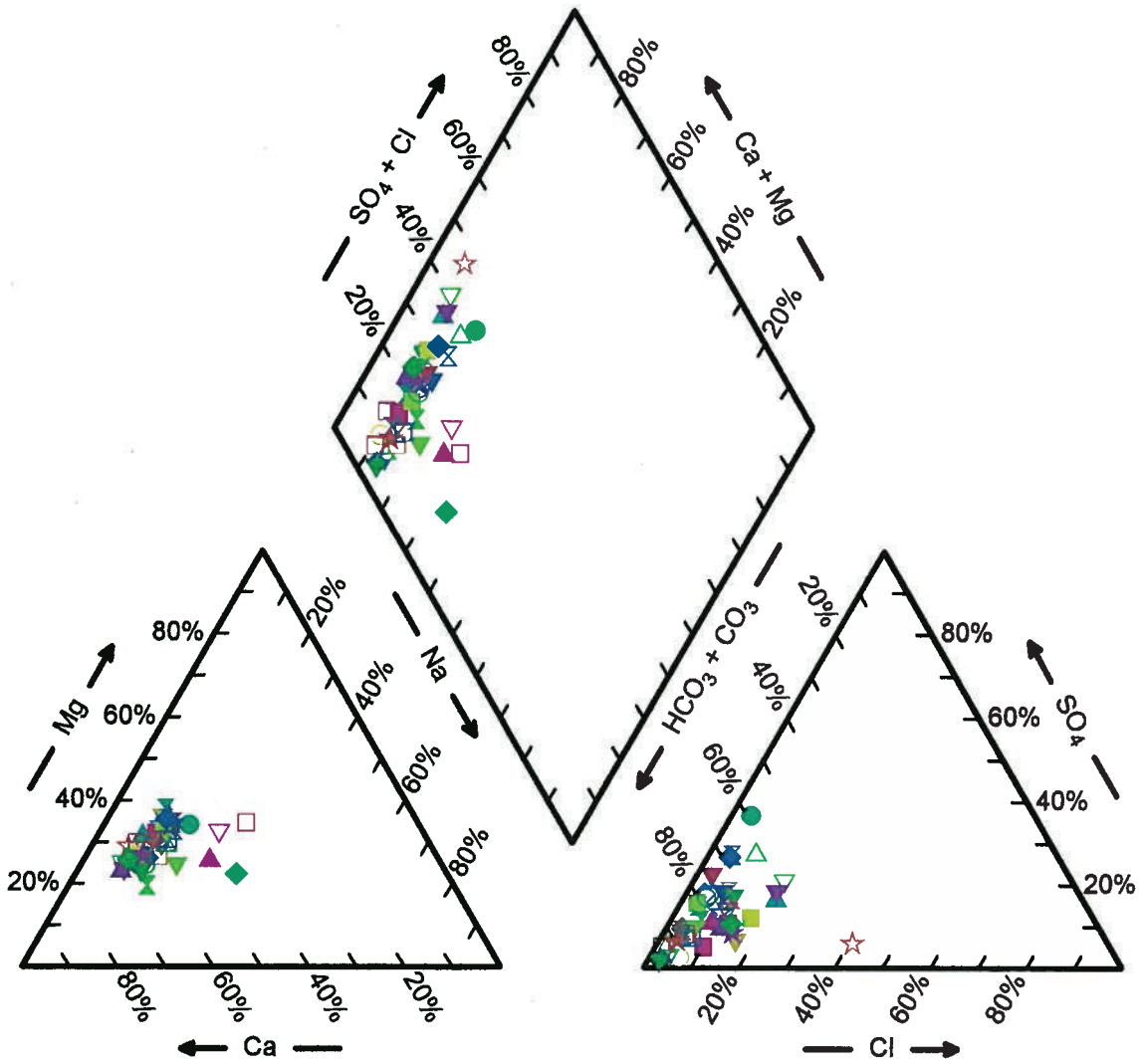
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229 More...

Yc Igneous


Legend
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WWIN-200...
WWIN-200...
WWIN-200...
WWTS-200...
WWTS-200...
52 More...
Ca + Mg
SO4 + Cl
Na
HCO3 + CO3
Mg
Ca
SO4
Cl
20%
40%
60%
80%

Ybg Igneous

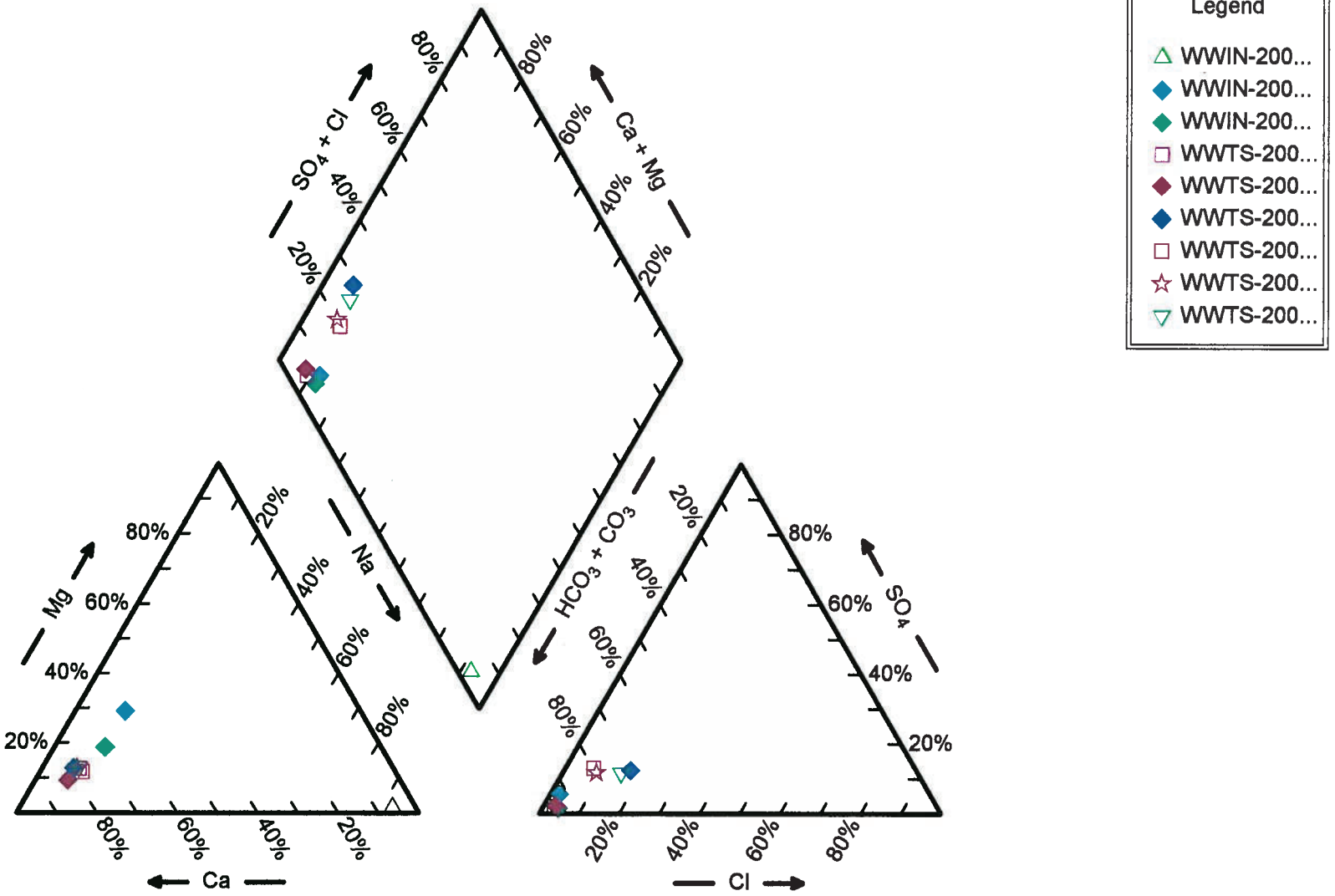


Legend

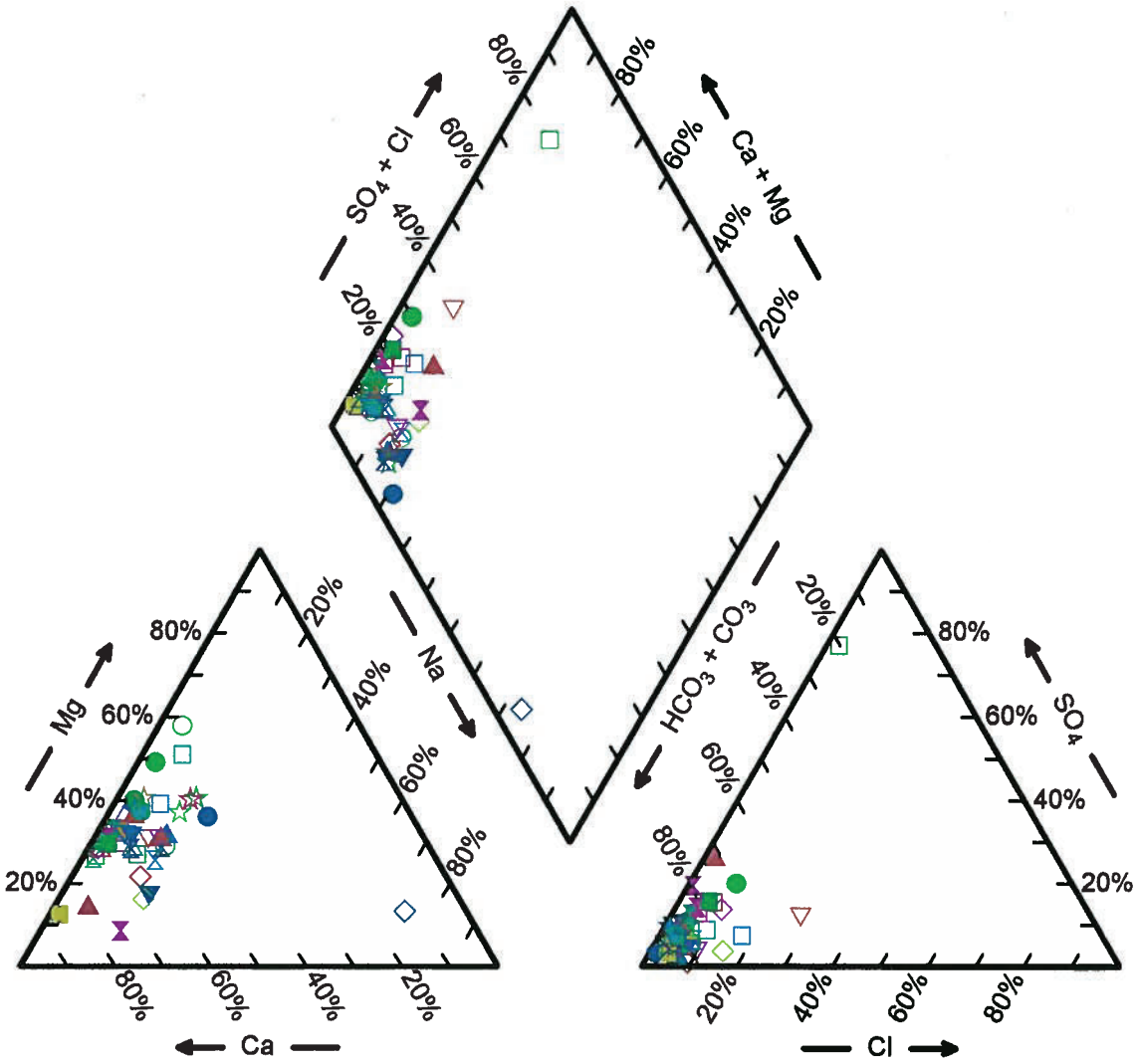
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- WWTS-200...

17 More...

TRmp Manassas



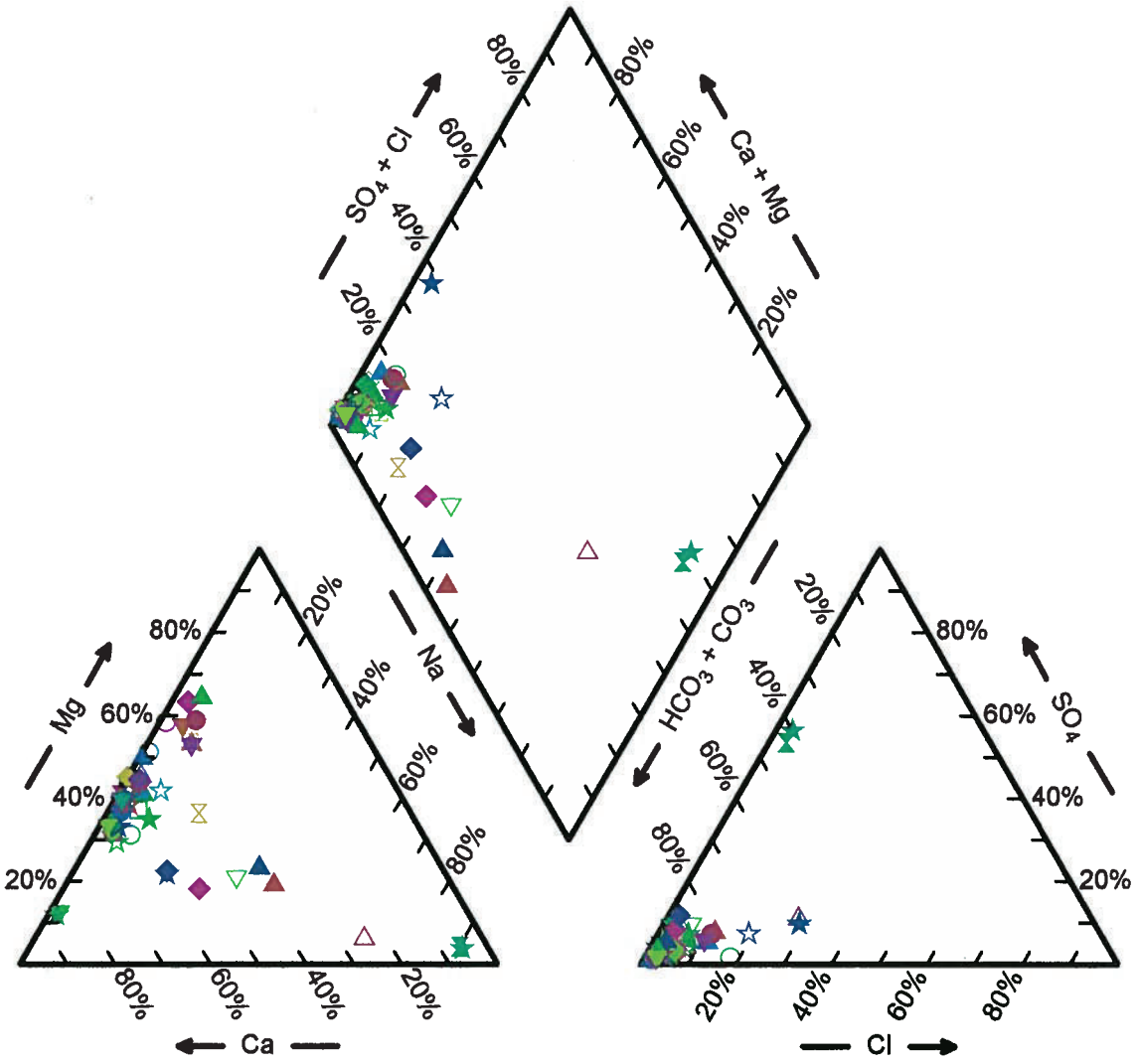
TRbs TRbsh Balls Bluff Siltstone



Legend

- WWIN-200...
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- 20 More...

TRbl Leesburg

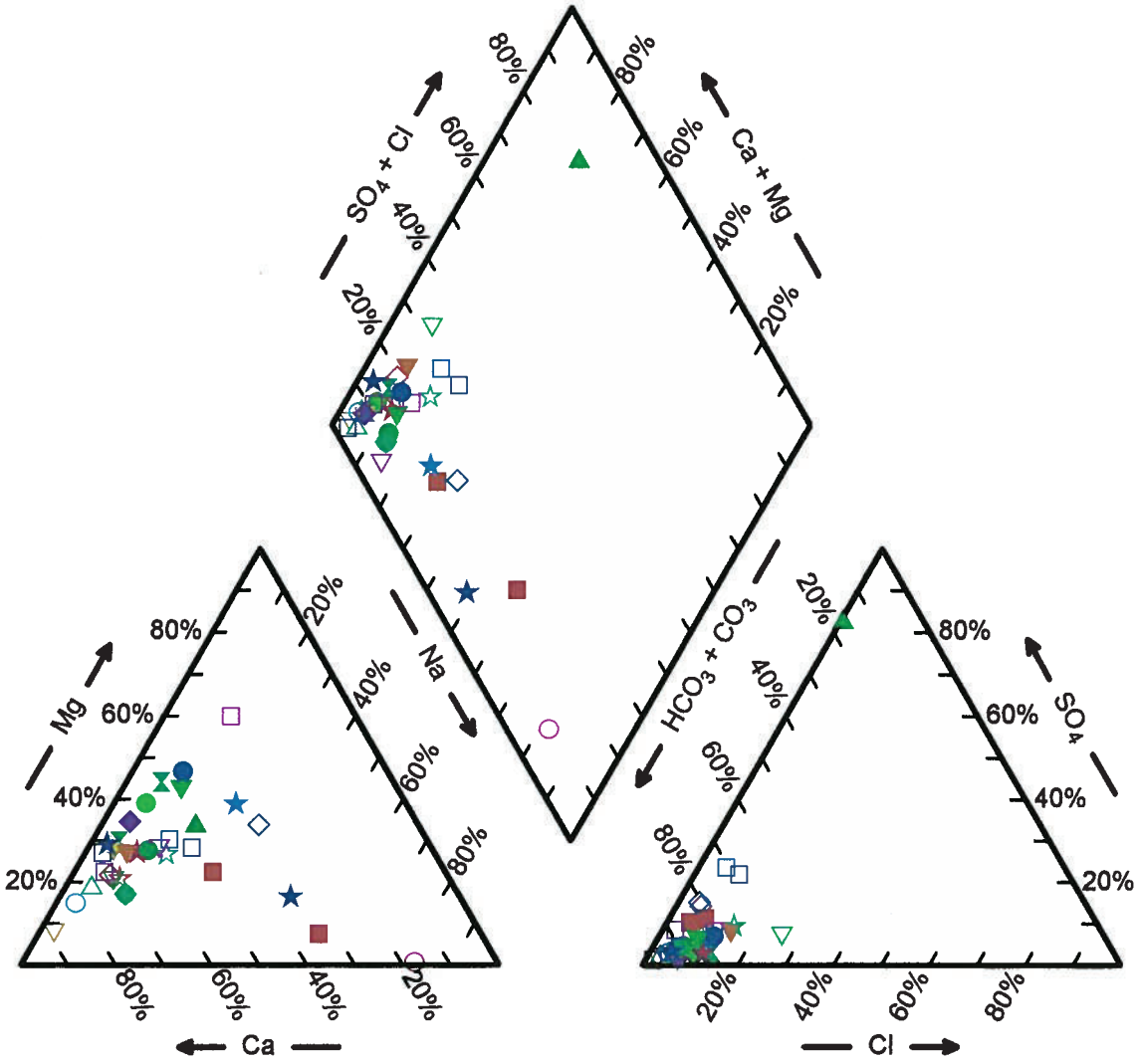


Legend

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25 More...

JTRtm JTRc JTRcg Catharpin

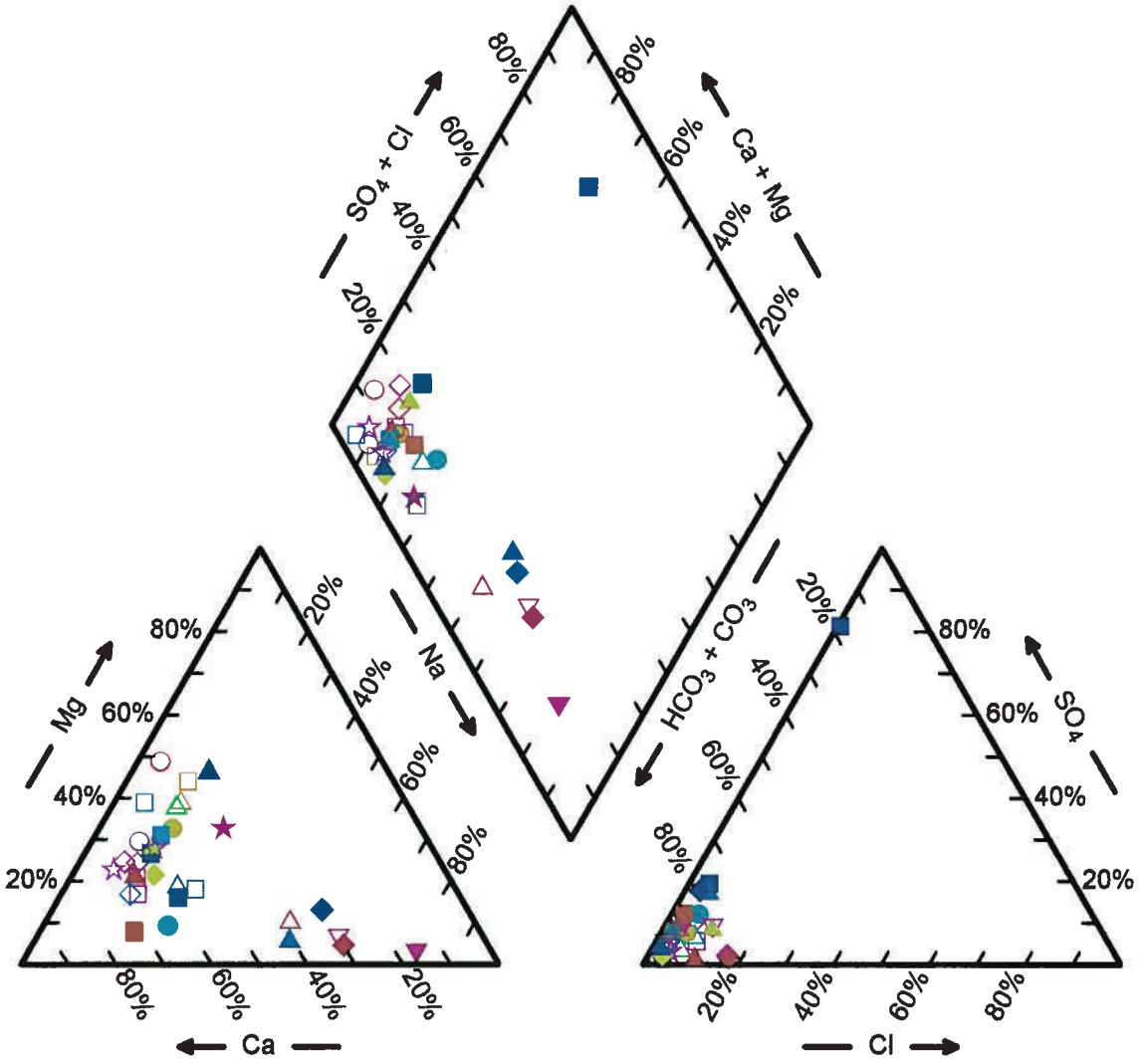


Legend

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9 More...

Jtr Jm Sediments

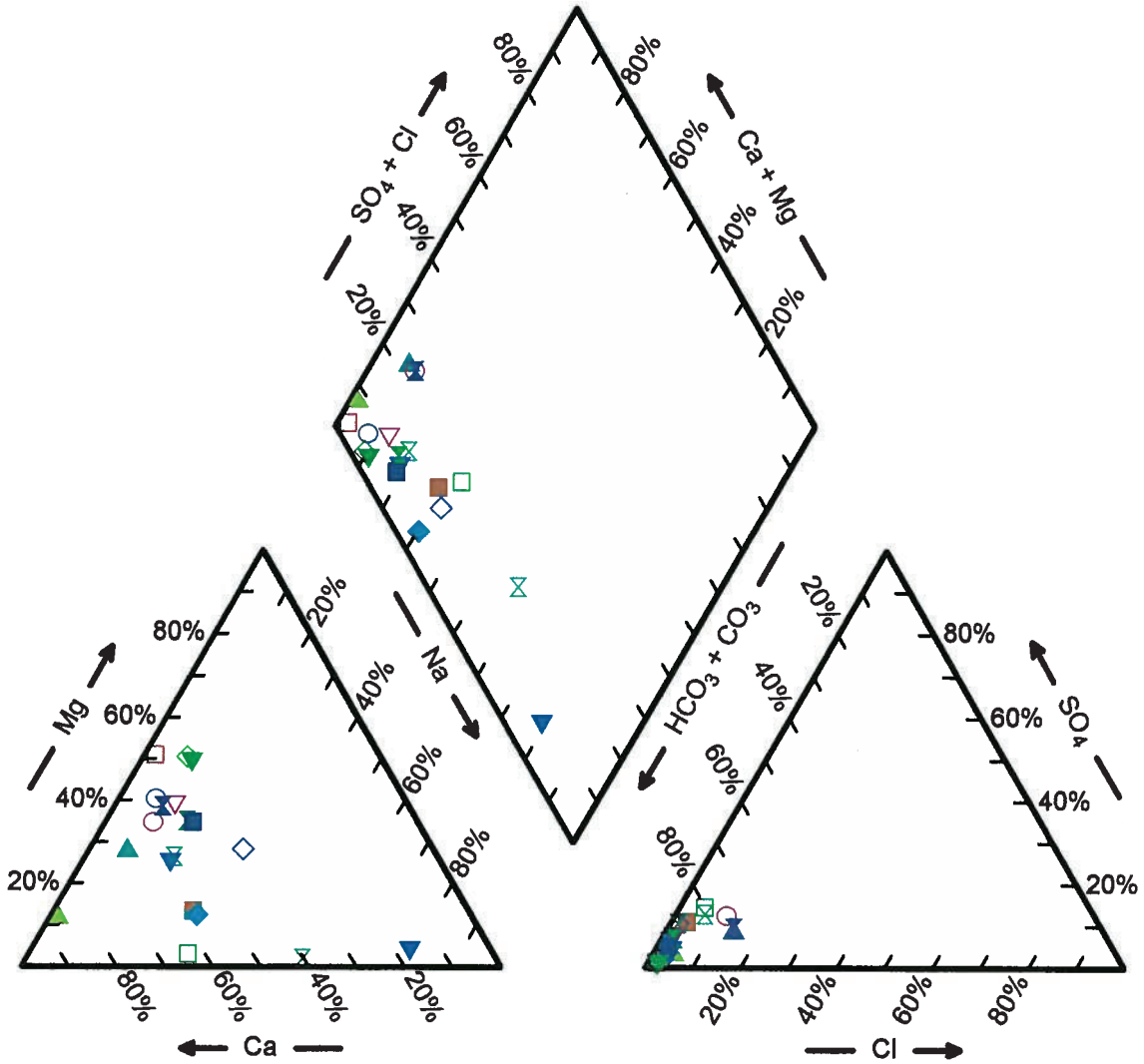


Legend

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6 More...

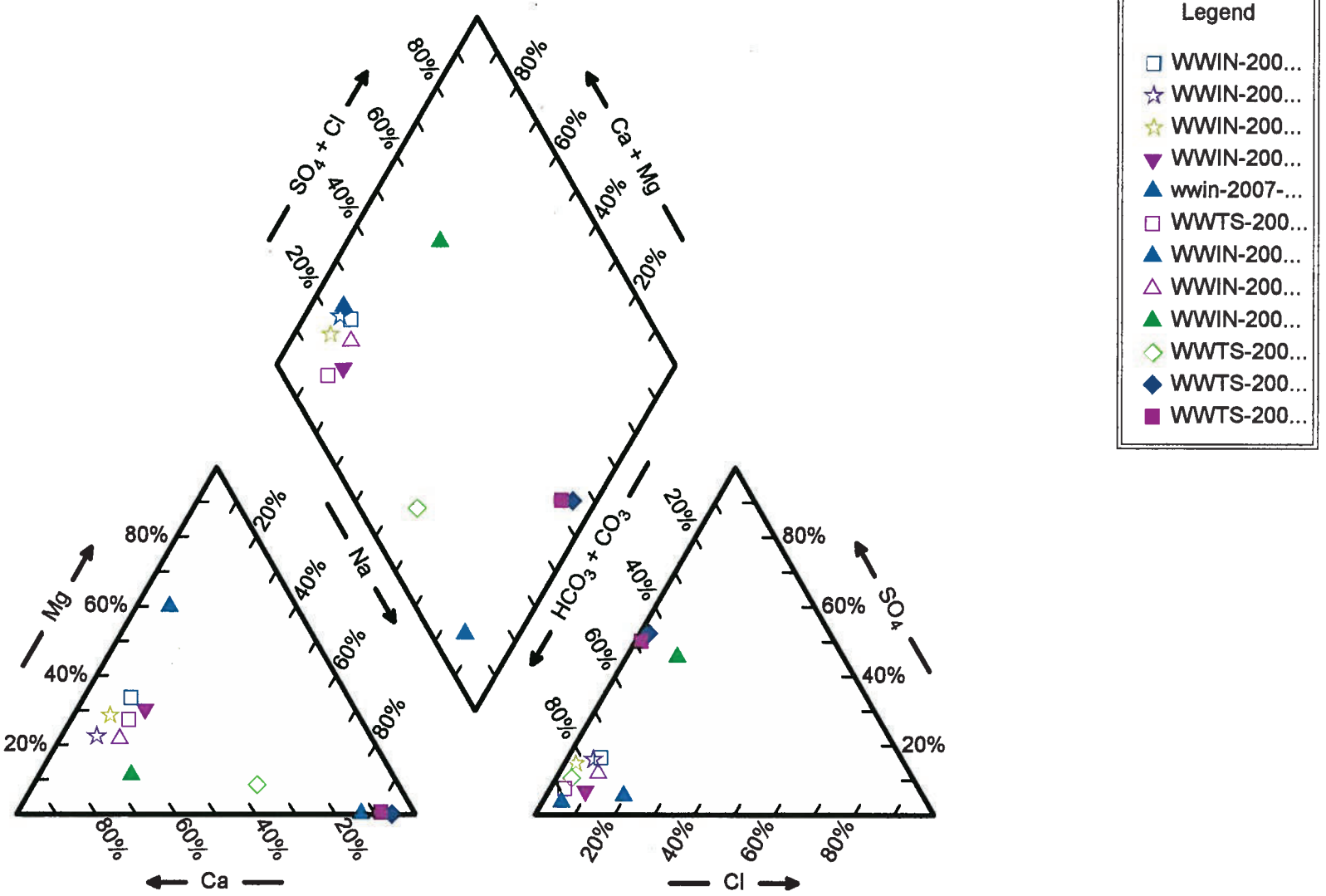
Jss Jmz Jhg Basalts



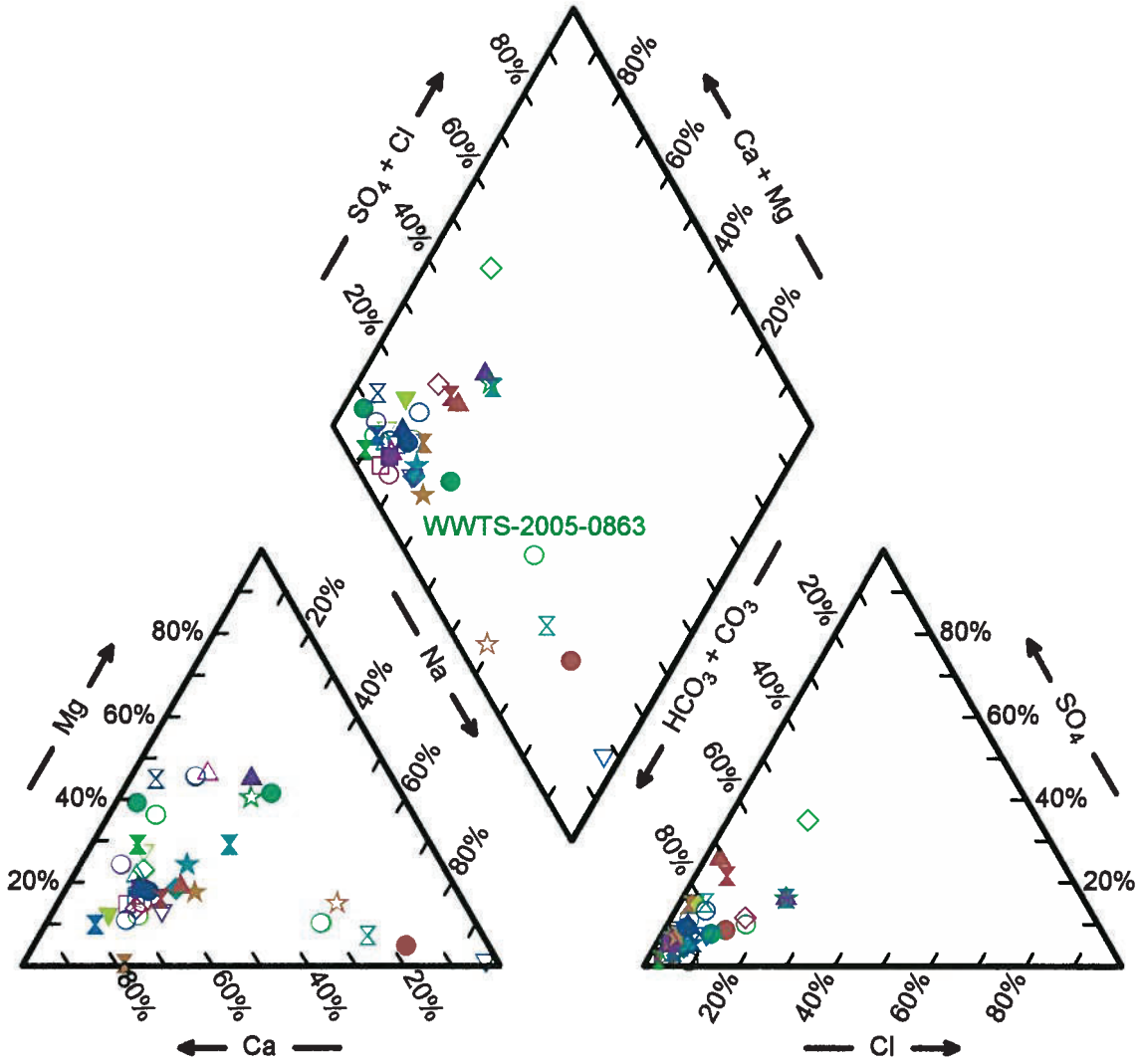
Legend

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- WWTS-200...

