2008 WATER MONITORING REPORT

June 2009

Prepared For:

South Washington Watershed District

Prepared by:

Washington Conservation District

Memorandum

To: Matt Moore —South Washington Watershed District Administrator
From: Erik Anderson, Matt Downing, Wendy Griffin, Rachel Kuykendall, Tim Sundby, Jessica Thiel, and Travis Thiel--Washington Conservation District
Date: June 2009
Re: SWWD 2008 Monitoring: MS1, MS2, Powers Lake North Tributary, Powers Lake East Tributary, Colby Lake West Tributary, 100th Street, St. Paul Park, Newport, Fox Run, Tamarack Road, Bailey Lift Station, 80th Street, 90th Street, West Draw 1, West Draw 3, 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 stormwater monitoring at eight stormwater quality monitoring stations, monitored six stormwater flow-only sites, monitored water quality and level on two lakes, monitored level and precipitation at the Bailey Lift Station, installed and read nine lake staff gages, and monitored six 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, 2008. This report and the accompanying data will also be provided in an electronic format.

Stormwater Sampling Sites: MS1, MS2, Powers East, Powers North, Colby West, 100th Street, Newport, & St. Paul Park

Continuous stage, velocity, and discharge measurements were taken every 15 minutes at Newport from April 9-October 14, 2008, at St. Paul Park from April 14-October 17, 2008, at 100th Street from April 3-November 5, 2008, at Powers East from April 16-November 5, 2008, at Powers North from April 9-November 4, 2008, at MS1 from April 3-November 5, 2008 and at MS2 from April 8-November 5, 2008. Precipitation data was also continuously collected at 100th Street, Powers East, MS1, and MS2 during the same time period for 2008.

Field stage measurements were taken in culverts and/or channel at all sites. Flow weighted storm event samples, storm event grab samples, snowmelt grab samples, baseflow composite samples, and baseflow grab samples were collected at all sites. In addition to these samples, *E. coli* bacteria grab samples were also taken or were attempted at all seven sites. The samples were analyzed at the Metropolitan Council Environmental Services Lab.

Stage to discharge relationships were developed at all stormwater 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 were used 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 or malfunctioned.

Continuous Stormwater Stage Site: Bailey Lift Station

Continuous stage and precipitation measurements were taken every hour at Bailey Lift Station from April 14-October 30, 2008.

A permanent staff gage was read at the Bailey Lift Station. Offsets between the level logger and staff gage allowed for a continuous stage to be measured.

Continuous Stormwater Flow and Stage Sites: 80th Street, 90th Street, Fox Run, Tamarack Road, West Draw 1, & West Draw 3.

Continuous stage measurements were taken every 15 minutes at 80th Street from April 15-October 29, 2008.

Continuous stage, velocity, and discharge measurements were taken every 15 minutes at 90th Street from April 7-October 30, 2008, at Fox Run from April 10-October 13, 2008, at Tamarack Road from May 14-October 14, 2008, at West Draw 1 from April 10-October 30, 2008, and at West Draw 3 from April 14-October 30, 2008.

Lake Water Quality Sites: Powers Lake and Cottage Grove Ravine Park Lake

The SWWD 2008 workplan included the monitoring of two lakes. Cottage Grove Ravine Park Lake was monitored monthly from April to October. Powers Lake was monitored biweekly from April to October. Both lakes were monitored by collecting Secchi transparencies, and temperature and dissolved oxygen profiles. Hypolimnion samples were also collected on Powers Lake for the 2008 monitoring season. 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. Both lakes had surface composite water quality samples taken for analysis of total phosphorus, total Kjeldahl nitrogen, and chlorophyll-a concentrations. Hypolimnion samples on Powers Lake were taken between one and two meters above the lake bottom for analysis of subsurface total phosphorus, total Kjeldahl nitrogen, and ortho-phosphate.

Further Lake quality discussion is provided by the Metropolitan Council in the annual "Study of the Water Quality of Metropolitan Area Lakes" reports found at http://www.metrocouncil.org/environment/RiversLakes/Lakes/index.htm.

ABBREVIATIONS, ACRONYMS, AND SYMBOLS

CAMP	Citizen-Assisted Lake Monitoring Program
cf	Cubic feet
cfs	Cubic feet per second
Chl-*a*	Chlorophyll-*a*
COD	Total Chemical Oxygen Demand
CS	Chronic Standard
DO	Dissolved Oxygen
E. Coli	*Escherichia coli*
FAV	Final Acute Standard
mg/L	milligram per liter
MN DNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
MPN	most probable number
MS	Maximum Standard
NTU	nephelometric turbidity units
Ortho-P	Ortho-phosphate
SWWD	South Washington Watershed District
TBOD	Total Biochemical Oxygen Demand
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TP	Total Phosphorus
TSI	Trophic State Index
TSS	Total Suspended Solids
µg/L	microgram per liter
µmhos/cm	micromhos per centimeter
VSS	Volatile Suspended Solids
WCD	Washington Conservation District

7050.0222 SPECIFIC STANDARDS OF QUALITY AND PURITY FOR CLASS 2B WATERS OF THE STATE; AQUATIC LIFE AND RECREATION.

Chemical Units CS Basis MS FAV Basis

Cadmium, total µg/l

The CS shall not exceed: exp.(0.7852[ln(total hardness mg/l)]-3.490)
The MS shall not exceed: exp.(1.128[ln(total hardness mg/l)]-1.685)
The FAV shall not exceed: exp.(1.128[ln(total hardness mg/l)]-0.9919)
For hardness values greater than 400 mg/l, 400 mg/l shall be used to calculate the standard.

Chloride mg/l 230 Tox. 860 1720 Tox.

Chromium +3, total µg/l

The CS shall not exceed: exp.(0.819[ln(total hardness mg/l)]+1.561)
The MS shall not exceed: exp.(0.819[ln(total hardness mg/l)]+3.688)
The FAV shall not exceed: exp.(0.819[ln(total hardness mg/l)]+4.380)
For hardness values greater than 400 mg/l, 400 mg/l shall be used to calculate the standard.

Copper, total µg/l

The CS shall not exceed: exp.(0.6200[ln(total hardness mg/l)]-0.570)
The MS shall not exceed: exp.(0.9422[ln(total hardness mg/l)]-1.464)
The FAV shall not exceed: exp.(0.9422[ln(total hardness mg/l)]-0.7703)
For hardness values greater than 400 mg/l, 400 mg/l shall be used to calculate the standard.

Fecal coliform organisms: 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 2,000 organisms per 100 milliliters. The standard applies only between April 1 and October 31.

Lead, total µg/l

The CS shall not exceed: exp.(1.273[ln(total hardness mg/l)]-4.705)
The MS shall not exceed: exp.(1.273[ln(total hardness mg/l)]-1.460)
The FAV shall not exceed: exp.(1.273[ln(total hardness mg/l)]-0.7643)
For hardness values greater than 400 mg/l, 400 mg/l shall be used to calculate the standard.

Nickel, total µg/l

The CS shall not exceed: exp.(0.846[ln(total hardness mg/l)]+1.1645)
The MS shall not exceed: exp.(0.846[ln(total hardness mg/l)]+3.3612)
The FAV shall not exceed: exp.(0.846[ln(total hardness mg/l)]+4.0543)
For hardness values greater than 400 mg/l, 400 mg/l shall be used to calculate the standard.

Zinc, total µg/l

The CS shall not exceed: exp.(0.8473[ln(total hardness mg/l)]+0.7615)
The MS shall not exceed: exp.(0.8473[ln(total hardness mg/l)]+0.8604)
The FAV shall not exceed: exp.(0.8473[ln(total hardness mg/l)]+1.5536)
For hardness values greater than 400 mg/l, 400 mg/l shall be used to calculate the standard.

The MPCA defines standards as follows: "Chronic standard is the highest concentration of a toxicant to which aquatic organisms can be exposed indefinitely with no harmful effects, or to which humans or wildlife consumers of aquatic organisms can be exposed indefinitely with no harmful effects". "Maximum standard is a concentration that protects aquatic organisms from potential lethal effects of a short-term "spike" in toxicant concentrations. This is always equal to one-half the final acute value". "Final acute value is the concentration that would kill about half of the exposed individuals of a very sensitive aquatic species".

(http://www.pca.state.mn.us/water/standards/index.html). MPCA has proposed to change current water quality standards from fecal coliform to E. coli bacteria. These changes would set the 30-day geometric mean to 126 cfu/100mL and 10% of Values not to Exceed 1260 cfu/mL.
(http://proteus.pca.state.mn.us/water/standards/rulechange.html)

The following paragraphs link where high concentrations of heavy metals are coming from. This is not an all-inclusive list of sources for the individual metals discussed.

