

Table 1.WI. Willow Creek Monitoring Station Information



Station Address: 2900 West State Highway 13, Burnsville, MN
County: Dakota
Major Basin: Minnesota River Basin
Watershed: Lower Minnesota
Drainage Area: 10.25 square miles

Station Operator: Black Dog Watershed Management Commission /
Barr Engineering, Inc.

Metropolitan Council Environmental Services Contact Information:

Contact Person: Leigh Harrod, P.G.
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Watershed District or Watershed Management Organization:

Black Dog Watershed Management Commission

Station Overview: MCES, with funding provided by the Minnesota Legislature via a grant from the Minnesota Pollution Control Agency (MPCA), has supported water quality monitoring of Willow Creek since 1999. The monitoring station is located in Burnsville, Minnesota, 1.0 mile upstream from the creek confluence with the Minnesota River.

Willow Creek originates above the bluff of the Minnesota River Valley. The creek flows from Lee and Keller Lakes into Crystal Lake, then through Twin and Early Lakes into Sunset Pond. From the dam at the outlet of Sunset Pond, the creek descends the bluff into the Lower Minnesota River Watershed. Below the bluff, Willow Creek is diverted into an underground box culvert that channels the flow underneath the Burnsville Landfill to the discharge location on the south bank of the Minnesota River.

MCES partners with the Black Dog Watershed Management Commission to operate the monitoring station through the commission's consulting engineering company, Barr Engineering, Inc. Because the creek is contained in an underground box culvert at the monitoring station, it is neither feasible nor safe to obtain direct in-stream flow measurements for rating curve development. Hence, the rating curve at this monitoring site is based upon a Manning's equation for the box culvert.

2003 Monitoring Year: Because the underground box culvert prevents Willow Creek from freezing, direct measurements of stage and flow were possible throughout the 2003 monitoring year. Spring snowmelt occurred throughout March 2003. The highest conductivity measurements of the year occurred during this period.

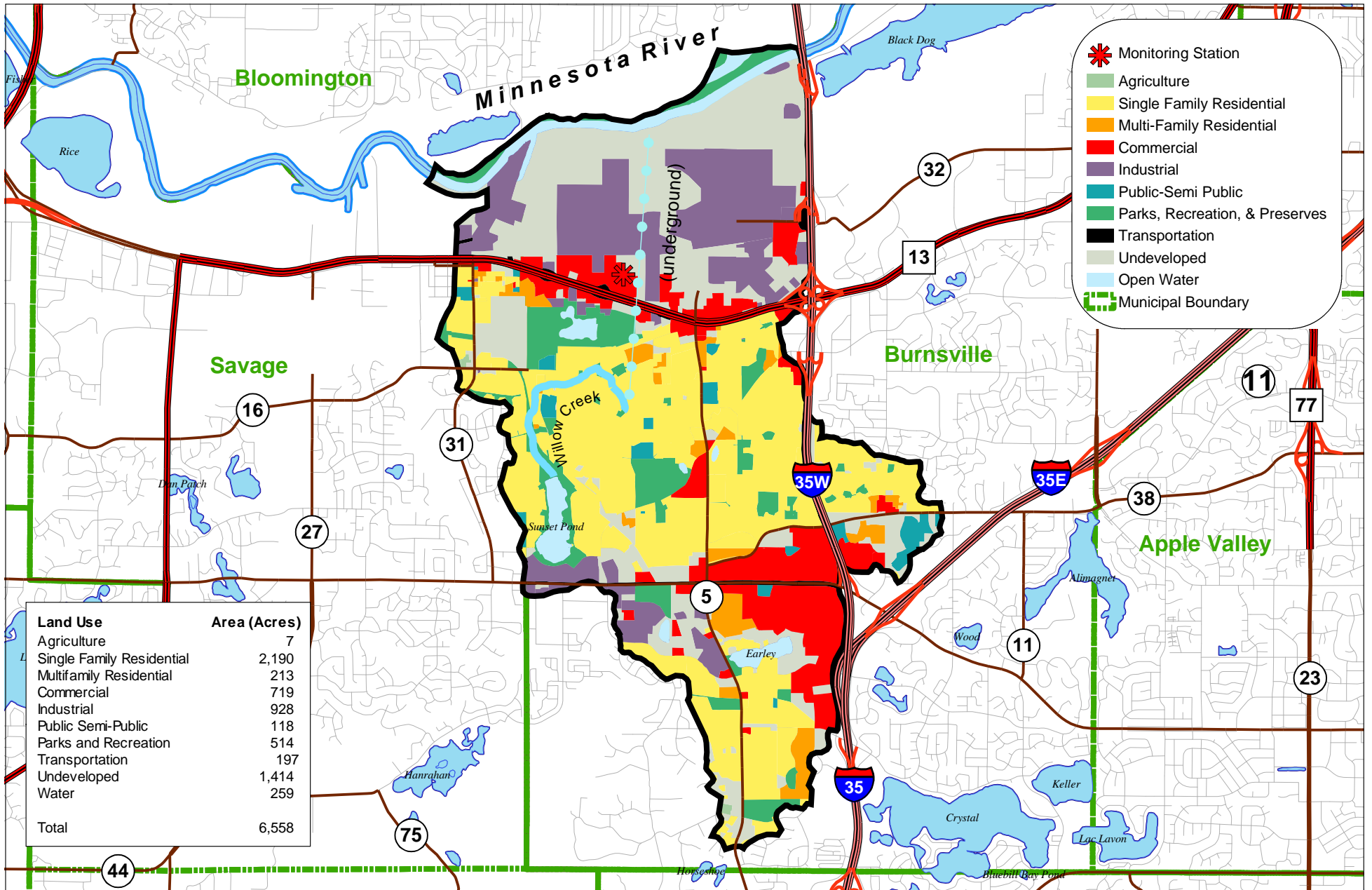
During a rain event, Willow Creek flow typically exhibits a rapid increase followed by a rapid subsidence after the storm. At all other times, the creek is usually characterized by low-flow conditions. In 2003, the peak daily average flow for Willow Creek was 36.6 cfs, with a daily average stage of 0.87 feet. This occurred on May 11 in response to a 1.38-inch rainfall in the watershed, when soil conditions were already saturated after a series of precipitation events. The peak instantaneous flow of 97 cfs, with a stage of 1.71 feet, occurred three days later during a storm event on May 14. A total of 5.6 inches of rain fell in the watershed during the month of May.