Jd Jdh Jurassic diabase



Cw Ch Metasediments



Legend

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11 More...

Task B.3.7 On-site waste disposal systems and non-onsite disposal system pollution sources.

B.3.7 On-site Sewage Disposal Systems (using data set 1.1)

On-Site Disposal Summary.

On-site Disposal (example map)

Community Wastewater Disposal (example map)

Data Set 1.1
Loudoun County Groundwater, Well, and Pollution Sources
Well construction and groundwater information in database (MS Access) with locations in GIS maintained by B&D and Health Department. Source of most data from paper files generated during Health Department well permitting process (e.g., GW2 well construction form). Subset of WellPoll database, which includes well data and pollution sources data. Data on ~18,500 wells dating from 1930 to present, with information of varying quality and completeness including: location (VA state plane coordinates), surface elevation (62% complete), well depth (70%), casing depth (65%), static water level (53%) {but of suspect accuracy}, total yield (60%), depth of primary yield zone (60%), and transmissivity (~250 values).

Also includes groundwater quality data. Water quality data for a limited number of parameters are entered in the database for some wells (~2,100) constructed and tested prior to 2002. Water quality data provided digitally to B&D by National Testing Labs started in 2002 and is available for approximately 2,250 wells. These data are considered level A quality and typically consist of 100 physical/chemical water quality parameters per well for a total of more than 200,000 individual analyses. NTL data linked to the groundwater database by Health Department Permit No.

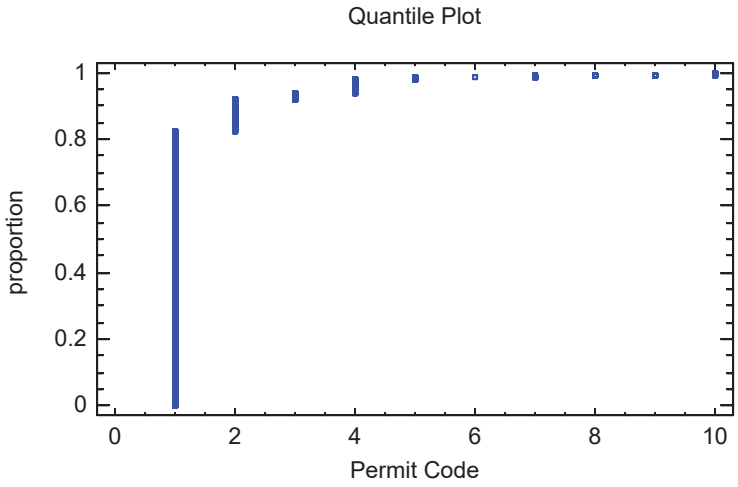
Also includes data on potential pollution sources – primarily on-site sewage disposal systems (e.g., drainfields) but also other sites such as cemeteries, landfills, chemical storage sites, etc. Currently approximately 15,000 records with site ID numbers and corresponding points in GIS. Data in some of the old records may be obsolete. Currently, data are obtained primarily from the Health Department sewage disposal system permitting process.

Task B.3.7 On-site waste disposal systems and non-onsite disposal system pollution sources.

Analysis of On-site disposal systems from Loudoun County Health Dept. data. This is a detailed analysis of the distribution both spatially and temporally of ten types of permitted on-site disposal systems. Includes a table with descriptions of the ten permit types.

Also includes a table showing the distribution of non-onsite disposal pollution sources as identified by VDH. These sources are shown by major watershed and by rock class.

Analysis of On-Site Disposal systems in Loudoun County. Data from County Dept. of Health. See table at bottom of document for descriptions of Permit Codes.

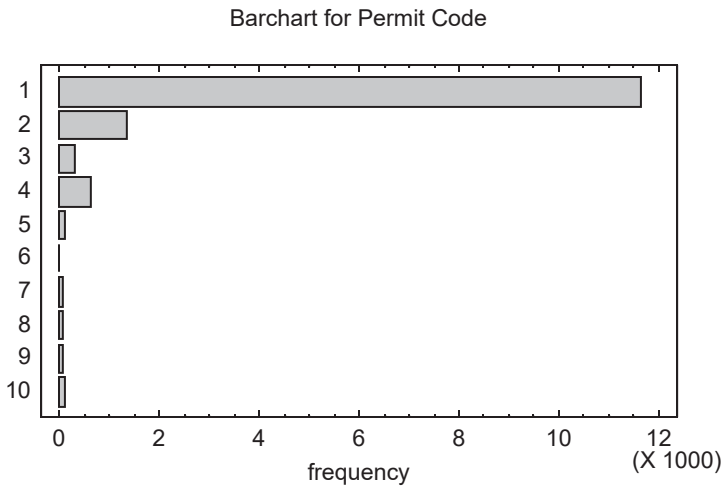


Tabulation - Permit Code (Year)

Data variable: Permit Code
Selection variable: Year

Number of observations: 14016
Number of unique values: 10

The StatAdvisor
This procedure counts the number of times each of the 10 unique values of Permit Code occurs. It then displays tables and graphs of the tabulation.



Frequency Table for Permit Code

			Relative	*Cumulative*	*Cum. Rel.*
Class	*Value*	*Frequency*	*Frequency*	*Frequency*	*Frequency*
1	1	11581	0.8263	11581	0.8263
2	2	1305	0.0931	12886	0.9194
3	3	279	0.0199	13165	0.9393
4	4	581	0.0415	13746	0.9807
5	5	76	0.0054	13822	0.9862
6	6	2	0.0001	13824	0.9863
7	7	43	0.0031	13867	0.9894
8	8	35	0.0025	13902	0.9919
9	9	29	0.0021	13931	0.9939
10	10	85	0.0061	14016	1.0000

The StatAdvisor

This table shows the number of times each value of Permit Code occurred, as well as percentages and cumulative statistics. For example, in 11581 rows of the data file Permit Code equaled 1. This represents 82.627% of the 14016 values in the file. The rightmost two columns give cumulative counts and percentages from the top of the table down.

Crosstabulation - Year by Permit Code

Row variable: Year
Column variable: Permit Code

Number of observations: 14015
Number of rows: 66
Number of columns: 10

The StatAdvisor
This procedure constructs a two-way table showing the frequency of occurrence of unique pairs of values for Year and Permit Code. It constructs a 66 by 10 contingency table for the data and displays the results in various ways. Of particular interest are the tests for independence between rows and columns, which you can select from the list of Tabular Options.

Frequency Table for Year by Permit Code

	1	2	3	4	5	6	7	8	9	10	Row Total
1939	2	0	0	0	0	0	0	0	0	0	2
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
1940	4	0	0	0	0	0	0	0	0	0	4
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03%
1942	1	0	0	0	0	0	0	0	0	0	1
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
1943	1	0	0	0	0	0	0	0	0	0	1
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
1946	3	0	0	0	0	0	0	0	0	0	3
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
1947	20	0	0	0	0	0	0	0	0	0	20
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.14%
1948	27	0	0	0	0	0	0	0	0	0	27
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.19%
1949	25	1	0	0	0	0	0	0	0	0	26
	96.15%	3.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.19%
1950	35	0	0	0	0	0	0	0	0	0	35
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.25%
1951	47	0	0	0	0	0	0	0	0	0	47
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.34%
1952	73	0	0	0	0	0	0	0	0	0	73
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.52%

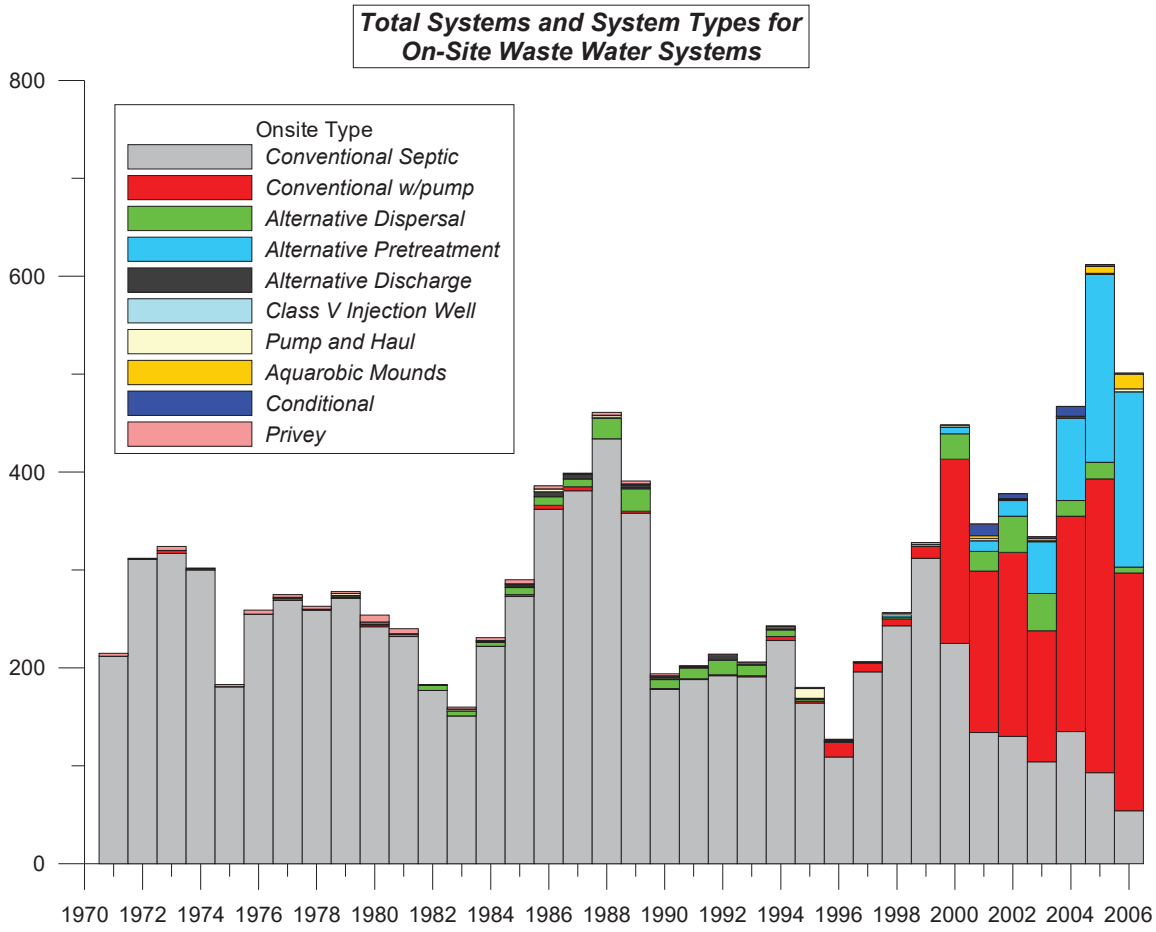
1953	80	0	0	0	0	0	0	0	0	0	80
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.57%
1954	94	0	0	0	0	0	0	0	0	0	94
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.67%
1955	111	0	0	0	0	0	0	0	0	0	111
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.79%
1956	140	1	0	0	0	0	0	0	0	0	141
	99.29%	0.71%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.01%
1957	142	0	0	0	0	0	0	0	0	0	142
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.01%
1958	137	0	0	0	0	0	0	0	0	0	137
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.98%
1959	183	0	0	0	0	0	0	0	0	0	183
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.31%
1960	178	0	0	0	0	0	0	0	0	0	178
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.27%
1961	182	0	0	0	0	0	0	0	0	0	182
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.30%
1962	186	0	0	0	1	0	0	0	0	0	187
	99.47%	0.00%	0.00%	0.00%	0.53%	0.00%	0.00%	0.00%	0.00%	0.00%	1.33%
1963	168	0	0	0	0	0	0	0	0	0	168
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.20%
1964	244	0	0	0	0	0	0	0	0	0	244
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.74%
1965	231	0	0	0	1	0	0	0	0	0	232
	99.57%	0.00%	0.00%	0.00%	0.43%	0.00%	0.00%	0.00%	0.00%	0.00%	1.66%
1966	240	0	0	0	0	0	0	0	0	0	240
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.71%
1967	185	1	0	0	0	0	0	0	0	0	186
	99.46%	0.54%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.33%
1968	187	1	0	0	1	0	0	0	0	0	189
	98.94%	0.53%	0.00%	0.00%	0.53%	0.00%	0.00%	0.00%	0.00%	0.00%	1.35%
1969	207	0	0	0	0	0	0	0	0	0	207
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.48%
1970	214	0	0	0	0	0	0	0	0	0	214
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.53%
1971	215	0	0	0	0	0	0	0	0	0	215
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.53%
1972	309	0	0	1	0	0	0	0	0	0	310
	99.68%	0.00%	0.00%	0.32%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.21%
1973	323	0	1	0	0	0	0	0	0	0	324
	99.69%	0.00%	0.31%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.31%
1974	301	0	0	0	0	0	0	0	0	0	301
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.15%
1975	182	0	0	0	0	0	0	0	0	0	182
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.30%
1976	259	0	0	0	0	0	0	0	0	0	259
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.85%
1977	273	1	0	0	0	0	0	1	0	0	275
	99.27%	0.36%	0.00%	0.00%	0.00%	0.00%	0.00%	0.36%	0.00%	0.00%	1.96%
1978	262	0	0	0	0	0	0	0	0	0	262
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.87%
1979	275	0	0	0	3	0	0	0	0	0	278
	98.92%	0.00%	0.00%	0.00%	1.08%	0.00%	0.00%	0.00%	0.00%	0.00%	1.98%
1980	254	0	0	0	0	0	0	0	0	0	254
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.81%
1981	240	0	0	0	0	0	0	0	0	0	240
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.71%

1982	186	0	0	0	0	0	0	0	0	0	186
	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.33%
1983	159	0	0	0	1	0	0	0	0	0	160
	99.38%	0.00%	0.00%	0.00%	0.63%	0.00%	0.00%	0.00%	0.00%	0.00%	1.14%
1984	230	0	0	0	1	0	0	0	0	0	231
	99.57%	0.00%	0.00%	0.00%	0.43%	0.00%	0.00%	0.00%	0.00%	0.00%	1.65%
1985	290	0	0	0	2	0	0	0	0	0	292
	99.32%	0.00%	0.00%	0.00%	0.68%	0.00%	0.00%	0.00%	0.00%	0.00%	2.08%
1986	382	1	0	0	4	0	0	0	0	0	387
	98.71%	0.26%	0.00%	0.00%	1.03%	0.00%	0.00%	0.00%	0.00%	0.00%	2.76%
1987	395	0	0	0	5	0	0	0	0	0	400
	98.75%	0.00%	0.00%	0.00%	1.25%	0.00%	0.00%	0.00%	0.00%	0.00%	2.85%
1988	459	0	0	0	1	0	0	0	0	0	460
	99.78%	0.00%	0.00%	0.00%	0.22%	0.00%	0.00%	0.00%	0.00%	0.00%	3.28%
1989	388	1	0	0	3	0	0	0	0	0	392
	98.98%	0.26%	0.00%	0.00%	0.77%	0.00%	0.00%	0.00%	0.00%	0.00%	2.80%
1990	191	0	0	0	3	0	0	0	0	0	194
	98.45%	0.00%	0.00%	0.00%	1.55%	0.00%	0.00%	0.00%	0.00%	0.00%	1.38%
1991	200	0	0	0	1	0	0	0	0	0	201
	99.50%	0.00%	0.00%	0.00%	0.50%	0.00%	0.00%	0.00%	0.00%	0.00%	1.43%
1992	210	0	0	0	5	0	0	0	0	0	215
	97.67%	0.00%	0.00%	0.00%	2.33%	0.00%	0.00%	0.00%	0.00%	0.00%	1.53%
1993	204	0	0	0	1	0	0	0	0	0	205
	99.51%	0.00%	0.00%	0.00%	0.49%	0.00%	0.00%	0.00%	0.00%	0.00%	1.46%
1994	243	0	0	0	1	0	0	0	0	0	244
	99.59%	0.00%	0.00%	0.00%	0.41%	0.00%	0.00%	0.00%	0.00%	0.00%	1.74%
1995	176	0	0	0	1	0	0	0	0	0	177
	99.44%	0.00%	0.00%	0.00%	0.56%	0.00%	0.00%	0.00%	0.00%	0.00%	1.26%
1996	126	1	0	0	0	0	0	0	0	0	127
	99.21%	0.79%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.91%
1997	204	0	0	0	1	0	0	0	0	0	205
	99.51%	0.00%	0.00%	0.00%	0.49%	0.00%	0.00%	0.00%	0.00%	0.00%	1.46%
1998	254	0	0	1	0	0	0	0	0	0	255
	99.61%	0.00%	0.00%	0.39%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.82%
1999	326	1	0	1	0	0	0	0	0	0	328
	99.39%	0.30%	0.00%	0.30%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.34%
2000	443	2	0	2	0	0	0	0	0	0	447
	99.11%	0.45%	0.00%	0.45%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.19%
2001	211	67	2	1	0	0	0	1	0	62	344
	61.34%	19.48%	0.58%	0.29%	0.00%	0.00%	0.00%	0.29%	0.00%	18.02%	2.45%
2002	32	315	2	1	0	0	0	1	0	23	374
	8.56%	84.22%	0.53%	0.27%	0.00%	0.00%	0.00%	0.27%	0.00%	6.15%	2.67%
2003	3	329	0	2	0	0	0	1	0	0	335
	0.90%	98.21%	0.00%	0.60%	0.00%	0.00%	0.00%	0.30%	0.00%	0.00%	2.39%
2004	17	432	10	7	0	0	2	1	0	0	469
	3.62%	92.11%	2.13%	1.49%	0.00%	0.00%	0.43%	0.21%	0.00%	0.00%	3.35%
2005	9	148	263	172	2	0	0	1	2	0	597
	1.51%	24.79%	44.05%	28.81%	0.34%	0.00%	0.00%	0.17%	0.34%	0.00%	4.26%
2006	3	3	1	391	38	2	31	10	7	0	486
	0.62%	0.62%	0.21%	80.45%	7.82%	0.41%	6.38%	2.06%	1.44%	0.00%	3.47%
2007	0	0	0	1	0	0	10	19	20	0	50
	0.00%	0.00%	0.00%	2.00%	0.00%	0.00%	20.00%	38.00%	40.00%	0.00%	0.36%
Column Total	11581	1305	279	580	76	2	43	35	29	85	14015
	82.63%	9.31%	1.99%	4.14%	0.54%	0.01%	0.31%	0.25%	0.21%	0.61%	100.00%

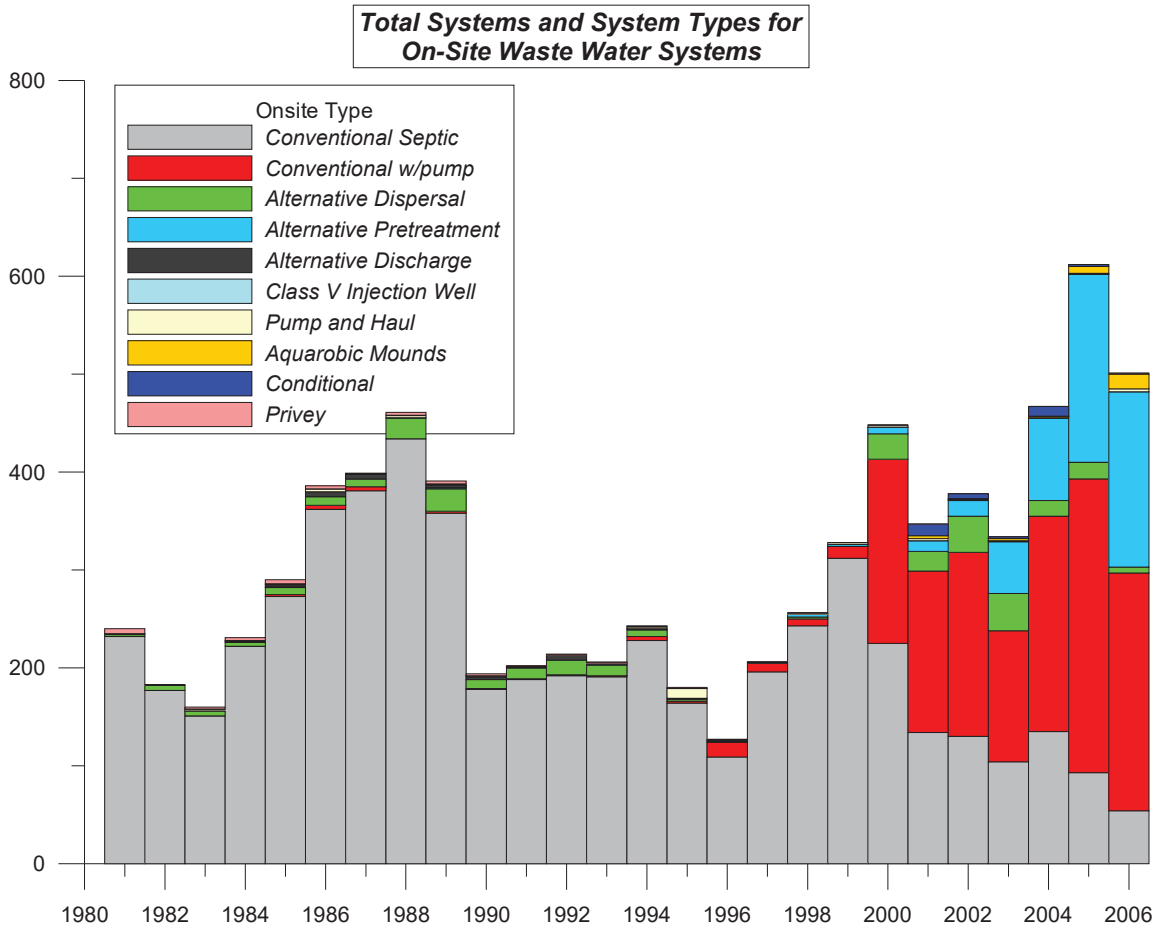
Cell contents:
Observed frequency
Percentage of row

The StatAdvisor
This table shows how often the 66 values of Year occur together with each of the 10 values of Permit Code. The first number in each cell of the table is the count or frequency. The second number shows that cell's percentage of the row in which it falls. For example, there were 2 times when Year equaled 1939 and Permit Code equaled 1. This represents 100.0% of the 2 times when Year equaled 1939.

tbl_OnSite_Permit_type	
OnSite_State_Permit_type	**Permit_type_description**
1. Conventional (Septic with Gravity)	Septic tank with traditional gravity fed drainfield.
2. Conventional (Pump)	Traditional septic tank with above grade drainfield, pump required.
3. Alternative Dispersal System Only	Non-traditional dispersals, such as drip irrigation, mounds, peat, etc…
4. Alternative Pretreatment System	Pre-treatment units required prior to dispersal.
5. Alternative Dischargeing	Discharges to sewage treatment plants. Tracking numbers will be "PSTP".
6. Commercial/Class 5 Well	Systems permitted by state as Class 5 injection wells.
7. Pump & Haul	No dispersal system. Tank is pumped.
8. Experimental	Aquarobic Mounds
9. Conditional	Conditions placed on system, such as water conservation devices.
10. Privey	No dispersal.



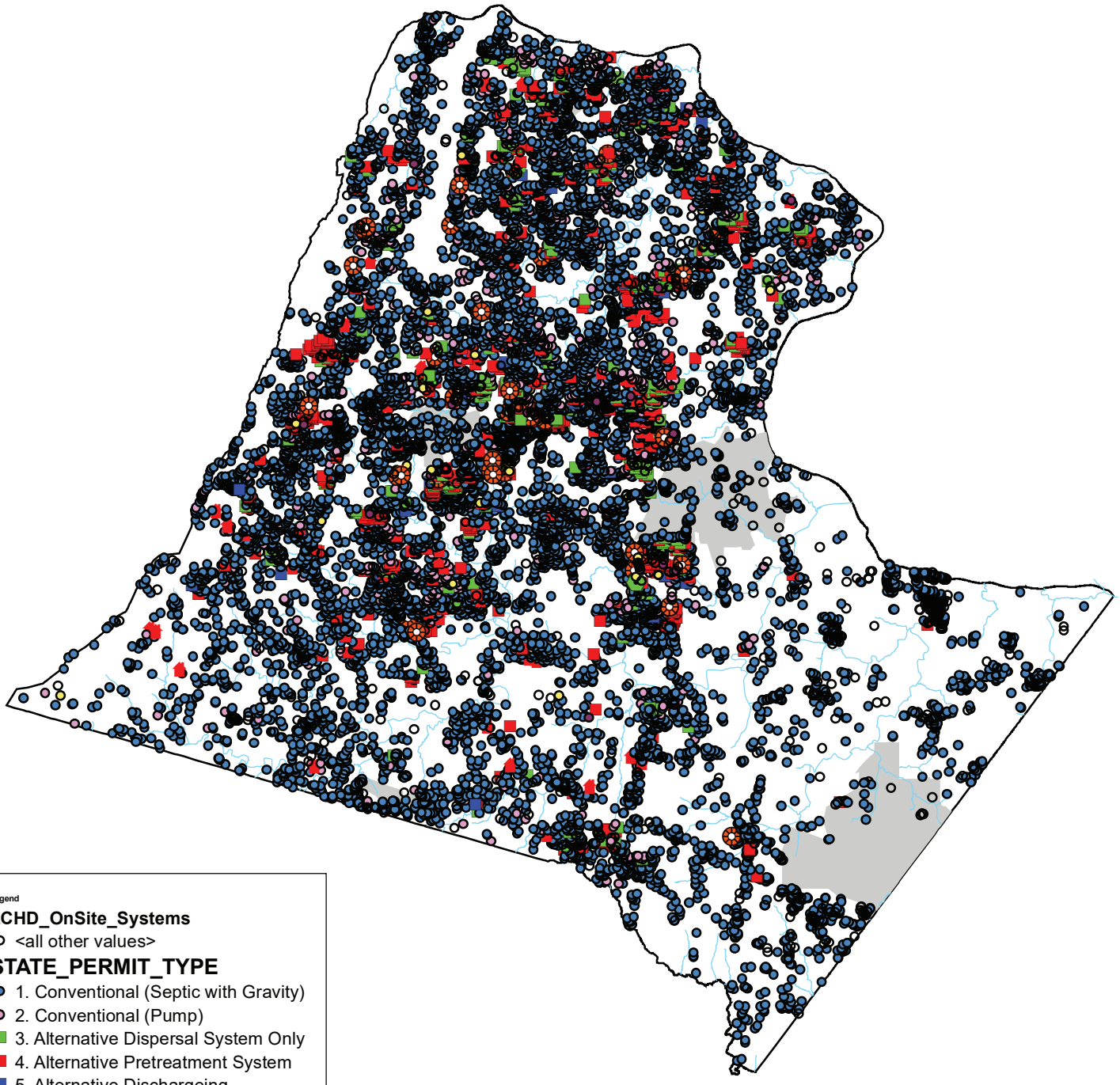
Low numbers in 1995-1996 due to limited input of electronic data. Data exists as paper records, to be entered later.



Low numbers in 1995-1996 due to limited input of electronic data. Data exists as paper records, to be entered later.

Summary of Non-Onsite Disposal Systems Pollution Sources

Source Type	Total	#	Watershed	#	Rock Class
PSBD Building (mostly barns)	33	2	Broad Run	16	Igneous
		10	Catoctin Creek	7	Igneous extrusive
		1	Clarks Run	6	Igneous intrusive
		2	Direct to Potomac	3	Metasedimentary
		6	Dutchman Creek	1	Sedimentary
		3	North Fork Catoctin Creek		
		9	Piney Run		
PCEM Cemetaries	163	11	Beaverdam Creek	59	Igneous
		25	Broad Run	13	Igneous extrusive
		7	Bull Run	16	Igneous intrusive
		7	Catoctin Creek	9	Metasedimentary
		3	Clarks Run	66	Sedimentary
		11	Cub Run		
		6	Direct to Potomac		
		3	Dutchman Creek		
		2	Limestone Branch		
		38	Lower Goose Creek		
		7	North Fork Catoctin Creek		
		10	North Fork Goose Creek		
		4	Piney Run		
		8	South Fork Catoctin Creek		
		21	Upper Goose Creek		
PSCS Chemical Storage (Mostly UST's)	499	54	Beaverdam Creek	205	Igneous
		64	Broad Run	48	Igneous extrusive
		9	Bull Run	69	Igneous intrusive
		54	Catoctin Creek	17	Metasedimentary
		6	Clarks Run	129	Sedimentary
		21	Cub Run		
		49	Direct to Potomac		
		20	Dutchman Creek		
		19	Dutchman Creek		
		18	Limestone Branch		
		63	Lower Goose Creek		
		14	North Fork Catoctin Creek		
		33	North Fork Goose Creek		
		8	Piney Run		
		22	South Fork Catoctin Creek		
		6	Sugarland Run		
		39	Upper Goose Creek		



Legend

LCHD_OnSite_Systems

- <all other values>

STATE_PERMIT_TYPE

- 1. Conventional (Septic with Gravity)
- 2. Conventional (Pump)
- 3. Alternative Dispersal System Only
- 4. Alternative Pretreatment System
- 5. Alternative Dischargeing
- 6. Commercial/Class 5 Well
- 7. Pump & Haul
- 8. Experimental
- 9. Conditional
- 10. Privey
- 14. Unofficial
- 16. Other

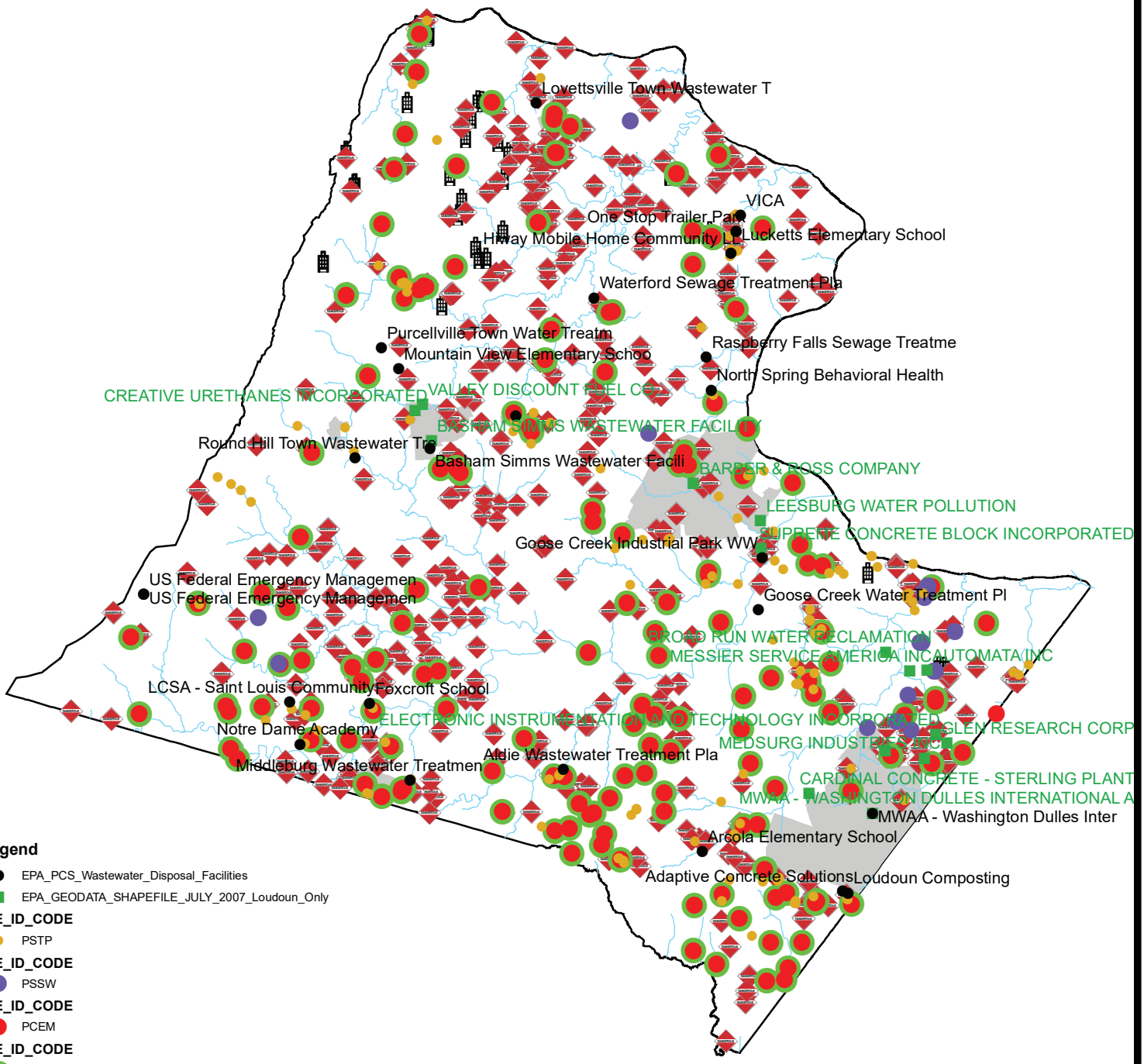
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Printed: Jul 20, 2007
Document: O:\project\wrmp\Alternate_Wastewater_Disposal\Alternate_Wastewater_Disposal_July_18_2007_Map01.mxd

Alternate Wastewater Disposal

From Health Dept July 17, 2007

Loudoun County, Building & Development



Legend

- EPA_PCS_Wastewater_Disposal_Facilities
- EPA_GEODATA_SHAPEFILE_JULY_2007_Loudoun_Only

WE_ID_CODE

- PSTP

WE_ID_CODE

- PSSW

WE_ID_CODE

- PCEM

WE_ID_CODE

- PCEM

Pollute_src_nonOnsite

WE_ID_CODE

- Cemetaries (PCEM)
- Buildings, such as barns and feedlots (PSBD)
- Chemical Storage (PSCS)
- majroad

Username: DWARD Computer: DWARD-50987C
Printed: Jul 20, 2007
Document: O:\project\wrmp\Alternate_Wastewater_Disposal\Alternate_Wastewater_Disposal_July_18_2007_Map01.mxd

0 1 2 4 6 8 Miles

Alternate Wastewater Disposal

From Health Dept July 17, 2007

Loudoun County, Building & Development

Preliminary Notes and Information for Upcoming Task B.3.8 – *Summary of Analyses and Assessment of Conditions*

B.3.8 Summary of Analyses and Assessment of Conditions

Prior to initiating this task, CH2M HILL will meet with County staff to provide draft findings and discuss results of Tasks B.3.1 through B.3.7. The meeting length is anticipated to be approximately 4 hours and will include key County and CH2M HILL staff familiar with and knowledgeable of the data and analyses from Tasks B.3.1 through B.3.7 and the proposed approach for Task B.3.8. The County will provide the meeting venue and arrange for the logistics.