Copper: A major source for copper in stormwater is from roads, specifically from corrosion of cars and trucks. Corrosion of copper pipes also leads to a source of copper in drinking water. Smelting operations and municipal incineration are other sources of copper concentrations.
(http://www.freedrinkingwater.com/water-contamination/copper-contaminants-removal-water.htm)

Nickel: Nickel concentrations may come from power plants, waste incinerators and other metal industries. Other sources include alloys used in the treatment of heavy metal polluted surface water, batteries containing nickel-cadmium, and as a pigment. Also included as a potential source of nickel are the alloys in kitchenware.

Nickel concentrations in soils, which have the potential to erode into surface waters, originate in several sources. Phosphate fertilizers contain trace nickel amounts and dust from waste incinerators all contribute to soil cumliation. (http://www.lenntech.com/elements-and-water/nickel-and-water.htm)

Lead: Sources of lead in drinking water are most notably from lead-based pipes or lead solder used for copper plumbing. This source is usually found in old homes. (http://www.extension.umn.edu/info-u/environment/BD303.html)

Lead is also released in to the environment from mining operations, ore processing, lead smelting, refining, recycling and disposal via the atmosphere. Water entry is usually from atmospheric deposition, runoff, or wastewater. (http://www.epa.gov/ogwdw/dwh/t-ioc/lead.html)

Zinc: Zinc is released to the environment largely through human activities. Main activities are mining, smelting, and steel production. Burning coal and waste are other sources of zinc deposition to the environment. Industrial release of dust containing zinc will eventually settle out onto soil and surface waters. Rain and snow will also act as conduit for removal of zinc from the air. If high levels of zinc are present, most likely other metals, such as lead and cadmium, will also be present.
(http://www.idph.state.il.us/envhealth/factsheets/zinc.htm)

Cadmium: Sources to air include the combustion of fossil fuels, iron and steel production, non-ferrous metals production, and municipal solid waste combustion. Sources to water include use of phosphate fertilizers, non-ferrous metals production, and the iron and steel industry. (http://www.cadmium.org/env_emi.html)

Chromium: Emissions to air and water may result from leather tanning industries, chemical manufacturing industries (e.g. dyes for paints, rubber and plastic products), metal finishing industries (e.g. chrome plating), manufacturers of pharmaceuticals, wood, stone, clay and glass products, electrical and aircraft manufacturers, steam and air conditioning supply services, cement producing plants (cement contains chromium), incineration of council refuse and sewage sludge, and combustion of oil and coal. Chromium may be oxidised and leached from stainless steel into a water-soluble form..
(http://www.npi.gov.au/database/substance-info/profiles/24.html#sourcesof)

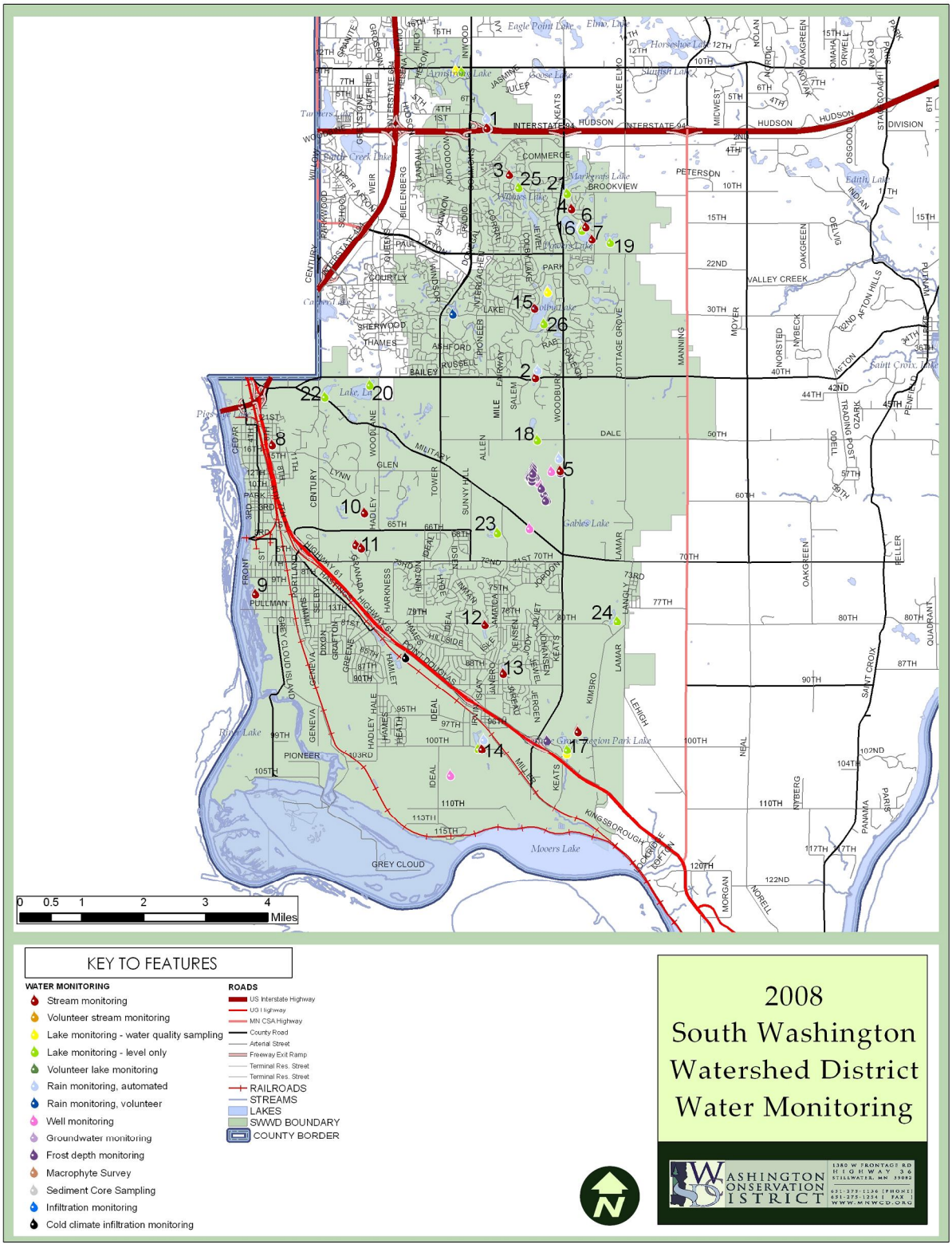


Figure 1. SWWD Water Monitoring Locations

Table 1. Parameters sampled for each South Washington Watershed District site.

Site Description	Map Site ID #	Site Name	Monitoring Parameters
Stream Monitoring	1	MS-1	Discharge, Water Quality Composite Samples, Rainfall
Stream Monitoring	2	MS-2	Discharge, Water Quality Composite Samples, Rainfall
Stream Monitoring	3	Tamarack Road	Discharge, Stage
Stream Monitoring	4	Fox Run Road	Discharge, Stage
Stream Monitoring	5	Bailey Lift Station	Stage, Rainfall
Stream Monitoring	6	Powers Lake North Inlet	Discharge, Water Quality Composite Samples
Stream Monitoring	7	Fish Lake Outlet at Powers Lake	Discharge, Water Quality Composite Samples, Rainfall
Stream Monitoring	8	Tributary to Mississippi R. at St. Paul Park	Discharge, Water Quality Composite Samples
Stream Monitoring	9	Tributary to Mississippi R. at Newport	Discharge, Water Quality Composite Samples
Stream Monitoring	10	West Draw 1	Discharge, Stage
Stream Monitoring	11	West Draw 3	Discharge, Stage
Stream Monitoring	12	80th St.	Discharge, Stage
Stream Monitoring	13	90th St.	Discharge, Stage
Stream Monitoring	14	100th St.	Discharge, Water Quality Composite Samples, Rainfall
Stream Monitoring	15	Colby Lake West Inlet	Discharge, Water Quality Composite Samples
Lake Monitoring	16	Powers Lake	Surface Water Quality Samples, Hypolimnion Water Quality Samples, Elevation
Lake Monitoring	17	Cottage Grove Ravine Park Lake	Surface Water Quality Samples, Elevation
Lake Monitoring	18	Bailey Lake	Elevation
Lake Monitoring	19	Fish Lake	Elevation
Lake Monitoring	20	La Lake	Elevation
Lake Monitoring	21	Markgrafs Lake	Elevation
Lake Monitoring	22	Ria Lake	Elevation
Lake Monitoring	23	Shepard's Pond	Elevation
Lake Monitoring	24	Vandeberg Lake	Elevation
Lake Monitoring	25	Wilmes Lake	Elevation
Lake Monitoring	26	Colby Lake	Elevation

Water Quality Sampling Sites: MS1, MS2, Powers East, Powers North, Colby, 100th, Newport, and St. Paul Park

MS1 (I94)

The hydrograph for the MS1 site shows flow from April 3–November 5, 2008 (Figure 2). Precipitation data was also collected during this time period. Total discharge during this period was 9,598,469 cf or 220 acre-ft. The peak discharge of 52.6 cfs was on August 28, 2008 from a storm precipitation of 2.07 inches. This event also had the highest storm precipitation of 2008.