Runoff event-based composite sampling began in late March 2003 and continued through mid-September. The highest total suspended solids (TSS) concentration (216 mg/l) observed in 2003 was measured in a composite sample obtained during a mid-April rainfall event.

Twenty samples were collected for water quality analysis during 2003, including 12 composite samples and 8 grab samples. The MCES annual water quality monitoring plan includes 12 monthly baseflow ("non-event") grab samples and approximately 10 to 15 flow-weighted composite samples collected during all runoff events in the open-water season (March-November). The 2003 sampling scheme did not quite meet the goals of the MCES monitoring work plan. Due to low-flow conditions, monthly baseflow samples could not be obtained in January and February. When higher flow conditions precluded baseflow sampling in May and July, additional composite samples were obtained. Overall, the 2003 sampling scheme adequately characterized Willow Creek water quality for the monitoring year.

For additional stream monitoring information and monitoring methods regarding this site, see www.metrocouncil.org/environment/RiversLakes.

Figure 1.WI. Willow Creek Monitoring Station Location and Watershed Characteristics



0 0.45 0.9 1.8 Miles



Figure 2.WI. Willow Creek 2003 Hydrograph, Precipitation and Sampling Information

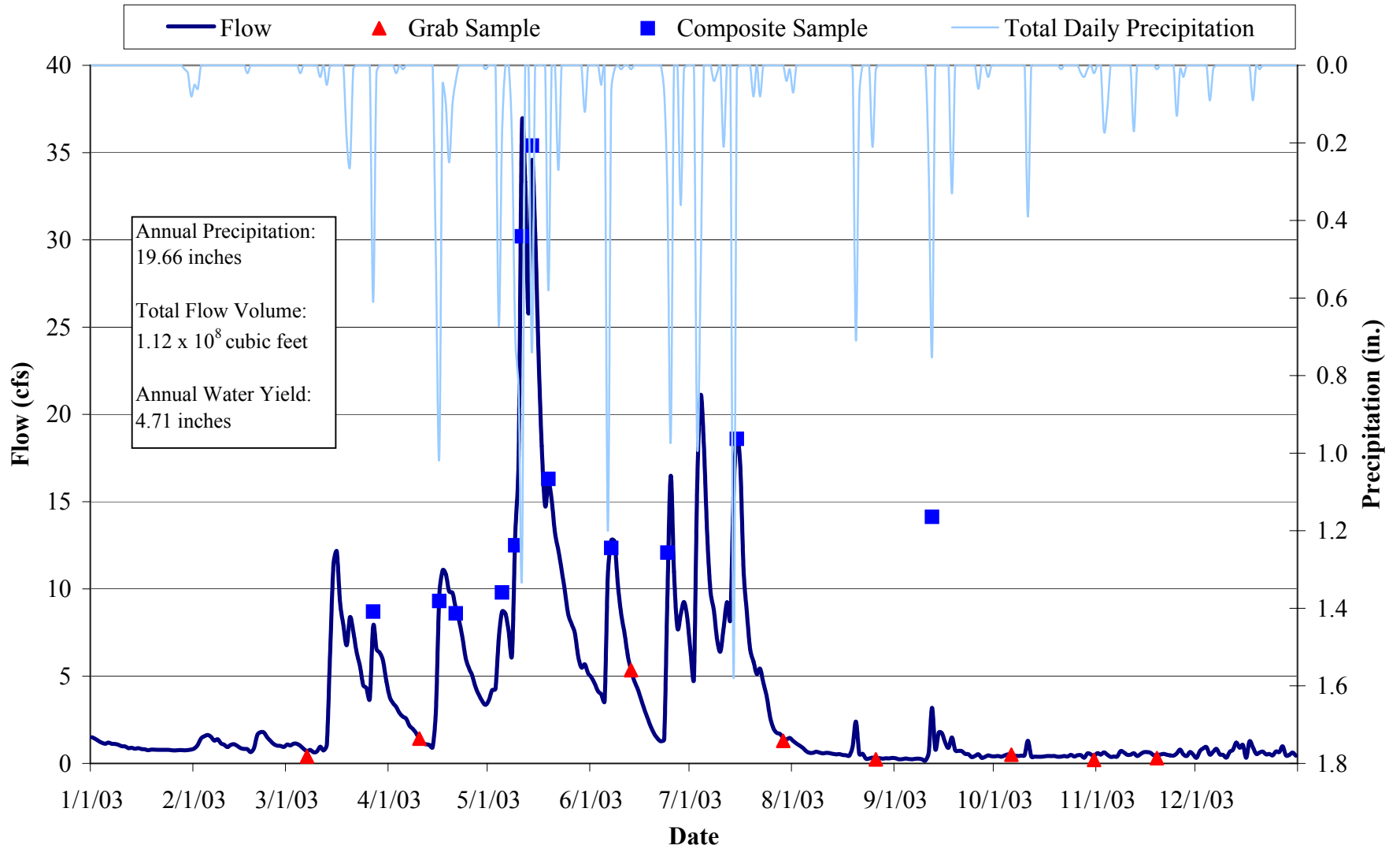