CH2M HILL will summarize and integrate the results of the analyses in Tasks B.3.2 through B.3.7 and use water budget and other hydrologic/hydrogeologic concepts and methods to assess the conditions of the quantity and quality of the surface water and groundwater in the county. The summary will include a discussion of the qualitative and, if possible, quantitative hydrologic relationships between the various monitored resources. Also, trends in water quantity and quality will be identified and discussed as will issues or areas of concern. Tables, graphs, and maps will be used as needed to present the summary of conditions.

The water budget will be comprised of mean values under current conditions of the surface and groundwater components (usage, discharges, withdrawals and sources) summarized on the 16 major watersheds and will be limited to the County boundary. The budget shall be developed within a GIS framework composed of point values (e.g., community and private well average pumpage, surface water intakes), line values (e.g. groundwater transfer between counties, direct discharge to Potomac River) and area values (e.g., subwatershed precipitation and net recharge based on streamflow records). Water budget components lacking quantitative data shall be estimated as needed. The water balance need not detail the stormshed hydraulics or the stormwater infrastructure.

Recommend additional data or modifications to existing data sets necessary to support recommended future analyses and identify areas or issues that warrant further study.

Impervious Surface - LC versus USGS (example map)

Impervious Surface and Population (example map)

Parcels History (example graphic)

Community Groundwater Supply Wells (memo)

Community Groundwater Supply Wells (example map)

Contributing Area (memo)

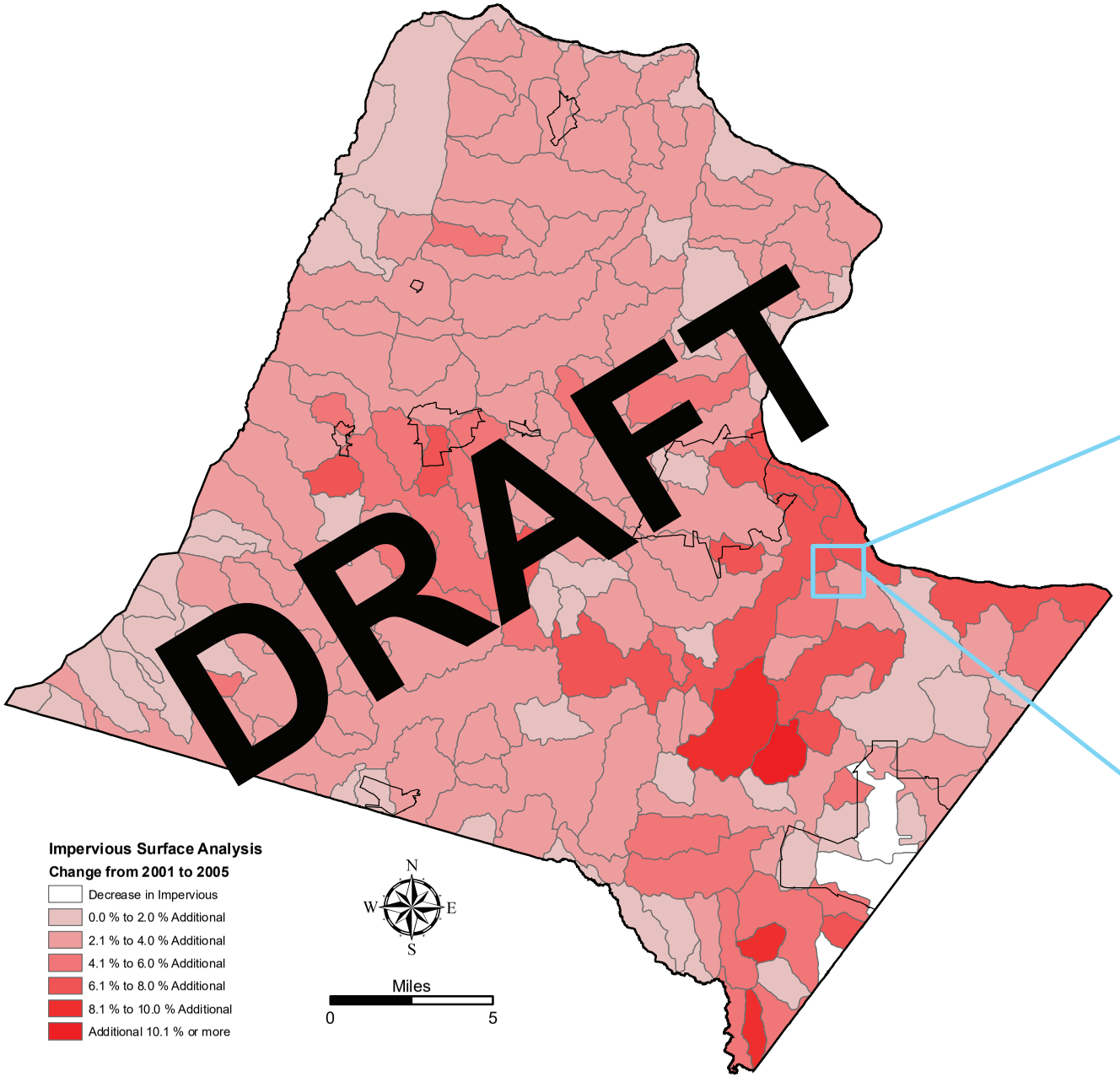
Population Methodology (memo)

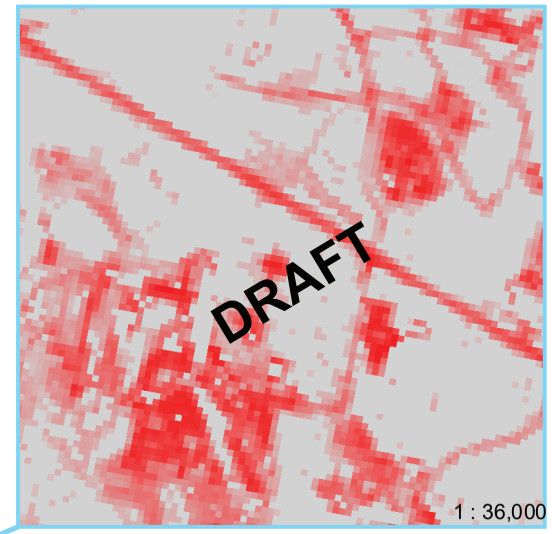
LCSA Service Area (memo)

Surface Water Intakes (example map)

Loudoun County, Virginia

Impervious Surface Analysis



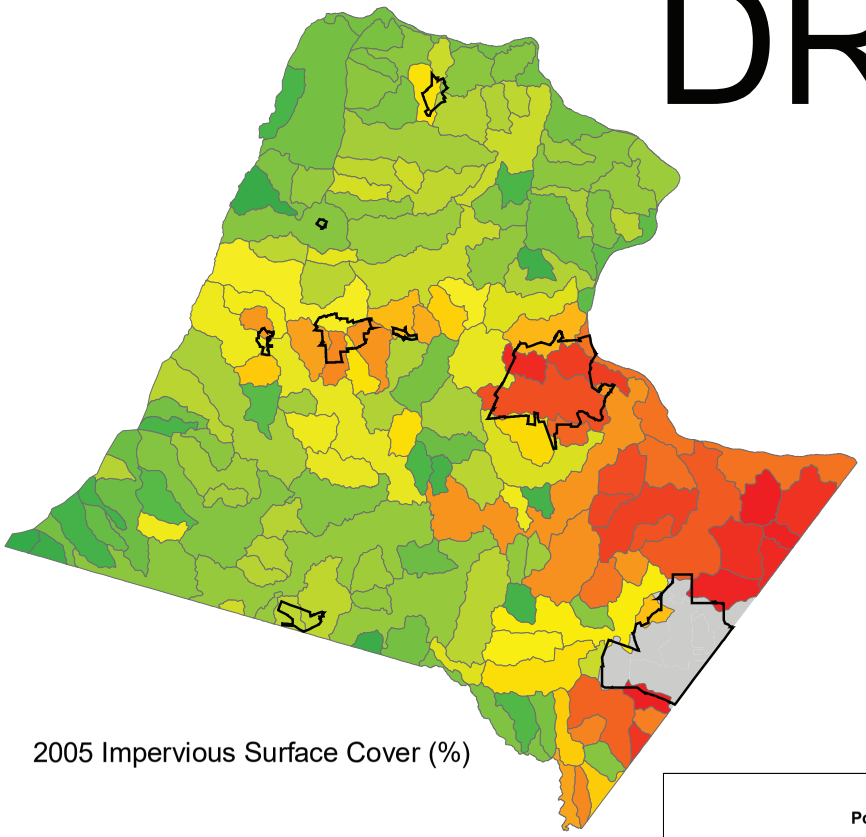


2001 USGS NLCD Impervious Surface

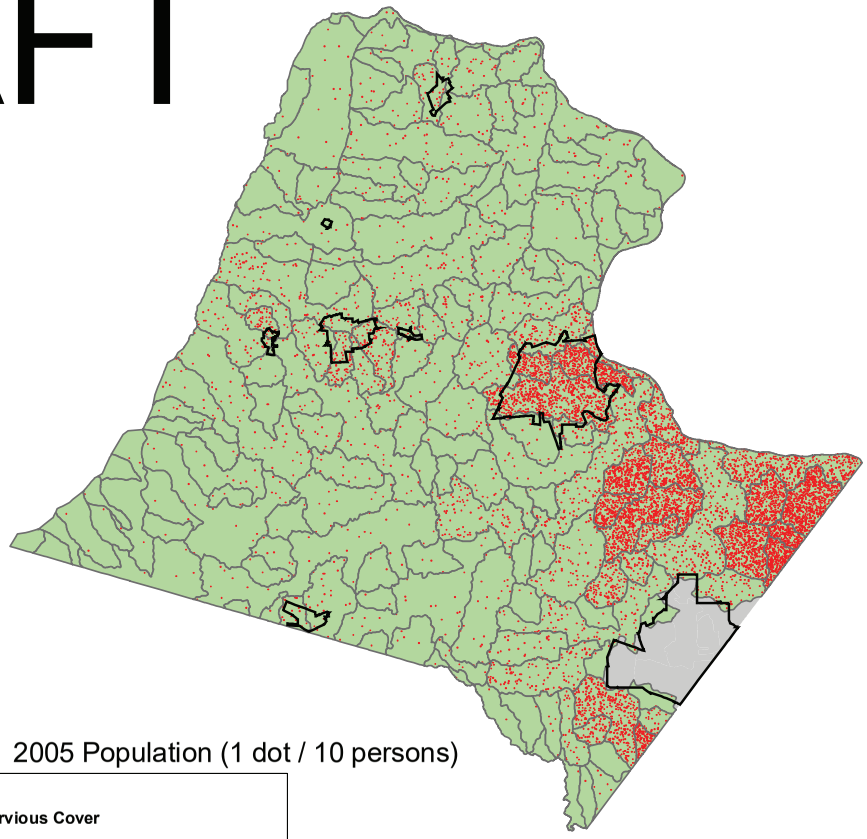


2005 Loudoun County Impervious Surface

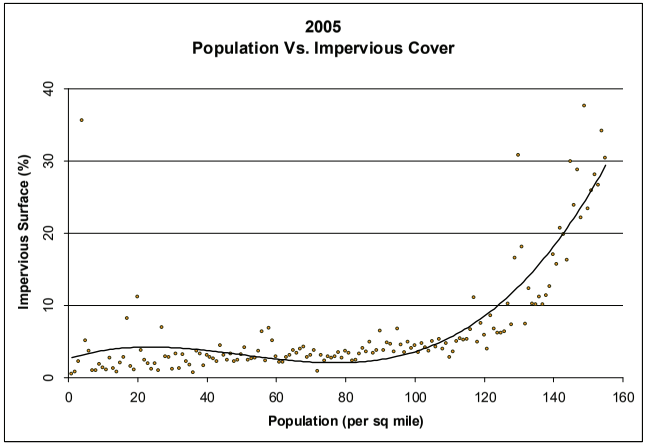
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2005 Impervious Surface Cover (%)



2005 Population (1 dot / 10 persons)



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Community Groundwater Supply Wells

Background: There are several sources of data for public water supply wells. These data need to be reviewed and merged.

Objective: To create a GIS of community groundwater usage rates to support subsequent analysis, such as water budget.

Summary of Available Data:

There are several sources of information on community water supply wells as described below. These data are summarized, compared and consolidated into GIS.

1) The **Virginia Dept of Health** maintains data of community water supply wells. We received data in 2003 and again in 2006. These are restricted data, providing well location, owners and population serves. A comparison between 2003 and 2006 showed:

- The number of water supply wells decreased from 128 to 117. Net change is 11 wells.
- Ten news wells were added while 22 were dropped.
- Coordinate mapping was revised.

Reference: E:\D\VDH_Community_Wells\VDH_Changes_2003_2006.xls

2) The **EPA** maintains data on safe water as part of their **Safe Drinking Water Information System (SDWIS)** program. The SWDIS web site may be queried from EPA SDWIS (http://www.epa.gov/enviro/html/sdwis/sdwis_ov.html)

```
http://oaspub.epa.gov/enviro/sdw_query_v2.get_list?wsys_name=&fac_search=fac_beginning&fac_county=LOUDOUN&pop_serv=500&pop_serv=3300&pop_serv=10000&pop_serv=100000&pop_serv=100001&sys_status=active&pop_serv=&wsys_id=&fac_state=VA&last_fac_name=&page=1&query_results=&total_rows_found=
```

The resulting table with 73 records is similar to VDH although the data are more limited. Both data sources indicate the population served. The VDH also provide average daily production in GPS as per metadata received with the shapefiles.

- There are a few more records in EPA's SDWIS compared to VDH and visa versa. For those listed in SDWIS, some may be incorrect records, such as POTOMIA and Grandale Farm. EPA provides what appear to be correct addresses in Loudoun, but data can not be located in LMIS.

  The SDWIS provides 5 more records as compared to VDH (BRIAR PATCH B&B, GRANDALE FARM, LOUDOUN COUNTY SANITATION AUTH, POTOMIA, RESERVE AT ROKEBY FARM)

  Conversely, VDH provides 3 more records as compared to SDWIS (LUCKETTS COMMUNITY CENTER, NATIONAL RECREATION & PARK ASSOC. HQ, CHURCH OF THE NAZARENE). The difference is likely due to age of EPA data.

- The population served reported by EPA is sometimes larger, presumably more current than VDH.

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- EPA SDWIS also includes LCSA serving 150,000 persons from "Purch_surface_water".

- EPA SDWIS does not include well locations, but VDH file provides latitude and longitude for each well at the facility in separate records.

- EPA typically only reports one record for each facility. Therefore, to match with VDH, EPA records were duplicated. In other words, the population served is for the group of wells and only be tallied once.

- There is some disagreement between the two data source for some of the water supply sources (ground versus surface water).

It is generally recommended that future water resource analysis use VDH files as the spatial data source. The EPA data confirms that population serves needs to be distributed among all wells in a community wellfield.

From this point forward, only VHD data will be used as this is the most complete and current information available.

The VDH files was expanded to include the average per capita use in gal/day/person as calculated based on rate (GPD) and population served. The rates were then allocated between multiple site facilities and converted to gallons per minute (GPM). During the review it was found that data for Lovettsville needs to be corrected by a factor of 30 (presumably a reporting error of days and months).

Reference: G:\BLDG_DEV\Engineering\H2O Team\Programs & Projects\EPA_SDWDIS_Safe_Drinking_Water

3. The **County Wellpoll GIS**

The **wellpoll** file include both water wells and disposal systems (i.e. septic fields). There are no names, population serves of water usage rates, just point location and type of well. The WE_SITE_ID contains the following selections (as per metadata) for wells:

WWCO	**Community well**
WWCS	Community spring
WWDH	Dry well
WWDU	Dug well
WWHP	Heat pump well
WWID	Industrial well
WWIN	Individual well
WWIR	Irrigation well
WWMN	Monitor well
WWNC	**Non-community well**
WWOB	Observation well
WWQM	Water quality monitoring well
WWSP	Spring
WWTS	Test well
WWUN	Unknown well

O:\data\Metadata\SDE_Source\Environment\HTM\wellpoll_point.htm

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Presumably the spatial location data is fairly accurate. In review of **VDH** and **wellpoll**, it appears that **wellpoll** is always the more accurate location, based on several factors.

The **VDH community wells** were assigned what spatially appeared to be the corresponding **wellpoll** site_ID. Of the 117 sites, all but 8 locations had a corresponding **wellpoll** location. The **VDH** wells are assigned latitude/longitude using different mapping accuracy as per table. The **wellpoll** sites have been mapped over time at the parcel-accuracy level.

In matching **VDH** and **wellpoll** locations there were numeous occurances where there were several probably wells in wellpoll that corresponded to one site in **VDH** data, even though **VDH** data does include multiple location per production system. For example, the Town of Hamilton has 10 records in **VDH**. In the GIS there may be as many as 16 locations of WWNC and WWCO type wells. In Lovettsville fours well are know to be in operation as reported by **VDH** and there are 6 sites in **wellpoll**.

4. The **B&D Welldatabase**

The **B&D** file is an on-going upgrade to wellpoll. This is MS Access file. The table **tbl_groundwater** has a fairly good and complete relationship from Well ID to Permit ID and the true well status. We need to match up "site_id" (text 25) in "tbl_groudnwater" with WE_SITE_ID" (text 14) assigned manually to "community wells" from **wellpoll** GIS basemap layer.

We can use this in helping to decide how to best assign WE_CODE_ID to the community_well records. Often there are multiple probable wells in wellpoll_GIS to match up with community_wells. Ideally we would have only one **wellpoll** GIS point per community well as the community_well already has separate records with distinct lat/long for the know wells in a well field. The additional points in the GIS may be test wells associated with the community well. They may be where several wells were drilled to find the community and then just one of two or more were selected as the true production wells. The additional wells may or may not have been abandoned.

5. **Water Usage from Annual Reports**

Historical water use for the major towns is typically summarized in terms of equivalent residual units (ERU/ERC) or connections. Data from Consumer Confidence Report (CCR) and Annual reports were compared for consistency and rates converted to million gallons per day (MGD). At the end an estimate for average 2007 use has been added.

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Annual Water & Wastewater Reports prepared by by Draper Arden
Rates in MGD were calculated from Equivalent Residential Unit values
http://www.daa.com/news/surveys.htm

	LCSA	Leesburg	Purcellville	Round Hill	Middleburg	Hamilton	Lovettsville	Total MGD
ERU	**250**	**350**	**250**	**250**	**250**	**250**	**250**	
2000	10.400	3.837	0.350	0.139	0.037	no data	no data	14.8
2001	no data	4.831	0.340	no data	no data	no data	0.049	5.2
2002	12.620	5.311	0.374	0.130	no data	0.131	no data	18.6
2003	13.277	5.487	0.373	0.172	0.206	0.130	no data	19.6
2004	13.950	5.704	0.490	0.586	0.062	0.125	no data	20.9
2005	14.237	5.639	0.598	0.293	0.660	0.125	no data	21.6
2006	15.485	5.538	no data	0.142	no data	0.150	no data	21.3

Equivalent Residential User: One equivalent residential water connection equals total water consumption per day divided by 250 gallons per day, except Leesburg is 350 gallons per day.

2007 Estimate	**16.50**	**5.80**	**0.70**	**0.30**	**0.50**	**0.17**	**0.10**	**24.1**

Reference: G:\BLDG_DEV\Engineering\H2O Team\Programs & Projects\Public_Water_Supplies

6. **Water Use by Towns**

Other than LCSA, the Towns are the major water users. To confirm the data and provide additional insight of future water use data was collected at the town level.

Town of Leesburg data were obtained directly. Virtually all water is obtained through an intake on the Potomac River. Using comparable ERU's, the town data is generally consistent with the annual reports.

Town of Purcellville data were obtained through a consultant. While the Town generally produces half of the water from Hirst Reservoir, the data did confirm the annual total usage report mentioned above. At this time the second reservoir (New Centential) will not be developed for at least a decade.

Both the town data and the annual report data were compared with the VDH for overall consistency. This cross check did not reveal any significant data problems.

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7. **Wellhead Protection Plans**

Wellhead protection plans have been compiled for: Town of Round Hill, Beacon Hill, Lenah Run, and Raspberry Falls. Plans for Lovettsville are in preparation. It is unknown as to whether plans exist or will be developed for Town of Hamilton. Plans will be forth coming for: Elysian Heights, the Reserve at Rokeby Farm, and Selma in 2007-2008. Thus far there has been no mention of WHP for Town of Purceville, know to have several wells and operates Hirst Reservoir. These reports often include the individual well names, depth, capacity (gpm) and status.

Reference: G:\BLDG_DEV\Engineering\H2O Team\Programs & Projects\Loudoun_Wellhead_Protection_Plans

Data Compilation:

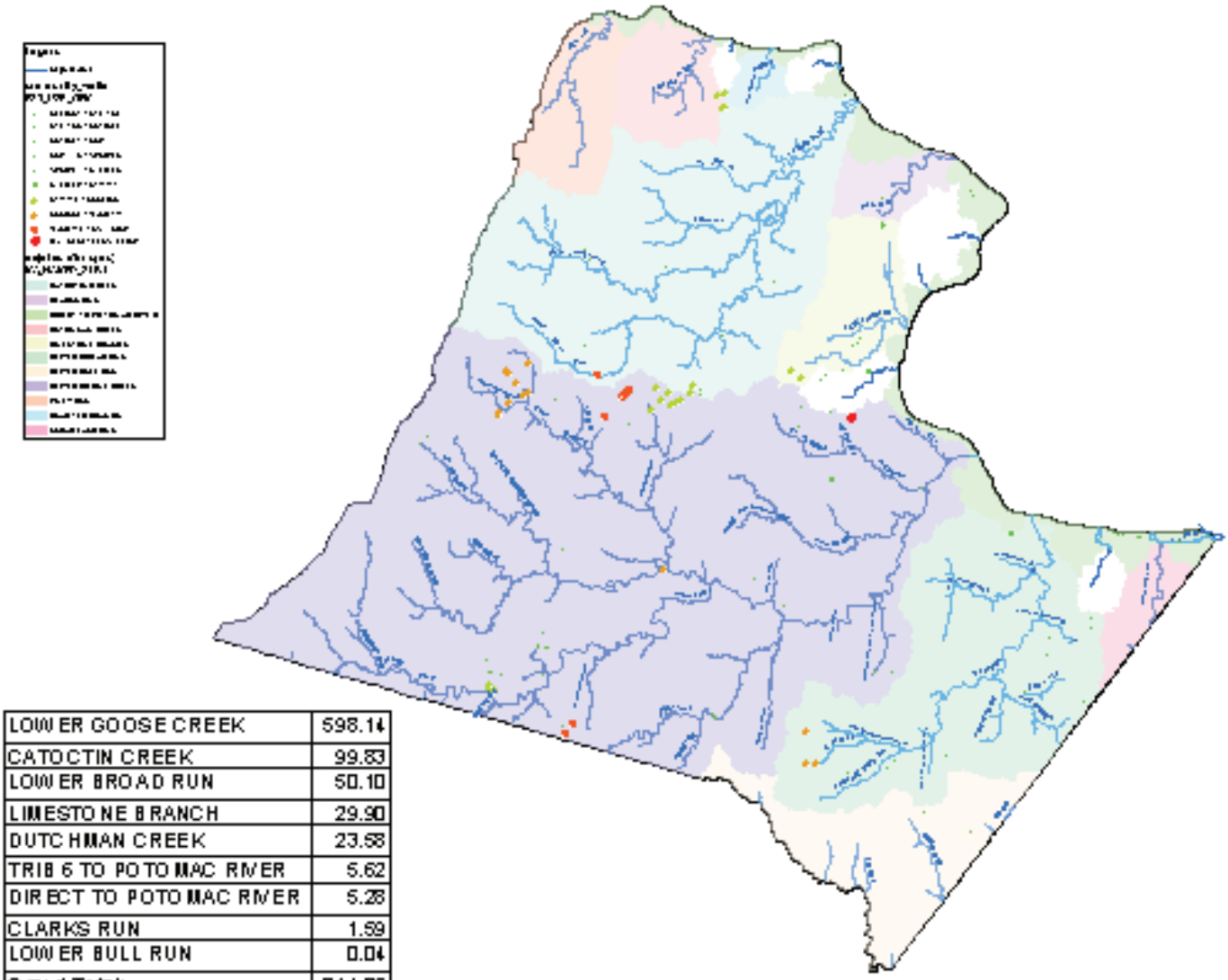
Using ArcToolBox Identity, create the feature class "community_wells_identity_majshed" in the pgdb pgdb_groundwater_use.mdb. Now using Crystal Report, summarize the estimated well usage by subwatershed (field MA_NAMED_SUB1). Also, edit the estimated rate and change LCSA surface water value to zero (it was over 2,700). Then rework/reformat the file into Excel file "report1.xls" as:

LOWER GOOSE CREEK	598.14
CATOCTIN CREEK	99.83
LOWER BROAD RUN	50.10
LIMESTONE BRANCH	29.90
DUTCHMAN CREEK	23.58
TRIB 6 TO POTOMAC RIVER	5.62
DIRECT TO POTOMAC RIVER	5.28
CLARKS RUN	1.59
LOWER BULL RUN	0.04
Grand Total:	814.06

The highest community well usage is in Goose Creek at over 600 gpm. *(Need to check to see if this includes Hirst Reservoir)*

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The below image can more easily be seen on screen or large plot



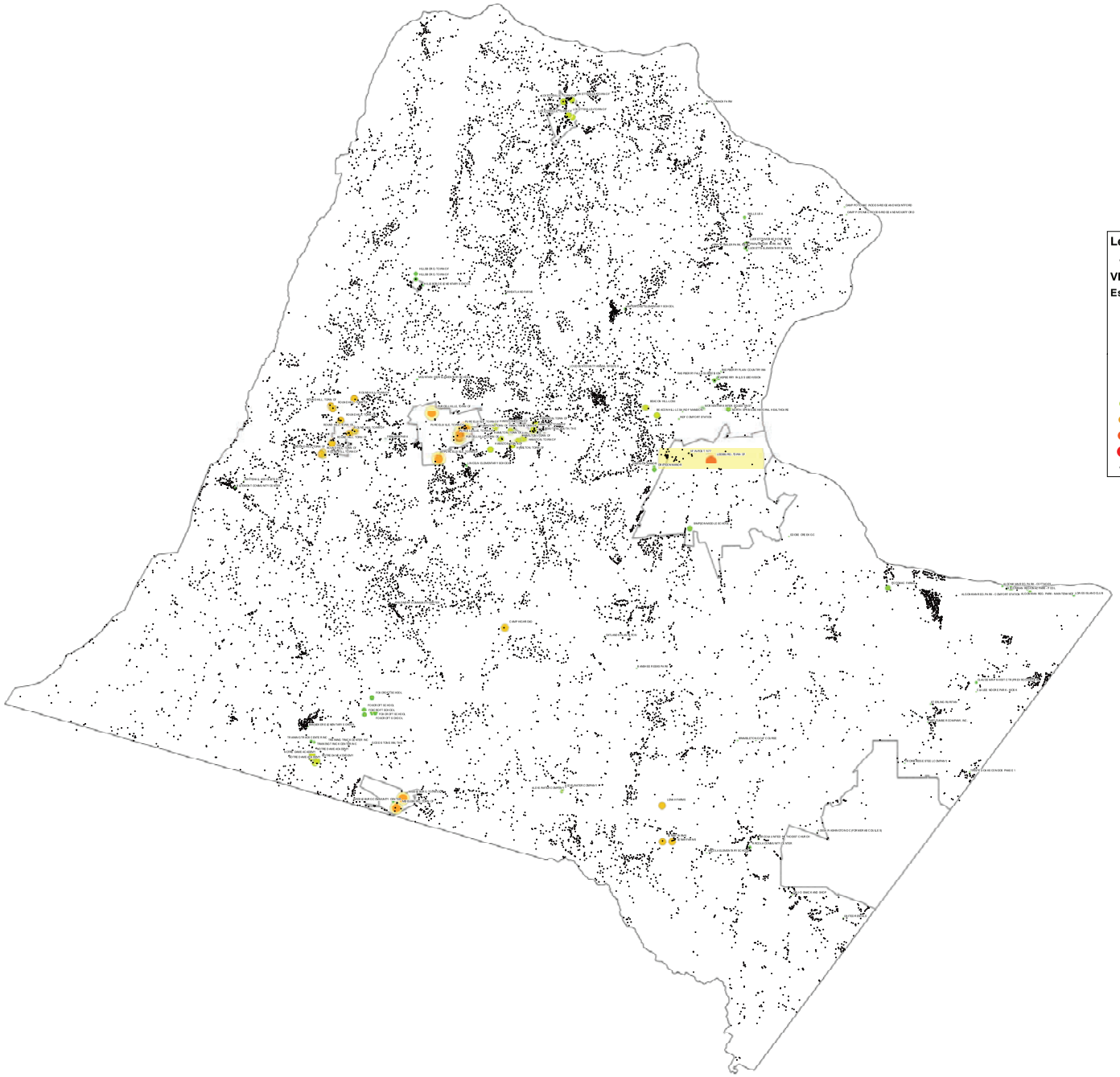
LOWER GOOSE CREEK	598.14
CATOCTIN CREEK	99.83
LOWER BROAD RUN	50.10
LIMESTONE BRANCH	29.90
DUTCHMAN CREEK	23.58
TRIB 6 TO POTOMAC RIVER	5.62
DIRECT TO POTOMAC RIVER	5.28
CLARKS RUN	1.59
LOWER BULL RUN	0.04
Grand Total:	814.06

Working folder: O:\project\wrmp\Groundwater_Use

Next Step: Tally up the private water well, eliminating the "imminent" wells that are these are not in operation. Tally up the surface water intakes on Goose Creek/Beaverdam Reservoir. Revisit Purcellville data and separate out wells from Hirst Reservoir.

Need to check on what significant agricultural wells exist that need to be included. Are there any surface water users not reported? Check with VA Extension and LSWCD.

Also, may consider development of additional water demand using "imminent" wells and an analysis of zoning and future "build-out".



Username: DWARD Computer: DWARD-50987C
Printed: Jun 06, 2007
Document: O:\project\wrmp\Groundwater_Use\Groundwater_Use_Map09.mxd

0 1 2 4 6 8 Miles

Groundwater Use (gpm)
Commmunity and Private Wells

Data developed from "wellpoll", VDH and EPA (SWDB)

Loudoun County, Building & Development

Contributing Area to Groundwater Wells using Volumetric Method

For each public water supply well, we can compute the average contributing area in several ways. In a separate memo, the "contributing area" is based on a calculated net recharge to groundwater. In the volumetric method, we calculate the pore volume pumped for a certain time period using a simple displacement using assumed values for aquifer porosity, thickness and time of pumping. EPA WHP refers to this as the "volumetric method".

The approach is to calculate a simple radius of circle based on the pumping and aquifer characteristics. This is a very simple first-order approximation. These values depend on the assumed time of interpretation and should probably not be extended too many years as the cone of depression would naturally hit recharge boundaries. The approach neglects regional groundwater gradient. This approach neglects non-steady pumpage. The approach does not allow for interference between wells. The approach does not include the effects of dispersion. In fractured bedrock in western Loudoun, pollution transport can be substantially greater than the average travel distance. Therefore, this method is not conservative and should be interpreted in light of minimal distances of wellhead protection.

The formula is:

```
radius_ft = sqrt(Time_days*Pumping_Rate_gpm*1440/7.48/* /
                 (Porosity*Aquifer_Thickness_ft*PI())
```

To apply this formula, we can assume aquifer porosity of 0.01 (1%) and an aquifer thickness of 300 feet. For rate and time, let's choose several values to cover the range of reasonably possibilities.

Time	Rate	Rate	Radius	Well Type
days	gpm	gpd	feet	
100	0.188	270	20	Small Residential
365	0.188	270	37	Small Residential
1,000	0.188	270	62	Small Residential
3,650	0.188	270	118	Small Residential
100	0.5	720	32	Large Residential
365	0.5	720	61	Large Residential
1,000	0.5	720	101	Large Residential
3,650	0.5	720	193	Large Residential
100	5	7,200	101	Small Community
365	5	7,200	193	Small Community
1,000	5	7,200	320	Small Community
3,650	5	7,200	611	Small Community
100	50	72,000	320	Large Community
365	50	72,000	611	Large Community
1,000	50	72,000	1011	Large Community
3,650	50	72,000	1931	Large Community

It is interesting to note that using the "recharge method", a residential household well pumping at 270 gpd (0.188 gpm) requires a 71 ft radius which compares with 3 to 4 years of comparable pumpage using the "volumetric method".

Due to groundwater gradients and regional groundwater flow patterns typical of western Loudoun County, caution should be used for times greater than a few years.

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How does this compare to the administrative wellhead protection limits?

- Zone 1 is a 1000-foot radius around the well and is a priority zone for managing potential sources of contamination; and
- Zone 2 is a one-mile (5,280-feet) radius which represents an estimate of the total recharge zone for the well.

It is somewhat difficult to reasonably compare the two approaches as the "volumetric method" depends on the value of time. Nonetheless, the method is generally consistent with the Zone 1 distance of 1,000 feet for several years of pumpage. Because the method does not include fracture contaminant transport or dispersion, the approach is generally consistent with Zone 2 administrative boundary of one mile distance from the well.