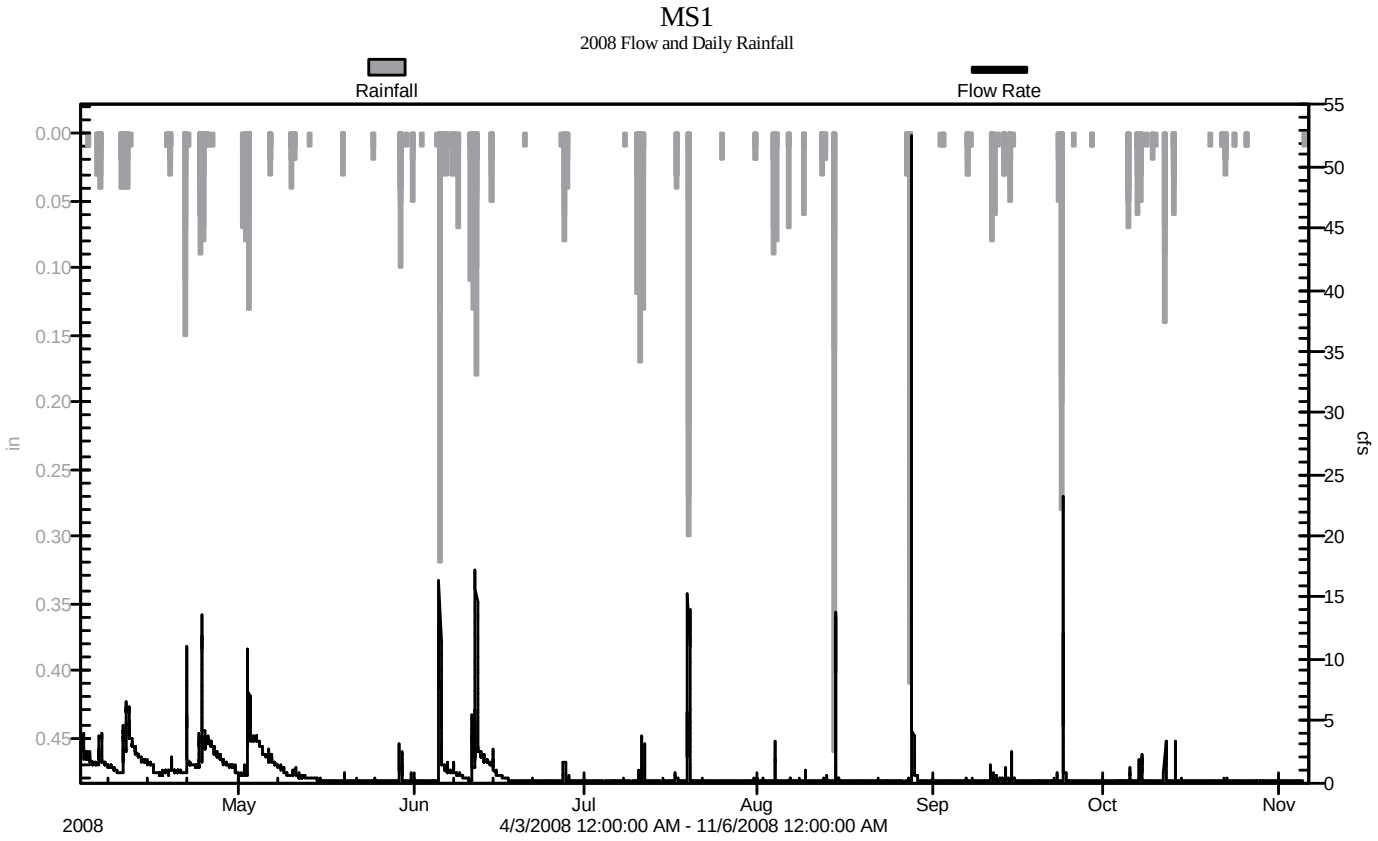


Figure 2. MS1 2008 Continuous Flow and Daily Rainfall

Table 2. MS1 Stormwater Total Phosphorus and Total Suspended Solids Loading Table

