2006 WATER MONITORING REPORT

May 2007

Prepared for:

South Washington Watershed District

Prepared by:

WASHINGTON CONSERVATION DISTRICT

Memorandum

To: Matt Moore —South Washington Watershed District Administrator
From: Wendy Griffin, Travis Thiel, Tim Sundby, Erik Anderson, and Jessica Arendt--Washington Conservation District
Date: May 2, 2007
Re: SWWD 2006 Monitoring: MS1, MS2, Powers, 100th Street, St. Paul Park, Newport, Fox Run, Tamarack Road, Bailey Lift Station, 80th Street, 90th Street, North Ravine of East Inlet of Cottage Grove Ravine Park (North Ravine), East Ravine of East Inlet of Cottage Grove Ravine Park (East Ravine), Armstrong Lake, Powers Lake, Cottage Grove Ravine Park Lake, Lake Gages, & Observation Wells

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At the request of the South Washington Watershed District (SWWD), the Washington Conservation District (WCD) conducted stream monitoring at four existing stream monitoring stations and two new stream monitoring stations (MS1, MS2, Powers, 100th Street, Newport, and St. Paul Park), monitored six stormwater sites (North Ravine, East Ravine, Fox Run, Tamarack Road, 80th Street, and 90th Street), monitored water quality and level on Armstrong Lake, Cottage Grove Regional Park Lake, and Powers Lake, monitored level and precipitation on Bailey Lake (at the Lift Station), installed and read nine lake staff gages, and monitored seven groundwater observation wells. The locations of the monitoring sites can be found in Figure 1. The following report summarizes our methods and results for monitoring conducted from January 1 - December 31, 2006. This report and the accompanying data will also be provided in an electronic format.

Stream Sample Sites: MS1, MS2, Powers, 100th Street, Newport, & St. Paul Park

Continuous stage, velocity, and discharge measurements were taken every 15 minutes at Newport from May 15-October 26, 2006, at 100th Street from April 6-October 31, 2006, at Powers from April 13-October 25, 2006, at MS1 from April 10-October 26, 2006 and at MS2 from April 5-October 25, 2006. Discharge measurements were taken every 5 minutes at St. Paul Park from May 15-October 26, 2006. Precipitation data was also continuously collected at 100th Street, Powers, MS2, and MS1 during the same time period for 2006.

Staff gages were installed and read at 100th Street, Powers, MS1, and MS2. Field stage measurements were taken in the outflow culverts. Temperature, dissolved oxygen, and transparency tube measurements were also taken. Flow weighted storm event samples, storm event grab samples, snowmelt grab samples, baseflow composite samples, and baseflow grab samples were collected at all stream sites. In addition to these samples, E. coli bacteria grab samples were also taken or were attempted at all six sites. The samples were analyzed at the Metropolitan Council Environmental Services Lab. Values with corresponding greater than/less than symbols presented in data by the Metropolitan Council Environmental Services Lab were divided by two when calculating averages and median values.

Stage to discharge relationships were developed at all stream sites, if possible. When the area-velocity probe was covered with debris or erroneous velocity readings were given, stage to discharge relationships had to be used. When data gaps were present, stage/velocity relationships based upon individual site data to interpolate missing data. MS1 and MS2 had backup level logger stage recorders that allowed for data collection during periods when the primary equipment was not recording.

Stream Continuous Stage Sites: 80th Street, 90th Street, North Inlet of East Inlet to Cottage Grove Ravine Park Lake (North Ravine), East Inlet of East Inlet to Cottage Grove Ravine Park Lake (East Ravine), & Bailey Lift Station

Continuous stage measurements were taken every 15 minutes at 80th Street from March 29-October 24, 2006, at 90th Street from April 4-October 24, 2006, at North Ravine from March 30-October 24, 2006, at East Ravine from March 30-October 24, 2006. East Ravine only had one event that was measured that was above zero, thus recorded data was not included in this report. Continuous stage and precipitation measurements were taken every hour at Bailey Lift Station from April 5-October 25, 2006.

Staff gages were installed and read at 80th Street, 90th Street, North Ravine, East Ravine and Bailey Lift Station. Offsets between level logger and staff gage allowed for a continuous stage to be measured. Stage to discharge relationships were developed at the 80th Street and 90th Street Sites.

Stream Flow and Continuous Stage Sites: Fox Run and Tamarack Road.

Continuous stage, velocity, and discharge measurements were taken every 15 minutes at Fox Run from March 30-October 24, 2006 and at Tamarack Road from March 29-October 25, 2006.

Lake Sites: Armstrong Lake, Powers Lake, and Cottage Grove Ravine Park Lake

Included in the 2006 work plan for SWWD were monitoring of three lakes. Armstrong and Cottage Grove Ravine Park Lake were monitored monthly from April to October. Powers Lake was monitored biweekly from April to October. All lakes were monitored by collecting Secchi transparencies, temperature, and dissolved oxygen profiles. Secchi transparencies are used for general comparisons of water quality across the watershed and for monitoring general water quality trends in a given lake from year to year. Temperature and dissolved oxygen profiles provide information on the in-lake dynamics and how each lake may be functioning each year. All three lakes had surface composite water quality samples taken for analysis of total phosphorus, total Kjeldahl nitrogen, chlorophyll-a concentrations, and total chloride ions.

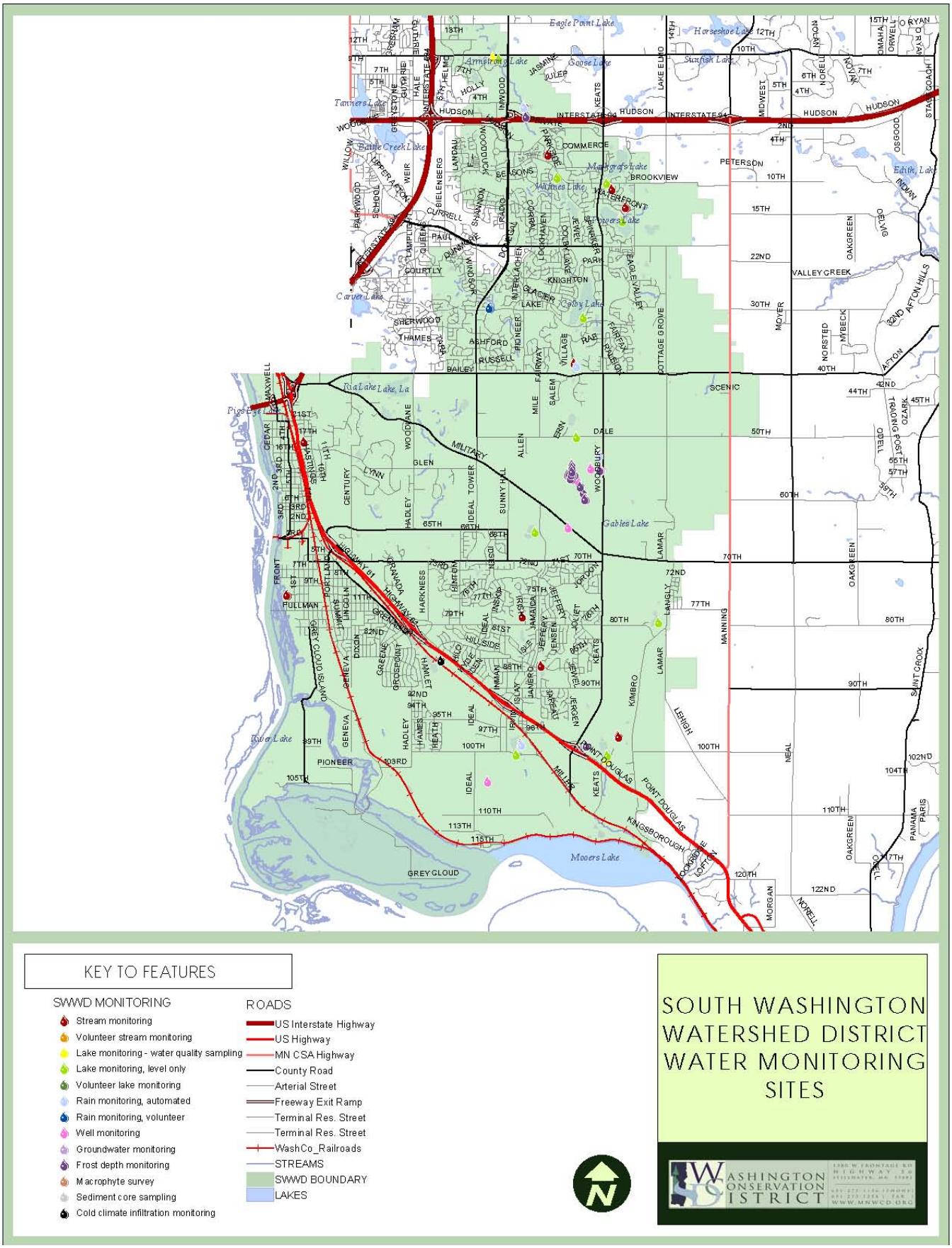


Figure 1. SWWD Water Monitoring Locations

Sample Sites: MS1, MS2, Powers, 100th, Newport, and St. Paul Park

MS1 (I94)

The hydrograph for the MS1 site shows flows from April 10–October 26, 2006 (Figure 2). Precipitation was logged from March 30-October 26, 2006 (Figure 2). Total discharge during this period was 7,615,256 cf or 175 acre-ft. The peak discharge of 60 cfs was on June 6, 2006 from a storm precipitation of 1.55 inches. The highest storm precipitation of 2006 occurred during the August 1st to 2nd storm, with a total of 2.78 inches.

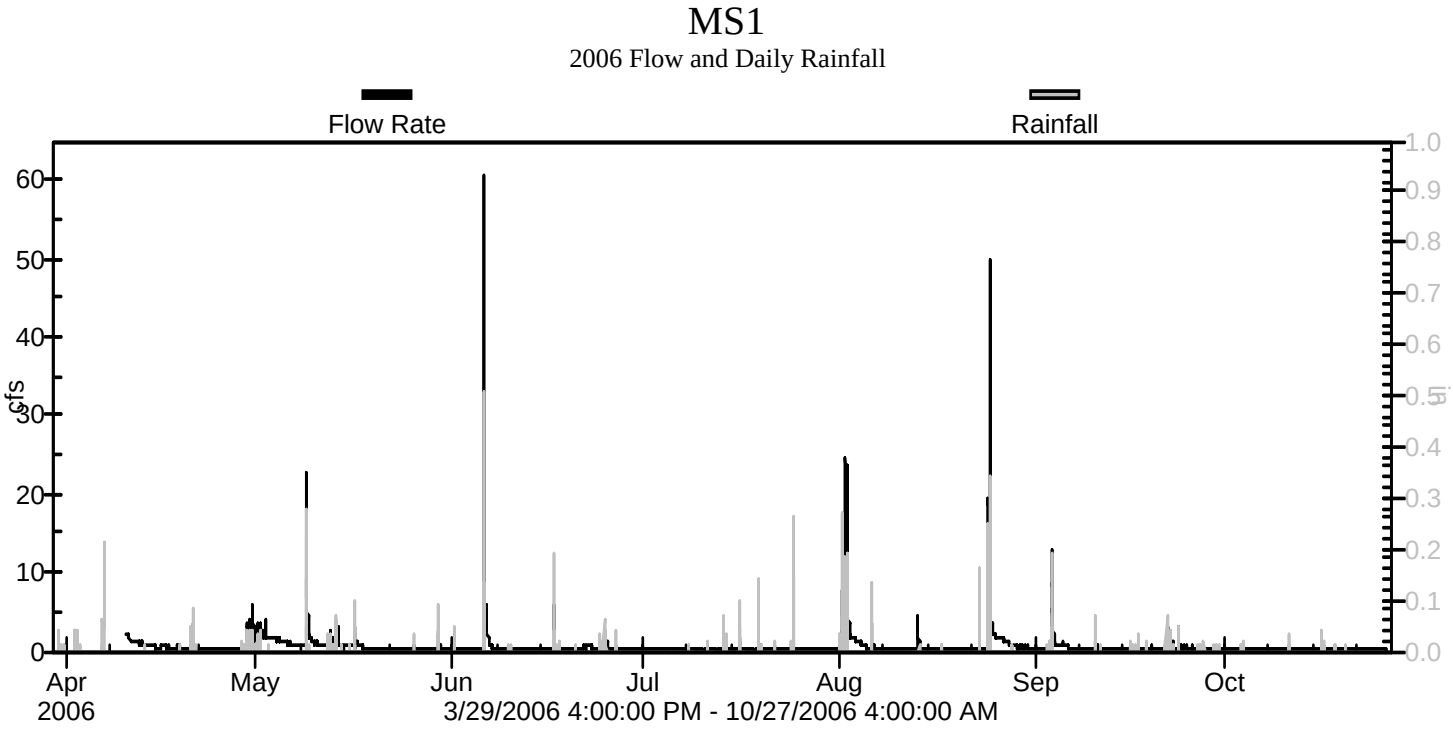


Figure 2. MS1 2006 Continuous Flow and Daily Rainfall

Table 1. MS1 Stream Loading Table

		Sample Collection Time				Loading Interval				
Sample Type	**Storm #**	**Start**	**End**	**TSS (mg/L)**	**TP (mg/L)**	**Start**	**End**	**Interval Volume (cf)**	**Interval TSS (lb)**	**Interval TP (lb)**
Base				*8*	*0.079*	*1/1/2006 0:00*	*3/20/2006 0:00*	*1,684,800*	*841*	*8.3*
Snowmelt Grab		3/22/06 14:15	3/22/06 14:15	8	0.137	3/20/2006 0:00	3/24/2006 0:00	691,200	345	5.9
Base				*8*	*0.079*	*3/24/2006 0:00*	*3/28/2006 0:00*	*172,800*	*86*	*0.9*
Snowmelt Grab		3/31/06 14:46	3/31/06 14:46	15	0.134	3/28/2006 0:00	4/2/2006 0:00	1,296,000	1,214	10.8
Base				*8*	*0.079*	*4/2/2006 0:00*	*4/10/2006 12:00*	*550,800*	*275*	*2.7*
Snowmelt Grab		4/10/06 12:30	4/10/06 12:30	296	0.230	4/10/2006 12:00	4/11/2006 2:00	93,818	1,734	1.3
Base				*8*	*0.079*	*4/11/2006 2:00*	*4/20/2006 13:00*	*469,992*	*235*	*2.3*
Storm	*1*			*203*	*0.442*	*4/20/2006 13:00*	*4/21/2006 5:00*	*49,957*	*634*	*1.4*
Base				*8*	*0.079*	*4/21/2006 5:00*	*4/28/2006 13:00*	*81,263*	*41*	*0.4*
Storm	*2*			*203*	*0.442*	*4/28/2006 13:00*	*5/2/2006 11:00*	*558,043*	*7,087*	*15.4*
Base				*8*	*0.079*	*5/2/2006 11:00*	*5/8/2006 16:00*	*600,420*	*300*	*3.0*
Storm	*3*			*203*	*0.442*	*5/8/2006 16:00*	*5/8/2006 18:00*	*9,400*	*119*	*0.3*
Base				*8*	*0.079*	*5/8/2006 18:00*	*5/8/2006 22:00*	*14,091*	*7*	*0.1*
Storm	*4*			*203*	*0.442*	*5/8/2006 22:00*	*5/9/2006 4:00*	*170,182*	*2,161*	*4.7*
Base				*8*	*0.079*	*5/9/2006 4:00*	*5/12/2006 5:00*	*273,207*	*136*	*1.3*
Storm	*5*			*203*	*0.442*	*5/12/2006 5:00*	*5/12/2006 23:00*	*89,877*	*1,141*	*2.5*
Base				*8*	*0.079*	*5/12/2006 23:00*	*5/13/2006 16:00*	*55,284*	*28*	*0.3*
Storm	*6*			*203*	*0.442*	*5/13/2006 16:00*	*5/13/2006 22:00*	*43,608*	*554*	*1.2*
Base				*8*	*0.079*	*5/13/2006 22:00*	*5/15/2006 14:00*	*101,043*	*50*	*0.5*
Storm	*7*			*203*	*0.442*	*5/15/2006 14:00*	*5/15/2006 20:00*	*13,979*	*178*	*0.4*
Base Grab		5/16/06 8:30	5/16/06 8:30	1	0.023	5/15/2006 20:00	5/16/2006 16:00	36,218	2	0.1
Storm	*8*			*203*	*0.442*	*5/16/2006 16:00*	*5/16/2006 23:00*	*26,444*	*336*	*0.7*
Base				*8*	*0.079*	*5/16/2006 23:00*	*5/25/2006 21:00*	*283,854*	*142*	*1.4*
Storm	*9*			*203*	*0.442*	*5/25/2006 21:00*	*5/26/2006 1:00*	*6,348*	*81*	*0.2*
Base				*8*	*0.079*	*5/26/2006 1:00*	*5/29/2006 16:00*	*48,765*	*24*	*0.2*
Storm	*10*			*203*	*0.442*	*5/29/2006 16:00*	*5/30/2006 6:00*	*23,155*	*294*	*0.6*
Base Composite		5/30/06 10:52	6/1/06 20:26	4	0.060	5/30/2006 6:00	6/5/2006 19:00	53,594	13	0.2
Storm	*11*			*203*	*0.442*	*6/5/2006 19:00*	*6/5/2006 21:00*	*11,233*	*143*	*0.3*
Base				*8*	*0.079*	*6/5/2006 21:00*	*6/5/2006 23:00*	*5,253*	*3*	*0.0*
Storm Composite	12	6/5/06 23:22	6/6/06 6:00	472	0.601	6/5/2006 23:00	6/6/2006 2:00	236,754	6,976	8.9
Base				*8*	*0.079*	*6/6/2006 2:00*	*6/16/2006 21:00*	*336,986*	*168*	*1.7*
Storm	*13*			*203*	*0.442*	*6/16/2006 21:00*	*6/17/2006 5:00*	*33,697*	*428*	*0.9*
Base				*8*	*0.079*	*6/17/2006 5:00*	*6/17/2006 18:00*	*11,971*	*6*	*0.1*
Storm	*14*			*203*	*0.442*	*6/17/2006 18:00*	*6/17/2006 20:00*	*2,584*	*33*	*0.1*
Base				*8*	*0.079*	*6/17/2006 20:00*	*6/24/2006 15:00*	*170,565*	*85*	*0.8*
Storm	*15*			*203*	*0.442*	*6/24/2006 15:00*	*6/25/2006 13:00*	*35,574*	*452*	*1.0*
Base				*8*	*0.079*	*6/25/2006 13:00*	*6/26/2006 17:00*	*10,212*	*5*	*0.1*
Storm	*16*			*203*	*0.442*	*6/26/2006 17:00*	*6/27/2006 1:00*	*4,336*	*55*	*0.1*
Base				*8*	*0.079*	*6/27/2006 1:00*	*7/13/2006 22:00*	*29,195*	*15*	*0.1*
Storm	*17*			*203*	*0.442*	*7/13/2006 22:00*	*7/14/2006 7:00*	*6,943*	*88*	*0.2*
Base Composite		7/14/06 8:41	7/14/06 19:51	18	0.086	7/14/2006 7:00	7/16/2006 8:00	5,177	6	0.0
Storm Composite	18	7/16/06 8:29	7/16/06 13:23	34	0.113	7/16/2006 8:00	7/16/2006 15:00	11,450	24	0.1
Base				*8*	*0.079*	*7/16/2006 15:00*	*7/19/2006 10:00*	*5,888*	*3*	*0.0*
Storm Composite	19	7/19/06 10:36	7/19/06 12:12	38	0.118	7/19/2006 10:00	7/19/2006 19:00	32,607	77	0.2
Base				*8*	*0.079*	*7/19/2006 19:00*	*7/24/2006 18:00*	*18,007*	*9*	*0.1*
Storm Composite	20	7/24/06 18:14	7/24/06 19:40	142	0.334	7/24/2006 18:00	7/24/2006 23:00	37,063	329	0.8
Base				*8*	*0.079*	*7/24/2006 23:00*	*8/1/2006 3:00*	*42,625*	*21*	*0.2*
Storm Composite	21	8/1/06 12:34	8/2/06 8:01	324	1.400	8/1/2006 3:00	8/2/2006 21:00	775,753	15,690	67.8
Base				*8*	*0.079*	*8/2/2006 21:00*	*8/6/2006 2:00*	*268,328*	*134*	*1.3*
Storm	*22*			*203*	*0.442*	*8/6/2006 2:00*	*8/6/2006 6:00*	*18,424*	*234*	*0.5*
Base				*8*	*0.079*	*8/6/2006 6:00*	*8/23/2006 4:00*	*229,561*	*115*	*1.1*
Storm Composite	23	8/23/06 4:36	8/23/06 8:46	50	0.222	8/23/2006 4:00	8/23/2006 12:00	65,805	205	0.9
Base				*8*	*0.079*	*8/23/2006 12:00*	*8/24/2006 15:00*	*13,577*	*7*	*0.1*
Storm Composite	24	8/24/06 15:22	8/24/06 17:31	200	0.391	8/24/2006 15:00	8/24/2006 18:00	86,316	1,078	2.1
Storm Composite	25	8/24/06 17:34	8/24/06 22:59	452	0.536	8/24/2006 18:00	8/25/2006 8:00	469,375	13,244	15.7
Base				*8*	*0.079*	*8/25/2006 8:00*	*9/3/2006 15:00*	*538,635*	*269*	*2.7*
Storm Composite	26	9/3/06 15:52	9/3/06 22:08	119	0.265	9/3/2006 15:00	9/4/2006 7:00	210,489	1,564	3.5
Base				*8*	*0.079*	*9/4/2006 7:00*	*9/10/2006 17:00*	*221,307*	*111*	*1.1*
Storm	*27*			*203*	*0.442*	*9/10/2006 17:00*	*9/10/2006 23:00*	*13,164*	*167*	*0.4*
Base Grab		9/13/06 9:45	9/13/06 9:45	9	0.147	9/10/2006 23:00	9/21/2006 14:00	101,392	57	0.9
Storm	*28*			*203*	*0.442*	*9/21/2006 14:00*	*9/23/2006 15:00*	*117,648*	*1,494*	*3.2*
Storm	*29*			*203*	*0.442*	*9/23/2006 15:00*	*9/24/2006 6:00*	*56,629*	*719*	*1.6*
Base				*8*	*0.079*	*9/24/2006 6:00*	*10/11/2006 5:00*	*214,703*	*107*	*1.1*
Storm	*30*			*203*	*0.442*	*10/11/2006 5:00*	*10/11/2006 17:00*	*12,819*	*163*	*0.4*
Base				*8*	*0.079*	*10/11/2006 17:00*	*10/16/2006 5:00*	*22,147*	*11*	*0.1*
Storm	*31*			*203*	*0.442*	*10/16/2006 5:00*	*10/16/2006 21:00*	*20,468*	*260*	*0.6*
Base				*8*	*0.079*	*10/16/2006 21:00*	*10/26/2006 13:00*	*11,736*	*6*	*0.1*
Base				*8*	*0.079*	*10/26/2006 13:00*	*1/1/2007 0:00*	*5,742*	*3*	*0.0*
Storm Average				203	0.442					
Base Average				8	0.079					
Snowmelt Average				12	0.136					
All Average				136	0.300					
Total								**12,020,274**	62,622	188
SWWD Major Subwatershed Total Acres								1,482		
Total TP/TSS(lb/ac/yr)									42.26	0.13
Total TP/TSS (kg/ha/yr)									47.36	0.14

*Italics indicate estimated concentrations based on average base and storm flow concentrations

Grab and flow weighted composite samples were taken at the MS1 site to determine water quality. Samples were taken during snowmelt and storm runoff, as well as during base flow conditions. The total suspended solids (TSS), total Kjeldahl nitrogen (TKN), total phosphorus (TP), total dissolved phosphorus (TDP), volatile suspended solids (VSS), chemical oxygen demand (COD), and E. Coliform concentrations from all collected samples are listed in Table 2. The highest TSS concentrations were collected in a storm composite on June 6, 2006. The highest TP concentration was collected in a storm composite on August 1, 2006. The highest TKN concentration was collected in a storm composite on August 1, 2006. Metals and other Nitrogen species chemical results are listed in Table 3.

Table 2. MS1 2006 Sample Chemistry Results

Sample Type	Start Date	End Date	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	E. Coliform (#/100 mL)	COD (mg/L)	TDP (mg/L)
Snowmelt Grab	3/22/06 14:15	3/22/06 14:15	8	~3	1.00	0.137		34	0.062
Snowmelt Grab	3/31/06 14:46	3/31/06 14:46	15	~6	0.95	0.134		30	~0.018
Storm Grab	4/10/06 12:30	4/10/06 12:30	296	~22	1.30	0.230		33	0.084
Base Grab	5/16/06 8:30	5/16/06 8:30	~1	~1	0.58	~0.023		18	<0.010
Base Composite	5/30/06 10:52	6/1/06 20:26	4	~2	0.92	0.060		29	~0.020
Storm Composite	6/5/06 23:22	6/6/06 6:00	472	41	1.90	0.601		61	0.077
E. Coli Grab	6/14/06 10:40	6/14/06 10:40					186		
Base Composite	7/14/06 8:41	7/14/06 19:51	18	~7	0.99	0.086		48	~0.049
Storm Composite	7/16/06 8:29	7/16/06 13:23	34	~12	2.00	0.113		52	0.075
Storm Composite	7/19/06 10:36	7/19/06 12:12	38	~10	1.30	0.118		54	~0.014
Storm Composite	7/24/06 18:14	7/24/06 19:40	142	21	1.30	0.334		61	~0.031
E. Coli Grab	7/25/06 9:10	7/25/06 9:10					816		
Storm Composite	8/1/06 12:34	8/2/06 8:01	324	~26	3.80	1.400		59	0.114
E. Coli Grab	8/10/06 10:15	8/10/06 10:15					176		
Storm Composite	8/23/06 4:36	8/23/06 8:46	50	9	1.20	0.222		45	0.063
Storm Composite	8/23/06 4:36	8/25/06 20:46	200	~22	2.00	0.391		55	0.082
Storm Composite	8/24/06 15:22	8/24/06 22:59	452	~31	1.80	0.536		56	0.118
Storm Composite	9/3/06 15:52	9/3/06 22:08	119	14	1.10	0.265		44	0.060
E. Coli Grab	9/6/06 9:30	9/6/06 9:30					488		
Base Grab	9/13/06 9:45	9/13/06 9:45	9	~2	0.49	0.147		16	0.091
E. Coli Grab	10/10/06 8:20	10/10/06 8:20					51		
Average			**136**	**14**	**1.41**	**0.300**	**343**	**43**	**0.060**

Table 3. MS1 2006 Sample Metals and Nitrogen Species Chemical Results

Sample Type	Start Date	End Date	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Chloride (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Nitrogen (mg/L)
Snowmelt Grab	3/22/06 14:15	3/22/06 14:15	0.0045	0.0045	0.00050	0.0159	<0.00004	0.0015	527	0.06	0.46	0.08
Snowmelt Grab	3/31/06 14:46	3/31/06 14:46	0.0026	0.0023	0.00060	0.0117	<0.00004	0.0013	82	<0.03	0.18	~0.04
Storm Grab	4/10/06 12:30	4/10/06 12:30	0.0045	0.0044	0.00180	0.0134	<0.00004	0.0029	82	<0.03	0.13	~0.05
Base Grab	5/16/06 8:30	5/16/06 8:30	0.0010	0.0020	0.00008	0.0038	<0.00004	0.0008	115	<0.03	0.06	<0.02
Base Composite	5/30/06 10:52	6/1/06 20:26	0.0101	0.0027	0.00010	0.0101	0.00020	0.0008	112	0.10	0.48	0.12
Storm Composite	6/5/06 23:22	6/6/06 6:00	0.0172	0.0104	0.00730	0.0460	0.00010	0.0097	52	0.03	0.12	~0.05
E. Coli Grab	6/14/06 10:40	6/14/06 10:40										
Base Composite	7/14/06 8:41	7/14/06 19:51	0.0062	0.0029	0.00050	0.0128	0.00140	0.0015	37	<0.03	1.02	<0.02
Storm Composite	7/16/06 8:29	7/16/06 13:23	0.0102	0.0031	0.00100	0.0290	0.00040	0.0024	19	0.05	1.50	0.56
Storm Composite	7/19/06 10:36	7/19/06 12:12	0.0072	0.0024	0.00080	0.0191	0.00040	0.0027	14	<0.03	0.92	~0.02
Storm Composite	7/24/06 18:14	7/24/06 19:40	0.0103	0.0045	0.00310	0.0450	0.00020	0.0057	11	<0.03	0.79	<0.02
E. Coli Grab	7/25/06 9:10	7/25/06 9:10										
Storm Composite	8/1/06 12:34	8/2/06 8:01	0.0220	0.0109	0.00570	0.0300	<0.00004	0.0110	26	0.09	0.59	0.10
E. Coli Grab	8/10/06 10:15	8/10/06 10:15										
Storm Composite	8/23/06 4:36	8/23/06 8:46	0.0073	0.0033	0.00130	0.0210	<0.00004	0.0027	12	0.04	1.00	0.07
Storm Composite	8/23/06 4:36	8/25/06 20:46	0.0149	0.0084	0.00500	0.0370	<0.00004	0.0092	14	0.12	0.73	0.20
Storm Composite	8/24/06 15:22	8/24/06 22:59	0.0179	0.0112	0.00660	0.0340	<0.00004	0.0120	20	0.13	0.45	0.17
Storm Composite	9/3/06 15:52	9/3/06 22:08	0.0176	0.0060	0.00300	0.0230	<0.00004	0.0061	16	0.04	0.63	~0.04
E. Coli Grab	9/6/06 9:30	9/6/06 9:30										
Base Grab	9/13/06 9:45	9/13/06 9:45	0.0030	0.0026	0.00020	0.0024	<0.00004	0.0013	33	<0.03	1.27	<0.02
E. Coli Grab	10/10/06 8:20	10/10/06 8:20										
Average			**0.0098**	**0.0051**	**0.00235**	**0.0221**	**0.00018**	**0.0045**	**73**	**0.05**	**0.65**	**0.10**

Summaries of rainfall events and the resulting discharges for MS1 are shown in Table 3 and Table 4. Average and maximum intensities are provided, as well as maximum stage and flow rates.

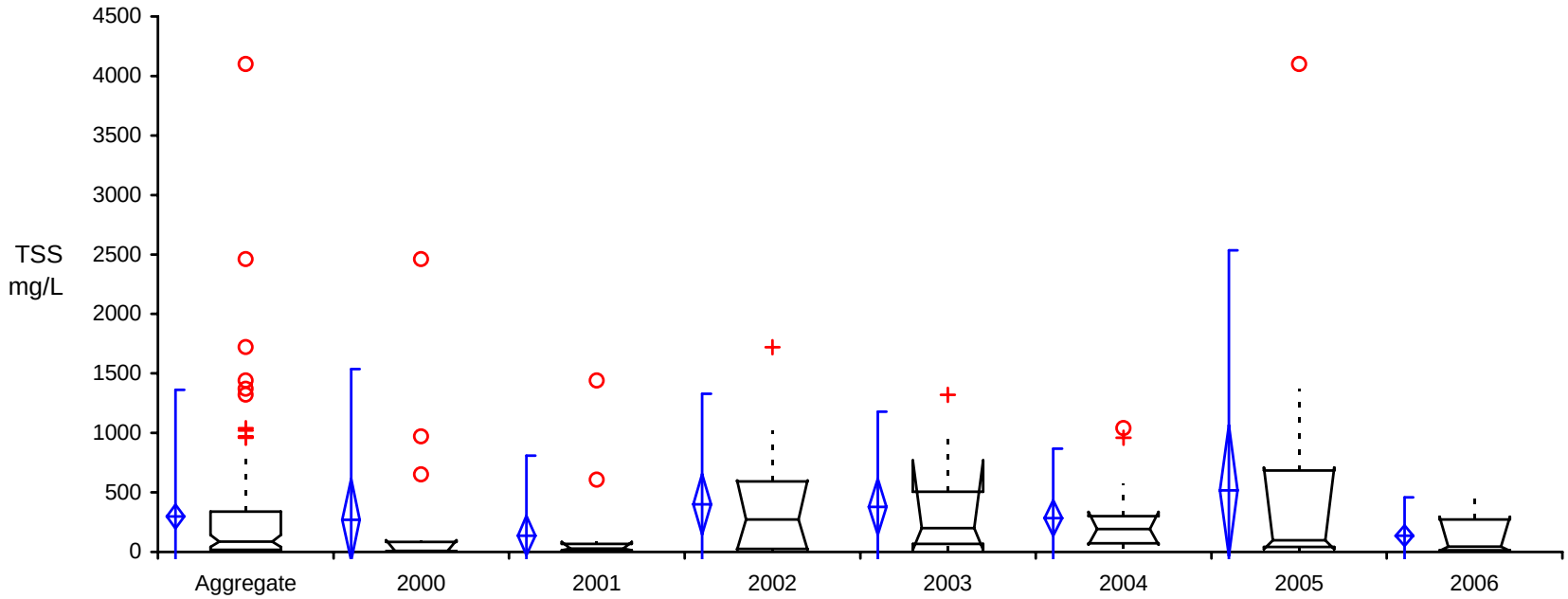
Statistical summaries for MS1 for the monitoring seasons 2000-2006 are shown as box plots in figures 3-10. The 2002 monitoring season recorded the largest increases in median values for total suspended solids, volatile suspended solids, total phosphorus, and total Kjedahl nitrogen. Further analysis of factors around this site is needed to fully understand why this occurred. Median values decline over the next four years for TSS, VSS, and TP. TKN maintains a stable trend from 2002-2006. Total chloride ions for MS1 had a stable trend since the first year of monitoring in 2003. Interestingly, the highest chloride results occurred during the first sample of each year. This points to a correlation to snowmelt and increased amounts of chloride being washed off the roads. Fecal Coliform statistical summary is difficult due to low numbers of samples, with the years 2003 and 2004 unable to perform tests because of these low numbers of samples. It should be noted that the geometric means of fecal coliform exceeds the numerical limits for water quality standards, however it does not violate the water quality standard due to the low amount of samples taken each year. The standard is as follows: “Not to exceed 200 organisms per 100 milliliters as a geometric mean of not less than five samples in any calendar month, nor shall more than ten percent of all samples taken during any calendar month individually exceed 400 organisms per 100 milliliters. The standard applies only between April 1 and October 31.” (Minnesota Pollution Control Agency. Waters of the State. Chapter 7050, Subsection 0222.). The box plots indicate further and more intensive E. Coli bacteria sampling to verify the flowing waters at MS1 are within the Minnesota Pollution Control Agency’s water quality standards. The geometric mean for MS1 in 2002 was 377 organisms per 100 mL, 2005 was 555 organisms per 100 mL, and 2006 was 343 organisms per 100 m/L.

Table 4. MS1 2006 Storm Events

MS 1	Storm Event								Max Storm Intensity					
Storm #	Start	End	Duration (days)	Hr	Total Rainfall (in)	Average Intensity (in/hr)	Max Intensity (in)	Max Intensity (in/hr)	Start	End	Days	Duration (hr)	Rainfall (in)	Average Intensity (in/hr)
1	4/20/2006 13:30	4/20/2006 20:30	0.29	7.25	0.45	0.06	0.08	0.32	4/20/2006 19:30	4/20/2006 20:15	0.03	1.00	0.24	0.24
2	4/28/2006 12:30	5/1/2006 18:45	3.26	78.50	1.73	0.02	0.04	0.16	4/29/2006 16:00	4/29/2006 17:00	0.04	1.25	0.16	0.13
3	5/8/2006 16:30	5/8/2006 17:15	0.03	1.00	0.11	0.11	0.08	0.32	5/8/2006 16:45	5/8/2006 16:45	0.00	0.25	0.08	0.32
4	5/8/2006 22:15	5/8/2006 23:15	0.04	1.25	0.81	0.65	0.28	1.12	5/8/2006 22:45	5/8/2006 23:00	0.01	0.50	0.51	1.02
5	5/12/2006 3:30	5/12/2006 19:45	0.68	16.50	0.43	0.03	0.03	0.12	5/12/2006 16:00	5/12/2006 16:30	0.02	0.75	0.06	0.08
6	5/13/2006 13:45	5/13/2006 18:15	0.19	4.75	0.19	0.04	0.07	0.28	5/13/2006 16:45	5/13/2006 16:45	0.00	0.25	0.07	0.28
7	5/15/2006 16:00	5/15/2006 18:00	0.08	2.25	0.04	0.02	0.01	0.04	5/15/2006 16:00	5/15/2006 16:30	0.02	0.75	0.03	0.04
8	5/16/2006 16:00	5/16/2006 17:00	0.04	1.25	0.20	0.16	0.10	0.40	5/16/2006 16:00	5/16/2006 16:15	0.01	0.50	0.18	0.36
9	5/25/2006 21:00	5/25/2006 22:00	0.04	1.25	0.07	0.06	0.03	0.12	5/25/2006 21:15	5/25/2006 21:15	0.00	0.25	0.03	0.12
10	5/29/2006 18:00	5/29/2006 19:30	0.06	1.75	0.20	0.11	0.09	0.36	5/29/2006 19:30	5/29/2006 19:30	0.00	0.25	0.09	0.36
11	6/5/2006 19:30	6/5/2006 20:00	0.02	0.75	0.18	0.24	0.13	0.52	6/5/2006 19:45	6/5/2006 19:45	0.00	0.25	0.13	0.52
12	6/5/2006 23:15	6/6/2006 0:15	0.04	1.25	1.27	1.02	0.51	2.04	6/5/2006 23:15	6/5/2006 23:45	0.02	0.75	1.25	1.67
13	6/16/2006 20:45	6/17/2006 0:30	0.16	4.00	0.38	0.10	0.19	0.76	6/16/2006 22:15	6/16/2006 22:30	0.01	0.50	0.22	0.44
14	6/17/2006 18:30	6/17/2006 18:45	0.01	0.50	0.03	0.06	0.02	0.08	6/17/2006 18:30	6/17/2006 18:45	0.01	0.50	0.03	0.06
15	6/24/2006 17:15	6/25/2006 7:45	0.60	14.75	0.31	0.02	0.06	0.24	6/24/2006 21:45	6/24/2006 22:00	0.01	0.50	0.08	0.16
16	6/26/2006 18:15	6/26/2006 20:15	0.08	2.25	0.06	0.03	0.04	0.16	6/26/2006 20:15	6/26/2006 20:15	0.00	0.25	0.04	0.16
17	7/13/2006 21:45	7/14/2006 2:30	0.20	5.00	0.14	0.03	0.07	0.28	7/13/2006 22:00	7/13/2006 22:00	0.00	0.25	0.07	0.28
18	7/16/2006 7:45	7/16/2006 9:45	0.08	2.25	0.24	0.11	0.10	0.40	7/16/2006 8:15	7/16/2006 8:15	0.00	0.25	0.1	0.40
19	7/19/2006 9:45	7/19/2006 16:30	0.28	7.00	0.42	0.06	0.14	0.56	7/19/2006 10:00	7/19/2006 10:45	0.03	1.00	0.33	0.33
20	7/24/2006 16:15	7/24/2006 18:30	0.09	2.50	0.40	0.16	0.26	1.04	7/24/2006 18:00	7/24/2006 18:15	0.01	0.50	0.31	0.62
21	8/1/2006 1:45	8/2/2006 8:00	1.26	30.50	2.78	0.09	0.27	1.08	8/1/2006 13:00	8/1/2006 13:00	0.00	0.25	0.27	1.08
22	8/6/2006 2:30	8/6/2006 3:00	0.02	0.75	0.20	0.27	0.13	0.52	8/6/2006 2:30	8/6/2006 2:45	0.01	0.50	0.19	0.38
23	8/23/2006 4:15	8/23/2006 6:30	0.09	2.50	0.52	0.21	0.16	0.64	8/23/2006 4:15	8/23/2006 4:30	0.01	0.50	0.29	0.58
24	8/24/2006 12:15	8/24/2006 18:15	0.25	6.25	0.99	0.16	0.25	1.00	8/24/2006 15:15	8/24/2006 15:30	0.01	0.50	0.34	0.68
25	8/24/2006 19:00	8/24/2006 19:30	0.02	0.75	0.53	0.71	0.34	1.36	8/24/2006 19:00	8/24/2006 19:15	0.01	0.50	0.48	0.96
26	9/3/2006 2:45	9/3/2006 22:00	0.80	19.50	1.00	0.05	0.19	0.76	9/3/2006 15:45	9/3/2006 16:15	0.02	0.75	0.47	0.63
27	9/10/2006 17:00	9/10/2006 18:30	0.06	1.75	0.15	0.09	0.07	0.28	9/10/2006 17:00	9/10/2006 17:15	0.01	0.50	0.12	0.24
28	9/21/2006 15:00	9/22/2006 20:00	1.21	29.25	0.74	0.03	0.07	0.28	9/21/2006 20:30	9/21/2006 20:45	0.01	0.50	0.11	0.22
29	9/23/2006 15:45	9/23/2006 20:15	0.19	4.75	0.25	0.05	0.05	0.20	9/23/2006 16:45	9/23/2006 17:15	0.02	0.75	0.1	0.13
30	10/11/2006 3:15	10/11/2006 8:30	0.22	5.50	0.16	0.03	0.03	0.12	10/11/2006 5:45	10/11/2006 5:45	0.00	0.25	0.03	0.12
31	10/16/2006 5:45	10/16/2006 14:45	0.38	9.25	0.18	0.02	0.04	0.16	10/16/2006 6:00	10/16/2006 6:00	0.00	0.25	0.04	0.16

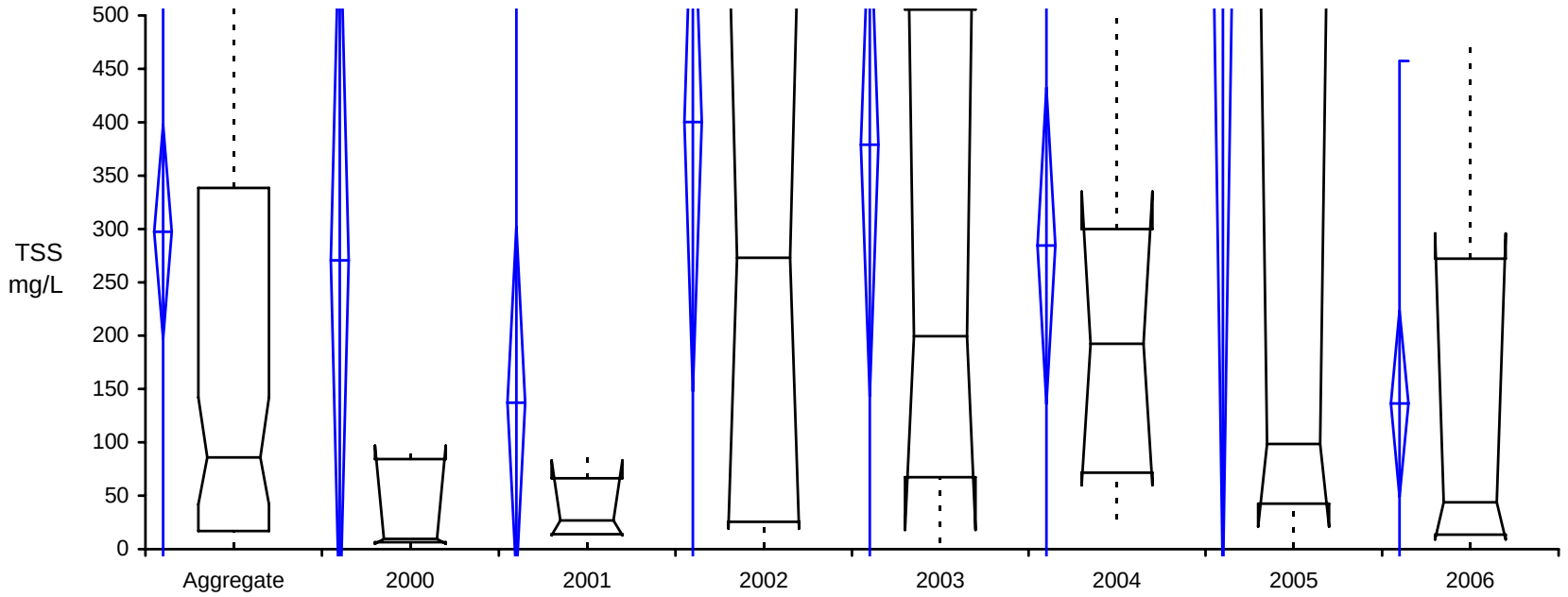
Table 5. MS1 2006 Storm Discharge Events

MS1		Hydrograph			Flow Rate (cfs)				Stage (ft)			
Storm #	Rainfall Total (in)	Start	End	Total Discharge (cf)	Max	Time	Start	End	Max	Time	Start	End
1	0.45	4/20/2006 13:00	4/21/2006 5:00	49,957	3.6	4/20/2006 20:30	0.288	0.374	0.480	4/20/2006 20:30	0.160	0.173
2	1.73	4/28/2006 13:00	5/2/2006 11:00	558,043	5.8	4/30/2006 10:30	0.042	1.605	0.622	4/30/2006 10:15	0.068	0.337
3	0.11	5/8/2006 16:00	5/8/2006 18:00	9,400	3.0	5/8/2006 17:00	0.751	1.170	0.439	5/8/2006 17:00	0.238	0.296
4	0.81	5/8/2006 22:00	5/9/2006 4:00	170,182	22.9	5/8/2006 23:15	0.861	3.189	1.342	5/8/2006 23:15	0.256	0.448
5	0.43	5/12/2006 5:00	5/12/2006 23:00	89,877	2.6	5/12/2006 18:00	0.751	1.283	0.407	5/12/2006 18:30	0.232	0.296
6	0.19	5/13/2006 16:00	5/13/2006 22:00	43,608	3.5	5/13/2006 17:00	0.689	1.418	0.471	5/13/2006 17:00	0.226	0.310
7	0.04	5/15/2006 14:00	5/15/2006 20:00	13,979	0.8	5/15/2006 16:45	0.545	0.570	0.244	5/15/2006 17:00	0.208	0.209
8	0.20	5/16/2006 16:00	5/16/2006 23:00	26,444	3.2	5/16/2006 16:30	0.464	0.668	0.444	5/16/2006 16:30	0.195	0.228
9	0.07	5/25/2006 21:00	5/26/2006 1:00	6,348	0.9	5/25/2006 21:45	0.301	0.314	0.260	5/25/2006 21:45	0.162	0.169
10	0.20	5/29/2006 16:00	5/30/2006 6:00	23,155	1.8	5/29/2006 19:00	0.095	0.270	0.354	5/29/2006 19:00	0.108	0.160
11	0.18	6/5/2006 19:00	6/5/2006 21:00	11,233	5.2	6/5/2006 20:00	0.068	1.152	0.579	6/5/2006 20:00	0.089	0.295
12	1.27	6/5/2006 23:00	6/6/2006 2:00	236,754	60.4	6/6/2006 0:00	0.504	10.268	1.987	6/6/2006 0:00	0.207	0.901
13	0.38	6/16/2006 21:00	6/17/2006 5:00	33,697	6.0	6/16/2006 22:30	0.047	0.441	0.645	6/16/2006 22:30	0.067	0.177
14	0.03	6/17/2006 18:00	6/17/2006 20:00	2,584	0.6	6/17/2006 19:00	0.200	0.313	0.198	6/17/2006 19:30	0.116	0.151
15	0.31	6/24/2006 15:00	6/25/2006 13:00	35,574	1.2	6/24/2006 22:15	0.235	0.250	0.289	6/24/2006 22:15	0.130	0.130
16	0.06	6/26/2006 17:00	6/27/2006 1:00	4,336	0.4	6/26/2006 20:45	0.046	0.108	0.166	6/26/2006 20:45	0.062	0.096
17	0.14	7/13/2006 22:00	7/14/2006 7:00	6,943	1.5	7/13/2006 22:15	0.014	0.071	0.300	7/13/2006 22:15	0.028	0.058
18	0.24	7/16/2006 8:00	7/16/2006 15:00	11,450	1.6	7/16/2006 9:30	0.004	0.097	0.321	7/16/2006 9:30	0.014	0.069
19	0.42	7/19/2006 10:00	7/19/2006 19:00	32,607	5.0	7/19/2006 10:45	0.018	0.129	0.590	7/19/2006 10:45	0.028	0.081
20	0.40	7/24/2006 18:00	7/24/2006 23:00	37,063	9.5	7/24/2006 18:30	0.102	0.305	0.858	7/24/2006 18:30	0.073	0.136
21	2.78	8/1/2006 3:00	8/2/2006 21:00	775,753	24.6	8/2/2006 4:45	0.000	1.839	1.385	8/2/2006 4:45	0.178	0.354
22	0.20	8/6/2006 2:00	8/6/2006 6:00	18,424	3.7	8/6/2006 2:45	0.270	0.767	0.523	8/6/2006 2:45	0.141	0.231
23	0.52	8/23/2006 4:00	8/23/2006 12:00	65,805	7.3	8/23/2006 4:45	0.106	0.362	0.728	8/23/2006 4:45	0.096	0.167
24	0.99	8/24/2006 15:00	8/24/2006 18:00	86,316	10.5	8/24/2006 15:45	0.166	5.224	0.913	8/24/2006 15:45	0.110	0.625
25	0.53	8/24/2006 18:00	8/25/2006 8:00	469,375	49.7	8/24/2006 19:15	19.566	2.475	1.882	8/24/2006 19:15	1.274	0.403
26	1.00	9/3/2006 15:00	9/4/2006 7:00	210,489	12.9	9/3/2006 16:15	0.248	0.975	0.990	9/3/2006 16:30	0.145	0.274
27	0.15	9/10/2006 17:00	9/10/2006 23:00	13,164	1.4	9/10/2006 17:45	0.148	0.299	0.325	9/10/2006 17:45	0.120	0.162
28	0.74	9/21/2006 14:00	9/23/2006 15:00	117,648	2.9	9/21/2006 21:00	0.168	0.057	0.434	9/21/2006 21:00	0.052	0.111
29	0.25	9/23/2006 15:00	9/24/2006 6:00	56,629	2.9	9/23/2006 17:30	0.057	0.507	0.445	9/23/2006 17:30	0.052	0.205
30	0.16	10/11/2006 5:00	10/11/2006 17:00	12,819	0.8	10/11/2006 6:15	0.091	0.070	0.266	10/11/2006 6:15	0.070	0.061
31	0.18	10/16/2006 5:00	10/16/2006 21:00	20,468	0.8	10/16/2006 6:30	0.113	0.074	0.264	10/16/2006 6:30	0.084	0.068



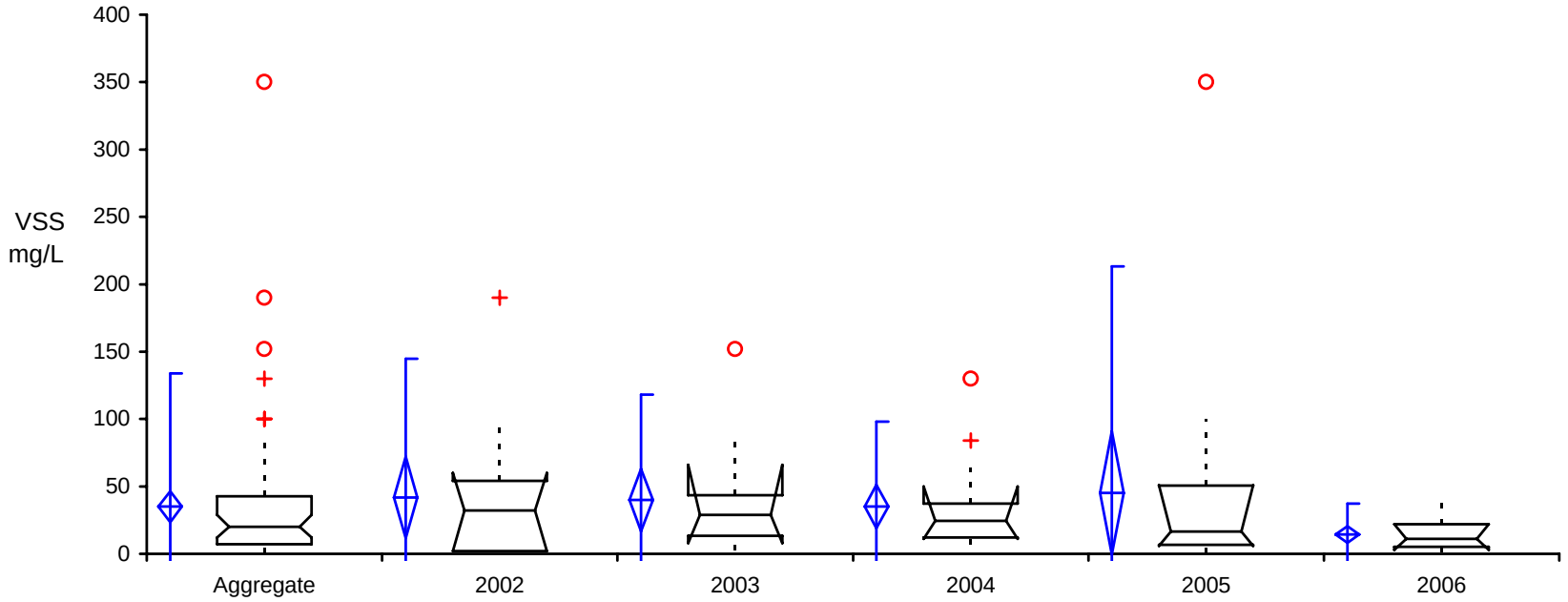
MS1 - TSS	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	115	297.478	543.2946	50.6625	197.116 to 397.840	86.000	321.500	42.000 to 142.000
2000	16	270.688	645.8105	161.4526	-73.441 to 614.816	9.500	77.750	5.000 to 97.000
2001	19	137.263	342.7968	78.6430	-27.960 to 302.486	27.000	52.500	13.000 to 83.000
2002	16	400.313	473.6705	118.4176	147.911 to 652.714	273.000	567.250	19.000 to 600.000
2003	14	378.857	407.3322	108.8641	143.671 to 614.044	199.500	438.250	18.000 to 771.000
2004	18	284.389	297.7399	70.1780	136.326 to 432.451	192.500	228.250	60.000 to 335.000
2005	16	516.313	1029.5844	257.3961	-32.314 to 1064.939	98.500	640.250	21.000 to 708.000
2006	16	136.375	163.7571	40.9393	49.115 to 223.635	44.000	258.500	9.000 to 296.000

Figure 3. MS1 Total Suspended Solids Box Plot (2000-2006)



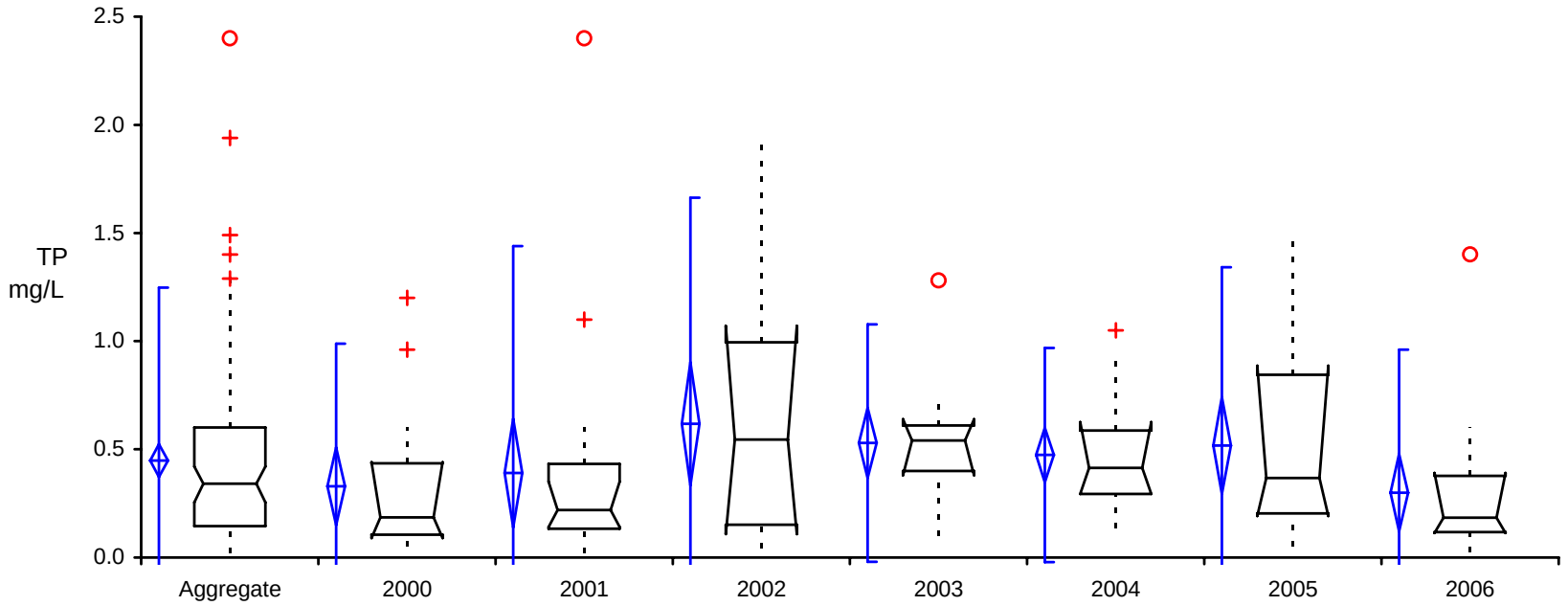
MS1 - TSS	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	115	297.478	543.2946	50.6625	197.116 to 397.840	86.000	321.500	42.000 to 142.000
2000	16	270.688	645.8105	161.4526	-73.441 to 614.816	9.500	77.750	5.000 to 97.000
2001	19	137.263	342.7968	78.6430	-27.960 to 302.486	27.000	52.500	13.000 to 83.000
2002	16	400.313	473.6705	118.4176	147.911 to 652.714	273.000	567.250	19.000 to 600.000
2003	14	378.857	407.3322	108.8641	143.671 to 614.044	199.500	438.250	18.000 to 771.000
2004	18	284.389	297.7399	70.1780	136.326 to 432.451	192.500	228.250	60.000 to 335.000
2005	16	516.313	1029.5844	257.3961	-32.314 to 1064.939	98.500	640.250	21.000 to 708.000
2006	16	136.375	163.7571	40.9393	49.115 to 223.635	44.000	258.500	9.000 to 296.000

Figure 4. MS1 Total Suspended Solids Box Plot (2000-2006) without outliers



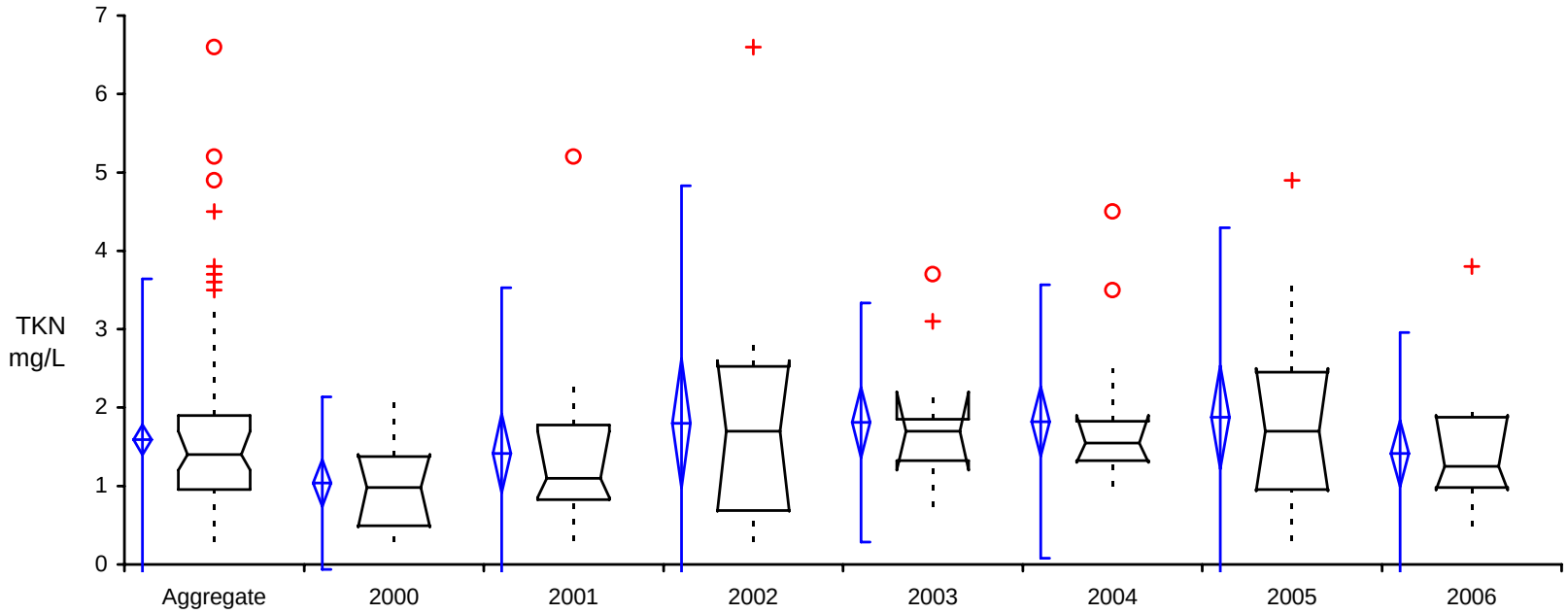
MS1 - VSS	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	78	34.962	50.4546	5.7129	23.586 to 46.337	20.000	35.500	12.000 to 29.000
2002	14	41.857	52.5252	14.0380	11.530 to 72.184	32.000	52.000	2.000 to 60.000
2003	14	39.929	39.9104	10.6665	16.885 to 62.972	29.000	30.250	8.000 to 66.000
2004	18	35.056	32.2043	7.5906	19.041 to 51.070	24.500	25.250	11.000 to 50.000
2005	16	45.125	85.7334	21.4334	-0.559 to 90.809	16.500	44.000	6.000 to 51.000
2006	16	14.313	11.7571	2.9393	8.048 to 20.577	11.000	16.750	3.000 to 22.000

Figure 5. MS1 Total Volatile Suspended Solids Box Plot (2000-2006)



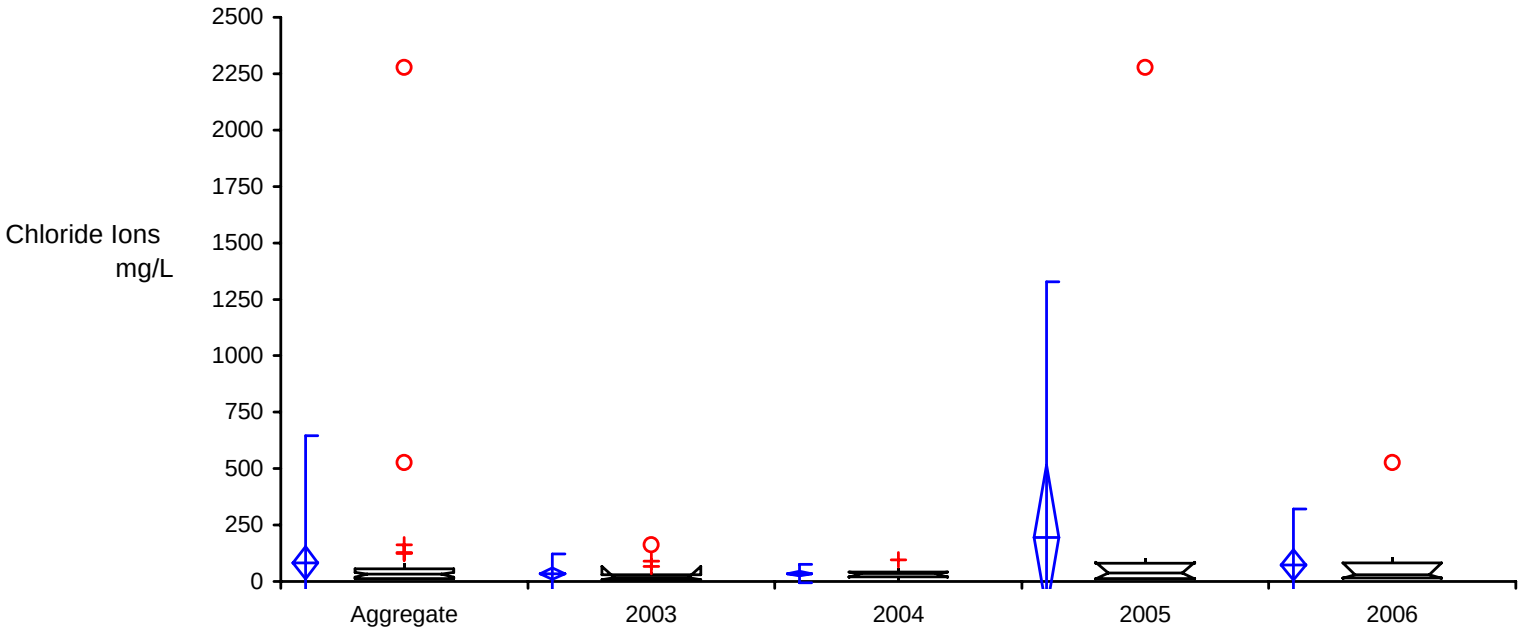
MS1 - TP	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	116	0.448	0.4081	0.0379	0.373 to 0.523	0.342	0.456	0.255 to 0.420
2000	16	0.329	0.3362	0.0841	0.150 to 0.509	0.185	0.330	0.090 to 0.440
2001	20	0.390	0.5355	0.1197	0.139 to 0.641	0.220	0.300	0.140 to 0.350
2002	16	0.617	0.5335	0.1334	0.333 to 0.902	0.545	0.843	0.108 to 1.070
2003	14	0.529	0.2802	0.0749	0.368 to 0.691	0.540	0.210	0.380 to 0.640
2004	18	0.473	0.2527	0.0596	0.348 to 0.599	0.414	0.293	0.293 to 0.626
2005	16	0.518	0.4203	0.1051	0.294 to 0.742	0.368	0.640	0.191 to 0.887
2006	16	0.300	0.3370	0.0843	0.120 to 0.479	0.185	0.260	0.113 to 0.391

Figure 6. MS1 Total Phosphorus Box Plot (2000-2006)



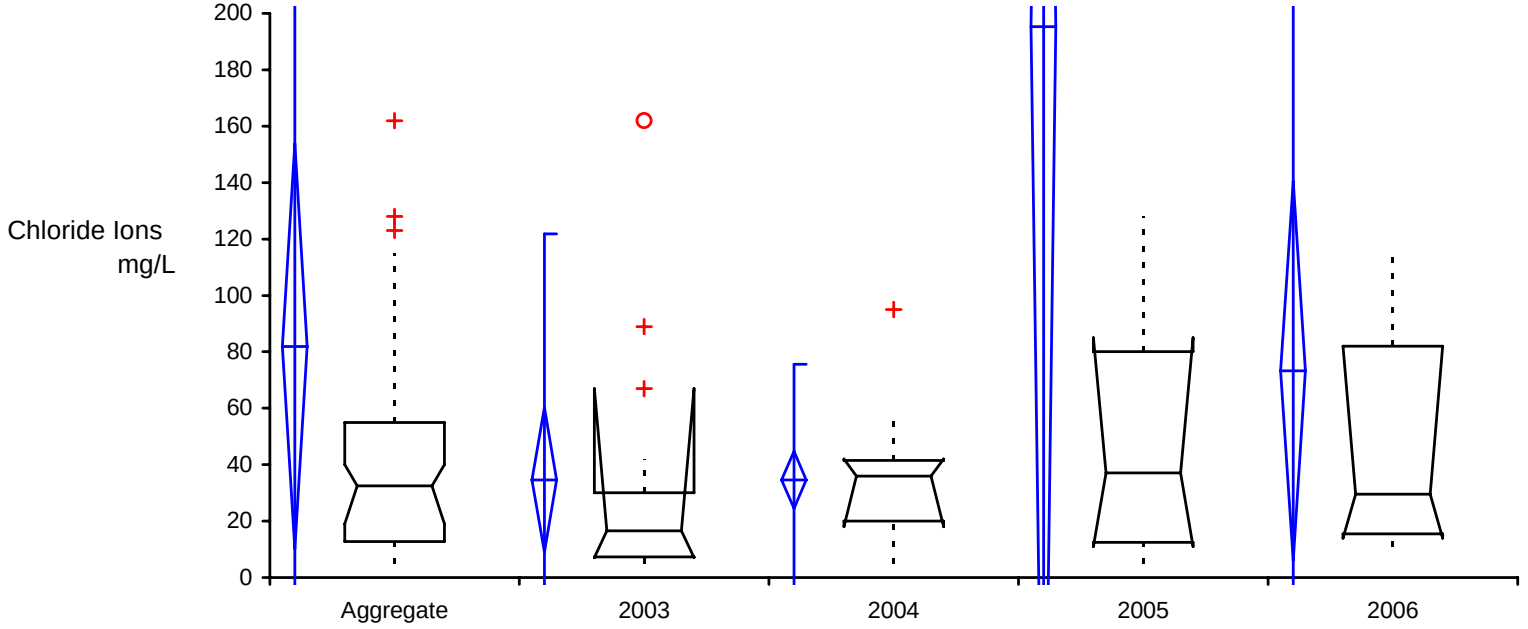
MS1 - TKN	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	116	1.591	1.0458	0.0971	1.398 to 1.783	1.400	0.943	1.200 to 1.700
2000	16	1.037	0.5612	0.1403	0.738 to 1.336	0.980	0.880	0.480 to 1.400
2001	20	1.416	1.0776	0.2409	0.911 to 1.920	1.100	0.950	0.850 to 1.700
2002	16	1.799	1.5470	0.3868	0.975 to 2.624	1.700	1.838	0.680 to 2.600
2003	14	1.810	0.7777	0.2078	1.361 to 2.259	1.700	0.525	1.200 to 2.200
2004	18	1.822	0.8902	0.2098	1.380 to 2.265	1.550	0.500	1.300 to 1.900
2005	16	1.878	1.2321	0.3080	1.221 to 2.534	1.700	1.495	0.940 to 2.500
2006	16	1.414	0.7877	0.1969	0.995 to 1.834	1.250	0.895	0.950 to 1.900

Figure 7. MS1 Total Kjedahl Nitrogen Box Plot (2000-2006)



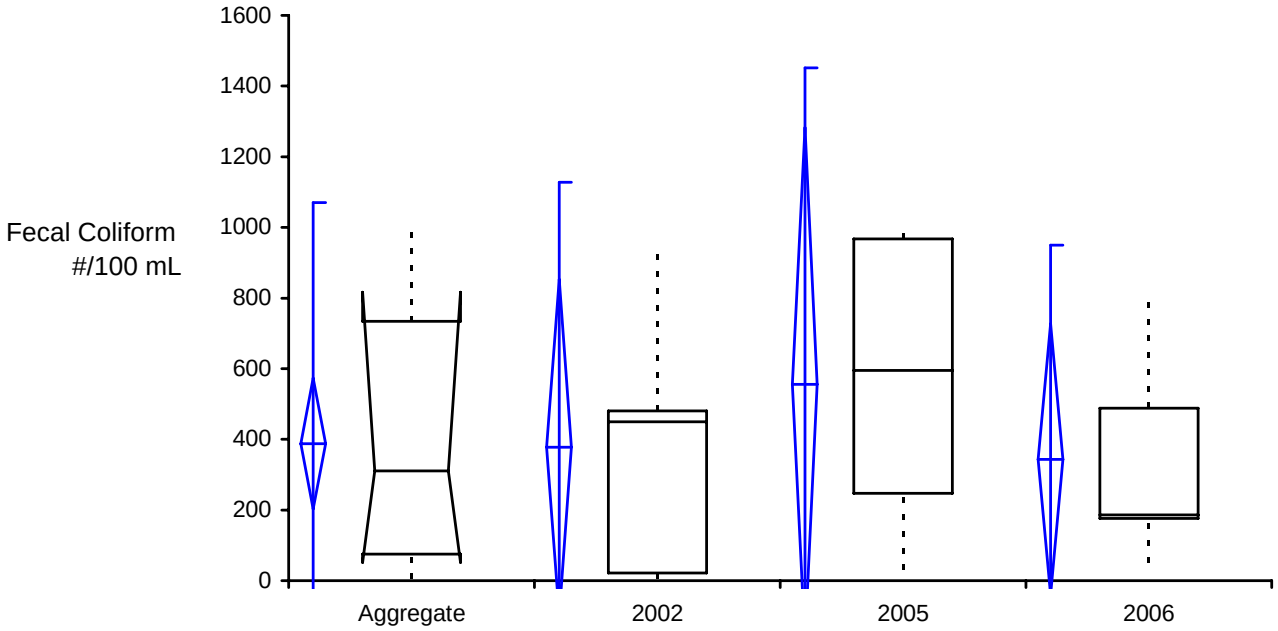
MS1 - Chloride	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	64	81.938	287.5964	35.9496	10.098 to 153.777	32.500	42.250	19.000 to 40.000
2003	14	34.643	44.4671	11.8843	8.968 to 60.317	16.500	22.750	7.000 to 67.000
2004	19	34.579	20.9558	4.8076	24.479 to 44.679	36.000	21.500	18.000 to 42.000
2005	15	195.333	577.5937	149.1341	-124.527 to 515.194	37.000	67.500	11.000 to 85.000
2006	16	73.250	126.1240	31.5310	6.043 to 140.457	29.500	66.500	14.000 to 82.000

Figure 8. MS1 Total Chloride Ions Box Plot (2003-2006)



MS1 - Chloride	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	64	81.938	287.5964	35.9496	10.098 to 153.777	32.500	42.250	19.000 to 40.000
2003	14	34.643	44.4671	11.8843	8.968 to 60.317	16.500	22.750	7.000 to 67.000
2004	19	34.579	20.9558	4.8076	24.479 to 44.679	36.000	21.500	18.000 to 42.000
2005	15	195.333	577.5937	149.1341	-124.527 to 515.194	37.000	67.500	11.000 to 85.000
2006	16	73.250	126.1240	31.5310	6.043 to 140.457	29.500	66.500	14.000 to 82.000

Figure 9. Total Chloride Ions Box Plot (2003-2006) without Outliers



MS1 - Fecal Coliform	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	16	387.875	348.3686	87.0921	202.243 to 573.507	310.000	659.000	51.000 to 816.000
2002	5	377.200	383.0473	171.3039	-98.416 to 852.816	450.000	458.000	- to -
2005	4	555.000	457.5660	228.7830	-173.090 to 1283.090	595.000	720.000	- to -
2006	5	343.400	309.2552	138.3031	-40.591 to 727.391	186.000	312.000	- to -

Figure 10. Fecal Coliform Box Plot (2002-2006)

***not enough samples to complete statistical analysis for 2003 and 2004.**

***E. Coli bacteria was sampled for the 2006 monitoring season, prior it was total fecal coliform**

MS2 (Bailey)

The hydrograph for the MS2 site shows flow from April 5 – October 25, 2006 (Figure 11). Total discharge during this period was 29,249,970 cf or 671 acre-ft. Peak discharge was 30.16 cfs on August 2, 2006 from a storm totaling 3.68 inches of rainfall, the highest storm total for 2006.