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Contributing Recharge Area to Groundwater Wells

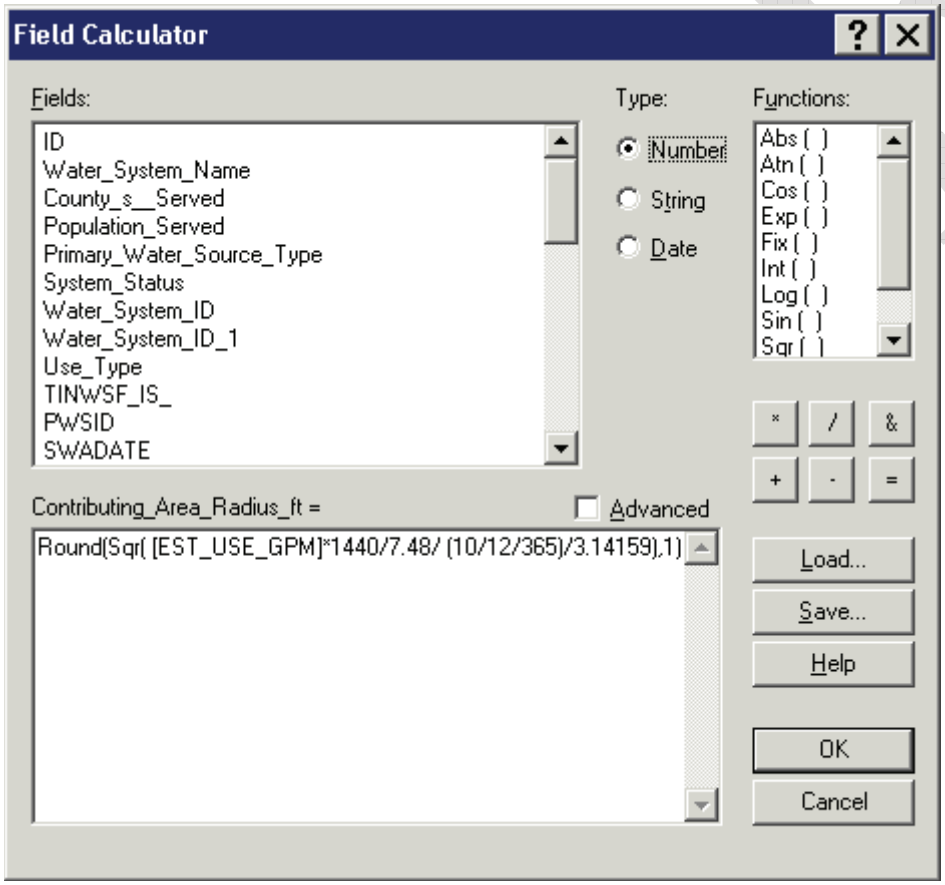
For each public water supply well, we can compute the average contributing area, based on a calculated net recharge to groundwater. The approach is to calculate a simple radius of circle in which the recharge equals the average pumping rate. This is a very simple first-order approximation. These values are much less than conservative estimates used in the wellhead protection strategy. The approach neglects regional groundwater gradient. This approach neglects non-steady pumpage. The approach does not allow for interference between wells.

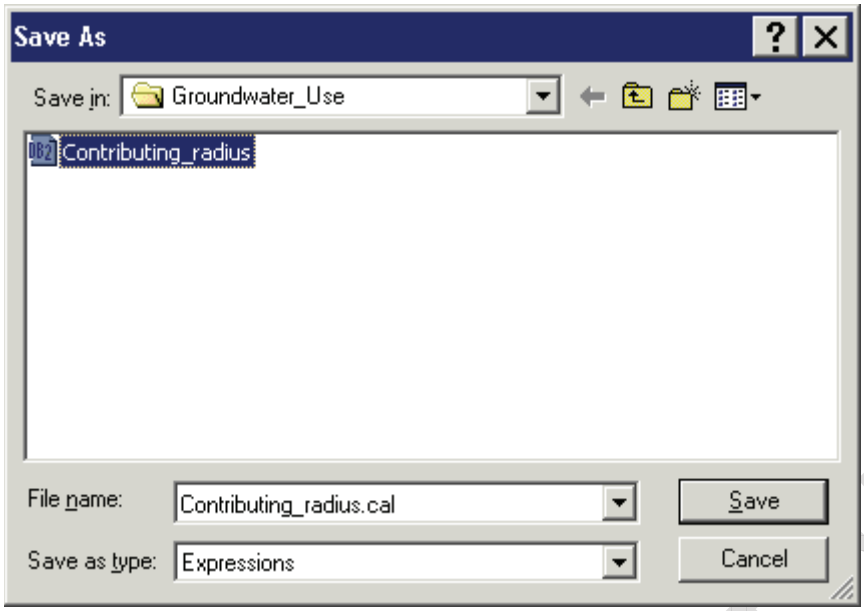
The formula is:

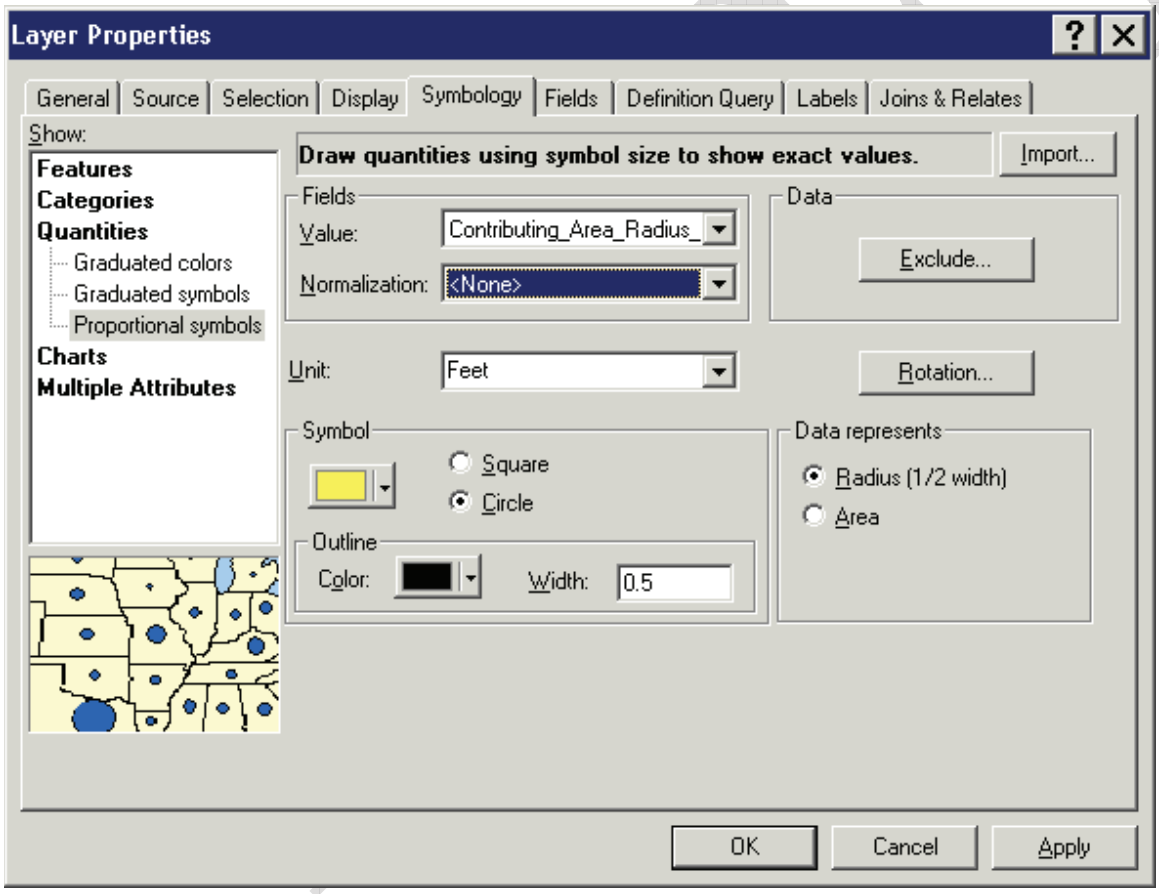
```
radius_ft = sqrt(rate_gpm*1440/7.48/(Recharge_in_per_year/12/365)/PI())
```

For example, a 1 gpm well requires recharge over a circle with a radius of 163.5 feet assuming 10 inches per year of recharge.

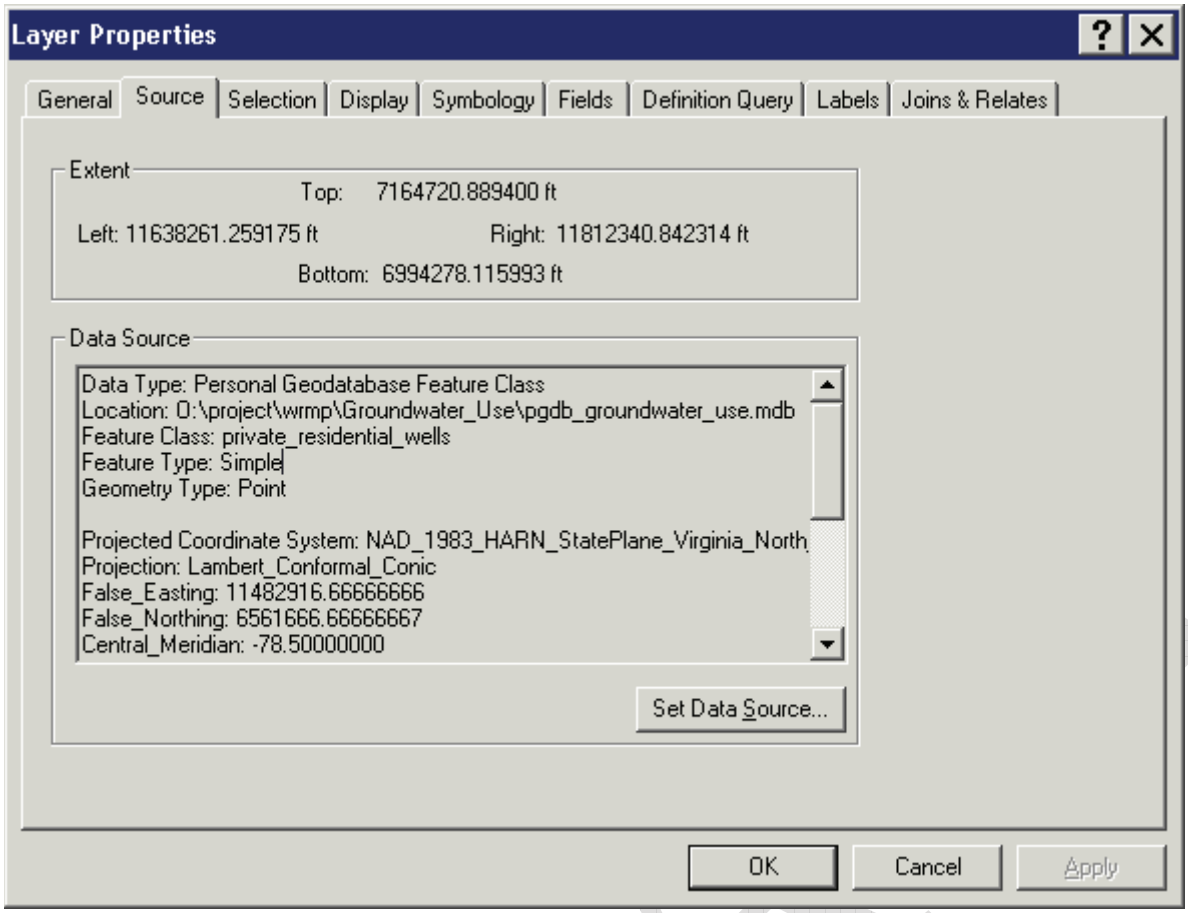
In geodatabase, add a field and calculate:



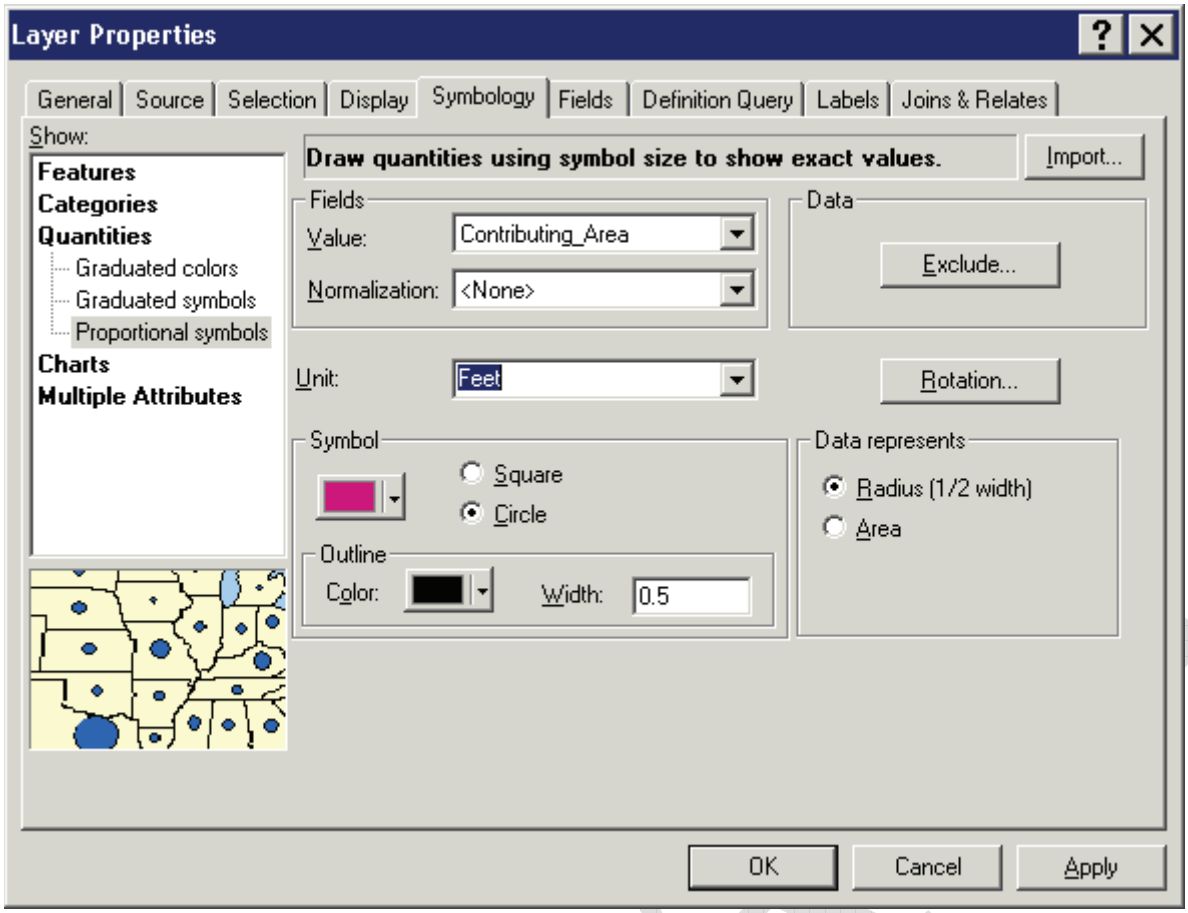




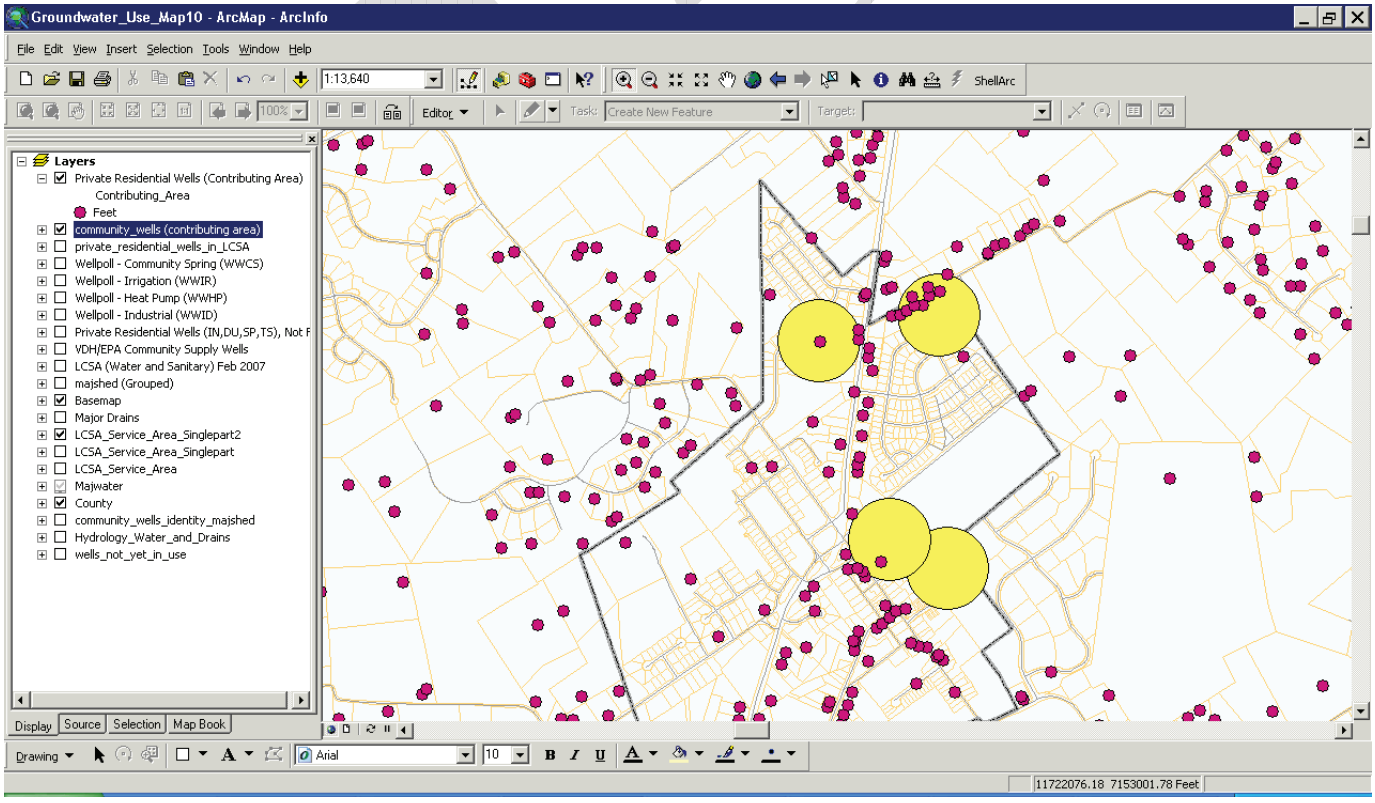
Now for private wells, lets assume about 270 gallons per day per well (per household). We add a field to the feature class “private residence wells” and set value to 71 feet. (See Excel file).


Layer Properties
General
Source
Selection
Display
Symbology
Fields
Definition Query
Labels
Joins & Relates
Extent
Top: 7164720.889400 ft
Left: 11638261.259175 ft
Right: 11812340.842314 ft
Bottom: 6994278.115993 ft
Data Source
Data Type: Personal Geodatabase Feature Class
Location: O:\project\wrmp\Groundwater_Use\pgdb_groundwater_use.mdb
Feature Class: private_residential_wells
Feature Type: Simple
Geometry Type: Point
Projected Coordinate System: NAD_1983_HARN_StatePlane_Virginia_North
Projection: Lambert_Conformal_Conic
False_Easting: 11482916.66666666
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Central_Meridian: -78.50000000
Set Data Source...
OK
Cancel
Apply

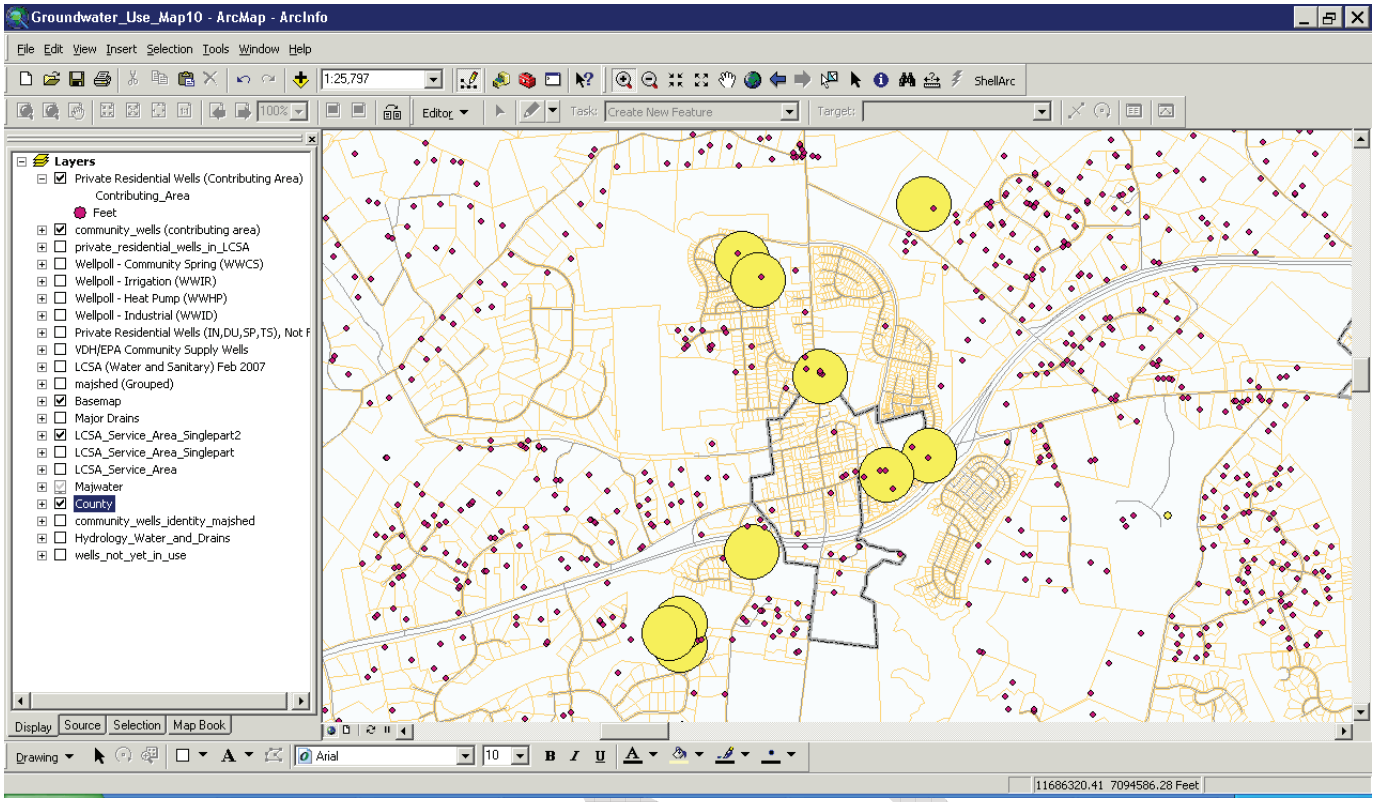
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In Lovettsville:

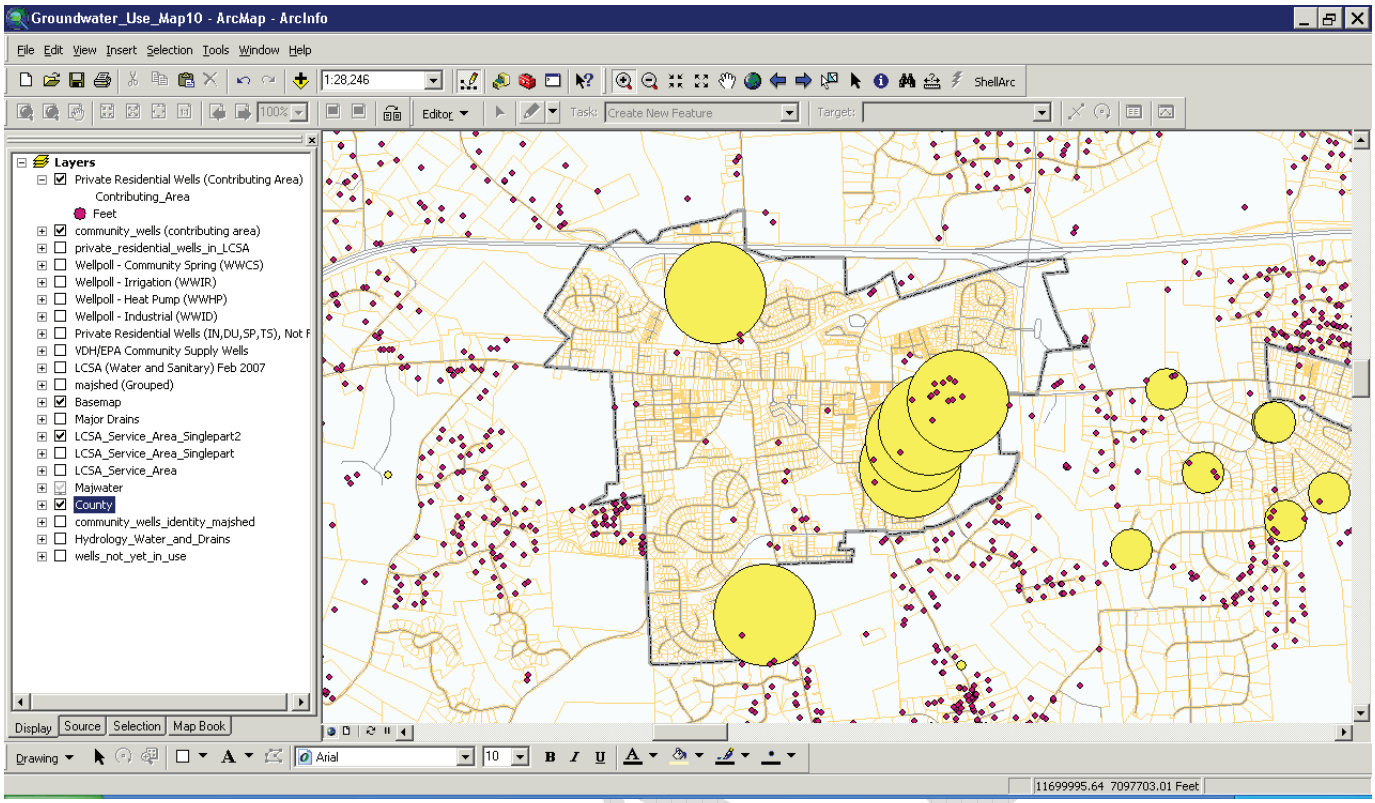


In Round Hill:

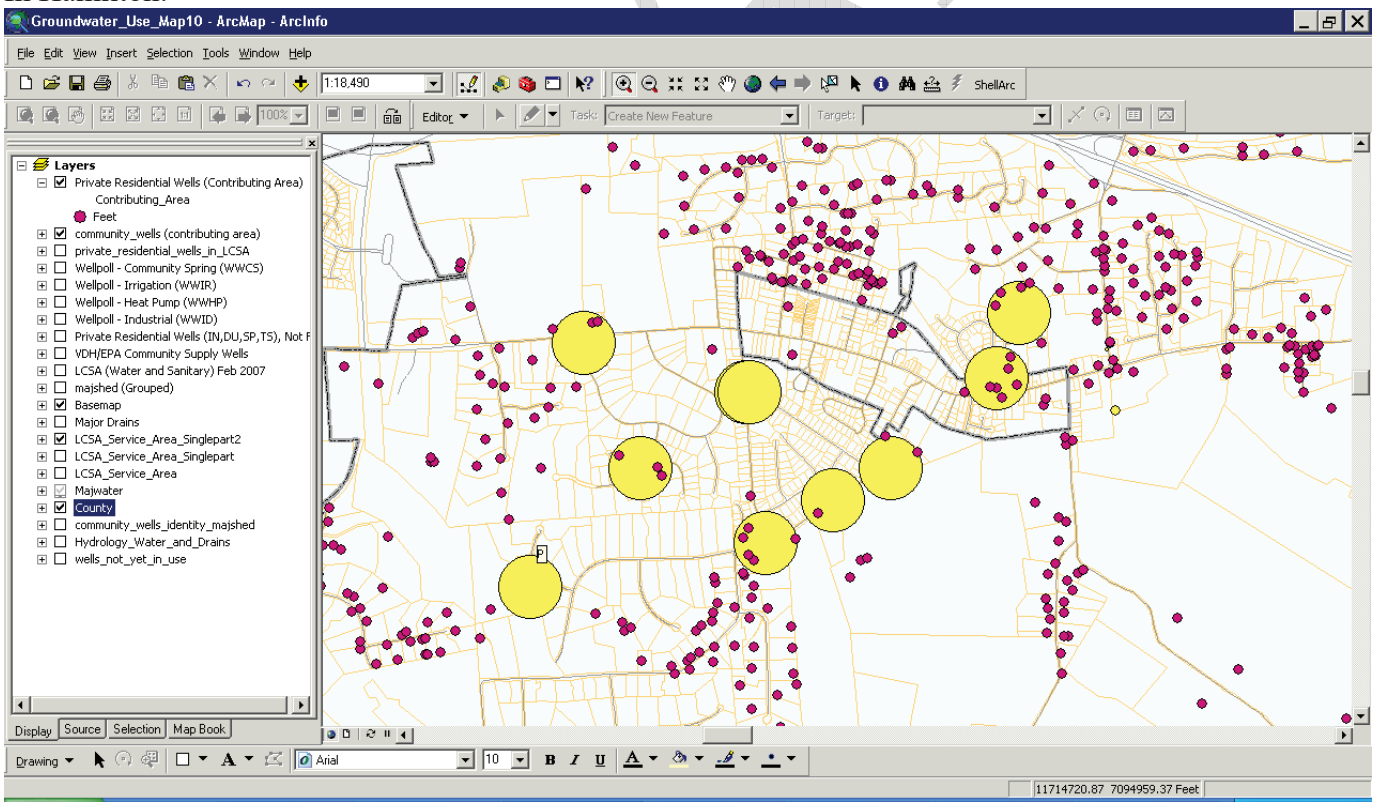

Groundwater_Use_Map10 - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
1:25,797
Editor
Task: Create New Feature
Target:
ShellArc
Layers
Private Residential Wells (Contributing Area)
Contributing_Area
Feet
community_wells (contributing area)
private_residential_wells_in_LCSA
Wellpoll - Community Spring (WWCS)
Wellpoll - Irrigation (WWIR)
Wellpoll - Heat Pump (WWHP)
Wellpoll - Industrial (WWID)
Private Residential Wells (IN,DU,SP,TS), Not F
VDH/EPA Community Supply Wells
LCSA (Water and Sanitary) Feb 2007
majshed (Grouped)
Basemap
Major Drains
LCSA_Service_Area_Singlepart2
LCSA_Service_Area_Singlepart
LCSA_Service_Area
Majwater
County
community_wells_identity_majshed
Hydrology_Water_and_Drains
wells_not_yet_in_use
Display Source Selection Map Book
Drawing
Arial
10
11686320.41 7094586.28 Feet

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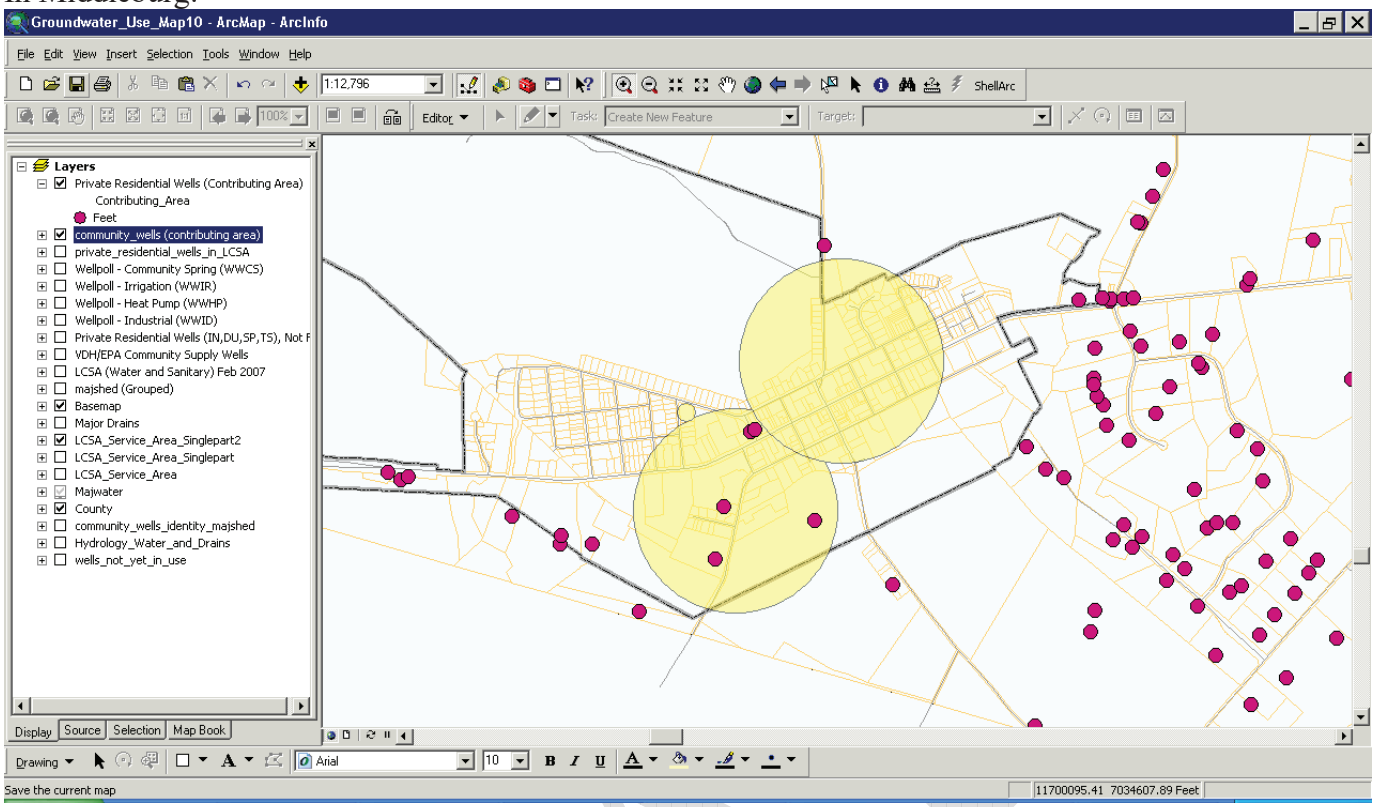
In Purcellville:



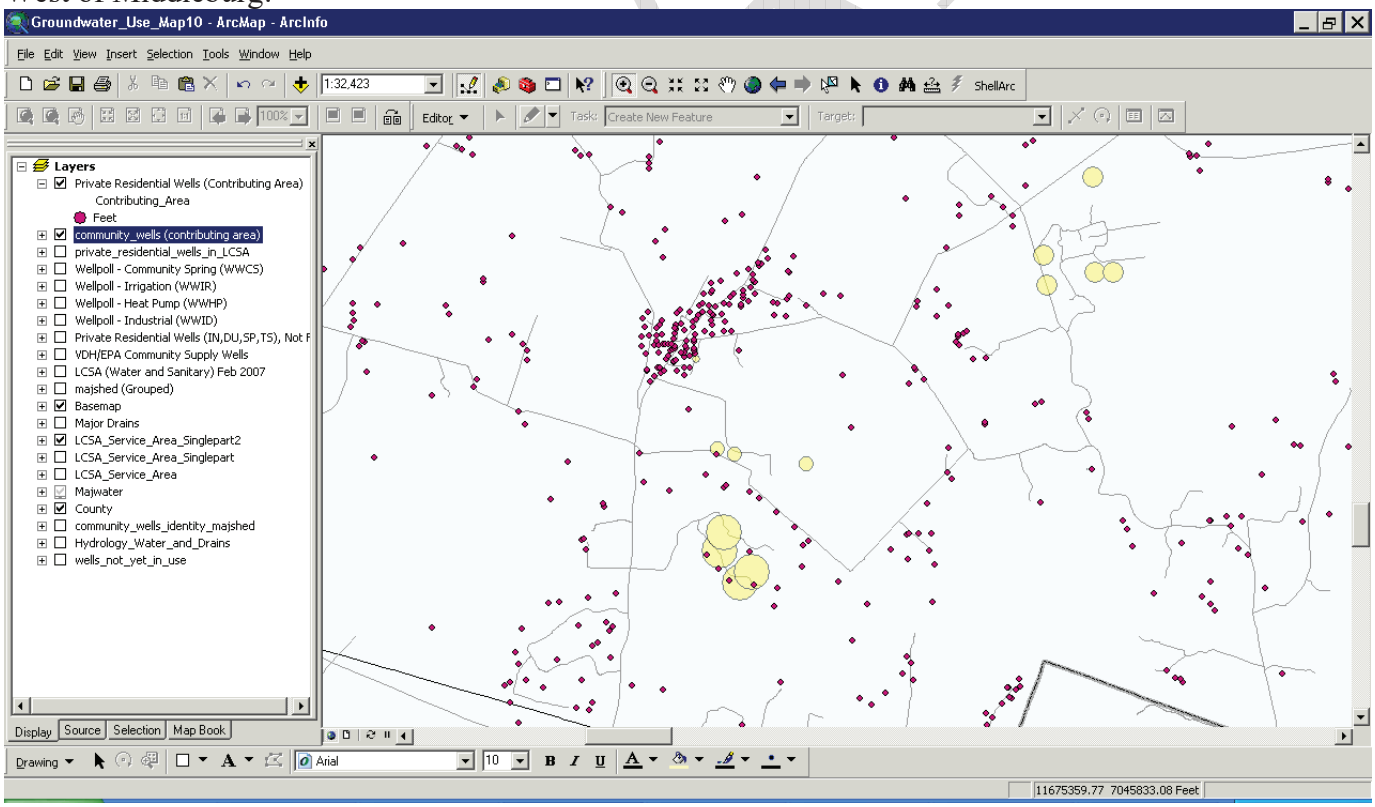
In Hamilton:



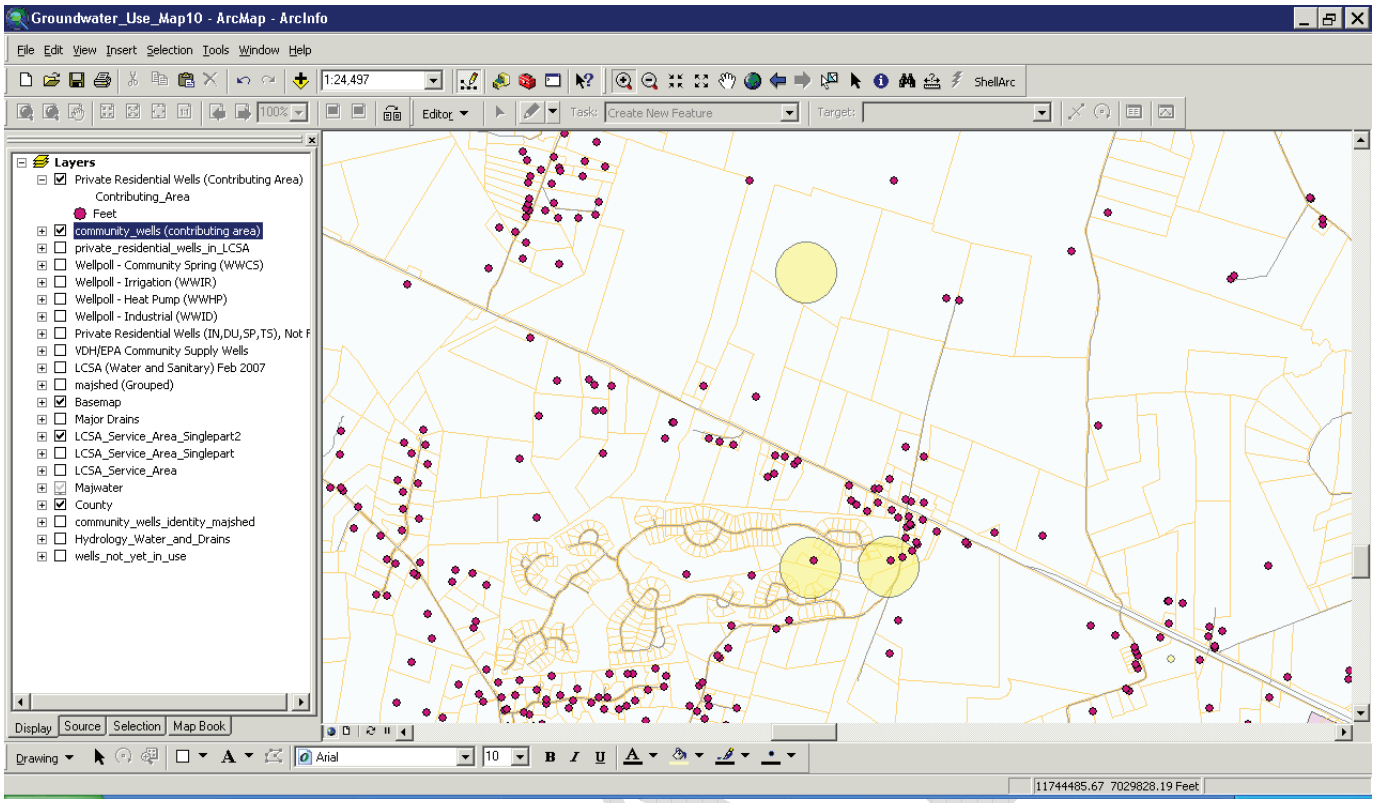
In Middleburg:



West of Middleburg:



In Lenah Run:



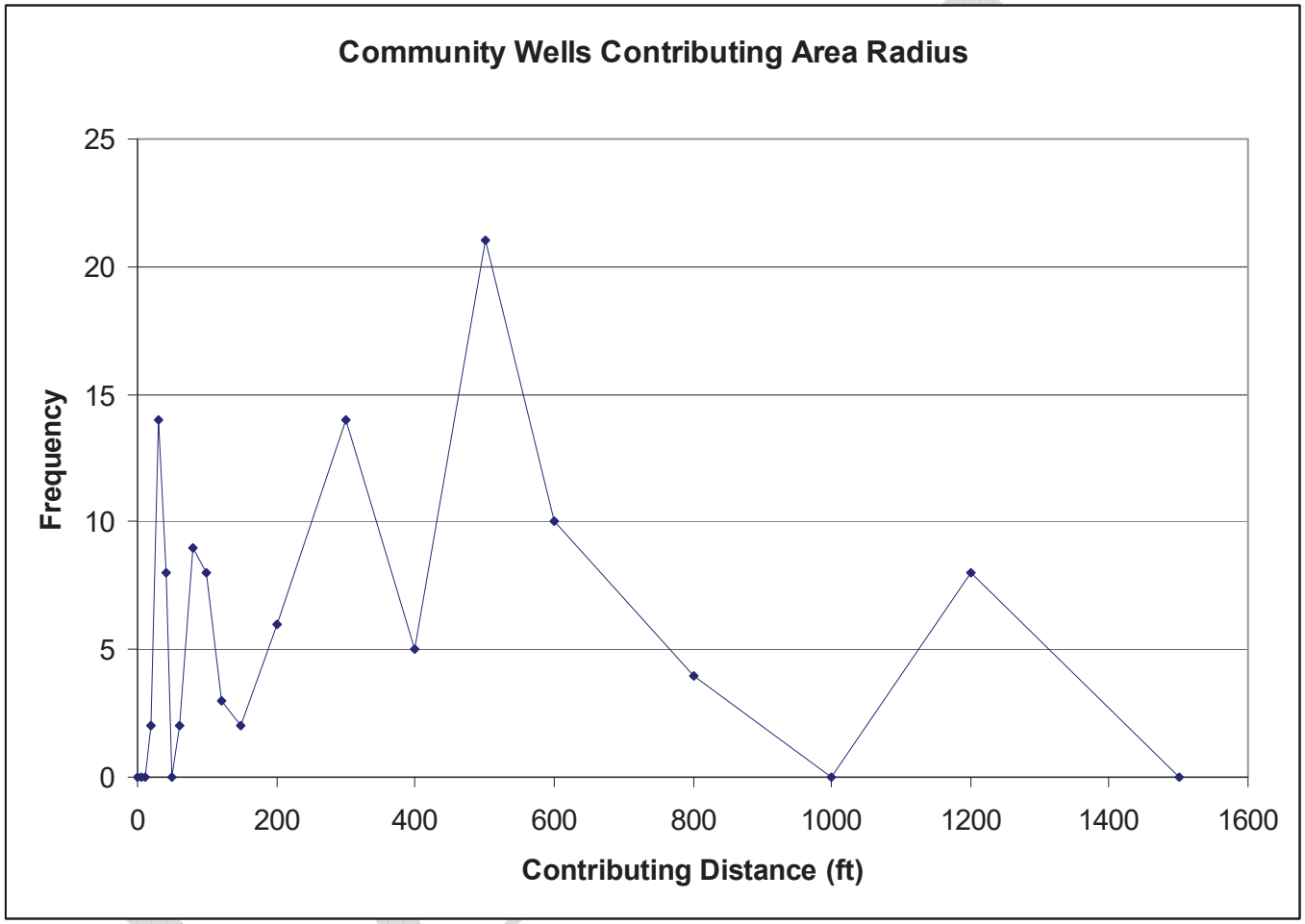
There are many situation where a private well is contained by the contributing area of a community well. What is not know is which the private wells are still in use today. When Towns began supplying water, many of the "in-town" wells were no longer used.

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How does this compare to the administrative wellhead protection limits?

- Zone 1 is a 1000-foot radius around the well and is a priority zone for managing potential sources of contamination; and
- Zone 2 is a one-mile (5,280-feet) radius which represents an estimate of the total recharge zone for the well.

Only the Purcellville and Middleburg wells have contributing areas radius values greater than 1,000 ft.



Water System Name	County(s) Served	Population Served	Primary Water Source Type	System Status	Water System ID
ALDIE WATER COMPANY	LOUDOUN	70	Groundwater	Active	VA6107010
BEACON HILL-LCSA	LOUDOUN	320	Groundwater	Active	VA6107037
FOXCROFT SCHOOL	LOUDOUN	290	Groundwater	Active	VA6107100
GRAYDON MANOR	LOUDOUN	33	Groundwater	Active	VA6107470
HAMILTON, TOWN OF	LOUDOUN	2000	Groundwater	Active	VA6107150
HILLSBORO, TOWN OF	LOUDOUN	90	Groundwater_under_infl_of_surface_water	Active	VA6107200
HIWAY TRAILER PARK, INC	LOUDOUN	72	Groundwater	Active	VA6107075
LEESBURG, TOWN OF	LOUDOUN	37000	Surface_water	Active	VA6107300
LENAH FARMS	LOUDOUN	800	Groundwater	Active	VA6107221
LOUDOUN COUNTY SANITATION AUTH	LOUDOUN	154589	Purch_surface_water	Active	VA6107350
LOVETTSVILLE, TOWN OF	LOUDOUN	1280	Groundwater	Active	VA6107400
LUCKETTS MOBILE HOME PARK	LOUDOUN	60	Groundwater	Active	VA6107420
MIDDLEBURG, TOWN OF	LOUDOUN	590	Groundwater	Active	VA6107450
NORTH SPRING BEHAVIORAL HEALTHCARE	LOUDOUN	77	Groundwater	Active	VA6107725
POTOMAC FARMS	LOUDOUN	100	Groundwater	Active	VA6107550
POTOMIA	LOUDOUN	50	Groundwater	Active	VA6107555
PURCELLVILLE, TOWN OF	LOUDOUN	6300	Surface_water	Active	VA6107600
RASPBERRY FALLS SUBDIVISION	LOUDOUN	650	Groundwater	Active	VA6107601
RESERVE AT ROKEBY FARM	LOUDOUN	25	Groundwater	Active	VA6107651
ROUND HILL, TOWN OF	LOUDOUN	3156	Groundwater	Active	VA6107650

Non-Transient Non-Community Water Systems: Water Systems that serve the same people, but not year-round (e.g. schools that have their own water system)

Water System Name	County(s) Served	Population Served	Primary Water Source Type	System Status	Water System ID
ADESA WASHINGTON DC (FORMER ABC DULLES)	LOUDOUN	80	Groundwater	Active	VA6107175
ALDIE ELEMENTARY SCHOOL	LOUDOUN	106	Groundwater	Active	VA6107011
ARCOLA COMMUNITY CENTER	LOUDOUN	200	Groundwater	Active	VA6107025
ARCOLA ELEMENTARY SCHOOL	LOUDOUN	430	Groundwater	Active	VA6107024
ARCOLA UNITED METHODIST CHURCH	LOUDOUN	200	Groundwater	Active	VA6107026
BANNEKER ELEMENTARY SCHOOL	LOUDOUN	171	Groundwater	Active	VA6107033
BLUEMONT COMMUNITY CENTER	LOUDOUN	100	Groundwater	Active	VA6107038
HILLSBORO ELEMENTARY SCHOOL	LOUDOUN	127	Groundwater	Active	VA6107205
LINCOLN ELEMENTARY SCHOOL	LOUDOUN	148	Groundwater	Active	VA6107325
LUCKETTS ELEMENTARY SCHOOL	LOUDOUN	269	Groundwater	Active	VA6107417
MOUNTAIN VIEW ELEMENTARY SCHOOL	LOUDOUN	800	Groundwater	Active	VA6107465

NOTRE DAME ACADEMY	LOUDOUN	200	Groundwater	Active	VA6107500
PHILOMONT COMMUNITY CENTER	LOUDOUN	75	Groundwater	Active	VA6107549
SIMPSON MIDDLE SCHOOL	LOUDOUN	1701	Groundwater	Active	VA6107675
TART LUMBER COMPANY, INC.	LOUDOUN	49	Groundwater	Active	VA6107623
TRAINING TRACK CENTER INC	LOUDOUN	100	Groundwater	Active	VA6107710
TROWBRIDGE STEEL COMPANY,	LOUDOUN	32	Groundwater	Active	VA6107715
TWISTED OAKS CONDOS PHASE 1	LOUDOUN	25	Groundwater	Active	VA6107520
UNITED RENTALS	LOUDOUN	26	Groundwater	Active	VA6107062
WATERFORD ELEMENTARY SCHOOL	LOUDOUN	161	Groundwater	Active	VA6107775

Transient Non-Community Water Systems: Water Systems that do not consistently serve the same people (e.g. rest stops, campgrounds, gas stations).

Water System Name	County(s) Served	Population Served	Primary Water Source Type	System Status	Water System ID
ALGONKIAN REG. PARK - COMFORT STATION	LOUDOUN	150	Groundwater	Active	VA6107018
ALGONKIAN REG. PARK - CONFERENCE CENTER	LOUDOUN	250	Groundwater	Active	VA6107015
ALGONKIAN REG. PARK - COTTAGES	LOUDOUN	200	Groundwater	Active	VA6107017
ALGONKIAN REG. PARK - MAINTENANCE	LOUDOUN	200	Groundwater	Active	VA6107019
ALGONKIAN REGIONAL PARK - POOL	LOUDOUN	200	Groundwater	Active	VA6107016
BANSHEE REEKS PARK	LOUDOUN	50	Groundwater	Active	VA6107045
BEAUTIFUL SOUTH, THE	LOUDOUN	25	Groundwater	Active	VA6107240
BRAMBLETON GOLF COURSE	LOUDOUN	25	Groundwater	Active	VA6107034
BRIAR PATCH B&B	LOUDOUN	50	Groundwater	Active	VA6107041
CAMP HIGHROAD	LOUDOUN	150	Groundwater	Active	VA6107052
CAMP POTOMAC WOODS-RIDGE AND MOUNTFORD	LOUDOUN	25	Groundwater	Active	VA6107120
CLAUDE MOORE PARK - KIOSK	LOUDOUN	25	Groundwater	Active	VA6107051
CLAUDE MR PK-VISIT CTR (PREV ROY GEIGER)	LOUDOUN	800	Groundwater	Active	VA6107030
DELI-O SNACK AND SHOP	LOUDOUN	25	Groundwater	Active	VA6107093
FRANKLIN PARK	LOUDOUN	400	Groundwater	Active	VA6107101
GOOD STONE INN, THE	LOUDOUN	25	Groundwater	Active	VA6107144
GOOSE CREEK GC	LOUDOUN	25	Groundwater	Active	VA6107148
GRANDALE FARM	LOUDOUN	30	Groundwater	Active	VA6107043
HAMILTON SAFETY CENTER/HARMONY HALL	LOUDOUN	250	Groundwater	Active	VA6107198
LOUDOUN COUNTY ANIMAL SHELTER	LOUDOUN	25	Groundwater	Active	VA6107349
LOWES ISLAND CLUB	LOUDOUN	725	Groundwater	Active	VA6107811
MIDDLEBURG COMMUNITY CENTER	LOUDOUN	150	Groundwater	Active	VA6107453
MORVEN PARK INTER EQUEST INST	LOUDOUN	50	Groundwater	Active	VA6107460

OATLANDS PLANTATION	LOUDOUN	30	Groundwater	Active	VA6107530
PATOWMACK FARM	LOUDOUN	50	Groundwater	Active	VA6107535
RASPBERRY PLAIN COUNTRY INN	LOUDOUN	25	Groundwater	Active	VA6107630
SKILLS USA	LOUDOUN	50	Groundwater	Active	VA6107012
STERLING RURITAN	LOUDOUN	50	Groundwater	Active	VA6107624
VFW-POST 1177	LOUDOUN	50	Groundwater	Active	VA6107760
WDF COMFORT STATION	LOUDOUN	25	Groundwater	Active	VA6107461
WDF MANSION	LOUDOUN	26	Groundwater	Active	VA6107462
WHEATLAND FARMS	LOUDOUN	50	Groundwater	Active	VA6107796
WHITEHALL ASSOCIATES LLC	LOUDOUN	25	Groundwater	Active	VA6107797

http://oaspub.epa.gov/enviro/sdw_query_v2.get_list?wsys_name=&fac_search=fac_beginning&fac_county=LOUDOUN&pop_serv=500&pop_serv=3300&pop_serv=10000&pop_serv=100000&pop_serv=100001&sys_status=active&pop_serv=&wsys_id=&fac_state=VA&last_fac_name=&page=1&query_results=&total_rows_found=

Contributing Recharge Area to Groundwater Wells

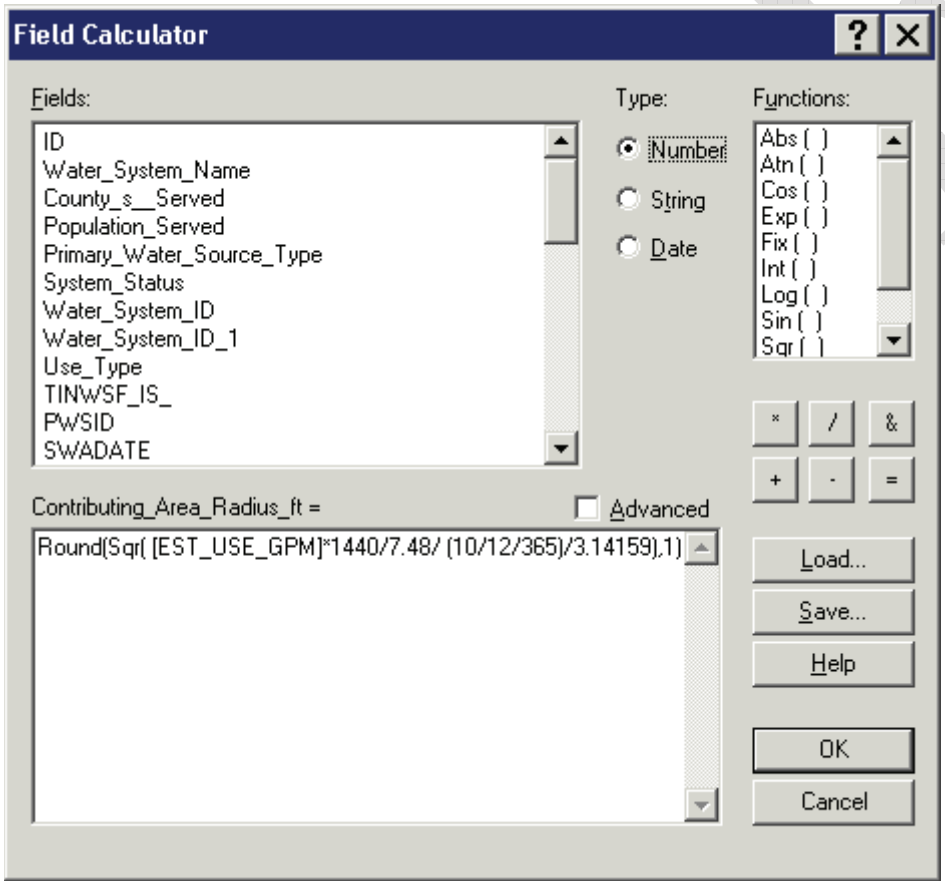
For each public water supply well, we can compute the average contributing area, based on a calculated net recharge to groundwater. The approach is to calculate a simple radius of circle in which the recharge equals the average pumping rate. This is a very simple first-order approximation. These values are much less than conservative estimates used in the wellhead protection strategy. The approach neglects regional groundwater gradient. This approach neglects non-steady pumpage. The approach does not allow for interference between wells.

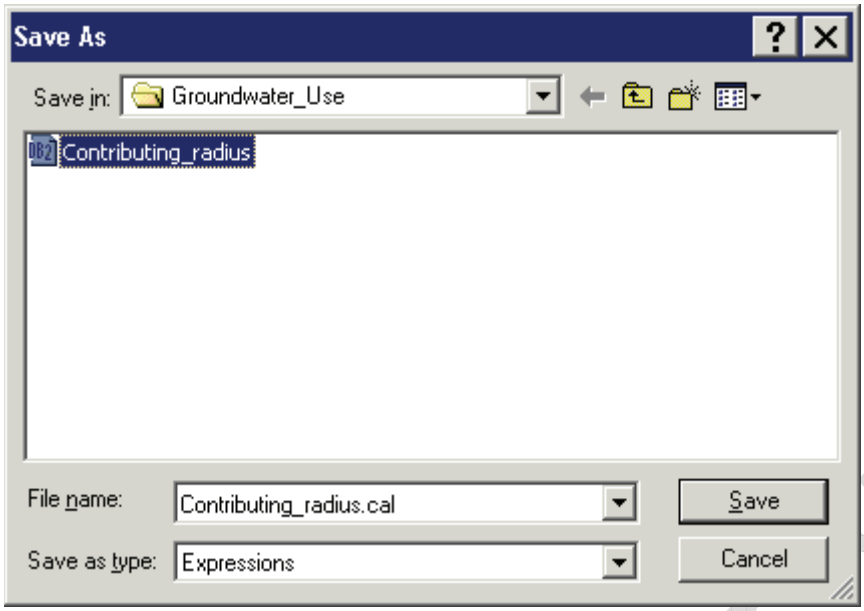
The formula is:

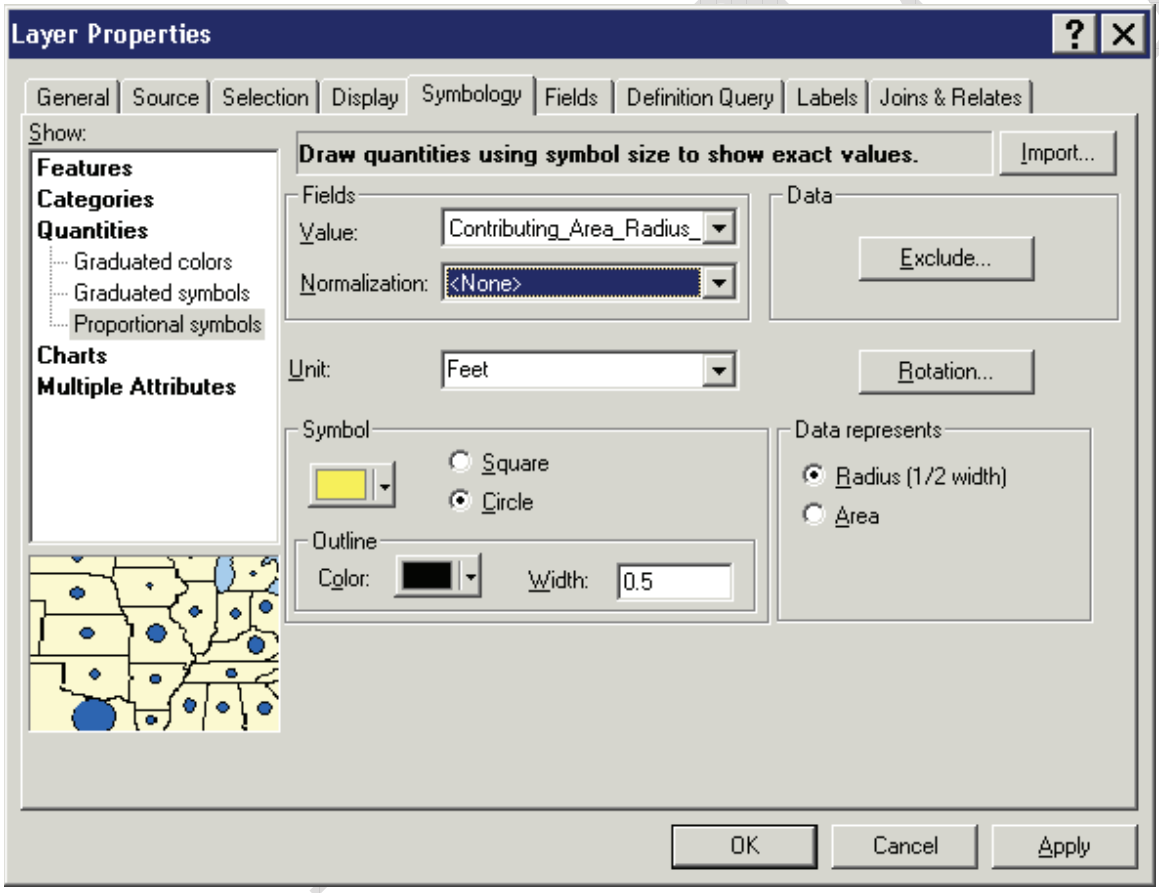
```
radius_ft = sqrt(rate_gpm*1440/7.48/(Recharge_in_per_year/12/365)/PI())
```

For example, a 1 gpm well requires recharge over a circle with a radius of 163.5 feet assuming 10 inches per year of recharge.

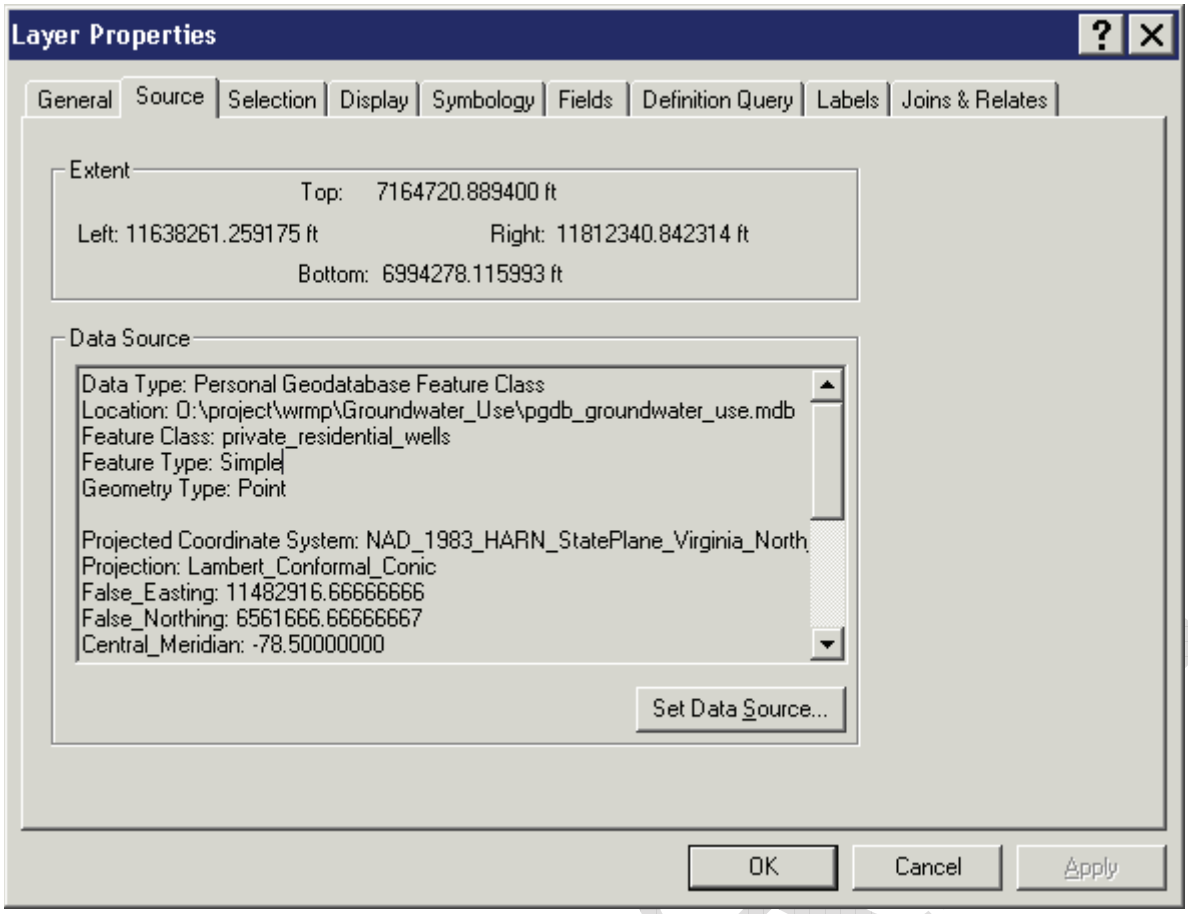
In geodatabase, add a field and calculate:



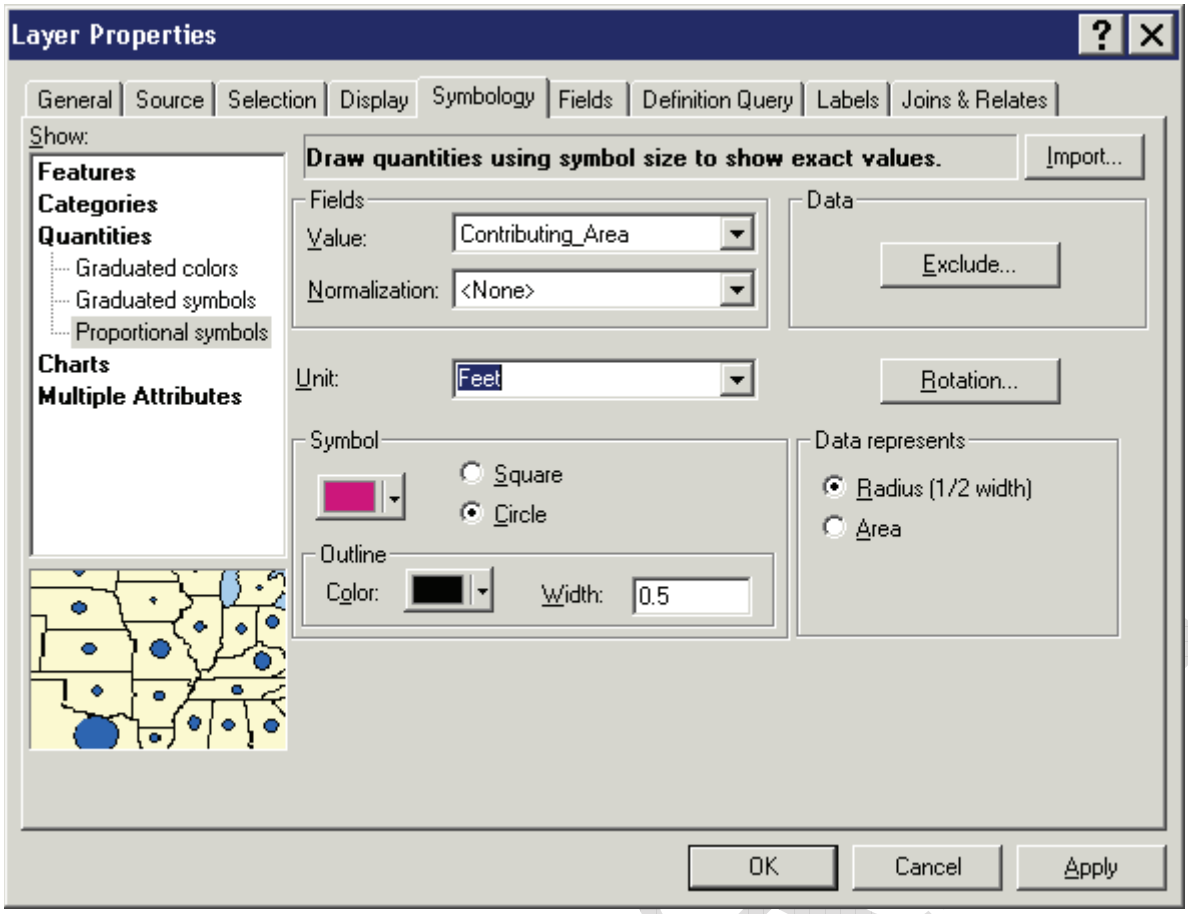




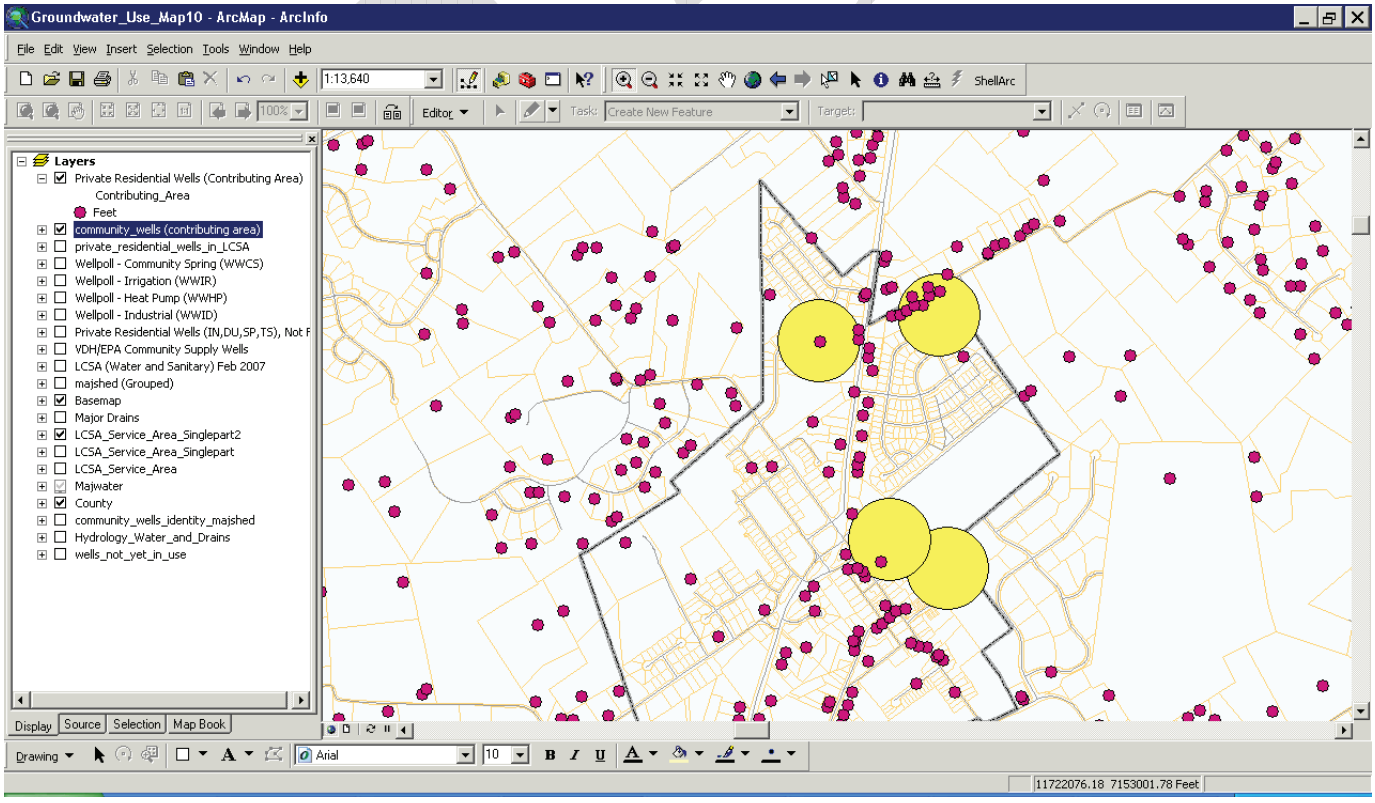
Now for private wells, lets assume about 270 gallons per day per well (per household). We add a field to the feature class “private residence wells” and set value to 71 feet. (See Excel file).