	Sample Collection Time				Loading Interval					
Sample Type	Start	End	TSS (mg/L)	TP (mg/L)	Start	End	Interval Volume (cf)	Interval Volume (ac-ft)	Interval TSS (lb)	Interval TP (lb)
*Base**			*2*	*0.119*	*1/1/2008 0:00*	*4/2/2008 8:00*	*1,595,520*	*36.65*	*199*	*11.9*
Snowmelt Grab	4/2/08 14:00	4/2/08 14:00	45	0.174	4/2/2008 8:00	4/4/2008 14:15	131,550	3.02	370	1.4
Base			*2*	*0.119*	*4/4/2008 14:15*	*4/6/2008 12:15*	*354,984*	*8.15*	*44*	*2.6*
Storm			*88*	*0.223*	*4/6/2008 12:15*	*4/7/2008 0:15*	*105,631*	*2.43*	*580*	*1.5*
Base			*2*	*0.119*	*4/7/2008 0:15*	*4/10/2008 15:15*	*361,456*	*8.30*	*45*	*2.7*
Storm			*88*	*0.223*	*4/10/2008 15:15*	*4/12/2008 4:15*	*566,378*	*13.01*	*3,111*	*7.9*
Base			*2*	*0.119*	*4/12/2008 4:15*	*4/18/2008 23:15*	*879,182*	*20.19*	*110*	*6.5*
Storm			*88*	*0.223*	*4/18/2008 23:15*	*4/19/2008 9:15*	*43,787*	*1.01*	*241*	*0.6*
Base			*2*	*0.119*	*4/19/2008 9:15*	*4/21/2008 21:15*	*180,547*	*4.15*	*23*	*1.3*
Storm Composite	4/21/08 23:43	4/22/08 12:22	215	0.277	4/21/2008 21:15	4/22/2008 4:15	101,889	2.34	1,368	1.8
Base			*2*	*0.119*	*4/22/2008 4:15*	*4/24/2008 7:15*	*260,910*	*5.99*	*33*	*1.9*
Storm Composite	4/24/2008 18:01	4/24/2008 20:56	64	0.247	4/24/2008 7:15	4/25/2008 0:15	265,648	6.10	1,061	4.1
Base			*2*	*0.119*	*4/25/2008 0:15*	*5/2/2008 12:15*	*1,148,002*	*26.37*	*143*	*8.5*
Storm Composite	5/2/2008 13:34	5/3/2008 2:29	37	0.169	5/2/2008 12:15	5/3/2008 7:15	415,868	9.55	961	4.4
Base			*2*	*0.119*	*5/3/2008 7:15*	*5/10/2008 14:15*	*1,228,276*	*28.21*	*153*	*9.1*
Storm			*88*	*0.223*	*5/10/2008 14:15*	*5/11/2008 8:15*	*51,610*	*1.19*	*284*	*0.7*
Base			*2*	*0.119*	*5/11/2008 8:15*	*5/19/2008 14:15*	*155,372*	*3.57*	*19*	*1.2*
Storm			*88*	*0.223*	*5/19/2008 14:15*	*5/19/2008 21:15*	*4,583*	*0.11*	*25*	*0.1*
Base Grab	5/20/2008 10:01	5/20/2008 10:01	76	0.184	5/19/2008 21:15	5/29/2008 16:15	33,770	0.78	*160*	*0.4*
Storm			*88*	*0.223*	*5/29/2008 16:15*	*5/30/2008 6:15*	*44,845*	*1.03*	*246*	*0.6*
Base			*2*	*0.119*	*5/30/2008 6:15*	*5/31/2008 19:15*	*11,783*	*0.27*	*1*	*0.1*
Storm			*88*	*0.223*	*5/31/2008 19:15*	*5/31/2008 23:15*	*3,187*	*0.07*	*18*	*0.0*
Base			*2*	*0.119*	*5/31/2008 23:15*	*6/5/2008 16:15*	*18,784*	*0.43*	*2*	*0.1*
Storm Composite	6/5/08 17:13	6/8/08 7:12	57	0.167	6/5/2008 16:15	6/8/2008 10:15	*400,113*	9.19	*1,424*	*4.2*
Base			*2*	*0.119*	*6/8/2008 10:15*	*6/11/2008 10:15*	*103,241*	*2.37*	*13*	*0.8*
Storm Composite	6/11/2008 17:29	6/12/2008 8:32	62	0.194	6/11/2008 10:15	6/12/2008 11:15	390,630	8.97	1,512	4.7
Base			*2*	*0.119*	*6/12/2008 11:15*	*6/14/2008 21:15*	*401,526*	*9.22*	*50*	*3.0*
Storm			*88*	*0.223*	*6/14/2008 21:15*	*6/15/2008 1:15*	*24,871*	*0.57*	*137*	*0.3*
Base			*2*	*0.119*	*6/15/2008 1:15*	*6/27/2008 16:15*	*170,053*	*3.91*	*21*	*1.3*
Storm			*88*	*0.223*	*6/27/2008 16:15*	*6/28/2008 18:15*	*19,451*	*0.45*	*107*	*0.3*
Base			*2*	*0.119*	*6/28/2008 18:15*	*7/10/2008 14:15*	*19,804*	*0.45*	*2*	*0.1*
Storm			*88*	*0.223*	*7/10/2008 14:15*	*7/12/2008 6:15*	*45,248*	*1.04*	*249*	*0.6*
Base			*2*	*0.119*	*7/12/2008 6:15*	*7/17/2008 11:15*	*13,428*	*0.31*	*2*	*0.1*
Storm			*88*	*0.223*	*7/17/2008 11:15*	*7/17/2008 19:15*	*5,969*	*0.14*	*33*	*0.1*
Base			*2*	*0.119*	*7/17/2008 19:15*	*7/19/2008 15:15*	*7,278*	*0.17*	*1*	*0.1*
Storm Composite	7/19/2008 16:01	7/19/2008 19:34	122	0.248	7/19/2008 15:15	7/19/2008 23:15	116,169	2.67	885	1.8
Base			*2*	*0.119*	*7/19/2008 23:15*	*8/3/2008 23:15*	*103,124*	*2.37*	*13*	*0.8*
Storm			*88*	*0.223*	*8/3/2008 23:15*	*8/4/2008 5:15*	*19,943*	*0.46*	*110*	*0.3*
Base Grab	8/5/08 13:52	8/5/08 13:52	2	0.085	8/4/2008 5:15	8/14/2008 14:15	48,400	1.11	6	0.3
Storm			*88*	*0.223*	*8/14/2008 14:15*	*8/14/2008 22:15*	*106,925*	*2.46*	*587*	*1.5*
Base			*2*	*0.119*	*8/14/2008 22:15*	*8/27/2008 18:15*	*55,643*	*1.28*	*7*	*0.4*
Storm Composite	8/27/2008 20:14	8/28/2008 13:42	67	0.249	8/27/2008 18:15	8/28/2008 15:15	675,381	15.51	2,825	10.5
Base			*2*	*0.119*	*8/28/2008 15:15*	*9/6/2008 15:15*	*77,809*	*1.79*	*10*	*0.6*
Storm			*88*	*0.223*	*9/6/2008 15:15*	*9/7/2008 2:15*	*5,066*	*0.12*	*28*	*0.1*
Base Grab	9/10/2008 11:30	9/10/2008 11:30	3	0.07	9/7/2008 2:15	9/11/2008 4:15	22,239	0.51	4	0.1
Storm			*88*	*0.223*	*9/11/2008 4:15*	*9/12/2008 0:15*	*23,470*	*0.54*	*129*	*0.3*
Base			*2*	*0.119*	*9/12/2008 0:15*	*9/13/2008 12:15*	*13,301*	*0.31*	*2*	*0.1*
Storm			*88*	*0.223*	*9/13/2008 12:15*	*9/15/2008 1:15*	*53,216*	*1.22*	*292*	*0.7*
Base			*2*	*0.119*	*9/15/2008 1:15*	*9/23/2008 17:15*	*33,393*	*0.77*	*4*	*0.2*
Storm Composite	9/23/08 17:55	9/23/08 22:41	76	0.23	9/23/2008 17:15	9/24/2008 9:15	191,683	4.40	909	2.8
Base			*2*	*0.119*	*9/24/2008 9:15*	*10/5/2008 9:15*	*25,998*	*0.60*	*3*	*0.2*
Storm			*88*	*0.223*	*10/5/2008 9:15*	*10/5/2008 17:15*	*4,572*	*0.11*	*25*	*0.1*
Base			*2*	*0.119*	*10/5/2008 17:15*	*10/7/2008 5:15*	*2,716*	*0.06*	*0*	*0.0*
Storm			*88*	*0.223*	*10/7/2008 5:15*	*10/8/2008 1:15*	*57,463*	*1.32*	*316*	*0.8*
Base			*2*	*0.119*	*10/8/2008 1:15*	*10/11/2008 19:15*	*9,154*	*0.21*	*1*	*0.1*
Storm			*88*	*0.223*	*10/11/2008 19:15*	*10/12/2008 4:15*	*27,104*	*0.62*	*149*	*0.4*
Base			*2*	*0.119*	*10/12/2008 4:15*	*10/13/2008 9:15*	*3,158*	*0.07*	*0*	*0.0*
Storm			*88*	*0.223*	*10/13/2008 9:15*	*10/13/2008 20:15*	*45,284*	*1.04*	*249*	*0.6*
Base Grab	10/22/08 12:59	10/22/08 12:59	2	0.135	10/13/2008 20:15	11/5/2008 10:15	39,156	0.90	5	0.3
*Base**			*2*	*0.119*	*11/5/2008 10:15*	*1/1/2009 0:00*	*977,580*	*22.45*	*122*	*7.3*
Storm Average			88	0.223						
Base Average			2	0.119						
Snowmelt Average			45	0.174						
All Average			63	0.187						
Total							**12,303,119**	**283**	**19,428**	**115**
SWWD Major Subwatershed Total Acres							1,482			
Total TP/TSS(lb/ac/yr)									13.11	0.08
Total TP/TSS (kg/ha/yr)									14.69	0.09

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

**Interval volumes between 1/1/08-4/4/08 and 11/5/08-1/1/09 were estimated based upon base flow

Grab and flow weighted composite samples were collected 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), and *E. coli* concentrations from all collected samples are listed in Table 3. The highest TSS and TP concentrations were collected in a storm composite on April 21, 2008. The highest TKN concentration was collected in a base grab on May 20, 2008. Three of the four *E. coli* samples collected exceeded the water quality standard. Metals, chloride, other Nitrogen species, and hardness chemical results are listed in Table 4. Table 4 outlines any chronic standards exceedences as stated within Chapter 7050 of the water quality rules of the MPCA. Multiple samples had both copper and lead that were above the chronic standard. The July 19, 2008 storm composite sample exceeded the maximum standard for copper and the April 24, 2008 storm composite sample exceeded the final acute standard for copper. Parameters that were tested under MPCA 7050 were copper, nickel, lead, cadmium, chromium, chloride, and zinc. The MPCA defines these standards as follows: "Chronic standard is the highest concentration of a toxicant to which aquatic organisms can be exposed indefinitely with no harmful effects, or to which humans or wildlife consumers of aquatic organisms can be exposed indefinitely with no harmful effects". "Maximum standard is a concentration that protects aquatic organisms from potential lethal effects of a short-term 'spike' in toxicant concentrations. This is always equal to one-half the final acute value". "Final acute value is the concentration that would kill about half of the exposed individuals of a very sensitive aquatic species". (http://www.pca.state.mn.us/water/standards/index.html). MPCA has proposed to change current water quality standards from fecal coliform to *E. coli* bacteria. These changes would set the 30-day geometric mean to 126 #/100mL and 10% of Values not to Exceed 1260 #/mL. (http://proteus.pca.state.mn.us/water/standards/rulechange.html)

Table 3. MS1 2008 Sample Chemistry Results

Sample Type	Start Date	End Date	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	E. Coli (#/100 mL)	TDP (mg/L)
Snowmelt Grab	4/2/08 14:00	4/2/08 14:00	45	6	2.2	0.174		~0.041
Storm Composite	4/21/08 23:43	4/22/08 12:22	215	31	1.8	0.277		0.124
Storm Composite	4/24/08 18:01	4/24/08 20:56	64	~10	2.1	0.247		0.114
Storm Composite	5/2/08 13:34	5/3/08 2:29	37	7	1.5	0.169		0.088
Base Grab	5/20/08 10:01	5/20/08 10:01	76	12	2.8	0.184		~0.031
E. Coli Grab	6/5/08 10:50	6/5/08 10:50					104	
Storm Composite	6/5/08 17:13	6/8/08 7:12	57	9	1.9	0.167		0.067
Storm Composite	6/11/08 17:29	6/12/08 8:32	62	9	1.2	0.194		0.076
E. Coli Grab	7/17/08 8:00	7/17/08 8:00					>2420	
Storm Composite	7/19/08 16:01	7/19/08 19:34	122	20	1.8	0.248		0.051
Base Grab	8/5/08 13:52	8/5/08 13:52	~2	~1	0.86	0.085		0.066
E. Coli Grab	8/7/08 9:50	8/7/08 9:50					517	
E. Coli Grab	8/27/08 9:53	8/27/08 9:53					>2420	
Storm Composite	8/27/08 20:14	8/28/08 13:42	67	11	1.5	0.249		0.134
Base Grab	9/10/08 11:30	9/10/08 11:30	3	~2	0.42	0.070		~0.035
Storm Composite	9/23/08 17:55	9/23/08 22:41	76	13	0.94	0.230		0.061
Base Grab	10/22/08 12:59	10/22/08 12:59	~2	~1	0.43	0.135		0.101