Table 2.WI. Willow Creek 2003 Water Chemistry Information

Variable	N	Mean	Median	Minimum	Maximum	25%	75%	STD
Chloride, mg/L	19	240	107	3	2640	71	149	584
Hardness, mg/L	19	222	110	34	694	99	250	214
Cadmium, ug/L	5	0.2	<0.1	<0.1	0.6	<0.1	0.3	0.2
Chromium, ug/L	5	2.3	0.3	0.2	8.2	0.2	2.5	3.5
Copper, ug/L	5	6.7	2.5	1.6	15.9	1.6	12.1	6.8
Lead, ug/L	5	2.9	0.1	0.1	10.2	0.1	4.2	4.4
Nickel, ug/L	5	7.2	7.9	3.0	10.0	6.9	8.4	2.6
Zinc, ug/L	5	33.0	3.7	2.1	79.0	3.2	77.0	41.1
Total Kjeldahl Nitrogen, mg/L	20	1.04	0.75	0.41	2.50	0.57	1.23	0.66
Total Nitrate Nitrogen, mg/L	20	0.42	0.22	0.12	1.23	0.16	0.51	0.38
Total Phosphorus, mg/L	20	0.11	0.08	0.01	0.38	0.05	0.14	0.09
Total Dissolved Phosphorus, mg/L	19	0.03	0.03	0.01	0.06	0.02	0.04	0.02
Total Suspended Solids, mg/L	20	34	29	1	216	3	44	48
Volatile Suspended Solids, mg/L	20	8	8	1	44	2	11	10
Turbidity, NTU	10	6	2	1	37	1	3	11

N: Sample Count

25%, 75%: 25th and 75th Percentiles

STD: Standard Deviation

Table 3.WI. Willow Creek 2003 Annual Loading Information* for Suspended Solids and Nutrients

Variable	Annual Load (tons)	Annual Yield (lbs/acre)	Annual Normalized Yield (lbs/acre/in of water)	Flow Weighted Mean Concentration (mg/L)
Total Suspended Solids	171	52	11	49
Total Phosphorus	0.48	0.15	0.03	0.14
Total Dissolved Phosphorus	0.15	0.05	0.01	0.04
Total Nitrate Nitrogen	1.52	0.46	0.10	0.43

* 2003 Annual Loading Information is provisional and may be subject to minor revisions.