Layer Properties
General
Source
Selection
Display
Symbology
Fields
Definition Query
Labels
Joins & Relates
Extent
Top: 7164720.889400 ft
Left: 11638261.259175 ft
Right: 11812340.842314 ft
Bottom: 6994278.115993 ft
Data Source
Data Type: Personal Geodatabase Feature Class
Location: O:\project\wrmp\Groundwater_Use\pgdb_groundwater_use.mdb
Feature Class: private_residential_wells
Feature Type: Simple
Geometry Type: Point
Projected Coordinate System: NAD_1983_HARN_StatePlane_Virginia_North
Projection: Lambert_Conformal_Conic
False_Easting: 11482916.66666666
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Central_Meridian: -78.50000000
Set Data Source...
OK
Cancel
Apply

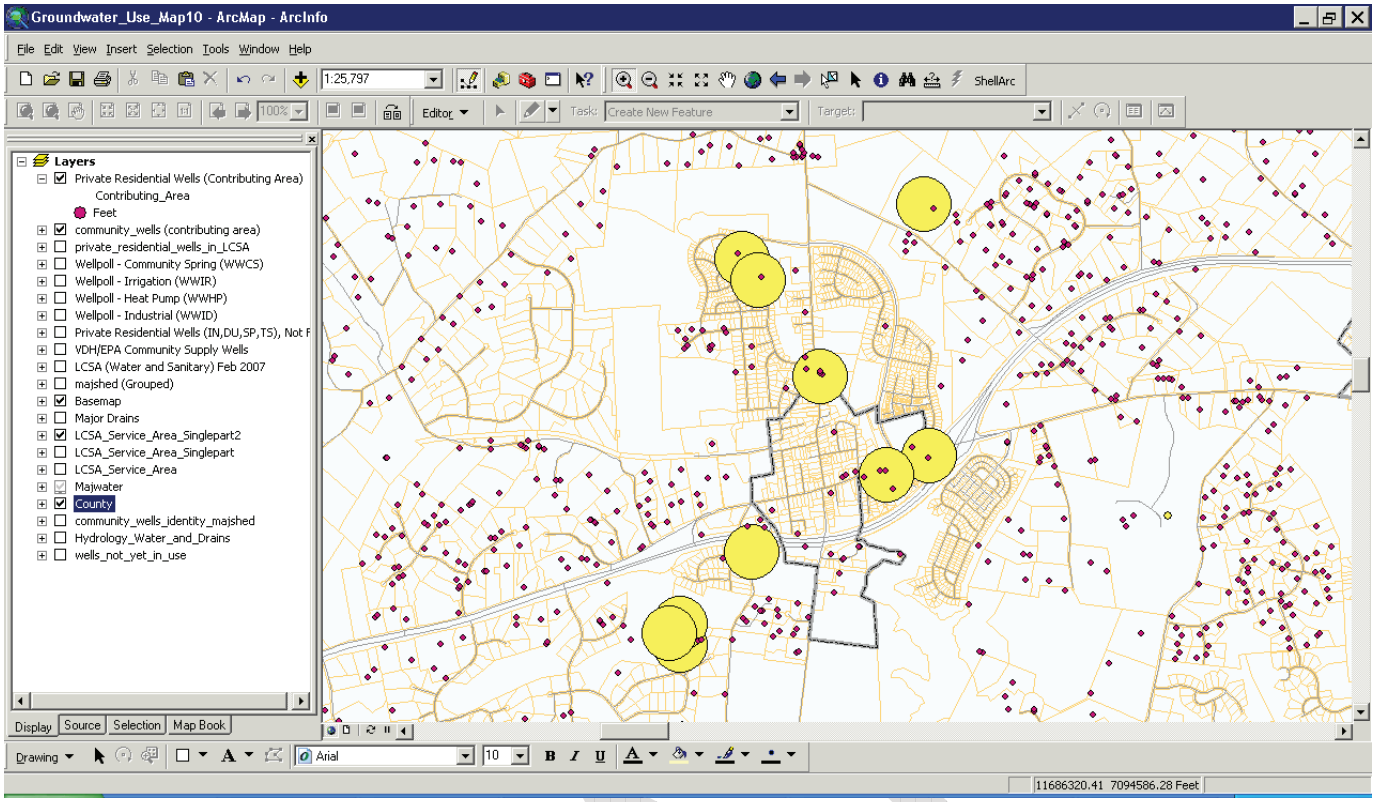
DRAFT



In Lovettsville:

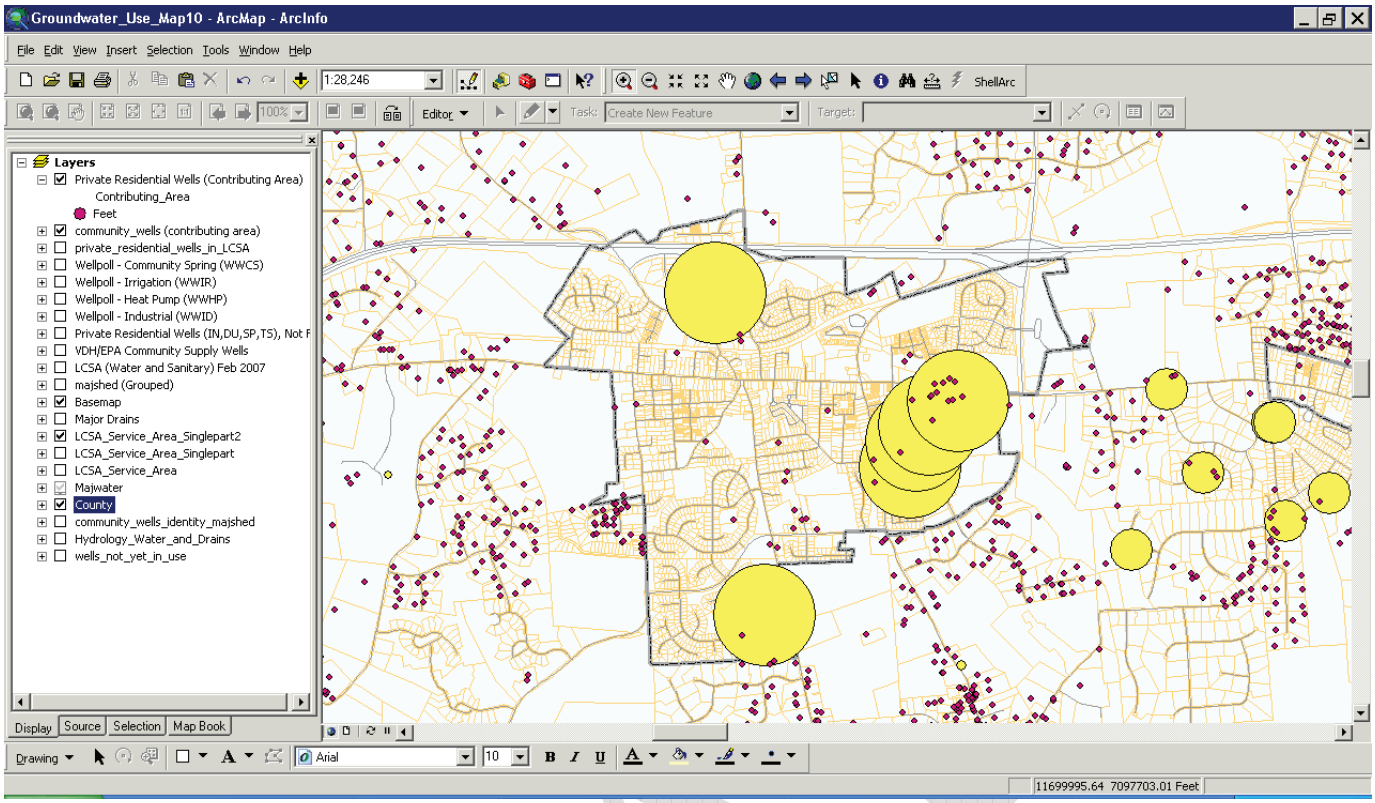


In Round Hill:

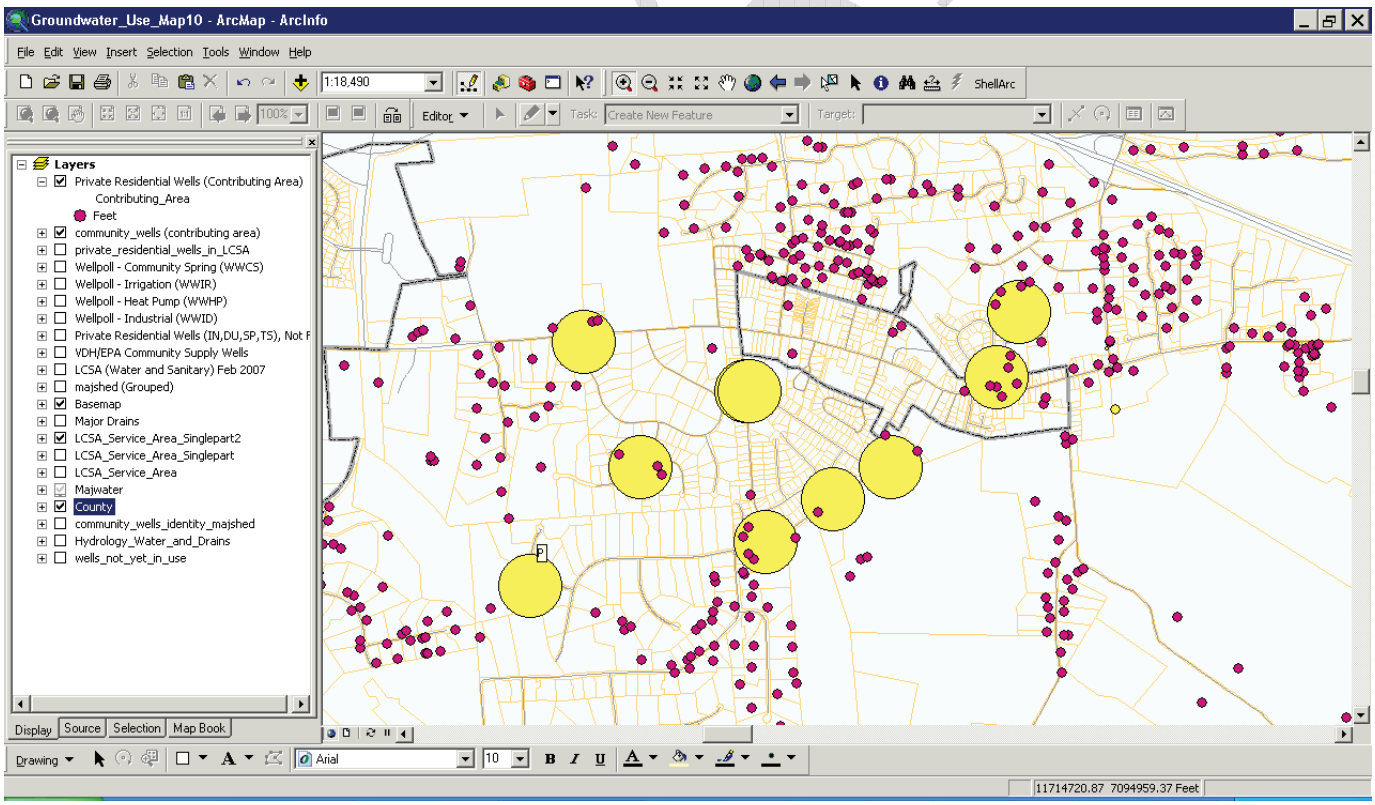

Groundwater_Use_Map10 - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
1:25,797
Editor
Task: Create New Feature
Target:
ShellArc
Layers
Private Residential Wells (Contributing Area)
Contributing_Area
Feet
community_wells (contributing area)
private_residential_wells_in_LCSA
Wellpoll - Community Spring (WWCS)
Wellpoll - Irrigation (WWIR)
Wellpoll - Heat Pump (WWHP)
Wellpoll - Industrial (WWID)
Private Residential Wells (IN,DU,SP,TS), Not F
VDH/EPA Community Supply Wells
LCSA (Water and Sanitary) Feb 2007
majshed (Grouped)
Basemap
Major Drains
LCSA_Service_Area_Singlepart2
LCSA_Service_Area_Singlepart
LCSA_Service_Area
Majwater
County
community_wells_identity_majshed
Hydrology_Water_and_Drains
wells_not_yet_in_use
Display Source Selection Map Book
Drawing
Arial
10
11686320.41 7094586.28 Feet

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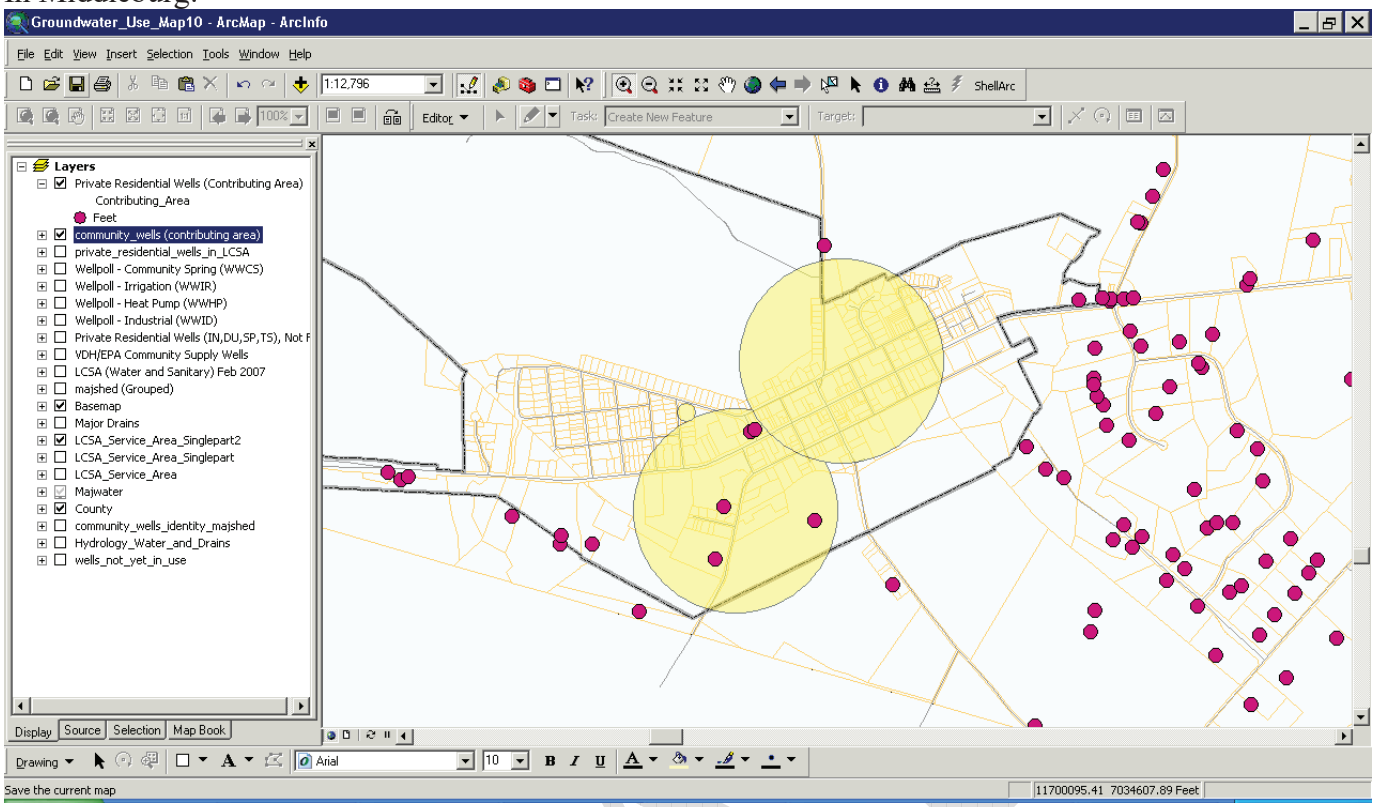
In Purcellville:



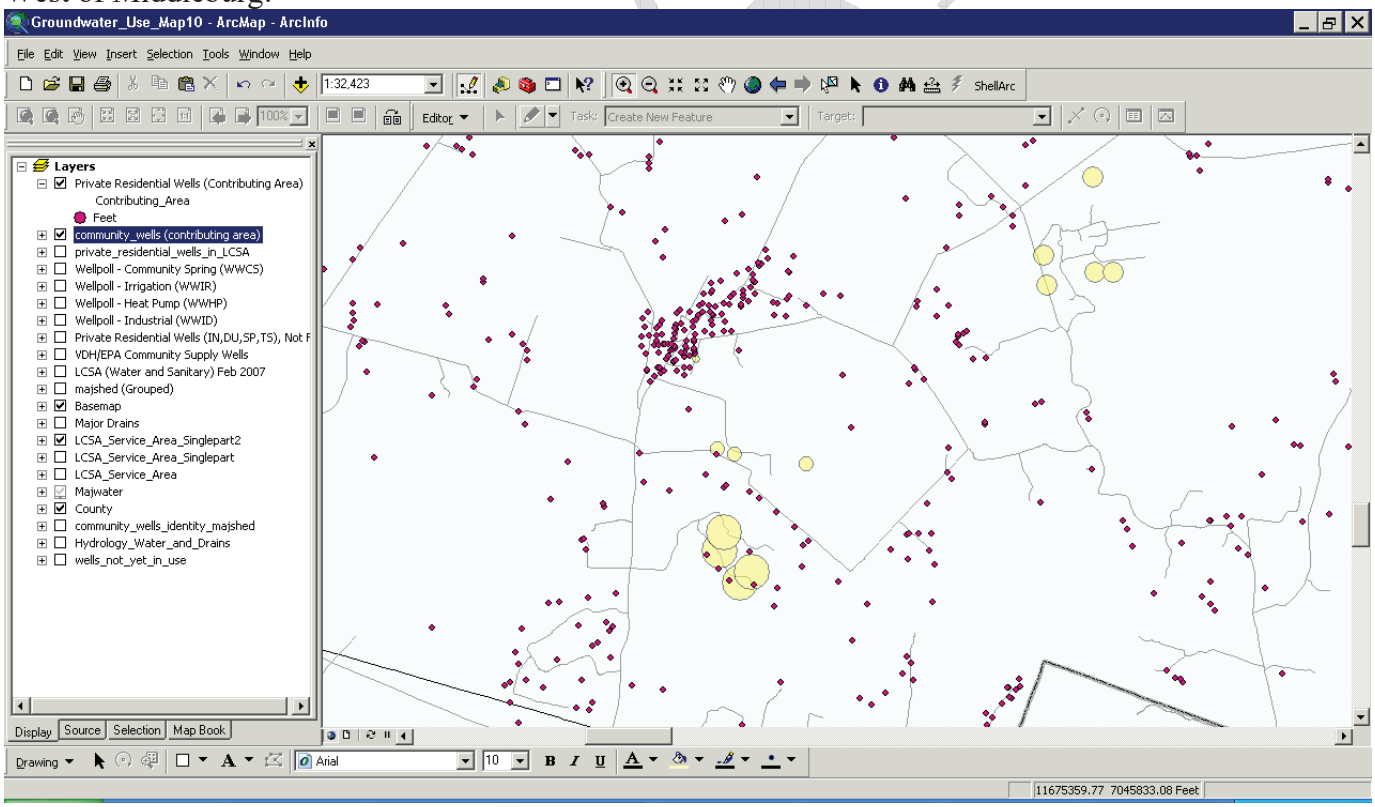
In Hamilton:



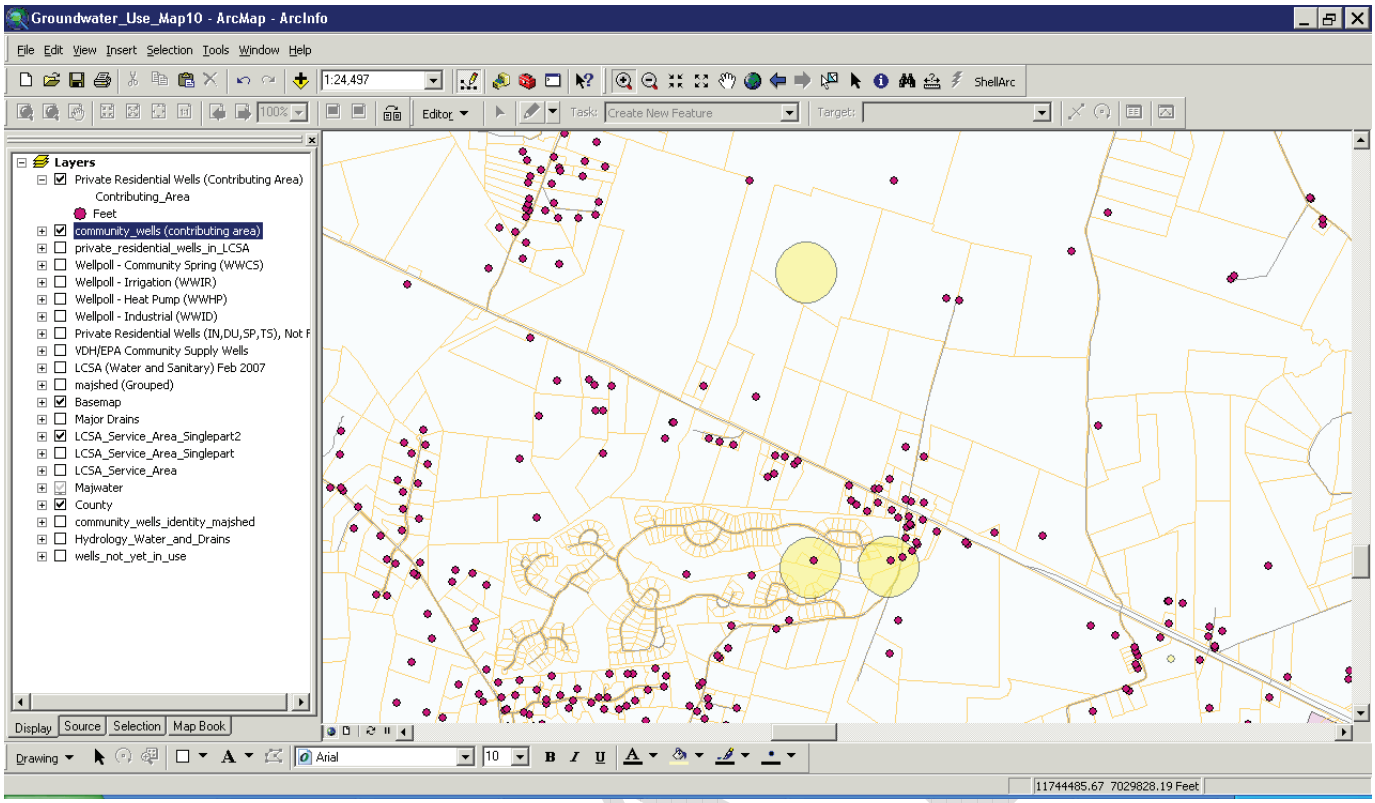
In Middleburg:



West of Middleburg:



In Lenah Run:



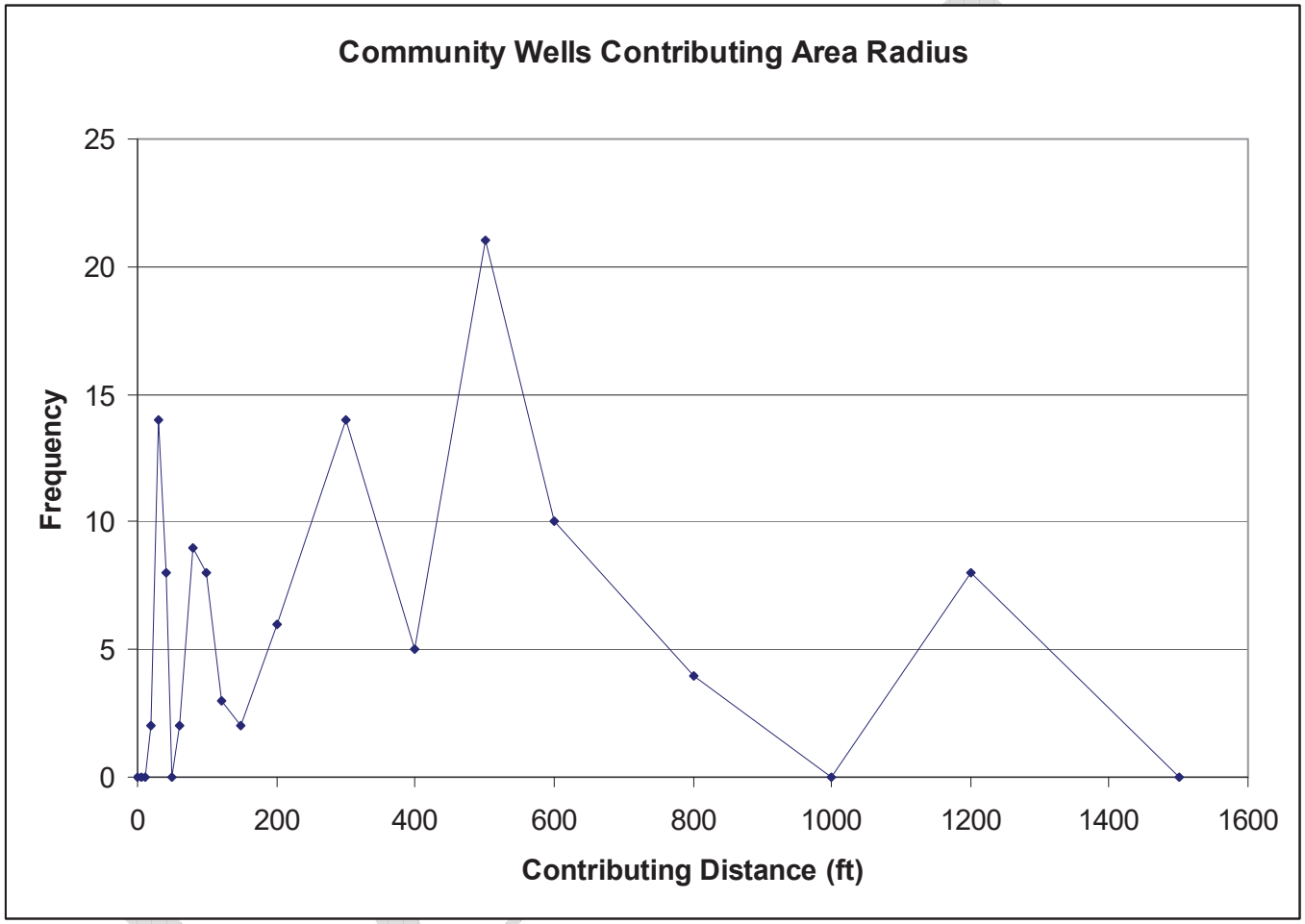
There are many situation where a private well is contained by the contributing area of a community well. What is not know is which the private wells are still in use today. When Towns began supplying water, many of the "in-town" wells were no longer used.

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How does this compare to the administrative wellhead protection limits?

- Zone 1 is a 1000-foot radius around the well and is a priority zone for managing potential sources of contamination; and
- Zone 2 is a one-mile (5,280-feet) radius which represents an estimate of the total recharge zone for the well.

Only the Purcellville and Middleburg wells have contributing areas radius values greater than 1,000 ft.



CWMP Population Methodology

Data Sources

- U.S. Census Bureau, *Census 2000* block data
- Loudoun County Department of Management and Financial Services population estimates through 2007.
- Loudoun County's Round 7.1 Cooperative Forecasts submitted to the Metropolitan Washington Council of Governments in June 2007.

Methodology

2000 Population

The Census 2000 census block populations are the building blocks for all estimates and forecasts post census. There are 2318 census blocks and 161 watersheds in Loudoun County. The watersheds do not follow the census block boundaries. Therefore, estimates of the 2000 population by watershed needed to be calculated. Due to time and resource limitations, the 2000 population estimates by watershed were calculated under the assumption that the population is evenly distributed throughout the census block.

2005 and 2007 Population

The 2005 and 2007 watershed populations were calculated by summing the population growth with the 2000 population. The County Demographer, whom is within the Department of Management and Financial Services, maintains a GIS database of the residential building permits issued from 2000 to the present and the estimated population associated with each of these new residential units. The factors that are used to calculate the estimated population within each new residential unit were adopted by the Fiscal Impact Committee and the Loudoun County Board of Supervisors in February 2007 and are documented in the Fiscal Impact Committee *2006 Annual Update* report. The watershed that each new residence is within was determined by performing a GIS overlay of the Demographer's residential permit database with the watersheds. A summary of the growth from 2000 to 2005 and from 2000 to 2007 by watershed was then achieved using this overlay data.

2010 to 2030 Population

The forecasted population growth from 2007 to 2030 was calculated using the Demographer's traffic analysis zone population growth data 2007 to 2030. The 2010, 2020, and 2030 traffic analysis zone figures were part of Loudoun County's Round 7.1 Cooperative Forecasts submission to the Metropolitan Council of Governments. The sum of the watershed 2010, 2020, and 2030 populations will equal the sum of the 2010, 2020, and 2030 traffic analysis zone populations.

The Route 7 traffic analysis zone forecasts were produced using a variety of different data sources. Approved residential projects, planned land uses according to the County's Revised General Plan, vacant land, and past growth trends were used to derive the traffic analysis zone data. Due to time and resources this level of analysis was not performed for the watersheds. There are 126 traffic analysis zones and 161 watersheds in Loudoun County. The watersheds do not follow the traffic analysis boundaries. Therefore, estimates of the growth from 2007 to 2010, 2010 to 2020, and 2020 to 2030 were calculated under the assumption that the forecasted population growth is evenly distributed throughout the census block.

LCSA Service Area Exclusion

Background: Many of the legacy groundwater wells are no longer used as the area is now served by Loudoun County Sanitation Authority (LCSA) water distribution system. In these areas, we need to exclude legacy private water wells that are no longer in use.