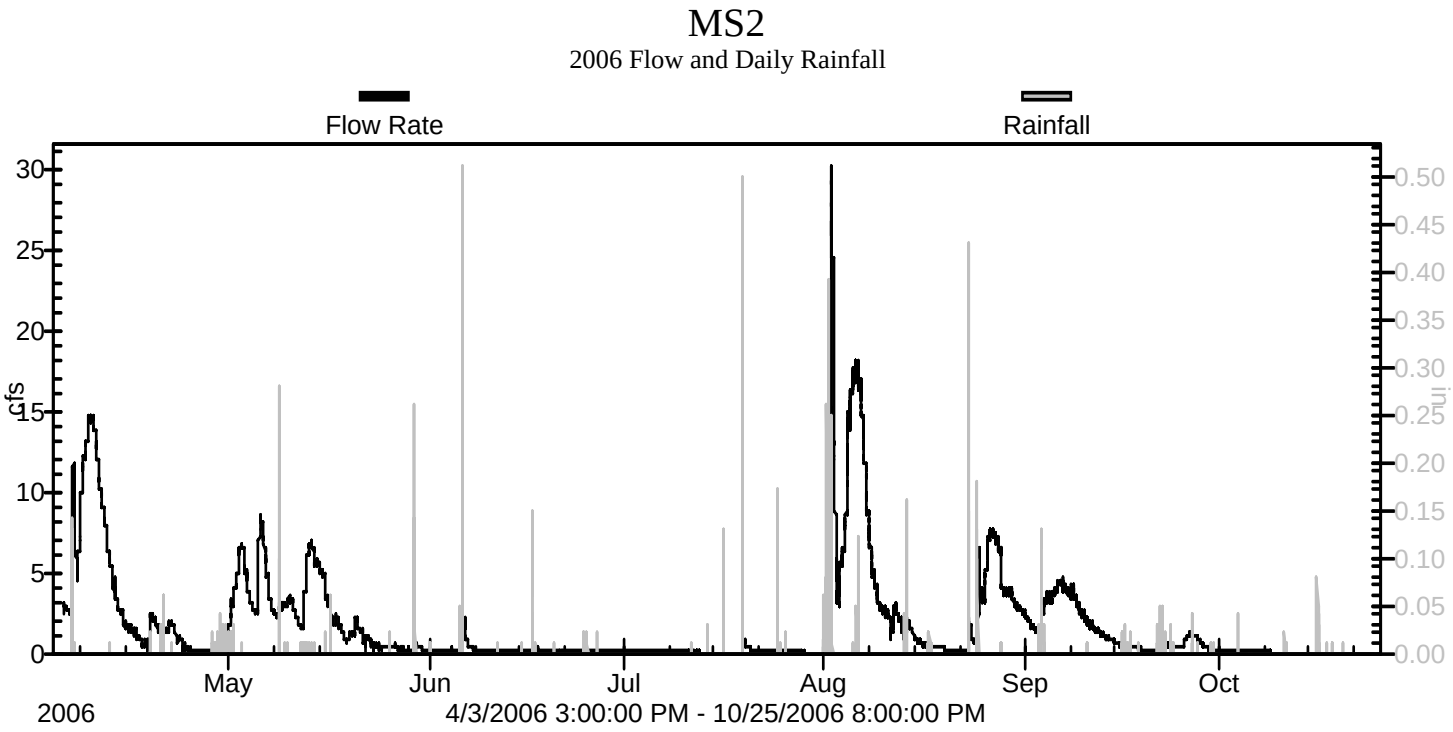


Figure 11. MS2 2006 Continuous Flow and Daily Rainfall

Table 6. MS2 Stream Loading Table

		Sample Collection Time				Loading Interval				
Sample Type	**Storm #**	**Start**	**End**	**TSS (mg/L)**	**TP (mg/L)**	**Start**	**End**	**Interval Volume (cf)**	**Interval TSS (lb)**	**Interval TP (lb)**
Base				*11*	*0.176*	*1/1/2006 0:00*	*3/28/2006 0:00*	*1,857,600*	*1304.6*	*20.4*
Snowmelt Grab		3/31/06 14:00	3/31/06 14:00	7	0.215	3/28/2006 0:00	4/1/2006 0:00	2,073,600	906.1	27.8
Base				*11*	*0.176*	*4/1/2006 0:00*	*4/5/2006 10:30*	*766,800*	*538.5*	*8.4*
Base				*11*	*0.176*	*4/5/2006 10:30*	*4/6/2006 11:30*	*243,805*	*171.2*	*2.7*
Storm Composite	1	4/6/06 21:07	4/9/06 13:37	11	0.087	4/6/2006 11:30	4/13/2006 5:30	5,574,486	3827.9	30.3
Base				*11*	*0.176*	*4/13/2006 5:30*	*4/28/2006 17:30*	*1,476,897*	*1037.2*	*16.2*
Storm	*2*			*11*	*0.169*	*4/28/2006 17:30*	*5/4/2006 13:30*	*1,459,425*	*965.7*	*15.4*
Base				*11*	*0.176*	*5/4/2006 13:30*	*5/8/2006 12:30*	*1,458,674*	*1024.4*	*16.0*
Storm	*3*			*11*	*0.169*	*5/8/2006 12:30*	*5/11/2006 8:30*	*703,087*	*465.2*	*7.4*
Base				*11*	*0.176*	*5/11/2006 8:30*	*5/12/2006 11:30*	*165,874*	*116.5*	*1.8*
Base Composite		5/13/06 6:06	5/13/06 19:16	5	0.058	5/12/2006 11:30	5/16/2006 14:30	1,799,452	561.7	6.5
Base				*11*	*0.176*	*5/16/2006 14:30*	*5/29/2006 11:30*	*945,710*	*664.2*	*10.4*
Storm	*4*			*11*	*0.169*	*5/29/2006 11:30*	*5/30/2006 14:30*	*35,335*	*23.4*	*0.4*
Base Grab		6/2/06 9:30	6/2/06 9:30	9	0.104	5/30/2006 14:30	6/5/2006 21:30	87,275	49.0	0.6
Storm Composite	5	6/6/06 1:29	6/6/06 5:14	11	0.310	6/5/2006 21:30	6/7/2006 8:30	147,155	97.4	2.8
Base				*11*	*0.176*	*6/7/2006 8:30*	*6/16/2006 22:30*	*78,060*	*54.8*	*0.9*
Storm	*6*			*11*	*0.169*	*6/16/2006 22:30*	*6/17/2006 23:30*	*23,177*	*15.3*	*0.2*
Base Composite		6/30/06 15:21	7/3/06 14:12	12	0.142	6/17/2006 23:30	7/19/2006 10:30	68,256	51.1	0.6
Storm	*7*			*11*	*0.169*	*7/19/2006 10:30*	*7/21/2006 1:30*	*45,061*	*29.8*	*0.5*
Base				*11*	*0.176*	*7/21/2006 1:30*	*7/24/2006 17:30*	*7,352*	*5.2*	*0.1*
Storm	*8*			*11*	*0.169*	*7/24/2006 17:30*	*7/26/2006 2:30*	*8,621*	*5.7*	*0.1*
Base				*11*	*0.176*	*7/26/2006 2:30*	*8/1/2006 12:30*	*2,735*	*1.9*	*0.0*
Storm Composite	9	8/1/06 13:14	8/2/06 1:28	3	0.132	8/1/2006 12:30	8/3/2006 5:30	1,587,187	297.2	13.1
Storm Composite	9	8/4/06 11:23	8/6/06 6:02	16	0.195	8/3/2006 5:30	8/8/2006 1:30	5,088,142	5082.1	61.9
Base				*11*	*0.176*	*8/8/2006 1:30*	*8/13/2006 11:30*	*1,362,368*	*956.8*	*15.0*
Storm	*10*			*11*	*0.169*	*8/13/2006 11:30*	*8/14/2006 18:30*	*181,472*	*120.1*	*1.9*
Base				*11*	*0.176*	*8/14/2006 18:30*	*8/23/2006 4:30*	*249,010*	*174.9*	*2.7*
Storm Grab	11	8/23/06 14:32	8/23/06 14:32	11	0.160	8/23/2006 4:30	8/24/2006 1:30	102,131	70.1	1.0
Base				*11*	*0.176*	*8/24/2006 1:30*	*8/24/2006 15:30*	*26,616*	*18.7*	*0.3*
Storm Composite	12	8/24/06 22:14	8/26/06 7:55	12	0.131	8/24/2006 15:30	8/28/2006 11:30	1,893,723	1418.6	15.5
Base				*11*	*0.176*	*8/28/2006 11:30*	*9/3/2006 15:30*	*1,360,468*	*955.4*	*14.9*
Storm	*13*			*11*	*0.169*	*9/3/2006 15:30*	*9/9/2006 5:30*	*1,736,970*	*1149.4*	*18.3*
Base Composite		9/12/06 12:06	9/13/06 4:04	19	0.400	9/9/2006 5:30	9/21/2006 17:30	909,041	1078.2	22.7
Storm	*14*			*11*	*0.169*	*9/21/2006 17:30*	*9/23/2006 16:30*	*63,785*	*42.2*	*0.7*
Storm	*15*			*11*	*0.169*	*9/23/2006 16:30*	*9/24/2006 11:30*	*25,740*	*17.0*	*0.3*
Base				*11*	*0.176*	*9/24/2006 11:30*	*10/25/2006 13:30*	*330,096*	*231.8*	*3.6*
No Flow				*0*	*0.000*	*10/25/2006 13:30*	*1/1/2007 0:00*	*0*	*0.0*	*0.0*
Storm Average				11	0.169					
Base Average				11	0.176					
Snowmelt Average										
All Average				11	0.162					
Total								**33,945,185**	23,530	342
SWWD Major Subwatershed Total Acres								10,174		
Total TP/TSS(lb/ac/yr)									2.31	0.03
Total TP/TSS (kg/ha/yr)									2.59	0.04

*Italics indicate estimated concentrations based on average base and storm flow concentrations

Grab and flow weighted composite samples were taken at the MS2 site to determine water quality. Samples were taken during snowmelt and storm runoff, as well as during base flow conditions. The TSS, TKN, TP, VSS, COD, TDP, and E. Coliform results from all collected samples are listed in Table 7. Both the highest TSS and TP concentrations were collected in a base composite on September 12, 2006. The highest TKN concentrations were collected in a storm composite on June 6, 2006. Metals and other Nitrogen species chemical results are listed in Table 8.

Table 7. MS2 2006 Sample Chemistry Results

Sample Type	Start Date	End Date	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	E. Coliform (#/100 mL)	COD (mg/L)	TDP (mg/L)
Snowmelt Grab	3/31/06 14:00	3/31/06 14:00	~7	~6	1.60	0.215		36	0.053
Storm Composite	4/6/06 21:07	4/9/06 13:37	11	~5	1.10	0.087		20	~0.032
Base Composite	5/13/06 6:06	5/13/06 19:16	5	4	0.97	0.058		23	~0.016
Base Grab	6/2/06 9:30	6/2/06 9:30	9	7	1.10	0.104		29	~0.018
Storm Composite	6/6/06 1:29	6/6/06 5:14	**NA**	**NA**	3.10	0.310		49	
E. Coli Grab	6/14/06 10:20	6/14/06 10:20					16		
Base Composite	6/30/06 15:21	7/3/06 14:12	12	9	0.95	0.142		33	0.070
E. Coli Grab	7/25/06 9:45	7/25/06 9:45					5		
Storm Composite	8/1/06 13:14	8/2/06 1:28	3	~2	1.10	0.132		23	0.084
Storm Composite	8/4/06 11:23	8/6/06 6:02	16	12	1.70	0.195		42	0.098
E. Coli Grab	8/10/06 9:30	8/10/06 9:30					18		
Storm Grab	8/23/06 14:32	8/23/06 14:32	11	9	1.30	0.160		36	0.060
Storm Composite	8/24/06 22:14	8/26/06 7:55	12	9	1.20	0.131		35	0.076
E. Coli Grab	9/6/06 9:00	9/6/06 9:00					8		
Base Composite	9/12/06 12:06	9/13/06 4:04	19	17	1.80	0.400		60	~0.030
Average			**11**	**8**	**1.45**	**0.176**	**12**	**35**	**0.054**

Table 8. MS2 2006 Sample Metals and Nitrogen Species Chemical Results

Sample Type	Start Date	End Date	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Chloride (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Nitrogen (mg/L)
Snowmelt Grab	3/31/06 14:00	3/31/06 14:00	0.0023	0.0014	0.0002	0.0053	<0.00004	0.0008	48	<0.03	0.24	0.15
Storm Composite	4/6/06 21:07	4/9/06 13:37	0.0163	0.0018	0.0007	0.0074	0.00010	0.0009	73	<0.03	0.13	0.08
Storm Composite	5/13/06 6:06	5/13/06 19:16	0.0074	0.0014	0.0003	0.0055	0.00040	0.0008	57	<0.03	<0.05	0.07
Base Grab	6/2/06 9:30	6/2/06 9:30	0.0016	0.0015	0.0002	0.0042	<0.00004	0.0004	64	<0.03	<0.05	~0.05
Storm Composite	6/6/06 1:29	6/6/06 5:14	0.0087	0.0019	0.0008	0.0087	0.00008	0.0003	61	0.05	0.09	<0.02
E. Coli Grab	6/14/06 10:20	6/14/06 10:20										
Base Composite	6/30/06 15:21	7/3/06 14:12	0.0027	0.0014	0.0007	0.0070	0.00040	0.0006	57	<0.03	0.06	0.08
E. Coli Grab	7/25/06 9:45	7/25/06 9:45										
Storm Composite	8/1/06 13:14	8/2/06 1:28	0.0038	0.0012	0.0003	0.0034	0.00010	0.0003	47	<0.03	0.06	0.15
Storm Composite	8/4/06 11:23	8/6/06 6:02	0.0105	0.0014	0.0008	0.0049	0.00009	0.0005	57	<0.03	<0.05	0.14
E. Coli Grab	8/10/06 9:30	8/10/06 9:30										
Storm Grab	8/23/06 14:32	8/23/06 14:32	0.0009	0.0014	0.0001	0.0021	<0.00004	0.0002	59	<0.03	<0.05	~0.02
Storm Composite	8/24/06 22:14	8/26/06 7:55	0.0055	0.0016	0.0005	0.0051	0.00009	0.0003	51	<0.03	0.10	0.13
E. Coli Grab	9/6/06 9:00	9/6/06 9:00										
Base Composite	9/12/06 12:06	9/13/06 4:04	0.0037	0.0014	0.0013	0.0043	0.00030	0.0006	63	<0.03	<0.05	<0.02
Average			**0.0058**	**0.0015**	**0.0005**	**0.0053**	**0.00015**	**0.0005**	**58**	**0.02**	**0.08**	**0.08**

Summaries of rainfall events and the resulting discharges for MS2 are shown in Table 9 and Table 10. Average and maximum intensities are provided, as well as maximum stage and flow rates.

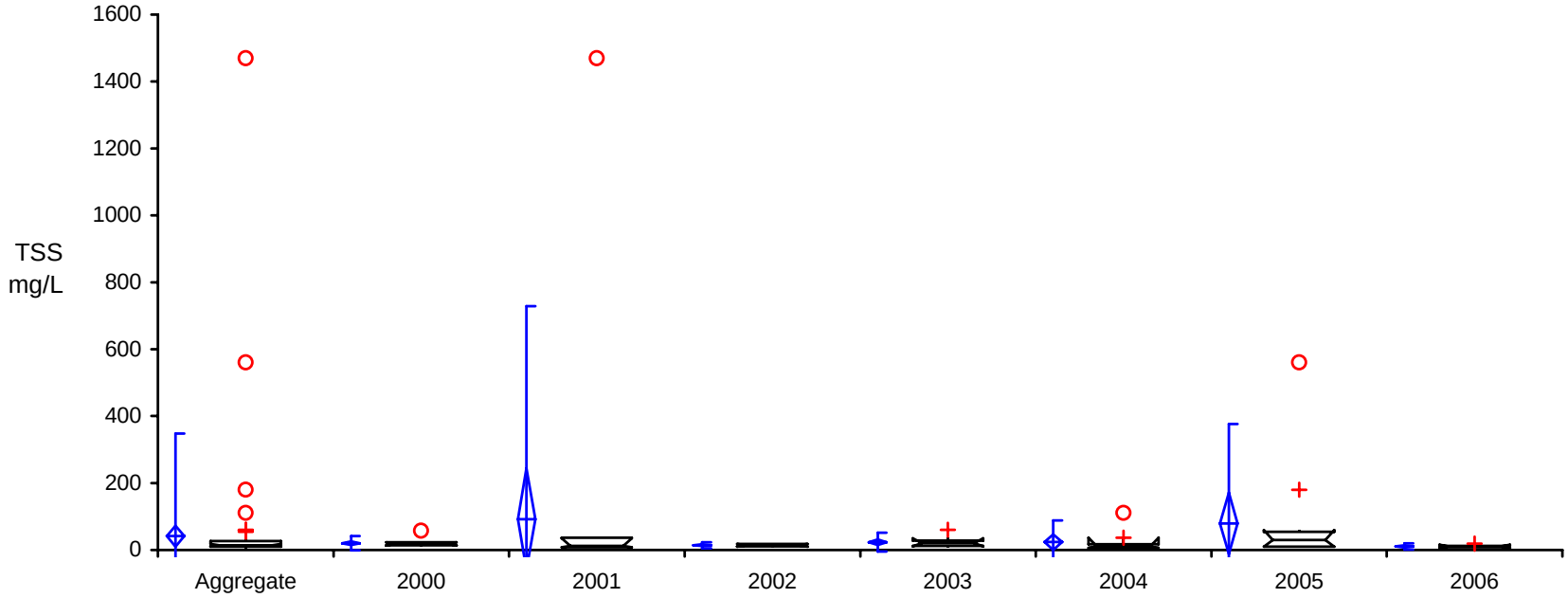
Table 9. MS2 2006 Storm Events

MS2	Storm Event								Max Storm Intensity					
Storm #	Start	End	Duration (days)	Hr	Total Rainfall (in)	Average Intensity (in/hr)	Max Intensity (in)	Max Intensity (in/hr)	Start	End	Days	Duration (hr)	Rainfall (in)	Average Intensity (in/hr)
1	4/6/2006 15:45	4/6/2006 21:00	0.22	5.50	0.81	0.15	0.14	0.56	4/6/2006 19:45	4/6/2006 20:00	0.01	0.50	0.23	0.46
2	4/28/2006 12:45	5/1/2006 19:15	3.27	78.75	1.58	0.02	0.04	0.16	4/29/2006 16:30	4/29/2006 17:15	0.03	1.00	0.13	0.13
3	5/8/2006 16:15	5/8/2006 23:15	0.29	7.25	0.56	0.08	0.28	1.12	5/8/2006 16:15	5/8/2006 17:15	0.04	1.25	0.4	0.32
4	5/29/2006 18:00	5/29/2006 19:30	0.06	1.75	0.54	0.31	0.26	1.04	5/29/2006 18:15	5/29/2006 19:00	0.03	1.00	0.5	0.50
5	6/5/2006 19:45	6/6/2006 0:30	0.20	5.00	1.10	0.22	0.51	2.04	6/5/2006 23:45	6/6/2006 0:00	0.01	0.50	0.91	1.82
6	6/16/2006 20:45	6/17/2006 0:15	0.15	3.75	0.26	0.07	0.15	0.60	6/16/2006 22:15	6/16/2006 22:30	0.01	0.50	0.21	0.42
7	7/19/2006 10:00	7/19/2006 12:45	0.11	3.00	0.73	0.24	0.50	2.00	7/19/2006 10:15	7/19/2006 10:30	0.01	0.50	0.6	1.20
8	7/24/2006 16:45	7/24/2006 18:15	0.06	1.75	0.25	0.14	0.17	0.68	7/24/2006 18:00	7/24/2006 18:15	0.01	0.50	0.19	0.38
9	8/1/2006 2:00	8/2/2006 8:00	1.25	30.25	3.68	0.12	0.39	1.56	8/1/2006 20:00	8/1/2006 20:15	0.01	0.50	0.63	1.26
10	8/13/2006 12:30	8/13/2006 15:15	0.11	3.00	0.32	0.11	0.16	0.64	8/13/2006 14:30	8/13/2006 14:45	0.01	0.50	0.23	0.46
11	8/23/2006 4:15	8/23/2006 6:30	0.09	2.50	0.87	0.35	0.43	1.72	8/23/2006 4:30	8/23/2006 4:45	0.01	0.50	0.56	1.12
12	8/24/2006 11:00	8/24/2006 19:30	0.35	8.75	0.87	0.10	0.18	0.72	8/24/2006 17:00	8/24/2006 17:45	0.03	1.00	0.3	0.30
13	9/3/2006 15:45	9/3/2006 21:45	0.25	6.25	0.79	0.13	0.13	0.52	9/3/2006 15:45	9/3/2006 16:15	0.02	0.75	0.33	0.44
14	9/21/2006 13:30	9/22/2006 17:45	1.18	28.50	0.82	0.03	0.05	0.20	9/21/2006 20:30	9/21/2006 21:00	0.02	0.75	0.1	0.13
15	9/23/2006 16:15	9/23/2006 20:00	0.16	4.00	0.16	0.04	0.03	0.12	9/23/2006 16:30	9/23/2006 16:45	0.01	0.50	0.05	0.10

Table 10. MS2 2006 Storm Discharge Events

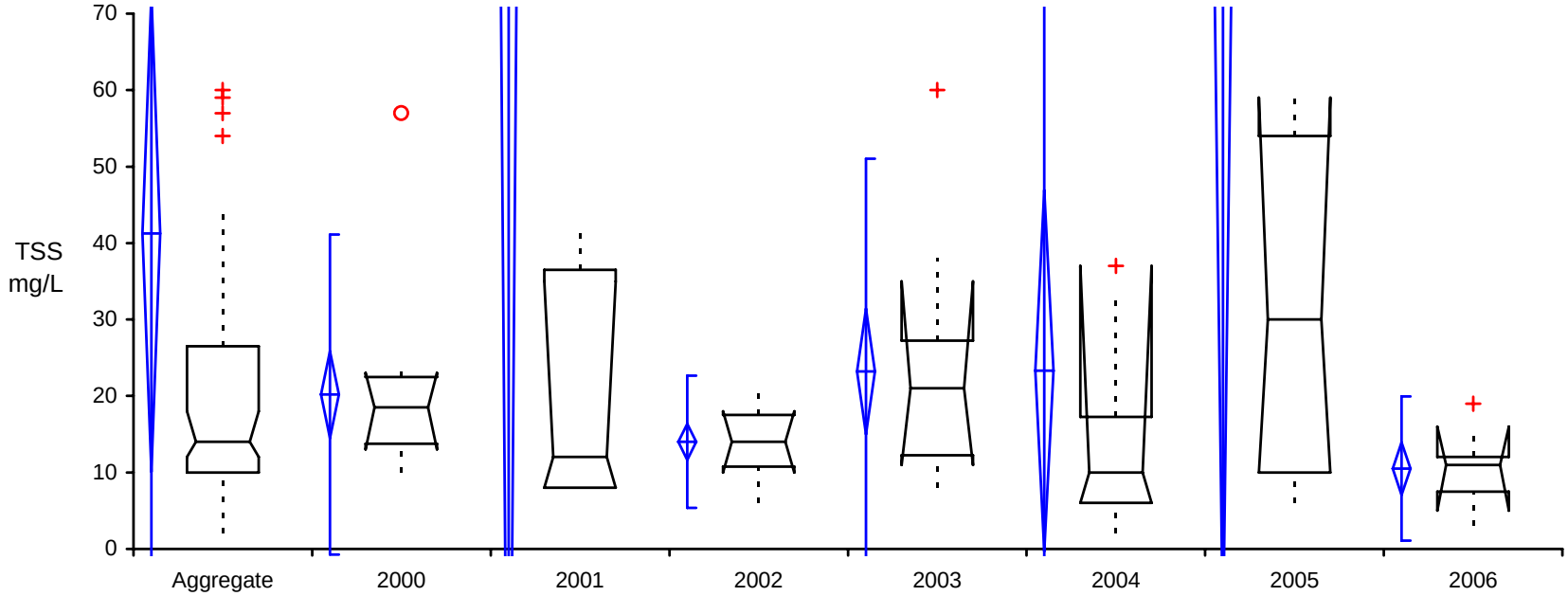
MS2		Hydrograph			Flow Rate (cfs)				Stage (ft)			
Storm #	Rainfall Total (in)	Start	End	Total Discharge (cf)	Max	Time	Start	End	Max	Time	Start	End
1	0.81	4/6/2006 11:30	4/13/2006 5:30	5,574,486	14.799	4/9/2006 13:15	2.485	3.886	1.428	4/9/2006 10:45	0.691	0.793
2	1.58	4/28/2006 17:30	5/4/2006 13:30	1,459,425	6.729	5/2/2006 23:45	0.102	2.860	1.063	5/2/2006 20:00	0.164	0.769
3	0.56	5/8/2006 12:30	5/11/2006 8:30	703,087	3.509	5/10/2006 7:00	2.213	2.220	0.806	5/9/2006 0:30	0.692	0.624
4	0.54	5/29/2006 11:30	5/30/2006 14:30	35,335	0.489	5/29/2006 22:30	0.132	0.293	0.350	5/29/2006 20:30	0.257	0.304
5	1.10	6/5/2006 21:30	6/7/2006 8:30	147,155	3.045	6/6/2006 2:00	0.128	0.347	0.874	6/6/2006 2:00	0.216	0.270
6	0.26	6/16/2006 22:30	6/17/2006 23:30	23,177	0.348	6/17/2006 8:30	0.122	0.154	0.263	6/17/2006 9:15	0.165	0.185
7	0.73	7/19/2006 10:30	7/21/2006 1:30	45,061	0.895	7/19/2006 15:45	0.000	0.079	0.351	7/19/2006 14:00	0.000	0.144
8	0.25	7/24/2006 17:30	7/26/2006 2:30	8,621	0.103	7/25/2006 7:15	0.008	0.040	0.163	7/25/2006 5:45	0.052	0.100
9	3.68	8/1/2006 12:30	8/8/2006 1:30	6,675,329	30.157	8/2/2006 5:30	0.048	7.008	2.175	8/2/2006 5:45	0.109	0.991
10	0.32	8/13/2006 11:30	8/14/2006 18:30	181,472	2.105	8/13/2006 18:15	1.217	1.199	0.642	8/13/2006 17:00	0.564	0.454
11	0.87	8/23/2006 4:30	8/24/2006 1:30	102,131	2.056	8/23/2006 10:00	0.184	0.777	0.615	8/23/2006 9:30	0.183	0.369
12	0.87	8/24/2006 15:30	8/28/2006 11:30	1,893,723	7.706	8/27/2006 4:00	0.431	4.418	1.014	8/24/2006 23:15	0.289	0.890
13	0.79	9/3/2006 15:30	9/9/2006 5:30	1,736,970	4.634	9/6/2006 19:15	1.142	2.959	0.930	9/8/2006 8:30	0.455	0.801
14	0.82	9/21/2006 17:30	9/23/2006 16:30	63,785	0.577	9/22/2006 19:30	0.083	0.260	0.307	9/22/2006 18:15	0.138	0.231
15	0.16	9/23/2006 16:30	9/24/2006 11:30	25,740	0.439	9/24/2006 0:45	0.260	0.331	0.290	9/23/2006 22:45	0.231	0.251

Statistical summaries of MS2 indicate that the pond is pre-treating water before discharging to Bailey Lake. Total suspended solids, volatile suspended solids, total phosphorus, and total Kjedahl nitrogen all are low in concentration. Total chloride ions had an increase in median values from 2003 to 2005, but results still show that the pond is pre-treating the water leaving the site. Similar results as MS1 for fecal coliform show that the number of samples taken are too few to draw any conclusions at this time. Figures 12-19 show the statistical summaries in the form of box plots for MS2.



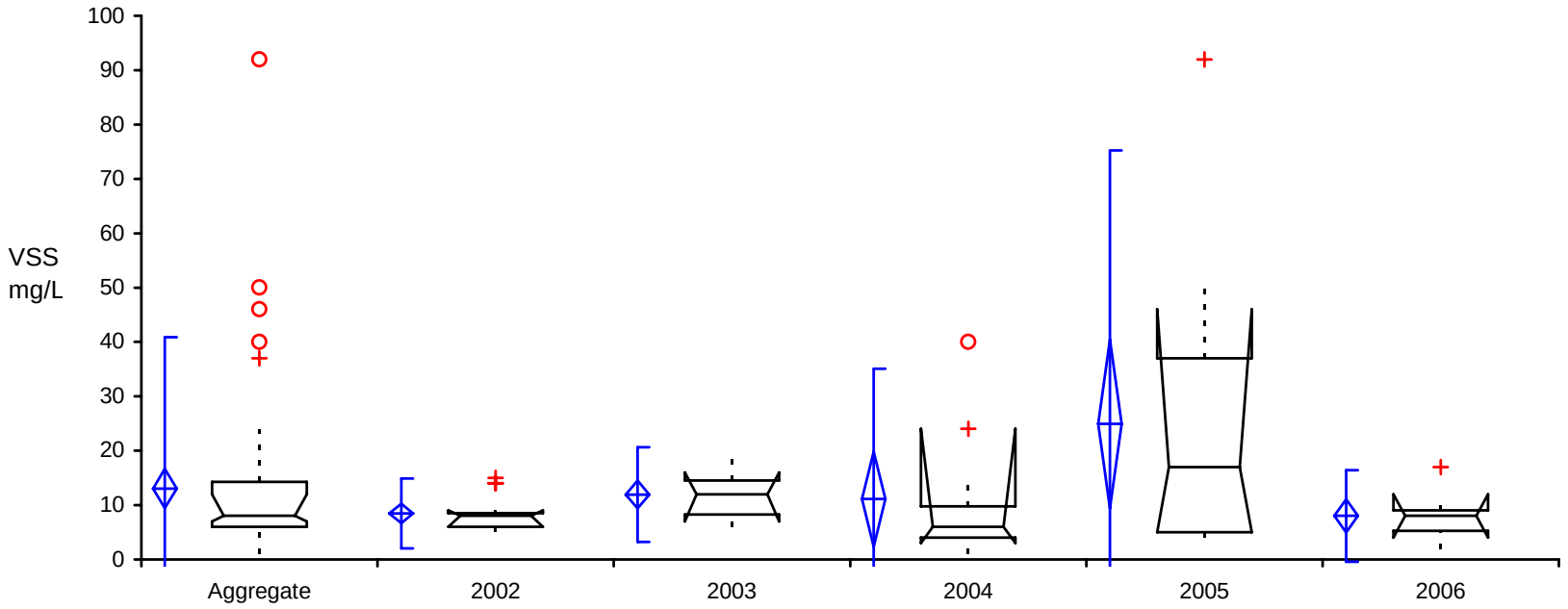
MS2 - TSS	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	99	41.263	156.4544	15.7243	10.058 to 72.467	14.000	16.500	12.000 to 18.000
2000	16	20.188	10.6722	2.6680	14.501 to 25.874	18.500	8.750	13.000 to 23.000
2001	20	92.150	324.5902	72.5806	-59.763 to 244.063	12.000	28.500	8.000 to 35.000
2002	16	14.000	4.4121	1.1030	11.649 to 16.351	14.000	6.750	10.000 to 18.000
2003	14	23.214	14.1920	3.7930	15.020 to 31.408	21.000	15.000	11.000 to 35.000
2004	10	23.300	33.0120	10.4393	-0.315 to 46.915	10.000	11.250	6.000 to 37.000
2005	13	79.385	151.5088	42.0210	-12.171 to 170.940	30.000	44.000	10.000 to 59.000
2006	10	10.500	4.8132	1.5221	7.057 to 13.943	11.000	4.500	5.000 to 16.000

Figure 12. MS2 Total Suspended Solids Box Plot (2000-2006)



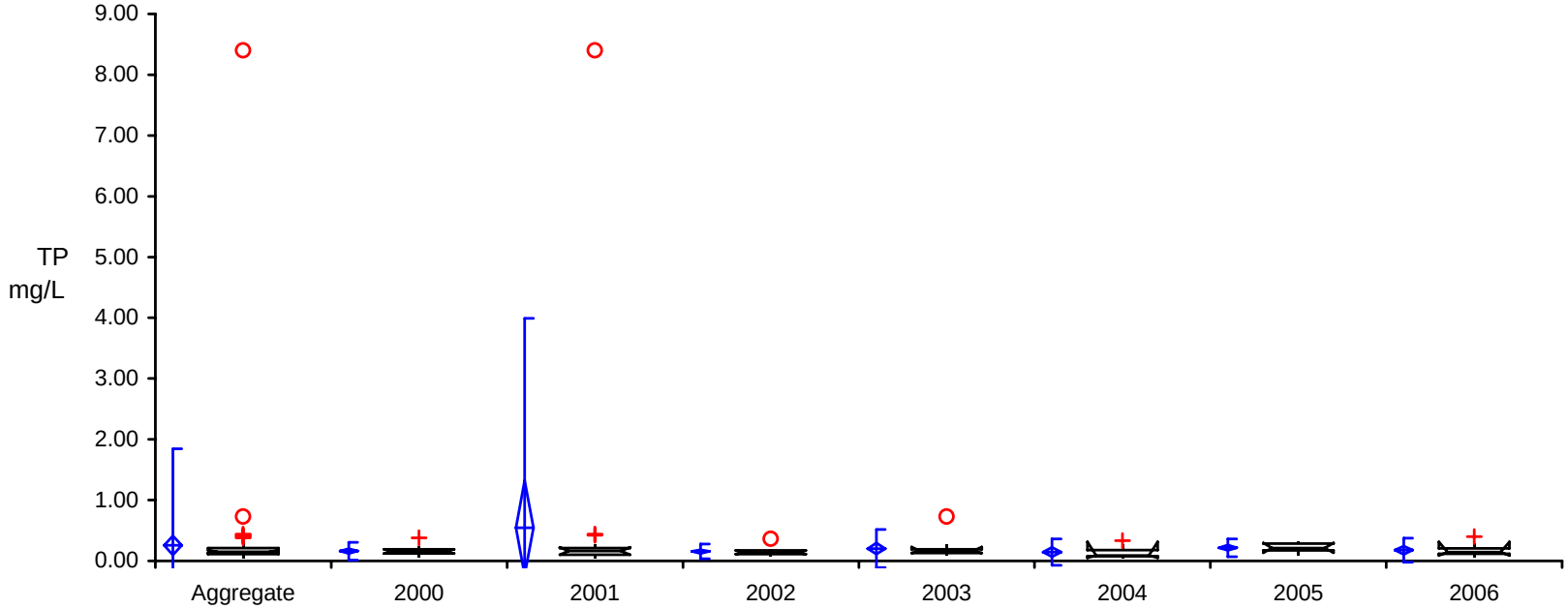
MS2 - TSS	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	99	41.263	156.4544	15.7243	10.058 to 72.467	14.000	16.500	12.000 to 18.000
2000	16	20.188	10.6722	2.6680	14.501 to 25.874	18.500	8.750	13.000 to 23.000
2001	20	92.150	324.5902	72.5806	-59.763 to 244.063	12.000	28.500	8.000 to 35.000
2002	16	14.000	4.4121	1.1030	11.649 to 16.351	14.000	6.750	10.000 to 18.000
2003	14	23.214	14.1920	3.7930	15.020 to 31.408	21.000	15.000	11.000 to 35.000
2004	10	23.300	33.0120	10.4393	-0.315 to 46.915	10.000	11.250	6.000 to 37.000
2005	13	79.385	151.5088	42.0210	-12.171 to 170.940	30.000	44.000	10.000 to 59.000
2006	10	10.500	4.8132	1.5221	7.057 to 13.943	11.000	4.500	5.000 to 16.000

Figure 13. MS2 Total Suspended Solids Box Plot (2000-2006) without Outliers



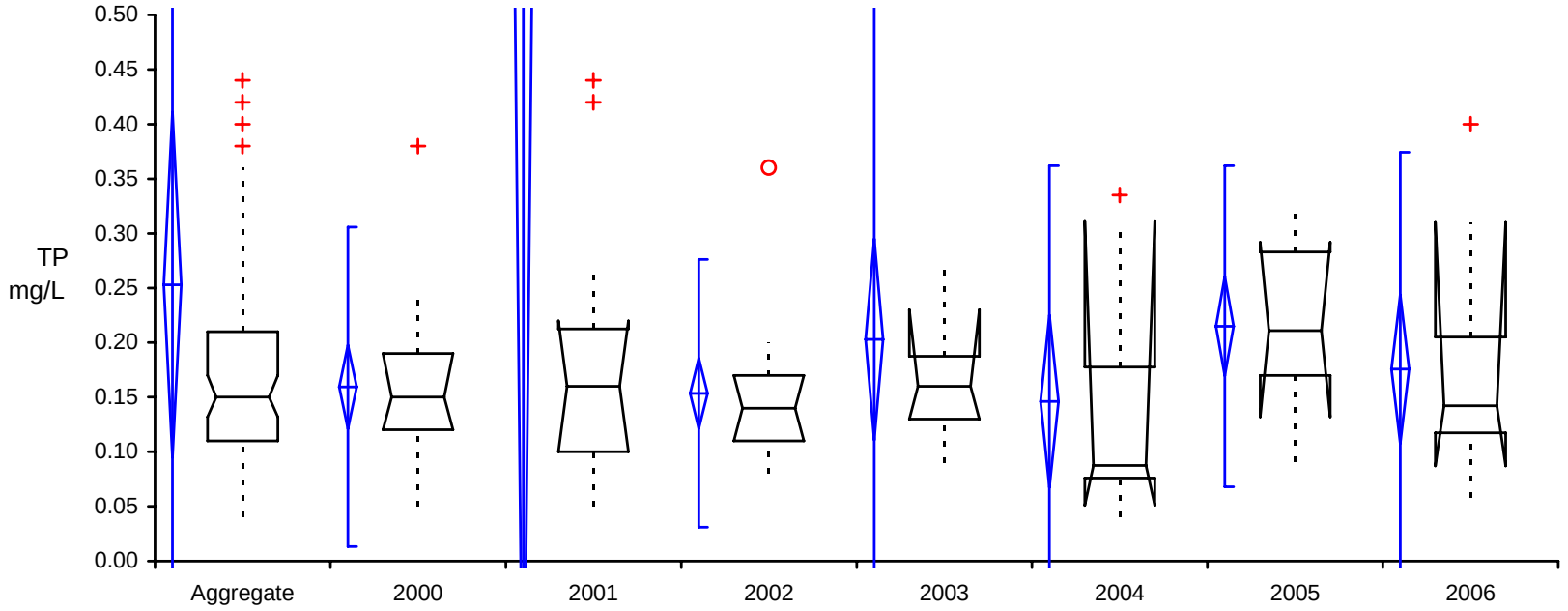
MS2 - VSS	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	62	13.048	14.1970	1.8030	9.443 to 16.654	8.000	8.250	7.000 to 12.000
2002	15	8.467	3.2704	0.8444	6.656 to 10.278	8.000	2.500	6.000 to 9.000
2003	14	11.929	4.4456	1.1881	9.362 to 14.495	12.000	6.250	7.000 to 16.000
2004	10	11.100	12.2425	3.8714	2.342 to 19.858	6.000	5.750	3.000 to 24.000
2005	13	24.923	25.6822	7.1230	9.403 to 40.443	17.000	32.000	5.000 to 46.000
2006	10	8.000	4.2947	1.3581	4.928 to 11.072	8.000	3.750	4.000 to 12.000

Figure 14. MS2 Total Volatile Suspended Solids Box Plot (2000-2006)



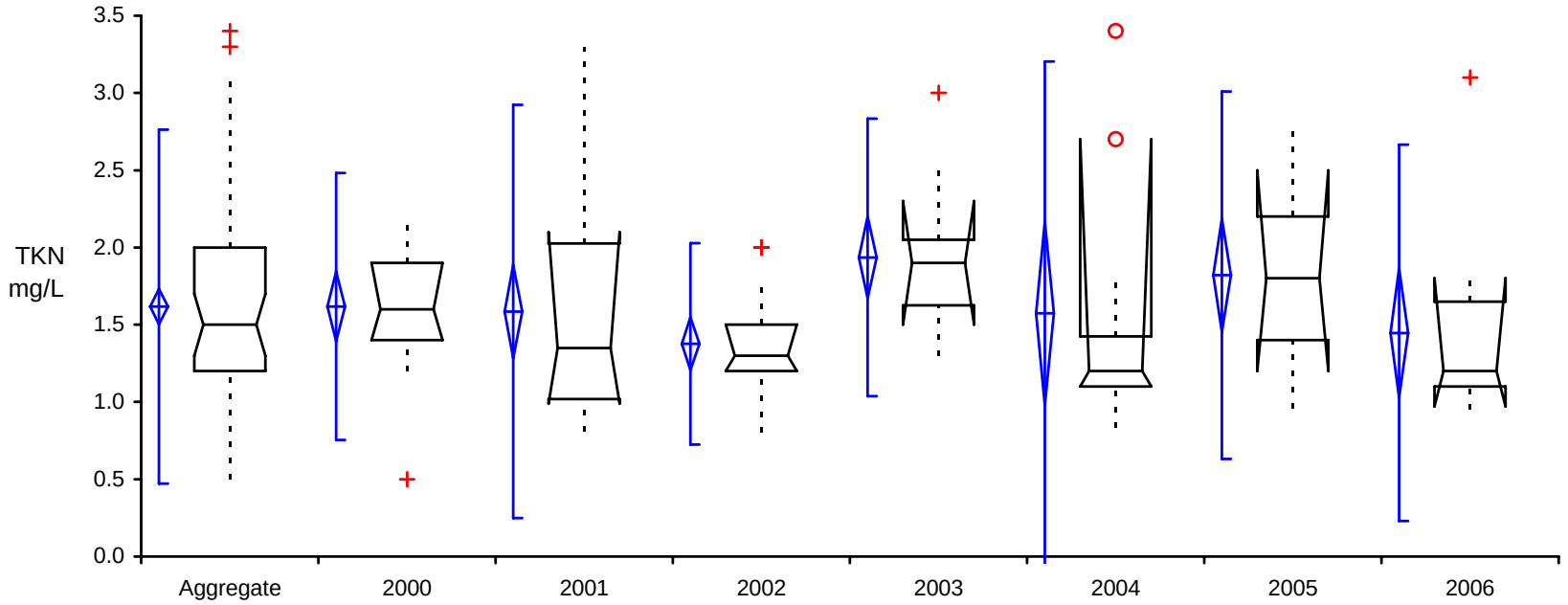
MS2 - TP	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	104	0.253	0.8129	0.0797	0.095 to 0.411	0.150	0.100	0.132 to 0.170
2000	17	0.159	0.0746	0.0181	0.121 to 0.198	0.150	0.070	0.120 to 0.190
2001	22	0.544	1.7578	0.3748	-0.236 to 1.323	0.160	0.113	0.100 to 0.220
2002	17	0.154	0.0625	0.0152	0.121 to 0.186	0.140	0.060	0.110 to 0.170
2003	14	0.203	0.1593	0.0426	0.111 to 0.295	0.160	0.058	0.130 to 0.230
2004	10	0.146	0.1101	0.0348	0.067 to 0.225	0.088	0.102	0.051 to 0.311
2005	13	0.215	0.0751	0.0208	0.170 to 0.260	0.211	0.113	0.132 to 0.292
2006	11	0.176	0.1012	0.0305	0.108 to 0.244	0.142	0.088	0.087 to 0.310

Figure 15. MS2 Total Phosphorus Box Plot (2000-2006)



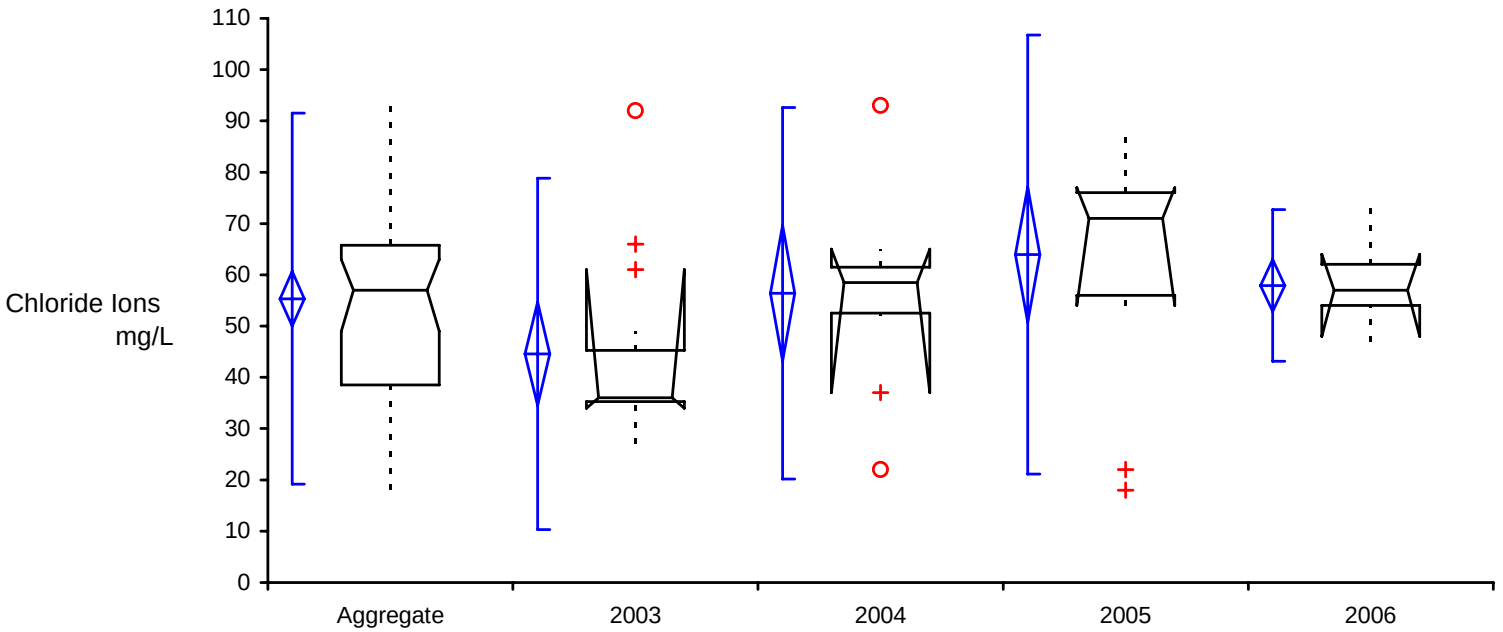
MS2 - TP	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	104	0.253	0.8129	0.0797	0.095 to 0.411	0.150	0.100	0.132 to 0.170
2000	17	0.159	0.0746	0.0181	0.121 to 0.198	0.150	0.070	0.120 to 0.190
2001	22	0.544	1.7578	0.3748	-0.236 to 1.323	0.160	0.113	0.100 to 0.220
2002	17	0.154	0.0625	0.0152	0.121 to 0.186	0.140	0.060	0.110 to 0.170
2003	14	0.203	0.1593	0.0426	0.111 to 0.295	0.160	0.058	0.130 to 0.230
2004	10	0.146	0.1101	0.0348	0.067 to 0.225	0.088	0.102	0.051 to 0.311
2005	13	0.215	0.0751	0.0208	0.170 to 0.260	0.211	0.113	0.132 to 0.292
2006	11	0.176	0.1012	0.0305	0.108 to 0.244	0.142	0.088	0.087 to 0.310

Figure 16. MS2 Total Phosphorus Box Plot (2000-2006) without Outliers



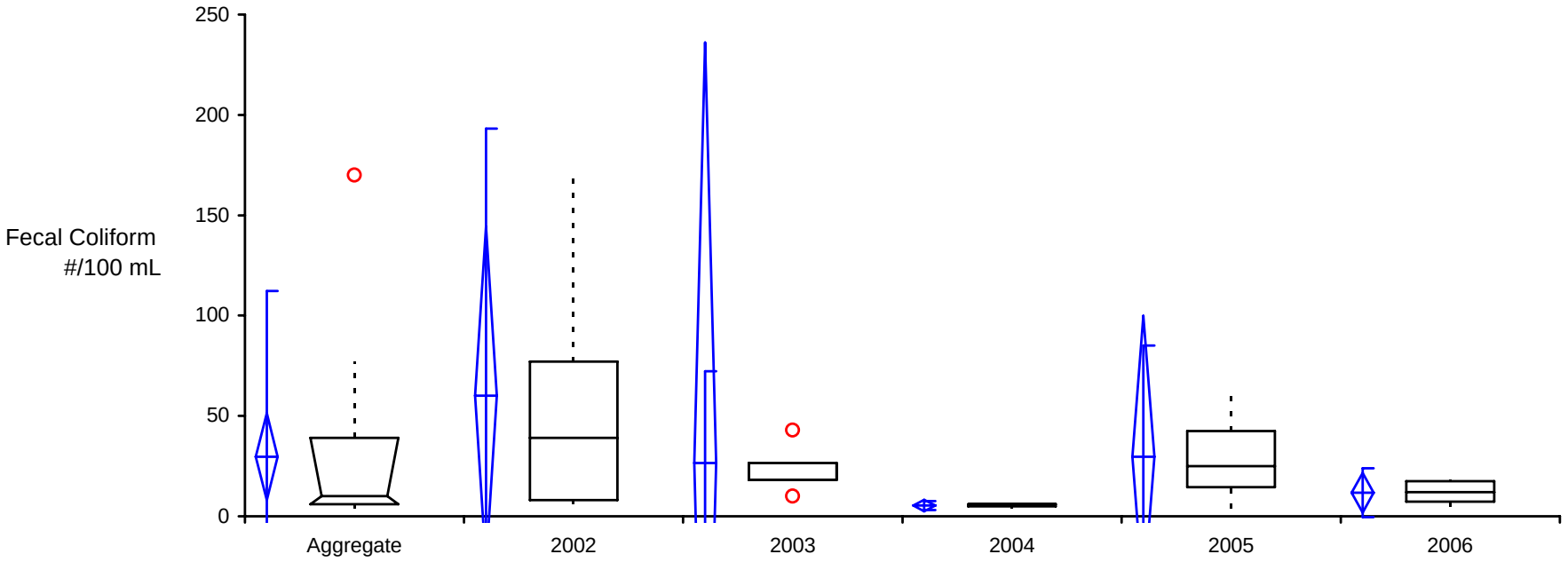
MS2 - TKN	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	104	1.617	0.5846	0.0573	1.504 to 1.731	1.500	0.800	1.300 to 1.700
2000	17	1.618	0.4405	0.1068	1.391 to 1.844	1.600	0.500	1.400 to 1.900
2001	22	1.585	0.6825	0.1455	1.283 to 1.888	1.350	1.008	0.990 to 2.100
2002	17	1.376	0.3327	0.0807	1.205 to 1.548	1.300	0.300	1.200 to 1.500
2003	14	1.936	0.4584	0.1225	1.671 to 2.200	1.900	0.425	1.500 to 2.300
2004	10	1.573	0.8324	0.2632	0.978 to 2.168	1.200	0.325	1.100 to 2.700
2005	13	1.820	0.6062	0.1681	1.454 to 2.186	1.800	0.800	1.200 to 2.500
2006	11	1.447	0.6215	0.1874	1.030 to 1.865	1.200	0.550	0.970 to 1.800

Figure 17. MS2 Total Kjedahl Nitrogen Box Plots (2000-2006)



MS2 - Chloride	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	48	55.333	18.4487	2.6628	49.976 to 60.690	57.000	27.250	49.000 to 63.000
2003	14	44.571	17.4740	4.6701	34.482 to 54.661	36.000	10.000	34.000 to 61.000
2004	10	56.400	18.4764	5.8428	43.183 to 69.617	58.500	9.000	37.000 to 65.000
2005	13	63.923	21.8345	6.0558	50.729 to 77.118	71.000	20.000	54.000 to 77.000
2006	11	57.909	7.5426	2.2742	52.842 to 62.976	57.000	8.000	48.000 to 64.000

Figure 18. MS2 Total Chloride Ions Box Plot (2003-2006)



MS2 - Fecal Coliform	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	17	29.706	42.1274	10.2174	8.046 to 51.366	10.000	33.000	6.000 to 39.000
2002	5	60.000	67.9154	30.3727	-24.328 to 144.328	39.000	69.000	- to -
2003	2	26.500	23.3345	16.5000	-183.152 to 236.152	26.500	0.000	- to -
2004	3	5.333	1.1547	0.6667	2.465 to 8.202	6.000	1.000	- to -
2005	3	29.667	28.2902	16.3333	-40.610 to 99.943	25.000	28.000	- to -
2006	4	11.750	6.2383	3.1192	1.823 to 21.677	12.000	10.250	- to -

Figure 19. MS2 Fecal Coliform Box Plot (2002-2006)

***E. Coli bacteria was sampled for the 2006 monitoring season, prior it was total fecal coliform**

Powers Lake East Tributary

The hydrograph for the Powers Lake site shows flow between April 13-October 25, 2006 (Figure 20). Precipitation was logged between May 23-October 25, 2006. Total discharge during this period was 4,932,268 cf or 113 acre/ft. The highest discharge—9.46 cfs occurred on August 2, 2006 from a total rainfall of 2.72 inches, which fell from August 1, 2006-August 2, 2006. This total rainfall was the highest for the 2006 monitoring season.

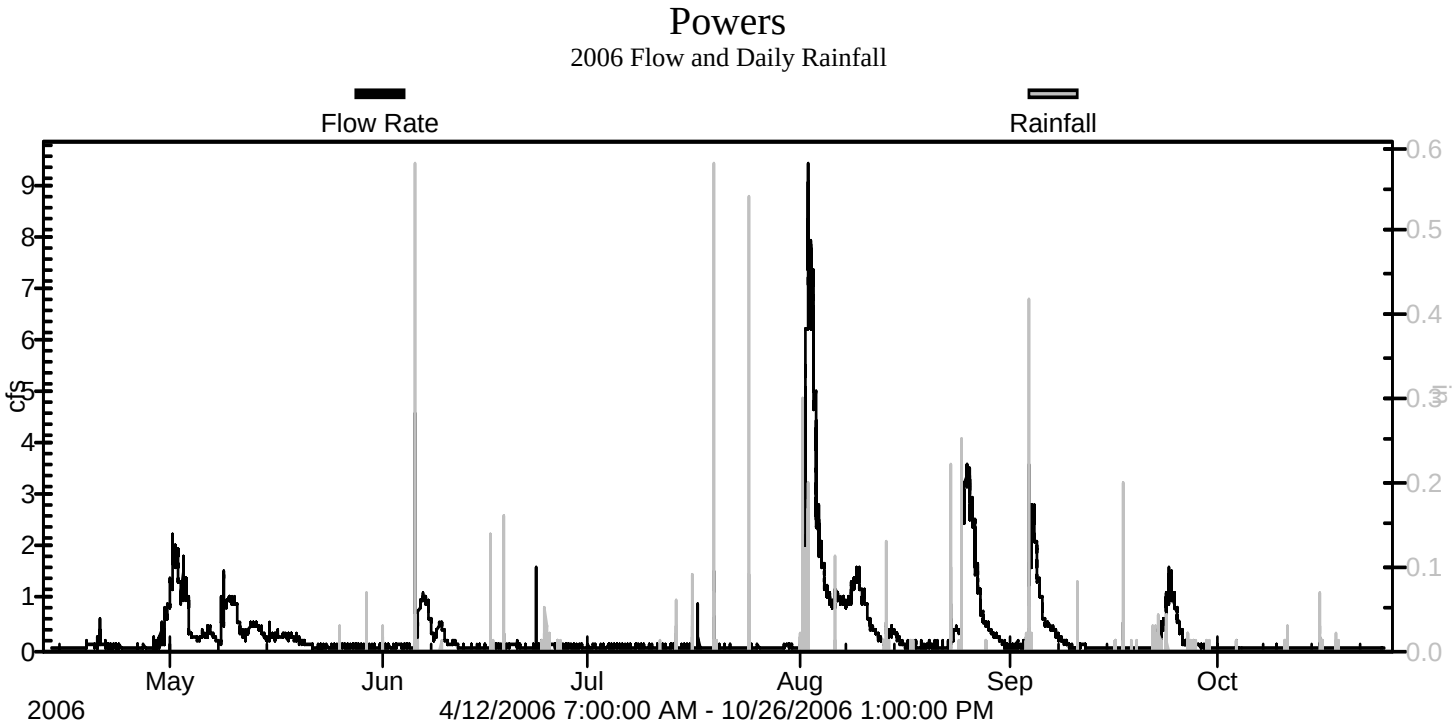


Figure 20. Powers Lake East Tributary 2006 Flow and Daily Rainfall

Grab and flow weighted composite samples were taken at the Powers site in 2006. The TSS, TKN, TP, VSS, COD, TDP, and E. Coliform results from all collected samples are listed in Table 11. The highest TSS concentration of 21 mg/L was from an August 10, 2006 base composite sample. TKN concentrations had a range of 0.46 to 2.80 mg/L, with the highest concentration coming from the September 3, 2006 storm composite sample. The highest TP concentration (0.737 mg/L) was also from the September 3, 2006 storm composite sample. Metals and other Nitrogen species chemical results are listed in Table 12.

Table 11. Powers Lake East Tributary 2006 Sample Chemistry Results

Sample Type	Start Date	End Date	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	E. Coliform (#/100 mL)	COD (mg/L)	TDP (mg/L)
Snowmelt Grab	3/31/06 14:15	3/31/06 14:15	20	~11	0.87	0.114		35	~0.034
Base Grab	5/16/06 10:45	5/16/06 10:45	~2	~2	0.72	~0.044		19	~0.016
Base Grab	5/30/06 10:00	5/30/06 10:00	~1	~2	0.46	~0.037		12	
Base Grab	6/6/06 10:48	6/6/06 10:48	3	~2	0.56	~0.042		19	<0.010
Base Grab	7/5/06 9:39	7/5/06 9:39	~3	~3	2.00	0.405		55	0.391
E. Coli Grab	7/25/06 9:30	7/25/06 9:30					2420		
Storm Composite	8/1/06 21:07	8/2/06 15:29	14	~6	0.92	0.093		33	~0.032
E. Coli Grab	8/10/06 10:00	8/10/06 10:00					73		
Base Composite	8/10/06 10:19	8/10/06 14:54	21	15	1.30	0.157		55	~0.039
Storm Composite	8/24/06 15:36	8/24/06 16:31	17	~5	1.00	0.123		30	~0.033
Storm Composite	9/3/06 15:44	9/3/06 16:03	**NA**	**NA**	2.80	0.737			~0.028
E. Coli Grab	9/6/06 9:15	9/6/06 9:15					54		
E. Coli Grab	9/10/06 8:45	9/10/06 8:45					39		
Base Grab	9/12/06 9:46	9/12/06 9:46	~1	~1	0.54	0.089		16	~0.030
Average			**9**	**5**	**1.12**	**0.184**	**647**	**30**	**0.068**

Table 12. Powers Lake East Tributary 2006 Sample Metals and Nitrogen Species Chemical Results

Sample Type	Start Date	End Date	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Chloride (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Nitrogen (mg/L)
Snowmelt Grab	3/31/06 14:15	3/31/06 14:15	0.0038	0.0022	0.00140	0.0121	<0.00004	0.0019	34	<0.03	0.07	<0.02
Base Grab	5/16/06 10:45	5/16/06 10:45	0.0013	0.0014	<0.00007	0.0046	<0.00004	0.0008	99	<0.03	<0.05	<0.02
Base Grab	5/30/06 10:00	5/30/06 10:00	0.0016	0.0021	0.00009	0.0035	<0.00004	0.0003	69	<0.03	0.52	<0.02
Storm Grab	6/6/06 10:48	6/6/06 10:48	0.0010	0.0014	0.00020	0.0058	<0.00004	0.0002	90	<0.03	0.08	<0.02
Base Grab	7/5/06 9:39	7/5/06 9:39	0.0181	0.0033	0.00007	0.0061	0.00006	0.0011	28	0.09	0.68	0.25
E. Coli Grab	7/25/06 9:30	7/25/06 9:30										
Storm Composite	8/1/06 21:07	8/2/06 15:29	0.0120	0.0018	0.00040	0.0055	0.00080	0.0008	41	<0.03	<0.05	<0.02
E. Coli Grab	8/10/06 10:00	8/10/06 10:00										
Storm Composite	8/10/06 10:19	8/10/06 14:54	0.0046	0.0020	0.00030	0.0057	0.00050	0.0009	14	<0.03	<0.05	~0.02
Storm Composite	8/24/06 15:36	8/24/06 16:31	0.0081	0.0019	0.00050	0.0062	0.00020	0.0007	14	<0.03	0.05	0.09
Storm Composite	9/3/06 15:44	9/3/06 16:03										
E. Coli Grab	9/6/06 9:15	9/6/06 9:15										
E. Coli Grab	9/10/06 8:45	9/10/06 8:45										
Base Grab	9/12/06 9:46	9/12/06 9:46	0.0013	0.0021	0.00009	0.0024	0.00030	0.0006	26	<0.03	0.26	<0.02
Average			**0.0058**	**0.0020**	**0.00034**	**0.0058**	**0.00022**	**0.0008**	**46**	**0.02**	**0.20**	**0.05**

Summaries of rainfall events and the resulting discharges for Powers Lake East Tributary are shown in Table 13 and Table 14. Average and maximum intensities are provided, as well as maximum stage and flow rates.

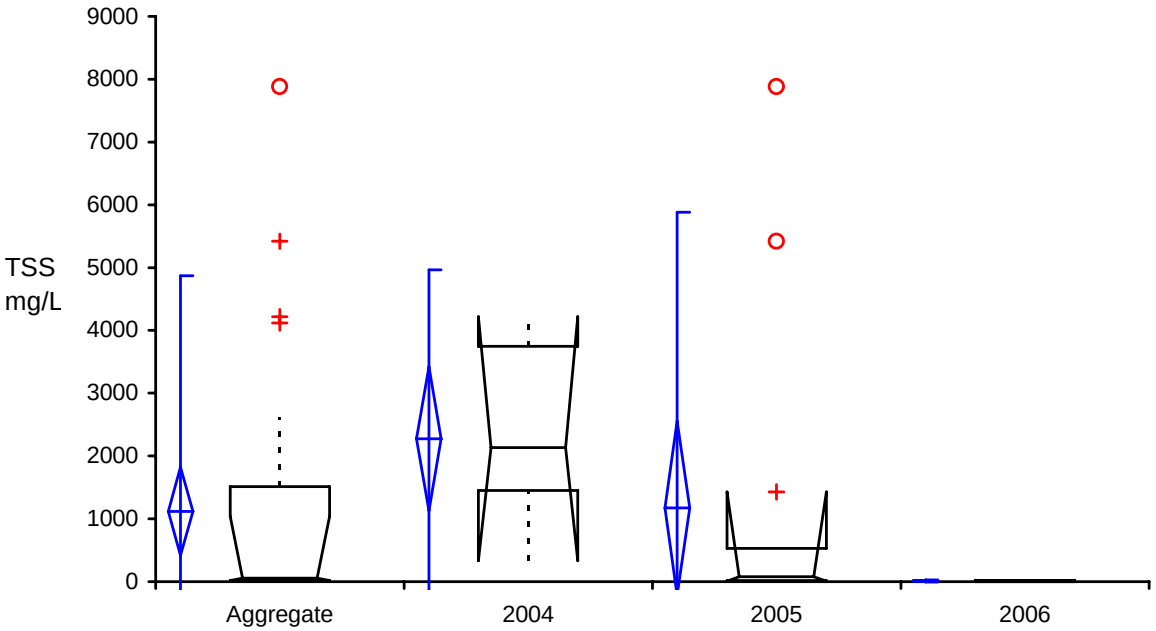
Table 13. Powers Lake East Tributary 2006 Storm Events

Powers	Storm Event								Max Storm Intensity					
Storm #	Start	End	Duration (days)	Hr	Total Rainfall (in)	Average Intensity (in/hr)	Max Intensity (in)	Max Intensity (in/hr)	Start	End	Days	Duration (hr)	Rainfall (in)	Average Intensity (in/hr)
1	4/28/2006 12:45	5/1/2006 6:45	2.75	66.25	1.47	0.02	0.04	0.16	4/29/2006 16:45	4/29/2006 17:15	0.02	0.75	0.1	0.13
2	5/8/2006 16:15	5/8/2006 17:15	0.04	1.25	0.40	0.32	0.28	1.12	5/8/2006 16:30	5/8/2006 17:00	0.02	0.75	0.37	0.49
3	5/8/2006 22:15	5/8/2006 23:15	0.04	1.25	0.16	0.13	0.04	0.16	5/8/2006 23:00	5/8/2006 23:00	0.00	0.25	0.04	0.16
4	5/12/2006 4:45	5/12/2006 19:15	0.60	14.75	0.19	0.01	0.01	0.04	5/12/2006 16:30	5/12/2006 17:00	0.02	0.75	0.03	0.04
5	5/25/2006 19:30	5/25/2006 21:00	0.06	1.75	0.07	0.04	0.03	0.12	5/25/2006 20:00	5/25/2006 20:00	0.00	0.25	0.03	0.12
6	5/29/2006 16:45	5/29/2006 18:15	0.06	1.75	0.21	0.12	0.07	0.28	5/29/2006 17:30	5/29/2006 17:30	0.00	0.25	0.07	0.28
7	6/1/2006 4:00	6/1/2006 5:00	0.04	1.25	0.05	0.04	0.03	0.12	6/1/2006 4:00	6/1/2006 4:00	0.00	0.25	0.03	0.12
8	6/5/2006 18:15	6/5/2006 23:00	0.20	5.00	1.26	0.25	0.58	2.32	6/5/2006 22:00	6/5/2006 22:30	0.02	0.75	1.16	1.55
9	6/16/2006 20:45	6/17/2006 4:30	0.32	8.00	0.26	0.03	0.14	0.56	6/16/2006 22:15	6/16/2006 22:30	0.01	0.50	0.19	0.38
10	6/18/2006 17:15	6/18/2006 17:15	0.00	0.25	0.16	0.64	0.16	0.64	6/18/2006 17:15	6/18/2006 17:15	0.00	0.25	0.16	0.64
11	6/24/2006 10:00	6/25/2006 7:45	0.91	22.00	0.26	0.01	0.05	0.20	6/24/2006 21:45	6/24/2006 22:15	0.02	0.75	0.11	0.15
12	6/26/2006 18:30	6/26/2006 21:30	0.13	3.25	0.03	0.01	0.01	0.04	6/26/2006 20:30	6/26/2006 20:30	0.00	0.25	0.01	0.04
13	7/13/2006 22:00	7/14/2006 2:30	0.19	4.75	0.12	0.03	0.06	0.24	7/13/2006 22:15	7/13/2006 22:15	0.00	0.25	0.06	0.24
14	7/16/2006 8:30	7/16/2006 10:30	0.08	2.25	0.22	0.10	0.09	0.36	7/16/2006 8:30	7/16/2006 8:45	0.01	0.50	0.11	0.22
15	7/19/2006 10:00	7/19/2006 12:30	0.10	2.75	0.83	0.30	0.58	2.32	7/19/2006 10:00	7/19/2006 10:45	0.03	1.00	0.77	0.77
16	7/24/2006 16:15	7/24/2006 18:30	0.09	2.50	0.84	0.34	0.54	2.16	7/24/2006 16:30	7/24/2006 16:45	0.01	0.50	0.6	1.20
17	8/1/2006 3:30	8/2/2006 8:00	1.19	28.75	2.72	0.09	0.30	1.20	8/1/2006 12:15	8/1/2006 13:00	0.03	1.00	0.42	0.42
18	8/6/2006 2:15	8/6/2006 4:45	0.10	2.75	0.17	0.06	0.11	0.44	8/6/2006 2:30	8/6/2006 2:45	0.01	0.50	0.15	0.30
19	8/13/2006 14:30	8/13/2006 15:15	0.03	1.00	0.27	0.27	0.13	0.52	8/13/2006 14:30	8/13/2006 14:45	0.01	0.50	0.23	0.46
20	8/23/2006 4:15	8/23/2006 6:30	0.09	2.50	0.56	0.22	0.22	0.88	8/23/2006 4:15	8/23/2006 4:45	0.02	0.75	0.36	0.48
21	8/24/2006 12:45	8/24/2006 20:00	0.30	7.50	1.25	0.17	0.25	1.00	8/24/2006 19:00	8/24/2006 19:30	0.02	0.75	0.45	0.60
22	8/28/2006 9:45	8/28/2006 11:15	0.06	1.75	0.04	0.02	0.01	0.04	8/28/2006 11:15	8/28/2006 11:15	0.00	0.25	0.01	0.04
23	9/3/2006 15:30	9/3/2006 20:45	0.22	5.50	1.35	0.25	0.42	1.68	9/3/2006 15:45	9/3/2006 16:15	0.02	0.75	0.9	1.20
24	9/10/2006 17:00	9/10/2006 18:15	0.05	1.50	0.19	0.13	0.08	0.32	9/10/2006 17:00	9/10/2006 17:30	0.02	0.75	0.17	0.23
25	9/17/2006 4:45	9/17/2006 9:00	0.18	4.50	0.23	0.05	0.20	0.80	9/17/2006 6:15	9/17/2006 6:15	0.00	0.25	0.2	0.80
26	9/21/2006 15:45	9/22/2006 18:00	1.09	26.50	0.68	0.03	0.04	0.16	9/22/2006 7:30	9/22/2006 8:00	0.02	0.75	0.08	0.11
27	9/23/2006 16:00	9/23/2006 20:30	0.19	4.75	0.28	0.06	0.04	0.16	9/23/2006 16:00	9/23/2006 16:15	0.01	0.50	0.06	0.12
28	10/3/2006 22:15	10/3/2006 22:30	0.01	0.50	0.02	0.04	0.01	0.04	10/3/2006 22:15	10/3/2006 22:30	0.01	0.50	0.02	0.04
29	10/11/2006 3:30	10/11/2006 7:30	0.17	4.25	0.15	0.04	0.03	0.12	10/11/2006 5:45	10/11/2006 5:45	0.00	0.25	0.03	0.12
30	10/16/2006 5:45	10/16/2006 14:45	0.38	9.25	0.25	0.03	0.07	0.28	10/16/2006 6:00	10/16/2006 6:15	0.01	0.50	0.1	0.20
31	10/18/2006 11:45	10/18/2006 12:15	0.02	0.75	0.03	0.04	0.02	0.08	10/18/2006 12:15	10/18/2006 12:15	0.00	0.25	0.02	0.08

Table 14. Powers Lake East Tributary 2006 Storm Discharge Events

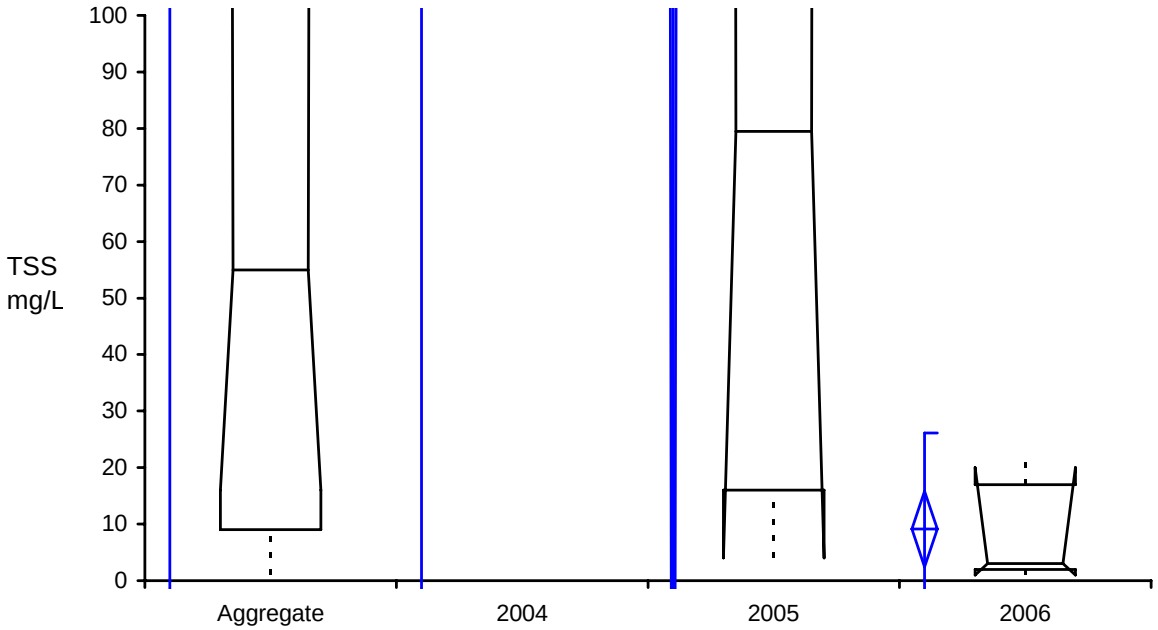
Powers		Hydrograph			Flow Rate (cfs)				Stage (ft)			
Storm #	Rainfall Total (in)	Start	End	Total Discharge (cf)	Max	Time	Start	End	Max	Time	Start	End
1	1.47	4/28/2006 10:45	5/3/2006 18:45	396,530	2.2822	5/1/2006 12:15	0.02	0.35	0.378	5/2/2006 18:30	0.052	0.094
2	0.40	5/8/2006 14:45	5/8/2006 16:45	4,508	1.0087	5/8/2006 15:15	0.281	0.48	0.178	5/8/2006 15:15	0.079	0.115
3	0.16	5/8/2006 19:45	5/9/2006 0:45	18,129	1.5244	5/8/2006 21:30	0.466	0.797	0.233	5/8/2006 21:30	0.113	0.155
4	0.19	5/12/2006 1:45	5/14/2006 15:45	95,728	0.5386	5/13/2006 1:30	0.214	0.296	0.123	5/13/2006 1:30	0.067	0.088
5	0.07	5/25/2006 18:45	5/26/2006 1:45	2,378	0.1376	5/25/2006 20:00	0.067	0.08	0.076	5/25/2006 20:00	0.053	0.058
6	0.21	5/29/2006 16:45	5/29/2006 19:45	1,296	0.2575	5/29/2006 18:15	0.064	0.059	0.1	5/29/2006 18:15	0.057	0.054
7	0.05	6/1/2006 3:45	6/1/2006 5:45	610	0.1701	6/1/2006 4:15	0.056	0.057	0.09	6/1/2006 4:15	0.052	0.053
8	1.26	6/5/2006 17:45	6/6/2006 0:45	14,551	4.5713	6/5/2006 22:30	0.066	0.234	0.418	6/5/2006 22:30	0.058	0.072
9	0.26	6/16/2006 20:45	6/17/2006 6:45	4,559	0.4309	6/16/2006 22:30	0.051	0.096	0.115	6/16/2006 22:30	0.034	0.051
10	0.16	6/18/2006 16:45	6/18/2006 20:45	1,509	0.3142	6/18/2006 17:15	0.07	0.077	0.104	6/18/2006 17:15	0.042	0.045
11	0.26	6/24/2006 9:45	6/25/2006 10:45	8,290	0.2918	6/24/2006 22:00	0.058	0.089	0.09	6/24/2006 22:00	0.035	0.047
12	0.03	6/26/2006 17:45	6/26/2006 23:45	1,686	0.1558	6/26/2006 20:45	0.065	0.07	0.065	6/26/2006 20:45	0.038	0.04
13	0.12	7/13/2006 21:45	7/14/2006 4:45	2,517	0.31	7/13/2006 22:00	0.068	0.043	0.097	7/13/2006 22:00	0.038	0.028
14	0.22	7/16/2006 6:45	7/16/2006 12:45	1,959	0.2399	7/16/2006 9:15	0.009	0.026	0.097	7/16/2006 9:15	0.01	0.02
15	0.83	7/19/2006 9:45	7/19/2006 13:45	5,430	1.5482	7/19/2006 10:30	0.001	0.062	0.338	7/19/2006 10:30	0.005	0.048
16	0.84	7/24/2006 15:45	7/24/2006 21:45	5,017	1.2651	7/24/2006 16:45	0.005	0.045	0.269	7/24/2006 16:45	0.013	0.041
17	2.72	8/1/2006 11:45	8/3/2006 19:45	1,002,859	9.455	8/2/2006 8:00	0.023	2.042	0.716	8/2/2006 4:45	0.032	0.277
18	0.17	8/6/2006 1:45	8/6/2006 13:45	45,436	1.1788	8/6/2006 3:00	0.823	1.014	0.223	8/6/2006 2:45	0.159	0.181
19	0.27	8/13/2006 13:45	8/15/2006 2:45	46,036	0.5274	8/13/2006 14:45	0.134	0.288	0.144	8/13/2006 14:45	0.077	0.094
20	0.56	8/23/2006 3:45	8/23/2006 8:45	6,473	0.8638	8/23/2006 4:30	0.028	0.179	0.235	8/23/2006 4:30	0.051	0.085
21	1.25	8/24/2006 14:45	8/27/2006 5:45	563,031	3.6109	8/25/2006 10:15	0.344	1.203	0.409	8/24/2006 19:15	0.106	0.2
22	0.04	8/28/2006 10:45	8/28/2006 14:45	7,314	0.5368	8/28/2006 12:15	0.468	0.5	0.134	8/28/2006 11:45	0.127	0.128
23	1.35	9/3/2006 14:45	9/3/2006 17:45	14,386	3.5834	9/3/2006 16:00	0.015	1.35	0.457	9/3/2006 16:00	0.071	0.234
24	0.19	9/10/2006 13:45	9/10/2006 19:45	3,255	0.5127	9/10/2006 17:30	0.007	0.091	0.127	9/10/2006 17:15	0.0756	0.0753
25	0.23	9/17/2006 5:45	9/17/2006 7:45	778	0.513	9/17/2006 6:15	0.003	0.011	0.129	9/17/2006 6:15	0.02	0.036
26	0.68	9/21/2006 13:45	9/23/2006 15:45	51,441	0.6088	9/23/2006 11:15	0.03	0.511	0.161	9/23/2006 11:15	0.036	0.146
27	0.28	9/23/2006 15:45	9/25/2006 10:45	158,407	1.5814	9/24/2006 2:45	0.511	0.55	0.316	9/23/2006 19:15	0.146	0.153
28	0.02	10/3/2006 21:45	10/4/2006 1:45	467	0.1626	10/3/2006 22:45	0.009	0.004	0.088	10/3/2006 22:45	0.032	0.024
29	0.15	10/11/2006 3:45	10/11/2006 9:45	1,592	0.1301	10/11/2006 4:30	0.007	0.005	0.072	10/11/2006 4:30	0.028	0.026
30	0.25	10/16/2006 4:45	10/16/2006 15:45	1,816	0.2245	10/16/2006 6:00	1E-03	0.01	0.083	10/16/2006 6:00	0.012	0.033
31	0.03	10/18/2006 11:45	10/18/2006 16:45	623	0.1263	10/18/2006 12:15	0.006	0.008	0.083	10/18/2006 12:15	0.028	0.031

Box plots for Powers Lake East Tributary for 2004 to 2006 are in figures 21-30. Total suspended solids, volatile suspended solids, total phosphorus, and total Kjedahl nitrogen all have median values decreasing over time and variability within the box plot decreasing as well. For all parameters, large decreases in concentrations are occurring between years. Such decreases may be attributed to the large amount of construction in the nearby development during the early monitoring seasons. Further erosion and sediment control over the last couple years combined with vegetation and cover establishment may be contributing to lower concentrations observed. Further analysis of different possible factors within the drainage area will be needed to fully understand both the large decreases and for such high results in 2004. Total chloride ions median values have an increasing trend over the past three monitoring seasons. These increases maybe contributed to the establishment of roads and salt applications in recent constructed developments. Fecal coliform samples are too few to draw statistical conclusions between monitoring seasons.