Exceeds Water Quality Standard

Table 4. MS1 2008 Sample Metals, Chloride, Nitrogen Species, and Hardness Chemical Results including MPCA 7050 Water Quality Standard Exceedences (http://www.revisor.leg.state.mn.us/arule/7050/)

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)	Hardness
Snowmelt Grab	4/2/08 14:00	4/2/08 14:00	0.0032	0.0024	0.0008	0.0175	<0.0005	0.0018	160	<0.03	0.23	0.08	140
Storm Composit	4/21/08 23:43	4/22/08 12:22							116	<0.03	0.4	0.12	
Storm Composit	4/24/08 18:01	4/24/08 20:56	0.0316	0.0032	0.0022	0.0254	<0.0005	<0.004	92	<0.03	0.15	0.13	64
Storm Composit	5/2/08 13:34	5/3/08 2:29	0.0087	0.0025	0.0019	0.0167	<0.0005	0.0028	94	<0.03	0.16	0.17	64
Base Grab	5/20/08 10:01	5/20/08 10:01	0.0067	0.0036	0.0014	0.03	<0.0005	<0.003	159	0.06	0.58	0.28	126
E. Coli Grab	6/5/08 10:50	6/5/08 10:50											
Storm Composit	6/5/08 17:13	6/8/08 7:12	0.0087	0.0026	0.0014	0.025	<0.0005	<0.004	121	0.06	0.56	0.1	60
Storm Composit	6/11/08 17:29	6/12/08 8:32	0.0064	0.0031	0.002	0.021	<0.0005	<0.004	56	<0.03	0.22	0.08	44
E. Coli Grab	7/17/08 8:00	7/17/08 8:00											
Storm Composit	7/19/08 16:01	7/19/08 19:34	0.0246	0.0038	0.003	0.0428	0.0011	0.0042	24	<0.03	0.45	0.13	84
Base Grab	8/5/08 13:52	8/5/08 13:52	0.0151	0.0026	0.0001	0.0028	<0.0005	<0.004	39	<0.03	0.23	~0.03	234
E. Coli Grab	8/7/08 9:50	8/7/08 9:50											
E. Coli Grab	8/27/08 9:53	8/27/08 9:53											
Storm Composit	8/27/08 20:14	8/28/08 13:42	0.0105	0.0026	0.0013	0.0159	<0.0005	<0.005	12	<0.03	0.62	0.28	64
Base Grab	9/10/08 11:30	9/10/08 11:30	0.0052	0.0019	<0.0001	0.0018	<0.0005	<0.003	31	<0.03	0.96	<0.02	146
Storm Composit	9/23/08 17:55	9/23/08 22:41	0.0094	0.0031	0.002	0.0211	<0.0005	0.0034	10	<0.03	0.28	~0.05	76
Base Grab	10/22/08 12:59	10/22/08 12:59	0.0038	0.0028	0.0003	0.0053	<0.0005	<0.003	39	<0.03	0.21	<0.02	116

No Exceedance Determinable
Exceeds Chronic Standard
Exceeds Max Standard
Exceeds Final Acute Standard

MS2 (Bailey Inlet)

The hydrograph for the MS2 site shows flow from April 8 – November 5, 2008 (Figure 3). Precipitation data was also collected during this time period. Total discharge during this period was 37,086,103 cf or 851 acre-ft. Peak discharge was 21.8 cfs on May 4, 2008 from a storm precipitation of 1.02 inches. The highest precipitation occurred during the April 5, 2008 storm event with 1.77 inches of rain.

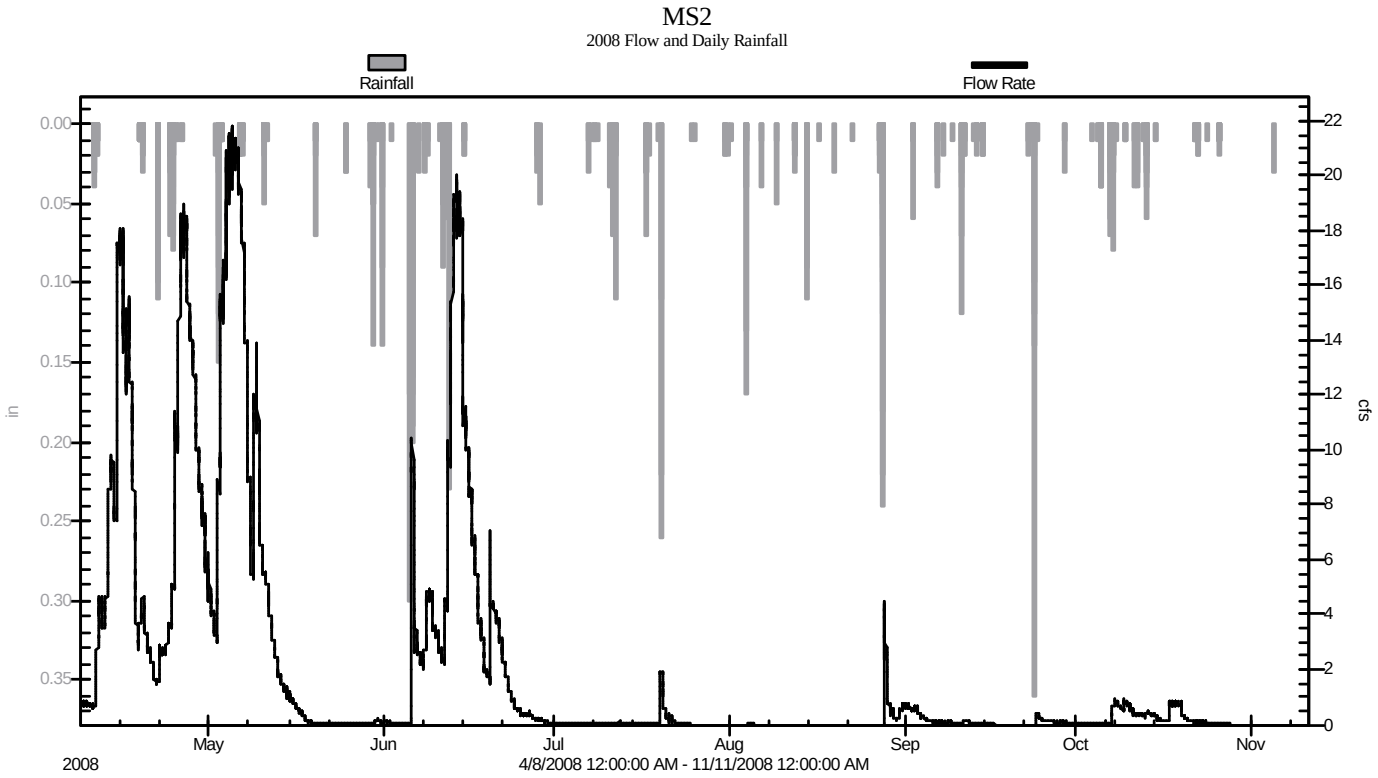


Figure 3. MS2 2008 Continuous Flow and Daily Rainfall

Table 5. MS2 Stormwater Total Phosphorus and Total Suspended Solids Loading Table