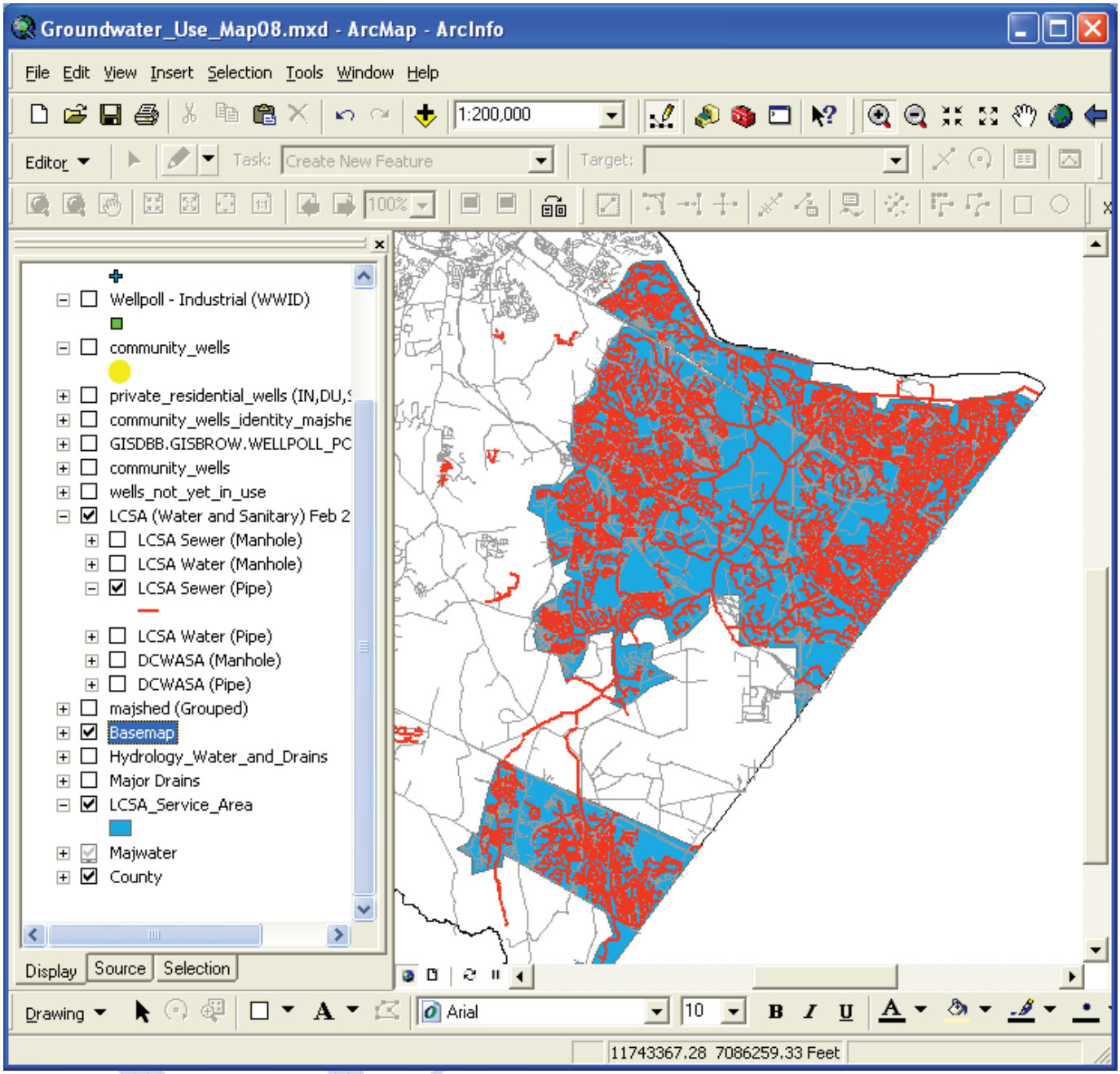
Approach: First, develop a LCSA Service area based on the latest GIS files for water distribution pipes.

Next, review wells in the service area and selectively exclude those wells that are presumed to no longer be in service.

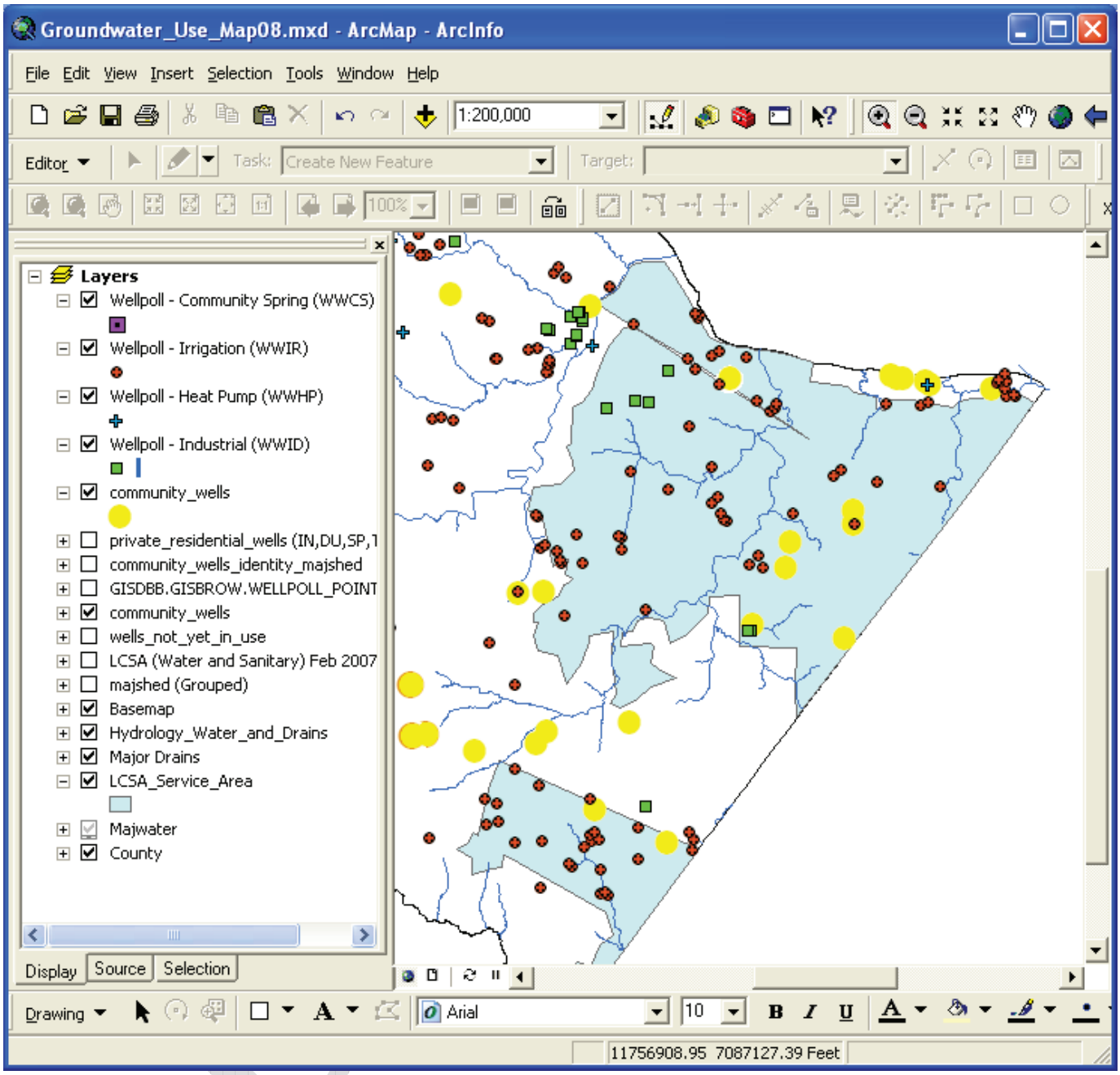
Definition of LCSA Service Area:

Currently LCSA does not offer a service area polygon. To facilitate the well exclusion, a polygon was created to "mask" the LCSA service area as shown below.

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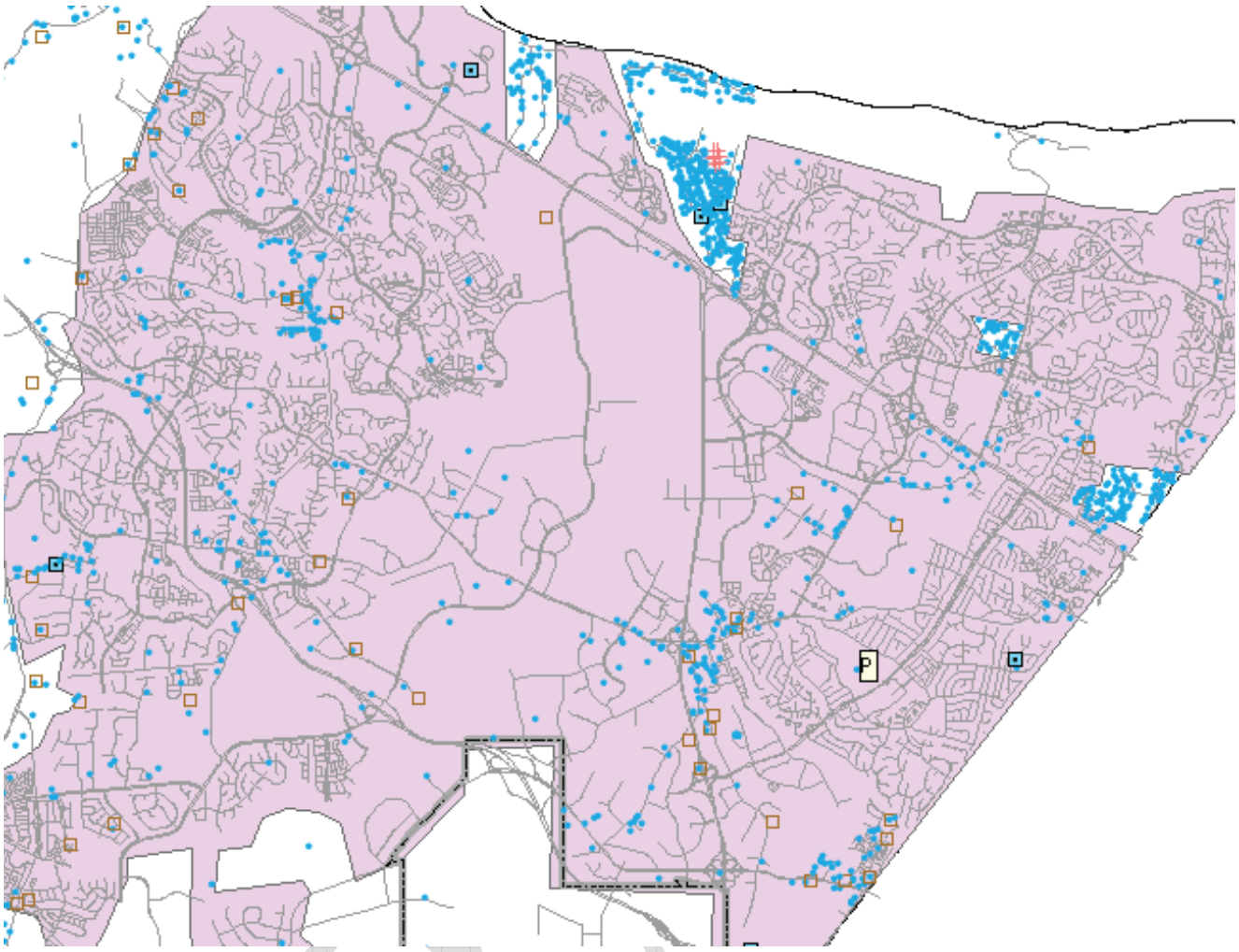

Groundwater_Use_Map08.mxd - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
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Editor
Task: Create New Feature
Target:
Wellpoll - Industrial (WWID)
community_wells
private_residential_wells (IN,DU,
community_wells_identity_majshe
GISDBB.GISBROW.WELLPOLL_PC
community_wells
wells_not_yet_in_use
LCSA (Water and Sanitary) Feb 2
LCSA Sewer (Manhole)
LCSA Water (Manhole)
LCSA Sewer (Pipe)
LCSA Water (Pipe)
DCWASA (Manhole)
DCWASA (Pipe)
majshed (Grouped)
Basemap
Hydrology_Water_and_Drains
Major Drains
LCSA_Service_Area
Majwater
County
Display
Source
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Drawing
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11743367.28 7086259.33 Feet

Now, examine some of the wells in the service, specifically highlight the irrigation and industrial as well as previously identified “community wells” as per VDH and EPA records.



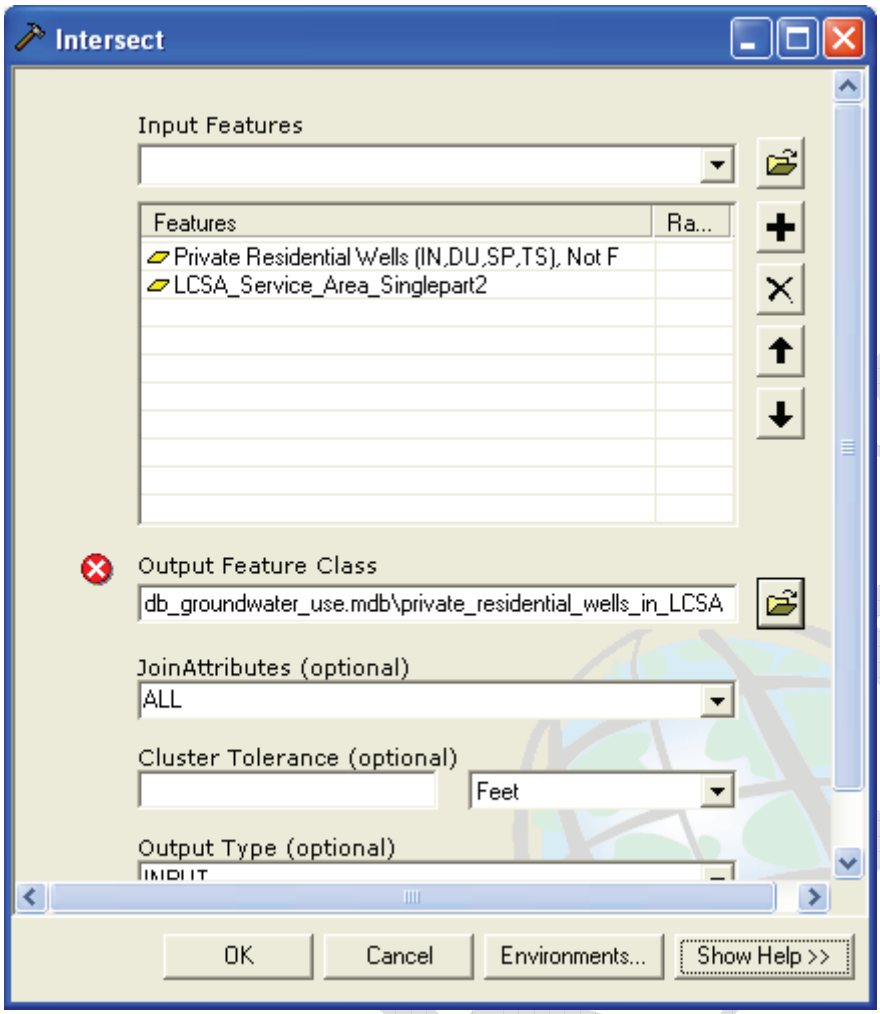
Need to review each of the VDH Community water wells that are within the LCSA services area.

Looking more closely at the data, we need to create a donut to exclude some of the older subdivisions still on well water and septic even though LCSA surrounds the neighborhood. To do this, use “Edit>Cut Polygon” then Sketch tool (read on-line help for more). This will result in a multipart feature. We can clean this up using “Xtools>Feature Conversion>Convert Multipart to SinglePart”. The result looks like



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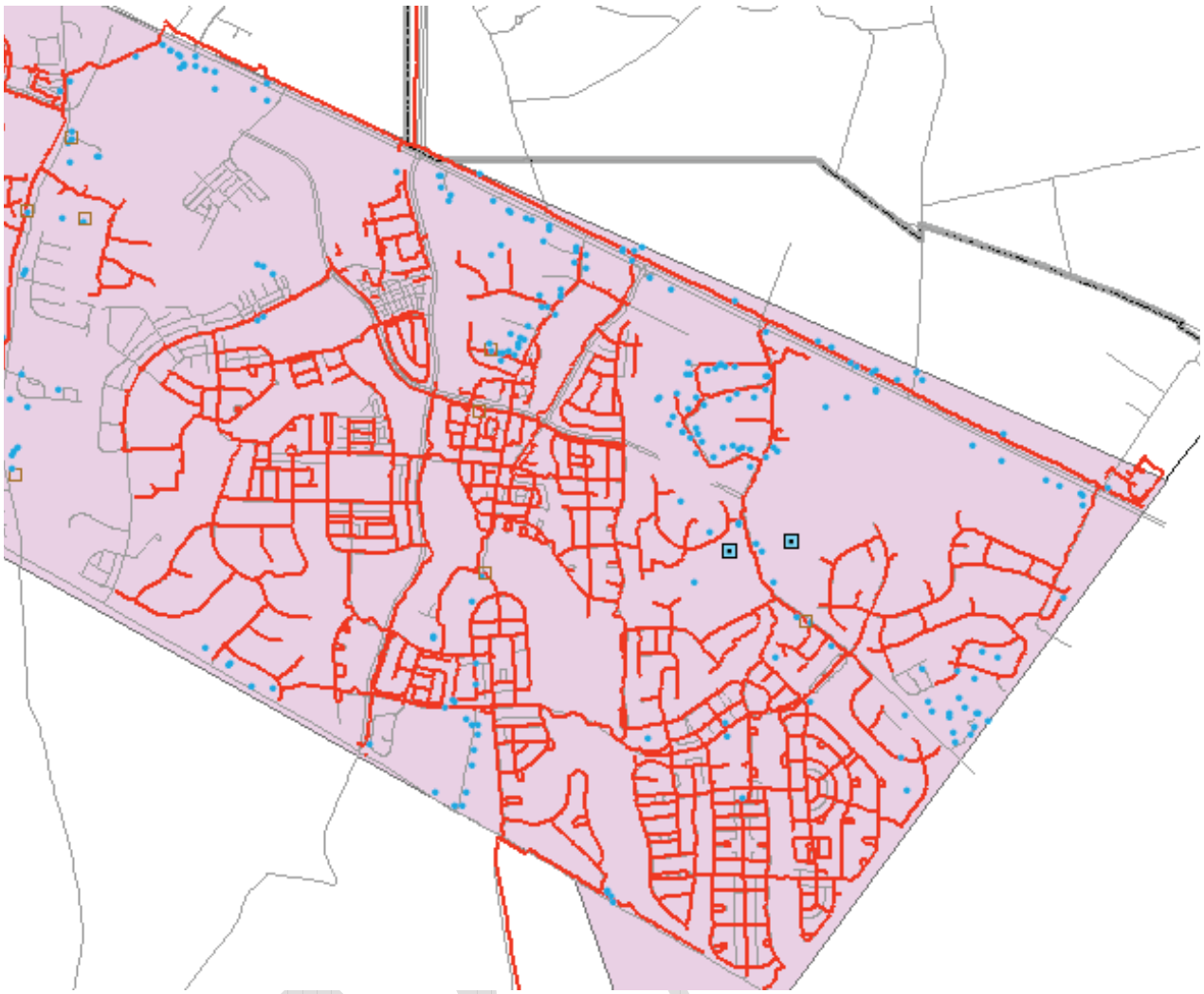
Now we want to select those private wells in the LCSA service area. The standard "Selection>Select by Location" fails to work properly. Instead, use "ArcToolBox>Data Management>Intersect":



This analysis is first order and there may be a few wells in use in or near the actual LCSA service area. For example wells along Rt. 50 may still be in use, but will be excluded through this analysis. Because the goal is to develop an overall water budget, such errors are probably acceptable in light of lack of detail on actual well-by-well usage.

We also need to develop exclusion for all wells in well-poll, not just private wells. ???

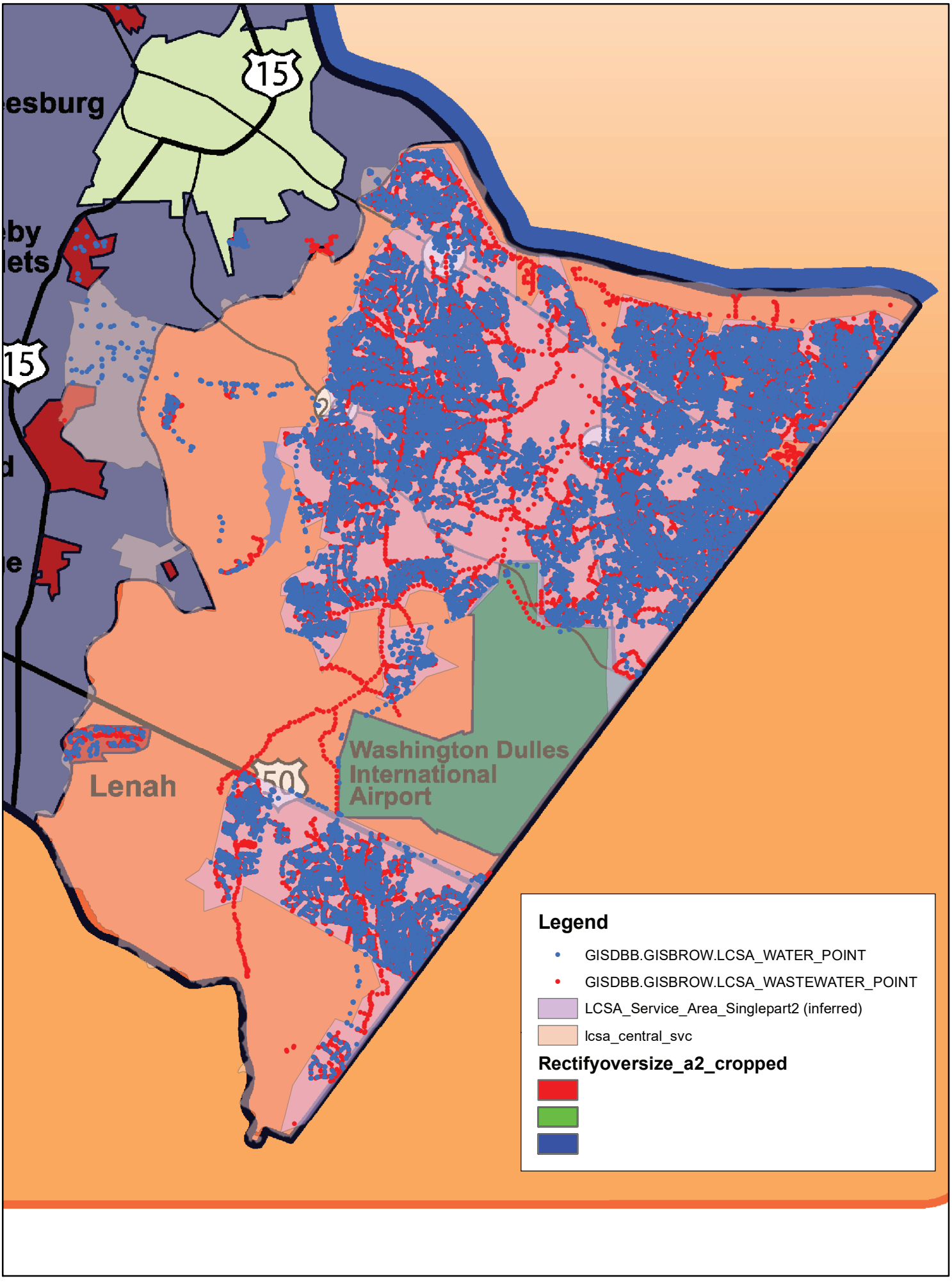
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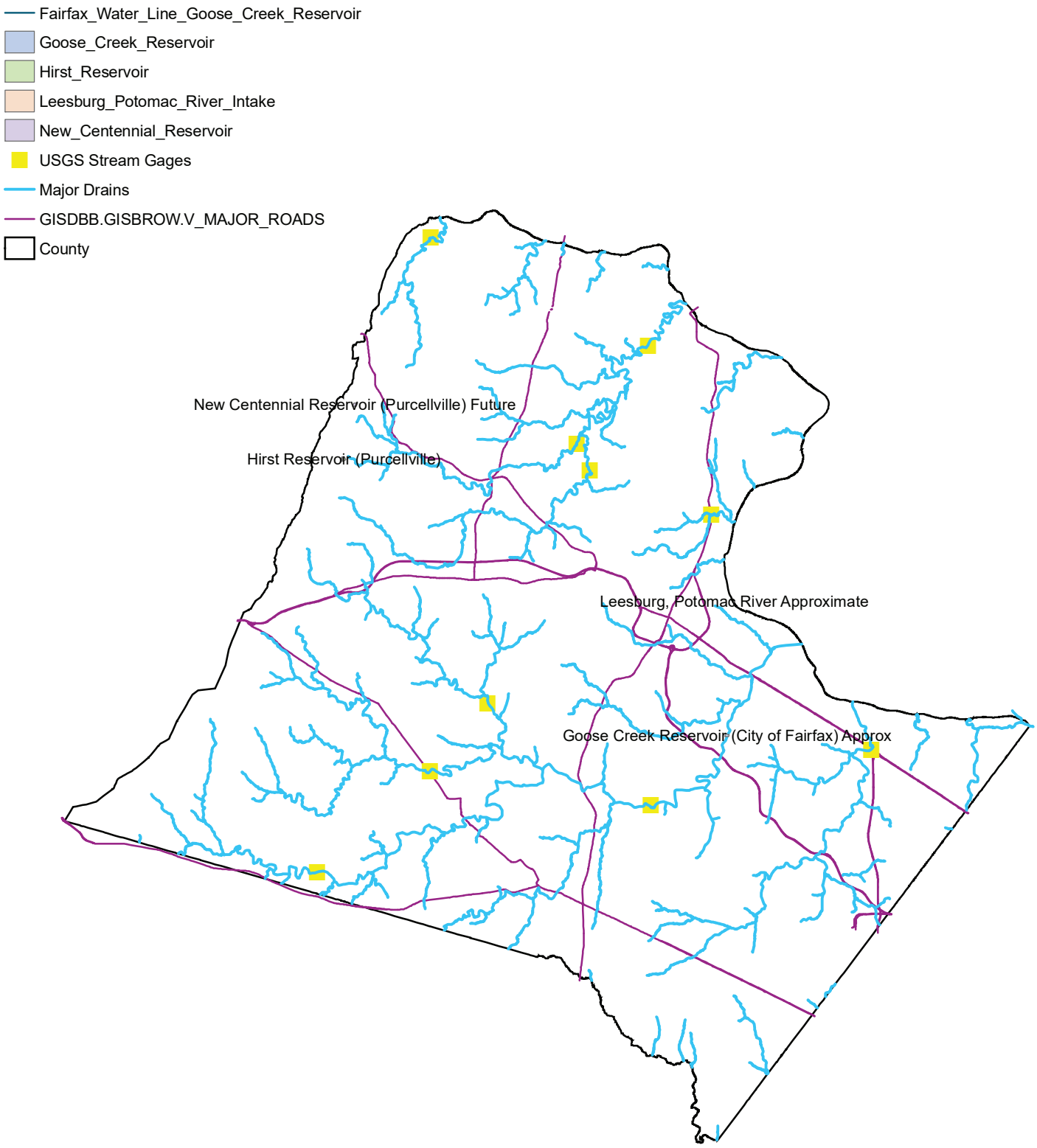


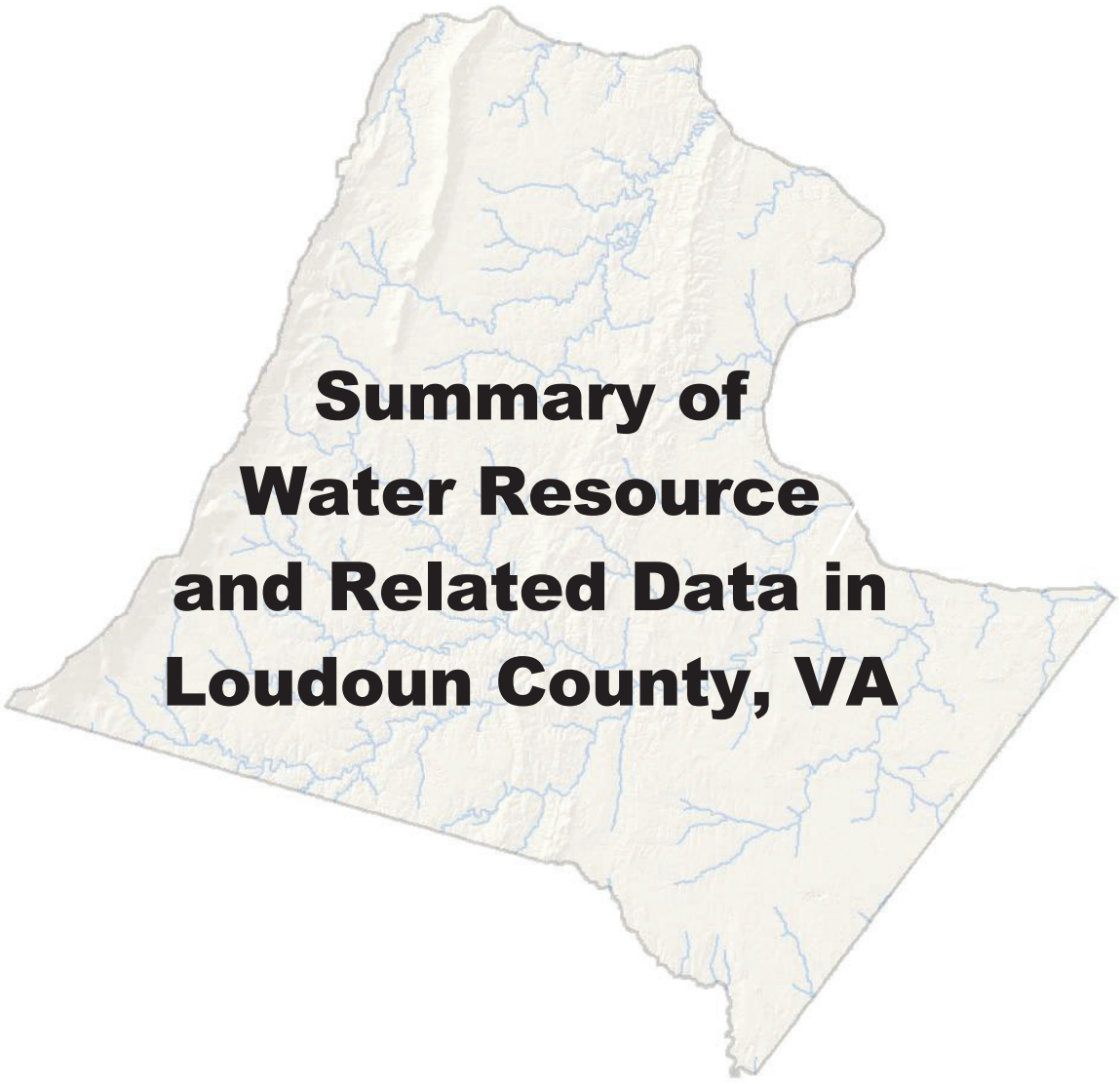
Working folder: O:\project\wrmp\Groundwater_Use

Next Step:

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15
esburg
by
lets
15
Lenah
50
Washington Dulles
International
Airport
Legend
GISDBB.GISBROW.LCSA_WATER_POINT
GISDBB.GISBROW.LCSA_WASTEWATER_POINT
LCSA_Service_Area_Singlepart2 (inferred)
lcsa_central_svc
Rectifyoversize_a2_cropped


Legend
Fairfax_Water_Line_Goose_Creek_Reservoir
Goose_Creek_Reservoir
Hirst_Reservoir
Leesburg_Potomac_River_Intake
New_Centennial_Reservoir
USGS Stream Gages
Major Drains
GISDBB.GISBROW.V_MAJOR_ROADS
County
New Centennial Reservoir (Purcellville) Future
Hirst Reservoir (Purcellville)
Leesburg, Potomac River Approximate
Goose Creek Reservoir (City of Fairfax) Approx
0 1.5 3 6 9 12
Miles



Summary of Water Resource and Related Data in Loudoun County, VA

Prepared by:

Loudoun County
Department of Building & Development
Water Resources Team

September, 2008

Loudoun County - Water Resources Data Summary

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This data summary highlights those data most pertinent to overall water resource monitoring and hydrological analysis. The discussions include a brief description of the data source, a summary of the data contents and relevant notes regarding the data compilation and status.

1 Groundwater Data

1.1 Loudoun County Groundwater, Well, and Pollution Sources

Well construction and groundwater information in database (MS Access) with locations in GIS maintained by B&D and Health Department. Source of most data from paper files generated during Health Department well permitting process (e.g., GW2 well construction form). Subset of the WellPoll database, which includes well data and pollution sources data. Data on ~18,500 wells dating from 1930 to present, with information of varying quality and completeness including: location (VA state plane coordinates), surface elevation (62% complete), well depth (70%), casing depth (65%), static water level (53%) {suspect accuracy}, total yield (60%), depth of primary yield zone (60%), and transmissivity (~250 values).

Also includes groundwater quality data. Water quality data for a limited number of parameters are entered in the database for some wells (~2,100) constructed and tested prior to 2002. Water quality data provided digitally to B&D by National Testing Labs started in 2002 and is available for approximately 2,250 wells. These data are considered level A quality and typically consist of 100 physical/chemical water quality parameters per well for a total of more than 200,000 individual analyses. NTL data linked to the groundwater database by Health Department Permit No.

Also includes data on potential pollution sources – primarily on-site sewage disposal systems (e.g., drain fields) but also other sites such as cemeteries, landfills, chemical storage sites, etc. Currently there are approximately 14,000 records with site ID numbers and corresponding points in GIS. Data in some of the old records may be obsolete. Currently, data are obtained primarily from the Health Department sewage disposal system permitting process.

1.2 USGS Groundwater Wells

The USGS operates three real-time water level measurement wells within Loudoun County or contributing watersheds. One well is located on the ridge of Short Hill north of Hillsboro (1963 to present), one is located east of Leesburg (1977 to present), and the third is in Prince William County, just south of the Loudoun County line in the Bull Run watershed (1968 to present). Data is added to B&D databases through automated web queries.

1.3 County Hydrogeologic Studies

These reports are valuable sources of high-quality groundwater data, including level data, geologic logs and aquifer testing data. The reports are required for most large subdivisions, as well as other developments with anticipated usage greater than 10,000 gallons per day. The County has ~ 165 reports on file. Well construction and aquifer testing data from these reports are electronically stored in County databases. Over 1,950 wells have been drilled and tested through this process.

1.4 USGS NAWQA Wells

As part of the USGS National Water-Quality Assessment Program (NAWQA) program, fourteen wells in Loudoun County were sampled between 1994 and 2004 for a broad range of chemicals. Data are compiled in a personal geodatabase format with related time series table. As many as 140 analyses per sample were analyzed including pesticides, radionuclides and volatile organic compounds. Two well sites in Purcellville were sampled in 2003 and 2004 with over 500 analyses each and showed little change over time. The total number of water quality analyses reported exceeds 3,000.

1.5 WRMP Monitoring Wells

B&D started monitoring groundwater levels in the county in 2003 and, with two wells added in December 2006, currently monitors ten wells (with the goal of establishing 17-20 wells by 2009). Water levels recorded by automatic data loggers several times per day and manually downloaded. Records are incomplete for some wells. (Water quality sampling from many of these wells may begin by late 2008.)

1.6 Water Quality Data from LCSA and VADH Public Water Supplies

These data are collected by state and local agencies to monitor public water supply wells. The only data obtained is from the annually published Consumer Confident Reports (CCR).

1.7 Luck Stone Special Exception Water Quality Reports

As part of the County regulatory process, Luck Stone Quarries supply B&D with quarterly groundwater quality and level data from their Bull Run facility.