Figure 3.WI. Willow Creek 2003 Hydrograph with Total Suspended Solids and Nitrate Nitrogen Concentrations

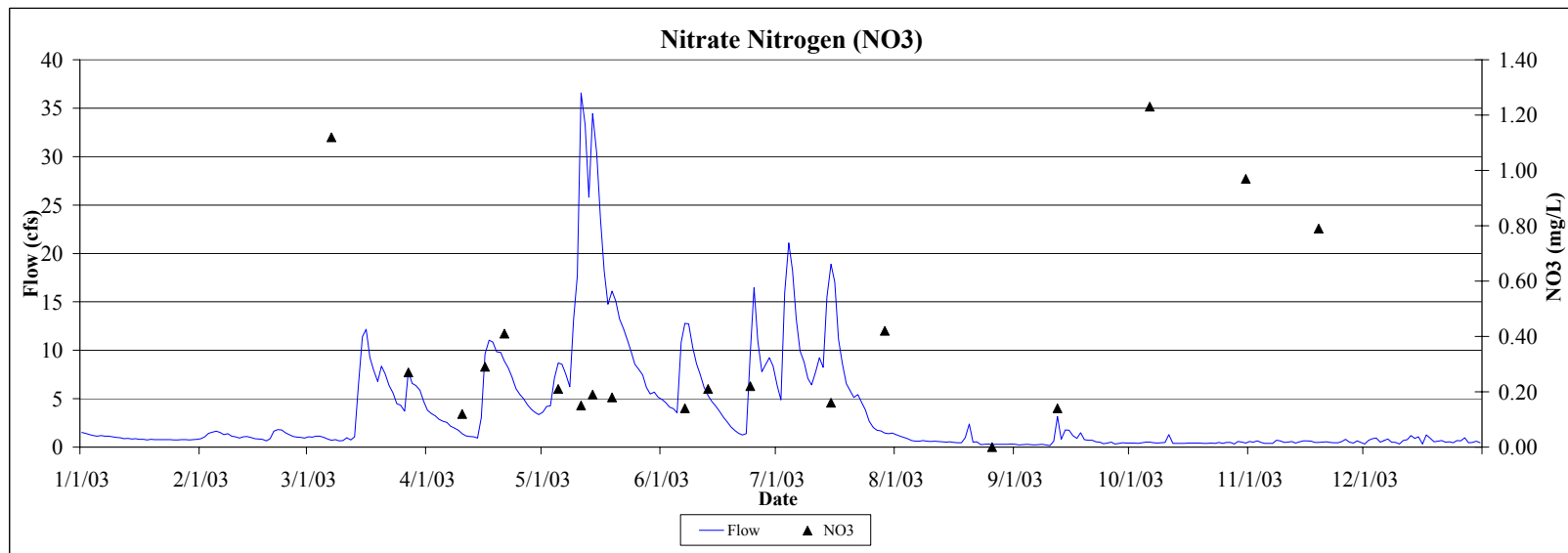
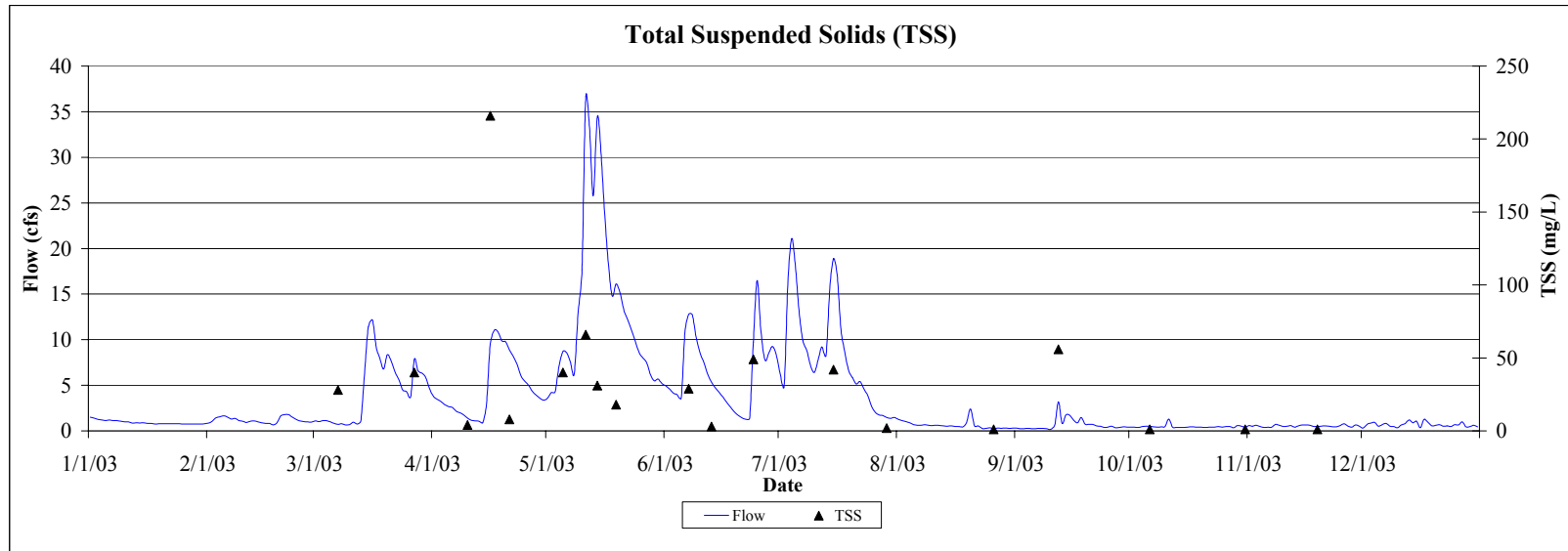