Powers 2 - TSS	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	31	1119.129	1914.9813	343.9408	416.708 to 1821.550	55.000	1501.000	16.000 to 1040.000
2004	8	2274.500	1373.2492	485.5169	1126.435 to 3422.565	2135.000	2292.500	336.000 to 4220.000
2005	14	1172.500	2402.0042	641.9626	-214.376 to 2559.376	79.500	511.000	4.000 to 1430.000
2006	9	9.111	8.6811	2.8937	2.438 to 15.784	3.000	15.000	1.000 to 20.000

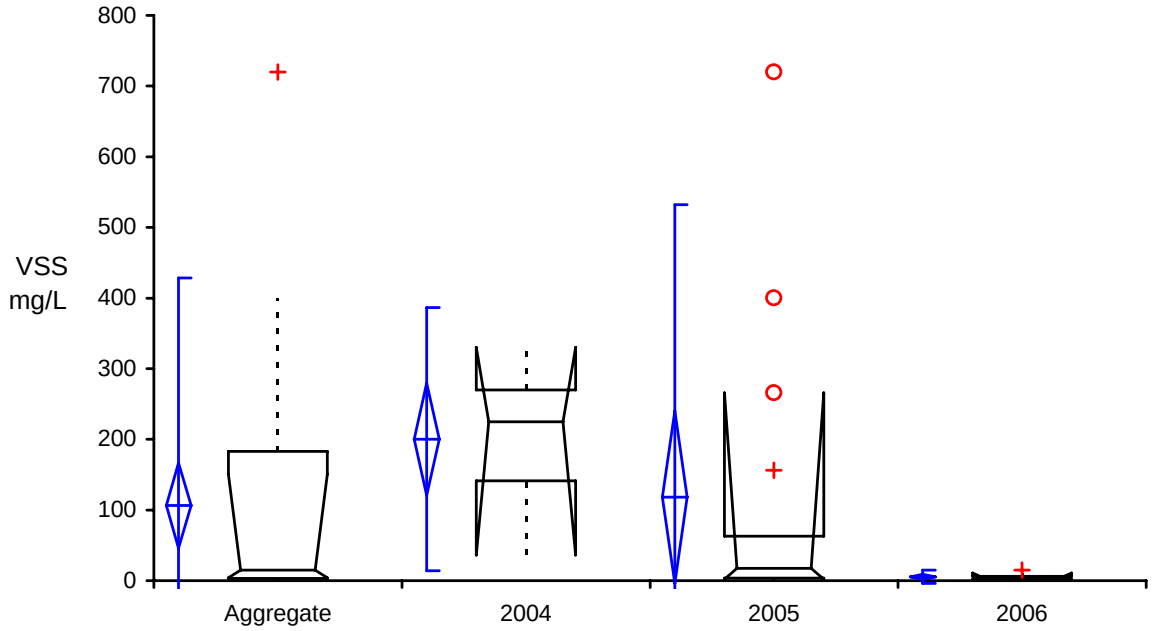
Figure 21. Powers Lake East Total Suspended Solids Box Plot (2004-2006)



Powers 2 - TSS	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	31	1119.129	1914.9813	343.9408	416.708 to 1821.550	55.000	1501.000	16.000 to 1040.000
2004	8	2274.500	1373.2492	485.5169	1126.435 to 3422.565	2135.000	2292.500	336.000 to 4220.000
2005	14	1172.500	2402.0042	641.9626	-214.376 to 2559.376	79.500	511.000	4.000 to 1430.000
2006	9	9.111	8.6811	2.8937	2.438 to 15.784	3.000	15.000	1.000 to 20.000

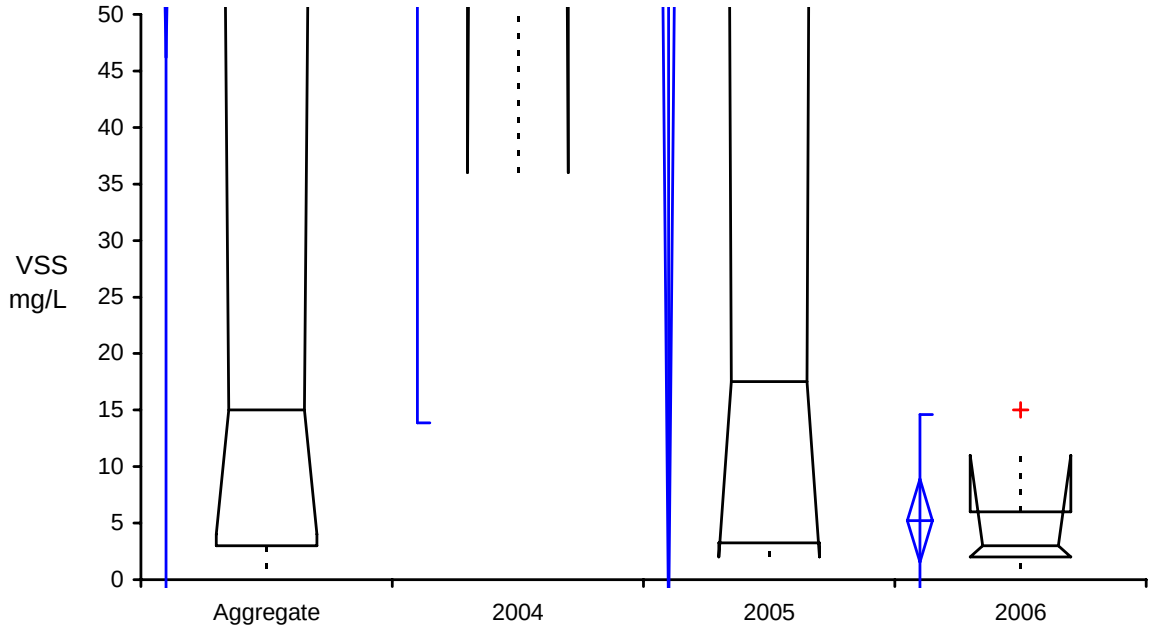
Figure 22. Powers Lake East Total Suspended Solids Box Plot (2004-2006) without Outliers

*2004 values are above the visible scale



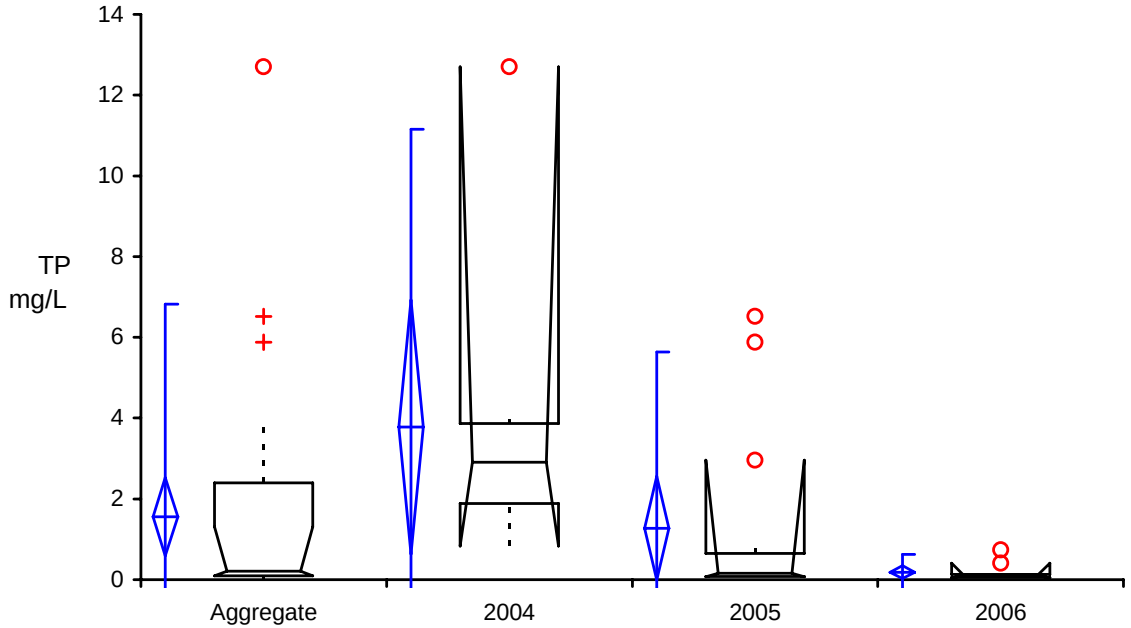
Powers 2 - VSS	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	31	106.419	164.1832	29.4882	46.196 to 166.642	15.000	180.000	4.000 to 150.000
2004	8	200.125	95.0345	33.5998	120.674 to 279.576	225.000	128.750	36.000 to 330.000
2005	14	117.929	211.4075	56.5010	-4.134 to 239.992	17.500	59.750	2.000 to 266.000
2006	9	5.222	4.7900	1.5967	1.540 to 8.904	3.000	4.000	2.000 to 11.000

Figure 23. Powers Lake East Total Volatile Suspended Solids Box Plot (2004-2006)



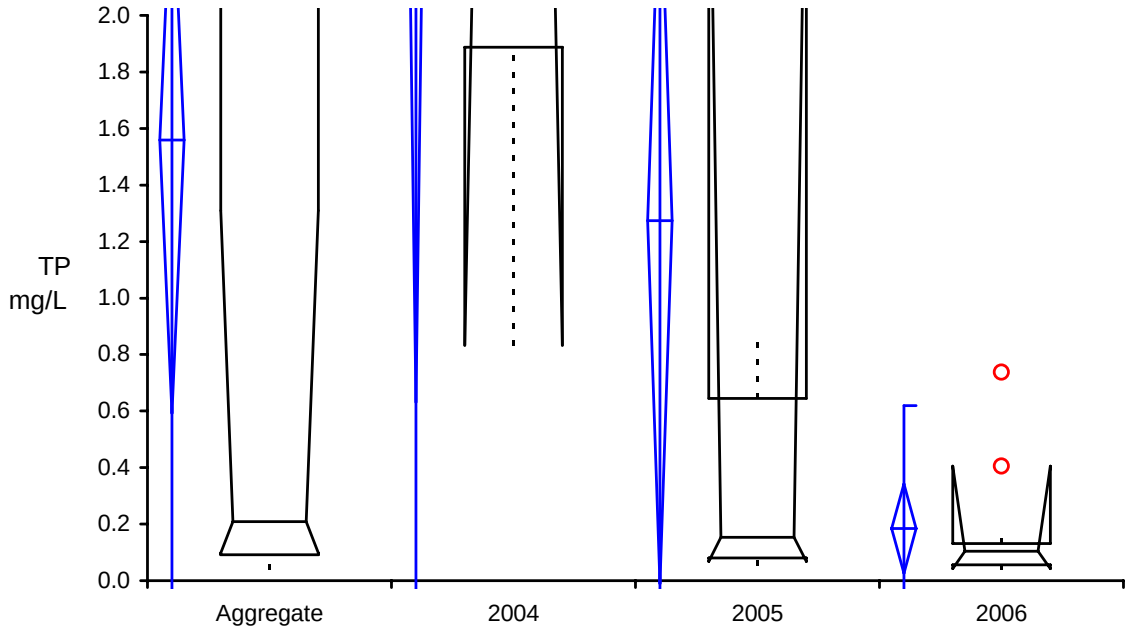
Powers 2 - VSS	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	31	106.419	164.1832	29.4882	46.196 to 166.642	15.000	180.000	4.000 to 150.000
2004	8	200.125	95.0345	33.5998	120.674 to 279.576	225.000	128.750	36.000 to 330.000
2005	14	117.929	211.4075	56.5010	-4.134 to 239.992	17.500	59.750	2.000 to 266.000
2006	9	5.222	4.7900	1.5967	1.540 to 8.904	3.000	4.000	2.000 to 11.000

Figure 24. Powers Lake East Total Volatile Suspended Solids Box Plot (2004-2006) without Outliers



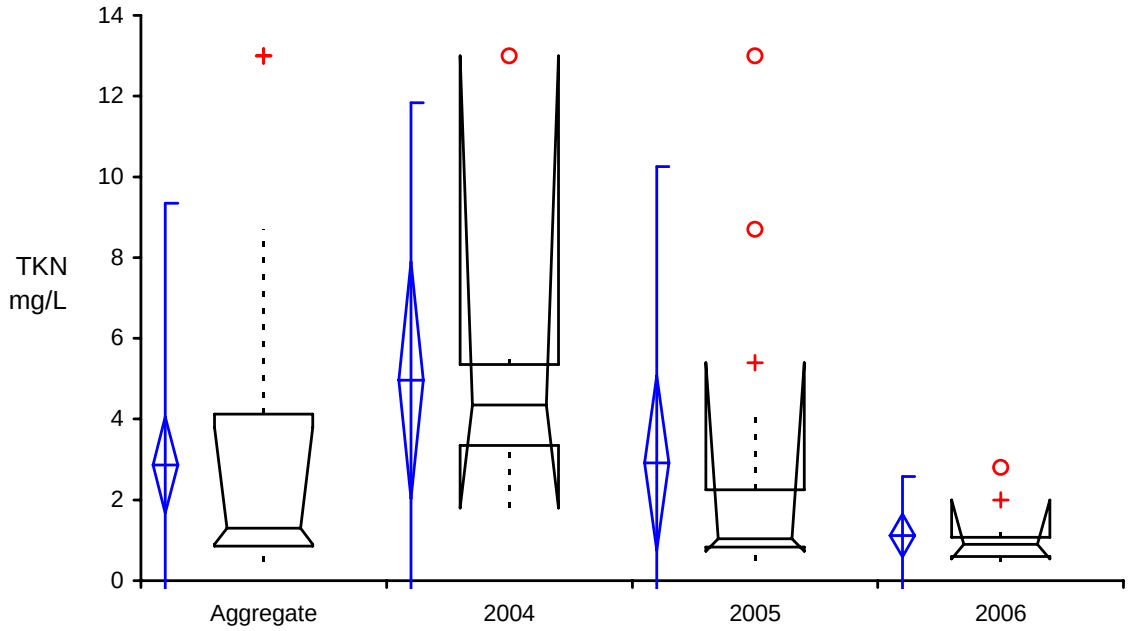
Powers 2 - TP	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	32	1.559	2.6852	0.4747	0.591 to 2.527	0.209	2.303	0.097 to 1.310
2004	8	3.779	3.7647	1.3310	0.632 to 6.926	2.905	1.978	0.833 to 12.700
2005	14	1.273	2.2255	0.5948	-0.012 to 2.558	0.154	0.564	0.068 to 2.960
2006	10	0.184	0.2218	0.0701	0.025 to 0.343	0.104	0.076	0.042 to 0.405

Figure 25. Powers Lake East Total Phosphorus Box Plot (2004-2006)



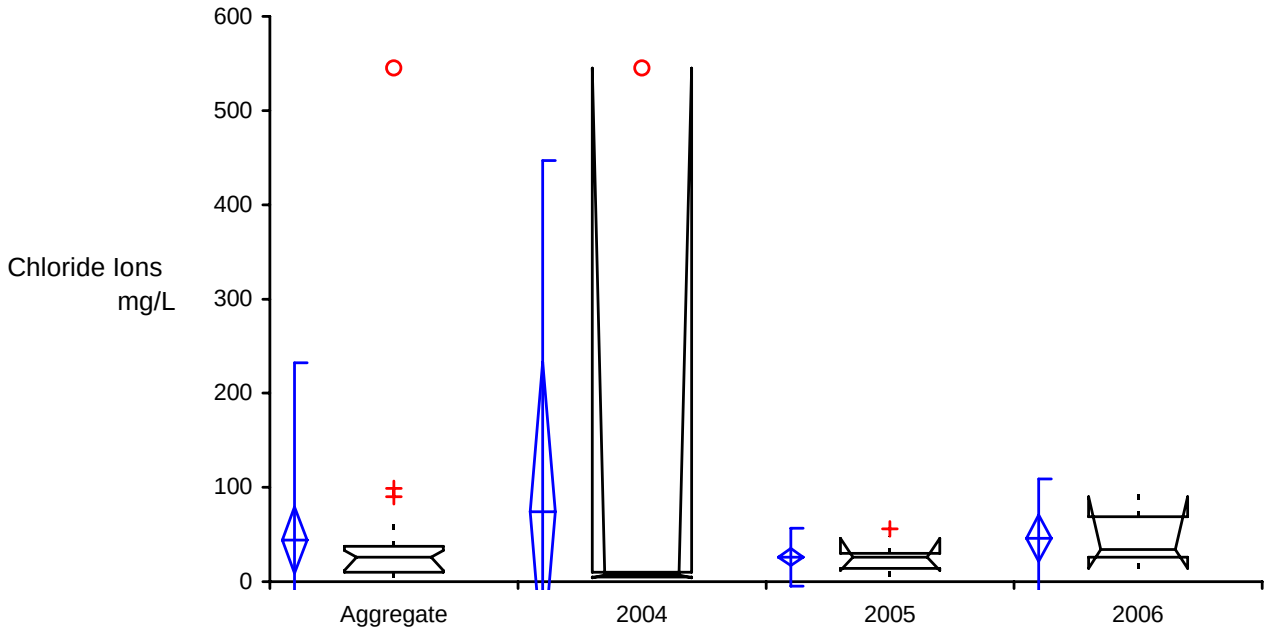
Powers 2 - TP	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	32	1.559	2.6852	0.4747	0.591 to 2.527	0.209	2.303	0.097 to 1.310
2004	8	3.779	3.7647	1.3310	0.632 to 6.926	2.905	1.978	0.833 to 12.700
2005	14	1.273	2.2255	0.5948	-0.012 to 2.558	0.154	0.564	0.068 to 2.960
2006	10	0.184	0.2218	0.0701	0.025 to 0.343	0.104	0.076	0.042 to 0.405

Figure 26. Powers Lake East Total Phosphorus Box Plot (2004-2006) without Outliers



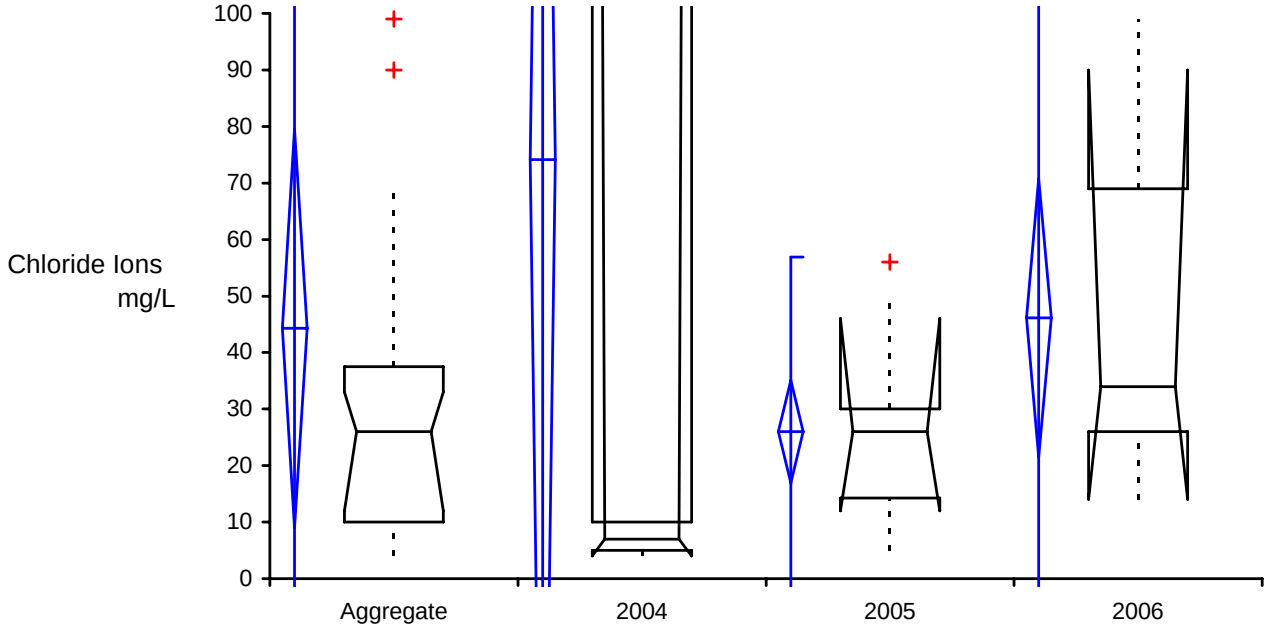
Powers 2 - TKN	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	32	2.866	3.3084	0.5849	1.673 to 4.059	1.300	3.270	0.900 to 3.800
2004	8	4.963	3.5087	1.2405	2.029 to 7.896	4.350	2.000	1.800 to 13.000
2005	14	2.917	3.7454	1.0010	0.755 to 5.080	1.040	1.418	0.730 to 5.400
2006	10	1.117	0.7447	0.2355	0.584 to 1.650	0.895	0.475	0.540 to 2.000

Figure 27. Powers Lake East Total Kjedahl Nitrogen Box Plot (2004-2006)



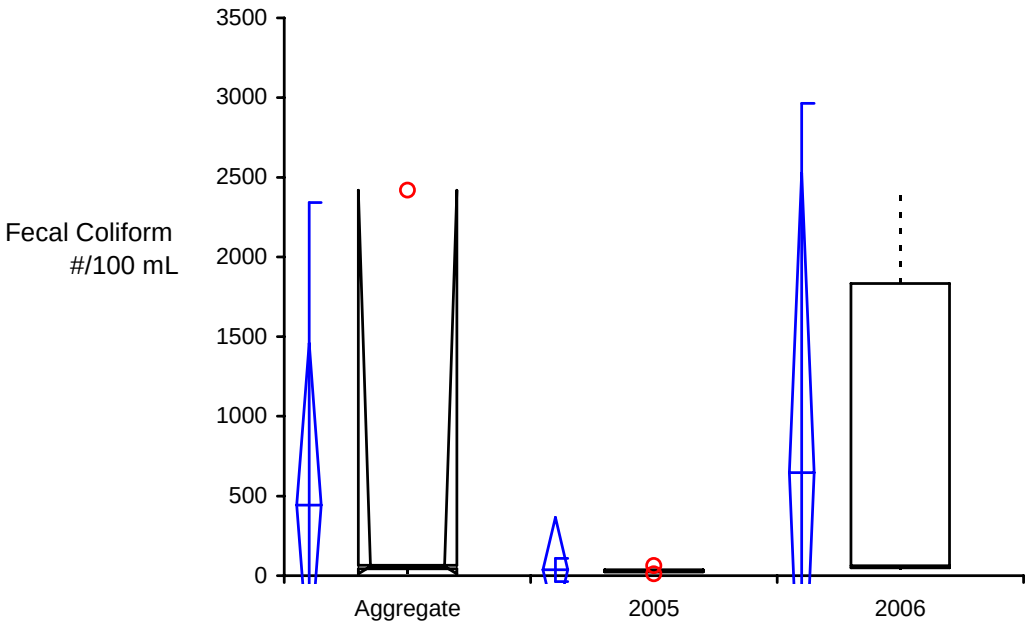
Powers 2 - Chloride	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	31	44.258	96.0396	17.2492	9.030 to 79.486	26.000	27.500	12.000 to 33.000
2004	8	74.125	190.2753	67.2725	-84.949 to 233.199	7.000	5.000	4.000 to 545.000
2005	14	26.000	15.7529	4.2101	16.905 to 35.095	26.000	15.750	12.000 to 46.000
2006	9	46.111	32.0447	10.6816	21.479 to 70.743	34.000	43.000	14.000 to 90.000

Figure 28. Powers Lake East Total Chloride Ions Box Plot (2004-2006)



Powers 2 - Chloride	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	31	44.258	96.0396	17.2492	9.030 to 79.486	26.000	27.500	12.000 to 33.000
2004	8	74.125	190.2753	67.2725	-84.949 to 233.199	7.000	5.000	4.000 to 545.000
2005	14	26.000	15.7529	4.2101	16.905 to 35.095	26.000	15.750	12.000 to 46.000
2006	9	46.111	32.0447	10.6816	21.479 to 70.743	34.000	43.000	14.000 to 90.000

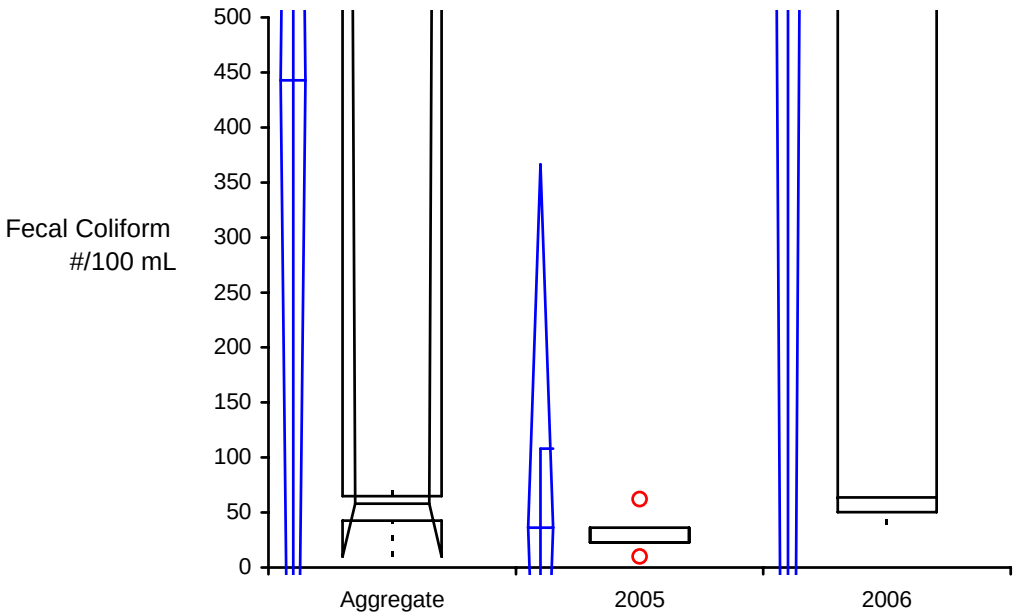
Figure 29. Powers Lake East Total Chloride Ions Box Plot (2004-2006) without Outliers



Powers 2 - Fecal Coliform	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	6	443.000	968.7741	395.5004	-573.666 to 1459.666	58.000	22.000	10.000 to 2420.000
2005	2	36.000	36.7696	26.0000	-294.361 to 366.361	36.000	0.000	- to -
2006	4	646.500	1182.4152	591.2076	-1234.986 to 2527.986	63.500	1783.000	- to -

Figure 30. Powers Lake East Fecal Coliform Box Plot (2005-2006)

***E. Coli bacteria was sampled for the 2006 monitoring season, prior it was total fecal coliform**



Powers 2 - Fecal Coliform	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	6	443.000	968.7741	395.5004	-573.666 to 1459.666	58.000	22.000	10.000 to 2420.000
2005	2	36.000	36.7696	26.0000	-294.361 to 366.361	36.000	0.000	- to -
2006	4	646.500	1182.4152	591.2076	-1234.986 to 2527.986	63.500	1783.000	- to -

Figure 31. Powers Lake East Fecal Coliform Box Plot (2005-2006) without Outliers

***E. Coli bacteria was sampled for the 2006 monitoring season, prior it was total fecal coliform**

100th Street (Cottage Grove)

The hydrograph for the 100th Street site shows flow recorded between April 6-October 31, 2006 (Figure 32). Total discharge during this period was 10,170,207 cf or 233 acre/ft. The highest discharge—4.82 cfs occurred on August 2, 2006 from a storm rainfall of 2.83 inches, the highest precipitation in a storm event for 2006. No flow data was collected from August 18, 2006 to September 18, 2006 due to equipment failure.

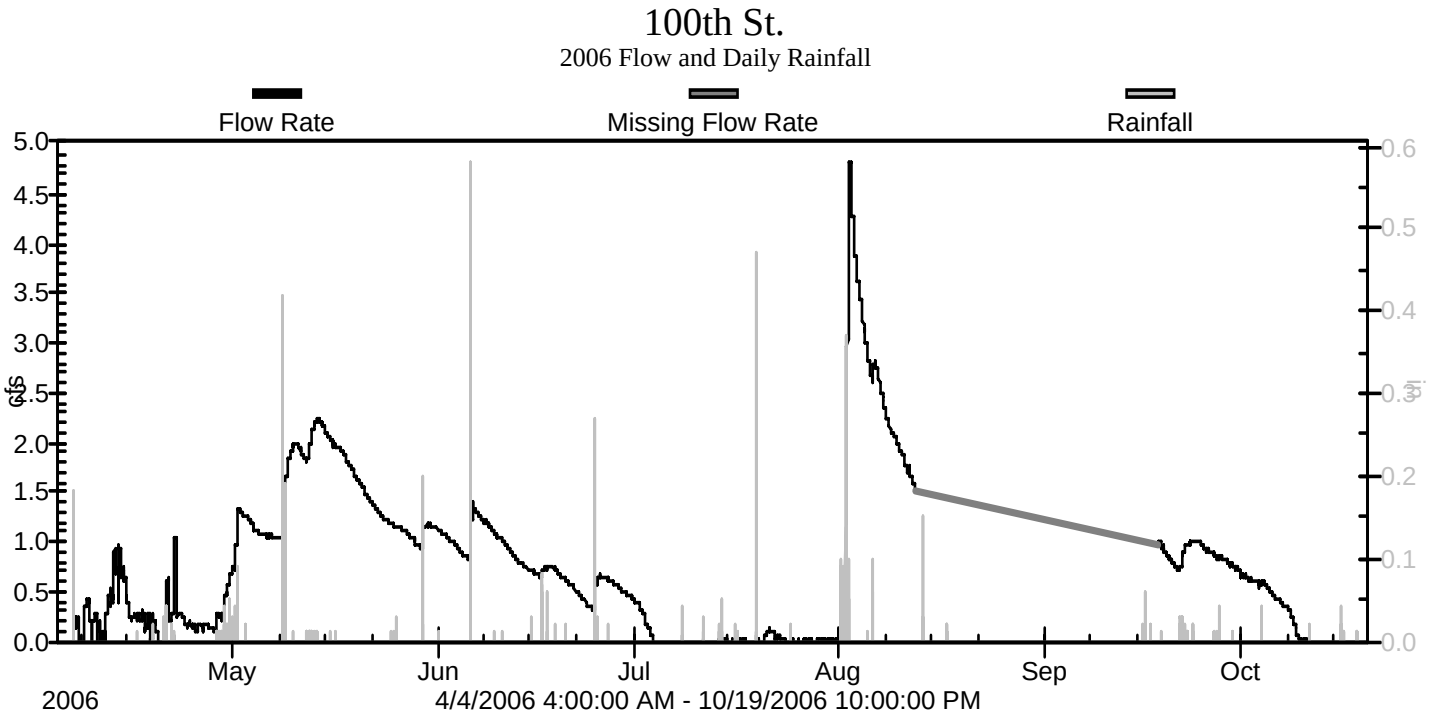


Figure 32. 100th Street 2006 Flow and Daily Rainfall

Table 15. 100th Street Stream Loading Table

		Sample Collection Time				Loading Interval				
Sample Type	**Storm #**	**Start**	**End**	**TSS (mg/L)**	**TP (mg/L)**	**Start**	**End**	**Interval Volume (cf)**	**Interval TSS (lb)**	**Interval TP (lb)**
Base				*1.7*	*0.049*	*1/1/2006 0:00*	*4/6/2006 20:15*	*82,809*	*8.6*	*0.3*
Storm	*1*			*3.3*	*0.056*	*4/6/2006 20:15*	*4/7/2006 18:15*	*11,844*	*2.4*	*0.0*
Base				*1.7*	*0.049*	*4/7/2006 18:15*	*4/20/2006 8:15*	*295,773*	*30.8*	*0.9*
Storm	*2*			*3.3*	*0.056*	*4/20/2006 8:15*	*4/23/2006 20:15*	*98,384*	*20.0*	*0.3*
Base				*1.7*	*0.049*	*4/23/2006 20:15*	*4/28/2006 5:15*	*54,378*	*5.7*	*0.2*
Storm	*3*			*3.3*	*0.056*	*4/28/2006 5:15*	*5/4/2006 2:15*	*413,341*	*83.9*	*1.4*
Base				*1.7*	*0.049*	*5/4/2006 2:15*	*5/8/2006 14:15*	*413,905*	*43.1*	*1.3*
Storm	*4*			*3.3*	*0.056*	*5/8/2006 14:15*	*5/12/2006 3:15*	*554,524*	*112.5*	*1.9*
Storm	*5*			*3.3*	*0.056*	*5/12/2006 3:15*	*5/16/2006 14:15*	*800,650*	*162.4*	*2.8*
Base Grab		5/16/06 14:15	5/16/06 14:15	1.0	0.018	5/16/2006 14:15	5/25/2006 19:15	1,201,551	75.0	1.4
Storm	*6*			*3.3*	*0.056*	*5/25/2006 19:15*	*5/26/2006 11:15*	*66,320*	*13.5*	*0.2*
Base				*1.7*	*0.049*	*5/26/2006 11:15*	*5/29/2006 16:15*	*287,303*	*29.9*	*0.9*
Storm	*7*			*3.3*	*0.056*	*5/29/2006 16:15*	*6/1/2006 18:15*	*303,167*	*61.5*	*1.1*
Base Grab		6/2/06 10:45	6/2/06 10:45	2.0	0.037	6/1/2006 18:15	6/5/2006 22:15	342,362	42.7	0.8
Storm Composite	8	6/6/06 8:46	6/6/06 16:37	4.0	0.049	6/5/2006 22:15	6/8/2006 11:15	272,856	68.1	0.8
Base				*1.7*	*0.049*	*6/8/2006 11:15*	*6/16/2006 17:15*	*627,603*	*65.3*	*1.9*
Storm	*9*			*3.3*	*0.056*	*6/16/2006 17:15*	*6/19/2006 11:15*	*172,654*	*35.0*	*0.6*
Base				*1.7*	*0.049*	*6/19/2006 11:15*	*6/24/2006 16:15*	*222,954*	*23.2*	*0.7*
Storm	*10*			*3.3*	*0.056*	*6/24/2006 16:15*	*6/27/2006 17:15*	*158,176*	*32.1*	*0.6*
Base Composite		6/30/06 9:20	7/2/06 16:01	11.0	0.137	6/27/2006 17:15	7/11/2006 9:15	193,767	133.1	1.7
Storm	*11*			*3.3*	*0.056*	*7/11/2006 9:15*	*7/11/2006 12:15*	*63*	*0.0*	*0.0*
No Flow				*1.7*	*0.049*	*7/11/2006 12:15*	*7/13/2006 15:15*	*0*	*0.0*	*0.0*
Storm	*12*			*3.3*	*0.056*	*7/13/2006 15:15*	*7/14/2006 2:15*	*225*	*0.0*	*0.0*
Intermittent Flow				*1.7*	*0.049*	*7/14/2006 2:15*	*7/16/2006 7:15*	*21*	*0.0*	*0.0*
Storm	*13*			*3.3*	*0.056*	*7/16/2006 7:15*	*7/16/2006 13:15*	*282*	*0.1*	*0.0*
Intermittent Flow				*1.7*	*0.049*	*7/16/2006 13:15*	*7/19/2006 8:15*	*103*	*0.0*	*0.0*
Storm	*14*			*3.3*	*0.056*	*7/19/2006 8:15*	*7/23/2006 16:15*	*14,385*	*2.9*	*0.1*
No Flow				*1.7*	*0.049*	*7/23/2006 16:15*	*7/24/2006 14:15*	*0*	*0.0*	*0.0*
Storm	*15*			*3.3*	*0.056*	*7/24/2006 14:15*	*7/24/2006 22:15*	*304*	*0.1*	*0.0*
Intermittent Flow				*1.7*	*0.049*	*7/24/2006 22:15*	*8/1/2006 0:15*	*681*	*0.1*	*0.0*
Storm Composite	16	8/2/06 2:19	8/2/06 5:44	3.0	0.057	8/1/2006 0:15	8/3/2006 17:15	566,031	106.0	2.0
Base				*1.7*	*0.049*	*8/3/2006 17:15*	*8/6/2006 1:15*	*625,056*	*65.0*	*1.9*
Storm	*17*			*3.3*	*0.056*	*8/6/2006 1:15*	*8/6/2006 20:15*	*188,827*	*38.3*	*0.7*
Base				*1.7*	*0.049*	*8/6/2006 20:15*	*8/12/2006 13:15*	*995,299*	*103.6*	*3.1*
No Data				1.7	0.049	**8/12/2006 13:15**	**9/18/2006 9:15**	**0**	**0.0**	**0.0**
Storm Grab		8/23/06 13:53	8/23/06 13:53	3.0	0.049				0.0	0.0
Storm Grab		8/28/06 10:45	8/28/06 10:45	3.0	0.069				0.0	0.0
Base Grab		9/12/06 10:48	9/12/06 10:48	2.0	0.093				0.0	0.0
Base				*1.7*	*0.049*	*9/18/2006 9:15*	*9/21/2006 14:15*	*234,811*	*24.4*	*0.7*
Storm	*18*			*3.3*	*0.056*	*9/21/2006 14:15*	*9/26/2006 5:15*	*376,870*	*76.5*	*1.3*
Base				*1.7*	*0.049*	*9/26/2006 5:15*	*10/31/2006 9:15*	*675,741*	*70.3*	*2.1*
Base				*1.7*	*0.049*	*10/31/2006 9:15*	*1/1/2007*	*53,235*	*5.5*	*0.2*
Storm Average				3.3	0.056					
Base Average				1.7	0.049					
Snowmelt Average										
All Average				3.6	0.064					
Total								**10,306,252**	1,542	32
SWWD Major Subwatershed Total Acres								8,046		
Total TP/TSS(lb/ac/yr)									0.19	0.00
Total TP/TSS (kg/ha/yr)									0.21	0.00

*Italics indicate estimated concentrations based on average base and storm flow concentrations

Grab samples and flow weighted composite samples were taken at the 100th Street site. The TSS, TKN, TP, VSS, COD, TDP, and E. Coliform results from all collected samples are listed in Table 16. The highest TSS concentration of 11 mg/L was collected in a June 30, 2006 base composite sample. The highest TP and TKN concentrations were collected from the June 30, 2006 base composite sample, 0.187 mg/L and 0.72 mg/L, respectively. Metals and other Nitrogen species chemicals are listed in Table 17.

Table 16. 100th Street 2006 Sample Chemistry Results

Sample Type	Start Date	End Date	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	E. Coliform (#/100 mL)	COD (mg/L)	TDP (mg/L)
Base Grab	5/16/06 14:15	5/16/06 14:15	<1	~1	0.36	~0.018		~8	<0.010
Base Grab	6/2/06 10:45	6/2/06 10:45	~2	~1	0.35	~0.037		~10	~0.013
Storm Composite	6/6/06 8:46	6/6/06 16:37	4	~2	0.41	~0.049		~13	<0.010
E Coli Grab	6/14/06 9:20	6/14/06 9:20					41		
Base Composite	6/30/06 9:20	7/2/06 16:01	11	4	0.72	0.137		17	~0.048
Storm Composite	8/2/06 2:19	8/2/06 5:44	3	~2	0.64	0.057		20	~0.032
E Coli Grab	8/10/06 8:30	8/10/06 8:30					99		
Storm Grab	8/23/06 13:53	8/23/06 13:53	3	~2	0.34	~0.049		~13	~0.017
Storm Grab	8/28/06 10:45	8/28/06 10:45	3	~1	0.36	0.069		~12	<0.010
E Coli Grab	9/6/06 8:30	9/6/06 8:30					66		
Base Grab	9/12/06 10:48	9/12/06 10:48	~2	~1	0.40	0.093		~6	~0.023
Average			**3.6**	**1.8**	**0.45**	**0.064**	**69**	**12**	**0.019**

Table 17. 100th Street 2006 Sample Metals and Nitrogen Species Chemical Results

Sample Type	Start Date	End Date	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Chloride (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Nitrogen (mg/L)
Base Grab	5/16/06 14:15	5/16/06 14:15	0.0021	0.0023	<0.00007	0.0018	<0.00004	0.0004	100	<0.03	0.09	<0.02
Base Grab	6/2/06 10:45	6/2/06 10:45	0.0020	0.0021	0.00008	0.0026	<0.00004	0.0002	88	<0.03	0.09	<0.02
Storm Composite	6/6/06 8:46	6/6/06 16:37	0.0028	0.0021	0.00100	0.0060	0.00020	0.0002	79	<0.03	0.14	<0.02
E Coli Grab	6/14/06 9:20	6/14/06 9:20										
Base Composite	6/30/06 9:20	7/2/06 16:01	0.0048	0.0025	0.00020	0.0032	<0.00004	0.0004	90	<0.03	<0.05	0.17
Storm Composite	8/2/06 2:19	8/2/06 5:44	0.0041	0.0014	0.00020	0.0051	0.00008	0.0011	19	0.06	0.48	0.11
E Coli Grab	8/10/06 8:30	8/10/06 8:30										
Storm Grab	8/23/06 13:53	8/23/06 13:53	0.0007	0.0024	<0.00007	0.0023	<0.00004	<0.0002	61	<0.03	<0.05	0.09
Storm Grab	8/28/06 10:45	8/28/06 10:45	0.0007	0.0026	<0.00007	0.0050	<0.00004	<0.0002	65	<0.03	0.05	<0.02
E Coli Grab	9/6/06 8:30	9/6/06 8:30										
Base Grab	9/12/06 10:48	9/12/06 10:48	0.0010	0.0024	<0.00007	<0.0004	<0.00004	0.0003	60	<0.03	0.07	<0.02
Average			**0.0023**	**0.0022**	**0.00020**	**0.0033**	**0.00005**	**0.0004**	**70**	**0.02**	**0.12**	**0.05**

Summaries of rainfall events and the resulting discharges for 100th Street are shown in Table 18 and Table 19. Average and maximum intensities are provided, as well as maximum stage and flow rates.

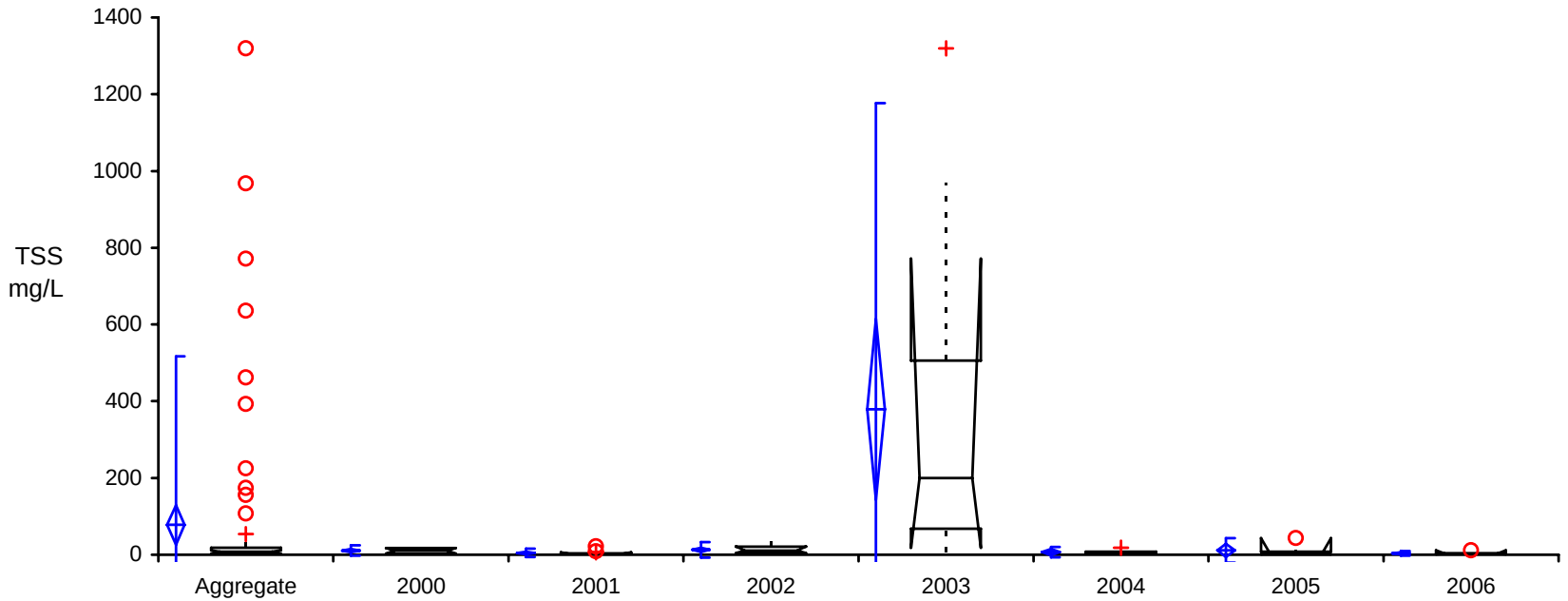
Table 18. 100th Street 2006 Storm Events

100th	Storm Event								Max Storm Intensity					
Storm #	Start	End	Duration (days)	Hr	Total Rainfall (in)	Average Intensity (in/hr)	Max Intensity (in)	Max Intensity (in/hr)	Start	End	Days	Duration (hr)	Rainfall (in)	Average Intensity (in/hr)
1	4/6/2006 15:15	4/6/2006 19:45	0.19	4.75	0.62	0.13	0.18	0.72	4/6/2006 18:00	4/6/2006 18:00	0.00	0.25	0.18	0.72
2	4/20/2006 13:15	4/20/2006 19:30	0.26	6.50	0.18	0.03	0.04	0.16	4/20/2006 16:15	4/20/2006 16:30	0.01	0.50	0.06	0.12
3	4/28/2006 11:15	5/1/2006 17:45	3.27	78.75	1.67	0.02	0.09	0.36	5/1/2006 12:15	5/1/2006 12:45	0.02	0.75	0.14	0.19
4	5/8/2006 15:00	5/8/2006 22:30	0.31	7.75	0.75	0.10	0.42	1.68	5/8/2006 15:00	5/8/2006 15:15	0.01	0.50	0.47	0.94
5	5/12/2006 3:30	5/12/2006 18:30	0.63	15.25	0.24	0.02	0.01	0.04	5/12/2006 3:30	5/12/2006 3:30	0.00	0.25	0.01	0.04
6	5/25/2006 20:00	5/25/2006 20:45	0.03	1.00	0.06	0.06	0.03	0.12	5/25/2006 20:15	5/25/2006 20:15	0.00	0.25	0.03	0.12
7	5/29/2006 16:45	5/29/2006 18:15	0.06	1.75	0.31	0.18	0.20	0.80	5/29/2006 16:45	5/29/2006 17:00	0.01	0.50	0.29	0.58
8	6/5/2006 22:30	6/5/2006 23:15	0.03	1.00	0.74	0.74	0.58	2.32	6/5/2006 22:45	6/5/2006 23:00	0.01	0.50	0.7	1.40
9	6/16/2006 17:30	6/16/2006 23:00	0.23	5.75	0.26	0.05	0.08	0.32	6/16/2006 23:00	6/16/2006 23:00	0.00	0.25	0.08	0.32
10	6/24/2006 16:30	6/25/2006 10:00	0.73	17.75	0.92	0.05	0.27	1.08	6/24/2006 20:15	6/24/2006 20:45	0.02	0.75	0.59	0.79
11	7/11/2006 9:15	7/11/2006 11:00	0.07	2.00	0.08	0.04	0.03	0.12	7/11/2006 9:45	7/11/2006 9:45	0.00	0.25	0.03	0.12
12	7/13/2006 21:00	7/14/2006 2:00	0.21	5.25	0.12	0.02	0.05	0.20	7/14/2006 1:00	7/14/2006 1:00	0.00	0.25	0.05	0.20
13	7/16/2006 7:15	7/16/2006 10:00	0.11	3.00	0.04	0.01	0.02	0.08	7/16/2006 7:15	7/16/2006 7:15	0.00	0.25	0.02	0.08
14	7/19/2006 8:45	7/19/2006 11:30	0.11	3.00	1.21	0.40	0.47	1.88	7/19/2006 9:00	7/19/2006 9:45	0.03	1.00	1.15	1.15
15	7/24/2006 15:30	7/24/2006 18:00	0.10	2.75	0.05	0.02	0.02	0.08	7/24/2006 16:15	7/24/2006 16:15	0.00	0.25	0.02	0.08
16	8/1/2006 1:15	8/2/2006 7:30	1.26	30.50	2.83	0.09	0.37	1.48	8/2/2006 0:00	8/2/2006 0:15	0.01	0.50	0.67	1.34
17	8/6/2006 1:15	8/6/2006 5:15	0.17	4.25	0.28	0.07	0.10	0.40	8/6/2006 1:45	8/6/2006 2:15	0.02	0.75	0.18	0.24
18	9/21/2006 12:30	9/22/2006 15:30	1.12	27.25	0.65	0.02	0.03	0.12	9/21/2006 19:15	9/21/2006 19:30	0.01	0.50	0.06	0.12

Table 19. 100th Street 2006 Storm Discharge Events

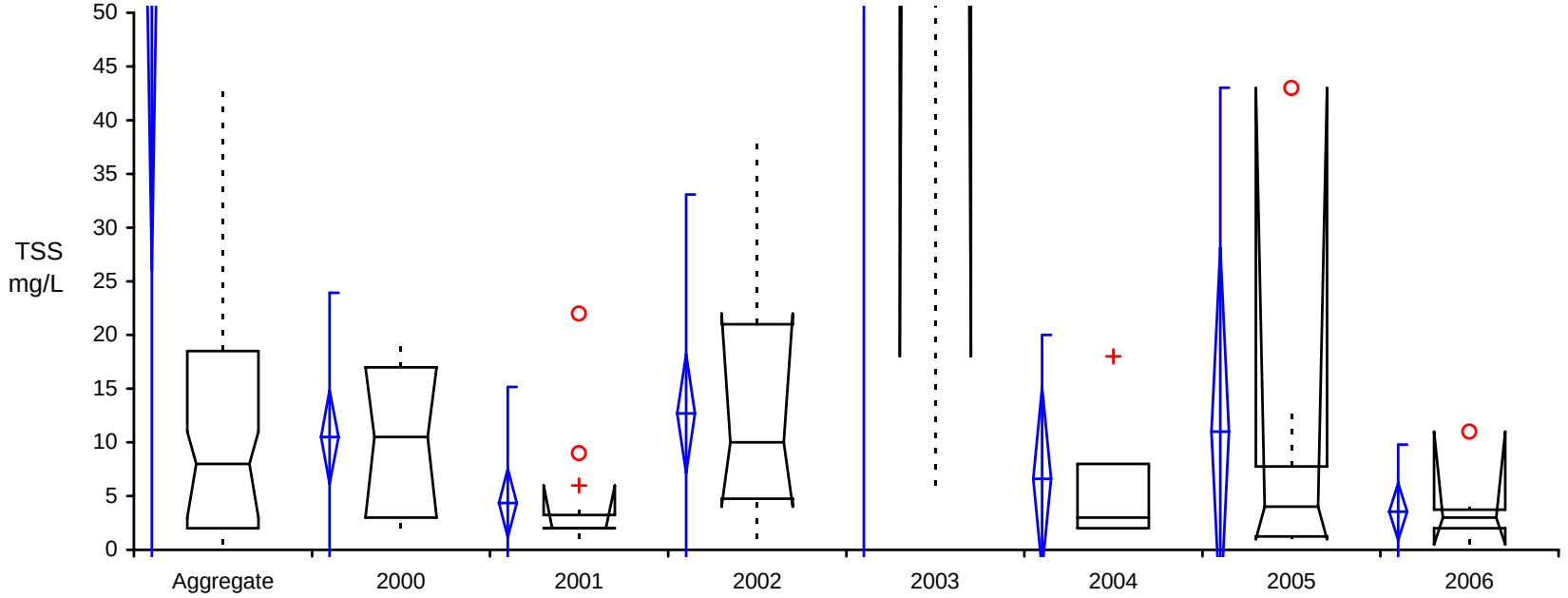
100th Street		Hydrograph			Flow Rate (cfs)				Stage (ft)			
Storm #	Rainfall Total (in)	Start	End	Total Discharge (cf)	Max	Time	Start	End	Max	Time	Start	End
1	0.62	4/6/2006 20:15	4/7/2006 18:15	11,844	0.238	4/6/2006 23:15	0.169	0.012	0.346	4/7/2006 18:00	0.093	0.344
2	0.18	4/20/2006 8:15	4/23/2006 20:15	98,384	1.024	4/22/2006 5:30	0.000	0.155	0.274	4/21/2006 20:30	0.255	0.250
3	1.67	4/28/2006 5:15	5/4/2006 2:15	413,341	1.339	5/1/2006 22:15	0.101	1.139	0.630	5/1/2006 22:15	0.116	0.552
4	0.75	5/8/2006 14:15	5/12/2006 3:15	554,524	1.979	5/10/2006 9:30	1.034	1.806	0.859	5/10/2006 9:30	0.509	0.800
5	0.24	5/12/2006 3:15	5/16/2006 14:15	800,650	2.234	5/13/2006 17:00	1.806	1.955	0.943	5/13/2006 17:00	0.800	0.851
6	0.06	5/25/2006 19:15	5/26/2006 11:15	66,320	1.162	5/26/2006 1:15	1.132	1.137	0.561	5/26/2006 1:15	0.549	0.551
7	0.31	5/29/2006 16:15	6/1/2006 18:15	303,167	1.179	5/30/2006 15:00	0.931	1.092	0.568	5/30/2006 15:00	0.466	0.533
8	0.74	6/5/2006 22:15	6/8/2006 11:15	272,856	1.418	6/6/2006 9:00	0.787	1.185	0.660	6/6/2006 9:00	0.404	0.570
9	0.26	6/16/2006 17:15	6/19/2006 11:15	172,654	0.756	6/18/2006 6:30	0.639	0.685	0.390	6/18/2006 6:30	0.337	0.358
10	0.92	6/24/2006 16:15	6/27/2006 17:15	158,176	0.663	6/25/2006 16:15	0.294	0.586	0.348	6/25/2006 16:15	0.167	0.312
11	0.08	7/11/2006 9:15	7/11/2006 12:15	63	0.015	7/11/2006 9:45	0.000	0.000	0.009	7/11/2006 9:45	0.000	0.000
12	0.12	7/13/2006 15:15	7/14/2006 2:15	225	0.031	7/13/2006 21:00	0.000	0.002	0.019	7/13/2006 21:00	0.000	0.001
13	0.04	7/16/2006 7:15	7/16/2006 13:15	282	0.031	7/16/2006 7:30	0.000	0.000	0.019	7/16/2006 7:30	0.000	0.000
14	1.21	7/19/2006 8:15	7/23/2006 16:15	14,385	0.115	7/21/2006 7:00	0.000	0.000	0.068	7/21/2006 7:00	0.000	0.000
15	0.05	7/24/2006 14:15	7/24/2006 22:15	304	0.025	7/24/2006 16:15	0.000	0.000	0.015	7/24/2006 16:15	0.000	0.000
16	2.83	8/1/2006 0:15	8/3/2006 17:15	566,031	4.816	8/2/2006 14:45	0.005	3.661	1.649	8/2/2006 14:45	0.003	1.359
17	0.28	8/6/2006 1:15	8/6/2006 20:15	188,827	2.805	8/6/2006 9:15	2.608	2.688	1.119	8/6/2006 9:15	1.060	1.084
18	0.65	9/21/2006 14:15	9/26/2006 5:15	376,870	1.012	9/24/2006 13:15	0.724	0.888	0.500	9/24/2006 13:15	0.376	0.448

Statistical summaries for 100th Street are included in figures 33-42 in the form of box plots. Total suspended solids, volatile suspended solids, and total phosphorus have median values that are steady over time. A large increase for these three parameters occurred in 2003, as well as an increase in variability of the box plots. Further analysis of factors in the drainage area would be needed to fully understand the source of this increase. Total chloride ions median values had an increasing trend from 2003 until 2005 and then the median value decreased in 2006. Statistical summaries for fecal coliform were not conducted due to too few samples for each year. Sample tests for 2004, 2005, and 2006 were few for all parameters based on lack of climatological events. These small sample sizes decrease confidence of temporal analysis for each parameter.



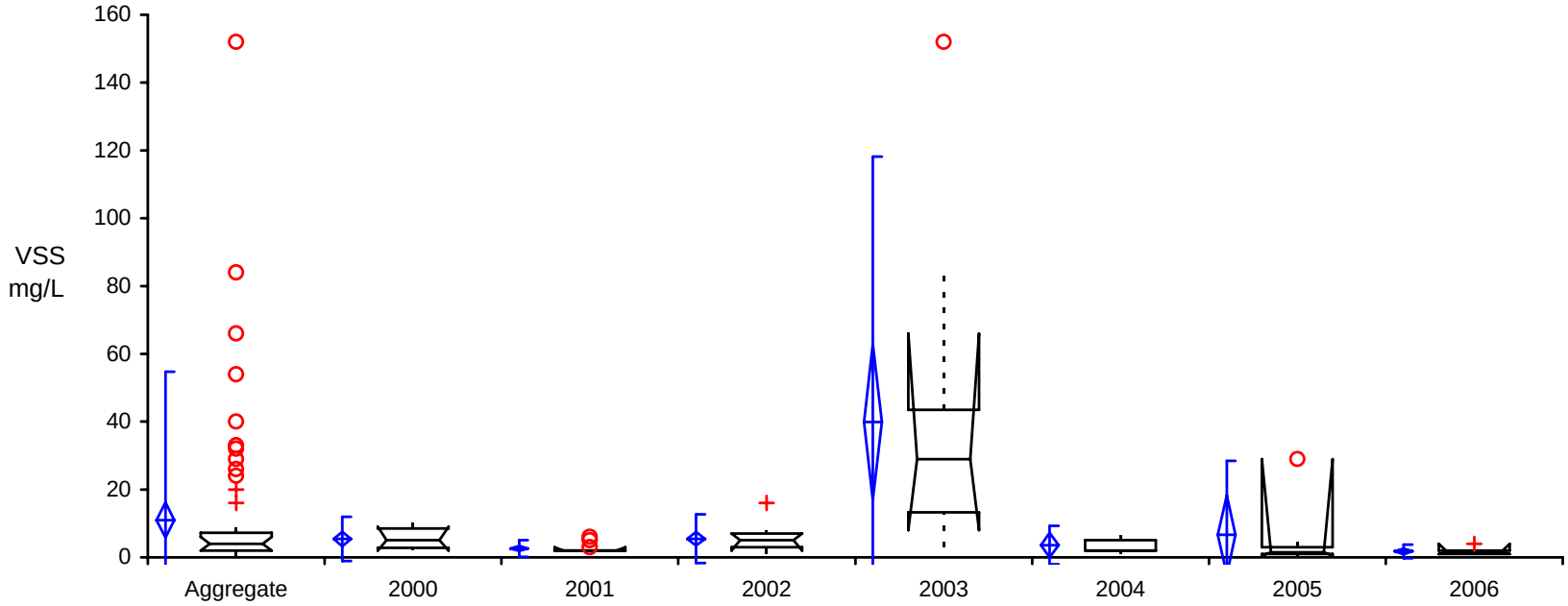
100th St - TSS	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	75	77.620	224.3274	25.9031	26.007 to 129.233	8.000	16.500	3.000 to 11.000
2000	12	10.500	6.8557	1.9791	6.144 to 14.856	10.500	14.000	3.000 to 17.000
2001	14	4.357	5.5137	1.4736	1.174 to 7.541	2.000	1.250	2.000 to 6.000
2002	16	12.688	10.4033	2.6008	7.144 to 18.231	10.000	16.250	4.000 to 22.000
2003	14	378.857	407.3322	108.8641	143.671 to 614.044	199.500	438.250	18.000 to 771.000
2004	5	6.600	6.8411	3.0594	-1.894 to 15.094	3.000	6.000	- to -
2005	6	11.000	16.3340	6.6683	-6.141 to 28.141	4.000	6.500	1.000 to 43.000
2006	8	3.563	3.1785	1.1238	0.905 to 6.220	3.000	1.750	0.500 to 11.000

Figure 33. 100th Street Total Suspended Solids Box Plot (2000-2006)



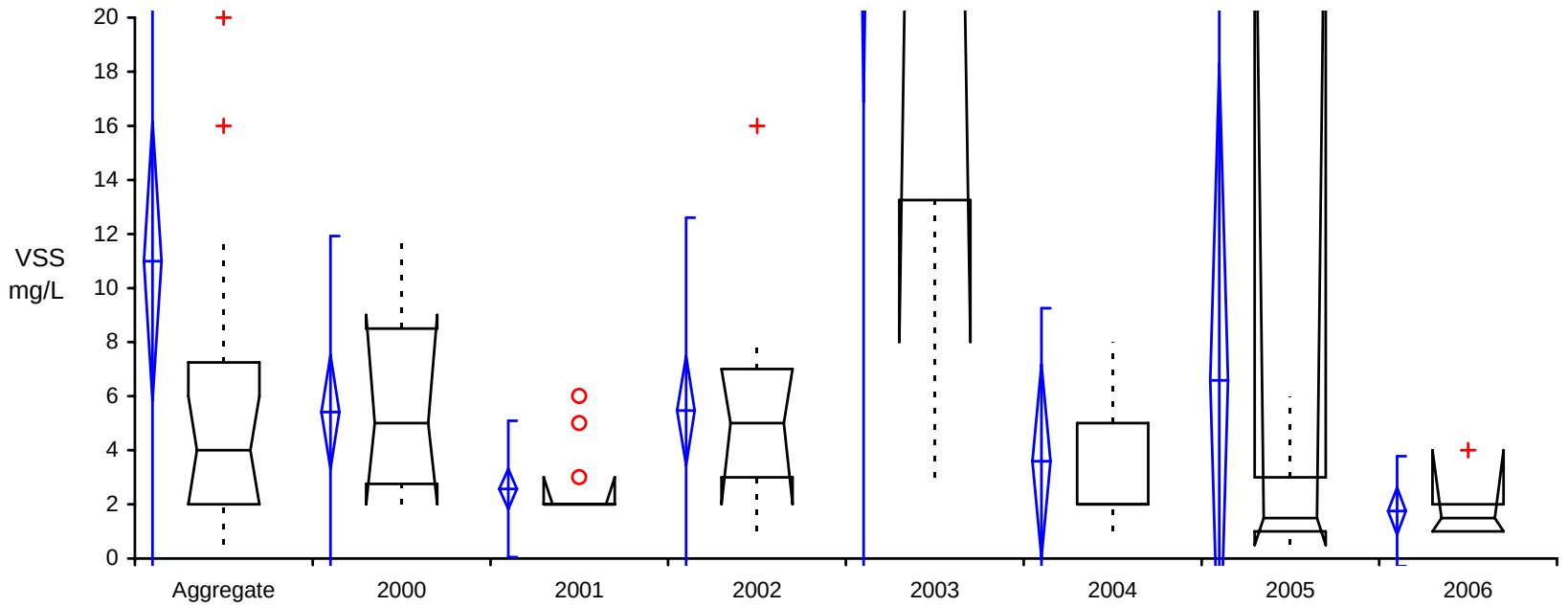
100th St - TSS	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	75	77.620	224.3274	25.9031	26.007 to 129.233	8.000	16.500	3.000 to 11.000
2000	12	10.500	6.8557	1.9791	6.144 to 14.856	10.500	14.000	3.000 to 17.000
2001	14	4.357	5.5137	1.4736	1.174 to 7.541	2.000	1.250	2.000 to 6.000
2002	16	12.688	10.4033	2.6008	7.144 to 18.231	10.000	16.250	4.000 to 22.000
2003	14	378.857	407.3322	108.8641	143.671 to 614.044	199.500	438.250	18.000 to 771.000
2004	5	6.600	6.8411	3.0594	-1.894 to 15.094	3.000	6.000	- to -
2005	6	11.000	16.3340	6.6683	-6.141 to 28.141	4.000	6.500	1.000 to 43.000
2006	8	3.563	3.1785	1.1238	0.905 to 6.220	3.000	1.750	0.500 to 11.000

Figure 34. 100th Street Total Suspended Solids Box Plot (2000-2006) without Outliers



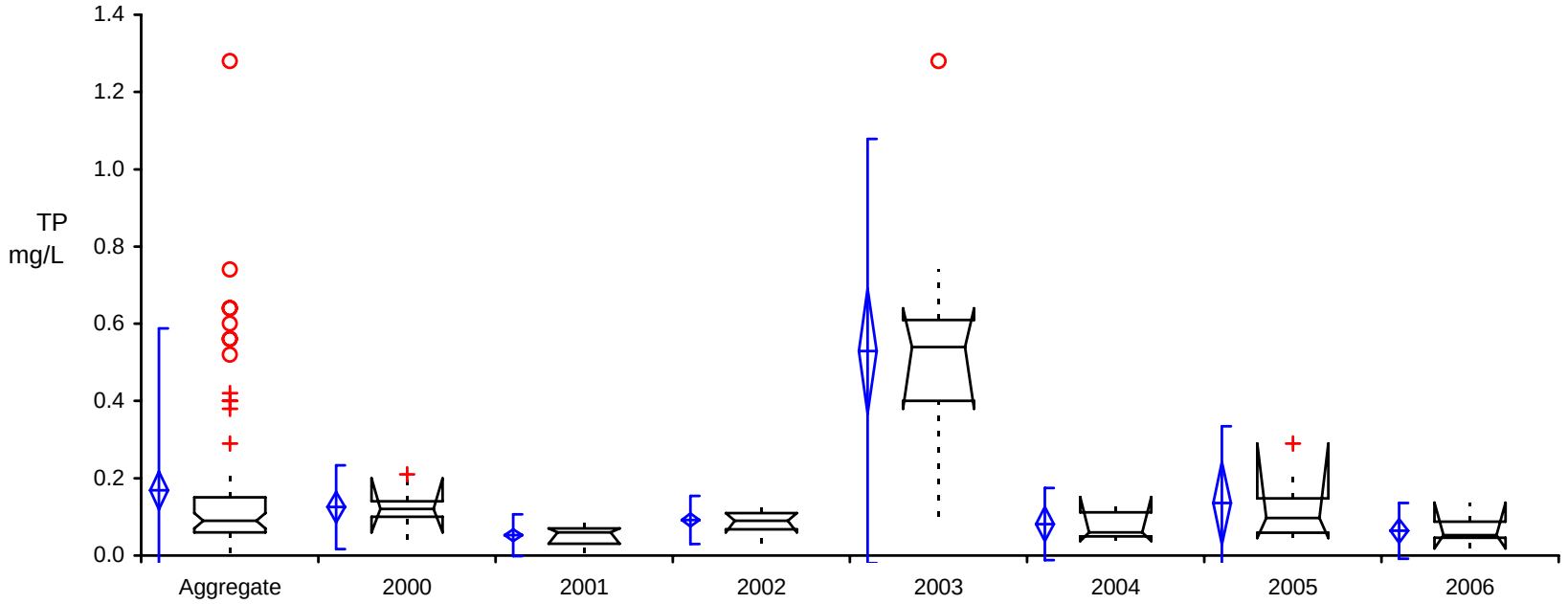
100th St - VSS	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	74	10.993	22.3049	2.5929	5.826 to 16.161	4.000	5.250	2.000 to 6.000
2000	12	5.417	3.3155	0.9571	3.310 to 7.523	5.000	5.750	2.000 to 9.000
2001	14	2.571	1.2839	0.3431	1.830 to 3.313	2.000	0.000	2.000 to 3.000
2002	15	5.467	3.6423	0.9404	3.450 to 7.484	5.000	4.000	2.000 to 7.000
2003	14	39.929	39.9104	10.6665	16.885 to 62.972	29.000	30.250	8.000 to 66.000
2004	5	3.600	2.8810	1.2884	0.023 to 7.177	2.000	3.000	- to -
2005	6	6.583	11.1643	4.5578	-5.133 to 18.300	1.500	2.000	0.500 to 29.000
2006	8	1.750	1.0351	0.3660	0.885 to 2.615	1.500	1.000	1.000 to 4.000

Figure 35. 100th Street Total Volatile Suspended Solids Box Plot (2000-2006)



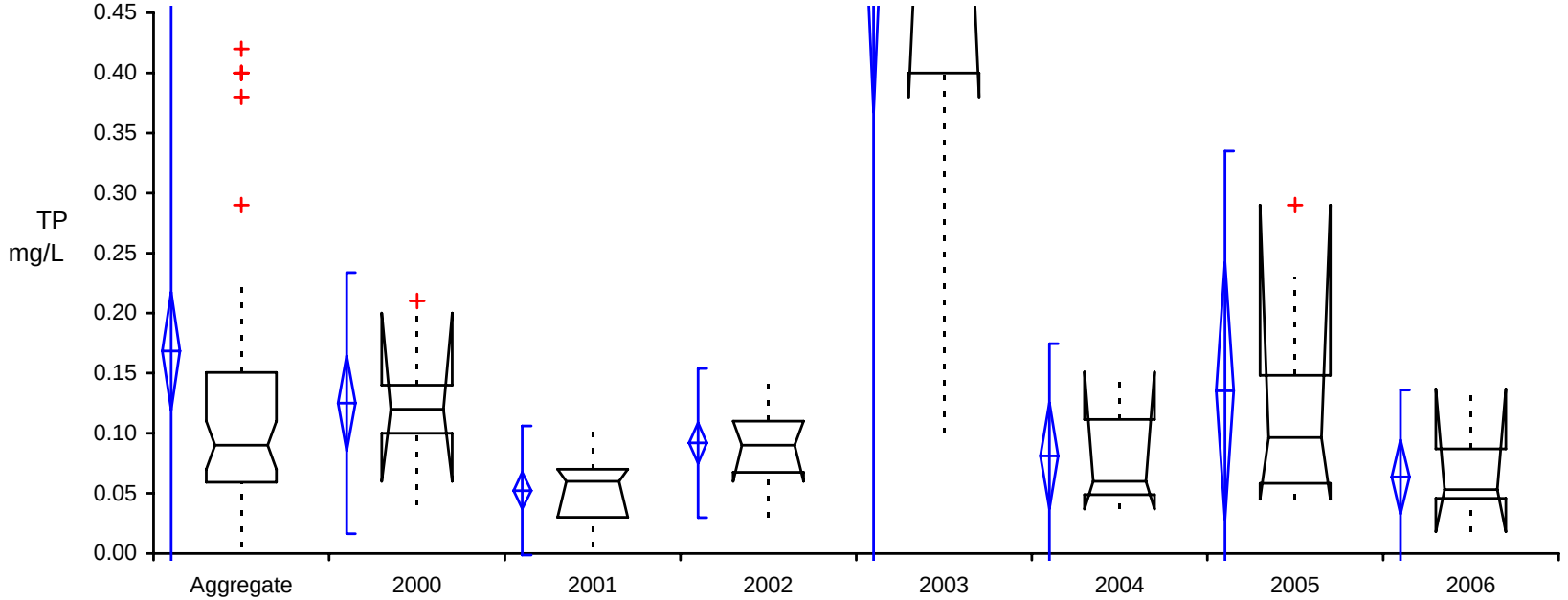
100th St - VSS	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	74	10.993	22.3049	2.5929	5.826 to 16.161	4.000	5.250	2.000 to 6.000
2000	12	5.417	3.3155	0.9571	3.310 to 7.523	5.000	5.750	2.000 to 9.000
2001	14	2.571	1.2839	0.3431	1.830 to 3.313	2.000	0.000	2.000 to 3.000
2002	15	5.467	3.6423	0.9404	3.450 to 7.484	5.000	4.000	2.000 to 7.000
2003	14	39.929	39.9104	10.6665	16.885 to 62.972	29.000	30.250	8.000 to 66.000
2004	5	3.600	2.8810	1.2884	0.023 to 7.177	2.000	3.000	- to -
2005	6	6.583	11.1643	4.5578	-5.133 to 18.300	1.500	2.000	0.500 to 29.000
2006	8	1.750	1.0351	0.3660	0.885 to 2.615	1.500	1.000	1.000 to 4.000