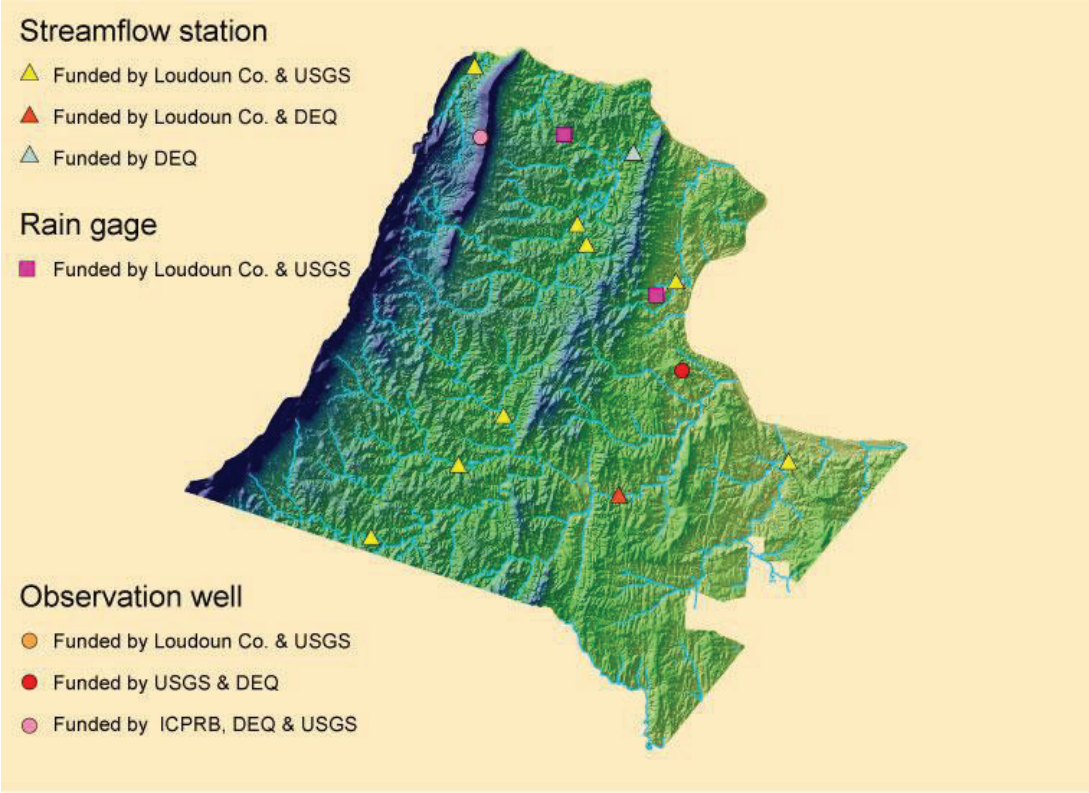
1.8 EPA Safe Drinking Water Information System (SDWIS)

Water Quality Data from Public water supply wells in Loudoun County. These data are routinely updated by EPA.

2 Government Hydrologic-related data:

2.1 Stream Stage & Discharge – USGS (and DEQ)

Ten stream gaging sites in Loudoun County (see map for locations) established by USGS and currently operated by USGS (8 sites) and DEQ (2 sites). Data include daily stage (ft) and discharge (cfs). Site locations and POR are: Broad Run at Rt. 7 (10/01-present), Limestone Branch at Rt. 15 (9/01-present), Goose Creek near Rt. 621 (1/30-present), Catoctin Creek at Taylorstown (11/70-present), S.F. Catoctin Creek at Rt. 698 (7/01-present), N.F. Catoctin Creek at Rt. 681 (8/01-present), N.F. Goose Creek at Rt. 734/Lincoln (8/01-present), Beaverdam Creek at Rt. 734/Mountvail (8/01-present), Goose Creek nr Middleburg (10/65-12/96 | 6/01-present), Piney Run at Rt. 671 (10/01-present). POR data and some statistics for these sites available on USGS web page. Since December 2006, the 15-minute "real-time" data available for only the last 30 days have been recorded as monthly snapshots, providing stage/discharge of provisional values for more detailed hydrographs. The Instantaneous Data Archive contained over 2.3 million records of 15-minute data since 1990.



Locations of stream gages, wells, and rainfall monitoring sites managed by, or in cooperation with, USGS.

2.2 Precipitation Data – National Weather Service / National Climatic Data Center

Daily precipitation (rain and frozen) collected as part of the National Weather Service Cooperative Station Network and purchased from NCDC. (These data sets are for distribution only by NCDC.) Five stations with relatively long and complete data sets in Loudoun County and vicinity currently purchased by B&D: Lincoln (1/30-7/06), Mt. Weather (8/48-7/06), Sterling RCS (9/77-7/06), Dulles Airport (3/63-7/06), and The Plains in Fauquier County (4/54-7/06). (See map for station locations.) Data sets have been converted from text files into Excel spreadsheets, missing records identified, and have monthly and annual totals calculated. **{Commercial data - restricted distribution}**

2.3 Precipitation Data – USGS

Two automated rain gauges (not heated to melt frozen precipitation) installed and activated for Loudoun County by the USGS in early 2003 (see map for locations). One station located in Lovettsville and one at Plains of Raspberry golf course. Stations equipped with telemetry devices for near-real time data posting to USGS web site. Equipment and reporting malfunctions resulted in impaired record quality to date.

2.4 USGS National Hydrology Data (NHD)

The NHD file, mapped at a 1:24,000 scale, provides a functional geometric network of all perennial and some intermittent streams. Stream locations are sometimes not consistent with recently developed suburban areas in eastern Loudoun. The geodatabase includes stream and water body naming consistent with GNIS.

2.5 USGS Elevation (NED)

The National Elevation Data available as a seamless download replaces the former DEM (Digital Elevation Model) tiles. Posting is 30 meters. Raster files are downloaded, converted to HARN and scaled from meter to feet.

2.6 National Wetlands Inventory (NWI)

The NWI inventory polygon file from the US Fish & Wildlife Service has been downloaded, merged and dissolved. In Loudoun the images dates are 1981 to 1994. Data are used for comparison with County wetlands models for eastern and western Loudoun.

2.7 Watershed Boundaries

There are several sources for watershed boundaries at different scales by several agencies.

Loudoun County watershed boundaries (aka "majsheds"), are mapped at 1:2,400 scale. There are 161 polygons, limited to Loudoun County. These are legacy, developed several years ago. Data is generally still current, though not necessarily completely consistent with the current "topo" layer. The mapping is to the 7th level. Naming is not consistent with federal efforts; however, naming is included for each level. Metadata is incomplete.

VA DCR: This includes 5th and 6th order of hydrologic units, mapped at 1:24,000 scale. The 6th order corresponds to the 12 digit HUC (12 digits - i.e. 020700040101). The 5th order corresponds to 10-digit HUC. Data is limited to state of Virginia.

NRCS USDA: Currently all of Virginia is "certified". This includes 5th and 6th order (10 and 12-digit HUC). Data extends into MD. The naming is generally consistent with DCR, however they are not identical. The packaging of DCR and NRCS differs in that NRCS stores both 10 and 12-digit numbering in one file, but requires 6 files for County. DCR files require that table names be joined and there are separate files for the 10 and 12-digit layers. Note that there are no data available for WV at this time.

USGS National Hydrology Data (NHD): The boundaries are mapped at 1:100,000 scale. This extends beyond the County boundary and contains 2 polygons nominally. This comes in two resolutions, medium and high. The USGS only maps down to the 4th level or 8-digit HUC.

3 Government Environmental Studies:

3.1 Geology – USGS/Loudoun County

Surficial and bedrock geology GIS layers and printed maps developed through mapping efforts by USGS with assistance from Loudoun County's former Department of Natural Resources. Bedrock map data updated by USGS in 1999. Following minor corrections with data labeling after consulting with USGS, layers incorporated into Loudoun County GIS in 2003.

3.2 VA DEQ Water Quality (Trend and Ambient Stream Monitoring)

The Dept of Environmental Quality (DEQ) operates numerous stream monitoring sites, often coincident with USGS stream flow gages. Water chemistry data includes basic cations and anions as well as pH, temperature, fecal/E.Coli. Trend stations are long-term sites and ambient stations are used on a rotating basis. Data are

obtained from DEQ web site. There is a total of 57 monitoring sites in Loudoun County. Only nine of these are designated as "trend" sites. There are 98,000 water measurements on file.
VA DEQ monitors for benthic macroinvertibrate as part of their stream assessment. The benthic database "EDAS" is available online and requires a password to access. There are 75 values for Loudoun County starting in 1994 with as many as 18 measurements at CAXO04.57 (Taylorstown). Data metrics include EPA RBP and SCI.

3.3 VA DEQ 2006 Water Quality Assessment

The Dept of Environmental Quality (DEQ) publishes water quality impairments as part of the Water Quality Assessment Integrated Reporting of 305(b)/303(d) listings within the TMDL program. Stream reaches are assessed for exceedance of water quality standards for a particular use. Data are in GIS format for all of the stream reaches, not just the impaired sections. Most impairments are bacteria, though there are several benthic impairments, probably caused by excess sediments. The 2008 WQA is currently under review and not available in digital GIS format.

3.4 Broad Run Water Quality Monitoring Program (OWML)

Since 1990, a station on Broad Run, upstream of the LCSA plant now under construction has been monitored for water chemistry and flow. Only an approximate site location is known. Over 430 sampling events have been recorded every two weeks with approximately 20 to 50 analyses per sample. In general the recent stream flow data were found to be consistent with the new USGS station on Broad Run. Review of the fecal concentration display the expected positive correlation with increased stream flow. Comparisons with DEQ data have not been examined. Data are available in raw Excel format only.

3.5 Fairfax County – SPS

In 1998, Fairfax County conducted stream monitoring for their Stream Protection Strategy. In 2002, a CD of the data was published that includes 2 sites in Loudoun County. Data also includes three sites upstream in Sugarland Run that flow into Loudoun County. Monitoring data is primarily related to macroinvertebrates using Rapid Bioassessment Protocol at over 120 sites. Other data include fish and habitat assessments. A GIS monitoring station file was received in 2003. The biological data reside in MS Application. Additionally the Fairfax Health Department provides data on fecal coliform, temperature, pH, DO, P and N from 1989 to 2002.

3.6 USGS NAWQA Surface Water

As part of the USGS National Water-Quality Assessment Program (NAWQA) program, five surface water samples were collected between 1992 and 2003 and analyzed for a broad range of chemicals. Data are compiled in a personal geodatabase format with a related time series table. As many as 80 analyses per sample were analyzed including pesticides and volatile organic compounds. At the Catoctin Creek -Taylorstown site, extensive sediment and analyses for PCBs were performed. The total number of water quality analyses reported exceeds 1,500 values.

3.7 Loudoun Soil & Water Conservation District Stream Monitoring

Since 1999, the LSWCD has monitored 14 stations in the Piney Run, Catoctin Creek, Little River, North Fork Goose Creek, and Beaver Dam watersheds for fecal coliform. This effort is related to the potential development of fecal coliform Total Maximum Daily Loads (TMDL) for these waterways, and was expanded to include E-Coli in 2003. Some water chemistry and macroinvertebrate data are also available. Data are periodically posted to the LSWCD web site (http://loudoun.vaswcd.org/).

3.8 Fairfax County - Cub Run and Bull Run Watershed

In Fairfax County, watershed planning efforts extends into Loudoun in the Cub Run and Bull Run watershed. The watershed management plan includes maps of habitat assessment, stream obstructions, head cuts, utility crossings and dump sites. No tabular or GIS files have been requested. Identification of structural restoration projects (riparian buffer planting, pond retrofit, dump site removal, etc.) are limited to Fairfax County.

3.9 Occoquan Source Water Assessment and TMDL

The Occoquan River has headwaters in southeast Loudoun County. In the TMDL for bacteria, approximately 11 percent is attributed to Loudoun County. Modeling using HSPF indicates that a 90% reduction in Loudoun is needed to achieve TMDL goals. Modeling also addresses MS4 (storm water) loads from Loudoun County (42.3 ton/yr of sediments). No TMDL-specific field data was collected in Loudoun County. Note that recently, DEQ added a segment of Bull Run along the County border to the 2006 Category 5A listing as being impaired for bacteria.

3.10 Tributary Strategies

The EPA Tributary Strategies program in conjunction with Chesapeake Bay waste loading modeling has resulting in the preparation of "input decks". Waste loadings are categorized and estimate loads computed. The Potomac watershed loads were then used to estimate the portion contributed by Loudoun County. These pollutant loadings are first order approximations only.

3.11 Wellhead Protection Plans

Well head protection plans prepared for several towns and community water systems within the past few years have been obtained for: Round Hill, Raspberry Falls, Lenah Run, and Beacon Hill. Plans for other communities are currently in development and will be obtained for Selma, Rokeby and Elysian Heights.

3.12 Town of Purcellville Water Supply Plan

In 2007, CH2M Hill and GeoTrans were contracted to conduct a water resources study for the town. Alternative water supply considerations included additional groundwater wells, reservoirs and surface water from the Potomac and Shenandoah Rivers.

3.13 Natural Resource and Conservation Service – Fish Survey

The Natural Resource and Conservation Service Fish Survey (Teels and Danielson, 2001, USDA) reported IBI score at 42 sites in Goose Creek, many of which rank as poor or very poor.
http://www.wli.nrcs.usda.gov/products/ibi.pdf

As a follow-up study, the 2005 USDA report evaluates the effectiveness of CREP restoration on stream biological integrity. Annual IBI and SVAP measurements from 2000 to 2003 are evaluated. Six Loudoun sites include: Hungry Run/632, Little River/632, Plum Run/50, Pantherskin Run, North Fork Goose Creek/782, North Fork Catotin/287. http://directives.nrcs.usda.gov/media/pdf/tn_b_58_a.pdf

4 Non-Government Environmental Studies:

4.1 Rapid Stream Assessment Technique (RSAT) Survey by Council of Governments (COG)

Since 1997, five reports have been prepared by Metropolitan Washington Council of Governments COG providing assessments of the stream health in Loudoun County. The purpose is to document the baseline conditions for possible future watershed protection, restoration, monitoring and resource management initiatives and action. The RSAT technique provides a systematic evaluation of the physical, chemical and biological stream quality conditions. The six RSAT categories include: stream bank stability, channel scouring/sediment deposition, physical aquatic habitat, water quality, riparian habitat conditions and biological indicators (macroinvertebrates).

RSAT of Sugarland Run Watershed - Phase I: Mainstem (1997). Prepared for Virginia Environmental Endowment. The survey included 10.4 stream miles.

RSAT of Sugarland Run Watershed - Phase II: Tributaries (1999). Prepared for Virginia Environmental Endowment.

Talbot Farm Tributary RSAT Survey (1998). Prepared for the Virginia Department of Forestry, Loudoun Soil and Water Conservation District and Natural Resources Conservation Services. The Talbot Farm tributary is a third-order stream in the Catoctin watershed, near Waterford. The 3.7 square mile watershed is primarily cow pasture.

Loudoun County Baseline Biological Monitoring Survey (2000-2002) - Phase I: Broad Run, Goose Creek, Limestone Branch, Catoctin Creek, Dutchman Creek and Piney Run Mainstem Conditions (2003). Prepared for the National Fish and Wildlife Foundation. Streams were monitored at 26 stations and conditions were assessed for each of the six watersheds. To address channel morphology, a limited number of modified Rosgen Level I stream morphology analyses were performed and several one-time fecal coliform grab samples were performed.

Loudoun County Baseline Biological Monitoring Survey (2004-2005), Phase II: Clark's Run, Catoctin Creek, Quarter Branch, Dutchmen Creek and Piney Run. Prepared for the National Fish and Wildlife Foundation. In northern Loudoun, 16 stations were surveyed. Additional analysis included existing riparian buffer. Over 25 miles of stream do not meet the 35-foot riparian buffer. Over 270 potential reforestation sites were mapped and GIS coordinates available. Summary RSAT scores have been input into GIS format.

4.2 Goose Creek Demonstration Watershed Vulnerability Analysis

In 2003, PEC and the Goose Creek Association in consultation with the Center for Watershed Protection, reported on subwatershed plans. Report includes a summary table for 40 subwatersheds. The underlying GIS data (land use, imperviousness, etc.) are not readily available. Data is available from printed report only.

4.3 LCSA Goose Creek Source Water Protection

In 2003, LCSA (now Loudoun Water) developed a comprehensive source water assessment of their water intake in Goose Creek. The plan focuses on pollutant source, primarily within a 5-mile radius of the intake. Analysis includes waste loading calculating using PLOAD for suspended solids, nitrogen and phosphorous. In addition to a review of existing watershed characteristics, the study included 45 stream miles (10%) of assessments. Using EPA's Rapid Bioassessment Protocol, 68 reaches were characterized. Stream Walk Assessment contract was completed by Michael Baker Corporation. The site investigations predate though are similar to USA & USSR techniques developed by Center for Watershed Protection (CWP). Data is available from the printed report and primary stream assessment data has been input into GIS.

4.4 Goose Creek Vulnerability Analysis

In 2002 and 2003, PEC and the Goose Creek Association in consultation with the Center for Watershed Protection, completed its study of the Goose Creek watershed, covering both Loudoun and Fauquier counties. The project assessed the current and future health of the watershed on a subwatershed basis, with a field-verified, in-depth analysis of three subwatersheds and recommendations to improve or maintain their health. Data is available from printed report only.

4.5 Tuscorora Creek Field Work and Baseline Assessment

In 2007, PEC contracted the Center for Watershed Protection to perform field studies within the watersheds of the Town of Leesburg. Stream surveys and environmental assessments were documented along with sensitive areas inventory and recommendations for environmental improvement. Funded by Piedmont Environmental Council (PEC), the USSR and USA techniques were applied and over 80 recommendations for restoration, revision or retrofits identified.

4.6 Virginia Commonwealth University - INSTAR

Developed by Virginia Commonwealth University, INSTAR is a combined stream and watershed integrity assessment approach of Virtual Stream Assessment (VSA) metric and modified Index of Biotic Integrity (mIBI). The technique alleges to eliminate limitations inherent with RBP and IBI. There are 35 sites classified in Loudoun County. It is unlikely that other groups or agencies will use this protocol.
http://instar.vcu.edu/stream_watershed.html

4.7 Dawson's Coner and Seven Hills –USM

As part of legislative application, Greenvest contracted with Virginia Waters and Wetlands, Inc. to conduct stream and habitat assessments at five sites in southeast portion of the County. Data was collected in August 2007 and May 2008. Methodology is Unified Stream Methodology (USM). Note that the habitat assessment metrics reported do not provide an interpretive scale. The benthic macroinvertebrate were sampling using EPA's RBP approach. Benthic scores of Order Richness and Percent EPT are provided. The benthic macroinvertebrate assessment metrics reported do not provide an interpretive scale.

5 TMDL Studies:

The five TMDL reports include: Catoctin Creek Bacteria (2002), Goose Creek Watershed Bacteria (2003), Limestone Branch Bacteria (2004), Piney Run Bacteria (2004), and Goose Creek and Little River Benthic (2004).

Each report is highly detailed and includes waste load modeling using a deterministic stream flow and waste load model or a statistical analysis of water quality data. In some TMDL reports, additional field work and stream monitoring data are included. All reports are available in Adobe format, though no data tables or GIS files have been received or recreated at this time.

TMDL Project	Watershed ID	Pollutant(s)	Comment document	Final report	EPA approval date
Catoctin Creek Watershed	A02R	Fecal Coliform	Comment document	Final report Addendum	05/31/2002 EPA rationale
Goose Creek and Little River Watersheds	A08R	Sediment	Comment document	Final report	04/26/2004 EPA rationale
Goose Creek Watershed	A04R, A05R, A06R, A07R, A08R	Fecal Coliform	Comment document	Final report Modification	05/01/2003 EPA rationale
Limestone Branch Watershed	A03R	E. Coli	-	Final report	07/06/2004 EPA rationale
Piney Run Watershed	A01R	E. Coli	-	Final report	07/06/2004 EPA rationale

The Catoctin Creek TMDL study was followed with an Implementation Plan (IP). The creek was first listed as impaired in 1996. The final TMDL was published in 2002. The Catoctin Creek IP includes implementation of the agricultural component of the Catoctin Creek TMDL Implementation Plan and is being funded annually with 319 Grant funds from DCR to LSWCD to work specifically with landowners in the Catoctin Creek watershed. Landowners in this watershed are provided financial and technical assistance for the installation of targeted agricultural bmps, and education programs that encourage landowners to exclude livestock access to Catoctin Creek and its tributaries. The LSWCD is now entering their second five-year grant with DCR to continue these efforts. To date, approximately $79,000 of cost share money has been used on 22 properties within the watershed.

Grant funding is available for the correction of fecal coliform contributions from both livestock and failing onsite wastewater treatment systems. The U.S. Environmental Protection Agency (EPA) with the Virginia Department of Conservation and Recreation (DCR) provides grant money to homeowners to pay for a percent of repairs and upgrades to existing individual wastewater systems, the program is administered locally by the Loudoun County Department of Health. A total of 20 systems have been repaired or upgraded in the watershed to date using approximately $165,000 in grant monies.

6 Citizen Stream Monitoring:

6.1 Loudoun Wildlife Conservancy (LWC) and Loudoun Watershed Watch (LWW)

The Loudoun Wildlife Conservancy (LWC) and has been collecting macroinvertebrate samples at 16 stations since the late 1990's. The LWC and data from other groups were compiled by Loudoun Watershed Watch (LWW) in the 2002 and 2005 State of the Streams Reports. The other groups include Loudoun Soil & Water Conservation District, North Fork Goose Creek Watershed Project, Audubon Naturalist and others. Data are available in report format and summary scoring has been input into GIS. Multiple measurements are available for most sites. Data include 249 benthic macroinvertebrate and 217 habitat assessments using the Audubon Naturalist protocols. Starting in 2008, LWC changed to using the VA SOS protocol.

6.2 Goose Creek Association (GCA)

The volunteers of Goose Creek Association conduct stream assessment using VA SOS methodology at 20 locations, mostly in Fauquier County, although some are in Loudoun County.

6.3 Catoctin Watershed Project (CWP)

In support of the Catoctin Creek TMDL Implementation, the Loudoun Wildlife Conservancy (LWC) volunteers have collected over 700 E. Coli samples at 14 stations in the Catoctin watershed between Lovettsville and Purcellville. Data are posted on web at Loudoun Watershed Watch (LWW) and used to constructed GIS layer with over 50 measurements per station.

6.4 Ashburn Pond (Student)

Several ponds in Ashburn have been monitored at fourteen locations for basic water parameters on a monthly basis since 2004. Measurements are in-field (LaMotte) and stored as Excel tables. Site locations coordinates are available.

6.5 EarthForce

In conjunction with several High Schools, Earth Force has collected about a dozen samples throughout the County in the fall 2005 and fall 2006. Water analysis includes: pH, turbidity, nitrate, phosphate, suspended solids, and E. Coli. Lab work was performed by Fairfax Water Authority. This data has not yet been compared with DEQ station data.

7 Basemap:

7.1 Loudoun Drains and Water

At a scale of 1:2,400, the creek, stream ponds and drainage swales are mapped in GIS. Data has been updated using 2005 in western Loudoun and 2004 in eastern Loudoun. The drainage network is generally cartographically correct, though not ready for construction of a geometric network. All streams greater than 10 feet wide are mapped as polygons with stream centerlines arcs. Over 3,200 farm ponds with areas greater than 1/10 acre are mapped. Data is current as of 2005/2004 in western/eastern Loudoun.

7.2 Loudoun 3D Drains

In addition to drains, three-dimensional GIS shapefiles of the “drains” include the Z or elevation at all vertexes in the polyline layer. Elevation values are generally accurate to +/- 0.1 feet.

7.3 Loudoun Historic Drains

The historic or preconstruction drainage GIS layer, mapped similar to “drains”. The reaches are assigned a hydrologic attribute of alluvium, perennial, intermittent and not classified. This is not a complete drainage network and drains occasionally cross. The layer is maintained to be consistent with the “soils” layer. This data is helpful in understanding post construction wet basement problems.

7.4 Loudoun Topography

At 1:2,400 scale, 5-foot topography contours are mapped with null sections for buildings and roads. Data is current as of 2005/2004 in western/eastern Loudoun. There is no equivalent DEM or DTM, though these formats are anticipated later in 2008.

7.5 Loudoun Stormwater Infrastructure

A field survey of the stormwater infrastructure includes 46,000 inlets and pipe outfalls. There are over 600 miles of pipe and culvert. In support of maintenance, the GIS data include detailed specifications such as material type, size, flow direction and maintenance condition. The outfalls are snapped to the “drain” GIS layer. The inventory is supported by several photo libraries.

7.6 Loudoun Soil and Water Conservation District Agricultural BMPs

During the past 20 years, the LSWCD has worked with landowners to install agricultural best management practices (BMP stream fencing, alternate water systems, cover crops hardened crossings, etc.) to minimize non-point source pollution from agricultural sources in Loudoun County. Technical and financial assistance is available to landowners from the Virginia Agricultural BMP Cost-Share & Tax Credit Program and the USDA-Conservation Reserve Enhancement Program (CREP). Data though 2005 has been obtained through VA DOF. Data for Ag BMP in Catoctin watershed 2005-2008 have been obtained. In the Catoctin Watershed, data on the

corrective actions performed by the Health Dept on private sewage disposal system has been obtained (2006-2008).

7.7 Loudoun County Sanitation Authority

The LCSA maps the water and sanitary in GIS. Data is primarily in eastern Loudoun and includes 50,000 water connection nodes, 17,000 sanitary sewer nodes, 650 miles of water lines and 838 miles of water lines. Tables include basic structural information. The geodatabase was restructured in 2007 and last updated in June 2007.

7.8 DC WASA

The Potomac Interceptor sanitary sewer line runs form Dulles airport north to the Potomac and also along Surgarland Run, eventually to the Blue Plains wastewater treatment plant in Washington DC. There are approximately 16 miles of pipe in GIS format. **{Restricted data}**

7.9 Virginia Conservation Lands Needs Assessment (VCLNA)

A statewide land use classification files have been obtained.

7.10 Virginia Department of Forestry Conservation Lands and Easements

The VFOD maps conservation easements and riparian buffer projects files have been obtained.

7.11 Orthoimagery

Loudoun County has numerous orthoimagery available for use in the GIS.
These include:

Digital Orthoimage 2007 B&W
Digital Orthoimage 2005 B&W
Digital Orthoimage 2004 B&W (Partial – eastern Loudoun)
Digital Orthoimage 2002 Color (VGIN)
Digital Orthoimage 2003 Color Infrared (CIR - Partial)
Digital Orthoimage 1957 B&W Soils
Digital Orthoimage 2006 Color UDSA/NRCS NAIP (partial, lower quality)
Digital Orthoimage 2005 Color leaf-on Aerial Express (not on-line, requires 9.2)
Digital Orthoimage 1937 B&W (In preparation as of Sept 2008)

7.12 DCR Land Use/Land Cover

The Dept Recreation and Conservation map land use. GIS files have been obtained.

7.13 USGS NLCD Land Use/Land Cover

The US Geological Survey offer land use classification. At present only eastern Loudoun County has been produced with the remainder soon to be posted on-line. Available files have been obtained.

7.14 Regulatory Stream Designations

Loudoun County has two scenic rivers, Catoctin and Goose Creek. These are mapped using arcs at several scales by Dept Recreation and Conservation (DCR) and by Loudoun County Office of Mapping. The arcs are buffered by 300 feet for zoning overlay analysis.

7.15 DCR Natural Heritage Screening

DCR maintains a natural heritage GIS layer, available though on-line web mapping via a subscription service. Loudoun County also received these data, subject to restrictions. "Natural heritage resources are defined as the habitat of rare, threatened, or endangered plant and animal species, rare or state significant natural communities or geologic sites, and similar features of scientific interest. DCR maintains a data system that is the most comprehensive and up-to-date repository of natural heritage resource information available. Information on potential impacts to natural heritage resources is crucial to a comprehensive environmental assessment of proposed developments or activities. "

8 GIS Zoning Overlays, Analysis and Models

8.1 Floodplain Overlay

The floodplain boundary includes the digital floodplain map of FEMA (DFIRM), as approved in July 2001. Additional to the floodplain layer include recent flood studies and floodplain alterations and do not necessarily edge match to the DFIRM.

The regulatory floodplain boundary reflects the limits of flooding resulting from a storm having an occurrence probability of 1%, identified as the 100 year storm. The floodplain boundary was recompiled from the listed sources onto the County's 1:2400 scale maps with five-foot interval topography.

Floodplain data is used to establish a Floodplain Overlay District (FOD) as defined in the Zoning Ordinance of Loudoun County, which restricts the allowable uses within the regulatory floodplain. Data is used to establish flood risk factors and eligibility to participate in the National Flood Insurance Program. Floodplain data are also used in land use planning and for taxation of land.

8.2 Mountainside Overlay

The Mountainside Development Overlay District is a zoning overlay district administered by the Department of Building and Development. Mountainside classifications are based upon the following criteria: critical elevation, soils, slope, and forest values. Critical elevation areas are determined from the County's digital topography, soil and slope values are based upon data the County's soil layer and digital forest data. For more information consult the metadata for those layers.

8.3 Limestone Overlay

The limestone overlay is an area represented by the Limestone Conglomerate Overlay District (LOD) is generally east from the Catoctin Mountain Range to the Potomac River (excludes Lost Corner), and from Leesburg north to Point of Rocks, MD. The LOD is a zoning overlay district administered by the Loudoun County Department of Building and Development. The Department is responsible for all development approvals, review procedures, modifications and density calculations in the LOD as governed by Article VI, "Development Process and Administration", of the Revised 1993 Zoning Ordinance, and procedures in Chapter 8 of the Facilities Standards manual.

The LOD is comprised of all or portions of the following geologic formations: Cf-Frederick Limestone, Ct-Tomstown Dolomite, JTRc-Catharpin Creek Formation, JTRcg-Catharpin Creek Formation Goose Creek Member, TRbl-Balls Bluff Siltstone Leesburg Member, and TRbs-Balls Bluff Siltstone Fluvial and Deltaic Sandstone Member.

NOTE: The Circuit Court of Loudoun County issued an opinion dated March 30, 2004 ruling that the Limestone Conglomerate Overlay District (LCOD) is void. The March 30, 2004 decision may be the subject of an appeal.

Purpose: The land area delineated by the boundaries of the LOD is comprised of limestone and "Karst terrain" areas. The terrain is also characterized by the presence of certain natural features, such as sinkholes and rock outcrops. Thus, development on Karst terrain has a direct correlation to the potential for collapse and ground slippage and the susceptibility of groundwater and surface water pollution, and spring contamination, posing serious risks to public health, safety and welfare. The provisions of Section 4-1900 of the Revised 1993 Zoning Ordinance are intended to regulate land use and development in areas underlain by limestone and in areas with Karst features and terrain as shown on the official Limestone Conglomerate Overlay District Map of Loudoun County.

8.4 Steep Slopes Overlay

The Steep Slope layer identifies areas with a slope greater than 15% in Loudoun County. Steep Slope assists in identifying steep slope areas. Improper uses and disturbances in steep slope areas cause erosion, result in structural failure of structures and roads, and lead to downstream flooding and other hazards.

8.5 River and Stream Corridor Overlay

The Circuit Court of Loudoun County issued an opinion dated March 30, 2004 ruling that the River and Stream Corridor Overlay District (RSCOD) is void. The Floodplain Overlay District (FOD) and the Scenic Creek Valley Buffer regulations in effect prior to adoption of the RSCOD on January 6, 2003, will apply in the administration of zoning regulations. The March 30, 2004 decision may be the subject of an appeal.

The River and Stream Corridor Overlay District (RSCOD) was created in the 2001 Comprehensive Plan. It was created to protect corridor resources, including water quality, aquatic and wildlife habit, and scenic value.

RSCOD is composed of:

a. Rivers and streams draining 100 acres or more

b. 100-year floodplains (includes major and minor)

c. adjacent steep slopes (25% or greater), starting within 50 feet of streams and floodplains but extending no further than 100 feet beyond

d. 50-foot management buffer around steep slopes and floodplain

e. 100-foot buffer measured from the scar line on both sides of streams that drain 100 acres or more

f. 300-foot buffers around state designated scenic rivers (Goose Creek, Bull Run, Catoctin Creek from the bridge at Route 698 at Waterford to the Potomac River); the Potomac River, and County reservoirs (Beaverdam and Goose Creek) the originating stream or floodplain

8.6 Wetlands Model(s)

Loudoun County has developed models to predict wetlands, under a grant from the United States Environmental Protection Agency. The model incorporates several sources of information and data available to the County to produce a weighted estimation of the presence of actual wetlands. Data inputs to the model include hydric soils, drainage, points for wet spots, marshes and springs, water bodies, slopes and National Wetlands Inventory. There are separate Wetlands model for the eastern and western Loudoun.

8.7 Impervious Surface Analysis

Using the basemap layers of roads and building, a composite feature class of "impervious surface" has been developed based on March 2005 conditions. Future refinements may include use of data for sidewalks and other impervious features not currently included.

8.8 Alternate Wastewater Disposal Potential Analysis

Using the soils classification table, areas favorable and unfavorable for alternate wastewater disposal sites are identified. The soils have been classified according to their soil mapping unit into the categories of no potential, spray irrigation, shallow-placed drip / alternative drain fields or conventional gravity and low pressure systems. This classification is an interpretation based on the soil mapping unit and its' basic characteristics.

8.9 Groundwater Recharge Analysis

Using the soils classification table, areas of groundwater recharge are mapped. Soil polygons are classified as being discharge areas, or having moderate to high or low to moderate recharge potential. This classification is an interpretation based on the soil mapping unit and its' basic characteristics.

8.10 LID Infiltration Potential Analysis

Using the soils classification table, areas of favorable low impact development (LID) infiltration are mapped. Classifications for infiltration potential include good, fair, poor, very poor, no potential or water. This classification is an interpretation based on the soil mapping unit and its' basic characteristics.

8.11 Open Space

The open space feature class contains permanent open space easements for Loudoun County. The open space feature class is utilized for taxation, planning and in the Purchase of Development Rights (PDR) Program (no longer in existence).

8.12 Planned Land Use

The planned land use feature class is a general reference relating to authorized land use. The data is used extensively by the Planning and Building and Development departments. The data layer is administered by the Planning and Development office.

8.13 Agricultural Districts

This data set identifies properties that participate in and are part of Agricultural overlay districts according to State enabling legislation per the Virginia State Code, Chapter 43, Section 15.2, Agricultural Districts. Economic Development administers the County's Agricultural District program. A parcel is not the smallest unit within an Agricultural District. A portion of any parcel can be in or out of a district, through appropriate reviews, without an official subdivision. This layer identifies properties within each of the Agricultural Districts, which are used by participants to preserve farmland and open space through parcel subdivision restrictions. Each Agricultural District has unique terms and subdivision restrictions.