	Sample Collection Time				Loading Interval					
Sample Type	**Start**	**End**	**TSS (mg/L)**	**TP (mg/L)**	**Start**	**End**	**Interval Volume (cf)**	**Interval Volume (ac-ft)**	**Interval TSS (lb)**	**Interval TP (lb)**
*Base***			*14*	*0.098*	*1/1/2008 0:00*	*4/8/2008 15:00*	*85,212*	*1.96*	*74.5*	*0.5*
Base			*14*	*0.098*	*4/8/2008 15:00*	*4/10/2008 15:00*	*121,718*	*2.80*	*106.4*	*0.7*
Storm Composite	4/11/08 10:05	4/12/08 21:08	8	0.195	4/10/2008 15:00	4/14/2008 10:00	1,741,557	40.00	869.7	21.2
Base			*14*	*0.098*	*4/14/2008 10:00*	*4/18/2008 13:00*	*4,406,949*	*101.22*	*3851.5*	*27.0*
Storm			*21*	*0.176*	*4/18/2008 13:00*	*4/19/2008 20:00*	*431,994*	*9.92*	*566.3*	*4.7*
Base			*14*	*0.098*	*4/19/2008 20:00*	*4/21/2008 22:00*	*394,407*	*9.06*	*344.7*	*2.4*
Storm			*21*	*0.176*	*4/21/2008 22:00*	*4/24/2008 7:00*	*592,029*	*13.60*	*776.1*	*6.5*
Storm Composite	4/24/08 19:53	4/26/08 3:18	11	0.106	4/24/2008 7:00	4/27/2008 9:00	3,577,857	82.18	2456.9	23.7
Base			*14*	*0.098*	*4/27/2008 9:00*	*5/2/2008 9:00*	*3,526,280*	*80.99*	*3081.8*	*21.6*
Storm Composite	5/2/2008 23:08	5/5/2008 3:14	12	0.080	5/2/2008 9:00	5/6/2008 20:00	6,827,063	156.81	5114.2	34.1
Base			*14*	*0.098*	*5/6/2008 20:00*	*5/8/2008 15:00*	*1,805,372*	*41.47*	*1577.8*	*11.0*
Storm			*21*	*0.176*	*5/8/2008 15:00*	*5/11/2008 22:00*	*2,103,148*	*48.31*	*2757.1*	*23.1*
Base Grab	5/20/08 10:46	5/20/08 10:46	20	0.108	5/11/2008 22:00	5/29/2008 17:00	721,829	16.58	901.2	4.9
Storm			*21*	*0.176*	*5/29/2008 17:00*	*6/2/2008 4:00*	*30,855*	*0.71*	*40.4*	*0.3*
Base			*14*	*0.098*	*6/2/2008 4:00*	*6/5/2008 16:00*	*7469.2*	*0.17*	*6.5*	*0.0*
Storm Composite	6/5/2008 19:04	6/9/2008 7:46	19	0.159	6/5/2008 16:00	6/9/2008 20:00	1,354,643	31.11	1606.7	13.4
Base			*14*	*0.098*	*6/9/2008 20:00*	*6/11/2008 10:00*	*391,824*	*9.00*	*342.4*	*2.4*
Storm Composite	6/12/2008 5:24	6/13/2008 11:11	15	0.119	6/11/2008 10:00	6/15/2008 0:00	4,224,424	97.03	3955.7	31.4
Base Grab	6/24/2008 11:27	6/24/2008 11:27	8	0.087	6/15/2008 0:00	7/11/2008 3:00	3,443,730	79.10	1719.8	18.7
Storm			*21*	*0.176*	*7/11/2008 3:00*	*7/13/2008 15:00*	*10,351*	*0.24*	*13.6*	*0.1*
Base			*14*	*0.098*	*7/13/2008 15:00*	*7/19/2008 16:00*	*3,178*	*0.07*	*2.8*	*0.0*
Storm Composite	7/19/08 19:02	7/20/08 3:19	35	0.244	7/19/2008 16:00	7/20/2008 14:00	85,672	1.97	187.2	1.3
Base			*14*	*0.098*	*7/20/2008 14:00*	*8/4/2008 3:00*	*31,863*	*0.73*	*27.8*	*0.2*
Storm			*21*	*0.176*	*8/4/2008 3:00*	*8/6/2008 13:00*	*284*	*0.01*	*0.4*	*0.0*
Base			*14*	*0.098*	*8/6/2008 13:00*	*8/28/2008 0:00*	*0*	*0.00*	*0.0*	*0.0*
Storm Composite	8/28/08 1:33	8/29/08 4:07	48	0.326	8/28/2008 0:00	8/29/2008 5:00	222,506	5.11	666.7	4.5
Base			*14*	*0.098*	*8/29/2008 5:00*	*9/11/2008 5:00*	*305,885*	*7.03*	*267.3*	*1.9*
Storm			*21*	*0.176*	*9/11/2008 5:00*	*9/12/2008 8:00*	*11,381*	*0.26*	*14.9*	*0.1*
Base			*14*	*0.098*	*9/12/2008 8:00*	*9/23/2008 18:00*	*9,543*	*0.22*	*8.3*	*0.1*
Storm			*21*	*0.176*	*9/23/2008 18:00*	*9/24/2008 1:00*	*5,602*	*0.13*	*7.3*	*0.1*
Base			*14*	*0.098*	*9/24/2008 1:00*	*10/5/2008 5:00*	*78,599*	*1.81*	*68.7*	*0.5*
Storm			*21*	*0.176*	*10/5/2008 5:00*	*10/8/2008 17:00*	*93,484*	*2.15*	*122.6*	*1.0*
Base			*14*	*0.098*	*10/8/2008 17:00*	*11/5/2008 14:00*	*524,606*	*12.05*	*458.5*	*3.2*
*Base***			*14*	*0.098*	*11/5/2008 14:00*	*1/1/2009 0:00*	*0*	*0.00*	*0.0*	*0.0*
Storm Average			21	0.176						
Base Average			14	0.098						
Snowmelt Average			N/A	N/A						
All Average			20	0.158						
Total							**37,171,315**	**854**	**31,996**	**261**
SWWD Major Subwatershed Total Acres							10,174			
Total TP/TSS(lb/ac/yr)									3.14	0.03
Total TP/TSS (kg/ha/yr)									3.52	0.03

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

**Interval volumes from 1/1/08-4/8/08 and 11/5/08 to 1/1/09 were estimated based upon base flow

Grab and flow weighted composite samples were collected 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, TDP, and *E. coli* results from all collected samples are listed in Table 6. All of the highest TSS, TKN, VSS, TDP, and TP concentrations were collected in a storm composite on August 28, 2008. Two of the three *E. coli* samples collected exceeded water quality standards. Metals, chloride, hardness, and other Nitrogen species concentrations are listed in Table 7. Water quality standard exceedences were also included in Table 7. The April 11, 2008 storm composite sample exceeded the chronic standard for chromium and the April 24, 2008 storm composite sample exceeded the chronic standard for copper.

Table 6. MS2 2008 Sample Chemistry Results

Sample Type	Start Date	End Date	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	E. Coli (#/100 mL)	TDP (mg/L)
Storm Composite	4/11/08 10:05	4/12/08 21:08	8	~5	2.9	0.195		0.064
Storm Composite	4/24/08 19:53	4/26/08 3:18	11	7	1.7	0.106		~0.019
Storm Composite	4/24/08 19:53	4/26/08 3:18	12	7	2.5	0.148		~0.018
Storm Composite	5/2/08 23:08	5/5/08 3:14	12	7	1.7	0.080		~0.015
Base Grab	5/20/08 10:46	5/20/08 10:46	20	11	1.9	0.108		<0.010
E. Coli Grab	6/5/08 10:15	6/5/08 10:15					185	
Storm Composite	6/5/08 19:04	6/9/08 7:46	19	12	2.2	0.159		~0.014
Storm Composite	6/12/08 5:24	6/13/08 11:11	15	11	2.1	0.119		~0.028
Base Grab	6/24/08 11:27	6/24/08 11:27	8	6	1.2	0.087		~0.024
E. Coli Grab	7/17/08 7:30	7/17/08 7:30					1	
Storm Composite	7/19/08 19:02	7/20/08 3:19	35	26	2.4	0.244		~0.023
E. Coli Grab	8/28/08 9:15	8/28/08 9:15					>2420	
Storm Composite	8/28/08 1:33	8/29/08 4:07	48	36	3.9	0.326		~0.036

Exceeds Water Quality Standards

Table 7. MS2 2008 Sample Metals, chloride, hardness, and Nitrogen Species Chemical Results including Exceeded MPCA 7050 Water Quality Standards

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)	Hardness
Storm Composite	4/11/08 10:05	4/12/08 21:08	0.0031	0.0015	0.0007	0.0088	<0.0005	0.0009	96	<0.03	0.26	0.45	74
Storm Composite	4/24/08 19:53	4/26/08 3:18	0.0022	0.0013	0.0003	0.0052	<0.0005	<0.004	78	<0.03	<0.05	0.13	84
Storm Composite	4/24/08 19:53	4/26/08 3:18	0.0116	0.0013	0.0007	0.0048	<0.0005	<0.004	76	<0.03	<0.05	0.14	76
Storm Composite	5/2/08 23:08	5/5/08 3:14	0.0025	0.0016	0.0003	0.0034	<0.0005	0.001	90	<0.03	<0.05	0.17	72
Base Grab	5/20/08 10:46	5/20/08 10:46	0.0026	0.0018	0.0007	0.0034	<0.0005	<0.003	94	<0.03	<0.05	~0.02	86
E. Coli Grab	6/5/08 10:15	6/5/08 10:15											
Storm Composite	6/5/08 19:04	6/9/08 7:46	0.0032	0.0026	0.0005	0.0083	<0.0005	<0.004	78	<0.03	0.16	0.14	128
Storm Composite	6/12/08 5:24	6/13/08 11:11	0.0038	0.0016	0.0004	0.004	<0.0005	<0.004	85	<0.03	<0.05	0.1	66
Base Grab	6/24/08 11:27	6/24/08 11:27	0.0026	0.0013	0.0003	0.0052	<0.0005	<0.005	92	<0.03	<0.05	<0.02	84
E. Coli Grab	7/17/08 7:30	7/17/08 7:30											
Storm Composite	7/19/08 19:02	7/20/08 3:19							97				
E. Coli Grab	8/28/08 9:15	8/28/08 9:15											
Storm Composite	8/28/08 1:33	8/29/08 4:07	0.0047	0.0018	0.0009	0.0049	<0.0005	<0.003	69	<0.03	<0.05	~0.04	74