Figure 36. 100th Street Total Volatile Suspended Solids Box Plot (2000-2006) without Outliers



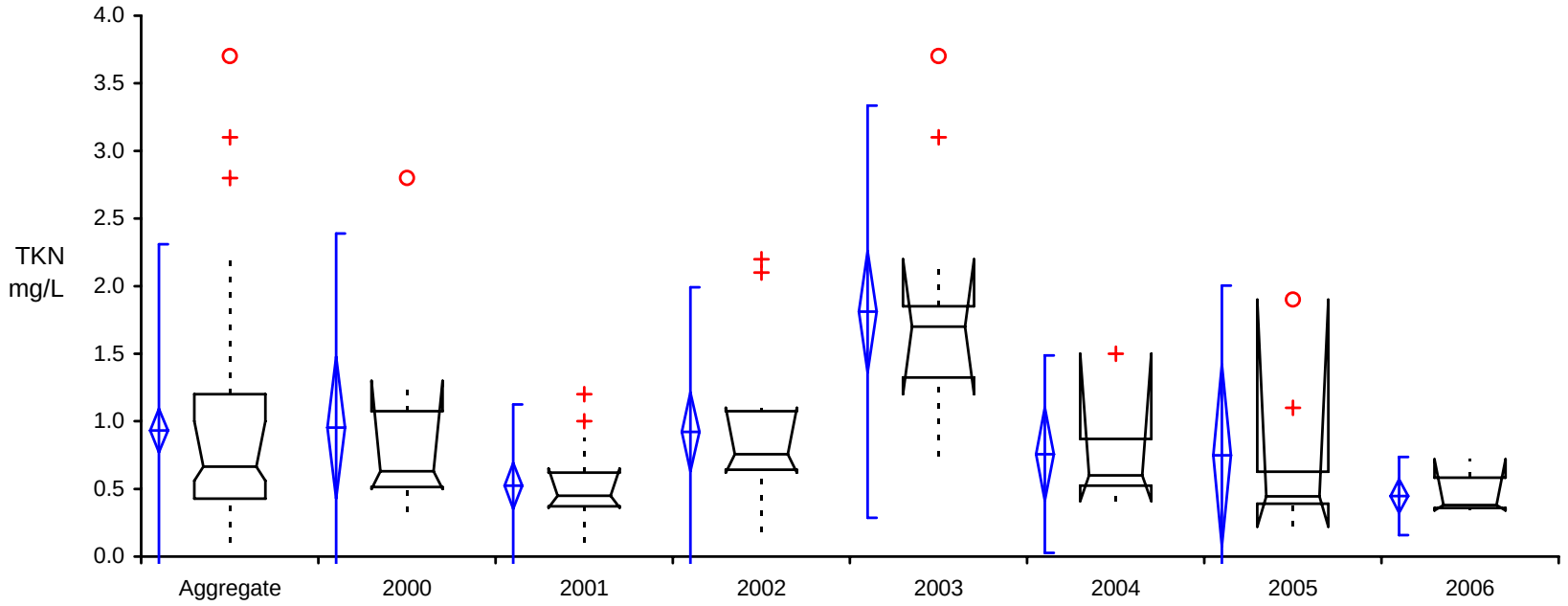
100th St - TP	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	76	0.168	0.2140	0.0245	0.120 to 0.217	0.090	0.092	0.070 to 0.110
2000	10	0.125	0.0554	0.0175	0.085 to 0.165	0.120	0.040	0.060 to 0.200
2001	15	0.052	0.0274	0.0071	0.037 to 0.068	0.060	0.040	0.030 to 0.070
2002	16	0.092	0.0317	0.0079	0.075 to 0.109	0.090	0.043	0.060 to 0.110
2003	14	0.529	0.2802	0.0749	0.368 to 0.691	0.540	0.210	0.380 to 0.640
2004	7	0.081	0.0476	0.0180	0.037 to 0.125	0.060	0.063	0.037 to 0.151
2005	6	0.135	0.1019	0.0416	0.028 to 0.242	0.097	0.090	0.045 to 0.290
2006	8	0.064	0.0369	0.0131	0.033 to 0.094	0.053	0.041	0.018 to 0.137

Figure 37. 100th Street Total Phosphorus Box Plot (2000-2006)



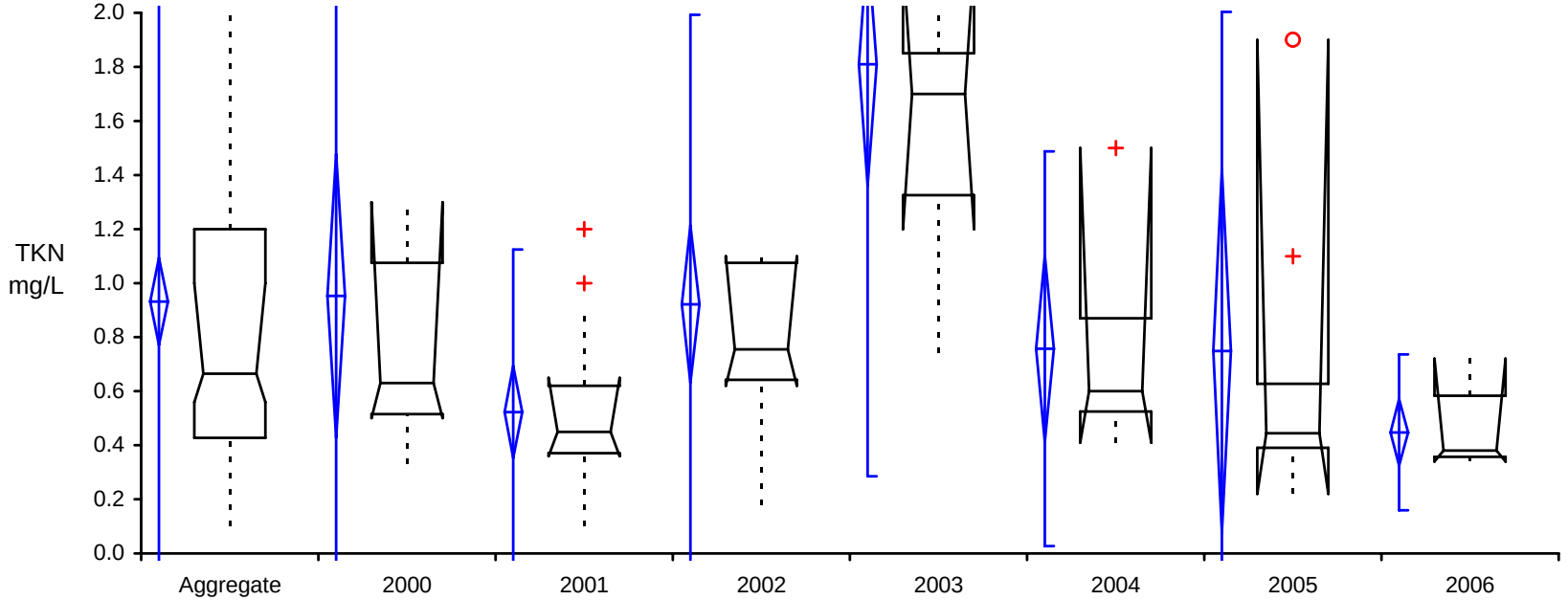
100th St - TP	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	76	0.168	0.2140	0.0245	0.120 to 0.217	0.090	0.092	0.070 to 0.110
2000	10	0.125	0.0554	0.0175	0.085 to 0.165	0.120	0.040	0.060 to 0.200
2001	15	0.052	0.0274	0.0071	0.037 to 0.068	0.060	0.040	0.030 to 0.070
2002	16	0.092	0.0317	0.0079	0.075 to 0.109	0.090	0.043	0.060 to 0.110
2003	14	0.529	0.2802	0.0749	0.368 to 0.691	0.540	0.210	0.380 to 0.640
2004	7	0.081	0.0476	0.0180	0.037 to 0.125	0.060	0.063	0.037 to 0.151
2005	6	0.135	0.1019	0.0416	0.028 to 0.242	0.097	0.090	0.045 to 0.290
2006	8	0.064	0.0369	0.0131	0.033 to 0.094	0.053	0.041	0.018 to 0.137

Figure 38. 100th Street Total Phosphorus Box Plot (2000-2006) without Outliers



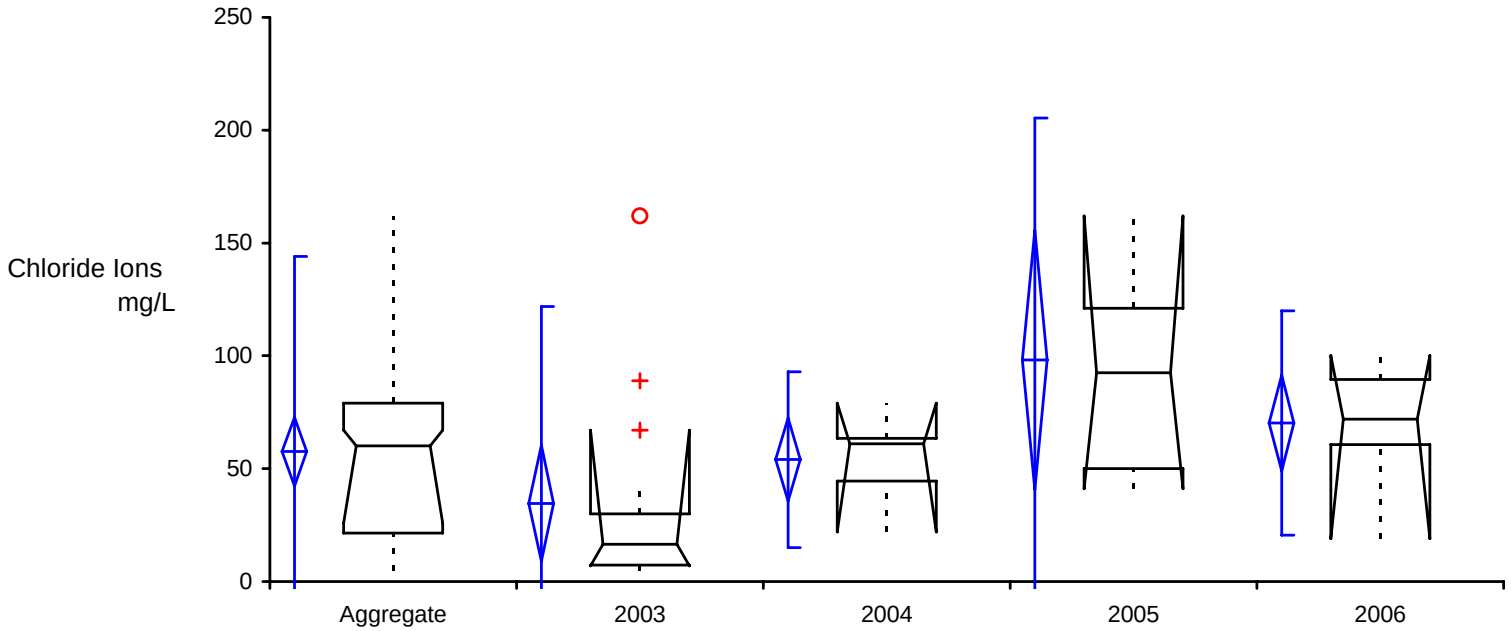
100th St - TKN	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	76	0.932	0.7035	0.0807	0.771 to 1.093	0.665	0.773	0.560 to 1.000
2000	10	0.953	0.7327	0.2317	0.429 to 1.477	0.630	0.560	0.500 to 1.300
2001	15	0.523	0.3066	0.0792	0.353 to 0.692	0.450	0.250	0.360 to 0.650
2002	16	0.922	0.5461	0.1365	0.631 to 1.213	0.755	0.433	0.620 to 1.100
2003	14	1.810	0.7777	0.2078	1.361 to 2.259	1.700	0.525	1.200 to 2.200
2004	7	0.757	0.3725	0.1408	0.413 to 1.102	0.600	0.345	0.410 to 1.500
2005	6	0.748	0.6403	0.2614	0.076 to 1.420	0.445	0.238	0.220 to 1.900
2006	8	0.448	0.1470	0.0520	0.325 to 0.570	0.380	0.225	0.340 to 0.720

Figure 39. 100th Street Total Kjedahl Nitrogen Box Plot (2000-2006)



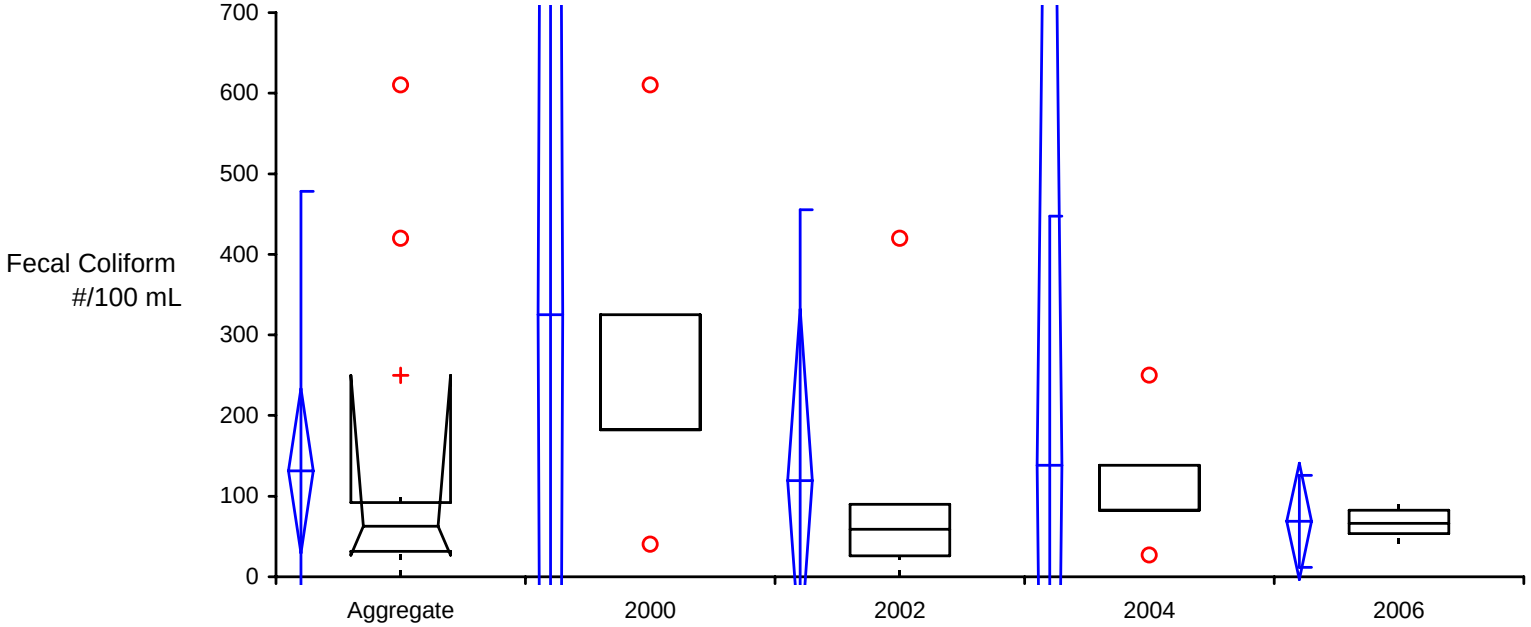
100th St - TKN	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	76	0.932	0.7035	0.0807	0.771 to 1.093	0.665	0.773	0.560 to 1.000
2000	10	0.953	0.7327	0.2317	0.429 to 1.477	0.630	0.560	0.500 to 1.300
2001	15	0.523	0.3066	0.0792	0.353 to 0.692	0.450	0.250	0.360 to 0.650
2002	16	0.922	0.5461	0.1365	0.631 to 1.213	0.755	0.433	0.620 to 1.100
2003	14	1.810	0.7777	0.2078	1.361 to 2.259	1.700	0.525	1.200 to 2.200
2004	7	0.757	0.3725	0.1408	0.413 to 1.102	0.600	0.345	0.410 to 1.500
2005	6	0.748	0.6403	0.2614	0.076 to 1.420	0.445	0.238	0.220 to 1.900
2006	8	0.448	0.1470	0.0520	0.325 to 0.570	0.380	0.225	0.340 to 0.720

Figure 40. 100th Street Total Kjedahl Nitrogen Box Plot (2000-2006) without Outliers



100th St - Chloride	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	35	57.543	44.1237	7.4583	42.386 to 72.700	60.000	57.500	26.000 to 67.000
2003	14	34.643	44.4671	11.8843	8.968 to 60.317	16.500	22.750	7.000 to 67.000
2004	7	54.000	19.8997	7.5214	35.596 to 72.404	61.000	19.000	22.000 to 79.000
2005	6	98.167	54.7336	22.3449	40.727 to 155.606	92.500	71.000	41.000 to 162.000
2006	8	70.250	25.3870	8.9757	49.026 to 91.474	72.000	28.750	19.000 to 100.000

Figure 41. 100th Street Total Chloride Ions Box Plot (2003-2006)



100th St - Fecal Coliform	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	14	131.500	176.9536	47.2928	29.330 to 233.670	62.500	60.500	27.000 to 250.000
2000	2	325.000	403.0509	285.0000	-3296.267 to 3946.267	325.000	0.000	- to -
2002	5	119.200	171.4751	76.6860	-93.714 to 332.114	59.000	64.000	- to -
2004	2	138.500	157.6848	111.5000	-1278.241 to 1555.241	138.500	0.000	- to -
2006	3	68.667	29.0918	16.7962	-3.601 to 140.935	66.000	29.000	- to -

Figure 42. 100th Street Fecal Coliform Box Plot (2004-2006)

*not enough samples were taken in 2001, 2003, and 2005 to perform statistical summaries on the data.

***E. Coli bacteria was sampled for the 2006 monitoring season, prior it was total fecal coliform**

Newport

2006 was the first year where water quality and flow were monitored at a stormwater site in Newport. The hydrograph for the Newport site shows flow from May 18-October 26, 2006 (Figure 43). Total discharge during this period was 714,750 cf or 16.4 acre-ft. The peak discharge of 2.85 cfs occurred on August 2, 2006. No precipitation data was collected at this site.

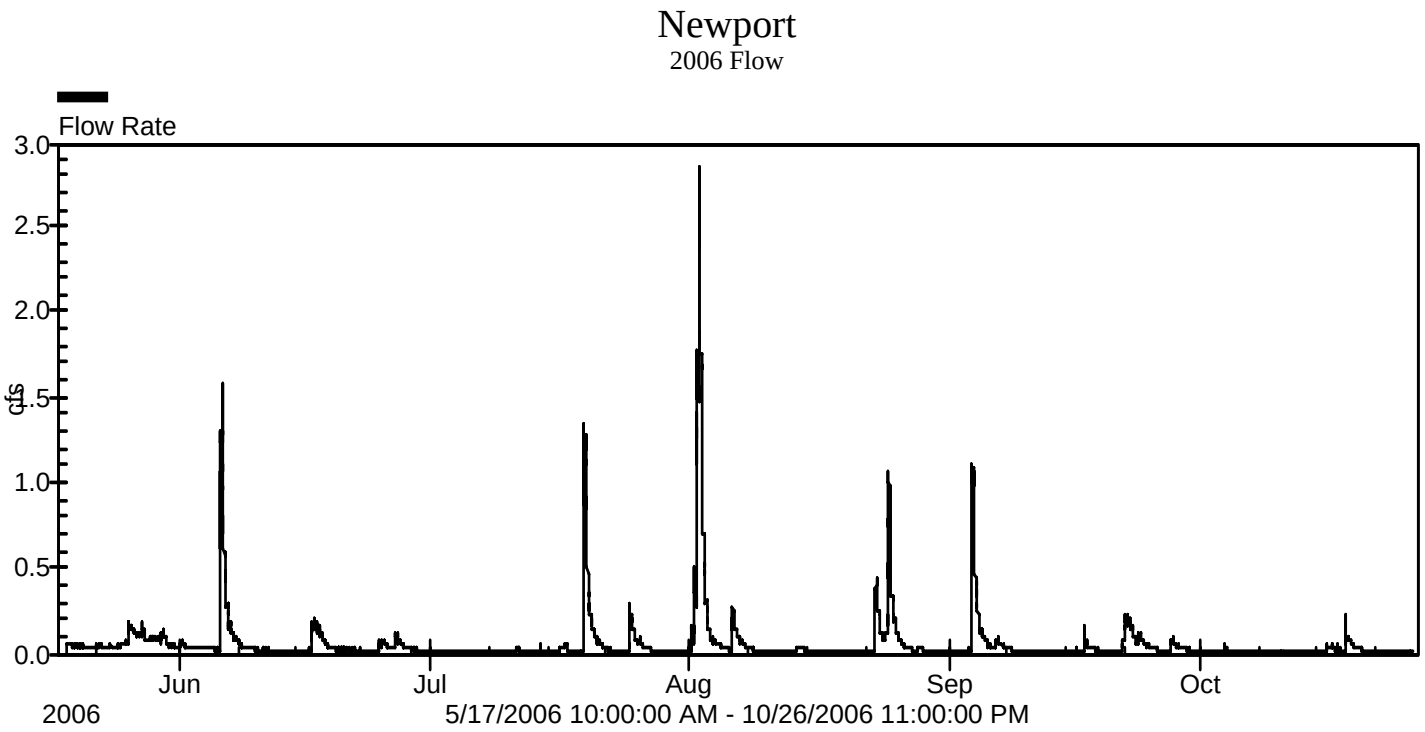


Figure 43. Newport 2006 Continuous Flow

Flow weighted composite samples were taken at the Newport site to determine water quality. Samples were taken during storm runoff, as well as during base flow conditions. The TSS, TKN, TP, TDP, VSS, COD, and E. coliform concentrations from all collected samples are listed in Table 20. The highest TSS concentrations were collected in a storm composite on July 19, 2006. This storm also produced the highest concentrations of TP and TKN. Metals and other Nitrogen species chemical results are listed in Table 21.

Table 20. Newport 2006 Chemical Results

Sample Type	Start Date	End Date	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	E. Coliform (#/100 mL)	COD (mg/L)	TDP (mg/L)
Storm Composite	6/6/06 0:12	6/6/06 15:12	30	12	1.7	0.207		32	~0.021
E. Coli Grab	6/14/06 9:45	6/14/06 9:45					56		
Storm Composite	7/19/06 10:30	7/19/06 21:15	276	74	2.4	0.313		60	~0.020
Storm Composite	8/1/06 11:42	8/2/06 8:28	31	~15	2.0	0.226		34	0.057
E. Coli Grab	8/10/06 9:00	8/10/06 9:00					16		
Storm Composite	8/23/06 4:57	8/24/06 7:28	51	29	3.4	0.234		65	~0.010
Storm Composite	9/3/06 15:27	9/4/06 10:57	36	20	2.5	0.270		53	~0.017
Base Composite	10/21/06 12:45	10/25/06 10:45	9	9	1.0	0.164		59	
Average			**72**	**29**	**2.2**	**0.236**	**36**	**51**	**0.025**

Table 21. Newport 2006 Sample Metals and Nitrogen Species Chemical Results

Sample Type	Start Date	End Date	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Chloride (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Ammonia Nitrogen (mg/L)
Storm Composite	6/6/06 0:12	6/6/06 15:12	0.0074	0.0027	0.0017	0.0290	0.00070	0.0012	70	<0.03	0.20	0.18
E. Coli Grab	6/14/06 9:45	6/14/06 9:45										
Storm Composite	7/19/06 10:30	7/19/06 21:15	0.0095	0.0041	0.0039	0.0420	0.00140	0.0022	58	0.03	0.65	~0.05
Storm Composite	8/1/06 11:42	8/2/06 8:28	0.0119	0.0019	0.0021	0.0161	0.00160	0.0011	39	0.13	0.26	0.41
E. Coli Grab	8/10/06 9:00	8/10/06 9:00										
Storm Composite	8/23/06 4:57	8/24/06 7:28	0.0068	0.0017	0.0019	0.0186	0.00030	0.0009	23	0.06	0.32	0.41
Storm Composite	9/3/06 15:27	9/4/06 10:57	0.0055	0.0025	0.0015	0.0168	0.00060	0.0011	17	<0.03	0.20	0.13
Base Composite	10/21/06 12:45	10/25/06 10:45	0.0019	0.0017	0.0003	0.0035	<0.00004	0.0007	23	<0.03	0.46	<0.02
Average			**0.0072**	**0.0024**	**0.0019**	**0.0210**	**0.00077**	**0.0012**	**38**	**0.04**	**0.35**	**0.20**

Summaries of rainfall events and the resulting discharges for Newport are shown in Table 22 and Table 23. Average and maximum intensities are provided, as well as maximum stage and flow rates.

Table 22. Newport 2006 Storm Events

Newport	Storm Event									Max Storm Intensity					
Storm #	Start	End	Duration (days)	Hr	Rain Gage Used	Total Rainfall (in)	Average Intensity (in/hr)	Max Intensity (in)	Max Intensity (in/hr)	Start	End	Days	Duration (hr)	Rainfall (in)	Average Intensity (in/hr)
1	5/25/2006 21:00	5/25/2006 22:00	0.04	1.25	MS 1	0.07	0.06	0.03	0.12	5/25/2006 21:15	5/25/2006 21:15	0.00	0.25	0.03	0.12
3	5/29/2006 18:00	5/29/2006 19:30	0.06	1.75	MS 1	0.20	0.11	0.09	0.36	5/29/2006 19:30	5/29/2006 19:30	0.00	0.25	0.09	0.36
4	6/1/2006 5:30	6/1/2006 6:45	0.05	1.50	MS 1	0.07	0.05	0.05	0.20	6/1/2006 5:30	6/1/2006 5:30	0.00	0.25	0.05	0.20
5	6/5/2006 19:30	6/6/2006 0:15	0.20	5.00	MS 1	1.45	0.29	0.51	2.04	6/5/2006 23:15	6/5/2006 23:45	0.02	0.75	1.25	1.67
6	6/16/2006 20:45	6/17/2006 0:30	0.16	4.00	MS 1	0.38	0.10	0.19	0.76	6/16/2006 22:15	6/16/2006 22:30	0.01	0.50	0.22	0.44
7	6/20/2006 10:15	6/20/2006 10:30	0.01	0.50	MS 1	0.02	0.04	0.01	0.04	6/20/2006 10:30	6/20/2006 10:30	0.00	0.25	0.01	0.04
8	6/24/2006 21:30	6/25/2006 7:45	0.43	10.50	MS 1	0.23	0.02	0.06	0.24	6/24/2006 21:45	6/24/2006 21:45	0.00	0.25	0.06	0.24
9	6/26/2006 18:15	6/26/2006 20:15	0.08	2.25	MS 1	0.06	0.03	0.04	0.16	6/26/2006 20:15	6/26/2006 20:15	0.00	0.25	0.04	0.16
10	7/11/2006 9:15	7/11/2006 11:00	0.07	2.00	100th	0.08	0.04	0.03	0.12	7/11/2006 9:45	7/11/2006 9:45	0.00	0.25	0.03	0.12
11	7/14/2006 2:00	7/14/2006 2:45	0.03	1.00	MS 2	0.08	0.08	0.03	0.12	7/14/2006 2:15	7/14/2006 2:30	0.01	0.50	0.06	0.12
12	7/16/2006 8:30	7/16/2006 10:30	0.08	2.25	Powers	0.22	0.10	0.09	0.36	7/16/2006 8:30	7/16/2006 8:45	0.01	0.50	0.11	0.22
13	7/19/2006 10:00	7/19/2006 12:45	0.11	3.00	MS 2	0.73	0.24	0.50	2.00	7/19/2006 10:15	7/19/2006 10:30	0.01	0.50	0.6	1.20
14	7/24/2006 16:15	7/24/2006 18:30	0.09	2.50	MS 1	0.40	0.16	0.26	1.04	7/24/2006 18:00	7/24/2006 18:15	0.01	0.50	0.31	0.62
15	8/1/2006 2:00	8/2/2006 8:00	1.25	30.25	MS 2	3.68	0.12	0.39	1.56	8/1/2006 20:00	8/1/2006 20:15	0.01	0.50	0.63	1.26
16	8/6/2006 1:45	8/6/2006 5:00	0.14	3.50	MS 2	0.30	0.09	0.12	0.48	8/6/2006 2:15	8/6/2006 2:45	0.02	0.75	0.22	0.29
17	8/13/2006 12:30	8/13/2006 15:15	0.11	3.00	MS 2	0.32	0.11	0.16	0.64	8/13/2006 14:30	8/13/2006 14:45	0.01	0.50	0.23	0.46
18	8/17/2006 3:45	8/17/2006 10:30	0.28	7.00	100th	0.14	0.02	0.02	0.08	8/17/2006 7:00	8/17/2006 7:15	0.01	0.50	0.04	0.08
19	8/23/2006 4:15	8/23/2006 6:30	0.09	2.50	MS 1	0.52	0.21	0.16	0.64	8/23/2006 4:15	8/23/2006 4:30	0.01	0.50	0.29	0.58
20	8/24/2006 12:15	8/24/2006 19:30	0.30	7.50	MS 1	1.52	0.20	0.34	1.36	8/24/2006 19:00	8/24/2006 19:15	0.01	0.50	0.48	0.96
21	8/28/2006 9:15	8/28/2006 12:00	0.11	3.00	MS 2	0.06	0.02	0.01	0.04	8/28/2006 9:15	8/28/2006 9:15	0.00	0.25	0.01	0.04
22	9/3/2006 2:00	9/3/2006 6:45	0.20	5.00	MS 2	0.13	0.03	0.03	0.12	9/3/2006 4:30	9/3/2006 4:30	0.00	0.25	0.03	0.12
23	9/3/2006 15:30	9/3/2006 20:45	0.22	5.50	Powers	1.35	0.25	0.42	1.68	9/3/2006 15:45	9/3/2006 16:15	0.02	0.75	0.9	1.20
24	9/16/2006 3:15	9/16/2006 8:15	0.21	5.25	Powers	0.07	0.01	0.01	0.04	9/16/2006 3:15	9/16/2006 3:15	0.00	0.25	0.01	0.04
25	9/17/2006 4:45	9/17/2006 9:00	0.18	4.50	Powers	0.23	0.05	0.20	0.80	9/17/2006 6:15	9/17/2006 6:15	0.00	0.25	0.2	0.80
26	9/21/2006 13:30	9/22/2006 17:45	1.18	28.50	MS 2	0.82	0.03	0.05	0.20	9/21/2006 20:30	9/21/2006 20:30	0.00	0.25	0.05	0.20
27	9/23/2006 16:15	9/23/2006 20:00	0.16	4.00	MS 2	0.16	0.04	0.03	0.12	9/23/2006 16:30	9/23/2006 16:30	0.00	0.25	0.03	0.12
28	9/27/2006 10:00	9/27/2006 13:00	0.12	3.25	100th	0.11	0.03	0.04	0.16	9/27/2006 12:00	9/27/2006 12:30	0.02	0.75	0.08	0.11
29	9/29/2006 17:30	9/29/2006 17:30	0.00	0.25	Powers	0.01	0.04	0.01	0.04	9/29/2006 17:30	9/29/2006 17:30	0.00	0.25	0.01	0.04
30	10/3/2006 22:30	10/3/2006 23:00	0.02	0.75	MS 2	0.07	0.09	0.04	0.16	10/3/2006 23:00	10/3/2006 23:00	0.00	0.25	0.04	0.16
31	10/11/2006 3:30	10/11/2006 7:30	0.17	4.25	Powers	0.15	0.04	0.03	0.12	10/11/2006 5:45	10/11/2006 5:45	0.00	0.25	0.03	0.12
32	10/16/2006 5:45	10/16/2006 13:00	0.30	7.50	MS 2	0.27	0.04	0.08	0.32	10/16/2006 6:00	10/16/2006 6:15	0.01	0.50	0.13	0.26
33	10/18/2006 12:15	10/18/2006 14:30	0.09	2.50	MS 2	0.03	0.01	0.01	0.04	10/18/2006 12:15	10/18/2006 12:15	0.00	0.25	0.01	0.04

Table 23. Newport 2006 Storm Discharge Events

Newport			Hydrograph			Flow Rate (cfs)				Stage (ft)			
Storm #	Rainfall Total (in)	Rain Gage	Start	End	Total Discharge (cf)	Max	Time	Start	End	Max	Time	Start	End
1	0.07	MS 1	5/25/2006 20:00	5/26/2006 19:00	11,790	0.187	5/25/2006 21:00	0.053	0.107	0.518	5/25/2006 21:00	0.201	0.253
3	0.20	MS 1	5/29/2006 10:00	5/30/2006 13:00	9,774	0.132	5/30/2006 0:30	0.080	0.069	0.380	5/29/2006 18:45	0.195	0.222
4	0.07	MS 1	6/1/2006 5:00	6/1/2006 17:00	2,424	0.076	6/1/2006 10:15	0.042	0.037	0.225	6/1/2006 5:30	0.197	0.197
5	1.45	MS 1	6/5/2006 23:00	6/7/2006 10:00	55,784	1.588	6/6/2006 2:00	0.029	0.124	1.774	6/5/2006 23:45	0.161	0.297
6	0.38	MS 1	6/16/2006 20:00	6/18/2006 11:00	16,912	0.212	6/17/2006 1:30	0.019	0.063	0.663	6/16/2006 22:00	0.148	0.230
7	0.02	MS 1	6/20/2006 9:00	6/20/2006 15:00	573	0.031	6/20/2006 13:45	0.020	0.023	0.180	6/20/2006 10:30	0.161	0.167
8	0.23	MS 1	6/24/2006 17:00	6/26/2006 20:00	7,929	0.085	6/25/2006 14:00	0.010	0.028	0.299	6/25/2006 7:45	0.138	0.180
9	0.06	MS 1	6/26/2006 20:00	6/27/2006 10:00	4,048	0.118	6/26/2006 22:30	0.028	0.060	0.310	6/26/2006 20:15	0.180	0.228
10	0.08	100th	7/11/2006 10:00	7/12/2006 8:00	1,338	0.035	7/11/2006 10:45	0.001	0.013	0.310	7/11/2006 10:45	0.070	0.148
11	0.08	MS 2	7/14/2006 2:00	7/14/2006 13:00	498	0.046	7/14/2006 2:15	0.004	0.007	0.302	7/14/2006 2:15	0.107	0.136
12	0.22	Powers	7/16/2006 8:00	7/17/2006 11:00	3,443	0.057	7/17/2006 1:45	0.001	0.013	0.430	7/16/2006 8:45	0.093	0.161
13	0.73	MS 2	7/19/2006 10:00	7/20/2006 5:00	40,872	1.343	7/19/2006 10:15	0.028	0.223	1.747	7/19/2006 10:15	0.281	0.386
14	0.40	MS 1	7/24/2006 16:00	7/26/2006 6:00	17,447	0.294	7/24/2006 19:15	0.003	0.061	0.688	7/24/2006 18:00	0.112	0.230
15	3.68	MS 2	8/1/2006 2:00	8/2/2006 22:00	141,883	2.847	8/2/2006 2:00	0.002	0.331	1.332	8/1/2006 20:00	0.100	0.460
16	0.30	MS 2	8/6/2006 1:00	8/7/2006 6:00	13,614	0.270	8/6/2006 3:45	0.014	0.060	0.770	8/6/2006 2:15	0.160	0.237
17	0.32	MS 2	8/13/2006 14:00	8/14/2006 12:00	2,589	0.042	8/13/2006 17:45	0.002	0.026	0.427	8/13/2006 14:30	0.080	0.185
18	0.14	100th	8/17/2006 4:00	8/17/2006 15:00	364	0.013	8/17/2006 12:45	0.004	0.008	0.173	8/17/2006 7:00	0.127	0.138
19	0.52	MS 1	8/23/2006 4:00	8/24/2006 12:00	20,988	0.439	8/23/2006 7:30	0.001	0.104	0.922	8/23/2006 4:30	0.077	0.325
20	1.52	MS 1	8/24/2006 12:00	8/25/2006 16:00	36,543	1.061	8/24/2006 20:15	0.104	0.167	0.987	8/24/2006 19:00	0.325	0.327
21	0.06	MS 2	8/28/2006 9:00	8/28/2006 20:00	999	0.033	8/28/2006 10:00	0.015	0.021	0.192	8/28/2006 10:00	0.155	0.160
22	0.13	MS 2	9/3/2006 1:00	9/3/2006 15:00	641	0.023	9/3/2006 6:30	0.001	0.009	0.243	9/3/2006 1:15	0.093	0.155
23	1.35	Powers	9/3/2006 15:00	9/5/2006 5:00	56,951	1.106	9/3/2006 18:00	0.009	0.090	1.013	9/3/2006 15:30	0.155	0.278
24	0.07	Powers	9/16/2006 3:00	9/16/2006 13:00	493	0.028	9/16/2006 4:30	0.004	0.010	0.178	9/16/2006 5:00	0.090	0.142
25	0.23	Powers	9/17/2006 5:00	9/17/2006 15:00	1,914	0.160	9/17/2006 6:00	0.013	0.043	0.722	9/17/2006 6:00	0.142	0.210
26	0.82	MS 2	9/21/2006 15:00	9/23/2006 6:00	19,471	0.230	9/22/2006 11:45	0.004	0.089	0.365	9/22/2006 0:00	0.107	0.252
27	0.16	MS 2	9/23/2006 16:00	9/24/2006 6:00	5,075	0.127	9/24/2006 0:00	0.056	0.074	0.342	9/23/2006 17:30	0.220	0.240
28	0.11	100th	9/27/2006 13:00	9/27/2006 23:00	2,582	0.090	9/27/2006 16:45	0.012	0.056	0.330	9/27/2006 13:45	0.138	0.222
29	0.01	Powers	9/29/2006 18:00	9/29/2006 22:00	339	0.028	9/29/2006 21:15	0.019	0.018	0.160	9/29/2006 18:15	0.154	0.154
30	0.07	MS 2	10/3/2006 22:00	10/4/2006 6:00	731	0.059	10/3/2006 22:30	0.004	0.016	0.371	10/3/2006 22:30	0.105	0.154
31	0.15	Powers	10/11/2006 5:00	10/11/2006 17:00	279	0.008	10/11/2006 11:30	0.001	0.006	0.180	10/11/2006 5:45	0.127	0.133
32	0.27	MS 2	10/16/2006 5:00	10/17/2006 4:00	2,756	0.055	10/16/2006 5:45	0.002	0.021	0.332	10/16/2006 5:45	0.108	0.182
33	0.03	MS 2	10/18/2006 8:00	10/19/2006 7:00	5,381	0.225	10/18/2006 11:15	0.016	0.042	0.547	10/18/2006 11:15	0.154	0.215

Saint Paul Park

2006 was the first year where water quality and flow were monitored at a stormwater site in Saint Paul Park. The hydrograph for the Saint Paul Park site shows flow from May 15-October 26, 2006 (Figure 45). Total discharge during this period was 441,934 cf or 10.1 acre-ft. Peak discharge was 8.18 cfs, which occurred on August 1, 2006. Precipitation was not collect at this site for 2006.

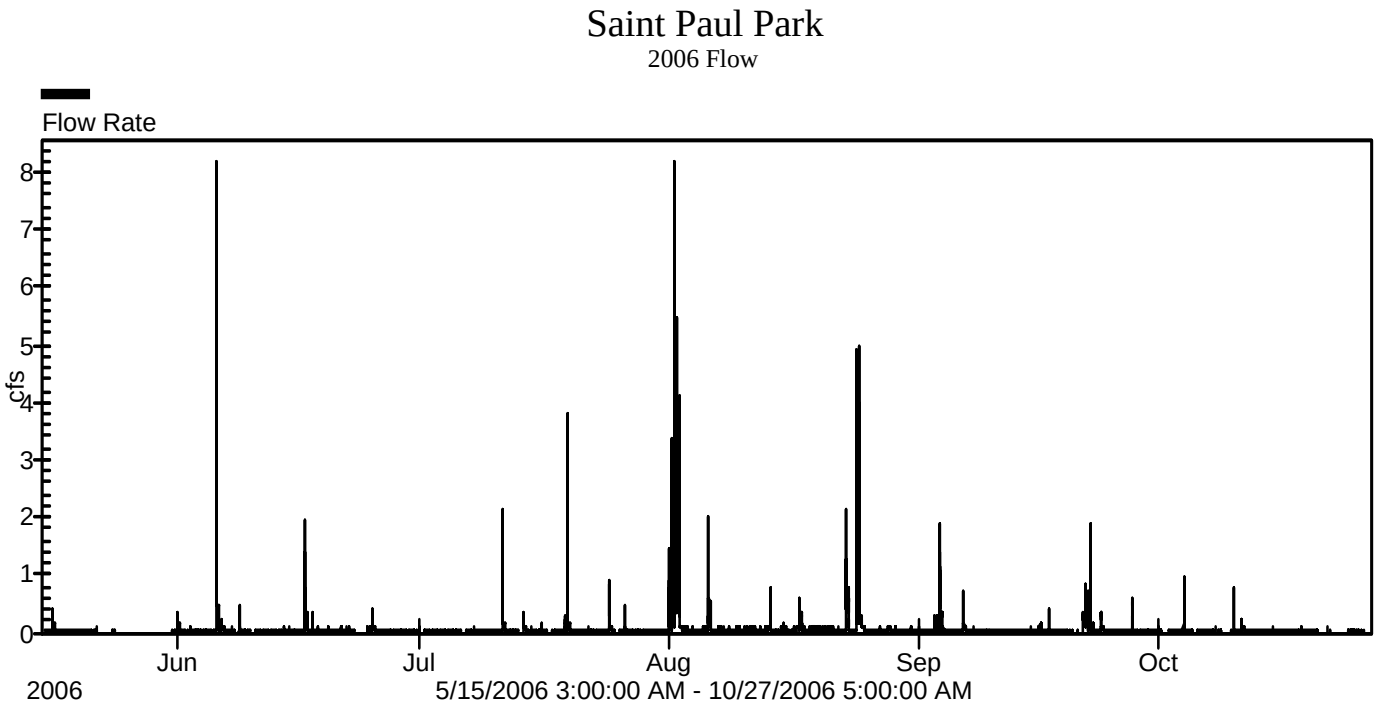


Figure 45. Saint Paul Park 2006 Continuous Flow

Flow weighted composite samples were taken at the Saint Paul Park site to determine water quality. Samples were taken during storm runoff. The TSS, TKN, TP, VSS, COD, and TDP results from all collected samples are listed in Table 24. E. coli bacteria samples were attempted through out the monitoring season, but were unable to produce enough liquid to analyze the samples. The highest concentrations for TSS, TP, and TKN all were collected from the July 24, 2006 storm composite. Metals and other Nitrogen species chemical results are listed in Table 25.

Table 24. Saint Paul Park 2006 Sample Chemistry Results

Sample Type	Start Date	End Date	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	E. Coliform (#/100 mL)	COD (mg/L)	TDP (mg/L)
Storm Composite	6/5/06 23:50	6/5/06 23:50	**NA**	**NA**	1.3	0.272		40	
Storm Composite	6/16/06 21:34	6/16/06 23:33	**NA**	**NA**	1.5	0.150		55	0.070
Storm Composite	7/11/06 10:45	7/11/06 11:40	86	21	1.6	0.249		53	0.067
Storm Composite	7/19/06 9:24	7/19/06 11:04	159	36	2.1	0.232		56	~0.039
Storm Composite	7/24/06 17:24	7/24/06 17:29	184	75	2.9	0.440			
Storm Composite	8/1/06 2:04	8/1/06 19:29	98	~28	1.0	0.168		50	~0.039
Storm Composite	8/23/06 4:25	8/23/06 6:35	77	19	2.0	0.298		47	0.112
Storm Composite	8/24/06 11:50	8/24/06 19:22	94	29	1.8	0.246		55	0.061
Storm Composite	9/3/06 14:49	9/3/06 19:54	27	8	0.6	0.106		16	~0.040
Average			**104**	**31**	**1.6**	**0.240**		**47**	**0.061**

Table 25. Saint Paul Park 2006 Sample Metals and Nitrogen Species Chemical Results

Sample Type	Start Date	End Date	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Chloride (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Ammonia Nitrogen (mg/L)
Storm Composite	6/5/06 23:50	6/5/06 23:50								0.04	0.43	0.27
Storm Composite	6/16/06 21:34	6/16/06 23:33	0.0176	0.0035	0.0033	0.0460	0.0003	0.0022	3	0.03	0.48	0.44
Storm Composite	7/11/06 10:45	7/11/06 11:40	0.0159	0.0036	0.0061	0.0440	0.0004	0.0030	5	0.07	0.64	0.49
Storm Composite	7/19/06 9:24	7/19/06 11:04	0.0195	0.0043	0.0101	0.0490	0.0003	0.0054	6	0.07	0.66	0.29
Storm Composite	7/24/06 17:24	7/24/06 17:29										
Storm Composite	8/1/06 2:04	8/1/06 19:29	0.0113	0.0030	0.0064	0.0113	0.0005	0.0029	4	0.15	0.69	0.10
Storm Composite	8/23/06 4:25	8/23/06 6:35	0.0119	0.0031	0.0074	0.0430	0.0002	0.0025	4	0.19	0.81	0.66
Storm Composite	8/24/06 11:50	8/24/06 19:22	0.0107	0.0036	0.0072	0.0400	0.0014	0.0039	3	0.10	0.56	0.36
Storm Composite	9/3/06 14:49	9/3/06 19:54	0.0068	0.0016	0.0031	0.0222	0.0002	0.0018	3	0.04	0.45	~0.04
Average			**0.0134**	**0.0032**	**0.0062**	**0.0365**	**0.0005**	**0.0031**	**4**	**0.09**	**0.59**	**0.33**

Summaries of rainfall events and the resulting discharges for Saint Paul Park are shown in Table 26 and Table 27. Average and maximum intensities are provided, as well as maximum stage and flow rates.

Table 26. Saint Paul Park 2006 Storm Events

St. Paul Park	Storm Event									Max Storm Intensity					
Storm #	Start	End	Duration (days)	Hr	Rain Gage Used	Total Rainfall (in)	Average Intensity (in/hr)	Max Intensity (in)	Max Intensity (in/hr)	Start	End	Days	Duration (hr)	Rainfall (in)	Average Intensity (in/hr)
1	5/15/2006 16:00	5/15/2006 18:00	0.08	2.25	MS 1	0.04	0.02	0.01	0.04	5/15/2006 16:00	5/15/2006 16:00	0.00	0.25	0.01	0.04
2	5/16/2006 16:00	5/16/2006 17:00	0.04	1.25	MS 1	0.20	0.16	0.10	0.40	5/16/2006 16:00	5/16/2006 16:15	0.01	0.50	0.18	0.36
3	6/1/2006 5:30	6/1/2006 6:45	0.05	1.50	MS 1	0.07	0.05	0.05	0.20	6/1/2006 5:30	6/1/2006 5:30	0.00	0.25	0.05	0.20
4	6/5/2006 19:30	6/6/2006 0:15	0.20	5.00	MS 1	1.45	0.29	0.51	2.04	6/5/2006 23:15	6/5/2006 23:45	0.02	0.75	1.25	1.67
5	6/16/2006 20:45	6/17/2006 0:30	0.16	4.00	MS 1	0.38	0.10	0.19	0.76	6/16/2006 22:15	6/16/2006 22:30	0.01	0.50	0.22	0.44
6	6/17/2006 18:30	6/17/2006 18:45	0.01	0.50	MS 1	0.03	0.06	0.02	0.08	6/17/2006 18:30	6/17/2006 18:30	0.00	0.25	0.02	0.08
7	6/24/2006 17:15	6/25/2006 7:45	0.60	14.75	MS 1	0.31	0.02	0.06	0.24	6/24/2006 21:45	6/24/2006 22:00	0.01	0.50	0.08	0.16
8	7/11/2006 9:15	7/11/2006 11:00	0.07	2.00	100th	0.08	0.04	0.03	0.12	7/11/2006 9:45	7/11/2006 9:45	0.00	0.25	0.03	0.12
9	7/14/2006 0:45	7/14/2006 2:00	0.05	1.50	100th	0.09	0.06	0.05	0.20	7/14/2006 1:00	7/14/2006 1:15	0.01	0.50	0.07	0.14
10	7/16/2006 7:45	7/16/2006 9:45	0.08	2.25	MS 1	0.24	0.11	0.10	0.40	7/16/2006 8:15	7/16/2006 8:15	0.00	0.25	0.1	0.40
11	7/19/2006 8:45	7/19/2006 11:30	0.11	3.00	100th	1.21	0.40	0.47	1.88	7/19/2006 9:00	7/19/2006 9:45	0.03	1.00	1.15	1.15
12	7/24/2006 16:15	7/24/2006 18:30	0.09	2.50	MS 1	0.40	0.16	0.26	1.04	7/24/2006 18:00	7/24/2006 18:15	0.01	0.50	0.31	0.62
13	8/1/2006 11:45	8/2/2006 8:00	0.84	20.50	MS 2	3.27	0.16	0.39	1.56	8/1/2006 20:00	8/1/2006 20:15	0.01	0.50	0.63	1.26
14	8/6/2006 1:45	8/6/2006 5:00	0.14	3.50	MS 2	0.30	0.09	0.12	0.48	8/6/2006 2:15	8/6/2006 2:45	0.02	0.75	0.22	0.29
15	8/13/2006 12:30	8/13/2006 15:15	0.11	3.00	MS 2	0.32	0.11	0.16	0.64	8/6/2006 2:30	8/6/2006 3:00	0.02	0.75	0.23	0.31
16	8/17/2006 3:15	8/17/2006 7:45	0.19	4.75	MS 2	0.08	0.02	0.02	0.08	8/17/2006 7:00	8/17/2006 7:00	0.00	0.25	0.02	0.08
17	8/23/2006 4:15	8/23/2006 6:30	0.09	2.50	MS 2	0.87	0.35	0.43	1.72	8/23/2006 4:30	8/23/2006 4:45	0.01	0.50	0.56	1.12
18	8/24/2006 12:15	8/24/2006 19:30	0.30	7.50	MS 1	1.52	0.20	0.34	1.36	8/24/2006 19:00	8/24/2006 19:15	0.01	0.50	0.48	0.96
19	9/3/2006 2:00	9/3/2006 6:45	0.20	5.00	MS 2	0.13	0.03	0.03	0.12	9/3/2006 4:30	9/3/2006 4:30	0.00	0.25	0.03	0.12
20	9/3/2006 15:15	9/3/2006 22:00	0.28	7.00	MS 1	0.90	0.13	0.19	0.76	9/3/2006 15:45	9/3/2006 16:15	0.02	0.75	0.47	0.63
22	9/16/2006 3:00	9/16/2006 9:00	0.25	6.25	MS 2	0.15	0.02	0.03	0.12	9/16/2006 7:45	9/16/2006 7:45	0.00	0.25	0.03	0.12
23	9/17/2006 5:45	9/17/2006 6:15	0.02	0.75	MS 1	0.06	0.08	0.03	0.12	9/17/2006 6:00	9/17/2006 6:00	0.00	0.25	0.03	0.12
24	9/18/2006 11:00	9/18/2006 18:00	0.29	7.25	MS 1	0.07	0.01	0.02	0.08	9/18/2006 12:45	9/18/2006 12:45	0.00	0.25	0.02	0.08
25	9/21/2006 13:30	9/22/2006 17:45	1.18	28.50	MS 2	0.82	0.03	0.05	0.20	9/21/2006 20:30	9/21/2006 21:00	0.02	0.75	0.1	0.13
26	9/23/2006 16:15	9/23/2006 20:00	0.16	4.00	MS 2	0.16	0.04	0.03	0.12	9/23/2006 16:30	9/23/2006 16:45	0.01	0.50	0.05	0.10
27	9/26/2006 19:15	9/27/2006 2:00	0.28	7.00	MS 1	0.06	0.01	0.01	0.04	9/26/2006 19:15	9/26/2006 19:15	0.00	0.25	0.01	0.04
28	9/27/2006 12:00	9/27/2006 13:00	0.04	1.25	100th	0.10	0.08	0.04	0.16	9/27/2006 12:00	9/27/2006 12:30	0.02	0.75	0.08	0.11
29	9/29/2006 17:45	9/29/2006 19:00	0.05	1.50	MS 2	0.02	0.01	0.01	0.04	9/29/2006 17:45	9/29/2006 17:45	0.00	0.25	0.01	0.04
30	10/3/2006 22:30	10/3/2006 23:00	0.02	0.75	MS 2	0.07	0.09	0.04	0.16	10/3/2006 22:45	10/3/2006 23:00	0.01	0.50	0.06	0.12
32	10/11/2006 3:30	10/11/2006 7:30	0.17	4.25	Powers	0.15	0.04	0.03	0.12	10/11/2006 5:45	10/11/2006 5:45	0.00	0.25	0.03	0.12
33	10/18/2006 11:45	10/18/2006 14:45	0.13	3.25	MS 1	0.03	0.01	0.01	0.04	10/18/2006 11:45	10/18/2006 11:45	0.00	0.25	0.01	0.04

Table 27. Saint Paul Park 2006 Storm Discharge Events

Saint Paul Park			Hydrograph			Flow Rate (cfs)				Stage (ft)			
Storm #	Rainfall Total (in)	Rain Gage	Start	End	Total Discharge (cf)	Max	Time	Start	End	Max	Time	Start	End
1	0.04	MS 1	5/15/2006 15:15	5/15/2006 18:15	124	0.030	5/15/2006 17:00	0.003	0.004	0.129	5/15/2006 16:30	0.038	0.058
2	0.20	MS 1	5/16/2006 15:15	5/16/2006 22:15	2,770	0.391	5/16/2006 16:00	0.003	0.054	0.986	5/16/2006 16:00	0.046	0.081
3	0.07	MS 1	6/1/2006 5:15	6/1/2006 9:15	1,405	0.320	6/1/2006 5:35	0.001	0.026	0.233	6/1/2006 5:25	0.031	0.068
4	1.45	MS 1	6/5/2006 23:15	6/6/2006 1:15	21,881	8.169	6/5/2006 23:55	0.017	0.839	1.828	6/5/2006 23:45	0.078	0.171
5	0.38	MS 1	6/16/2006 21:15	6/17/2006 2:15	7,367	1.950	6/17/2006 0:05	0.054	0.182	1.155	6/16/2006 22:10	0.178	0.125
6	0.03	MS 1	6/17/2006 17:15	6/17/2006 19:15	610	0.348	6/17/2006 18:15	0.028	0.075	0.365	6/17/2006 18:15	0.085	0.116
7	0.31	MS 1	6/24/2006 17:15	6/25/2006 12:15	5,504	0.398	6/25/2006 8:10	0.000	0.056	0.278	6/25/2006 7:45	0.000	0.096
8	0.08	100th	7/11/2006 10:15	7/11/2006 14:15	8,129	2.146	7/11/2006 11:15	0.085	0.191	1.041	7/11/2006 11:15	0.276	0.129
9	0.09	100th	7/14/2006 1:15	7/14/2006 5:15	1,948	0.349	7/14/2006 2:50	0.011	0.080	0.293	7/14/2006 2:15	0.079	0.101
10	0.24	MS 1	7/16/2006 8:15	7/16/2006 11:15	591	0.134	7/16/2006 8:40	0.026	0.028	0.268	7/16/2006 8:40	0.098	0.085
11	1.21	100th	7/19/2006 9:15	7/19/2006 17:15	14,094	3.807	7/19/2006 10:25	0.030	0.144	1.916	7/19/2006 10:25	0.058	0.113
12	0.40	MS 1	7/24/2006 16:15	7/24/2006 20:15	4,201	0.871	7/24/2006 18:00	0.005	0.142	0.473	7/24/2006 18:00	0.050	0.129
13	3.27	MS 2	8/1/2006 2:15	8/2/2006 9:15	74,215	8.178	8/1/2006 21:10	0.119	0.569	1.474	8/1/2006 21:10	0.233	0.158
14	0.30	MS 2	8/6/2006 1:15	8/6/2006 7:15	6,042	2.010	8/6/2006 2:15	0.016	0.096	1.554	8/6/2006 2:15	0.060	0.108
15	0.32	MS 2	8/13/2006 14:15	8/13/2006 20:15	4,417	0.800	8/13/2006 14:25	0.065	0.089	0.724	8/13/2006 14:25	0.129	0.108
16	0.08	MS 2	8/17/2006 6:15	8/17/2006 14:15	7,702	0.559	8/17/2006 10:30	0.049	0.125	0.263	8/17/2006 7:35	0.104	0.141
17	0.87	MS 2	8/23/2006 4:15	8/23/2006 9:15	10,079	2.108	8/23/2006 6:05	0.019	0.195	1.554	8/23/2006 4:25	0.081	0.144
18	1.52	MS 1	8/24/2006 11:15	8/24/2006 20:15	23,042	4.967	8/24/2006 19:05	0.008	0.592	0.943	8/24/2006 19:05	0.054	0.168
19	0.13	MS 2	9/3/2006 0:15	9/3/2006 10:15	5,099	0.266	9/3/2006 6:35	0.015	0.075	0.260	9/3/2006 1:15	0.090	0.131
20	0.90	MS 1	9/3/2006 14:15	9/4/2006 0:15	19,087	1.895	9/3/2006 19:50	0.026	0.111	0.553	9/3/2006 16:35	0.078	0.119
21	0.15	MS 2	9/16/2006 3:15	9/16/2006 12:15	3,540	0.177	9/16/2006 5:45	0.066	0.052	0.205	9/16/2006 4:25	0.170	0.090
22	0.06	MS 1	9/17/2006 5:15	9/17/2006 12:15	2,250	0.379	9/17/2006 6:10	0.009	0.031	0.447	9/17/2006 6:05	0.055	0.073
23	0.07	MS 1	9/18/2006 5:15	9/18/2006 20:15	784	0.037	9/18/2006 16:55	0.012	0.017	0.133	9/18/2006 16:55	0.047	0.070
24	0.82	MS 2	9/21/2006 15:15	9/22/2006 22:15	23,124	1.913	9/22/2006 13:50	0.092	0.044	0.293	9/22/2006 13:50	0.098	0.078
25	0.16	MS 2	9/23/2006 16:15	9/23/2006 21:15	3,150	0.357	9/23/2006 19:05	0.002	0.143	0.183	9/23/2006 19:05	0.018	0.118
26	0.06	MS 1	9/26/2006 23:15	9/27/2006 3:15	343	0.059	9/27/2006 1:00	0.002	0.015	0.131	9/27/2006 1:00	0.020	0.065
27	0.10	100th	9/27/2006 12:15	9/27/2006 17:15	2,840	0.587	9/27/2006 13:50	0.001	0.056	0.356	9/27/2006 13:50	0.018	0.125
28	0.02	MS 2	9/29/2006 18:15	9/29/2006 22:15	130	0.037	9/29/2006 19:10	0.000	0.004	0.108	9/29/2006 19:10	0.001	0.038
29	0.07	MS 2	10/3/2006 22:15	10/4/2006 2:15	3,518	0.973	10/4/2006 0:00	0.000	0.096	0.701	10/3/2006 22:30	0.003	0.091
30	0.15	Powers	10/11/2006 4:15	10/11/2006 11:15	2,823	0.212	10/11/2006 5:00	0.066	0.037	0.190	10/11/2006 5:00	0.076	0.075
31	0.03	MS 1	10/18/2006 11:15	10/18/2006 16:15	1,110	0.123	10/18/2006 12:20	0.000	0.049	0.146	10/18/2006 12:10	0.000	0.088

Flow-only Sites: Fox Run, Tamarack Road, 80th Street, 90th Street, Bailey Lake (at Lift Station), and East Tributary to Cottage Grove Ravine Park Lake

Fox Run

The Fox Run stormwater site recorded stage, velocity, and flow between March 30-October 24, 2006 (Figure 46). The total discharge for this period was 807,953 cf or 19 acre-ft. The highest recorded flow was 3.19 cfs on August 2, 2006. There was no precipitation gage at this site and no chemistry data was collected at this site.

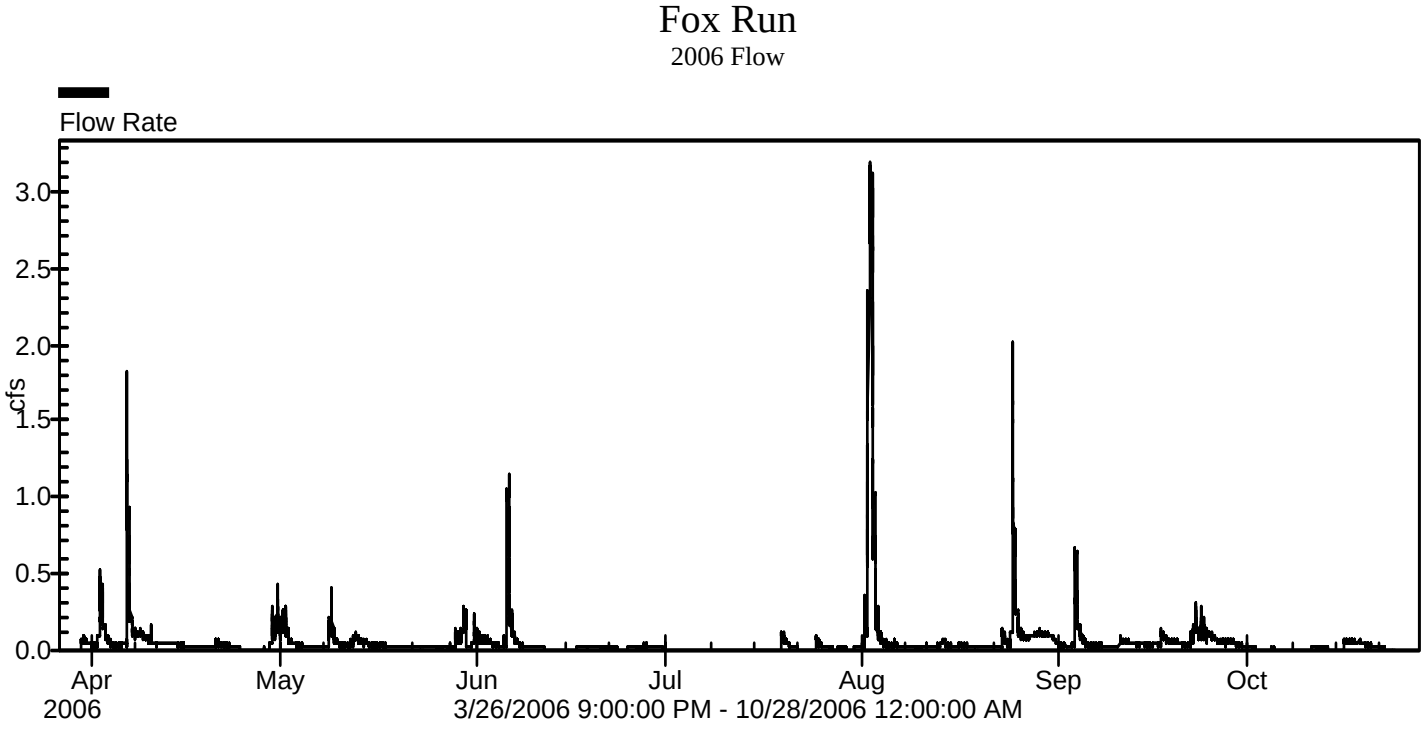


Figure 46. Fox Run 2006 Continuous Flow

Tamarack Road

The Tamarack Road stormwater site recorded stage, velocity, and flow between March 29-October 25, 2006 (Figure 47). The total discharge for this period was 1,504,844 cf or 35 acre-ft. The highest discharge at this site was 54.73 cfs on June 6, 2006. There was no precipitation gage at this site and no chemistry data was collected at this site.

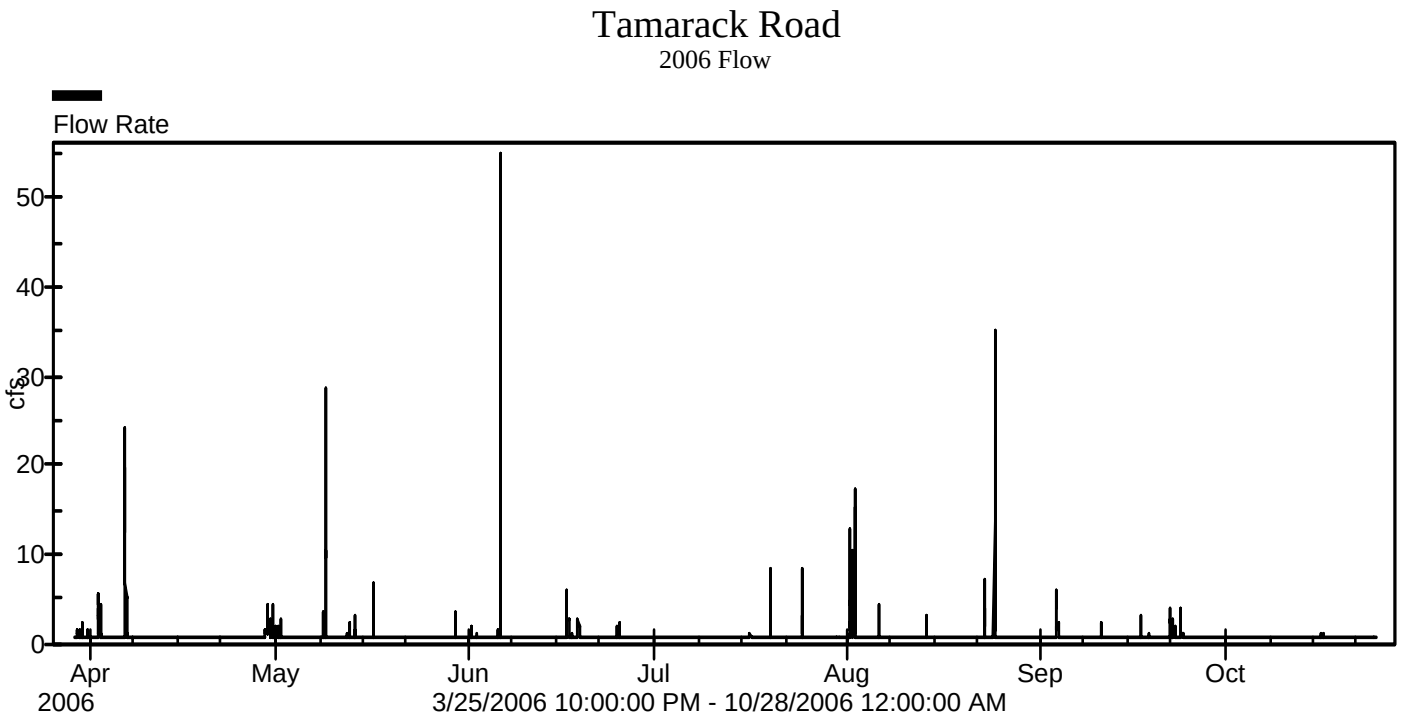


Figure 47. Tamarack Road 2006 Continuous Flow

80th Street

The 80th Street stormwater site recorded stage and flow between March 29-October 24, 2006 (Figure 48). The total discharge for this period was 6,825,830 cf or 157 acre-ft. The high flow at this site—11.69 cfs was on July 19, 2006. There was no precipitation gage at this site and no chemistry data was collected at this site.

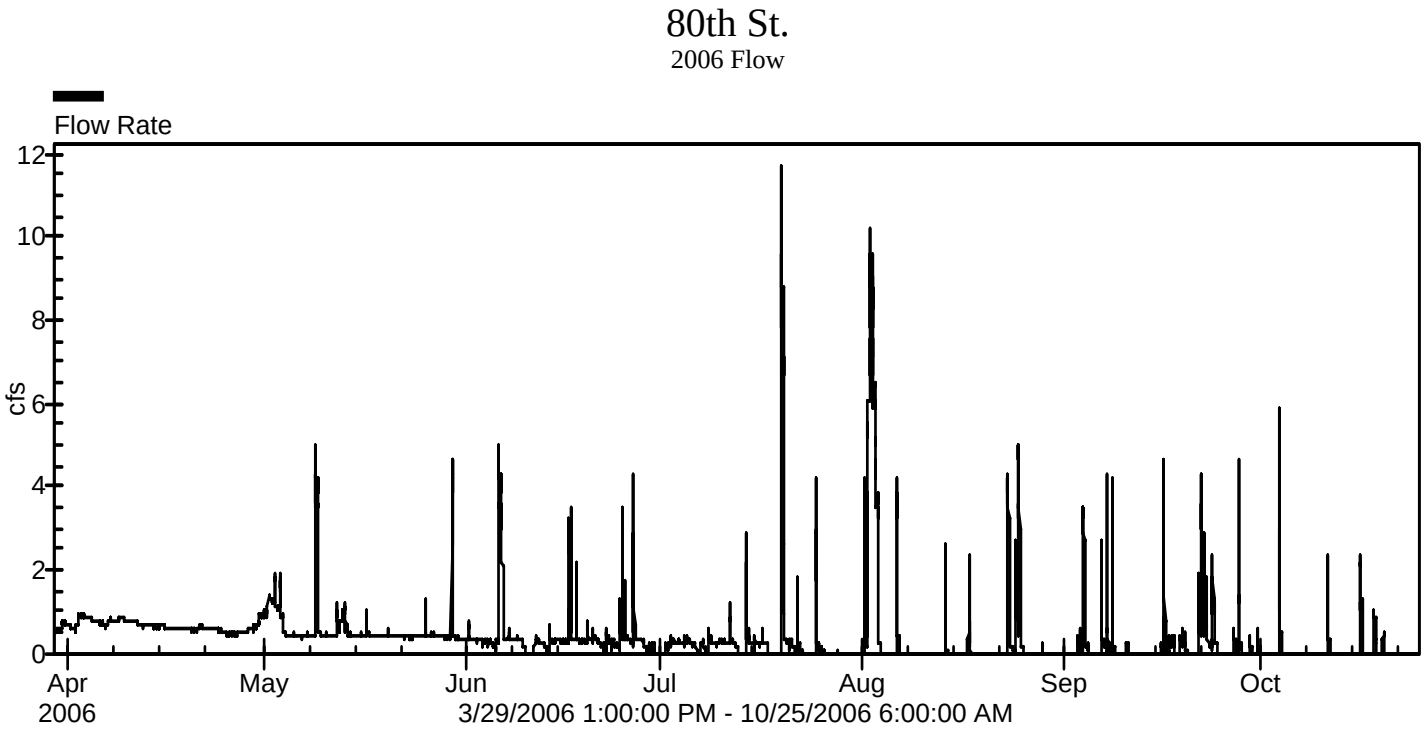


Figure 48. 80th Street 2006 Continuous Flow

90th Street

The 90th Street stormwater site recorded stage and flow between April 5-October 24, 2006 (Figure 49). The total discharge for this period was 2,147,911 cf or 49 acre-ft. The highest discharge at this site was 23.23 cfs on August 2, 2006. There was no precipitation gage at this site. No chemistry data was collected at this site.

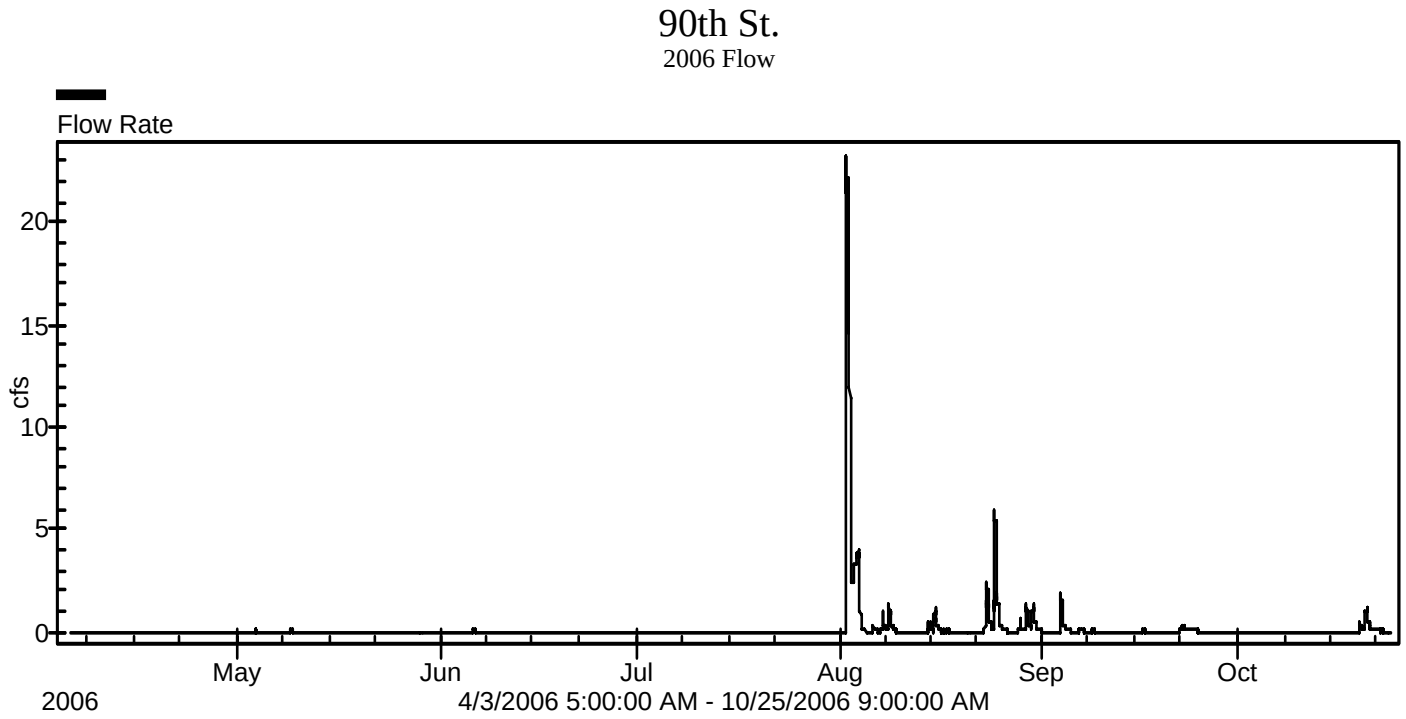


Figure 49. 90th Street 2006 Continuous Flow

Bailey Lake (at Lift Station)

Stage and precipitation measurements were recorded every hour between April 5-October 24, 2006 at this site (Figure 50). The highest recorded Elevation—867.31 ft., was recorded on September 12, 2006. The average stage during the monitoring season was 860.80 ft. The highest recorded storm event precipitation—3.24 inches, was recorded August 1-August 2, 2006.