Figure 4.WI. Willow Creek 2003 Hydrograph with Total and Dissolved Phosphorus Concentrations

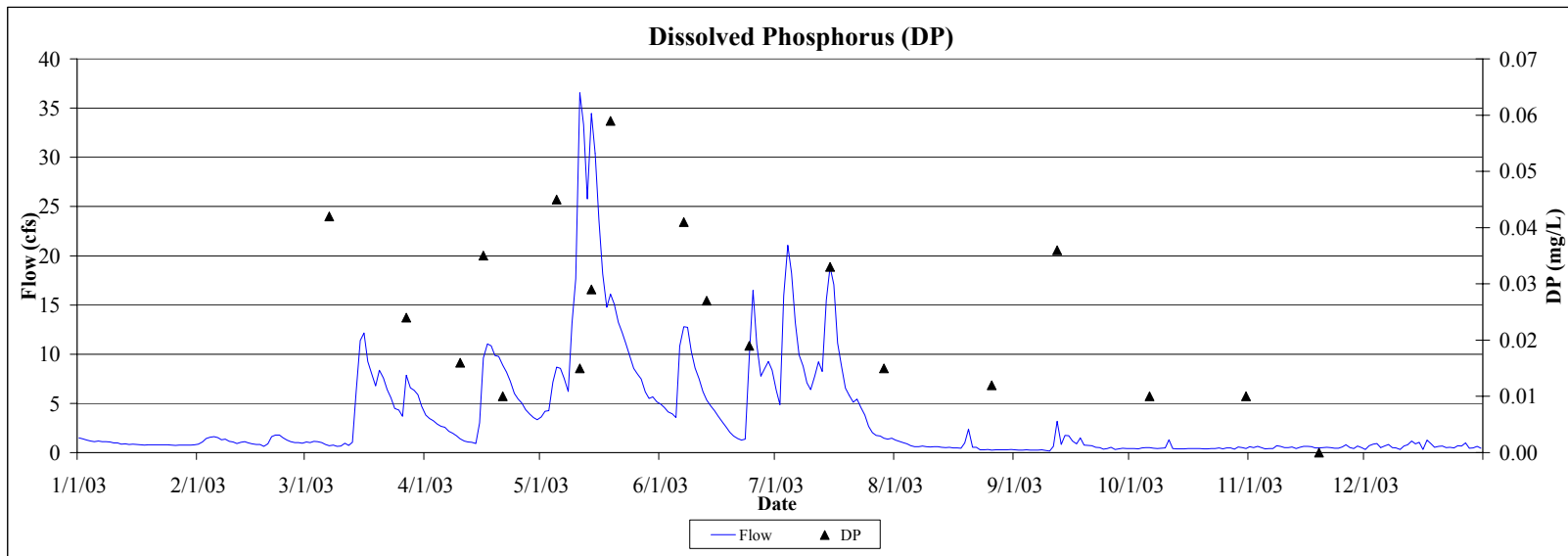
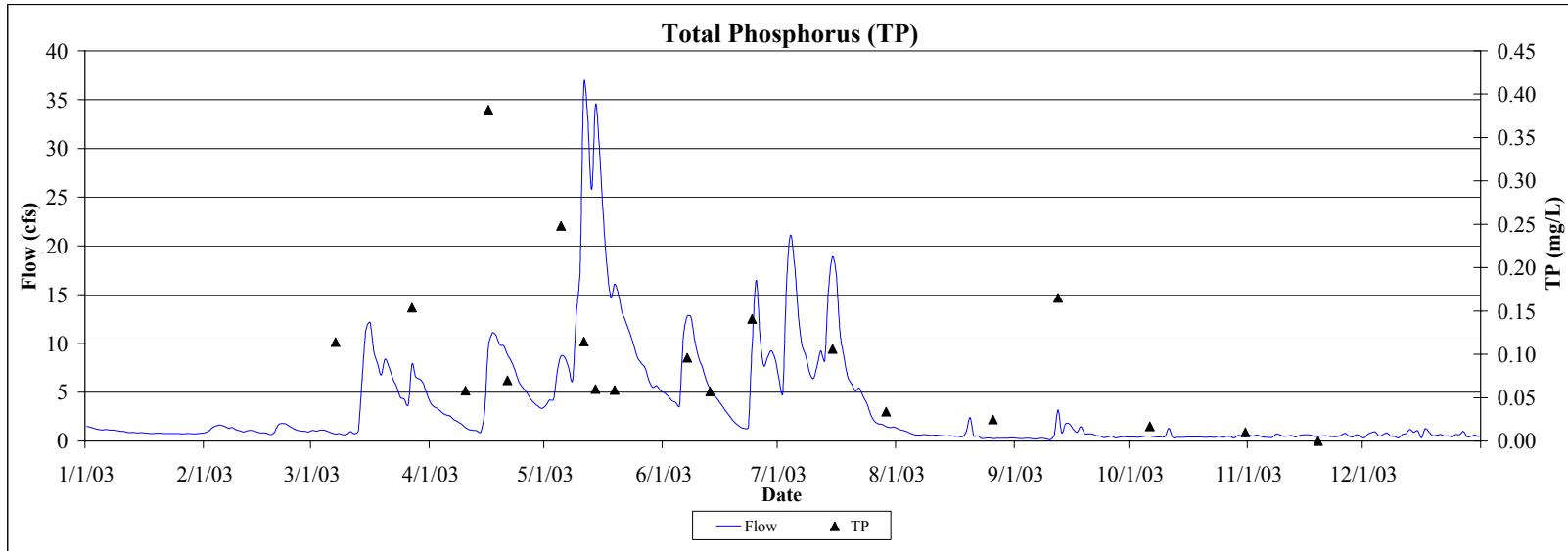


Table 4.WI. Willow Creek: Comparison of 2001-2003 Hydrology and Water Chemistry

	2001*	2002*	2003
Hydrology			
Total Precipitation (inches)	28.92	34.22	19.66
Water Yield (inches)	8.9	10.9	4.7
Total Volume (cubic feet)	2.1 x 10 ⁸	2.6 x 10 ⁸	1.1 x 10 ⁸
Annual Load (tons)			
Total Suspended Solids	378	527	171
Total Phosphorus	0.94	1.24	0.48
Total Dissolved Phosphorus	0.29	0.37	0.15
Total Nitrate Nitrogen	2.51	3.21	1.52
Annual Yield (lbs/acre)			
Total Suspended Solids	115	161	52
Total Phosphorus	0.29	0.38	0.15
Total Dissolved Phosphorus	0.09	0.11	0.05
Total Nitrate Nitrogen	0.77	0.98	0.46
Annual Normalized Yield (lbs/acre/inch of water)			
Total Suspended Solids	13	15	11
Total Phosphorus	0.03	0.03	0.03
Total Dissolved Phosphorus	0.01	0.01	0.01
Total Nitrate Nitrogen	0.09	0.09	0.10
Flow-Weighted Mean Concentration (mg/L)			
Total Suspended Solids	57	65	49
Total Phosphorus	0.14	0.15	0.14
Total Dissolved Phosphorus	0.04	0.04	0.04
Total Nitrate Nitrogen	0.38	0.40	0.43

* Note: Annual loads, yields, normalized yields, and flow-weighted mean concentrations have been revised.