No Exceedance Determinable
Exceeds Chronic Standard
Exceeds Max Standard
Exceeds Final Acute Standard

Powers Lake East Tributary

The hydrograph for the Powers Lake East site shows flow between April 16-November 5, 2008 (Figure 4). Precipitation was logged between April 23-November 5, 2008. Total discharge during this period was 3,530,652 cf or 81 acre-ft. Peak discharge was 3.5 cfs on April 21, 2008 from a storm precipitation of 0.52 inches that fell at the MS1 site; no precipitation data is available from the Powers Lake East site for that storm event. The highest rainfall for a storm occurred on August 27, 2008 with 2.98 inches.

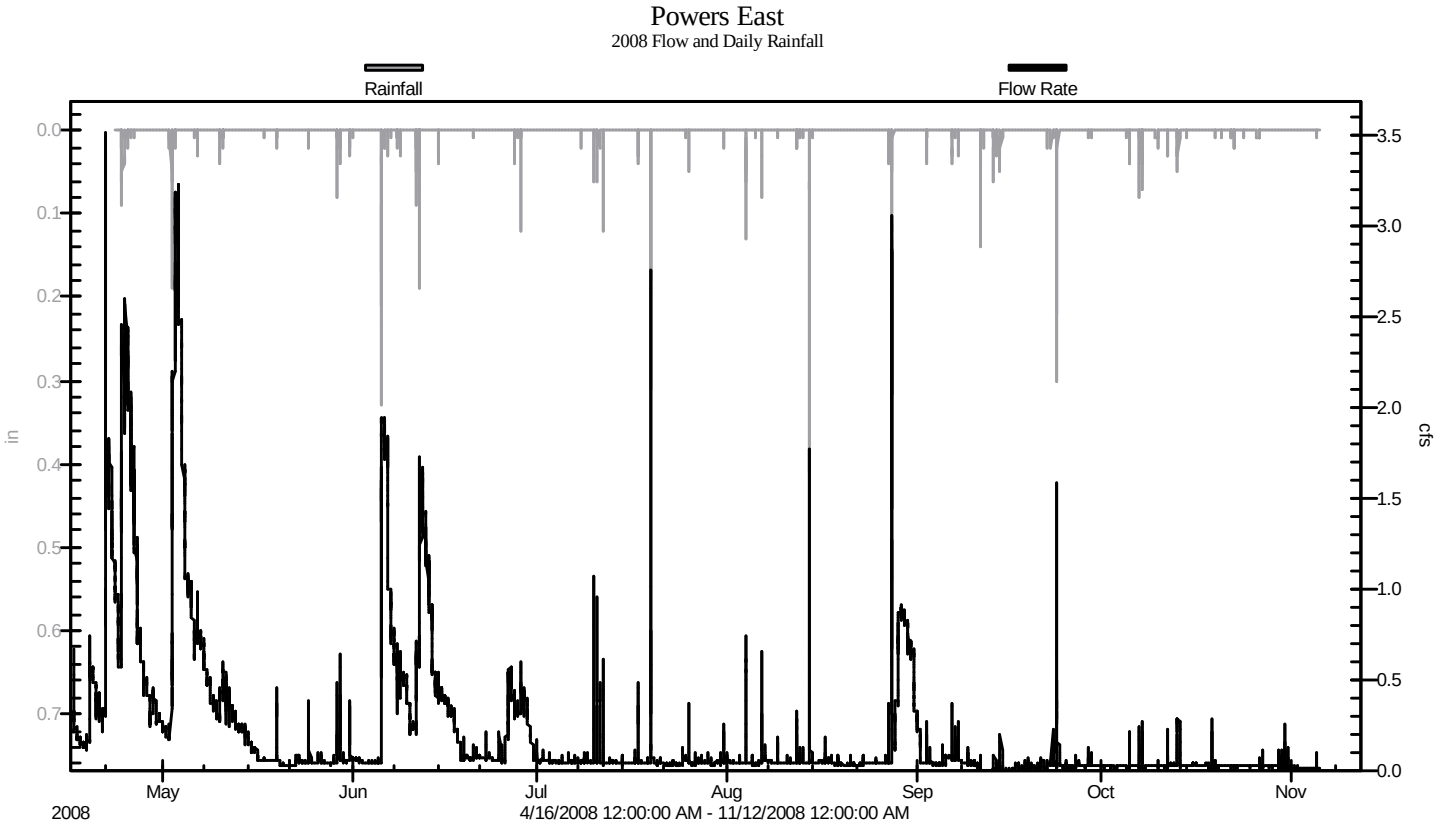


Figure 4. Powers Lake East Tributary 2008 Flow and Daily Rainfall

Table 8. Powers Lake East Tributary Stormwater Total Phosphorus and Total Suspended Solids Loading