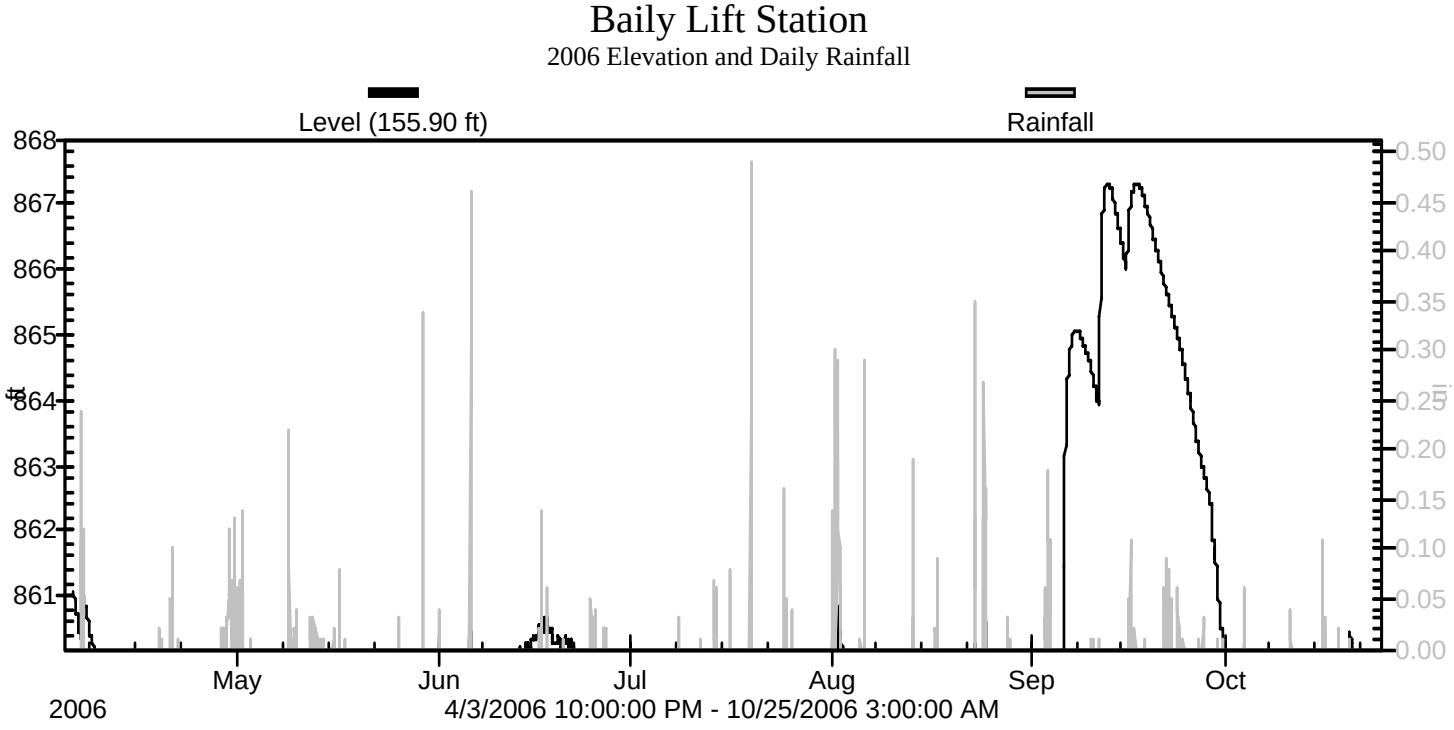


Figure 50. Bailey Lake (at Lift Station) 2006 Elevation and Daily Precipitation

North Ravine (N. Ravine of East Inlet to Cottage Grove Ravine Park Lake)
The North Ravine site recorded stage between March 30-October 24, 2006 (Figure 51), with the highest stage of 2.61 ft recorded on August 2, 2006. Total discharge wasn't calculated for this site because a usable and accurate stage to discharge rating curve could not be developed. A stage recorder was installed in a nearby smaller ravine which drains to the East Inlet during the same time period; however the site was dry for the year and only once was the stage above zero. Therefore, no data for this site is presented in this report.

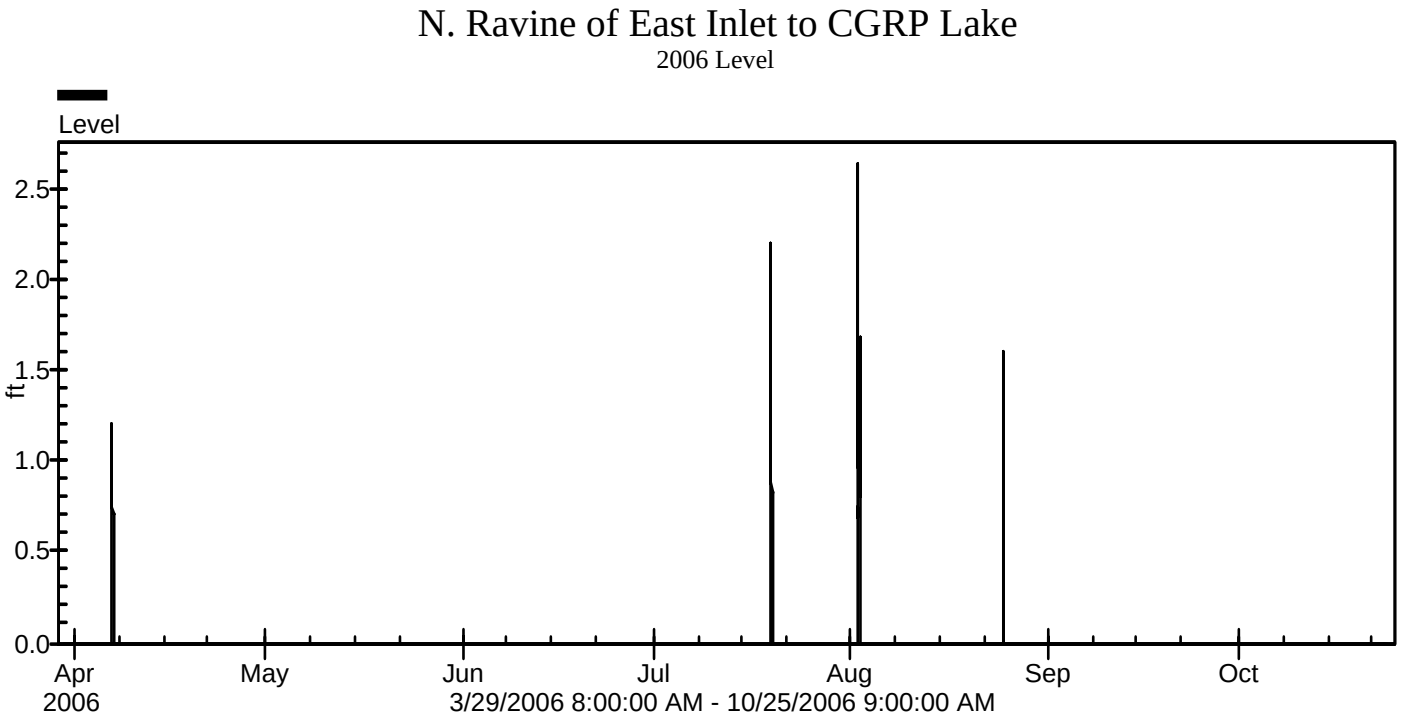
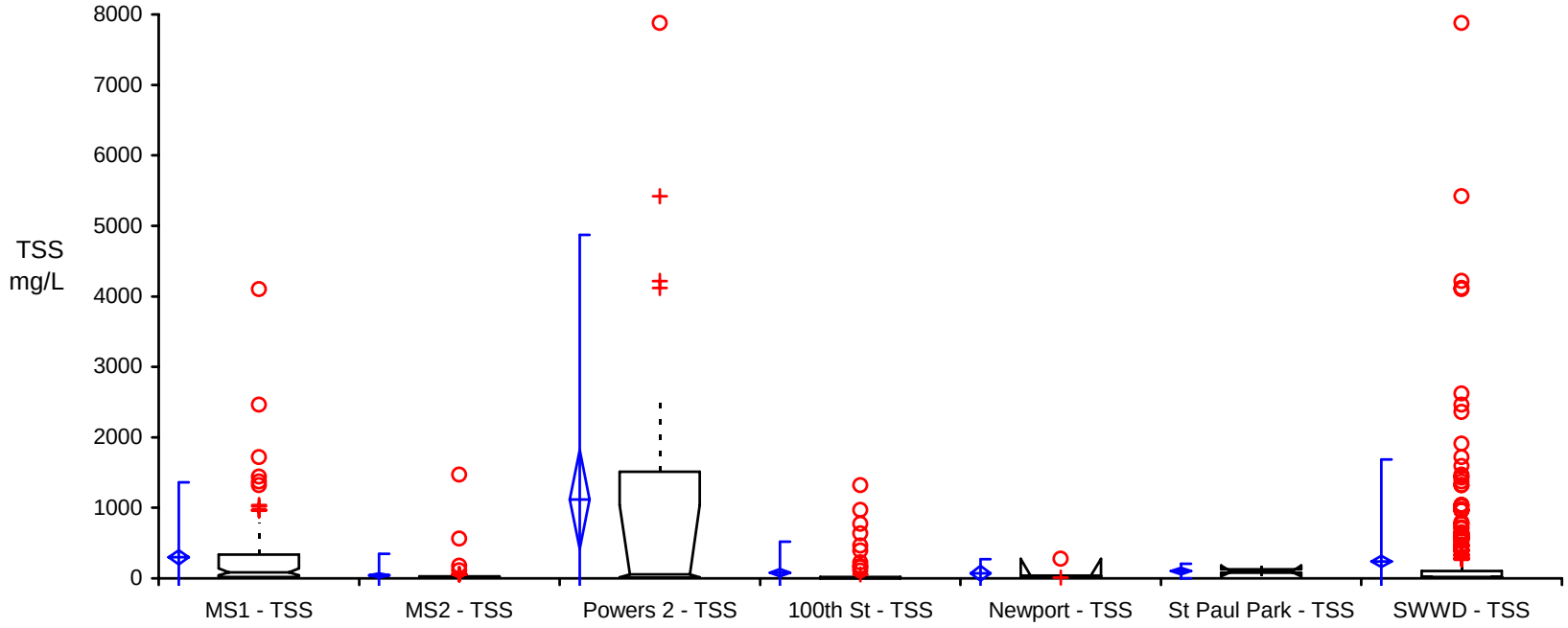


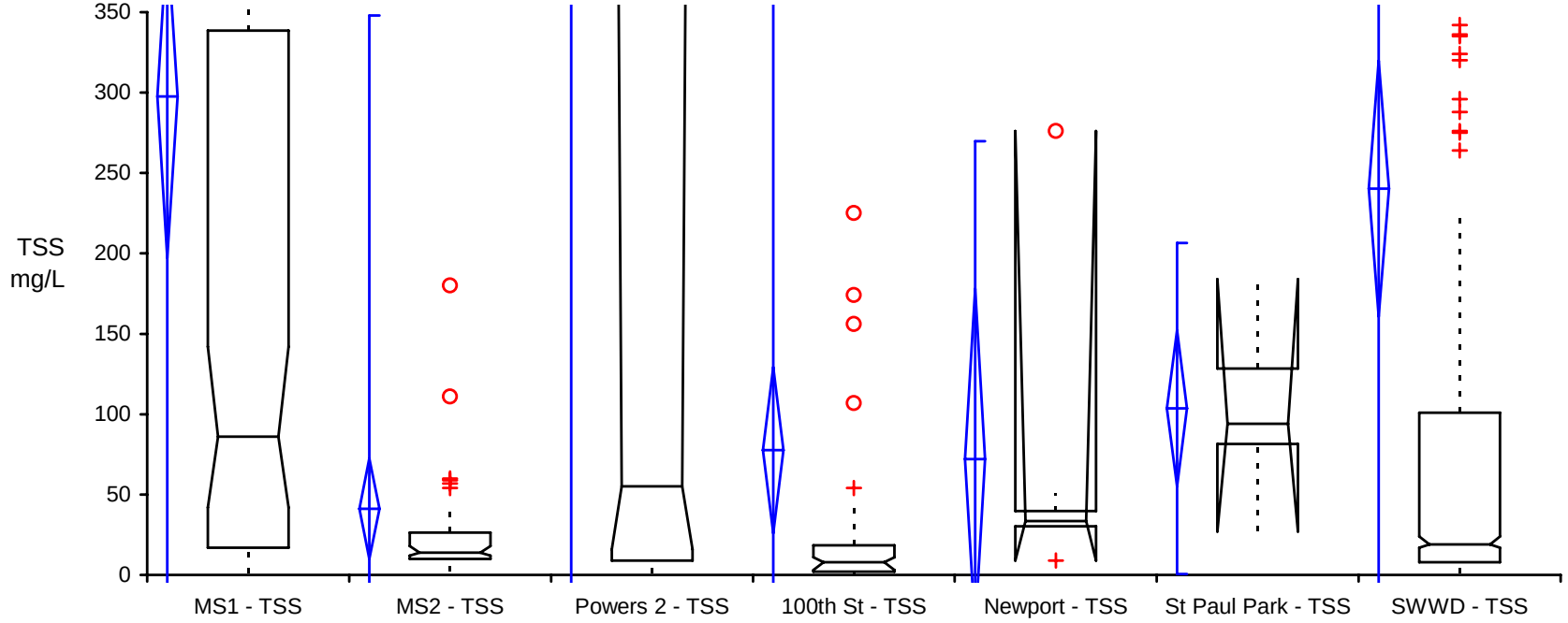
Figure 51. North Ravine of East Inlet to Ravine Park Lake 2006 Continuous Level

Figures 52-63 record the statistical summery comparing stream sites, depicted in box plots. Box plots show the benefit of ponds at sites MS2 and 100th Street. Both of these sites have the lowest median values for total suspended solids, volatile suspended solids, total phosphorus, and total Kjedahl nitrogen. Further analysis of factors within each drainage area would be needed to fully understand the differences between MS1 and Powers East sites. Total chloride ions median values had opposite trends when compared to TSS, VSS, TP, and TKN. Fecal coliform comparisons could not be done due to small sample sizes.



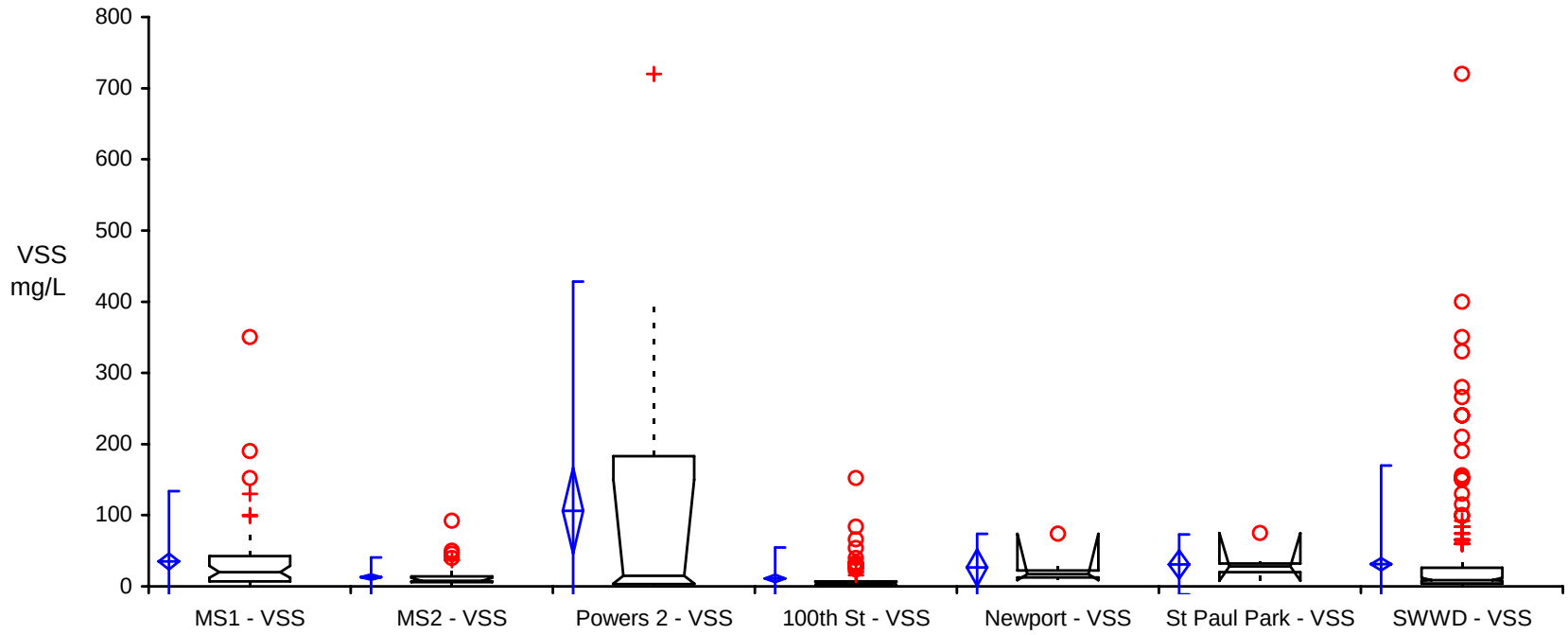
	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
MS1 - TSS	115	297.504	543.2802	50.6611	197.145 to 397.864	86.000	321.500	42.000 to 142.000
MS2 - TSS	99	41.263	156.4544	15.7243	10.058 to 72.467	14.000	16.500	12.000 to 18.000
Powers 2 - TSS	31	1119.129	1914.9813	343.9408	416.708 to 1821.550	55.000	1501.000	16.000 to 1040.000
100th St - TSS	75	77.665	224.3117	25.9013	26.056 to 129.275	8.000	16.500	3.000 to 11.000
Newport - TSS	6	72.167	100.7639	41.1367	-33.579 to 177.912	33.500	9.500	9.000 to 276.000
St Paul Park - TSS	7	103.571	52.5067	19.8457	55.011 to 152.132	94.000	47.000	27.000 to 184.000
SWWD - TSS	333	240.162	737.0911	40.3923	160.705 to 319.619	19.000	93.000	17.000 to 24.000

Figure 52. Total Suspended Solids Box Plot (All Sites)



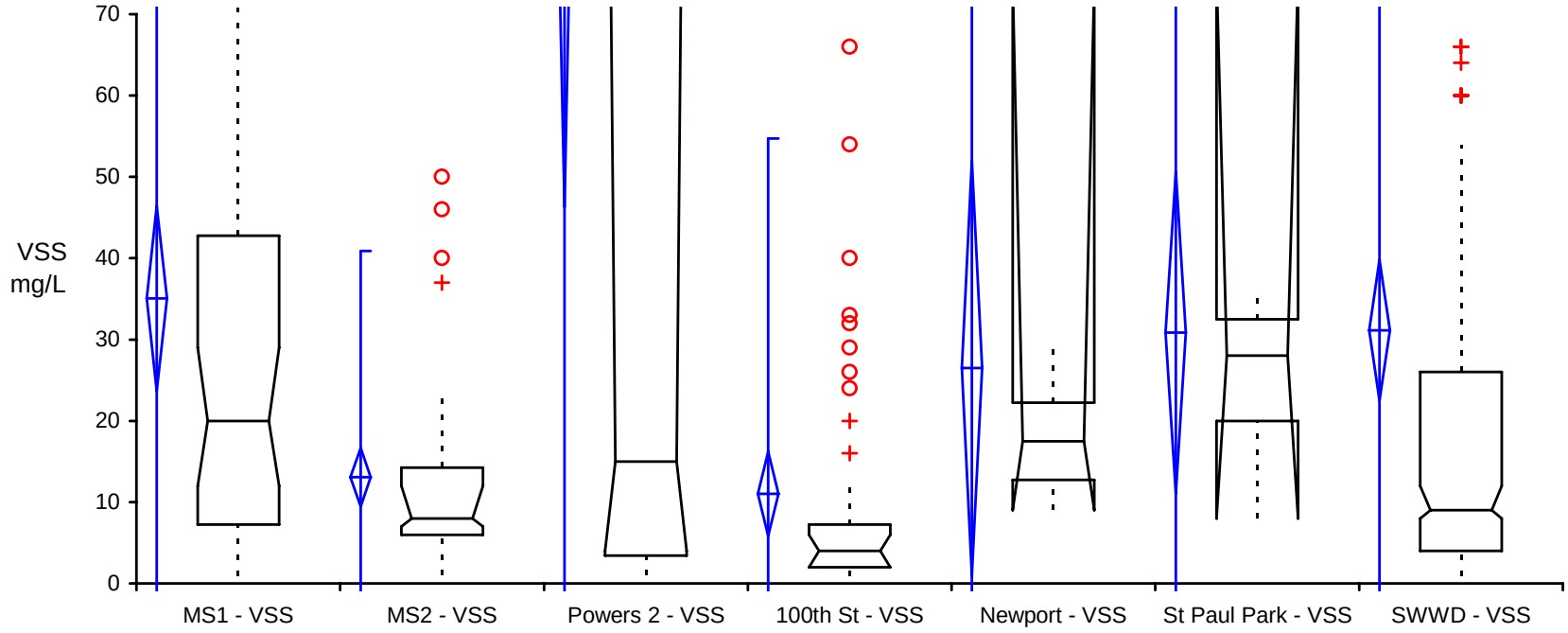
	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
MS1 - TSS	115	297.504	543.2802	50.6611	197.145 to 397.864	86.000	321.500	42.000 to 142.000
MS2 - TSS	99	41.263	156.4544	15.7243	10.058 to 72.467	14.000	16.500	12.000 to 18.000
Powers 2 - TSS	31	1119.129	1914.9813	343.9408	416.708 to 1821.550	55.000	1501.000	16.000 to 1040.000
100th St - TSS	75	77.665	224.3117	25.9013	26.056 to 129.275	8.000	16.500	3.000 to 11.000
Newport - TSS	6	72.167	100.7639	41.1367	-33.579 to 177.912	33.500	9.500	9.000 to 276.000
St Paul Park - TSS	7	103.571	52.5067	19.8457	55.011 to 152.132	94.000	47.000	27.000 to 184.000
SWWD - TSS	333	240.162	737.0911	40.3923	160.705 to 319.619	19.000	93.000	17.000 to 24.000

Figure 53. Total Suspended Solids Box Plot (All Sites) without Outliers



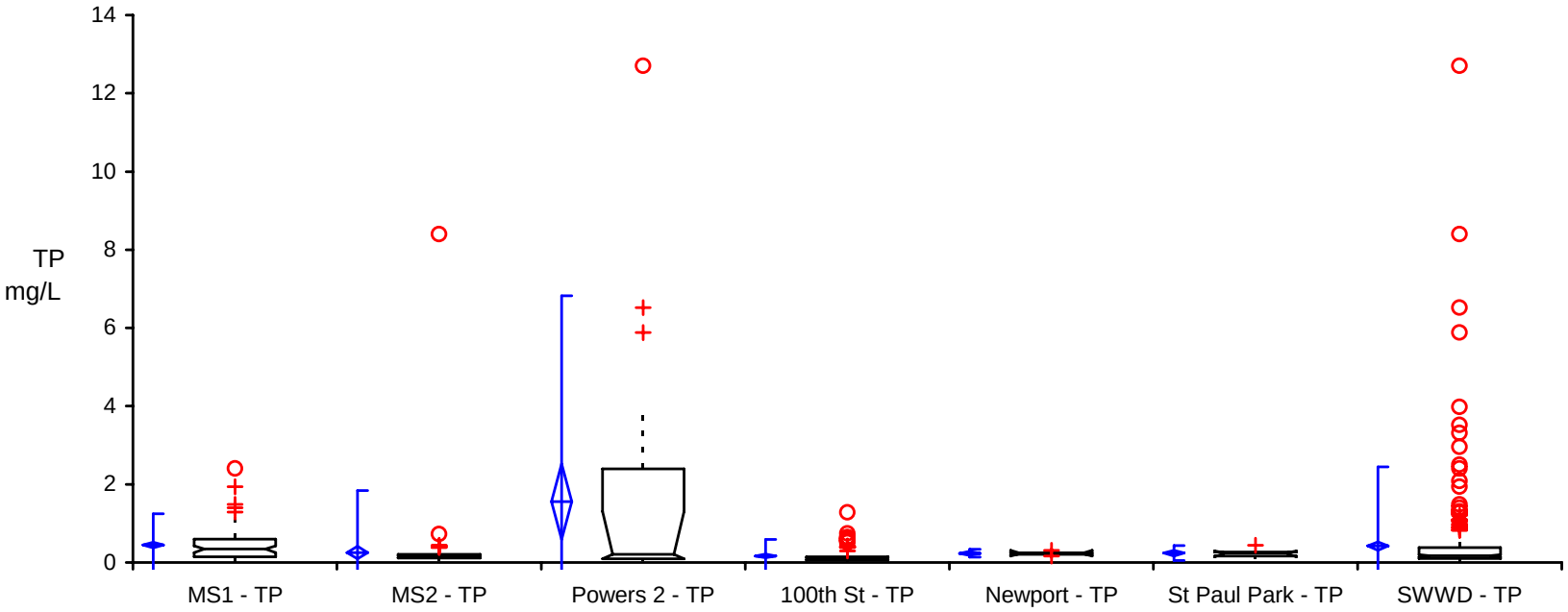
	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
MS1 - VSS	78	35.049	50.3715	5.7035	23.692 to 46.406	20.000	35.500	12.000 to 29.000
MS2 - VSS	62	13.048	14.1970	1.8030	9.443 to 16.654	8.000	8.250	7.000 to 12.000
Powers 2 - VSS	31	106.481	164.1433	29.4810	46.272 to 166.689	15.000	179.550	4.000 to 150.000
100th St - VSS	74	11.038	22.2871	2.5908	5.874 to 16.201	4.000	5.250	2.000 to 6.000
Newport - VSS	6	26.500	24.3043	9.9222	0.994 to 52.006	17.500	9.500	9.000 to 74.000
St Paul Park - VSS	7	30.857	21.3965	8.0871	11.069 to 50.646	28.000	12.500	8.000 to 75.000
SWWD - VSS	258	31.145	70.7216	4.4029	22.475 to 39.816	9.000	22.000	8.000 to 12.000

Figure 54. Total Volatile Suspended Solids Box Plot (All Sites)



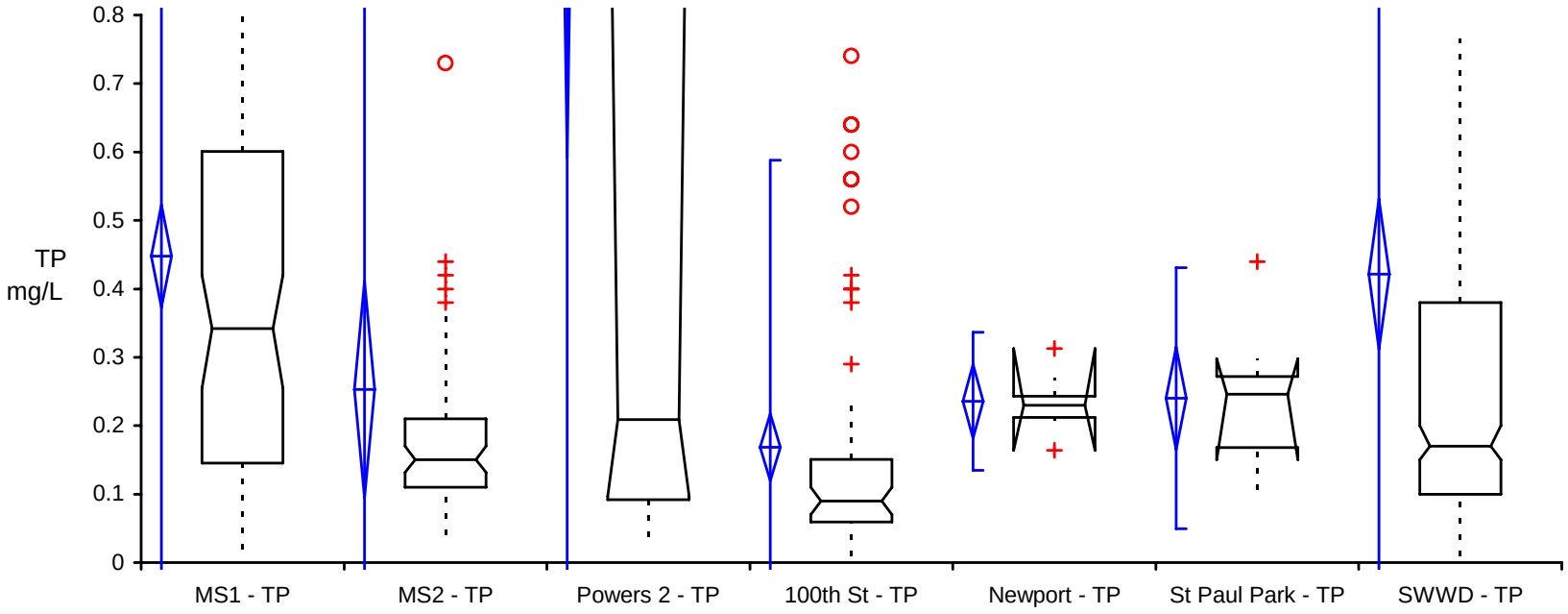
	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
MS1 - VSS	78	35.049	50.3715	5.7035	23.692 to 46.406	20.000	35.500	12.000 to 29.000
MS2 - VSS	62	13.048	14.1970	1.8030	9.443 to 16.654	8.000	8.250	7.000 to 12.000
Powers 2 - VSS	31	106.481	164.1433	29.4810	46.272 to 166.689	15.000	179.550	4.000 to 150.000
100th St - VSS	74	11.038	22.2871	2.5908	5.874 to 16.201	4.000	5.250	2.000 to 6.000
Newport - VSS	6	26.500	24.3043	9.9222	0.994 to 52.006	17.500	9.500	9.000 to 74.000
St Paul Park - VSS	7	30.857	21.3965	8.0871	11.069 to 50.646	28.000	12.500	8.000 to 75.000
SWWD - VSS	258	31.145	70.7216	4.4029	22.475 to 39.816	9.000	22.000	8.000 to 12.000

Figure 55. Total Volatile Suspended Solids Box Plot (All Sites) without Outliers



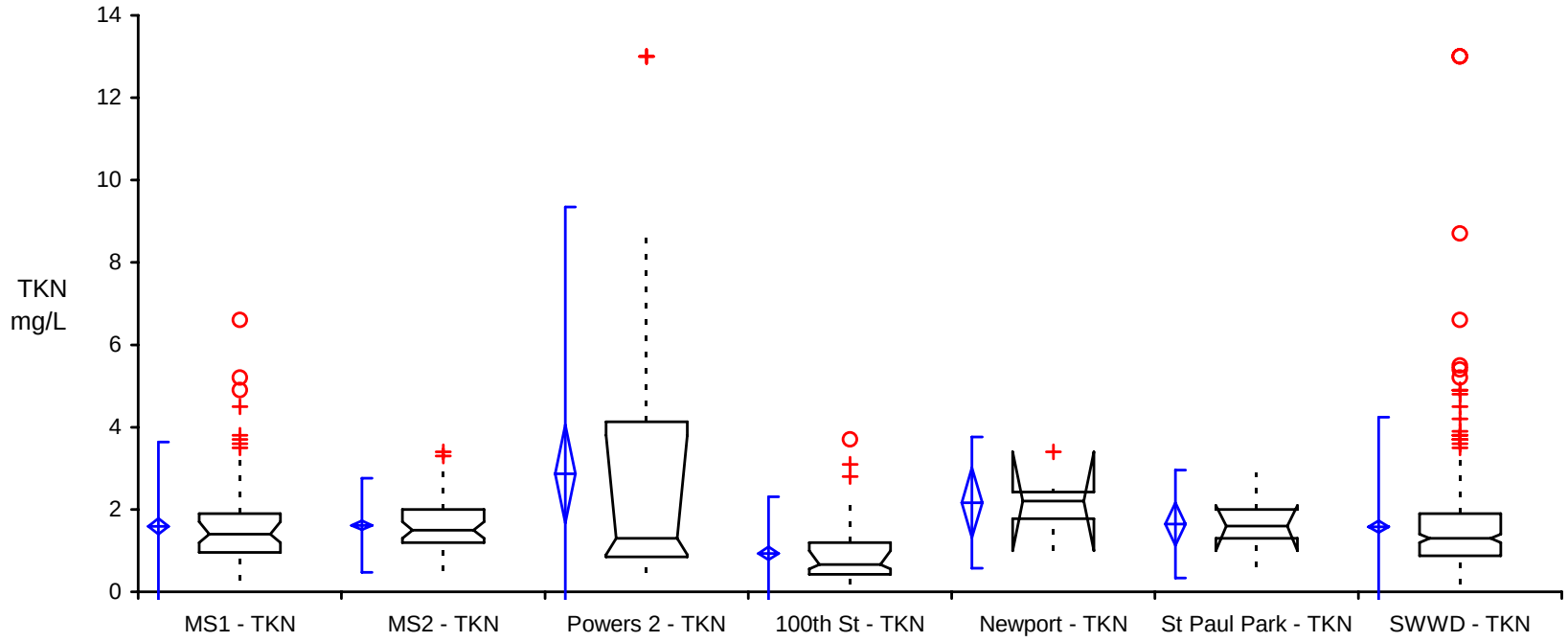
	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
MS1 - TP	116	0.448	0.4081	0.0379	0.373 to 0.523	0.342	0.456	0.255 to 0.420
MS2 - TP	104	0.253	0.8129	0.0797	0.095 to 0.411	0.150	0.100	0.132 to 0.170
Powers 2 - TP	32	1.559	2.6852	0.4747	0.591 to 2.527	0.209	2.303	0.097 to 1.310
100th St - TP	76	0.169	0.2139	0.0245	0.120 to 0.217	0.090	0.092	0.070 to 0.110
Newport - TP	6	0.2357	0.05141	0.02099	0.182 to 0.290	0.2300	0.0313	0.164 to 0.313
St Paul Park - TP	9	0.2401	0.09735	0.03245	0.165 to 0.315	0.2460	0.1040	0.150 to 0.298
SWWD - TP	343	0.421	1.0318	0.0557	0.312 to 0.531	0.170	0.280	0.150 to 0.200

Figure 56. Total Phosphorus Box Plot (All Sites)



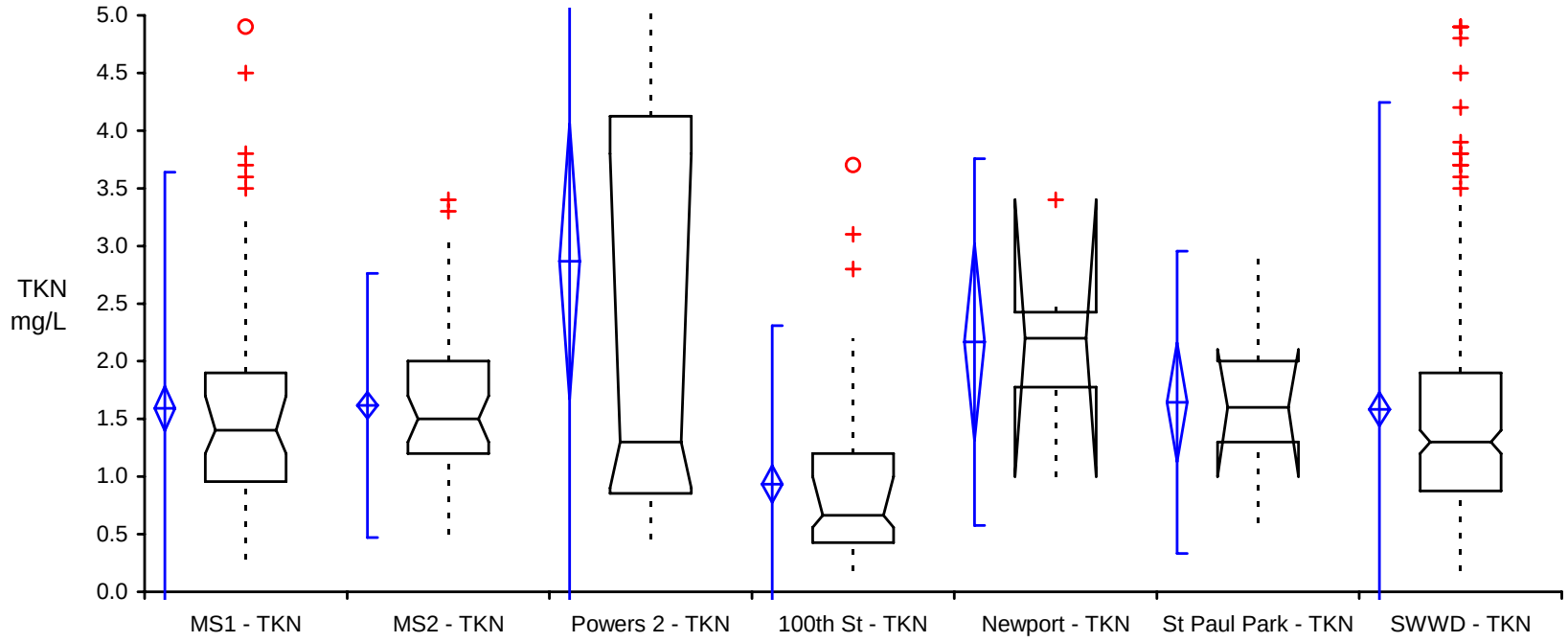
	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
MS1 - TP	116	0.448	0.4081	0.0379	0.373 to 0.523	0.342	0.456	0.255 to 0.420
MS2 - TP	104	0.253	0.8129	0.0797	0.095 to 0.411	0.150	0.100	0.132 to 0.170
Powers 2 - TP	32	1.559	2.6852	0.4747	0.591 to 2.527	0.209	2.303	0.097 to 1.310
100th St - TP	76	0.169	0.2139	0.0245	0.120 to 0.217	0.090	0.092	0.070 to 0.110
Newport - TP	6	0.2357	0.05141	0.02099	0.182 to 0.290	0.2300	0.0313	0.164 to 0.313
St Paul Park - TP	9	0.2401	0.09735	0.03245	0.165 to 0.315	0.2460	0.1040	0.150 to 0.298
SWWD - TP	343	0.421	1.0318	0.0557	0.312 to 0.531	0.170	0.280	0.150 to 0.200

Figure 57. Total Phosphorus Box Plot (All Sites) without Outliers



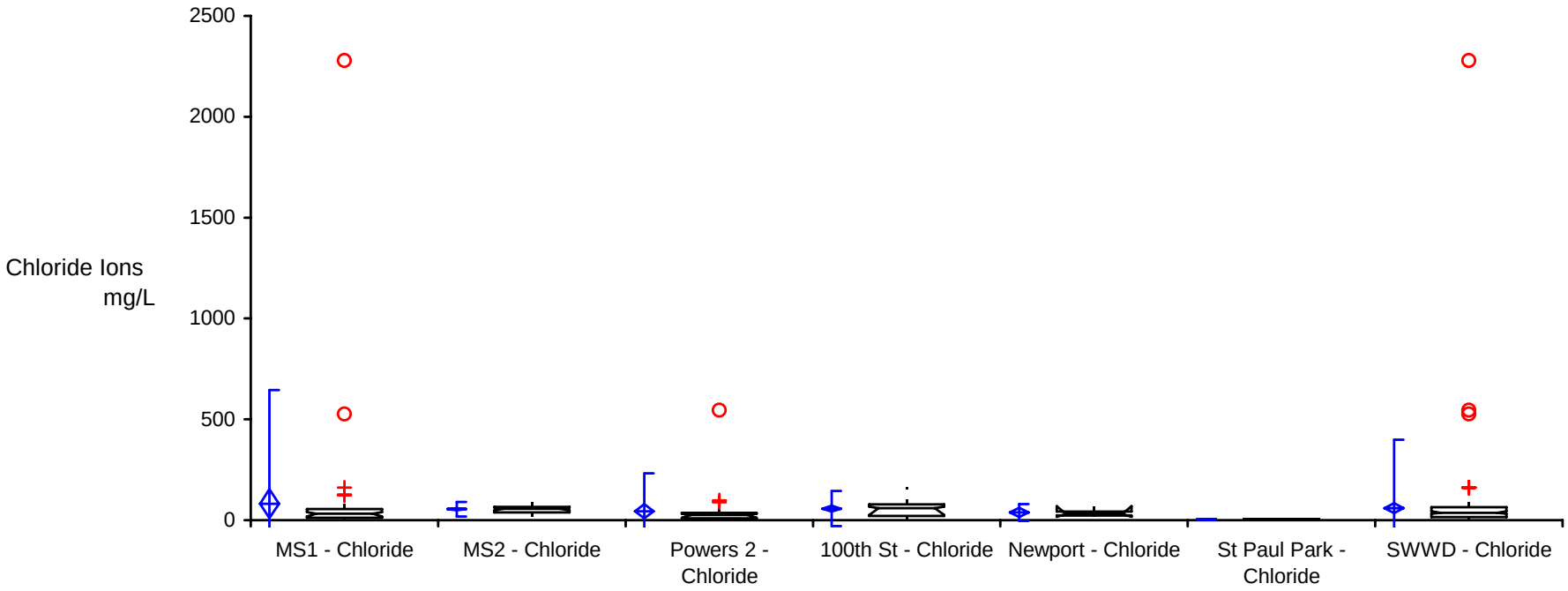
	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
MS1 - TKN	116	1.591	1.0458	0.0971	1.398 to 1.783	1.400	0.943	1.200 to 1.700
MS2 - TKN	104	1.617	0.5846	0.0573	1.504 to 1.731	1.500	0.800	1.300 to 1.700
Powers 2 - TKN	32	2.866	3.3084	0.5849	1.673 to 4.059	1.300	3.270	0.900 to 3.800
100th St - TKN	76	0.935	0.7006	0.0804	0.775 to 1.095	0.665	0.773	0.560 to 1.000
Newport - TKN	6	2.17	0.812	0.331	1.315 to 3.018	2.20	0.65	1.000 to 3.400
St Paul Park - TKN	9	1.64	0.669	0.223	1.130 to 2.159	1.60	0.70	1.000 to 2.100
SWWD - TKN	343	1.584	1.3581	0.0733	1.440 to 1.728	1.300	1.025	1.200 to 1.400

Figure 58. Total Kjedahl Nitrogen Box Plot (All Sites)



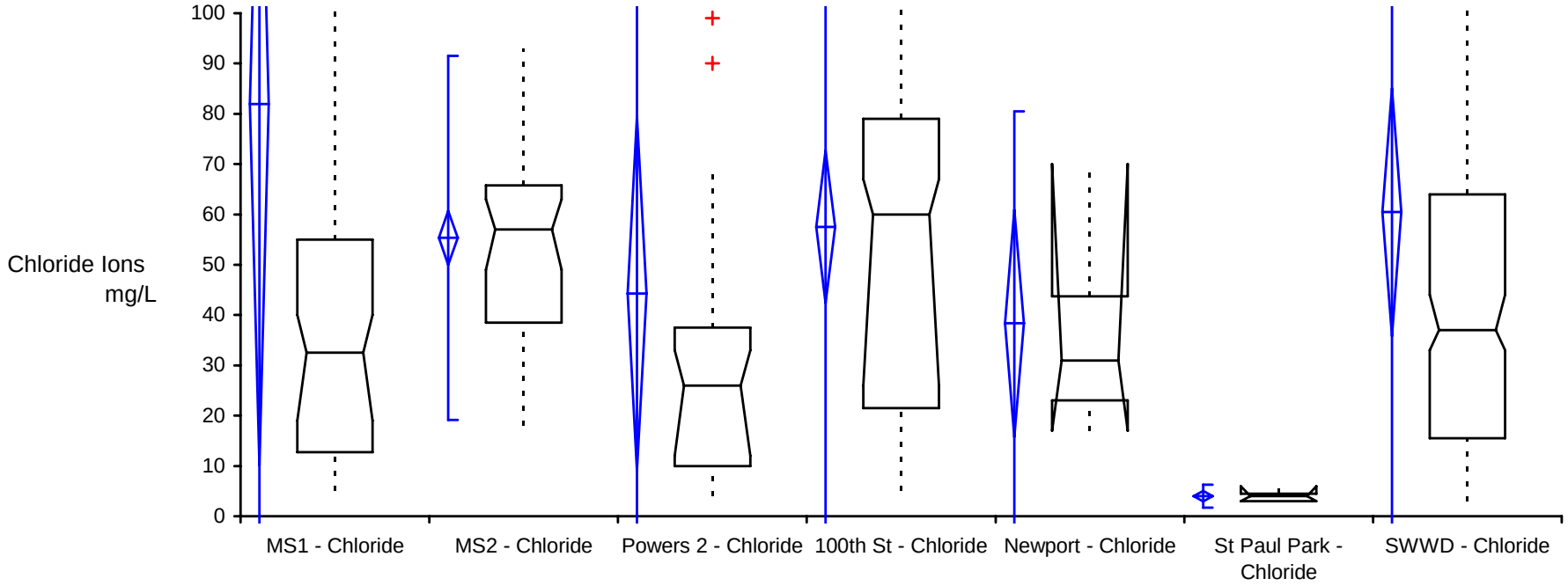
	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
MS1 - TKN	116	1.591	1.0458	0.0971	1.398 to 1.783	1.400	0.943	1.200 to 1.700
MS2 - TKN	104	1.617	0.5846	0.0573	1.504 to 1.731	1.500	0.800	1.300 to 1.700
Powers 2 - TKN	32	2.866	3.3084	0.5849	1.673 to 4.059	1.300	3.270	0.900 to 3.800
100th St - TKN	76	0.935	0.7006	0.0804	0.775 to 1.095	0.665	0.773	0.560 to 1.000
Newport - TKN	6	2.17	0.812	0.331	1.315 to 3.018	2.20	0.65	1.000 to 3.400
St Paul Park - TKN	9	1.64	0.669	0.223	1.130 to 2.159	1.60	0.70	1.000 to 2.100
SWWD - TKN	343	1.584	1.3581	0.0733	1.440 to 1.728	1.300	1.025	1.200 to 1.400

Figure 59. Total Kjedahl Nitrogen Box Plot (All Sites) without Outliers



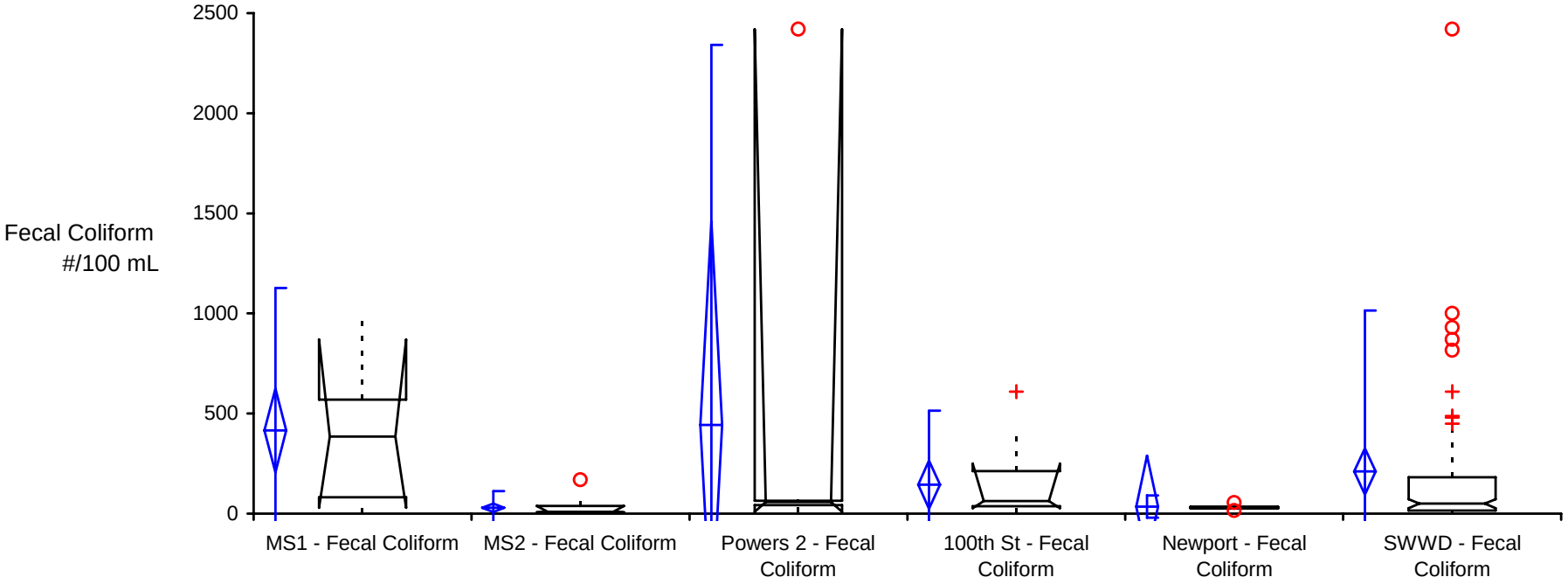
	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
MS1 - Chloride	64	81.938	287.5964	35.9496	10.098 to 153.777	32.500	42.250	19.000 to 40.000
MS2 - Chloride	48	55.333	18.4487	2.6628	49.976 to 60.690	57.000	27.250	49.000 to 63.000
Powers 2 - Chloride	31	44.258	96.0396	17.2492	9.030 to 79.486	26.000	27.500	12.000 to 33.000
100th St - Chloride	35	57.543	44.1237	7.4583	42.386 to 72.700	60.000	57.500	26.000 to 67.000
Newport - Chloride	6	38.333	21.5190	8.7851	15.751 to 60.916	31.000	20.750	17.000 to 70.000
St Paul Park - Chloride	7	4.000	1.1547	0.4364	2.932 to 5.068	4.000	1.500	3.000 to 6.000
SWWD - Chloride	191	60.440	172.2381	12.4627	35.857 to 85.023	37.000	48.500	33.000 to 44.000

Figure 60. Total Chloride Ions Box Plot (All Sites)



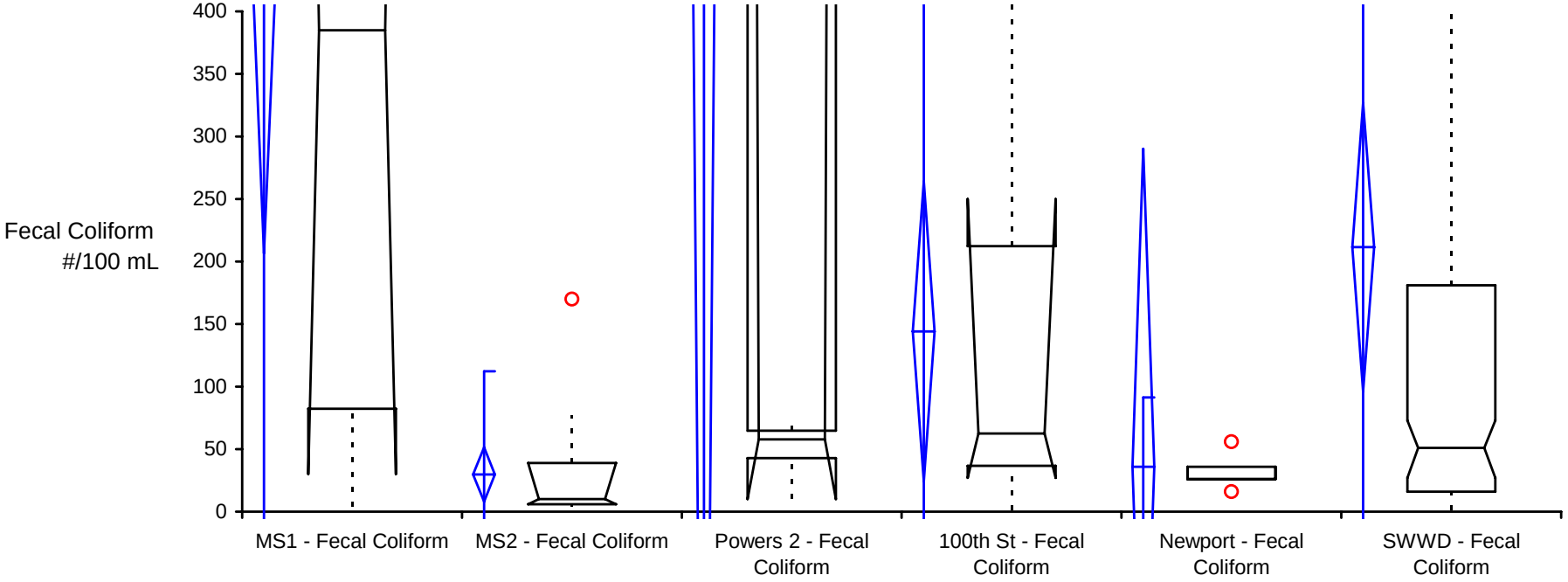
	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
MS1 - Chloride	64	81.938	287.5964	35.9496	10.098 to 153.777	32.500	42.250	19.000 to 40.000
MS2 - Chloride	48	55.333	18.4487	2.6628	49.976 to 60.690	57.000	27.250	49.000 to 63.000
Powers 2 - Chloride	31	44.258	96.0396	17.2492	9.030 to 79.486	26.000	27.500	12.000 to 33.000
100th St - Chloride	35	57.543	44.1237	7.4583	42.386 to 72.700	60.000	57.500	26.000 to 67.000
Newport - Chloride	6	38.333	21.5190	8.7851	15.751 to 60.916	31.000	20.750	17.000 to 70.000
St Paul Park - Chloride	7	4.000	1.1547	0.4364	2.932 to 5.068	4.000	1.500	3.000 to 6.000
SWWD - Chloride	191	60.440	172.2381	12.4627	35.857 to 85.023	37.000	48.500	33.000 to 44.000

Figure 61. Total Chloride Ions Box Plot (All Sites) without Outliers



	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
MS1 - Fecal Coliform	14	415.929	362.5466	96.8947	206.600 to 625.257	385.000	487.750	30.000 to 870.000
MS2 - Fecal Coliform	17	29.706	42.1274	10.2174	8.046 to 51.366	10.000	33.000	6.000 to 39.000
Powers 2 - Fecal Coliform	6	443.000	968.7741	395.5004	-573.666 to 1459.666	58.000	22.000	10.000 to 2420.000
100th St - Fecal Coliform	12	144.083	188.8494	54.5161	24.094 to 264.072	62.500	175.500	27.000 to 250.000
Newport - Fecal Coliform	2	36.000	28.2843	20.0000	-218.124 to 290.124	36.000	0.000	- to -
SWWD - Fecal Coliform	51	211.510	410.0595	57.4198	96.179 to 326.841	51.000	165.000	27.000 to 73.000

Figure 62. Fecal Coliform Box Plot (All Sites)
*St Paul Park did not have any Fecal Coliform Samples



	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
MS1 - Fecal Coliform	14	415.929	362.5466	96.8947	206.600 to 625.257	385.000	487.750	30.000 to 870.000
MS2 - Fecal Coliform	17	29.706	42.1274	10.2174	8.046 to 51.366	10.000	33.000	6.000 to 39.000
Powers 2 - Fecal Coliform	6	443.000	968.7741	395.5004	-573.666 to 1459.666	58.000	22.000	10.000 to 2420.000
100th St - Fecal Coliform	12	144.083	188.8494	54.5161	24.094 to 264.072	62.500	175.500	27.000 to 250.000
Newport - Fecal Coliform	2	36.000	28.2843	20.0000	-218.124 to 290.124	36.000	0.000	- to -
SWWD - Fecal Coliform	51	211.510	410.0595	57.4198	96.179 to 326.841	51.000	165.000	27.000 to 73.000

Figure 63. Fecal Coliform Box Plot (All Sites) without Outliers

*St Paul Park did not have any Fecal Coliform Samples

***E. Coli bacteria was sampled for the 2006 monitoring season, prior it was total fecal coliform**

Armstrong Lake

Vital Statistics:

DNR ID #: 82-0116
LOCATION: NW$^{1/4}$ Section 33 T29N-R21W
MUNICIPALITY: City of Lake Elmo
LAKE SIZE: 28.1 acres (North—7.3 acres, South—20.8 acres)
ORDINARY HIGH WATER MARK: 1019.1 ft

Armstrong Lake was monitored from April 17 to October 5, 2006, in accordance with the Metropolitan Council Citizen-Assisted Monitoring Program (CAMP). Monitoring consisted of 14 biweekly lake gage readings and 7 monthly samplings of Secchi disk, surface total phosphorus, surface total Kjeldahl nitrogen, surface chlorophyll-*a*, and surface total chloride ion. In addition, a temperature and dissolved oxygen profile was taken during each sampling round. The Metropolitan Council Lab analyzed the samples.

Table 28 gives the Armstrong Lake 2006 high, low, and average lake levels. Individual lake level readings are shown in Figure 64.

Table 28. Armstrong 2006 Lake Level

	High	High Date	Low	Low Date	Average
Lake Level (ft)	1019.31	5/23/06	1018.04	7/18/06	1018.63

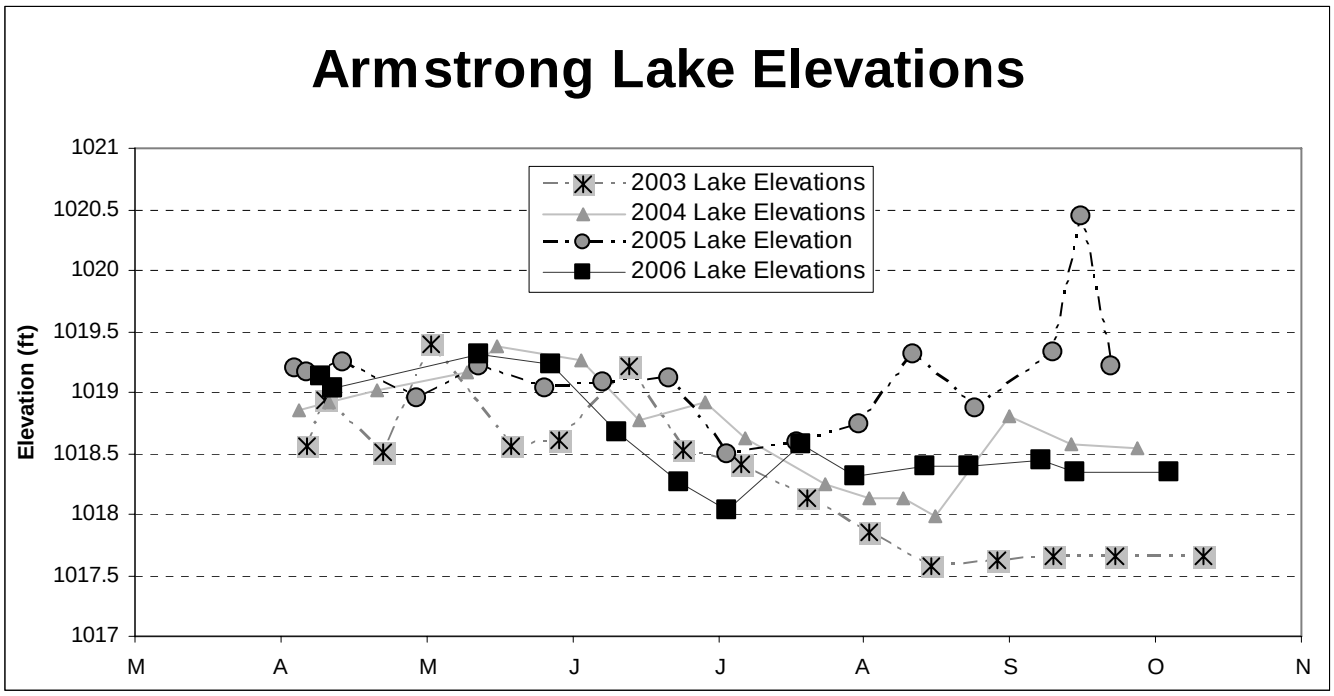


Figure 64. Armstrong Lake Elevations 2003-06

Table 29 gives the 2006 Armstrong Lake monitoring chemistry results and Secchi disk readings for the 2006 water-monitoring season.

Table 29. Armstrong Lake 2006 Monitoring Results

Date & Time	Secchi (m)	Surface TP (mg/L)	Surface TKN (mg/L)	Surface CLA (ug/L)	Surface Chloride (mg/L)	Surface Temperature (C)	Surface Dissolved Oxygen (mg/L)
4/17/2006	1.22	0.046	0.8	17	99	14.0	6.21
5/23/2006	1.37	0.045	1.1	4	119	18.0	11.70
6/23/2006	0.91	0.187	1.8	3	118	23.3	7.91
7/18/2006	0.91	0.086	1.8	16	136	29.4	9.17
8/16/2006	0.91	0.072	1.8	21	112	23.1	8.10
9/11/2006	0.91	0.070	1.6	14	114	14.4	6.73
10/5/2006	1.07	0.117	1.2	10	118	14.7	7.37
2006 Average	1.04	0.089	1.4	12	117	19.6	8.17
2006 Summer Average	0.91	0.104	1.8	14	120	22.6	7.98

Table 30 shows the Armstrong Lake Water Quality Summary. Armstrong Lake showed a lower grade for Total Phosphorus in 2006, which in turn lowered the overall lake grade down to a C-. This was a change from the 2005 lake grade of a C.

Table 30. Lake Grade and Trophic Status.

	Trophic Status (2005 Summer Average)	Lake Grade (2005 Summer Average)	Trophic Status (2006 Summer Average)	Lake Grade (2006 Summer Average)
Total Phosphorus (mg/L)	Eutrophic	C	Hypereutrophic	D
Chlorophyll-a (ug/L)	Mesotrophic	A	Eutrophic	B
Secchi disk (ft)	Eutrophic	D	Eutrophic	D
Overall	Eutrophic	C+	Eutrophic	C-

Figure 65-70 compare the lake chemistry data and Secchi disk readings.

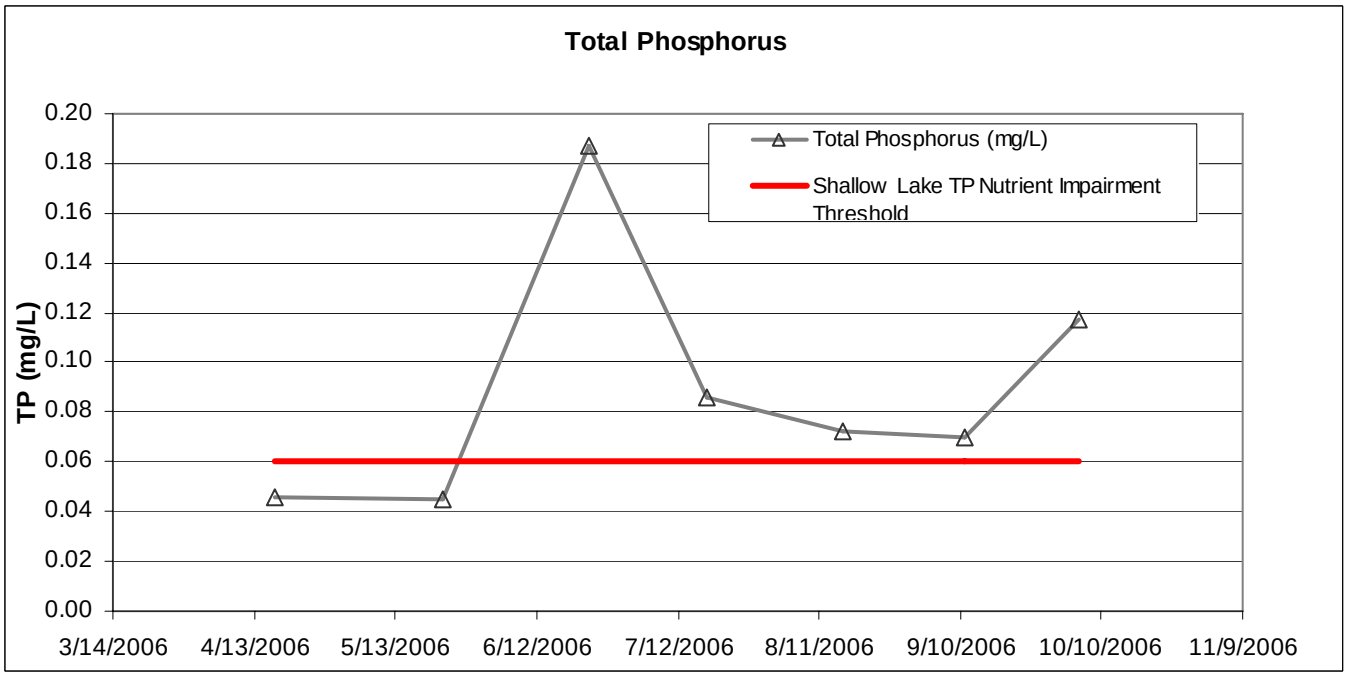


Figure 65. Surface Total Phosphorus and Nutrient Impairment Threshold

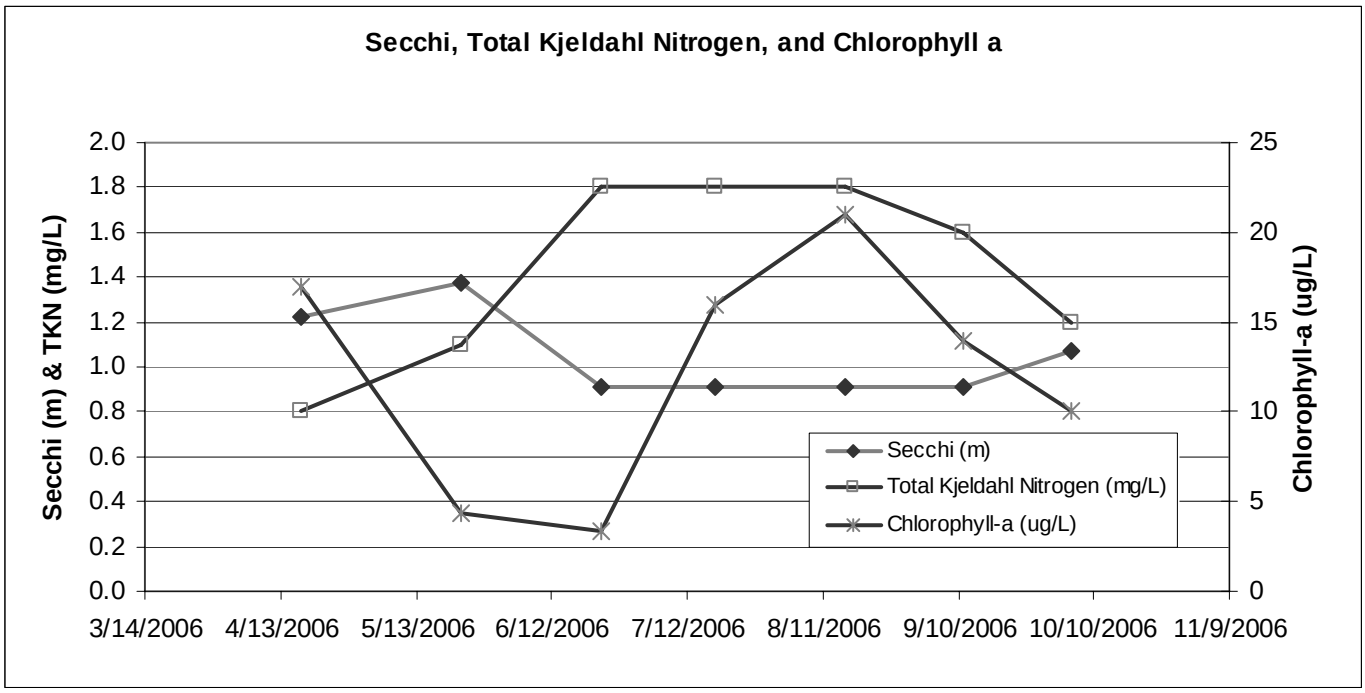


Figure 66. Secchi, Total Kjeldahl Nitrogen and Chlorophyll-*a*

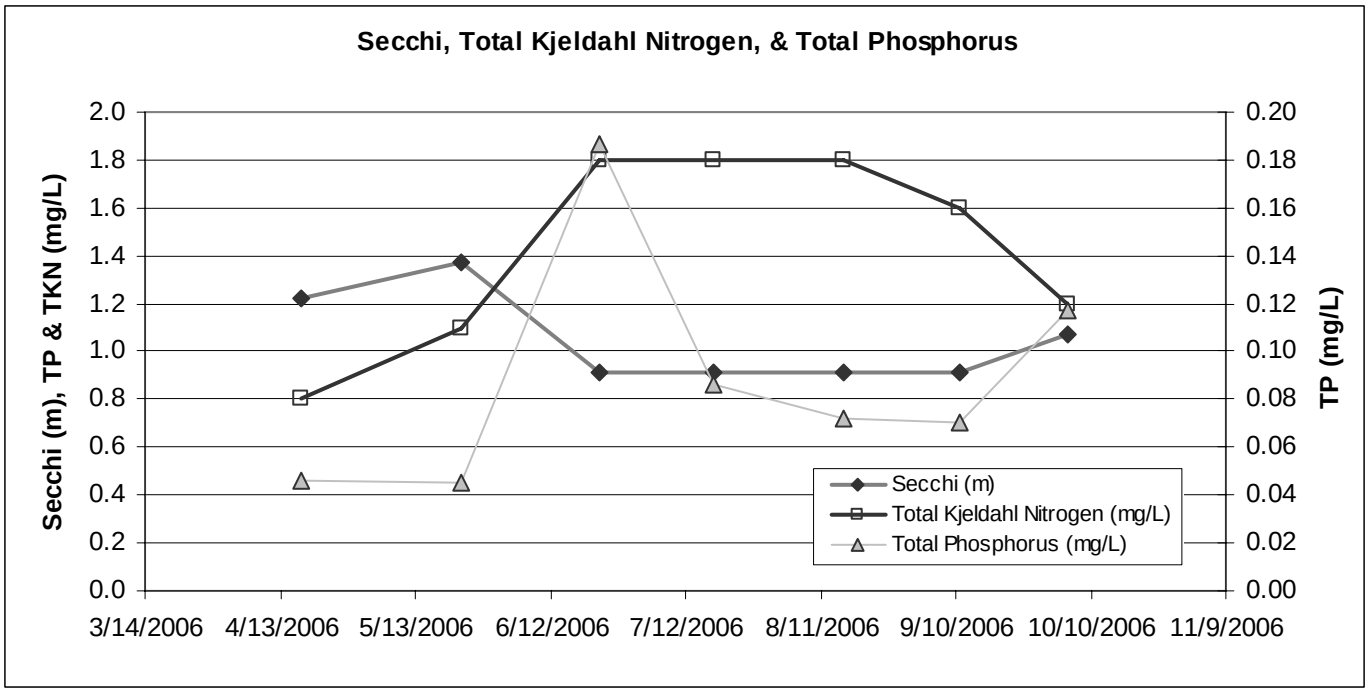


Figure 67. Secchi, Total Kjeldahl Nitrogen, and Total Phosphorus

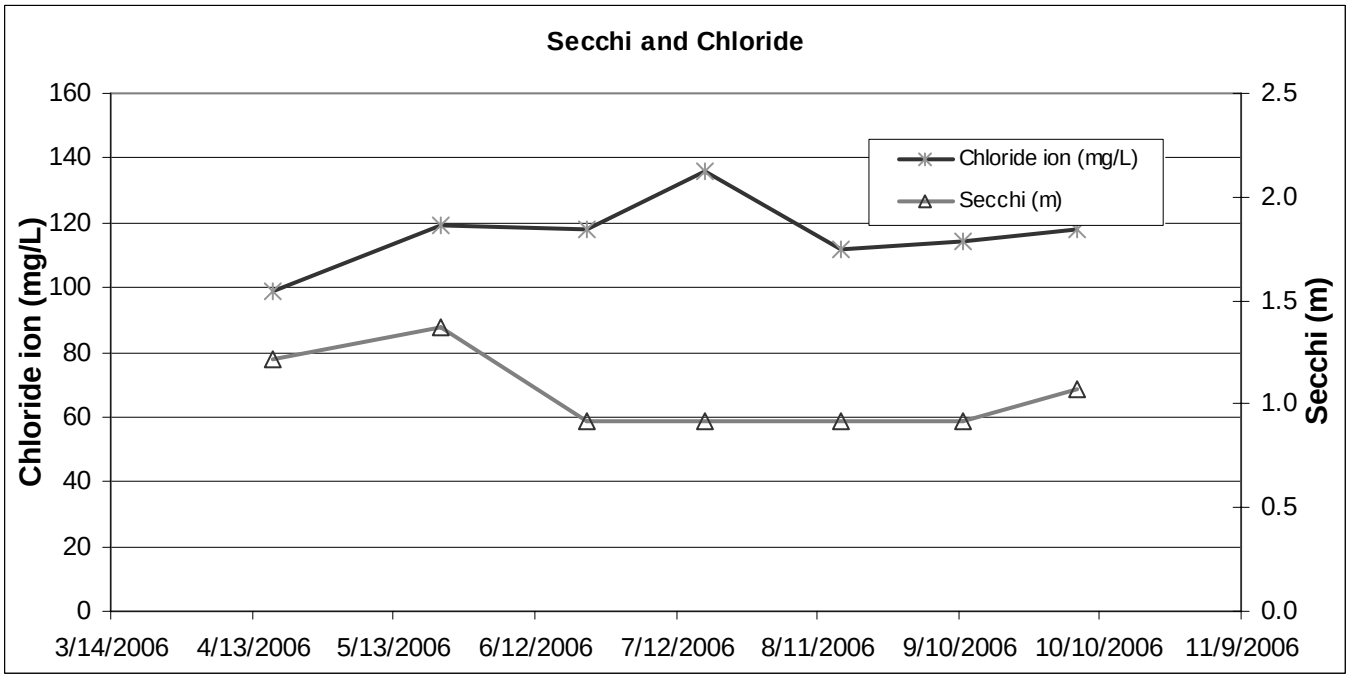


Figure 68. Secchi and Chloride ion

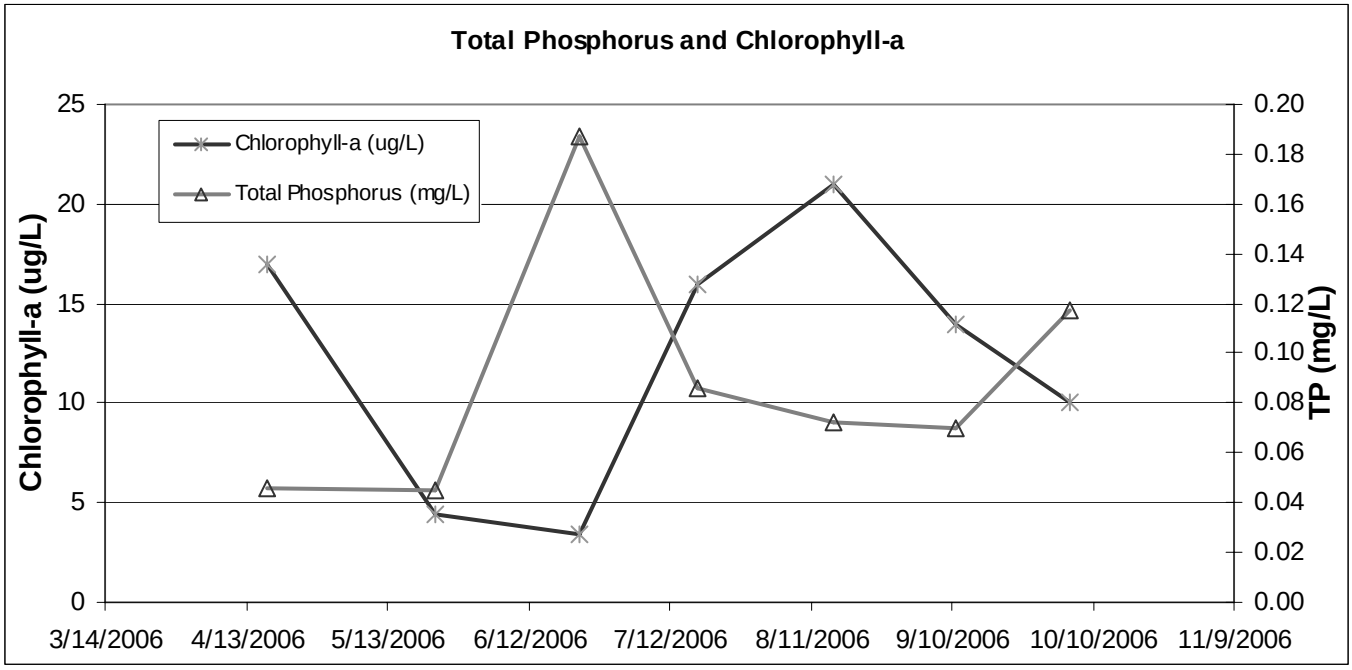


Figure 69. Total Phosphorous and Chlorophyll *a*

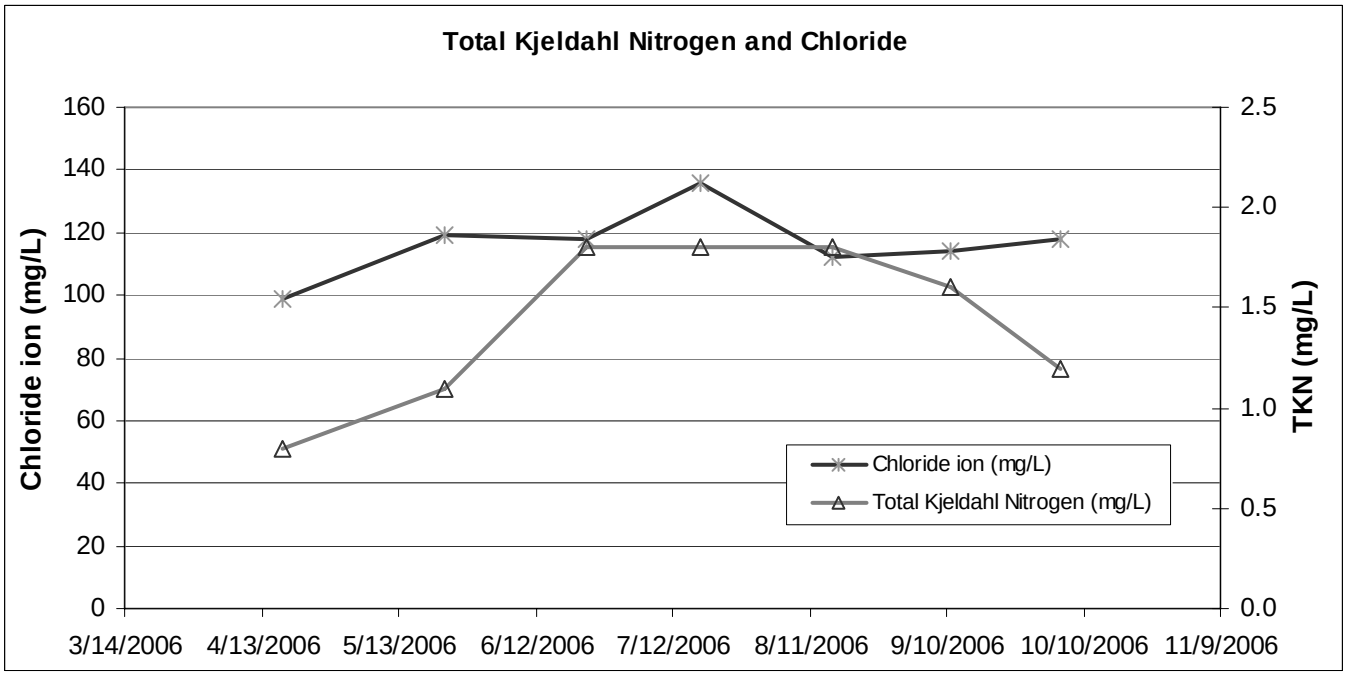


Figure 70. Total Kjeldahl Nitrogen and Chloride ion

Table 31 lists the dissolved oxygen and temperature profiles. The maximum depth was 2 meters. No thermocline was present in the lake. The surface dissolved oxygen and surface temperatures are shown in Figure 71.

Table 31. Dissolved Oxygen and Temperature Profiles

Date	4/17/2006		5/23/2006		6/23/2006		7/18/2006		8/16/2006		9/11/2006		10/5/2006	
Depth	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)
0	6.21	14.0	11.70	18.0	7.91	23.3	9.17	29.4	8.10	23.1	6.73	14.4	7.37	14.7
1	6.09	14.0	12.08	17.8	4.84	21.8	6.56	27.0	3.78	22.7	6.70	14.5	7.57	14.4
2							0.29	25.8			0.12	15.0	0.16	14.7

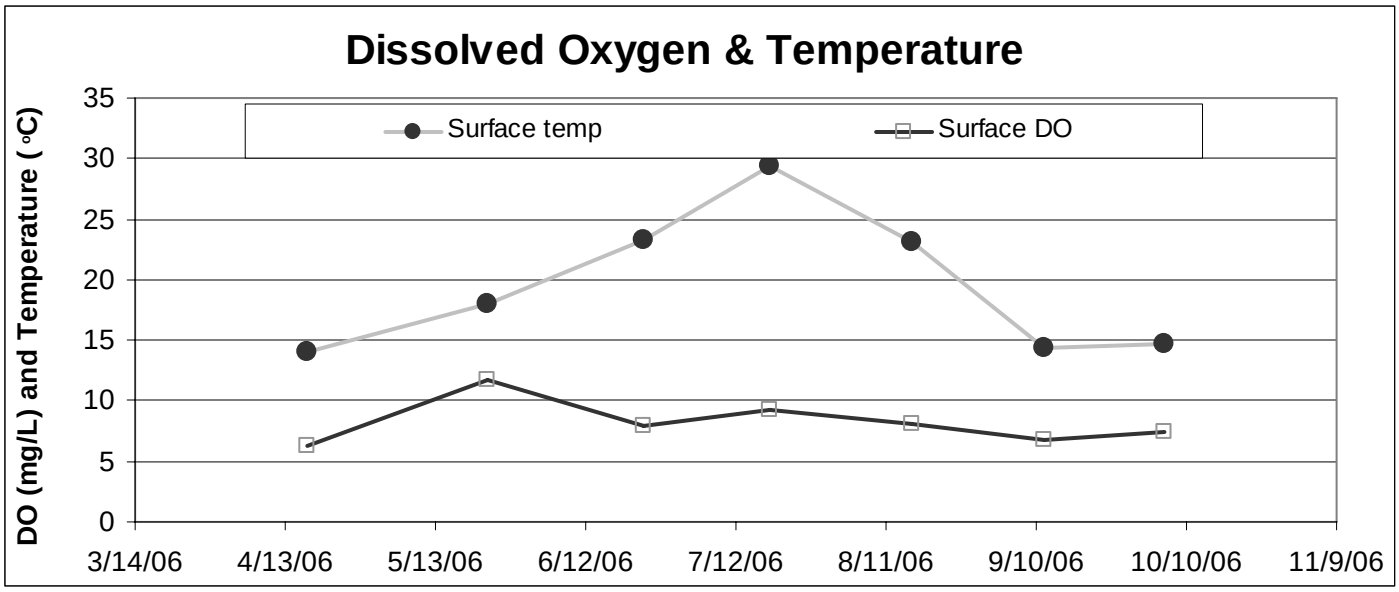
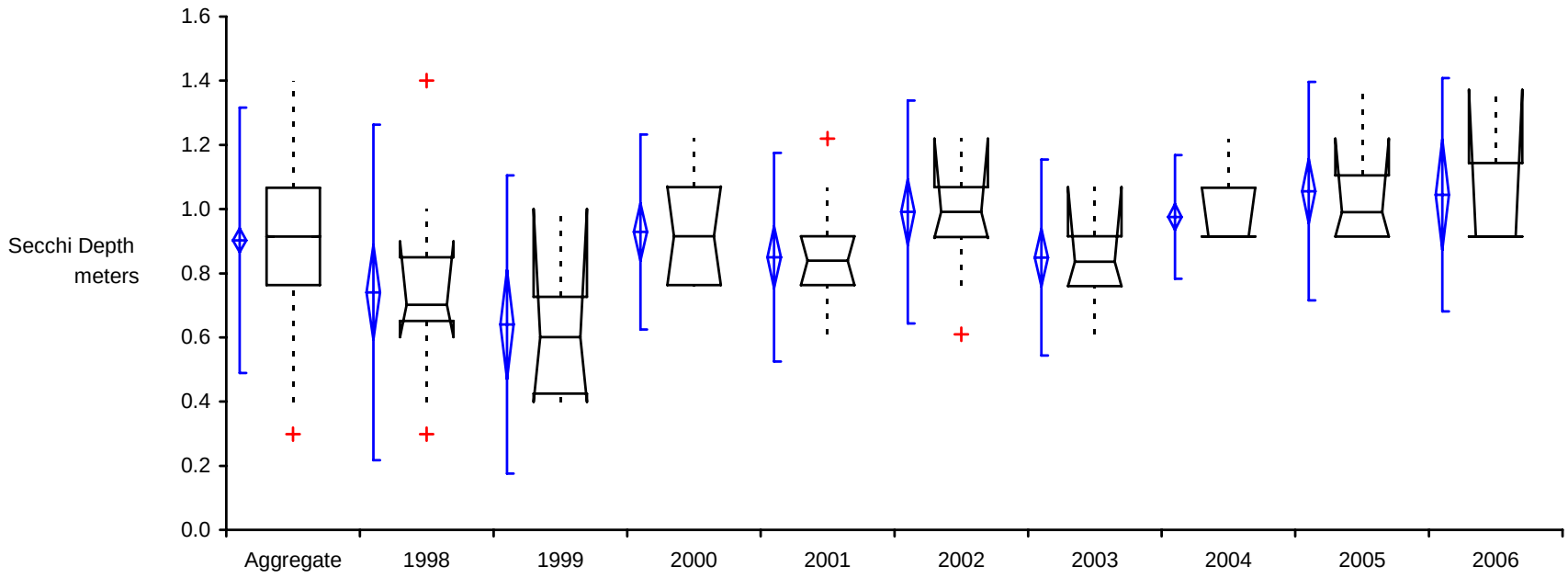


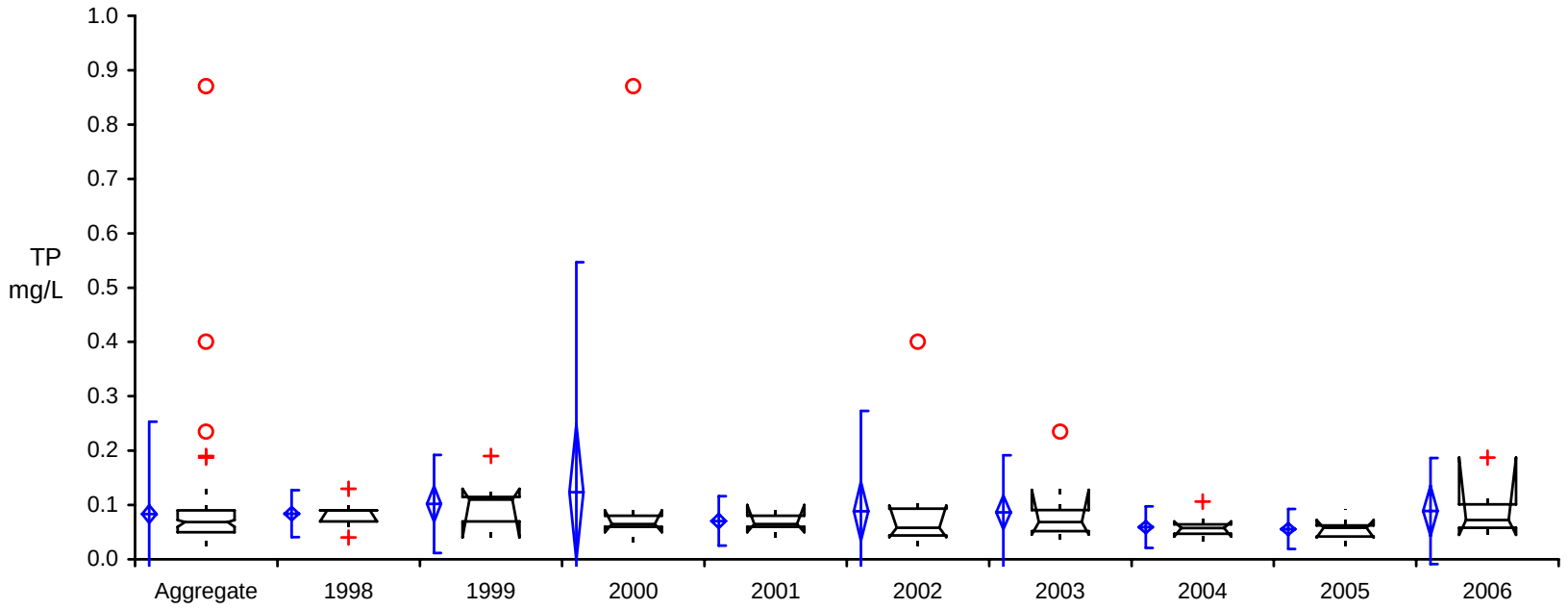
Figure 71. Surface Dissolved Oxygen and Surface Temperatures

Statistical box plot summaries are included for Armstrong Lake in Figures 72-79. Secchi disk readings median values have been slightly increasing since 1999. Chlorophyll-a trends have had the opposite, but expected, trend, with median values decreasing over time, as well as the variability within the box plot. Both total phosphorus and total Kjedahl nitrogen median values have no clear trend over time. Total chloride ions have an increasing median value trend since 2002, except for the 2005 monitoring season.



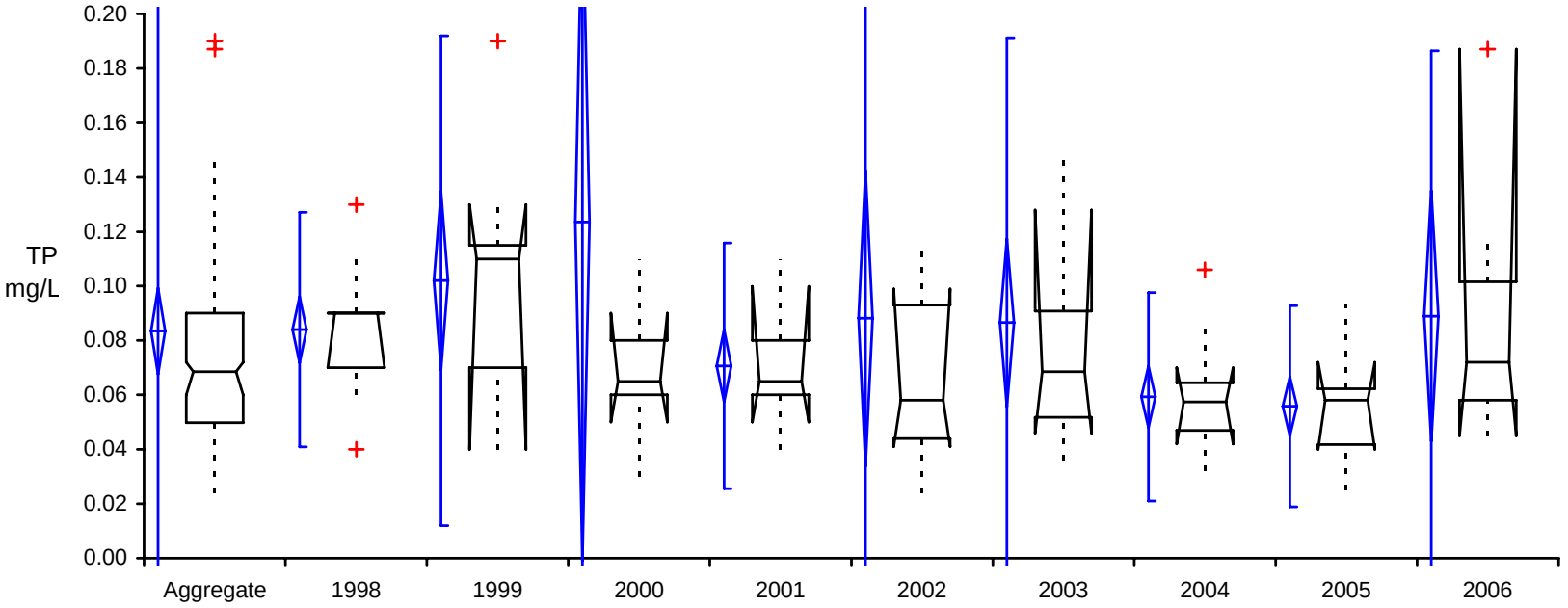
Armstrong Lake - Secchi Depth	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	127	0.903	0.2110	0.0187	0.866 to 0.940	0.914	0.304	0.914 to 0.915
1998	15	0.741	0.2668	0.0689	0.593 to 0.888	0.702	0.198	0.601 to 0.900
1999	10	0.640	0.2369	0.0749	0.471 to 0.810	0.601	0.301	0.400 to 1.000
2000	14	0.929	0.1551	0.0414	0.839 to 1.018	0.915	0.306	0.763 to 1.070
2001	14	0.850	0.1661	0.0444	0.754 to 0.946	0.839	0.152	0.763 to 0.915
2002	14	0.991	0.1773	0.0474	0.889 to 1.093	0.992	0.155	0.910 to 1.220
2003	14	0.849	0.1556	0.0416	0.759 to 0.939	0.836	0.155	0.760 to 1.068
2004	25	0.975	0.0984	0.0197	0.935 to 1.016	0.914	0.153	0.914 to 1.067
2005	14	1.056	0.1739	0.0465	0.956 to 1.156	0.991	0.191	0.914 to 1.219
2006	7	1.045	0.1854	0.0701	0.873 to 1.216	0.914	0.229	0.914 to 1.372

Figure 72. Secchi Disk box plots for Armstrong Lake (1998-2006)



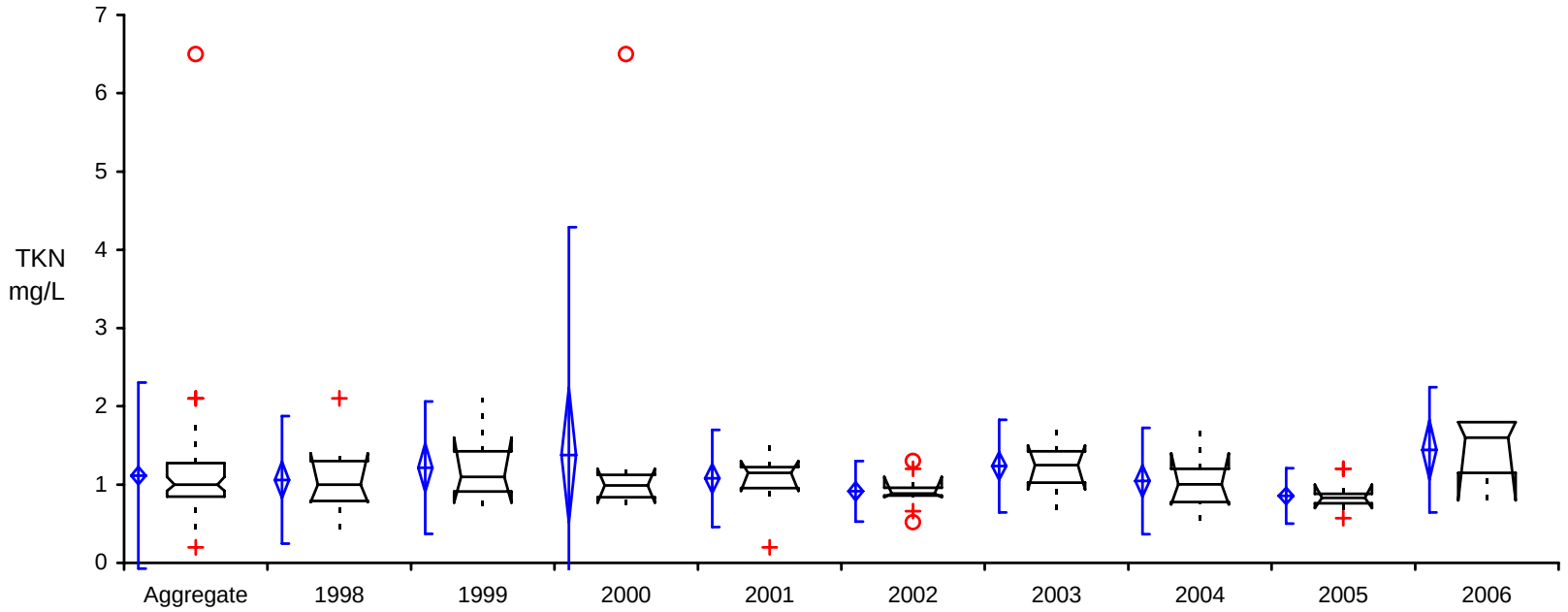
Armstrong Lake - TP	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	116	0.083	0.0866	0.0080	0.068 to 0.099	0.069	0.040	0.060 to 0.072
1998	15	0.084	0.0220	0.0057	0.072 to 0.096	0.090	0.020	0.070 to 0.090
1999	10	0.102	0.0459	0.0145	0.069 to 0.135	0.110	0.045	0.040 to 0.130
2000	14	0.124	0.2158	0.0577	-0.001 to 0.248	0.065	0.020	0.050 to 0.090
2001	14	0.071	0.0230	0.0062	0.057 to 0.084	0.065	0.020	0.050 to 0.100
2002	14	0.088	0.0943	0.0252	0.034 to 0.143	0.058	0.049	0.041 to 0.099
2003	14	0.087	0.0534	0.0143	0.056 to 0.117	0.069	0.039	0.046 to 0.128
2004	14	0.059	0.0195	0.0052	0.048 to 0.071	0.058	0.018	0.042 to 0.070
2005	14	0.056	0.0188	0.0050	0.045 to 0.067	0.058	0.021	0.040 to 0.072
2006	7	0.089	0.0497	0.0188	0.043 to 0.135	0.072	0.044	0.045 to 0.187

Figure 73. Total Phosphorus box plots for Armstrong Lake (1998-2006)



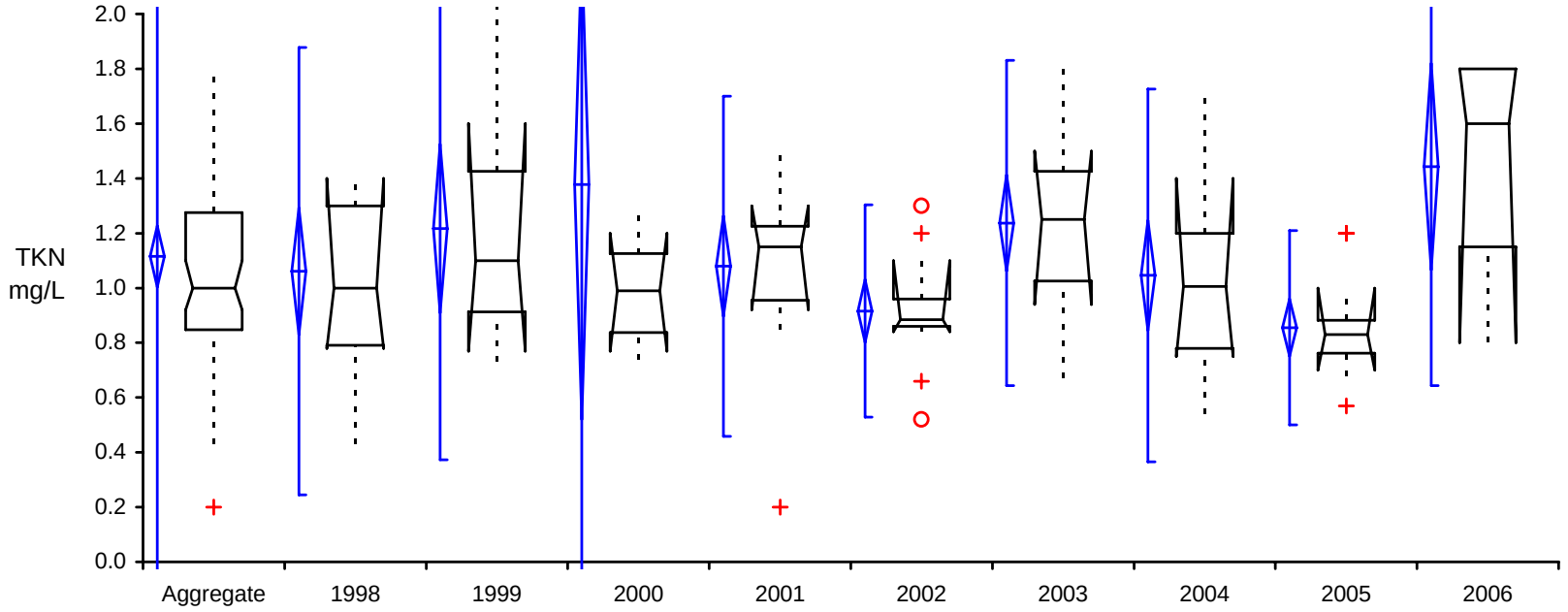
Armstrong Lake - TP	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	116	0.083	0.0866	0.0080	0.068 to 0.099	0.069	0.040	0.060 to 0.072
1998	15	0.084	0.0220	0.0057	0.072 to 0.096	0.090	0.020	0.070 to 0.090
1999	10	0.102	0.0459	0.0145	0.069 to 0.135	0.110	0.045	0.040 to 0.130
2000	14	0.124	0.2158	0.0577	-0.001 to 0.248	0.065	0.020	0.050 to 0.090
2001	14	0.071	0.0230	0.0062	0.057 to 0.084	0.065	0.020	0.050 to 0.100
2002	14	0.088	0.0943	0.0252	0.034 to 0.143	0.058	0.049	0.041 to 0.099
2003	14	0.087	0.0534	0.0143	0.056 to 0.117	0.069	0.039	0.046 to 0.128
2004	14	0.059	0.0195	0.0052	0.048 to 0.071	0.058	0.018	0.042 to 0.070
2005	14	0.056	0.0188	0.0050	0.045 to 0.067	0.058	0.021	0.040 to 0.072
2006	7	0.089	0.0497	0.0188	0.043 to 0.135	0.072	0.044	0.045 to 0.187

Figure 74. Total Phosphorus box plots for Armstrong Lake (1998-2006) without Outliers



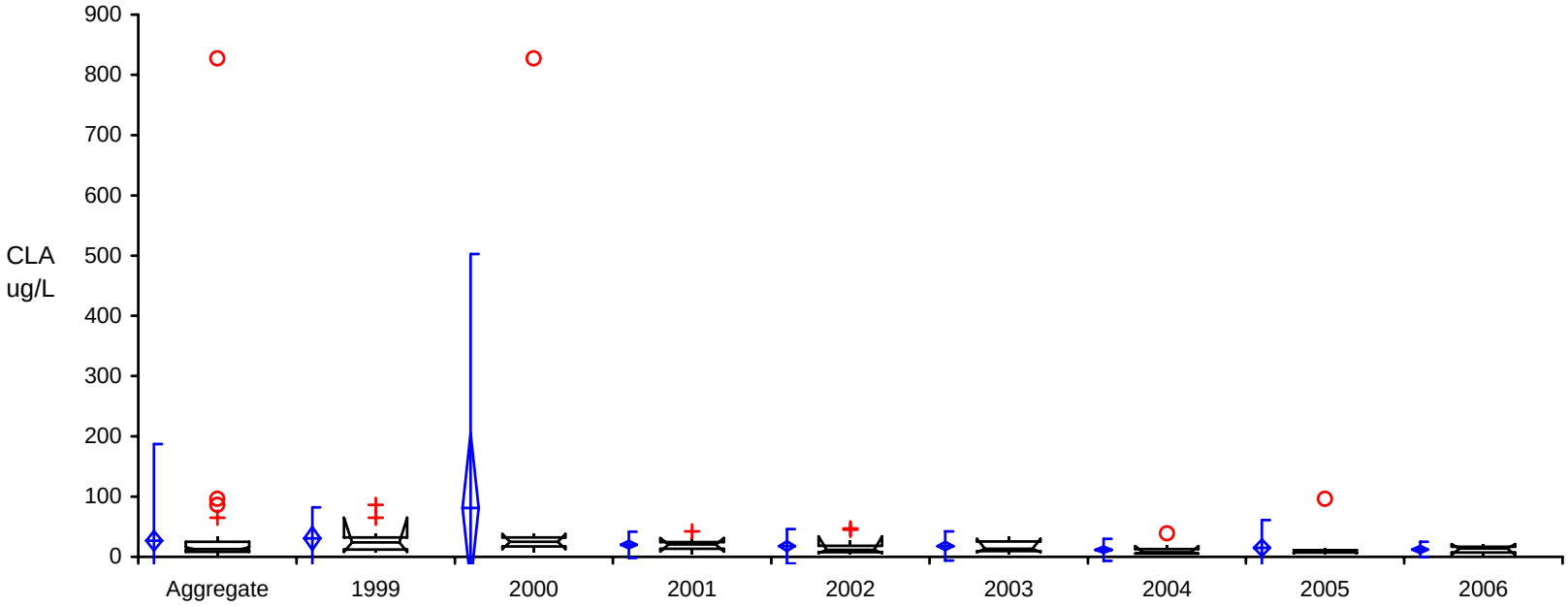
Armstrong Lake - TKN	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	116	1.115	0.6074	0.0564	1.003 to 1.227	1.000	0.428	0.920 to 1.100
1998	15	1.061	0.4167	0.1076	0.831 to 1.292	1.000	0.510	0.780 to 1.400
1999	10	1.217	0.4304	0.1361	0.909 to 1.525	1.100	0.513	0.770 to 1.600
2000	14	1.377	1.4853	0.3970	0.520 to 2.235	0.990	0.288	0.770 to 1.200
2001	14	1.079	0.3168	0.0847	0.896 to 1.262	1.150	0.270	0.920 to 1.300
2002	14	0.916	0.1976	0.0528	0.802 to 1.030	0.885	0.100	0.840 to 1.100
2003	14	1.237	0.3030	0.0810	1.062 to 1.412	1.250	0.400	0.940 to 1.500
2004	14	1.046	0.3470	0.0927	0.845 to 1.246	1.005	0.420	0.750 to 1.400
2005	14	0.855	0.1807	0.0483	0.751 to 0.959	0.830	0.120	0.700 to 1.000
2006	7	1.443	0.4077	0.1541	1.066 to 1.820	1.600	0.650	0.800 to 1.800

Figure 75. Total Kjedahl Nitrogen box plots for Armstrong Lake (1998-2006)



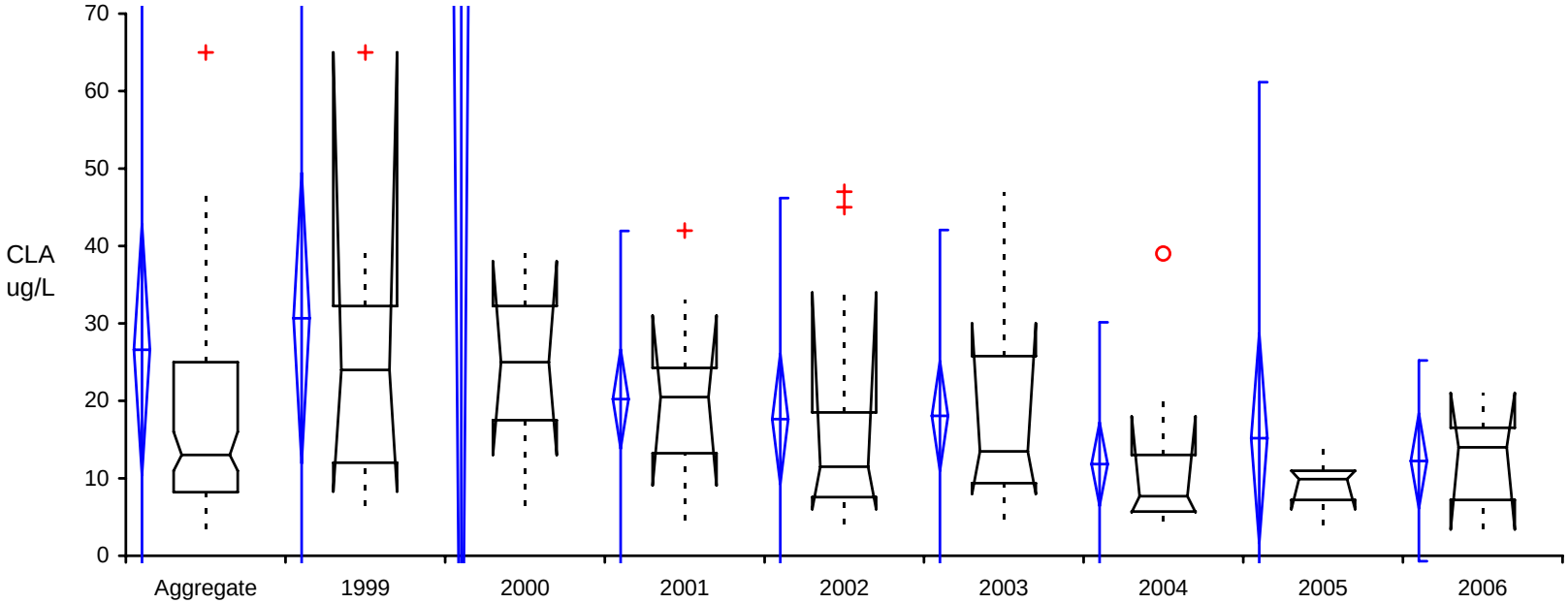
Armstrong Lake - TKN	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	116	1.115	0.6074	0.0564	1.003 to 1.227	1.000	0.428	0.920 to 1.100
1998	15	1.061	0.4167	0.1076	0.831 to 1.292	1.000	0.510	0.780 to 1.400
1999	10	1.217	0.4304	0.1361	0.909 to 1.525	1.100	0.513	0.770 to 1.600
2000	14	1.377	1.4853	0.3970	0.520 to 2.235	0.990	0.288	0.770 to 1.200
2001	14	1.079	0.3168	0.0847	0.896 to 1.262	1.150	0.270	0.920 to 1.300
2002	14	0.916	0.1976	0.0528	0.802 to 1.030	0.885	0.100	0.840 to 1.100
2003	14	1.237	0.3030	0.0810	1.062 to 1.412	1.250	0.400	0.940 to 1.500
2004	14	1.046	0.3470	0.0927	0.845 to 1.246	1.005	0.420	0.750 to 1.400
2005	14	0.855	0.1807	0.0483	0.751 to 0.959	0.830	0.120	0.700 to 1.000
2006	7	1.443	0.4077	0.1541	1.066 to 1.820	1.600	0.650	0.800 to 1.800

Figure 76. Total Kjedahl Nitrogen box plots for Armstrong Lake (1998-2006) without Outliers



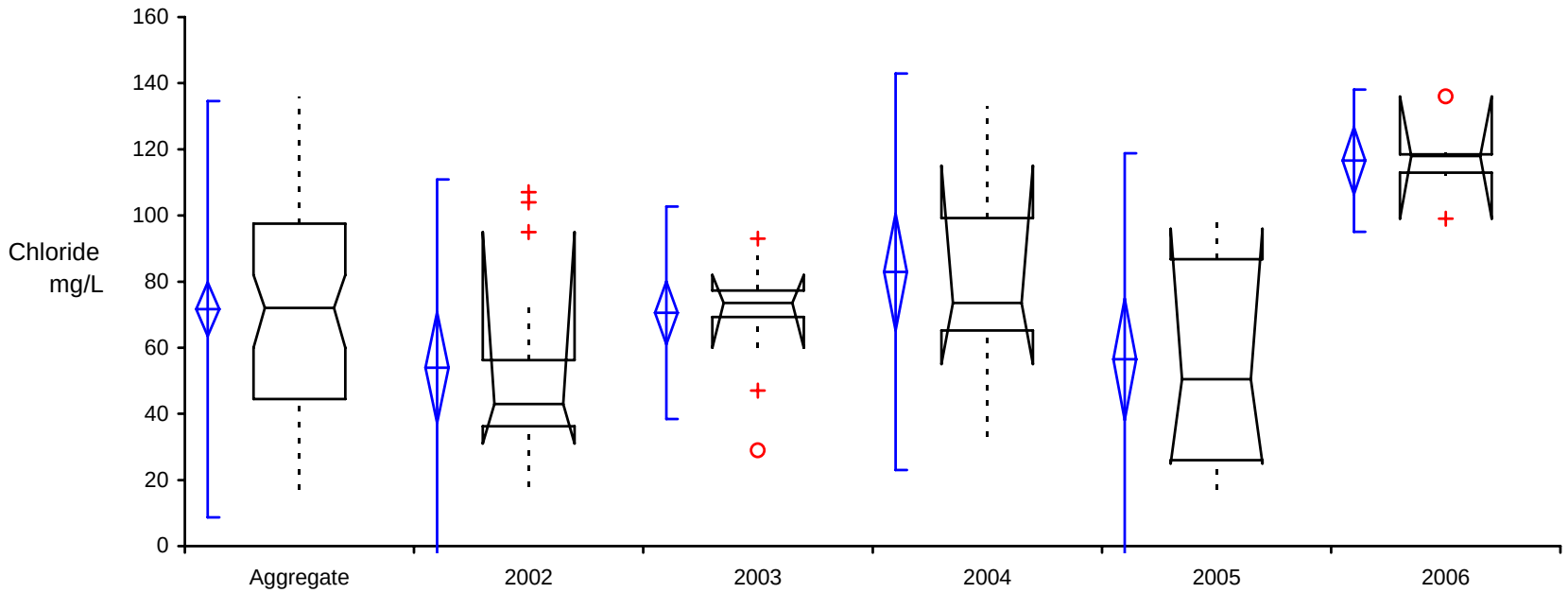
Armstrong Lake - CLA	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	101	26.600	81.9971	8.1590	10.413 to 42.787	13.000	16.800	11.000 to 16.000
1999	10	30.670	26.2199	8.2915	11.913 to 49.427	24.000	20.250	8.300 to 65.000
2000	14	80.914	214.9821	57.4564	-43.213 to 205.041	25.000	14.750	13.000 to 38.000
2001	14	20.243	11.0740	2.9597	13.849 to 26.637	20.500	11.000	9.100 to 31.000
2002	14	17.657	14.5494	3.8885	9.257 to 26.058	11.500	10.950	6.000 to 34.000
2003	14	18.057	12.2413	3.2716	10.989 to 25.125	13.500	16.350	8.000 to 30.000
2004	14	11.829	9.3485	2.4985	6.431 to 17.226	7.700	7.275	5.600 to 18.000
2005	14	15.164	23.4502	6.2673	1.625 to 28.704	9.900	3.775	6.000 to 11.000
2006	7	12.257	6.5987	2.4941	6.154 to 18.360	14.000	9.300	3.400 to 21.000

Figure 77. Chlorophyll-a box plots for Armstrong Lake (1999-2006)



Armstrong Lake - CLA	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	101	26.600	81.9971	8.1590	10.413 to 42.787	13.000	16.800	11.000 to 16.000
1999	10	30.670	26.2199	8.2915	11.913 to 49.427	24.000	20.250	8.300 to 65.000
2000	14	80.914	214.9821	57.4564	-43.213 to 205.041	25.000	14.750	13.000 to 38.000
2001	14	20.243	11.0740	2.9597	13.849 to 26.637	20.500	11.000	9.100 to 31.000
2002	14	17.657	14.5494	3.8885	9.257 to 26.058	11.500	10.950	6.000 to 34.000
2003	14	18.057	12.2413	3.2716	10.989 to 25.125	13.500	16.350	8.000 to 30.000
2004	14	11.829	9.3485	2.4985	6.431 to 17.226	7.700	7.275	5.600 to 18.000
2005	14	15.164	23.4502	6.2673	1.625 to 28.704	9.900	3.775	6.000 to 11.000
2006	7	12.257	6.5987	2.4941	6.154 to 18.360	14.000	9.300	3.400 to 21.000

Figure 78. Chlorophyll-a box plots for Armstrong Lake (1999-2006) without Outliers



Armstrong Lake - Total Chloride	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	63	71.619	32.1174	4.0464	63.530 to 79.708	72.000	53.000	60.000 to 82.000
2002	14	54.000	29.0040	7.7516	37.254 to 70.746	43.000	20.000	31.000 to 95.000
2003	14	70.571	16.3975	4.3824	61.104 to 80.039	73.500	8.000	60.000 to 82.000
2004	14	82.929	30.5802	8.1729	65.272 to 100.585	73.500	34.000	55.000 to 115.000
2005	14	56.500	31.7993	8.4987	38.140 to 74.860	50.500	60.750	25.000 to 96.000
2006	7	116.571	10.9827	4.1511	106.414 to 126.729	118.000	5.500	99.000 to 136.000

Figure 79. Total Chloride box plots for Armstrong Lake (1998-2006)

Powers Lake

Vital Statistics:

DNR ID #: 82-0092
LOCATION: SW$^{1/4}$ Section 11 T28N-R21W
MUNICIPALITY: City of Woodbury
LAKE SIZE: 54 acres
ORDINARY HIGH WATER MARK: 891.3 ft

Powers Lake was monitored from April 17 to October 17, 2006, in accordance with the Metropolitan Council Citizen-Assisted Monitoring Program (CAMP). Monitoring consisted of 14 biweekly lake gage readings and samplings of Secchi disk, surface total phosphorus, surface total Kjeldahl nitrogen, surface chlorophyll-*a*, surface total chloride ion, hypolimnion chloride, hypolimnion total phosphorus, and hypolimnion total Kjeldahl nitrogen. In addition, a temperature and dissolved oxygen profile was taken during each sampling round. The Metropolitan Council Lab analyzed the samples.

Table 32 gives the Powers Lake 2005 high, low, and average lake levels. Individual lake level readings are shown in Figure 80.

Table 32. Powers 2005 Lake Level

	High	High Date	Low	Low Date	Average
Lake Level (ft)	891.15	5/17/06	889.63	7/25/06	890.64

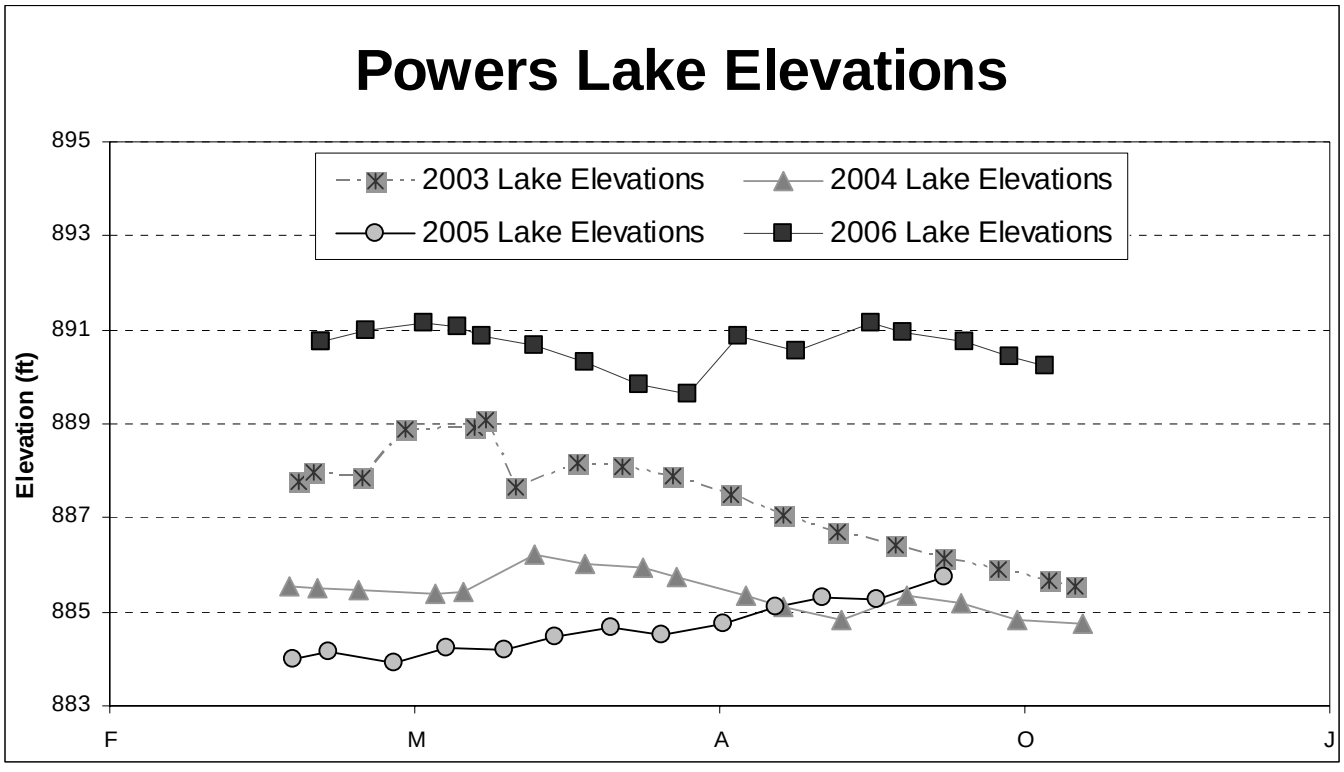


Figure 80. Powers Lake Elevations 2003-06

Table 33 gives the 2006 Powers Lake monitoring chemistry results and Secchi disk readings for the 2006 water-monitoring season.

Table 33. Powers 2006 Monitoring Results

Date & Time	Secchi (m)	Surface TP (mg/L)	Surface TKN (mg/L)	Surface CLA (ug/L)	Surface Chloride	Surface Temperature (C)	Surface Dissolved Oxygen	Hypolimnion Chloride	Hypolimnion TKN (mg/L)	Hypolimnion TP (mg/L)
4/17/2006	1.83	0.038	1.1	20	30	15.7	7.95			
5/2/2006	1.37	0.034	1.0	12	31	17.8	7.51			
5/17/2006	1.22	0.033	1.0	25	**NA**	19.7	6.30	**NA**	1.3	0.265
6/1/2006	1.98	0.024	1.0	6	35	10.4	6.30	45	1.4	0.332
6/15/2006	0.91	0.051	1.1	14	35	25.3	10.53			
6/28/2006	1.22	0.092	1.5	29	36	27.8	9.40	43	2.1	0.499
7/12/2006	1.22	0.040	1.6	16	36	28.3	8.39			
7/25/2006	1.22	0.047	1.5	12	28	27.3	10.32	44	2.2	0.429
8/7/2006	3.35	0.159	1.9	28	36	24.6	6.27			
8/22/2006	1.07	0.013	1.0	34	**NA**	24.0	10.44	46	2.0	0.329
9/11/2006	1.68	0.028	1.6	29	35	23.5	10.19			
9/19/2006	2.13	0.041	1.0	23	34	11.9	8.84	42	3.1	0.376
10/5/2006	2.59	0.136	1.3	14	34	15.5	11.16			
10/17/2006	2.90	0.152	1.7	8	15	15.2	9.60	**NA**	2.3	0.164
2006 Averages	1.76	0.063	1.3	19	32	20.5	8.80	44	2.1	0.342
2006 Summer Averages	1.64	0.055	1.4	21	34	22.6	8.96	44	2.2	0.393

Table 34 shows the Powers Lake Water Quality Summary. Powers Lake received an average lake grade of a C for 2006.

Table 34. Lake Grade and Trophic Status

	Trophic Status (2005 Summer Average)	Lake Grade (2005 Summer Average)	Trophic Status (2006 Summer Average)	Lake Grade (2006 Summer Average)
Total Phosphorus (mg/L)	Eutrophic	C	Eutrophic	C
Chlorophyll-a (ug/L)	Eutrophic	C	Eutrophic	C
Secchi disk (ft)	Eutrophic	C	Eutrophic	C
Overall	Eutrophic	C	Eutrophic	C

Figure 81-89 compare the lake chemistry data and Secchi disk readings.

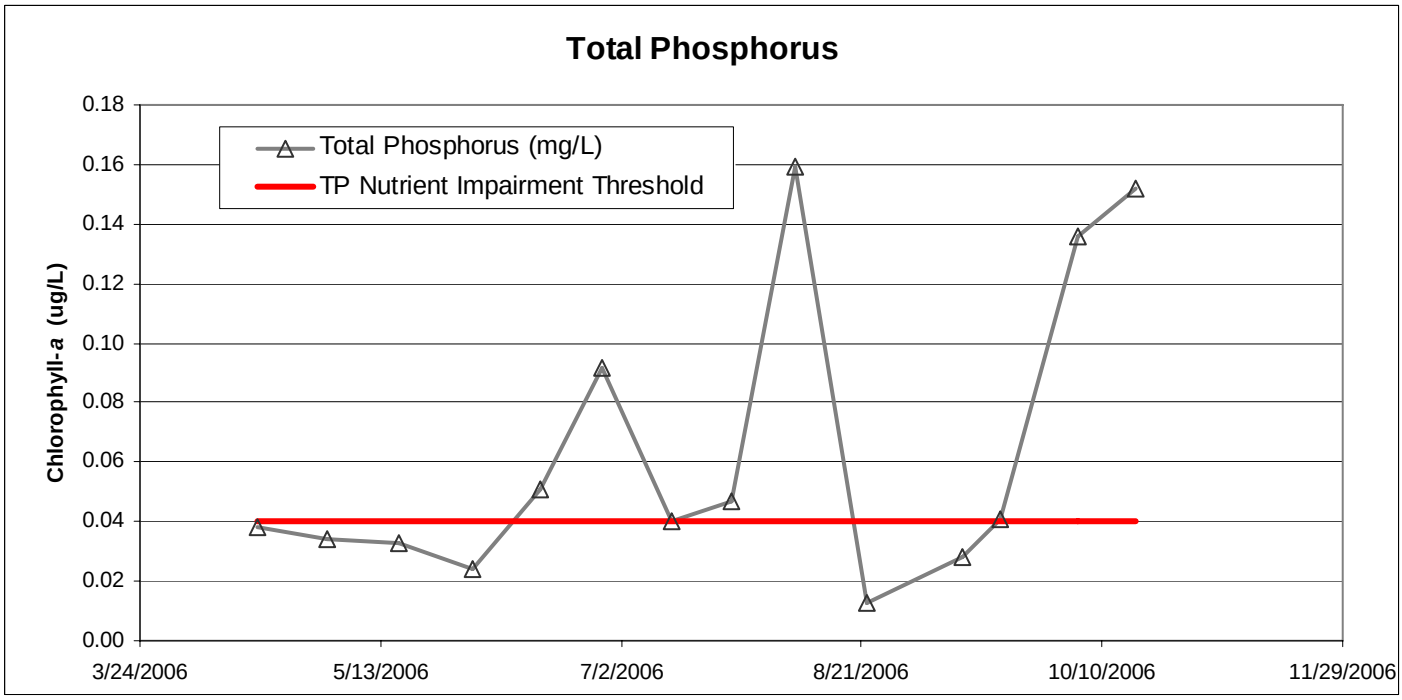


Figure 81. Surface Total Phosphorus and Nutrient Impairment Threshold

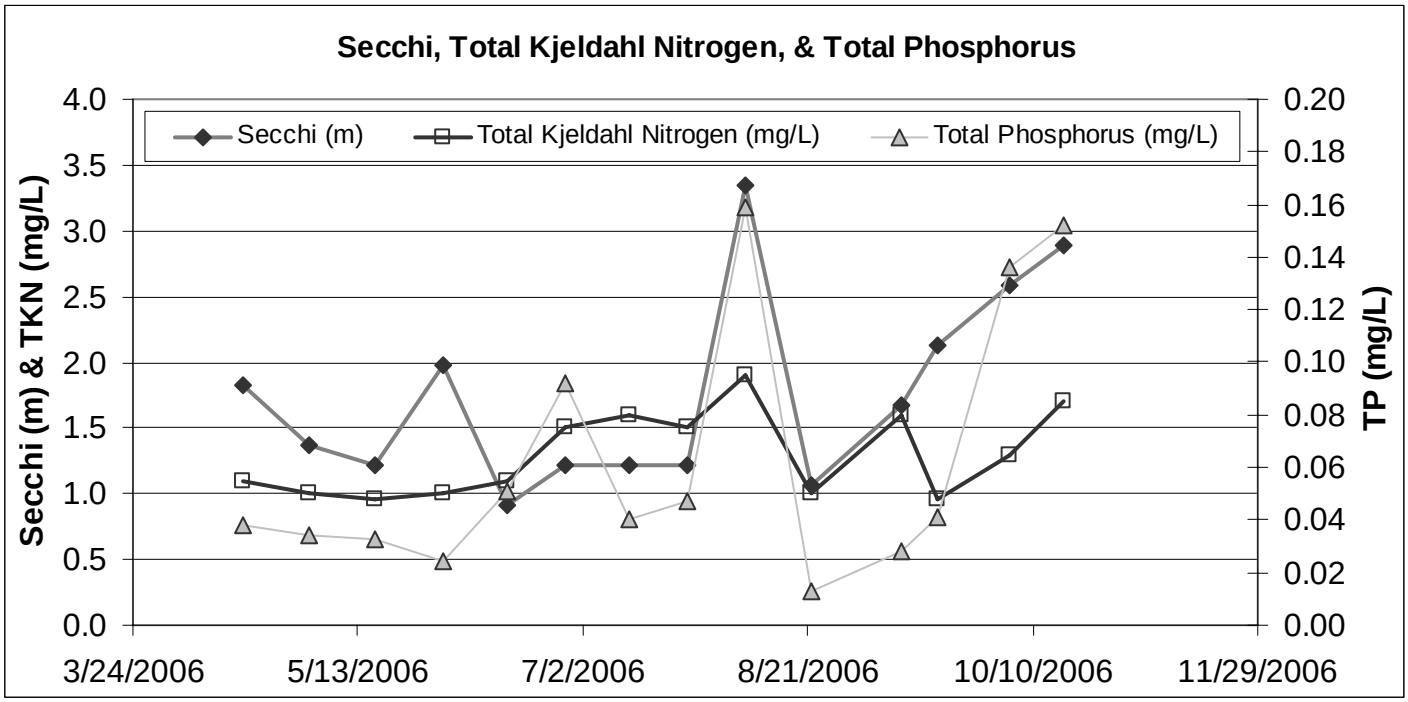


Figure 82. Secchi, Total Kjeldahl Nitrogen and Chlorophyll-*a*

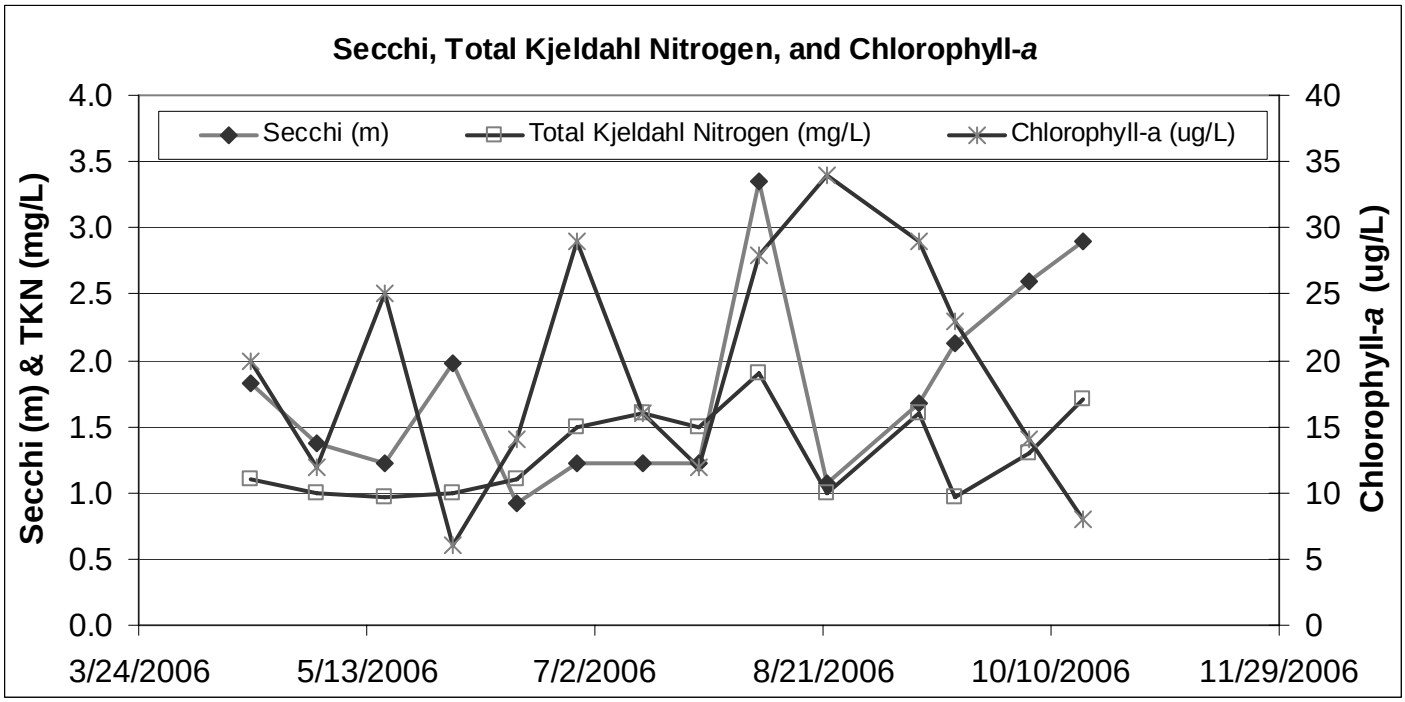


Figure 83. Secchi, Total Kjeldahl Nitrogen, and Total Phosphorus

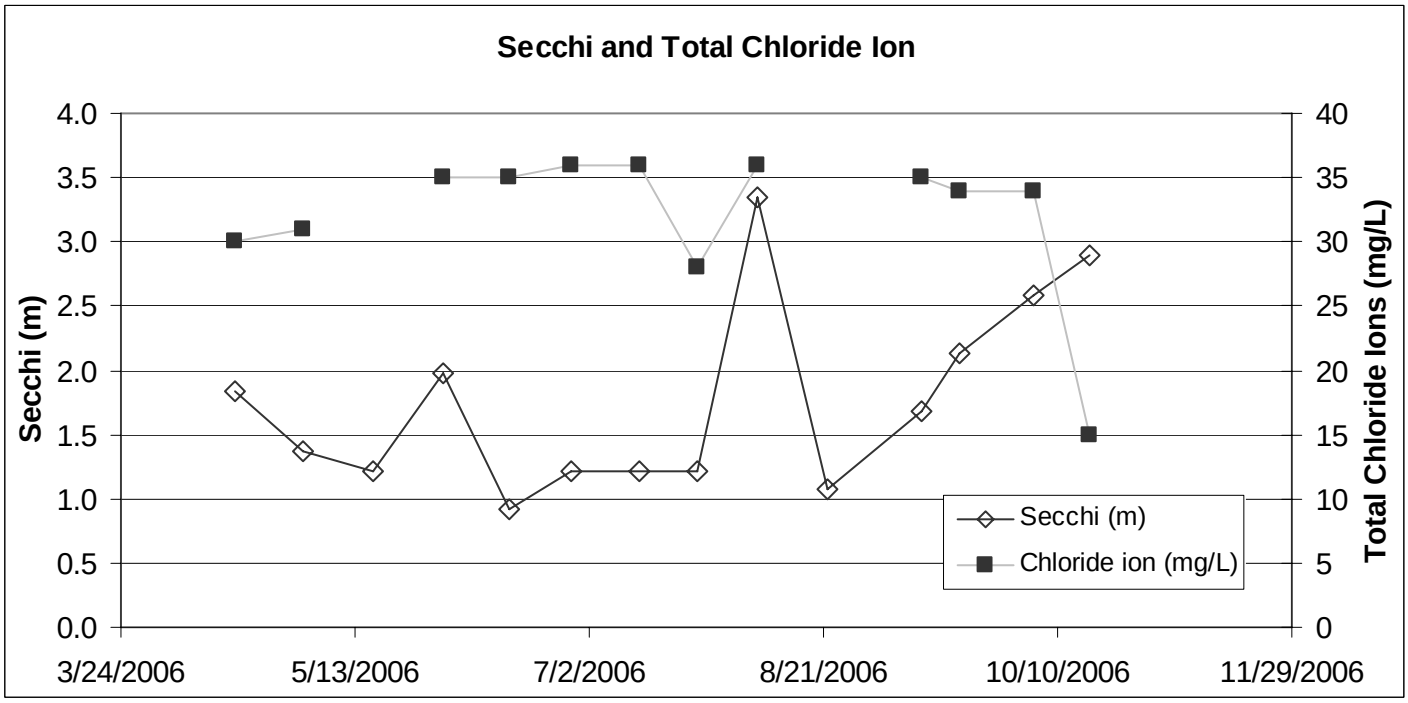


Figure 84. Secchi and Chloride ion

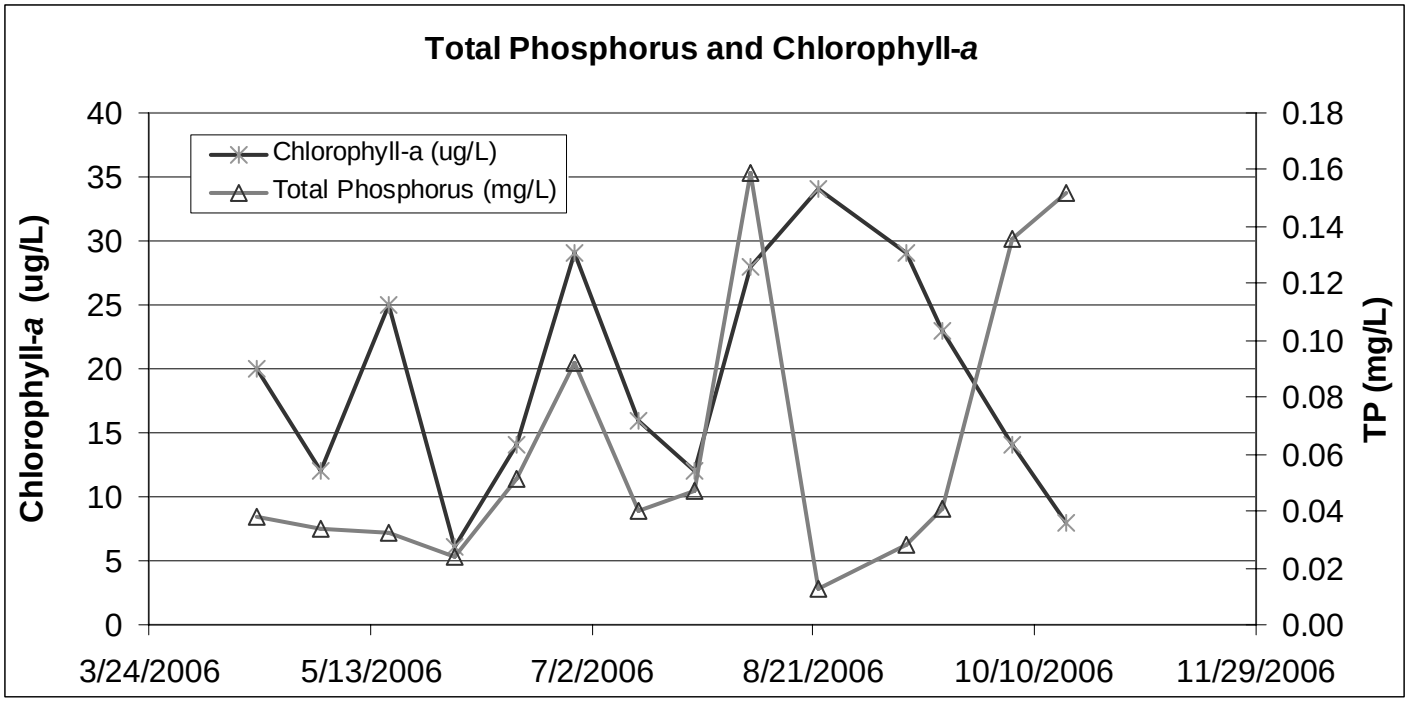


Figure 85. Total Phosphorous and Chlorophyll *a*

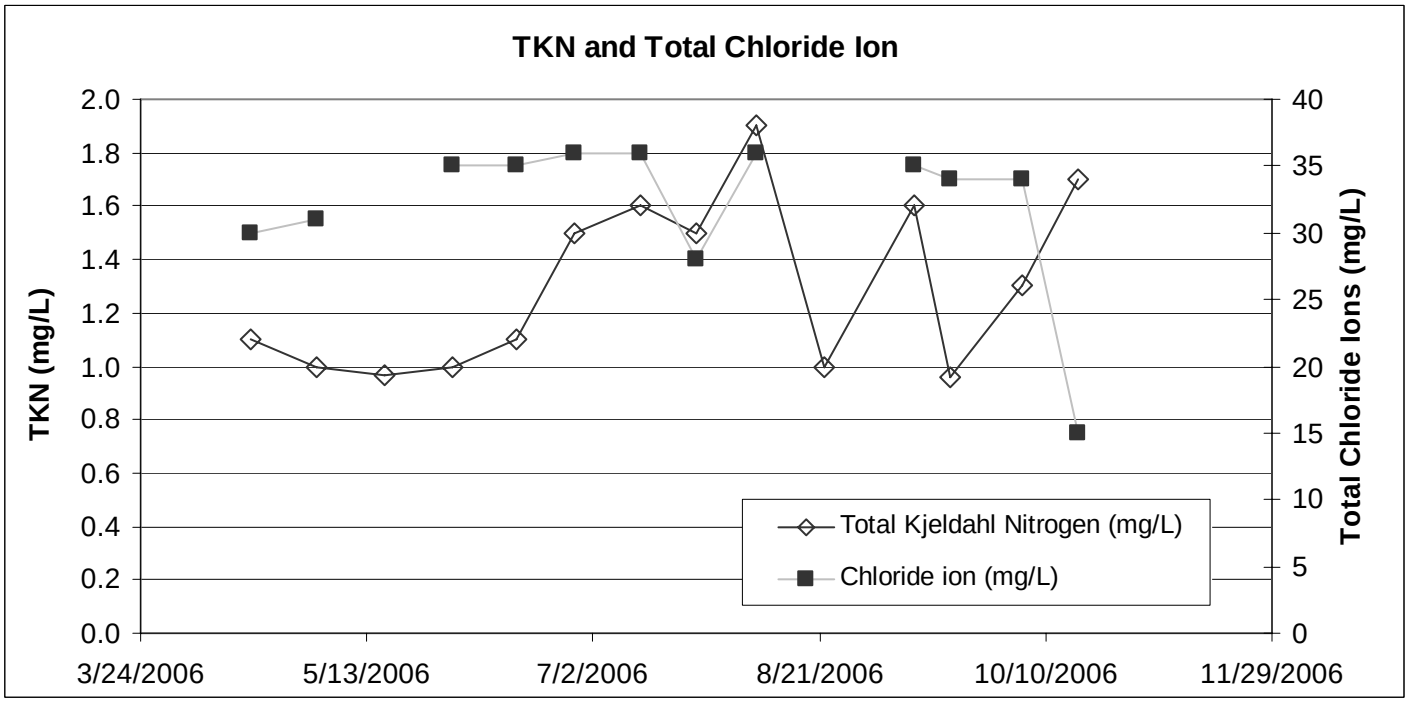


Figure 86. Total Kjeldahl Nitrogen and Chloride ion

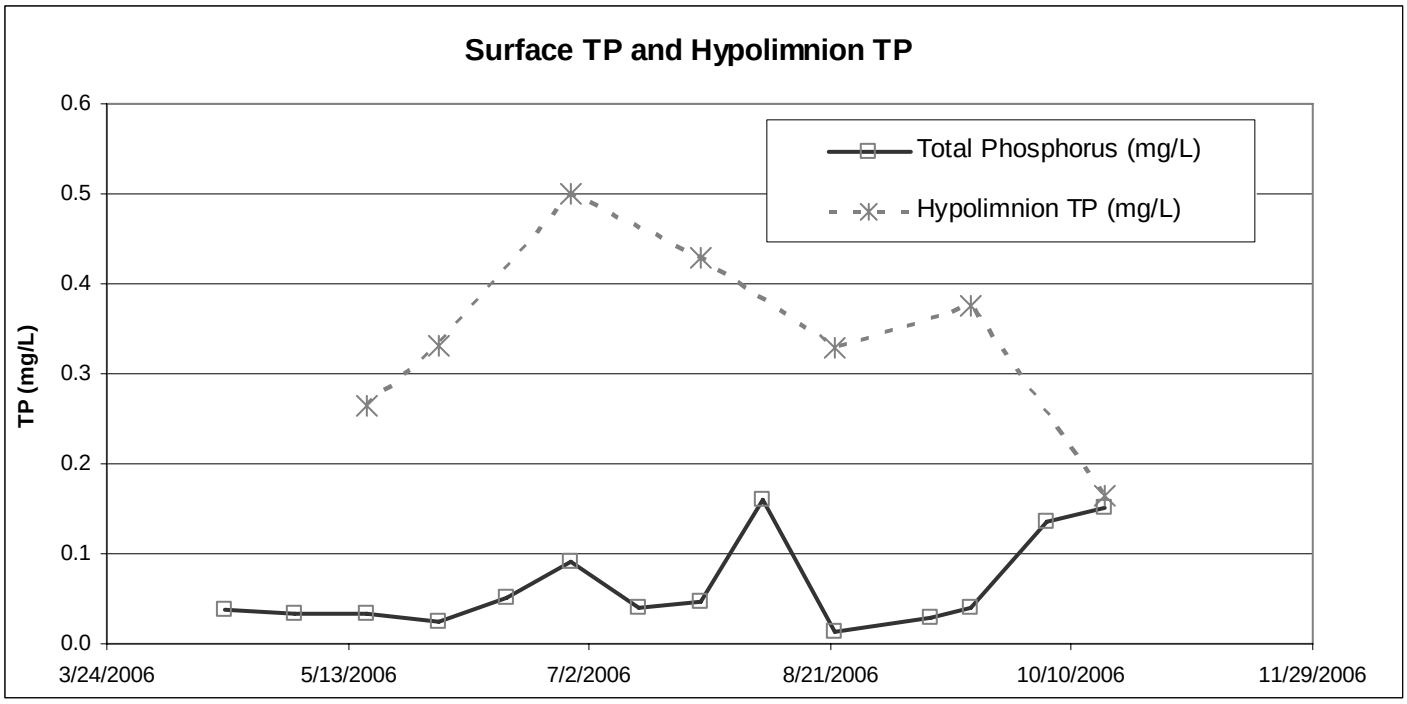


Figure 87. Surface Total Phosphorus and Hypolimnion Total Phosphorus

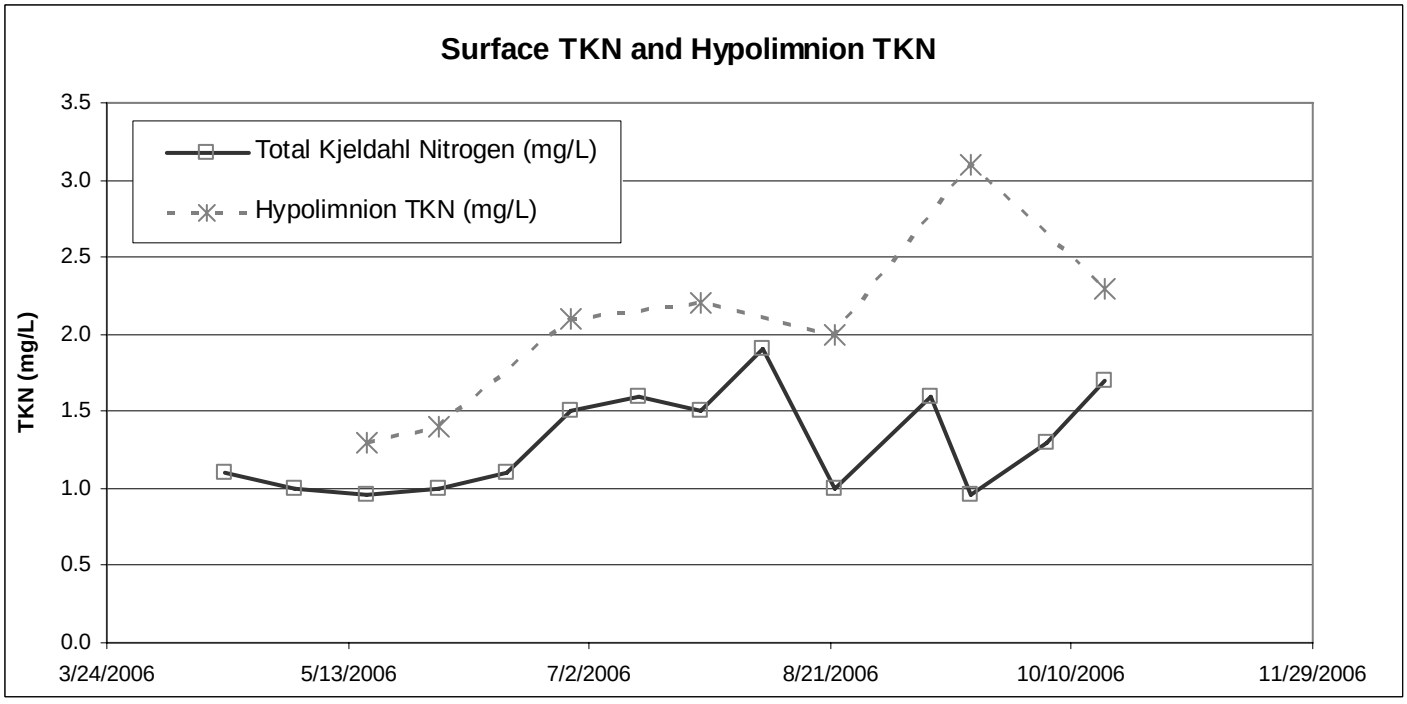


Figure 88. Surface Total Kjeldahl Nitrogen and Hypolimnion Total Kjedahl Nitrogen

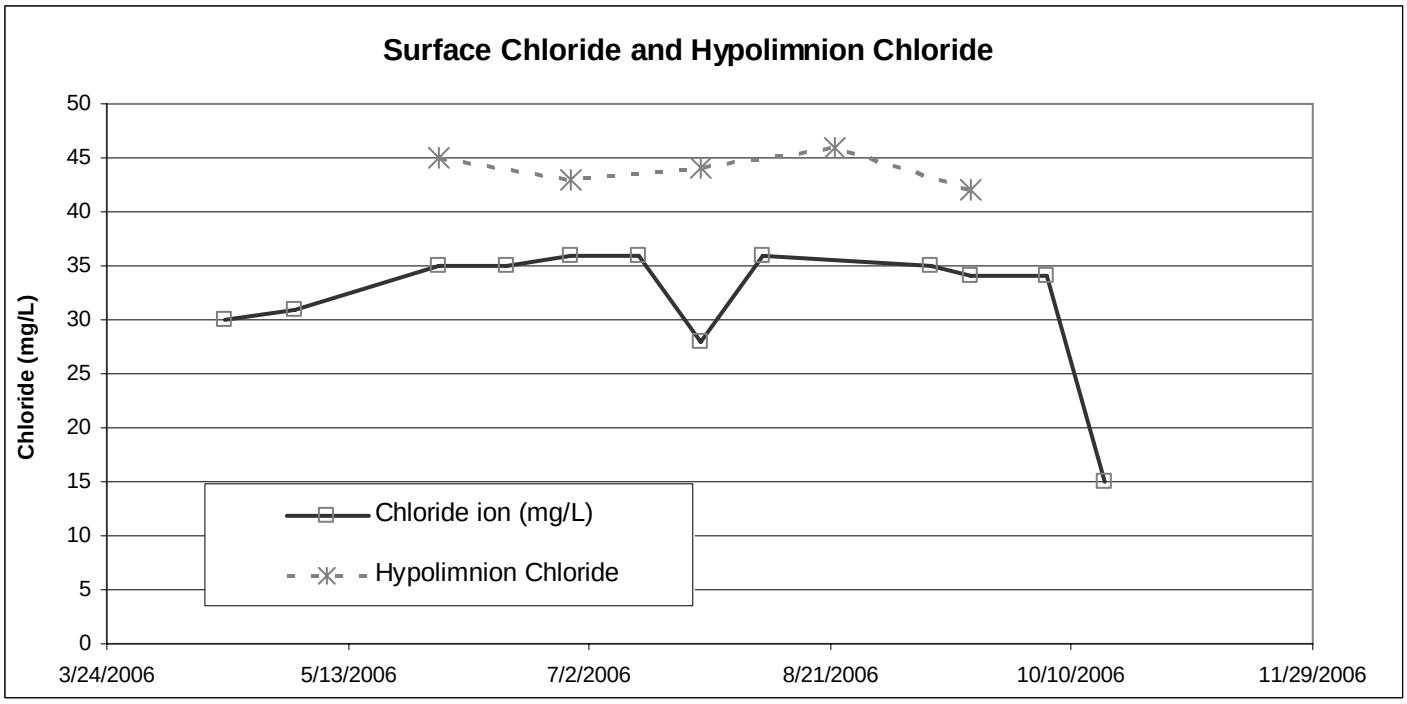


Figure 89. Surface Chloride Ion and Hypolimnion Chloride Ion

Table 35 lists the dissolved oxygen and temperature profiles. The maximum depth was approximately 14 meters depending on the level of the lake at the time of sampling. A thermocline was present between 3 and 4 meters during the majority of the monitoring season. The surface dissolved oxygen and surface temperatures are shown in Figure 90. Due to equipment failure, DO probe was not able to take measurements past 7 meters on 6/1/2006.

Table 35. Dissolved Oxygen and Temperature Profiles

Date	4/17/2006		5/2/2006		5/17/2006		6/1/2006		6/15/2006		6/28/2006		7/12/2006	
Depth	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)
0	8.84	11.9	9.60	15.2	11.16	15.5	6.27	24.6	10.19	23.5	10.44	24.0	10.32	27.3
1	8.72	11.8	9.63	14.0	11.10	15.3	6.17	24.6	10.25	23.5	10.26	23.7	10.47	26.8
2	8.79	11.8	9.49	13.5	10.10	14.9	6.05	24.3	11.77	22.1	9.46	23.7	9.97	26.4
3	8.75	11.8	9.44	13.3	10.13	14.8	7.95	20.9	10.59	21.6	9.56	23.6	9.89	25.8
4	8.67	11.7	9.16	13.1	9.65	13.7	7.36	16.7	6.76	18.9	0.25	19.3	0.17	20.9
5	8.46	10.4	8.20	12.7	8.80	13.1	4.93	14.5	4.78	15.9	0.05	15.0	0.12	14.7
6	8.09	7.7	5.80	9.7	6.98	11.9	3.89	12.3	1.60	12.2	0.04	11.9	0.10	12.3
7	6.96	6.0	4.31	6.9	2.47	8.1	0.25	8.8	0.11	9.2	0.05	8.8	0.11	9.6
8	5.26	5.3	0.90	5.5	0.45	6.4			0.07	7.6	0.04	7.4	0.10	7.9
9	4.66	5.1	0.51	5.4	0.44	5.8			0.06	6.9	0.04	6.8	0.09	7.1
10	3.73	5.0	0.45	5.2	0.43	5.6			0.05	6.3	0.04	6.5	0.07	6.8
11	3.66	5.0	0.44	5.2	0.42	5.5			0.04	6.2	0.04	6.4	0.08	6.6
12	3.64	4.9	0.44	5.2	0.42	5.4			0.04	6.1	0.04	6.3	0.08	6.5
13	3.62	5.0	0.43	5.2	0.40	5.4			0.03	6.0	0.03	6.3	0.06	6.5
14	3.76	5.0	0.41	5.4										
15														
Top of Thermocline (m)	7		6		6		3		4		4		4	

Date	7/25/2006		8/7/2006		8/22/2006		9/11/2006		9/19/2006		10/5/2006		10/17/2006	
Depth	D.O.	Temp	D.O.	Temp	D.O.	Temp	D.O.	Temp	D.O.	Temp	D.O.	Temp	D.O.	Temp
0	8.39	28.3	9.40	27.8	10.53	25.3	6.30	19.7	7.51	17.8	7.95	15.7	6.30	10.4
1	8.75	27.8	9.34	27.6	11.06	24.7	5.74	19.7	7.64	17.8	7.91	15.8	6.34	10.3
2	9.00	27.1	8.37	26.6	10.15	24.6	6.13	19.7	7.31	17.8	7.83	15.7	6.11	10.3
3	8.25	25.8	7.76	26.4	6.29	24.1	6.29	19.7	7.22	17.8	7.28	15.7	5.42	10.2
4	0.43	20.4	1.75	25.8	2.84	23.7	6.00	19.7	7.31	17.8	5.43	15.3	5.34	10.1
5	0.10	15.8	0.08	18.4	0.11	19.7	0.12	15.1	7.32	17.8	4.83	15.0	5.50	10.1
6	0.09	8.9	0.06	13.2	0.09	14.4	0.08	11.5	4.92	17.4	0.66	14.2	5.44	10.1
7	0.07	7.9	0.07	10.6	0.07	9.6	0.07	9.2	0.14	11.8	0.19	11.5	4.92	10.0
8	0.10	11.1	0.07	8.4	0.07	8.4	0.06	8.4	0.08	9.7	0.10	9.2	4.47	9.9
9	0.07	7.3	0.05	7.7	0.07	7.8	0.06	7.6	0.07	8.5	0.09	8.1	3.03	9.8
10	0.06	7.1	0.06	7.4	0.06	7.4	0.05	7.4	0.06	8.3	0.09	7.7	1.99	9.7
11	0.06	6.9	0.05	7.1	0.07	7.2	0.04	7.3	0.05	7.9	0.07	7.6	0.07	9.0
12	0.06	6.8	0.06	6.9	0.05	7.1	0.04	7.2	0.05	7.6	0.07	7.6	0.05	7.8
13	0.06	6.8	0.06	7.1	0.05	7.0	0.04	7.2	0.04	7.4	0.06	7.6	0.03	7.5
14					0.05	7.0			0.03	7.3	0.06	7.6	0.52	10.3
15														
Top of Thermocline (m)	4		5		5		5		7		7		12	

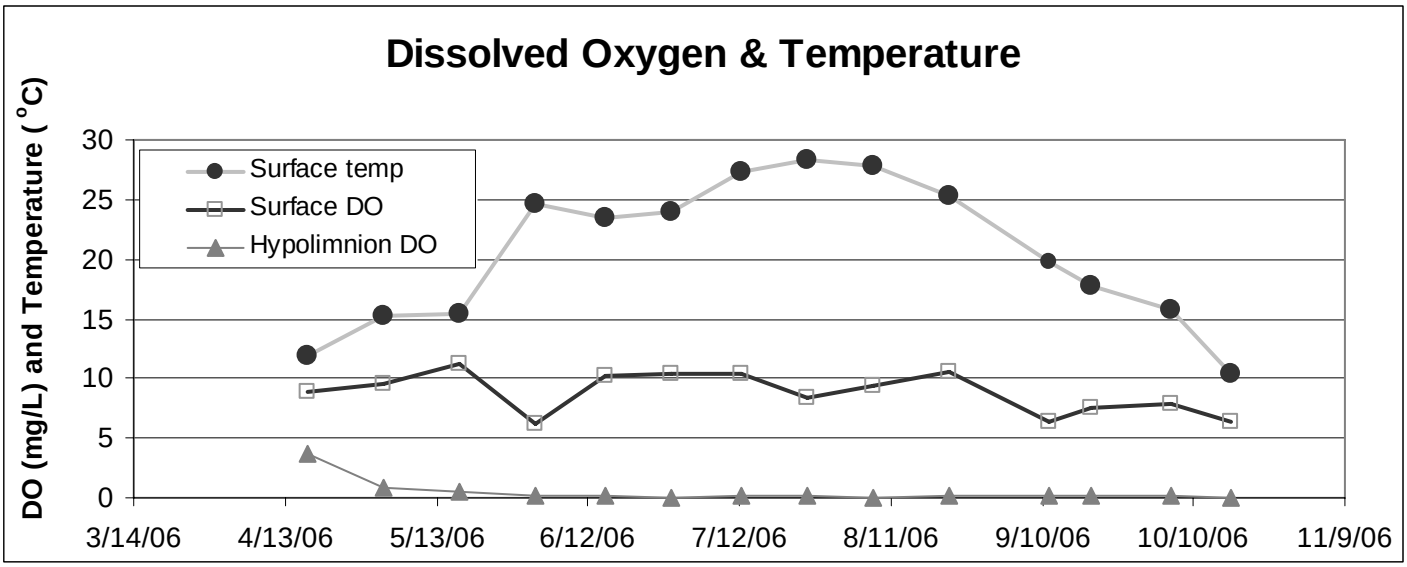
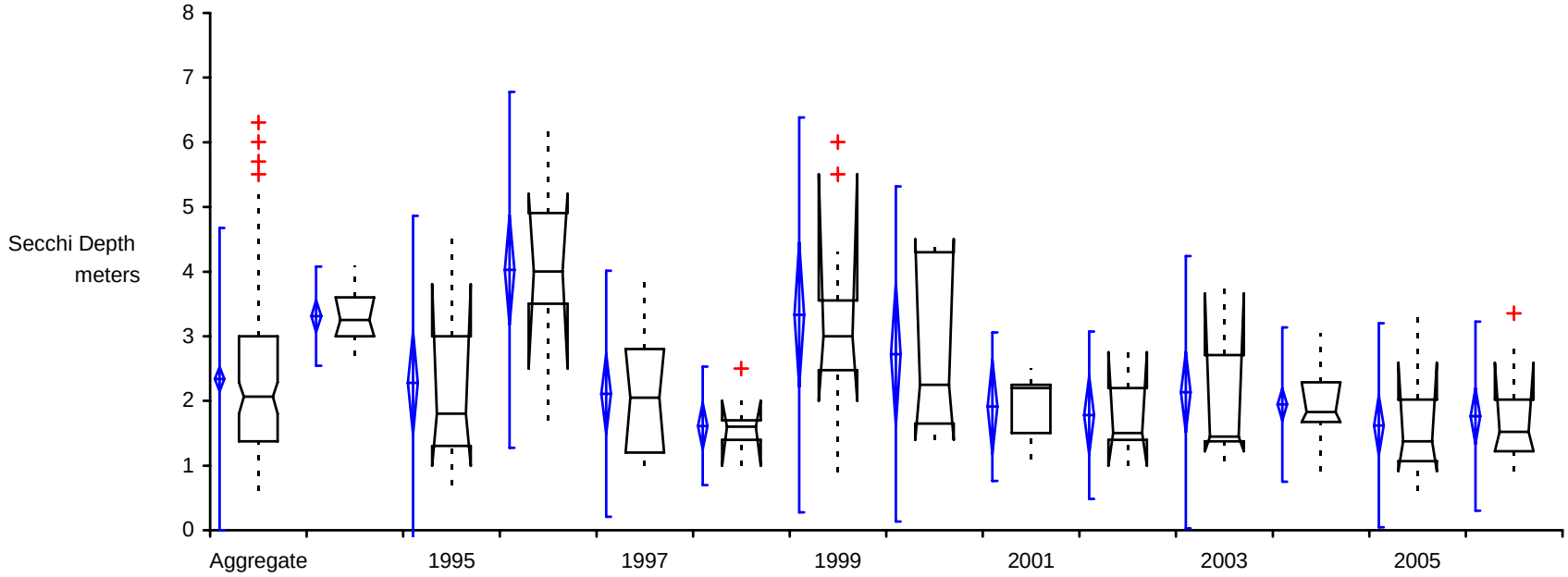


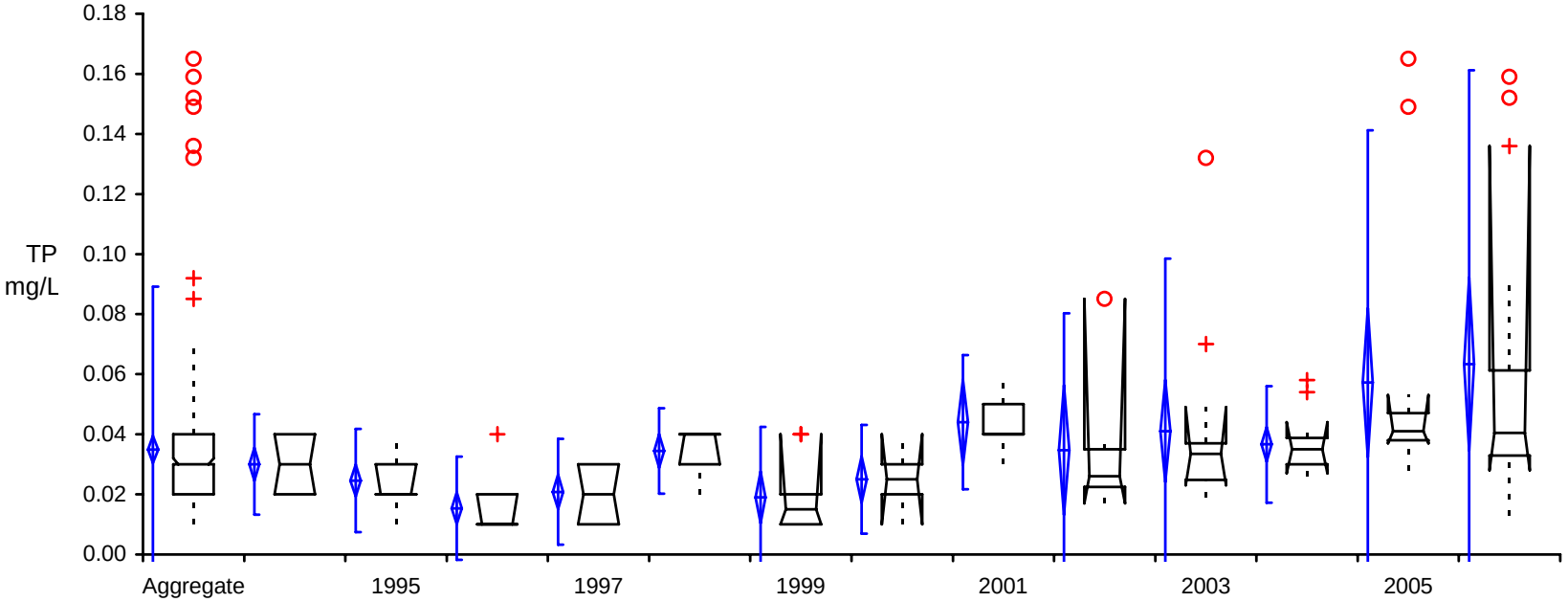
Figure 90. Surface Dissolved Oxygen, Hypolimnion Dissolved Oxygen, and Surface Temperatures

Box plot statistical summaries for Powers Lake are included in Figures 91-96. Secchi disk median values has no apparent trend since 1994. During the monitoring seasons of 1996 and 1999, a large increase in the Secchi disk median value occurred. This is paired with the lowest median values for total phosphorous and chlorophyll-a. Total phosphorus and total Kjedahl nitrogen has a slight increase trend over time. Chlorophyll-a has no discernible trend in median values, the same with total chloride ions.



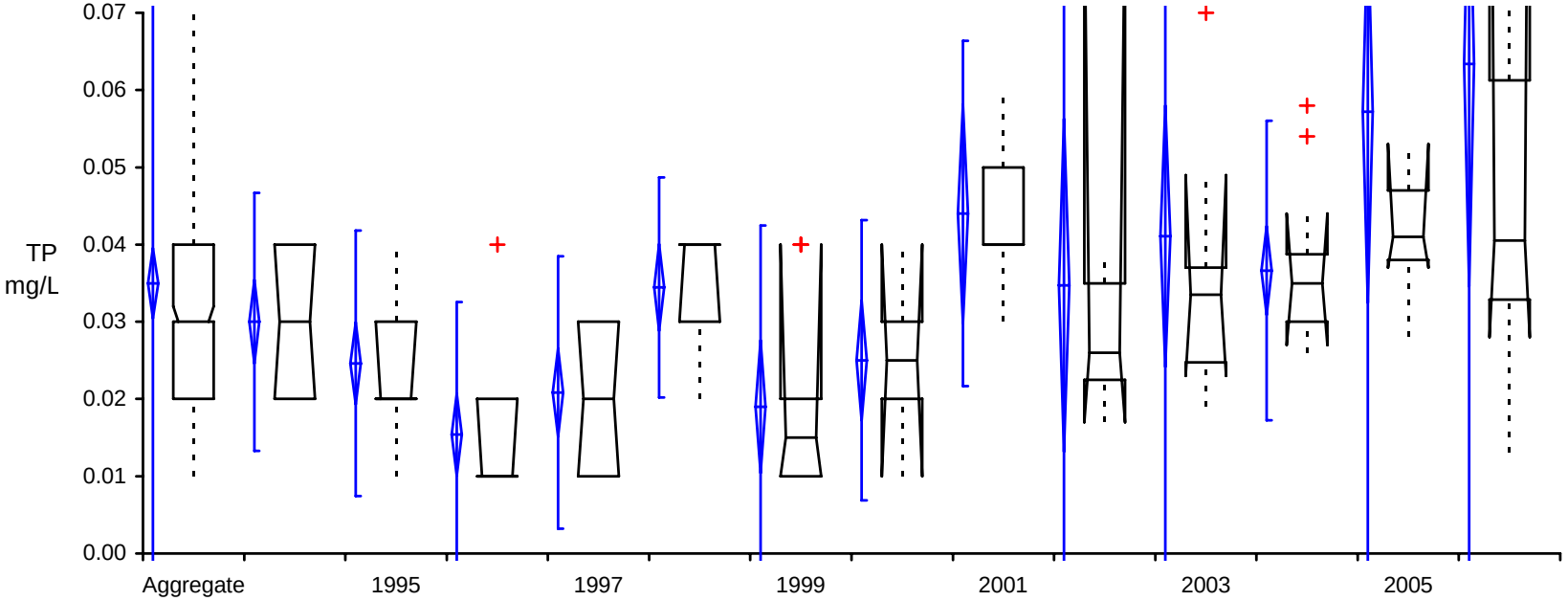
Powers Lake - Secchi Depth	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	156	2.337	1.1918	0.0954	2.148 to 2.525	2.067	1.629	1.803 to 2.290
1994	12	3.310	0.3898	0.1125	3.063 to 3.558	3.253	0.601	3.001 to 3.602
1995	13	2.279	1.3183	0.3656	1.482 to 3.075	1.803	1.699	1.000 to 3.803
1996	13	4.026	1.4044	0.3895	3.177 to 4.874	4.002	1.403	2.501 to 5.203
1997	12	2.110	0.9710	0.2803	1.493 to 2.727	2.053	1.601	1.202 to 2.803
1998	9	1.612	0.4678	0.1559	1.252 to 1.972	1.601	0.302	1.000 to 2.001
1999	10	3.332	1.5585	0.4929	2.217 to 4.447	3.001	1.076	2.001 to 5.502
2000	8	2.725	1.3231	0.4678	1.619 to 3.831	2.250	2.650	1.400 to 4.500
2001	5	1.910	0.5857	0.2619	1.183 to 2.637	2.200	0.750	- to -
2002	7	1.779	0.6595	0.2493	1.169 to 2.388	1.500	0.800	1.000 to 2.750
2003	14	2.135	1.0735	0.2869	1.515 to 2.755	1.449	1.336	1.220 to 3.660
2004	25	1.945	0.6085	0.1217	1.693 to 2.196	1.829	0.610	1.676 to 2.286
2005	14	1.622	0.8056	0.2153	1.157 to 2.087	1.372	0.953	0.914 to 2.591
2006	14	1.763	0.7459	0.1994	1.333 to 2.194	1.524	0.800	1.219 to 2.591

Figure 91. Secchi Disk box plots for Powers Lake (1994-2006)



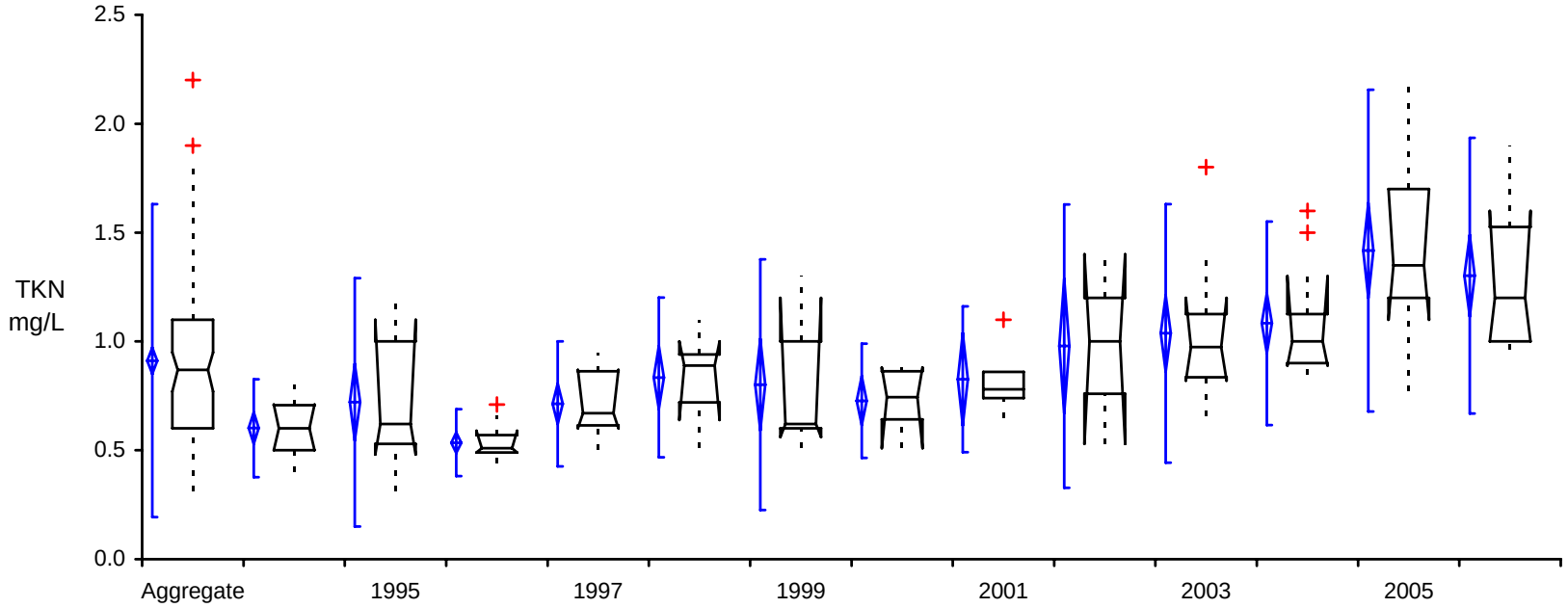
Powers Lake - TP	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	145	0.035	0.0276	0.0023	0.030 to 0.039	0.030	0.020	0.030 to 0.032
1994	12	0.030	0.0085	0.0025	0.025 to 0.035	0.030	0.020	0.020 to 0.040
1995	13	0.025	0.0088	0.0024	0.019 to 0.030	0.020	0.010	0.020 to 0.030
1996	13	0.015	0.0088	0.0024	0.010 to 0.021	0.010	0.010	0.010 to 0.020
1997	12	0.021	0.0090	0.0026	0.015 to 0.027	0.020	0.020	0.010 to 0.030
1998	9	0.034	0.0073	0.0024	0.029 to 0.040	0.040	0.010	0.030 to 0.040
1999	10	0.019	0.0120	0.0038	0.010 to 0.028	0.015	0.010	0.010 to 0.040
2000	8	0.025	0.0093	0.0033	0.017 to 0.033	0.025	0.010	0.010 to 0.040
2001	5	0.044	0.0114	0.0051	0.030 to 0.058	0.040	0.010	- to -
2002	7	0.035	0.0233	0.0088	0.013 to 0.056	0.026	0.013	0.017 to 0.085
2003	14	0.041	0.0293	0.0078	0.024 to 0.058	0.034	0.012	0.023 to 0.049
2004	14	0.037	0.0099	0.0026	0.031 to 0.042	0.035	0.009	0.027 to 0.044
2005	14	0.057	0.0429	0.0115	0.032 to 0.082	0.041	0.009	0.037 to 0.053
2006	14	0.063	0.0499	0.0133	0.035 to 0.092	0.041	0.028	0.028 to 0.136

Figure 92. Total Phosphorus box plots for Powers Lake (1994-2006)



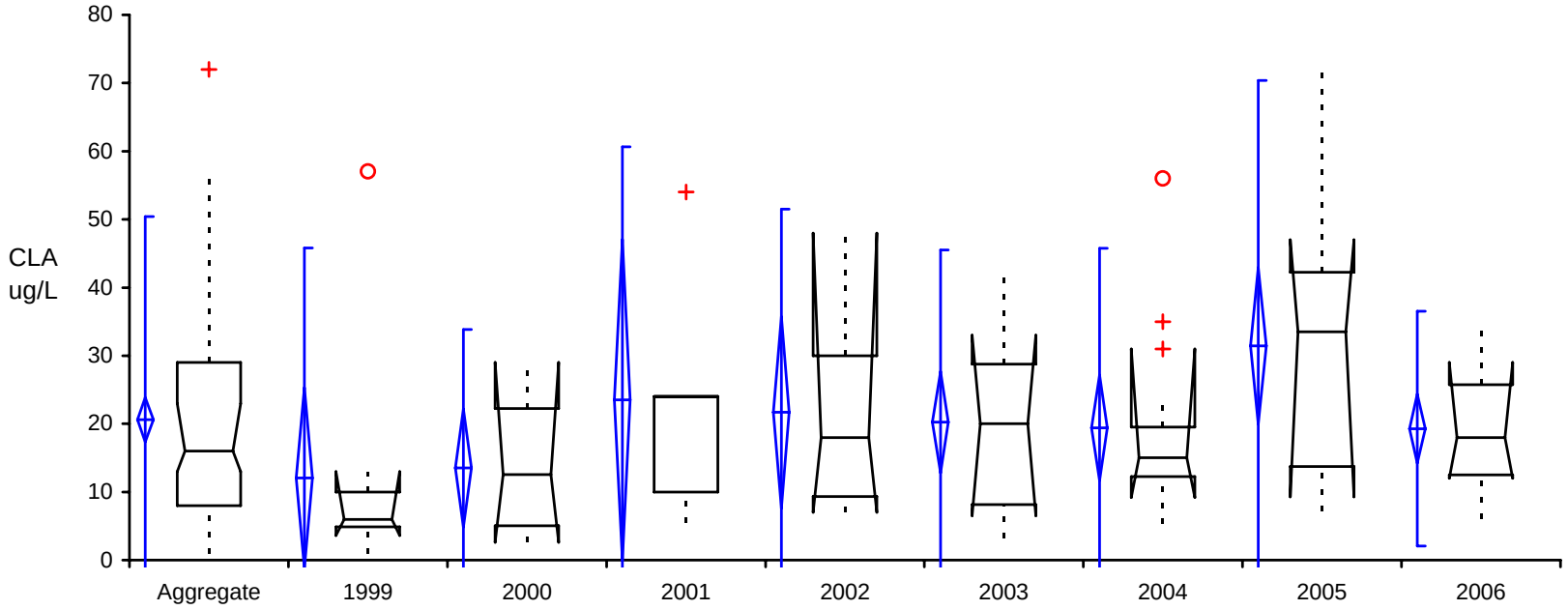
Powers Lake - TP	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	145	0.035	0.0276	0.0023	0.030 to 0.039	0.030	0.020	0.030 to 0.032
1994	12	0.030	0.0085	0.0025	0.025 to 0.035	0.030	0.020	0.020 to 0.040
1995	13	0.025	0.0088	0.0024	0.019 to 0.030	0.020	0.010	0.020 to 0.030
1996	13	0.015	0.0088	0.0024	0.010 to 0.021	0.010	0.010	0.010 to 0.020
1997	12	0.021	0.0090	0.0026	0.015 to 0.027	0.020	0.020	0.010 to 0.030
1998	9	0.034	0.0073	0.0024	0.029 to 0.040	0.040	0.010	0.030 to 0.040
1999	10	0.019	0.0120	0.0038	0.010 to 0.028	0.015	0.010	0.010 to 0.040
2000	8	0.025	0.0093	0.0033	0.017 to 0.033	0.025	0.010	0.010 to 0.040
2001	5	0.044	0.0114	0.0051	0.030 to 0.058	0.040	0.010	- to -
2002	7	0.035	0.0233	0.0088	0.013 to 0.056	0.026	0.013	0.017 to 0.085
2003	14	0.041	0.0293	0.0078	0.024 to 0.058	0.034	0.012	0.023 to 0.049
2004	14	0.037	0.0099	0.0026	0.031 to 0.042	0.035	0.009	0.027 to 0.044
2005	14	0.057	0.0429	0.0115	0.032 to 0.082	0.041	0.009	0.037 to 0.053
2006	14	0.063	0.0499	0.0133	0.035 to 0.092	0.041	0.028	0.028 to 0.136

Figure 93. Total Phosphorus box plots for Powers Lake (1994-2006) without Outliers



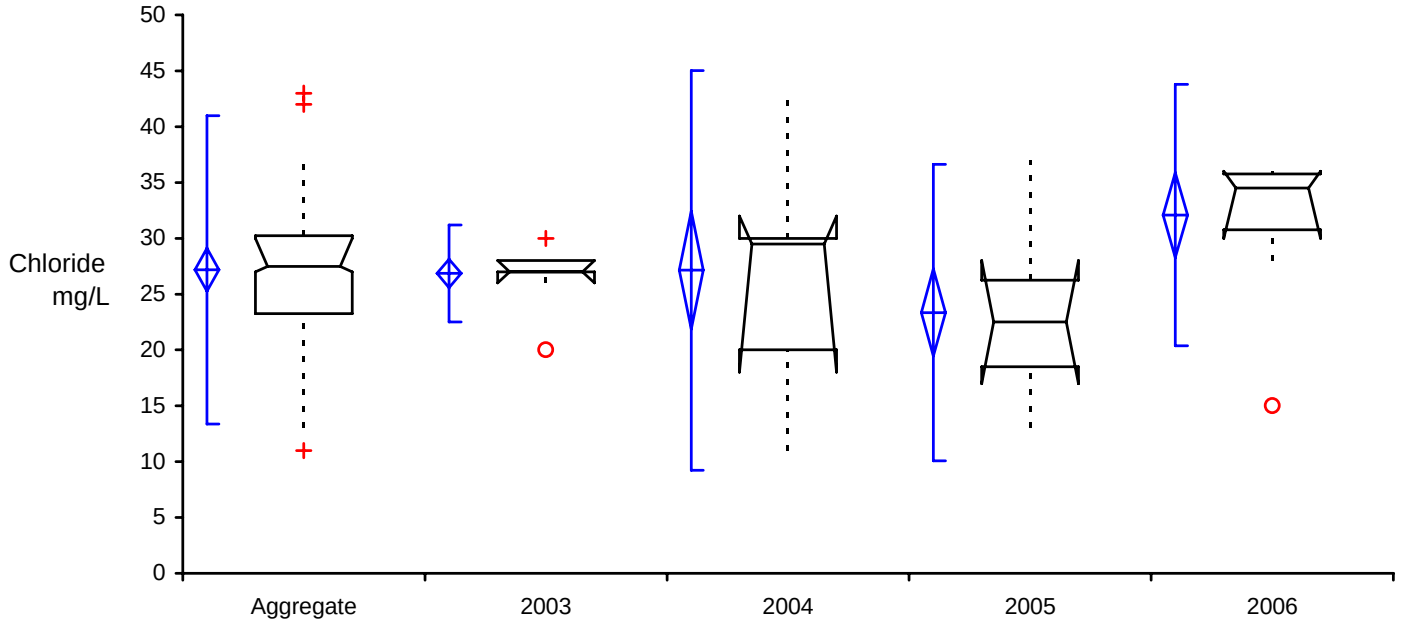
Powers Lake - TKN	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	145	0.912	0.3668	0.0305	0.851 to 0.972	0.870	0.500	0.770 to 0.950
1994	12	0.602	0.1145	0.0330	0.529 to 0.674	0.600	0.208	0.500 to 0.710
1995	13	0.721	0.2910	0.0807	0.545 to 0.897	0.620	0.470	0.480 to 1.100
1996	13	0.535	0.0783	0.0217	0.487 to 0.582	0.510	0.080	0.490 to 0.590
1997	12	0.713	0.1467	0.0424	0.620 to 0.807	0.670	0.248	0.600 to 0.870
1998	9	0.834	0.1872	0.0624	0.691 to 0.978	0.890	0.220	0.640 to 1.000
1999	10	0.801	0.2937	0.0929	0.591 to 1.011	0.620	0.400	0.560 to 1.200
2000	8	0.728	0.1341	0.0474	0.615 to 0.840	0.745	0.220	0.510 to 0.880
2001	5	0.826	0.1708	0.0764	0.614 to 1.038	0.780	0.120	- to -
2002	7	0.979	0.3319	0.1255	0.672 to 1.286	1.000	0.440	0.530 to 1.400
2003	14	1.037	0.3030	0.0810	0.862 to 1.212	0.975	0.290	0.820 to 1.200
2004	14	1.084	0.2383	0.0637	0.946 to 1.221	1.000	0.225	0.890 to 1.300
2005	14	1.417	0.3770	0.1008	1.199 to 1.635	1.350	0.500	1.100 to 1.700
2006	14	1.302	0.3232	0.0864	1.115 to 1.488	1.200	0.525	1.000 to 1.600

Figure 94. Total Kjedahl Nitrogen box plots for Powers Lake (1994-2006)



Powers Lake - CLA	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	85	20.607	15.1920	1.6478	17.330 to 23.884	16.000	21.000	13.000 to 23.000
1999	9	12.056	17.2226	5.7409	-1.183 to 25.294	6.000	5.100	3.600 to 13.000
2000	8	13.525	10.3682	3.6657	4.857 to 22.193	12.550	17.225	2.600 to 29.000
2001	5	23.500	18.9539	8.4764	-0.034 to 47.034	24.000	14.000	- to -
2002	7	21.671	15.2082	5.7482	7.606 to 35.737	18.000	20.650	7.000 to 48.000
2003	14	20.257	12.8827	3.4430	12.819 to 27.695	20.000	20.575	6.500 to 33.000
2004	14	19.407	13.4337	3.5903	11.651 to 27.164	15.000	7.250	9.200 to 31.000
2005	14	31.450	19.8644	5.3090	19.981 to 42.919	33.500	28.500	9.300 to 47.000
2006	14	19.293	8.7803	2.3466	14.223 to 24.362	18.000	13.250	12.000 to 29.000

Figure 95. Chlorophyll-a box plots for Powers Lake (1999-2006)



Powers Lake - Total Chloride	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	54	27.185	7.0472	0.9590	25.262 to 29.109	27.500	7.000	27.000 to 30.000
2003	14	26.857	2.2138	0.5917	25.579 to 28.135	27.000	1.000	26.000 to 28.000
2004	14	27.143	9.1303	2.4402	21.871 to 32.415	29.500	10.000	18.000 to 32.000
2005	14	23.357	6.7779	1.8115	19.444 to 27.271	22.500	7.750	17.000 to 28.000
2006	12	32.083	5.9766	1.7253	28.286 to 35.881	34.500	5.000	30.000 to 36.000

Figure 96. Total Chloride box plots for Powers Lake (2003-2006)

Cottage Grove Ravine Regional Park Lake

Vital Statistics:

DNR ID #: 82-0116
LOCATION:SW$^{1/4}$ Section 23 T26&27N-R21W
MUNICIPALITY: Cottage Grove Ravine Regional Park
LAKE SIZE: 24.7 acres
ORDINARY HIGH WATER MARK: 770.7 ft

Cottage Grove Ravine Lake was monitored from April 17 to October 5, 2006, in accordance with the Metropolitan Council Citizen-Assisted Monitoring Program (CAMP). Monitoring consisted of 14 biweekly lake gage readings and 7 monthly samplings of Secchi disk, surface total phosphorus, surface total Kjeldahl nitrogen, surface chlorophyll-*a*, and surface total chloride ion. In addition, a temperature and dissolved oxygen profile was taken during each sampling round. The Metropolitan Council Lab analyzed the samples.

Table 36 gives the Cottage Grove Ravine Lake 2006 high, low, and average lake levels. Individual lake level readings are shown in Figure 97.

Table 36. Cottage Grove Ravine Lake 2006 Lake Level

	High	High Date	Low	Low Date	Average
Lake Level (ft)	771.18	5/26/06	770.84	7/18/06 & 9/1/06	770.97

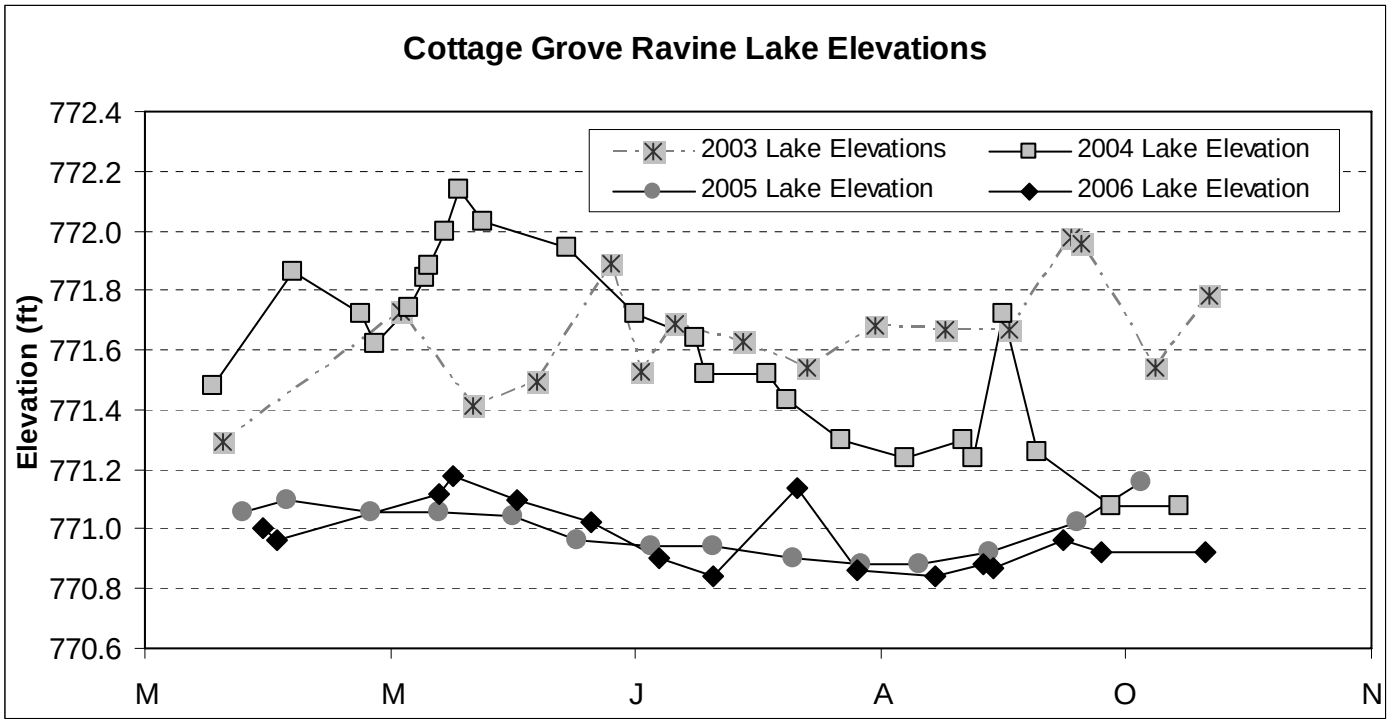


Figure 97. Cottage Grove Ravine Lake Elevations 2003-06

Table 37 gives the 2006 Cottage Grove Ravine Lake monitoring chemistry results and Secchi disk readings for the 2006 water-monitoring season.

Table 37. Cottage Grove Ravine Lake 2006 Monitoring Results

Date & Time	Secchi (m)	Surface TP (mg/L)	Surface TKN (mg/L)	Surface CLA (ug/L)	Surface Chloride	Surface Temperature (C)	Surface Dissolved Oxygen
4/17/2006	2.59	0.030	0.6	9	17	14.8	11.51
5/23/2006	3.20	0.039	0.8	2	18	17.8	13.69
6/23/2006	0.91	0.150	1.5	40	20	23.3	8.06
7/18/2006	1.37	0.138	1.5	54	20	28.5	8.02
8/16/2006	1.98	0.074	1.2	32	17	23.8	7.30
9/11/2006	1.98	0.110	1.4	32	20	18.0	3.51
10/5/2006	3.05	0.090	1.1	10	20	15.1	8.44
2006 Average	2.16	0.090	1.2	26	19	20.2	8.65
2006 Summer Average	1.56	0.118	1.4	40	19	23.4	6.72

Table 38 shows the Cottage Grove Ravine Lake Water Quality Summary. Cottage Grove Ravine Lake received a summer average lake grade of a C- for 2006. It should be noted that the lake grade for 2006 shows a slight decrease, but this might be due to looking at the summer average instead of the whole monitoring season as was the case for 2005.

Table 38. Lake Grade and Trophic Status

	Trophic Status (2005 Summer Average)	Lake Grade (2005 Summer Average)	Trophic Status (2006 Summer Average)	Lake Grade (2006 Summer Average)
Total Phosphorus (mg/L)	Eutrophic	C	Hypereutrophic	D
Chlorophyll-a (ug/L)	Eutrophic	C	Hypereutrophic	C
Secchi disk (ft)	Mesotrophic	C	Eutrophic	C
Overall	Eutrophic	C	Hypereutrophic	C-

Figure 98-103 compare the lake chemistry data and Secchi disk readings.

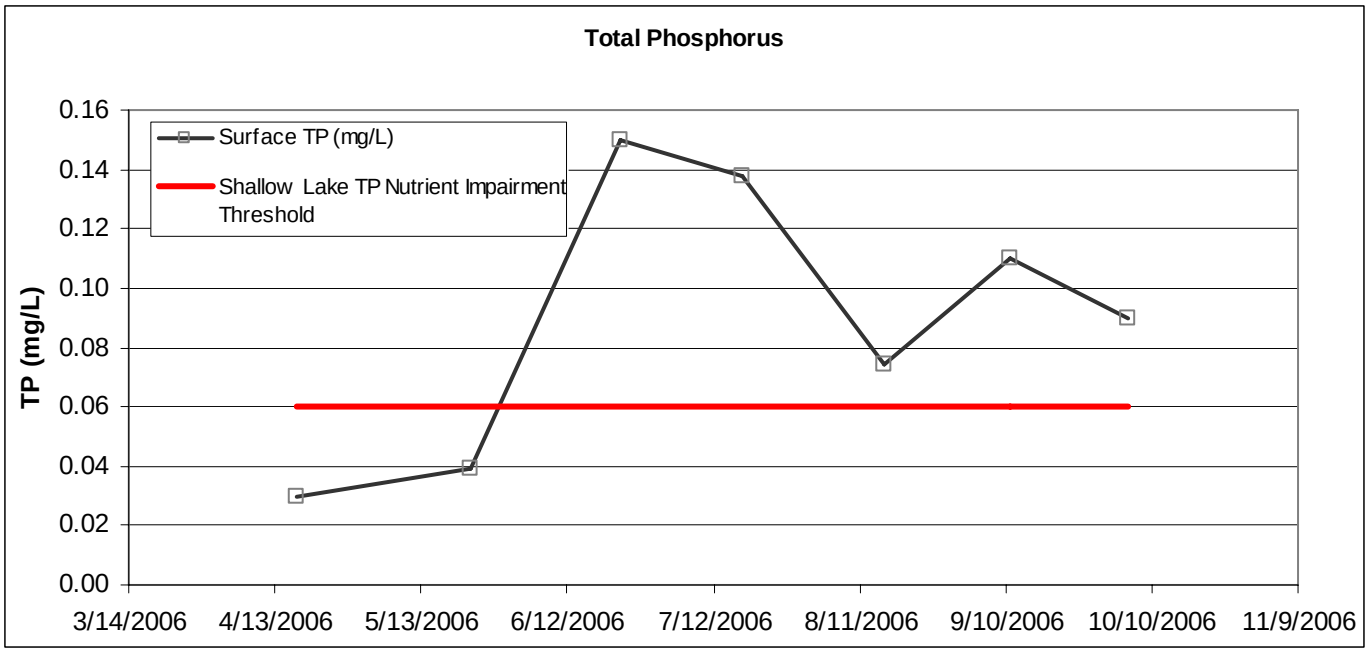


Figure 98. Total Phosphorus and Nutrient Impairment Threshold

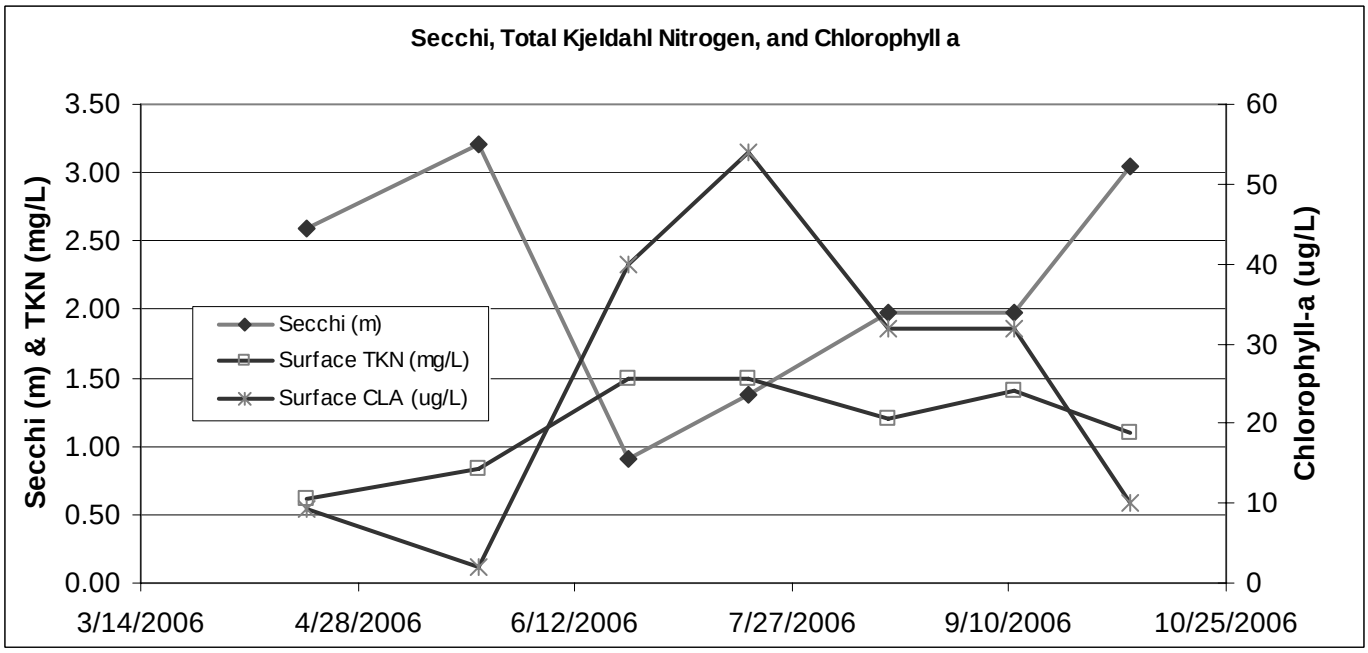


Figure 99. Secchi, Total Kjeldahl Nitrogen and Chlorophyll-*a*

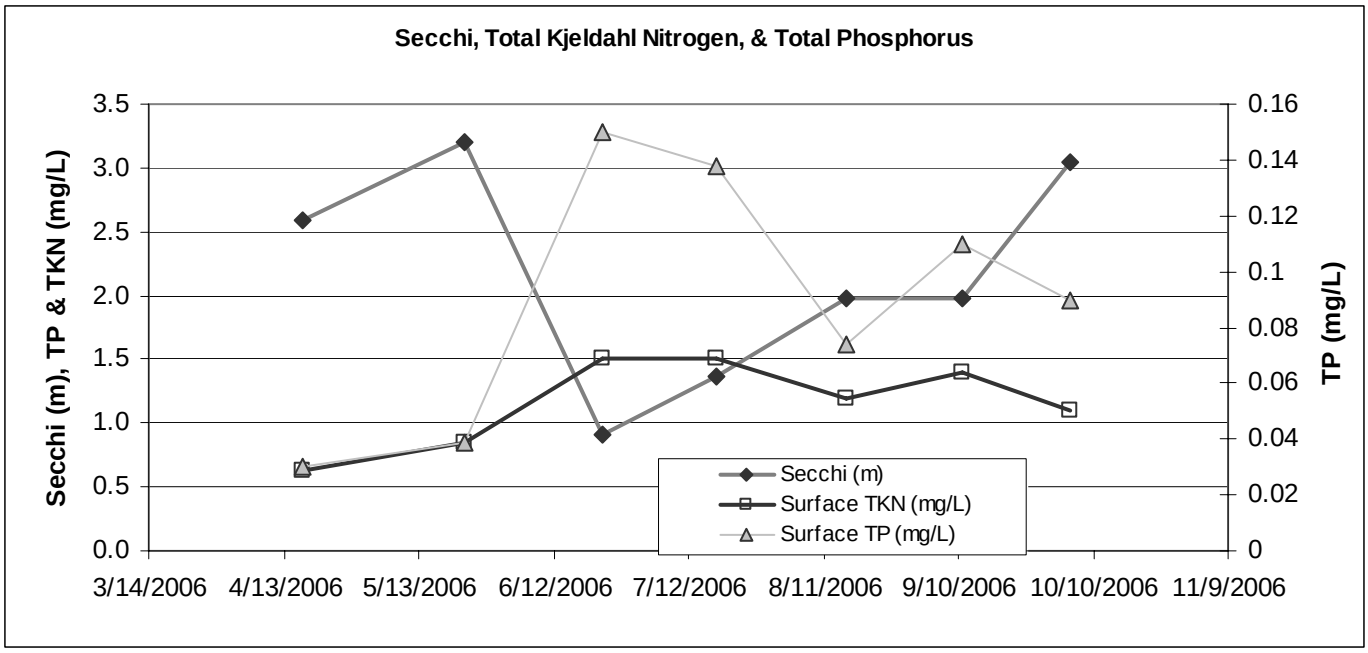


Figure 100. Secchi, Total Kjeldahl Nitrogen, and Total Phosphorus

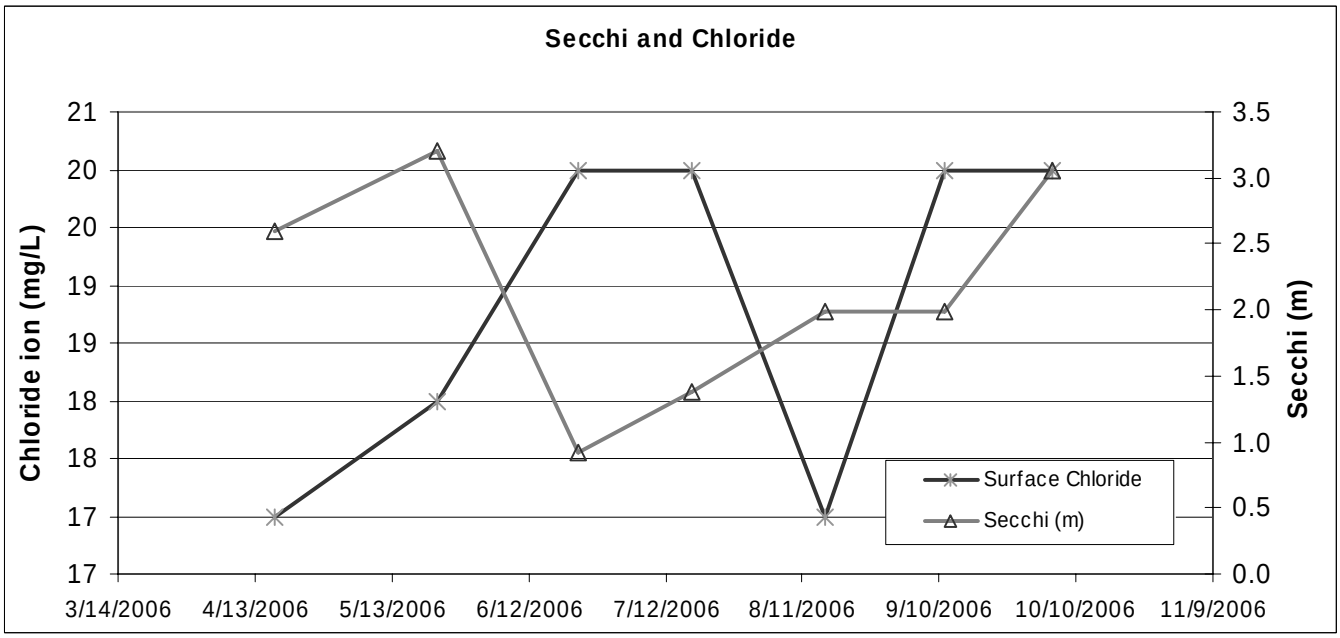


Figure 101. Secchi and Chloride ion

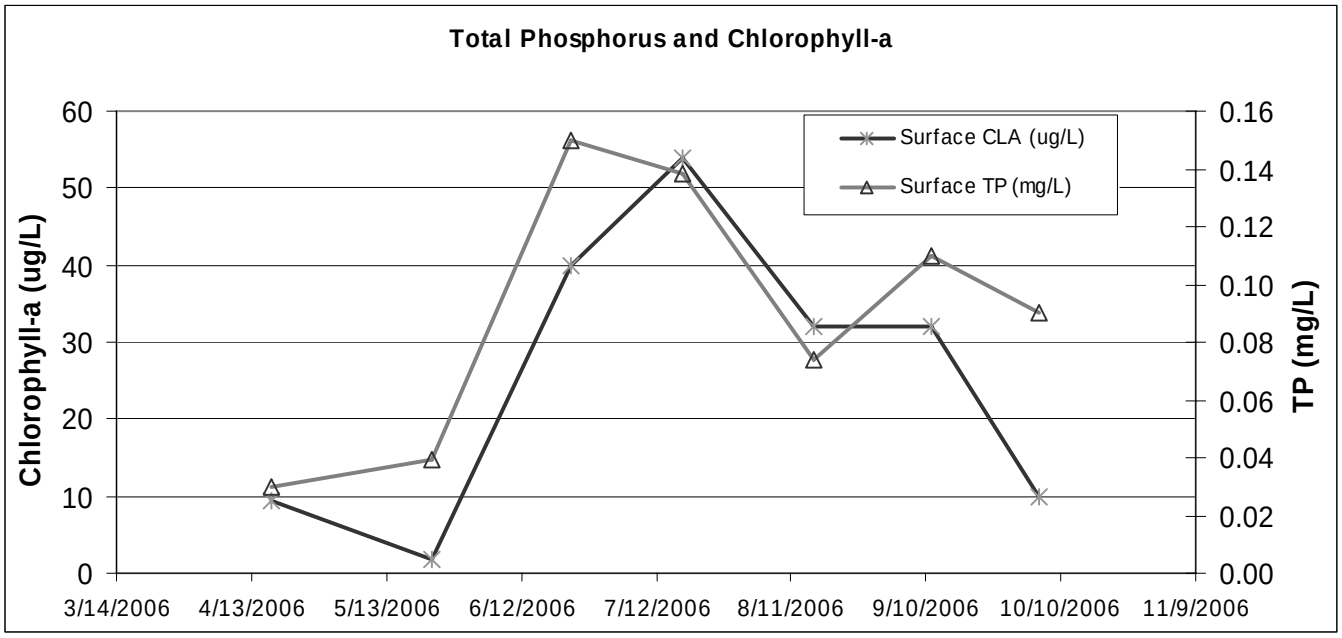


Figure 102. Total Phosphorous and Chlorophyll *a*

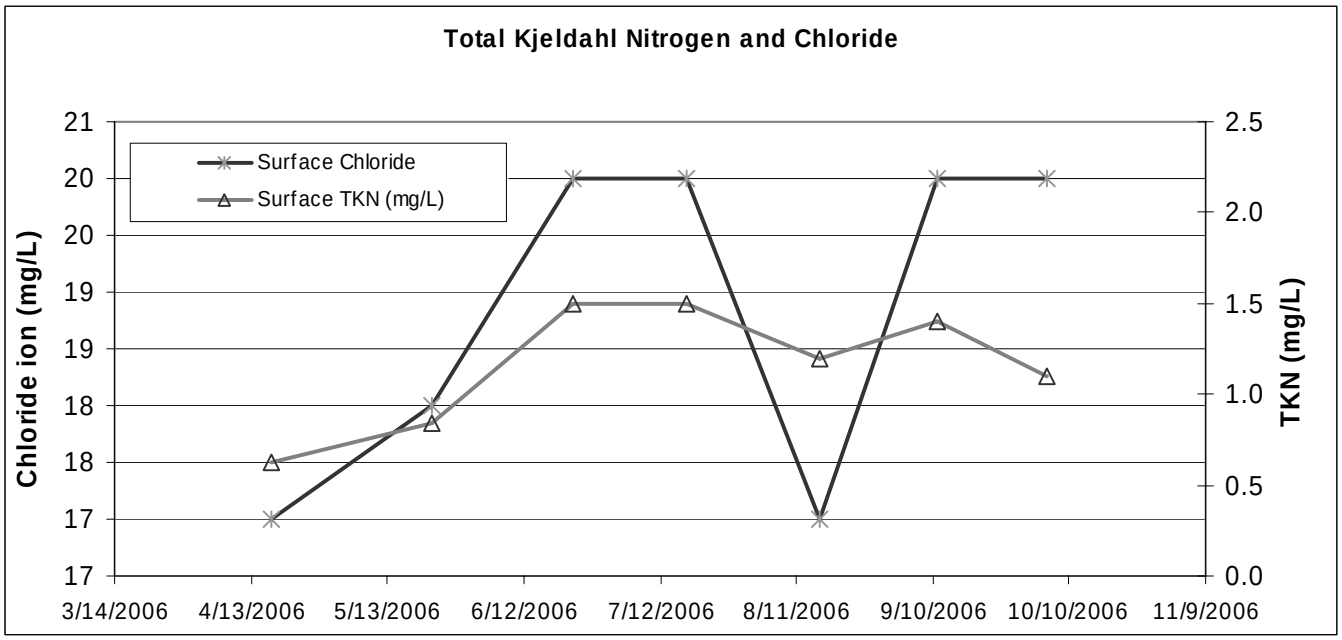


Figure 103. Total Kjeldahl Nitrogen and Chloride ion

Table 39 lists the dissolved oxygen and temperature profiles. The maximum depth was 6 meters. A thermocline was present between 3 and 4 meters in the lake. The surface dissolved oxygen and surface temperatures are shown in Figure 104.

Table 39. Dissolved Oxygen and Temperature Profiles

Date	4/17/2006 10:38		5/23/2006 9:17		6/23/2006 10:05		7/18/2006 15:21		8/16/2006 11:08		9/11/2006 9:39		10/5/2006 9:19	
Depth	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)	D.O. (mg/L)	Temp (C)
0	11.51	14.8	13.69	17.8	8.06	23.3	8.02	28.5	7.30	23.8	3.51	18.0	8.44	15.1
1	10.35	14.8	13.67	17.8	7.99	23.2	8.45	28.0	7.15	23.7	3.43	18.0	8.33	15.2
2	10.04	14.6	13.96	17.3	1.17	22.0	4.18	25.5	1.46	22.9	3.33	18.0	8.41	15.1
3	9.59	13.7	11.19	16.1	0.06	20.0	0.17	21.7	2.13	22.5	3.23	17.9	8.11	15.1
4	9.39	9.5	2.40	13.4	0.02	17.2	0.09	16.8	0.05	17.9	0.80	17.7	4.08	14.4
5	5.53	6.6	1.04	10.7	0.03	13.9	0.07	14.4	0.04	15.0	0.05	15.7	0.16	14.1
6					0.03	12.9								
Top of Thermocline (m)	4		4		3		2		3		4		5	

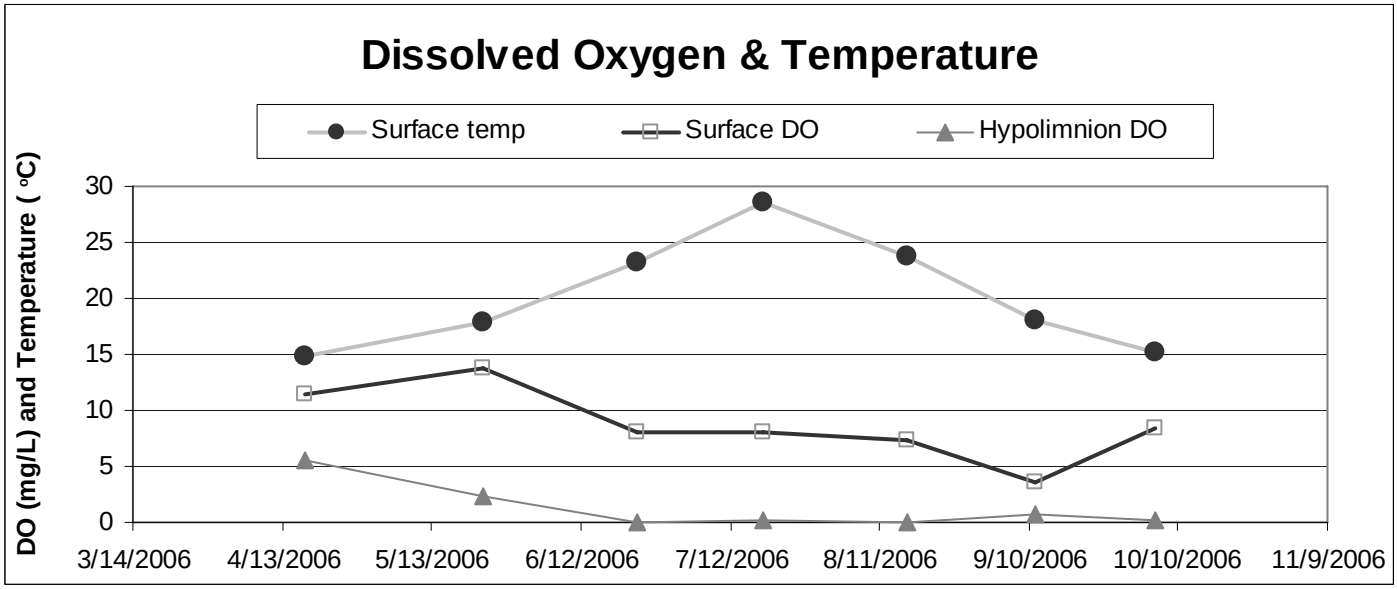
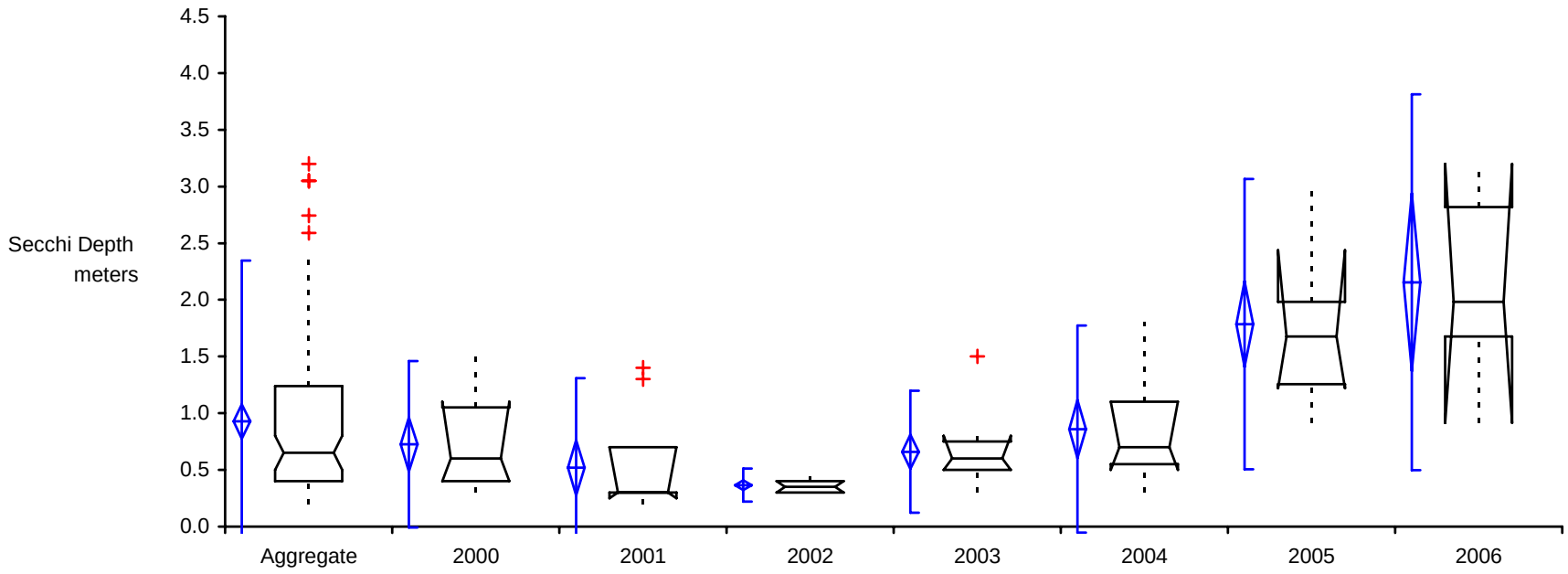


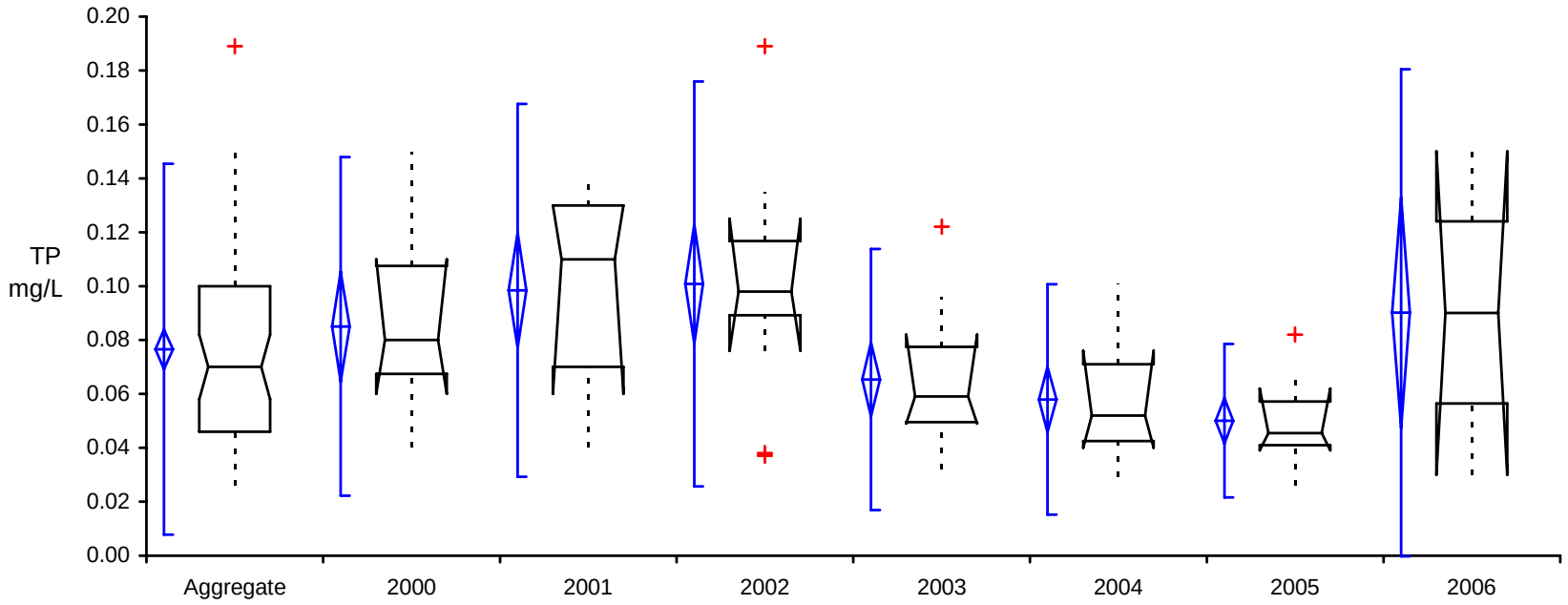
Figure 104. Surface Dissolved Oxygen, Hypolimnion Dissolved Oxygen, and Surface Temperatures

Statistical box plot summaries for Cottage Grove Regional Ravine Park Lake are included in figures 105-109. Median value trends for Secchi disk show both an increasing trend (better transparency) since 2001. Variability in the box plots have also increased during this time. Total phosphorous median values have had an expected declining trend since 2001. Chlorophyll-a median value was at a low in 2002, which correlates to the highest median value for Secchi disk. Median values for CLA had a similar trend at total phosphorus. Total Kjedahl nitrogen median values declined over three monitoring seasons, from 2001 to 2003. Median levels have been steady since that time. Not enough samples were taken for total chloride ions to make conclusions on trends over time.



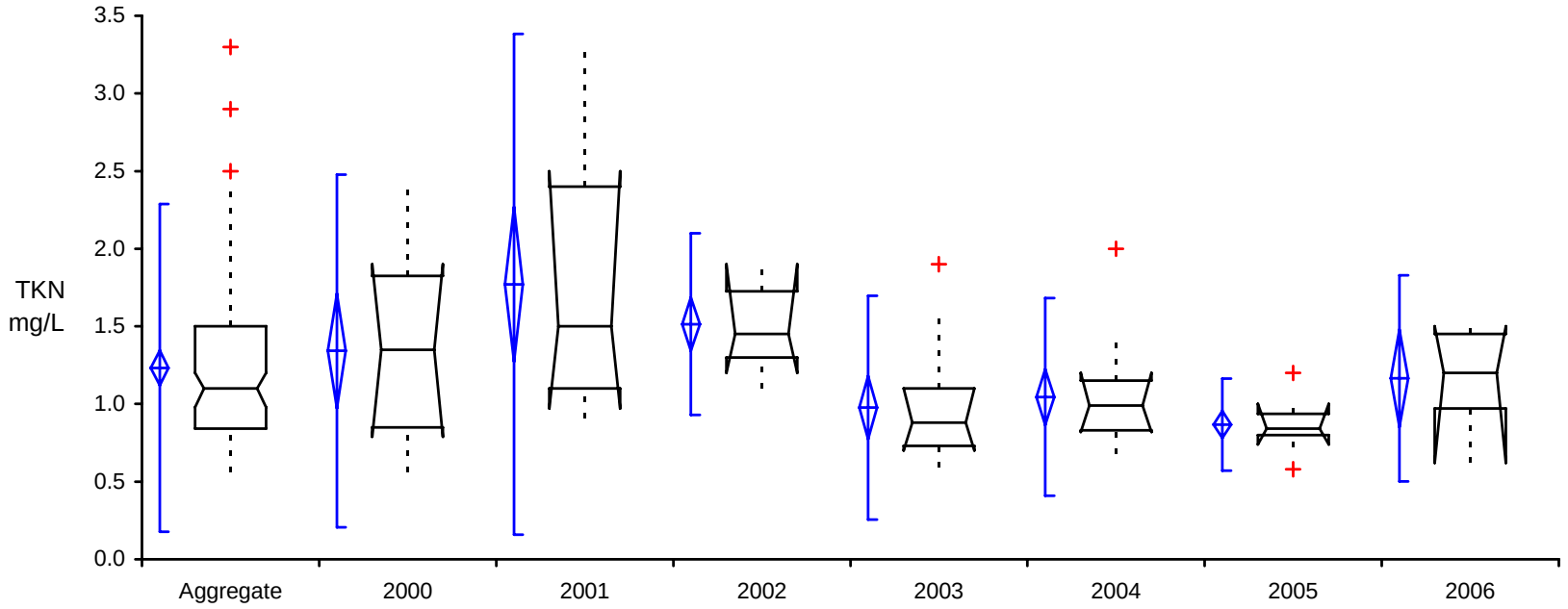
CGRP Lake - Secchi Depth	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	90	0.927	0.7235	0.0763	0.775 to 1.079	0.650	0.839	0.500 to 0.800
2000	12	0.725	0.3745	0.1081	0.487 to 0.963	0.600	0.650	0.400 to 1.100
2001	13	0.519	0.4029	0.1117	0.276 to 0.763	0.300	0.400	0.250 to 0.700
2002	14	0.364	0.0745	0.0199	0.321 to 0.407	0.350	0.100	0.300 to 0.400
2003	15	0.660	0.2746	0.0709	0.508 to 0.812	0.600	0.250	0.500 to 0.800
2004	15	0.860	0.4657	0.1202	0.602 to 1.118	0.700	0.550	0.500 to 1.100
2005	14	1.785	0.6533	0.1746	1.408 to 2.162	1.676	0.724	1.219 to 2.438
2006	7	2.155	0.8459	0.3197	1.373 to 2.938	1.981	1.143	0.914 to 3.200

Figure 105. Secchi Disk Depth box plots for Cottage Grove Ravine Lake (2000-2006)



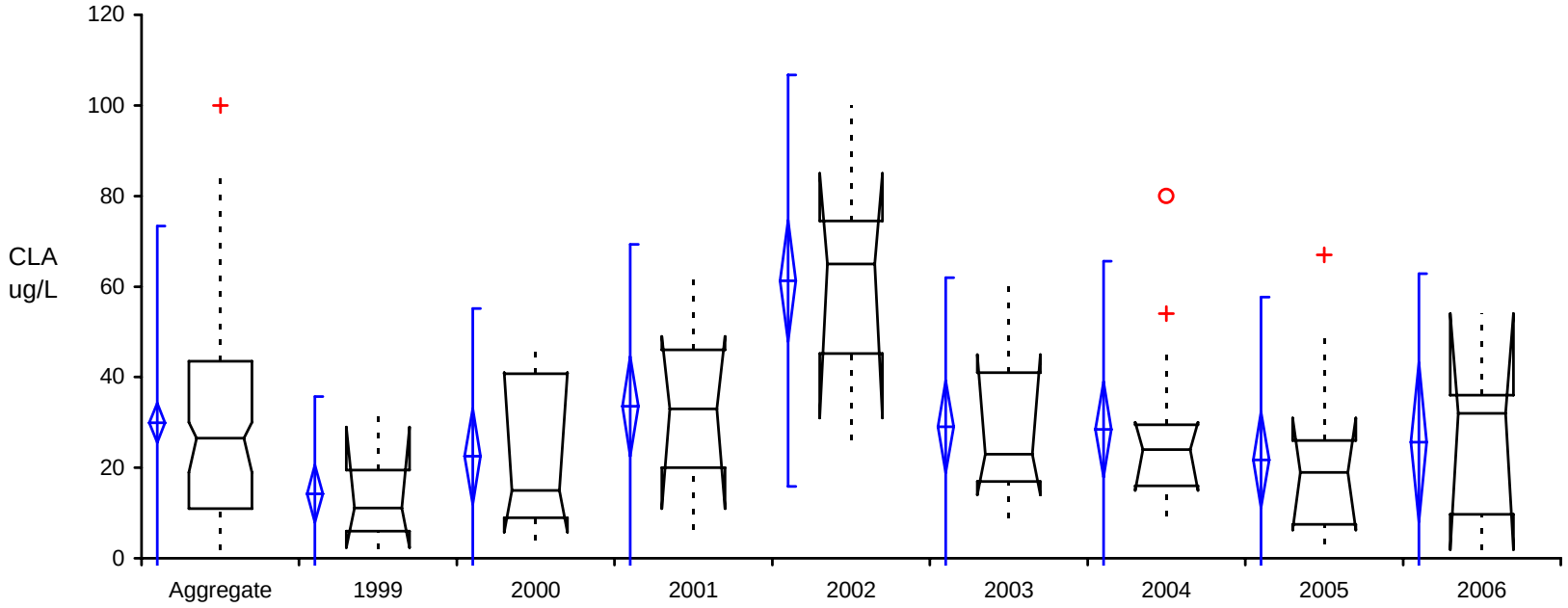
CGRP Lake - TP	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	90	0.077	0.0351	0.0037	0.069 to 0.084	0.070	0.054	0.058 to 0.082
2000	12	0.085	0.0321	0.0093	0.065 to 0.105	0.080	0.040	0.060 to 0.110
2001	13	0.098	0.0353	0.0098	0.077 to 0.120	0.110	0.060	0.060 to 0.130
2002	14	0.101	0.0383	0.0102	0.079 to 0.123	0.098	0.028	0.076 to 0.125
2003	15	0.065	0.0247	0.0064	0.052 to 0.079	0.059	0.028	0.049 to 0.082
2004	15	0.058	0.0218	0.0056	0.046 to 0.070	0.052	0.029	0.040 to 0.076
2005	14	0.050	0.0145	0.0039	0.042 to 0.058	0.046	0.016	0.039 to 0.062
2006	7	0.090	0.0461	0.0174	0.047 to 0.133	0.090	0.068	0.030 to 0.150

Figure 106. Total Phosphorus box plots for Cottage Grove Ravine Lake (2000-2006)



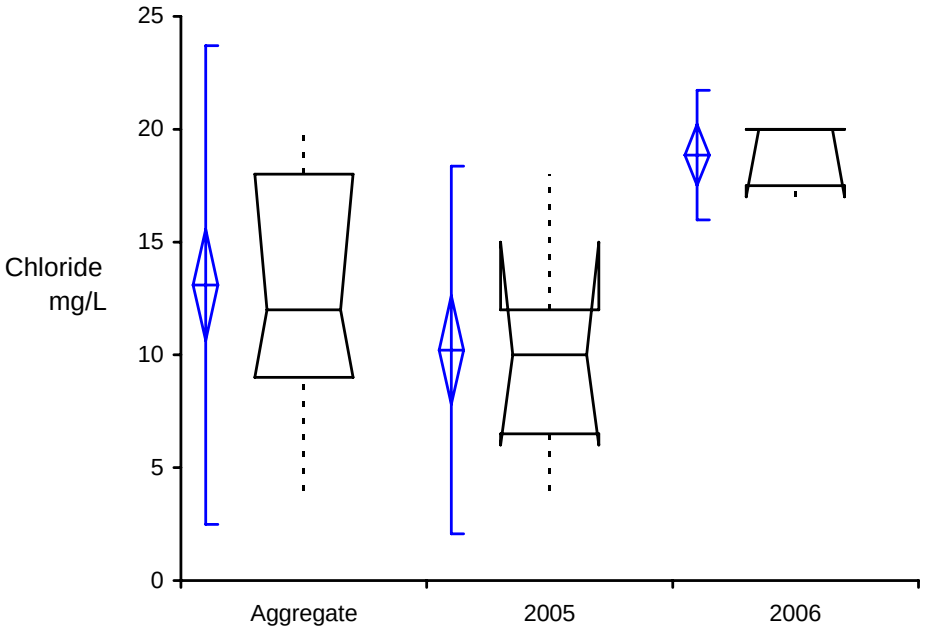
CGRP Lake - TKN	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	90	1.233	0.5380	0.0567	1.120 to 1.345	1.100	0.660	0.980 to 1.200
2000	12	1.342	0.5800	0.1674	0.973 to 1.710	1.350	0.975	0.790 to 1.900
2001	13	1.770	0.8229	0.2282	1.273 to 2.267	1.500	1.300	0.970 to 2.500
2002	14	1.514	0.2983	0.0797	1.342 to 1.687	1.450	0.425	1.200 to 1.900
2003	15	0.977	0.3678	0.0950	0.773 to 1.180	0.880	0.370	0.700 to 1.100
2004	15	1.045	0.3247	0.0838	0.865 to 1.225	0.990	0.320	0.820 to 1.200
2005	14	0.867	0.1513	0.0404	0.780 to 0.954	0.840	0.135	0.740 to 1.000
2006	7	1.166	0.3386	0.1280	0.853 to 1.479	1.200	0.480	0.620 to 1.500

Figure 107. Total Kjedahl Nitrogen box plots for Cottage Grove Ravine Lake (2000-2006)



CGRP Lake - CLA	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	102	29.922	22.1786	2.1960	25.565 to 34.278	26.500	32.500	19.000 to 30.000
1999	14	14.236	10.9768	2.9337	7.898 to 20.574	11.100	13.500	2.400 to 29.000
2000	12	22.500	16.6528	4.8072	11.919 to 33.081	15.000	31.800	5.800 to 41.000
2001	13	33.546	18.2290	5.0558	22.530 to 44.562	33.000	26.000	11.000 to 49.000
2002	14	61.286	23.1763	6.1941	47.904 to 74.667	65.000	29.250	31.000 to 85.000
2003	13	29.077	16.7902	4.6568	18.931 to 39.223	23.000	24.000	14.000 to 45.000
2004	15	28.453	18.9640	4.8965	17.951 to 38.955	24.000	13.500	15.000 to 30.000
2005	14	21.750	18.3091	4.8933	11.179 to 32.321	19.000	18.525	6.200 to 31.000
2006	7	25.614	18.9883	7.1769	8.053 to 43.176	32.000	26.300	1.900 to 54.000

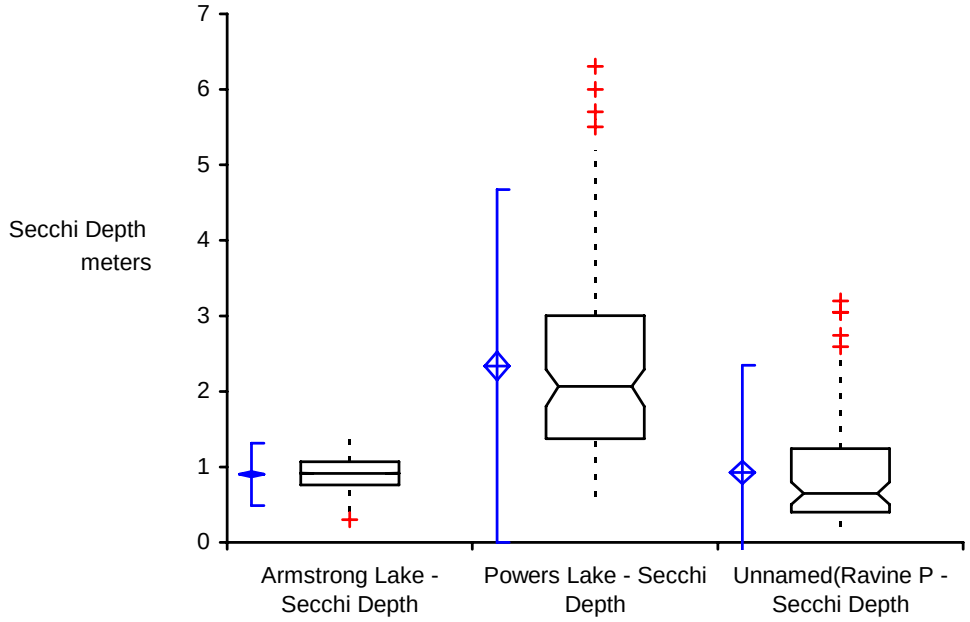
Figure 108. Chlorophyll-a box plots for Cottage Grove Ravine Lake (2000-2006)



CGRP Lake - Total Chloride	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Aggregate	21	13.095	5.4121	1.1810	10.632 to 15.559	12.000	9.000	9.000 to 18.000
2005	14	10.214	4.1543	1.1103	7.816 to 12.613	10.000	5.500	6.000 to 15.000
2006	7	18.857	1.4639	0.5533	17.503 to 20.211	20.000	2.500	17.000 to 20.000

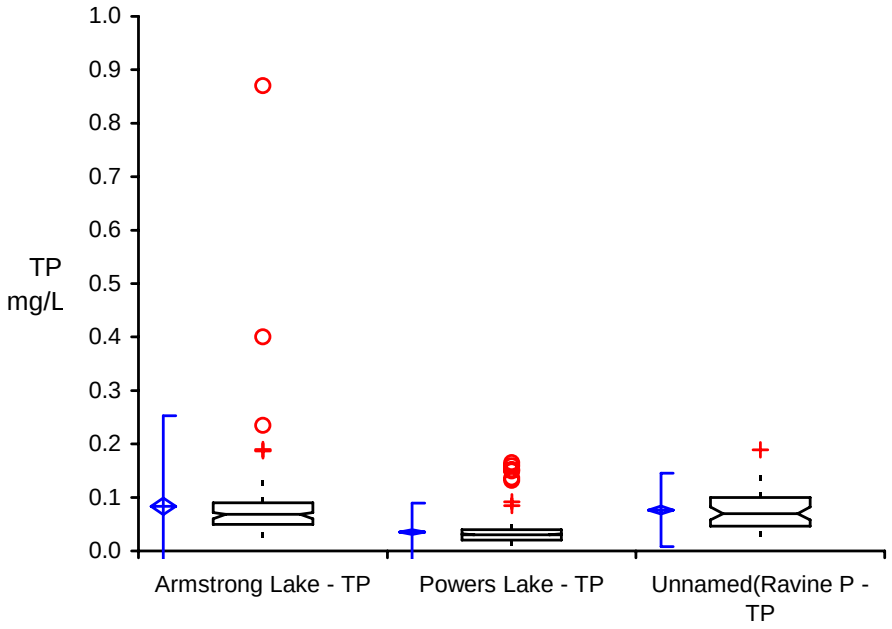
Figure 109. Total Chloride box plots for Cottage Grove Ravine Lake (2005-2006)

Figures 110-117 are box plot summaries showing relationships between the three lakes monitored in South Washington Watershed District. Powers Lake has the highest Secchi disk readings in the district. Armstrong Lake has limited variability in Secchi disk readings due to the shallow nature of the lake. Powers Lake also has the lowest total phosphorus median values and total Kjedahl nitrogen median values, correlating to the higher Secchi disk readings. Both Cottage Grove Ravine Park Lake and Armstrong Lake have similar medians for total phosphorus, once again correlating towards similar median values for Secchi disk readings. Armstrong Lake has the highest outlier for chlorophyll-a, which is matched to the highest total phosphorus outlier. Cottage Grove Ravine Park Lake has the highest median values for CLA, and also the highest variability in box plot summary. Total chloride ions box plots have interesting summaries. Armstrong has the highest median value, with Powers Lake and then Cottage Grove Ravine Park Lake with the mid and low median values. Hypothesis for such an outcome would be the difference in land use and the connection of roads to the water bodies. Further investigation is needed to confirm this hypothesis.



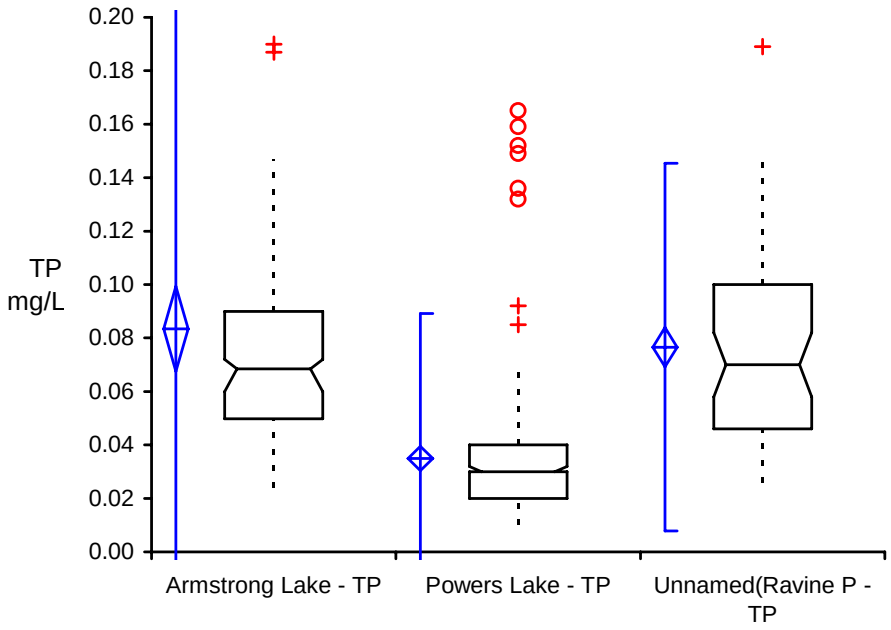
	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Armstrong Lake - Secchi Depth	127	0.903	0.2110	0.0187	0.866 to 0.940	0.914	0.304	0.914 to 0.915
Powers Lake - Secchi Depth	156	2.337	1.1918	0.0954	2.148 to 2.525	2.067	1.629	1.803 to 2.290
CGRP Lake - Secchi Depth	90	0.927	0.7235	0.0763	0.775 to 1.079	0.650	0.839	0.500 to 0.800

Figure 110. Secchi Disk Depth box plots for Armstrong, Powers, and Cottage Grove Ravine Lakes



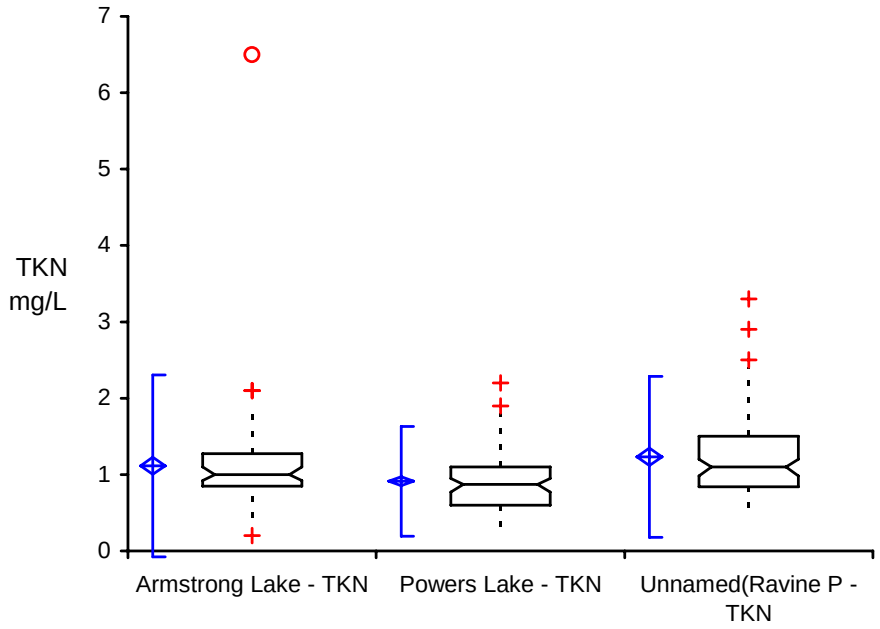
	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Armstrong Lake - TP	116	0.083	0.0866	0.0080	0.068 to 0.099	0.069	0.040	0.060 to 0.072
Powers Lake - TP	145	0.035	0.0276	0.0023	0.030 to 0.039	0.030	0.020	0.030 to 0.032
CGRP Lake - TP	90	0.077	0.0351	0.0037	0.069 to 0.084	0.070	0.054	0.058 to 0.082

Figure 111. Total Phosphorus box plots for Armstrong, Powers, and Cottage Grove Ravine Lakes



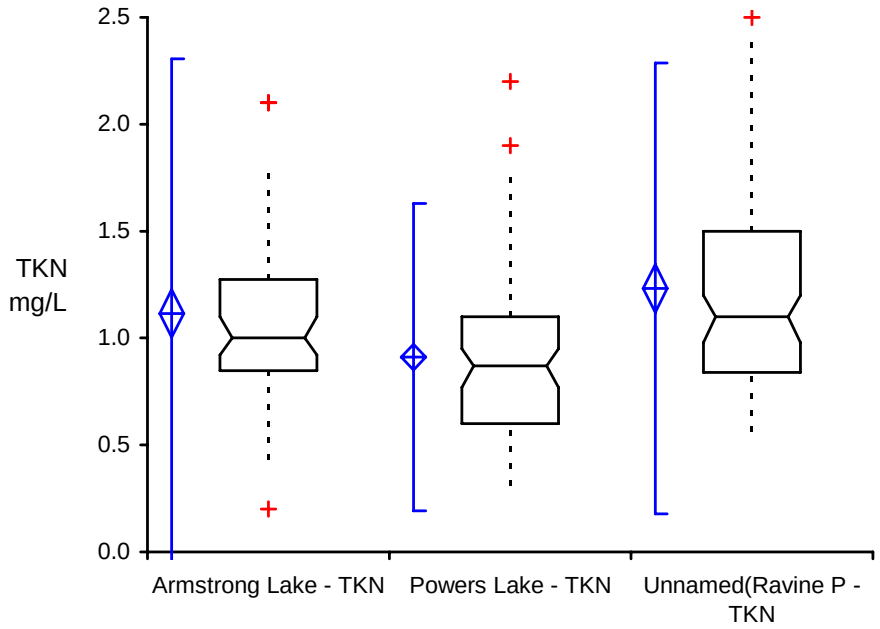
	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Armstrong Lake - TP	116	0.083	0.0866	0.0080	0.068 to 0.099	0.069	0.040	0.060 to 0.072
Powers Lake - TP	145	0.035	0.0276	0.0023	0.030 to 0.039	0.030	0.020	0.030 to 0.032
CGRP Lake - TP	90	0.077	0.0351	0.0037	0.069 to 0.084	0.070	0.054	0.058 to 0.082

Figure 112. Total Phosphorus box plots for Armstrong, Powers, and Cottage Grove Ravine Lakes without Outliers



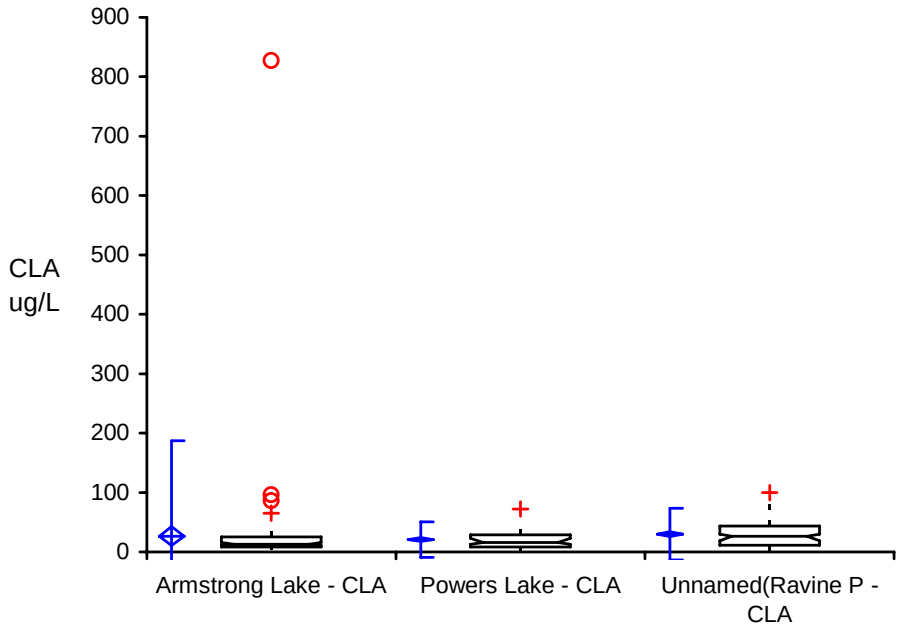
	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Armstrong Lake - TKN	116	1.115	0.6074	0.0564	1.003 to 1.227	1.000	0.428	0.920 to 1.100
Powers Lake - TKN	145	0.912	0.3668	0.0305	0.851 to 0.972	0.870	0.500	0.770 to 0.950
CGRP Lake - TKN	90	1.233	0.5380	0.0567	1.120 to 1.345	1.100	0.660	0.980 to 1.200

Figure 113. Total Kjedahl Nitrogen box plots for Armstrong, Powers, and Cottage Grove Ravine Lakes



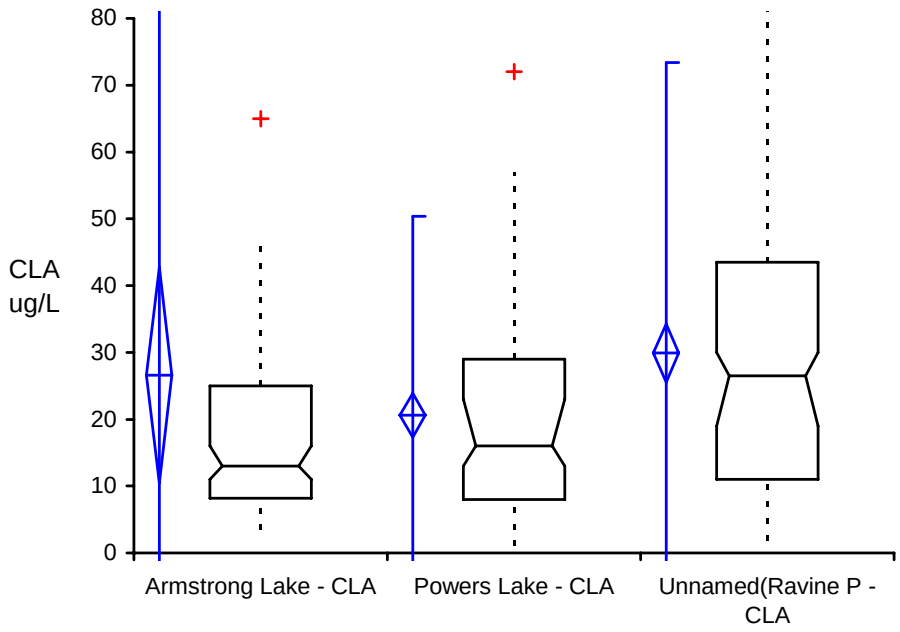
	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Armstrong Lake - TKN	116	1.115	0.6074	0.0564	1.003 to 1.227	1.000	0.428	0.920 to 1.100
Powers Lake - TKN	145	0.912	0.3668	0.0305	0.851 to 0.972	0.870	0.500	0.770 to 0.950
CGRP Lake - TKN	90	1.233	0.5380	0.0567	1.120 to 1.345	1.100	0.660	0.980 to 1.200

Figure 114. Total Kjedahl Nitrogen box plots for Armstrong, Powers, and Cottage Grove Ravine Lakes without Outliers



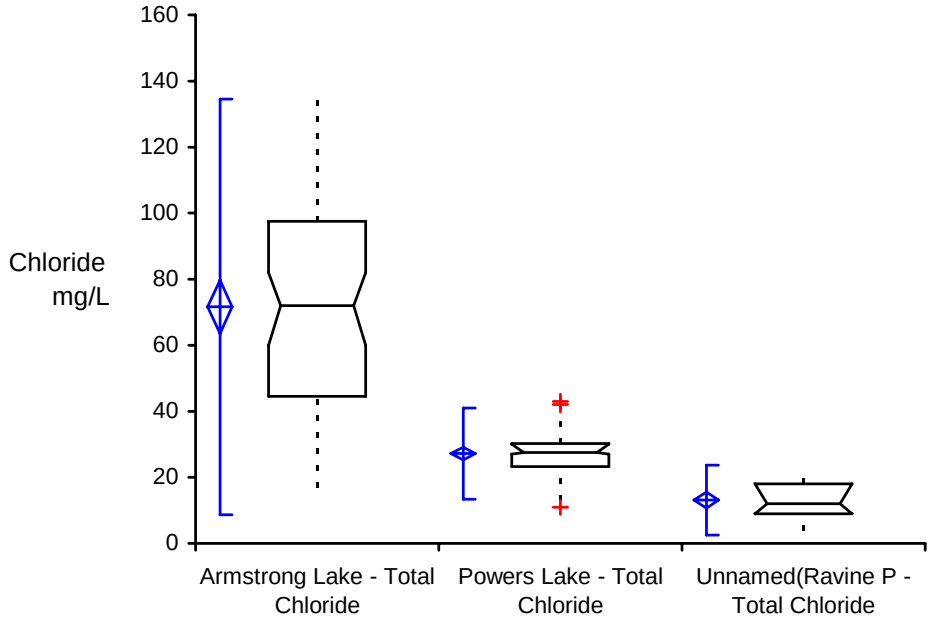
	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Armstrong Lake - CLA	101	26.600	81.9971	8.1590	10.413 to 42.787	13.000	16.800	11.000 to 16.000
Powers Lake - CLA	85	20.607	15.1920	1.6478	17.330 to 23.884	16.000	21.000	13.000 to 23.000
CGRP Lake - CLA	102	29.922	22.1786	2.1960	25.565 to 34.278	26.500	32.500	19.000 to 30.000

Figure 115. Chlorophyll-a box plots for Armstrong, Powers, and Cottage Grove Ravine Lakes



	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Armstrong Lake - CLA	101	26.600	81.9971	8.1590	10.413 to 42.787	13.000	16.800	11.000 to 16.000
Powers Lake - CLA	85	20.607	15.1920	1.6478	17.330 to 23.884	16.000	21.000	13.000 to 23.000
CGRP Lake - CLA	102	29.922	22.1786	2.1960	25.565 to 34.278	26.500	32.500	19.000 to 30.000

Figure 116. Chlorophyll-a box plots for Armstrong, Powers, and Cottage Grove Ravine Lakes without Outliers



	n	Mean	SD	SE	95% CI of Mean	Median	IQR	95% CI of Median
Armstrong Lake - Total Chloride	63	71.619	32.1174	4.0464	63.530 to 79.708	72.000	53.000	60.000 to 82.000
Powers Lake - Total Chloride	54	27.185	7.0472	0.9590	25.262 to 29.109	27.500	7.000	27.000 to 30.000
CGRP Lake - Total Chloride	21	13.095	5.4121	1.1810	10.632 to 15.559	12.000	9.000	9.000 to 18.000

Figure 117. Total Chloride box plots for Armstrong, Powers, and Cottage Grove Ravine Lakes

Lake Gages

Lake gages were read biweekly on twelve lakes in SWWD from April 17-October 26, 2006. Table 40 lists the high, low, range and average elevations for each lake monitored in 2006. Figure 118-129 shows the fluctuation in elevation for each lake monitored in 2006.

Table 40. SWWD 2006 Lake Gage Readings

Lake Name	DNR ID#	Dates Monitored	# Readings	Lowest Reading (ft) Date	Highest Reading (ft) Date	Range (ft)	Average Elevation (ft)	OHW (ft)
Cottage Grove Ravine Park	82-0087	4/17/06-10/26/06	16	770.84 9/1/2006	771.18 5/6/2006	0.34	770.97	770.70
Markgrafs	82-0089	4/20/06-10/26/06	25	923.41 7/21/06 and 7/25/06	924.31 5/2/2006	0.90	923.97	925.30
Wilmes	82-0090	4/20/06-10/26/06	14	900.92 7/21/06	905.16 8/4/2006	4.24	902.58	902.60
Powers	82-0092	4/20/06-10/26/06	17	889.63 7/25/2006	891.15 5/17/2006	1.52	890.64	891.30
Colby	82-0094	4/20/06-10/26/06	15	889.73 7/21/2006	891.14 8/4/2006	1.41	890.45	891.80
Bailey	82-0456	6/29/06-9/27/06	8	867.1 9/27/2006	869.93 9/1/2006	2.83	868.55	NA
Armstrong	82-0116-02	4/17/06-10/26/06	15	1018.04 7/18/2006	1019.31 5/23/2006	1.27	1018.63	1019.10
Vandeberg	82-0084	4/20/2006-10/26/06	16	836.07 10/26/2006	837.95 4/20/2006	1.88	837.03	NA
Fish	82-0093	4/20/06-10/26/06	14	914.29 7/21/2006	915.66 10/26/2006	1.37	915.05	916.40
Ria Lake	82-0098	4/20/06-10/26/06	15	949.06 10/26/2006	951.03 5/10/2006	1.97	950.02	NA
La Lake	82-0097	4/20/06-10/26/06	15	998.52 10/26/2006	999.81 5/10/2006	1.29	999.16	1000.60
Shepard's Pond	82-0083	4/20/06-6/29/06	6	919.82 6/29/2006	920.87 4/20/2006	1.05	920.57	NA

Figure 118-129. SWWD 2006 Lake Elevations

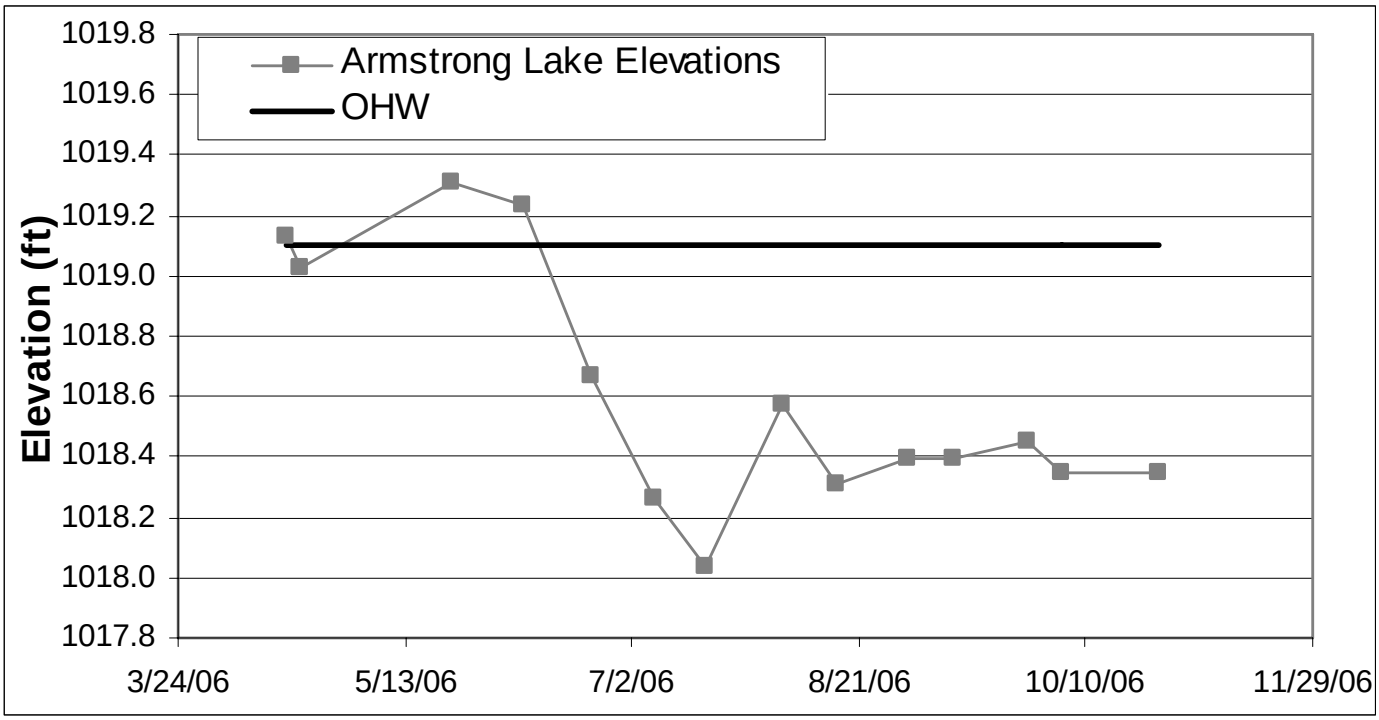


Figure 118. Armstrong Lake Elevations and Ordinary High Water (OHW)

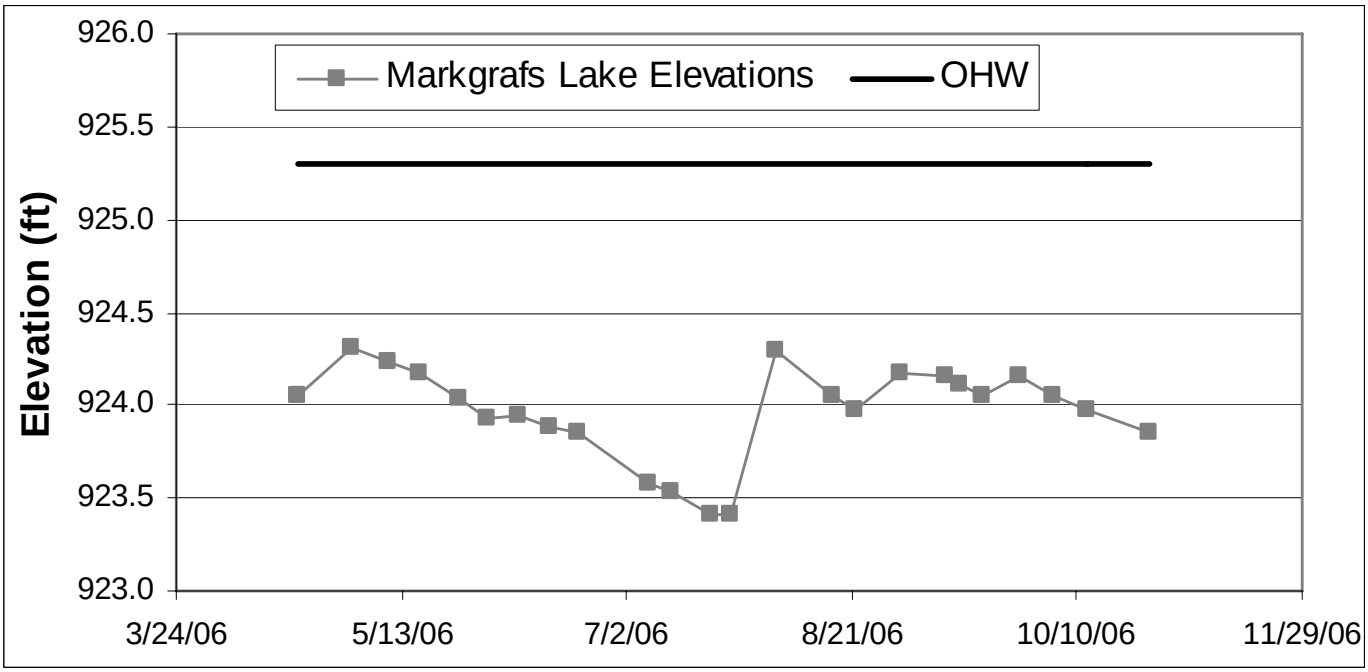


Figure 119. Markgrafs Lake Elevations and Ordinary High Water (OHW)

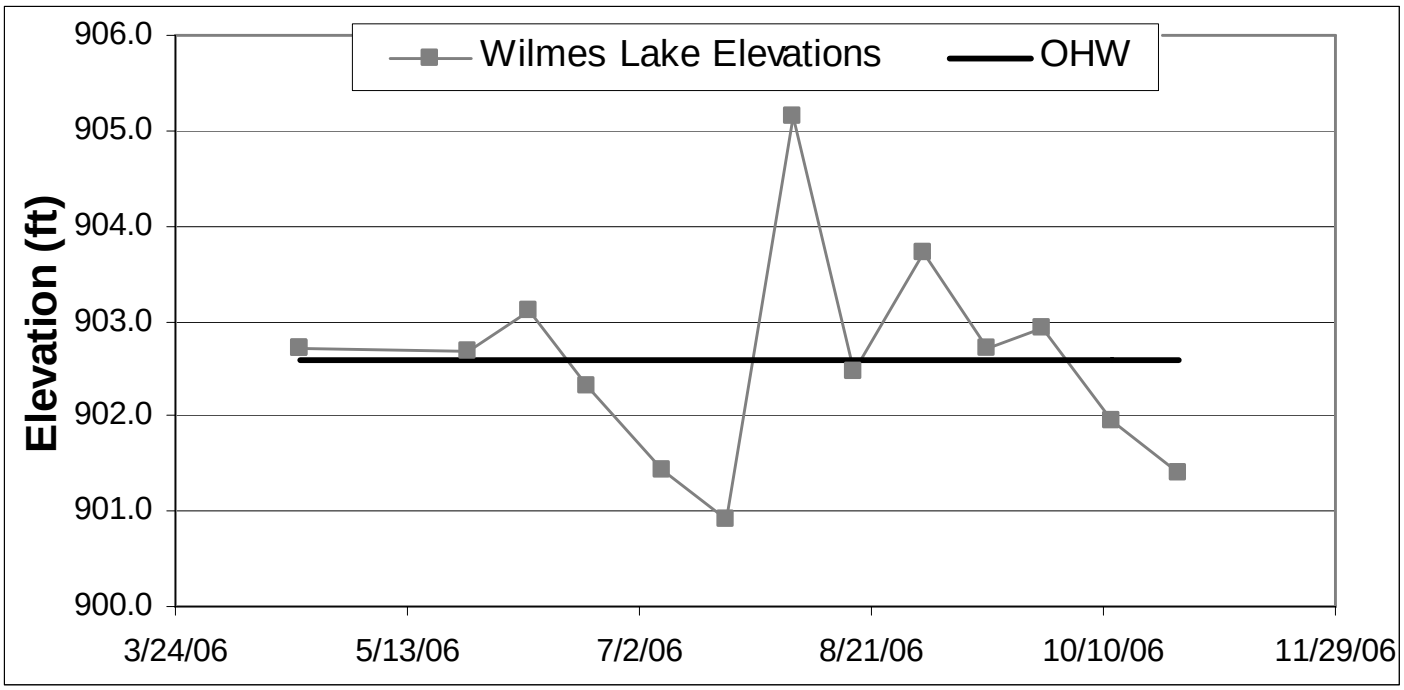


Figure 120. Wilmes Lake Elevations and Ordinary High Water (OHW)

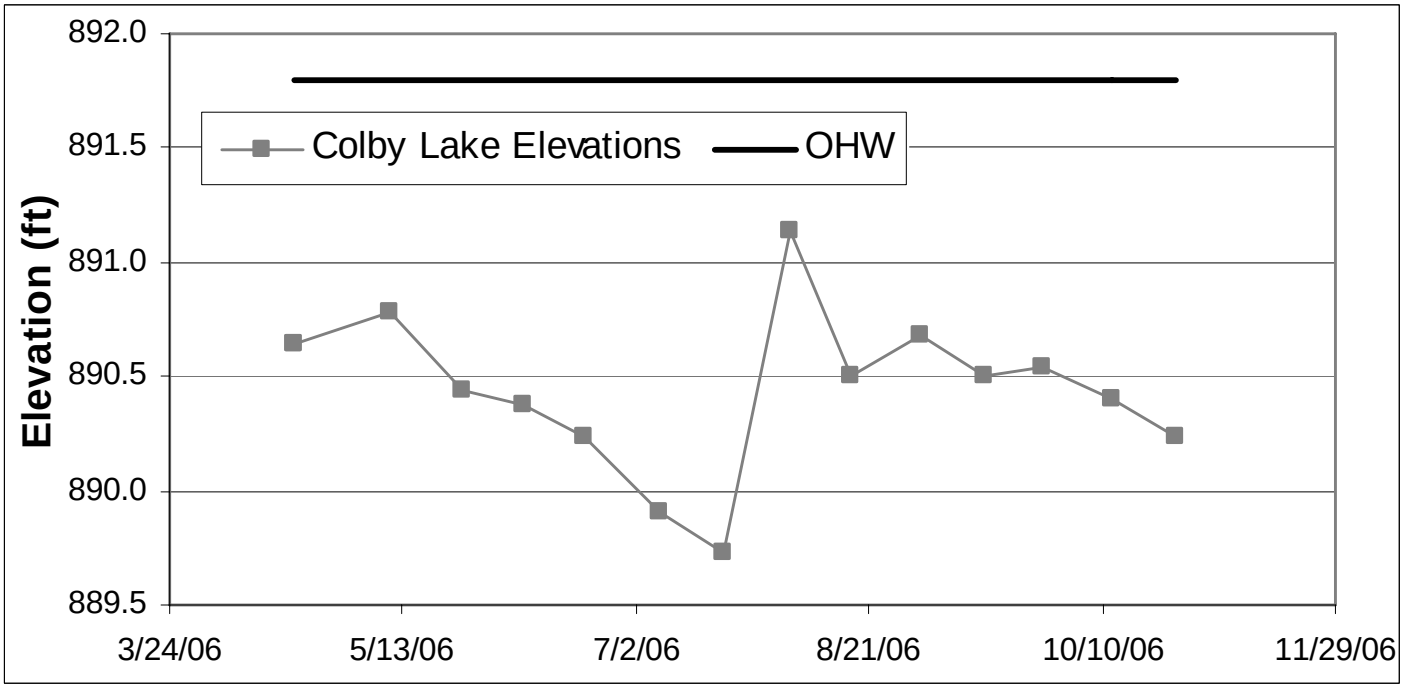


Figure 121. Colby Lake Elevations and Ordinary High Water (OHW)

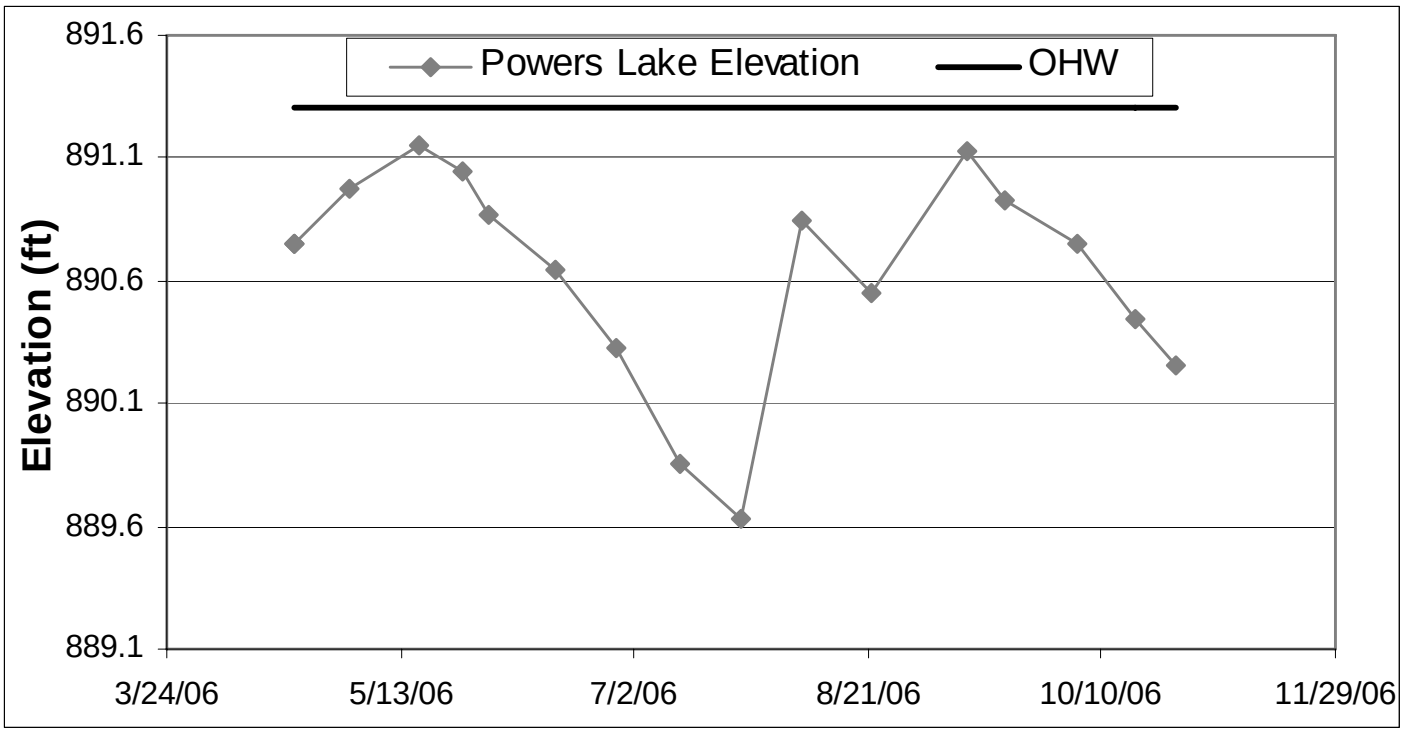


Figure 122. Powers Lake Elevations and Ordinary High Water (OHW)

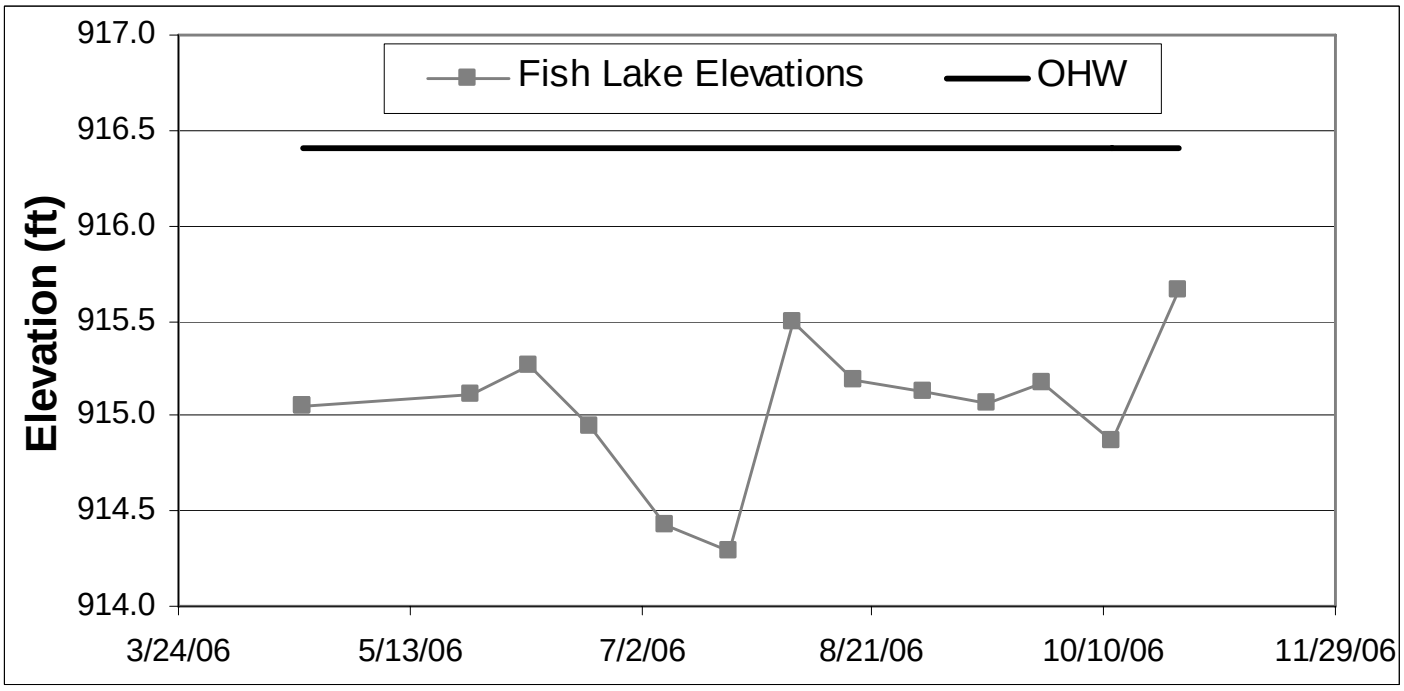


Figure 123. Fish Lake Elevations

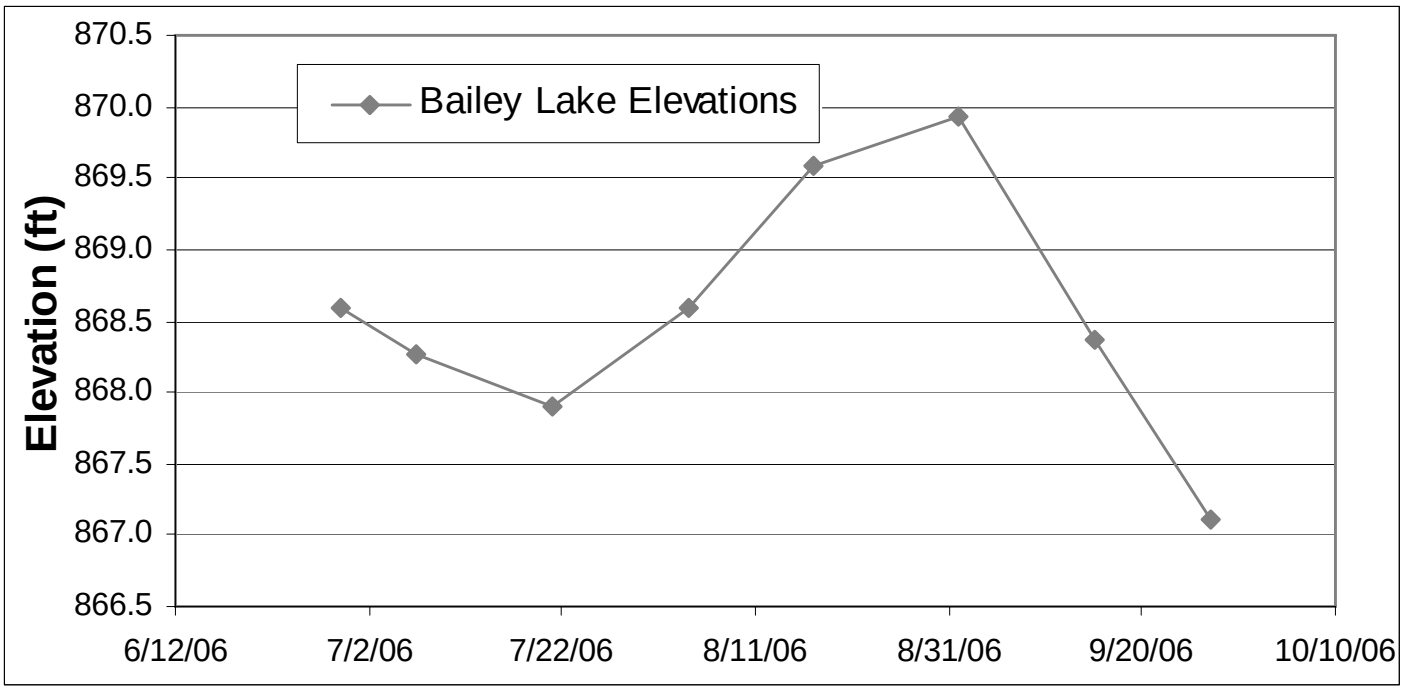


Figure 124. Bailey Lake Elevations

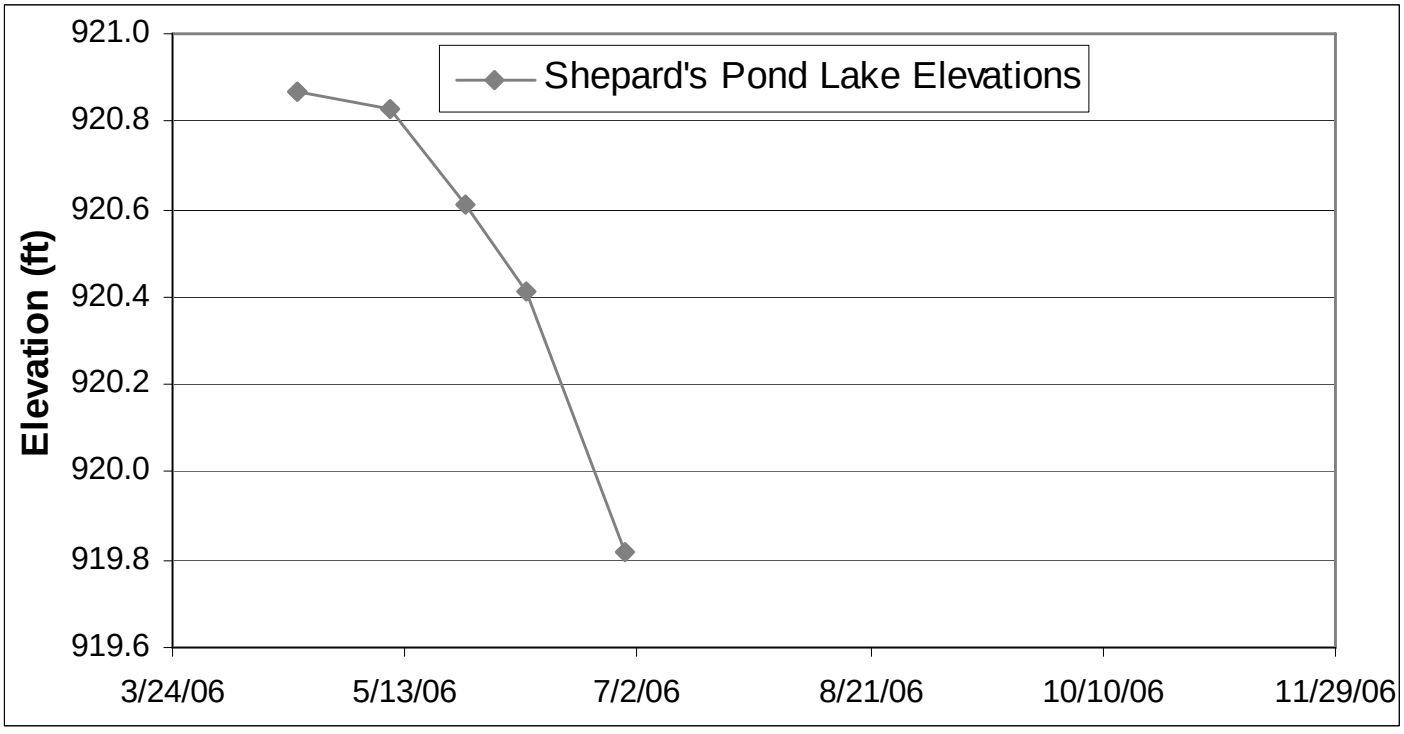


Figure 125. Shepard's Pond Elevations

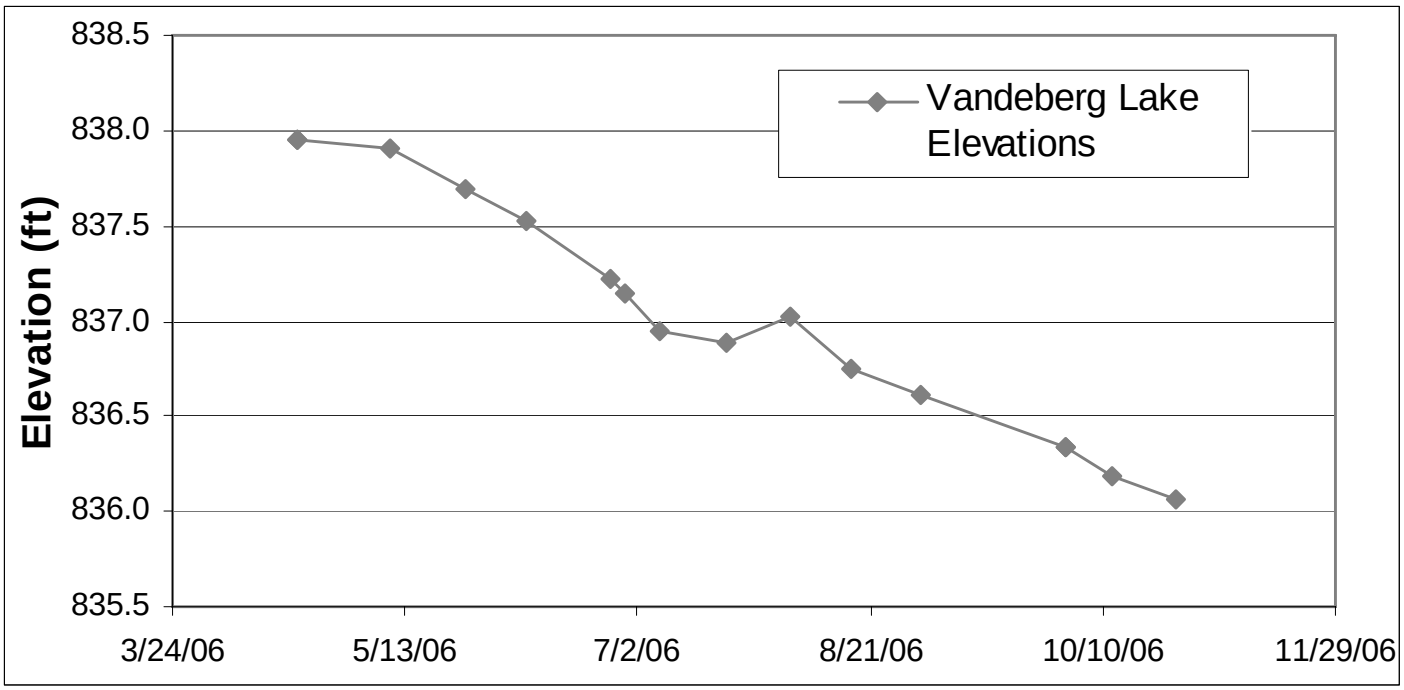


Figure 126. Vandeberg Lake Elevations

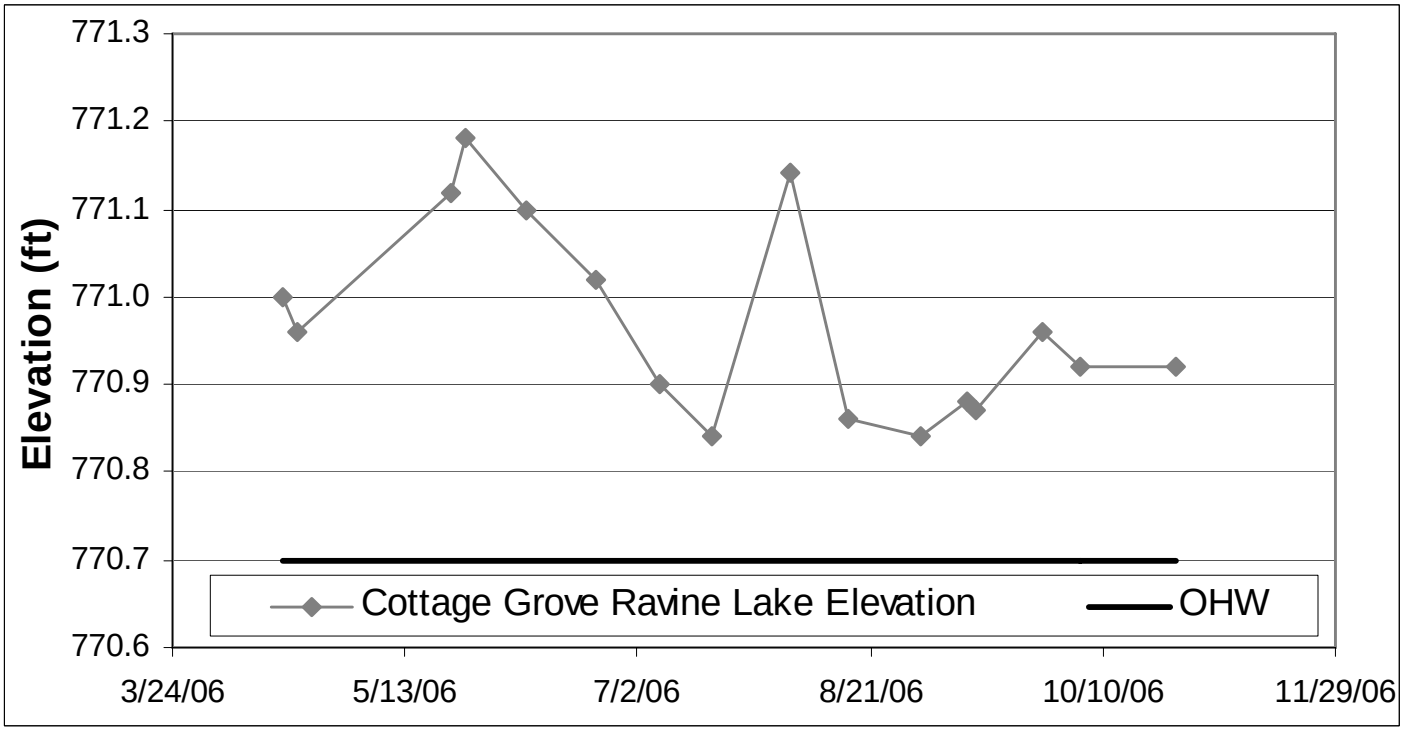


Figure 127. Cottage Grove Ravine Park Lake Elevations and Ordinary High Water (OHW)

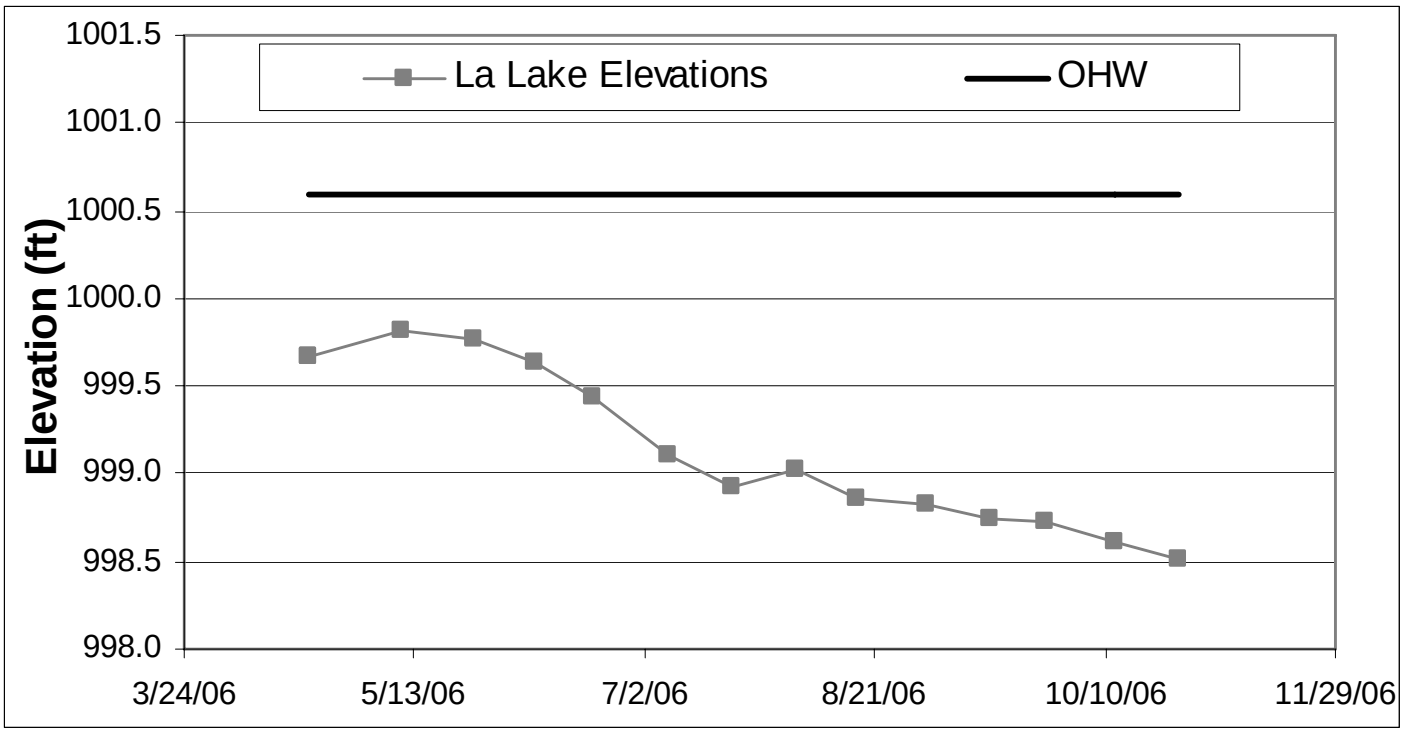


Figure 128. La Lake Elevations and Ordinary High Water (OHW)

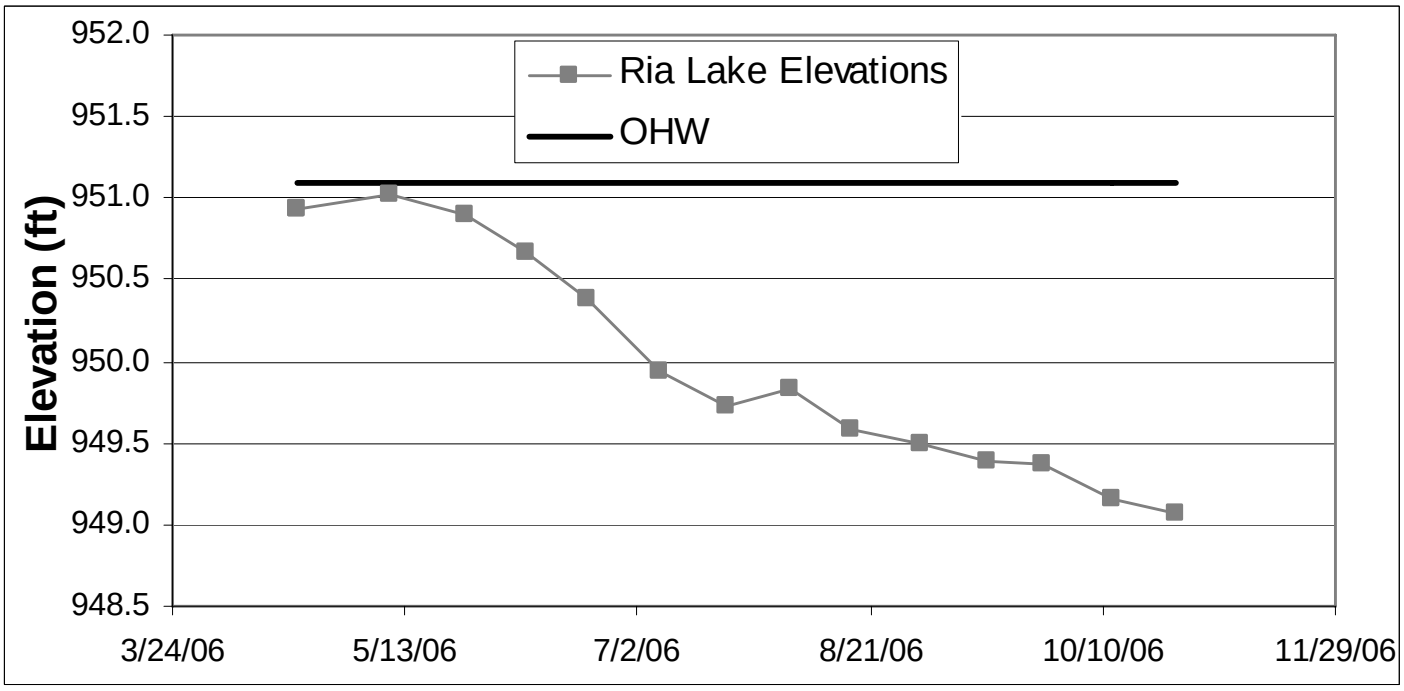


Figure 129. Ria Lake Elevations and Ordinary High Water (OHW)

Observation Wells

Seven observation wells were monitored for elevation concurrently by the Washington Conservation District from January 20-December 27, 2006. Table 41 shows the high, low, range and average groundwater observations during the 2006 monitoring season. Figure 130 shows the fluctuation of the groundwater elevations for each well during the 2006 monitoring season. Water levels for observation wells were highest during January for all except for well # 545604, which has the most shallow groundwater elevations. Low groundwater elevations occurred mainly during August and December.

Table 41. SWWD 2006 Observation Well Elevations

Well #	Dates Monitored	# Readings	Monitoring Point Elevation (ft)	Lowest Reading (ft)	Lowest Reading Date	Highest Reading (ft)	Highest Reading Date	Range (ft)	Average Elevation (ft)
545602	1-20-06 to 12-27-06	12	889.25	816.27	12/27/2006	818.05	1/20/2006	1.78	817.27
545603	1-20-06 to 12-27-06	12	909.15	849.3	8/30/2006	858.06	1/20/2006	8.76	852.67
545604	1-20-06 to 12-27-06	12	906.70	862.06	8/30/2006	868.7	9/29/2006	6.64	864.86
616493	1-20-06 to 12-27-06	9	916.75	835.7	12/27/2006	840.4	1/20/2006	4.7	837.68
616494	1-20-06 to 12-27-06	5	916.95	836.95	7/27/2006	844.15	1/20/2006	7.2	839.10
616497	1-20-06 to 12-27-06	12	913.53	862.13	12/27/2006	862.24	1/20/2006	0.11	862.20
616498	1-20-06 to 2-15-06	1	920.24	NA	NA	NA	NA	NA	NA

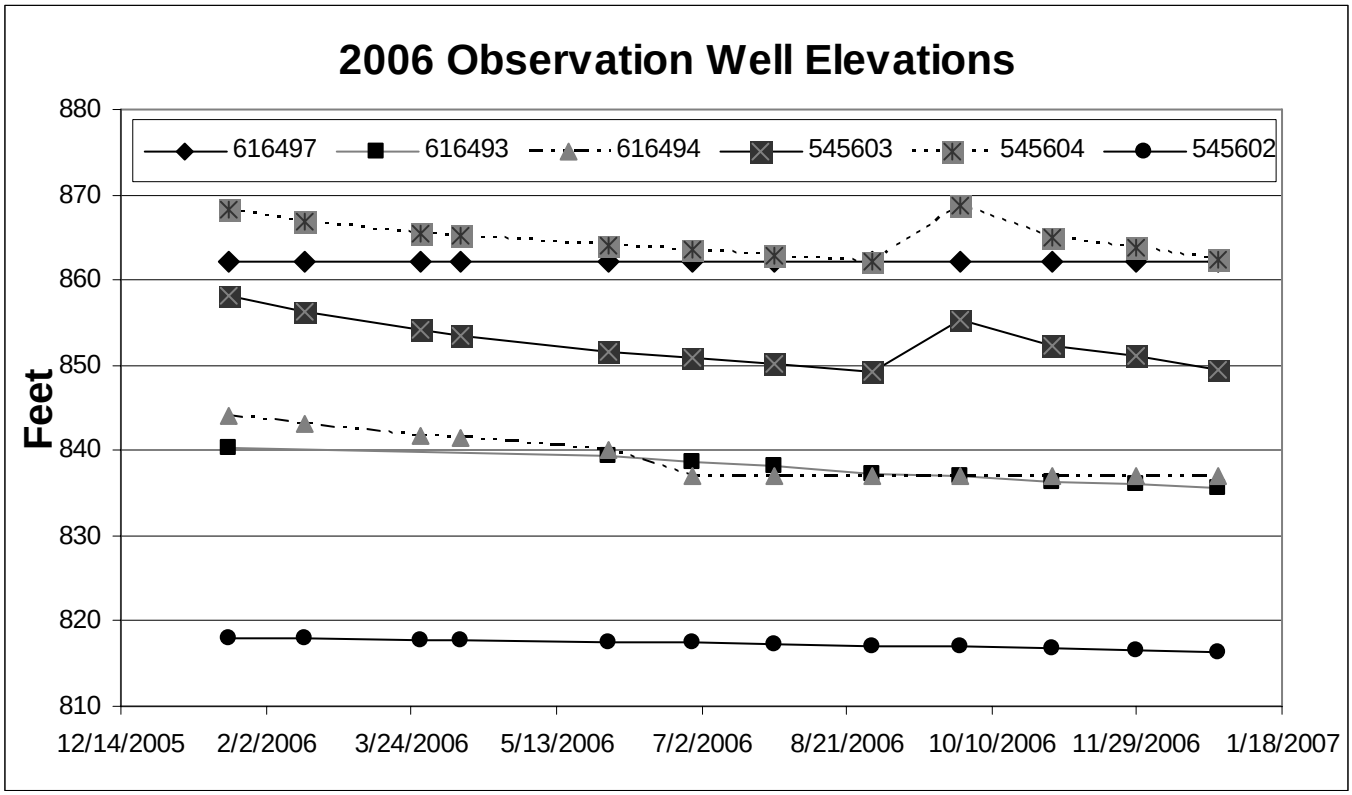


Figure 130. SWWD 2006 Observation Well Elevations