	Sample Collection Time				Loading Interval					
Sample Type	Start	End	TSS (mg/L)	TP (mg/L)	Start	End	Interval Volume (cf)	Interval Volume (ac-ft)	Interval TSS (lb)	Interval TP (lb)
*Base***			*5*	*0.069*	*1/1/2008 0:00*	*4/2/2008 0:00*	*394,848*	*9.07*	*123.2*	*1.7*
Snowmelt Grab	4/2/08 13:50	4/2/08 13:50	51	0.234	4/2/2008 0:00	4/4/2008 0:15	243,180	5.59	774.2	3.6
*Base***			*5*	*0.069*	*4/4/2008 0:15*	*4/16/2008 14:30*	*652,860*	*15.00*	*203.8*	*2.8*
Base			*5*	*0.069*	*4/16/2008 14:30*	*4/19/2008 2:30*	*38,184*	*0.88*	*11.9*	*0.2*
Storm			*100*	*0.264*	*4/19/2008 2:30*	*4/20/2008 0:30*	*41,144*	*0.95*	*256.8*	*0.7*
Base			*5*	*0.069*	*4/20/2008 0:30*	*4/21/2008 21:30*	*58,654*	*1.35*	18.3	0.3
Storm			*100*	*0.264*	*4/21/2008 21:30*	*4/22/2008 23:30*	*149,076*	*3.42*	930.6	2.5
Base			*5*	*0.069*	*4/22/2008 23:30*	*4/24/2008 6:30*	*106,449*	*2.45*	33.2	0.5
Storm			*100*	*0.264*	*4/24/2008 6:30*	*4/26/2008 3:30*	*319,185*	*7.33*	1992.5	5.3
Base			*5*	*0.069*	*4/26/2008 3:30*	*5/2/2008 11:30*	*291,683*	*6.70*	*91.0*	*1.3*
Storm			*100*	*0.264*	*5/2/2008 11:30*	*5/4/2008 14:30*	*400,784*	*9.21*	*2501.9*	*6.6*
Base			*5*	*0.069*	*5/4/2008 14:30*	*5/29/2008 17:30*	*546,824*	*12.56*	*170.7*	*2.4*
Storm			*100*	*0.264*	*5/29/2008 17:30*	*5/30/2008 3:30*	*6,562*	*0.15*	*41.0*	*0.1*
Base			*5*	*0.069*	*5/30/2008 3:30*	*6/5/2008 16:30*	*26,498*	*0.61*	*8.3*	*0.1*
Storm Composite	6/5/08 17:17	6/6/08 12:42	10	0.080	6/5/2008 16:30	6/7/2008 9:30	222,434	5.11	138.9	1.1
Base			*5*	*0.069*	*6/7/2008 9:30*	*6/11/2008 9:30*	*162,170*	*3.72*	*50.6*	*0.7*
Storm			*100*	*0.264*	*6/11/2008 9:30*	*6/14/2008 2:30*	*239,686*	*5.51*	*1496.3*	*4.0*
Base Grab	6/25/08 9:38	6/25/08 9:38	6	0.071	6/14/2008 2:30	6/25/2008 19:30	181,330	4.16	67.9	0.8
Storm			*100*	*0.264*	*6/25/2008 19:30*	*6/30/2008 10:30*	*131,245*	*3.01*	*819.3*	*2.2*
Base			*5*	*0.069*	*6/30/2008 10:30*	*7/10/2008 12:30*	*41,030*	*0.94*	*12.8*	*0.2*
Storm			*100*	*0.264*	*7/10/2008 12:30*	*7/12/2008 5:30*	*12,325*	*0.28*	*76.9*	*0.2*
Base			*5*	*0.069*	*7/12/2008 5:30*	*7/17/2008 0:30*	*15,506*	*0.36*	*4.8*	*0.1*
Storm			*100*	*0.264*	*7/17/2008 0:30*	*7/17/2008 16:30*	*4,965*	*0.11*	*31.0*	*0.1*
Base			*5*	*0.069*	*7/17/2008 16:30*	*7/19/2008 15:30*	*6,098*	*0.14*	*1.9*	*0.0*
Storm			*100*	*0.264*	*7/19/2008 15:30*	*7/20/2008 3:30*	*11,687*	*0.27*	*73.0*	*0.2*
Base			*5*	*0.069*	*7/20/2008 3:30*	*8/3/2008 23:30*	*48,068*	*1.10*	*15.0*	*0.2*
Storm			*100*	*0.264*	8/3/2008 23:30	8/4/2008 6:30	5,000	*0.11*	31.2	0.1
Base			*5*	*0.069*	8/4/2008 6:30	8/14/2008 13:30	38,600	*0.89*	12.0	0.2
Storm			*100*	*0.264*	*8/14/2008 13:30*	*8/14/2008 21:30*	6,404	*0.15*	2.0	0.0
Base			*5*	*0.069*	*8/14/2008 21:30*	*8/26/2008 22:30*	*35,957*	*0.83*	*11.2*	*0.2*
Storm			*100*	*0.264*	*8/26/2008 22:30*	*8/27/2008 11:30*	*3,378*	*0.08*	*21.1*	*0.1*
Base			*5*	*0.069*	*8/27/2008 11:30*	*8/27/2008 21:30*	*25,173*	*0.58*	*7.9*	*0.1*
Storm Composite	8/27/08 23:36	8/28/08 1:18	240	0.477	8/27/2008 21:30	9/1/2008 11:30	215,937	4.96	3235.2	6.4
Base			*5*	*0.069*	*9/1/2008 11:30*	*9/6/2008 18:30*	*22,420*	*0.51*	*7.0*	*0.1*
Storm			*100*	*0.264*	*9/6/2008 18:30*	*9/7/2008 13:30*	*6,545*	*0.15*	*40.9*	*0.1*
Base Grab	9/10/08 12:35	9/10/08 12:35	3	0.067	9/7/2008 13:30	9/13/2008 4:30	11,535	0.26	2.2	0.0
Storm			*100*	*0.264*	*9/13/2008 4:30*	*9/15/2008 10:30*	*1,303*	*0.03*	*8.1*	*0.0*
Base			*5*	*0.069*	*9/15/2008 10:30*	*9/23/2008 11:30*	*9,944*	*0.23*	*3.1*	*0.0*
Storm			*100*	*0.264*	*9/23/2008 11:30*	*9/24/2008 2:30*	*7,395*	*0.17*	*46.2*	*0.1*
Base			*5*	*0.069*	*9/24/2008 2:30*	*10/5/2008 5:30*	*18,858*	*0.43*	*5.9*	*0.1*
Storm			*100*	*0.264*	*10/5/2008 5:30*	*10/5/2008 14:30*	*1,123*	*0.03*	*7.0*	*0.0*
Base			*5*	*0.069*	*10/5/2008 14:30*	*10/7/2008 3:30*	*2,143*	*0.05*	*0.7*	*0.0*
Storm			*100*	*0.264*	*10/7/2008 3:30*	*10/7/2008 23:30*	*5,263*	*0.12*	*32.9*	*0.1*
Base			*5*	*0.069*	*10/7/2008 23:30*	*10/11/2008 16:30*	*6,295*	*0.14*	*2.0*	*0.0*
Storm			*100*	*0.264*	*10/11/2008 16:30*	*10/12/2008 2:30*	*890*	*0.02*	*5.6*	*0.0*
Base			*5*	*0.069*	*10/12/2008 2:30*	*10/13/2008 8:30*	*2,929*	*0.07*	*0.9*	*0.0*
Storm			*100*	*0.264*	*10/13/2008 8:30*	*10/13/2008 21:30*	*3,524*	*0.08*	*22.0*	*0.1*
Base			*5*	*0.069*	*10/13/2008 21:30*	*10/18/2008 19:30*	*10,871*	*0.25*	*3.4*	*0.0*
Storm			*100*	*0.264*	*10/18/2008 19:30*	*10/19/2008 22:30*	*1,805*	*0.04*	*11.3*	*0.0*
Base			*5*	*0.069*	*10/19/2008 22:30*	*10/28/2008 9:30*	*16,811*	*0.39*	*5.2*	*0.1*
Storm			*100*	*0.264*	*10/28/2008 9:30*	*10/29/2008 7:30*	*1,581*	*0.04*	*9.9*	*0.0*
Base			*5*	*0.069*	*10/29/2008 7:30*	*11/5/2008 11:30*	*7,386*	*0.17*	*2.3*	*0.0*
*Base***			*5*	*0.069*	*11/5/2008 11:30*	*1/1/2009 0:00*	*48,834*	*1.12*	*15.2*	*0.2*
Storm Average***			100	0.264						
Base Average			6	0.070						
All Average			18	0.144						
Total							**4,870,374**	**112**	**13,498**	**46**
SWWD Major Subwatershed Total Acres							549			
Total TP/TSS(lb/ac/yr)									24.59	0.08
Total TP/TSS (kg/ha/yr)									27.57	0.09

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

**Interval volumes between 1/1/08-4/16/08 and 11/5/08-1/1/09 were estimated based upon base flow

***Storm average includes snowmelt sample, in order to better represent the conditions present

Grab and flow weighted composite samples were collected at the Powers East site to determine water quality. The TSS, TKN, TP, VSS, TDP, and *E. coli* results from all collected samples are listed in Table 9. The highest concentrations of TSS, TKN, VSS, and TP all came from a storm composite sample collected on August 27, 2008. All three of the *E. coli* samples collected exceeded water quality standards. Metals, chloride, hardness, and other nitrogen species concentrations are listed in Table 10. Minnesota Pollution Control Agency's water quality standard exceedences are also listed in Table 10. Copper and lead concentrations for the April 2, 2008 snowmelt grab exceeded the chronic standard. The copper concentration for the August 27, 2008 storm composite sample exceeded the maximum standard.

Table 9. Powers Lake East Tributary 2008 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)	TDP (mg/L)
Snowmelt Grab	4/2/08 13:50	4/2/08 13:50	51	21	1.1	0.234		0.074
Storm Composite	6/5/08 17:17	6/6/08 12:42	10	4	0.91	0.080		~0.017
Base Grab	6/25/08 9:38	6/25/08 9:38	6	3	1.1	0.071		0.053
E. Coli Grab	7/17/08 7:45	7/17/08 7:45					1203	
E. Coli Grab	8/7/08 9:30	8/7/08 9:30					980	
E. Coli Grab	8/27/08 9:36	8/27/08 9:36					980	
Storm Composite	8/27/08 23:36	8/28/08 1:18	240	41	2.5	0.477		0.066
Base Grab	9/10/08 12:35	9/10/08 12:35	3	~2	0.74	0.067		0.065

Exceeds Water Quality Standards

Table 10. Powers Lake East Tributary 2008 Sample Metals, Chloride, Hardness, and Nitrogen Species Chemical Results including Exceeded MPCA 7050 Water Quality Standards

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)	Hardness
Snowmelt Grab	4/2/08 13:50	4/2/08 13:50	0.006	0.0066	0.0014	0.0275	<0.0005	0.003	18	<0.03	0.15	<0.02	44
Storm Composite	6/5/08 17:17	6/6/08 12:42	0.0018	0.0015	0.0007	0.0075	<0.0005	<0.004	51	<0.03	<0.05	<0.02	68
Base Grab	6/25/08 9:38	6/25/08 9:38	0.0082	0.0029	0.0002	0.008	<0.0005	<0.005	36	<0.03	0.94	<0.02	204
E. Coli Grab	7/17/08 7:45	7/17/08 7:45											
E. Coli Grab	8/7/08 9:30	8/7/08 9:30											
E. Coli Grab	8/27/08 9:36	8/27/08 9:36											
Storm Composite	8/27/08 23:36	8/28/08 1:18	0.0127	0.0077	0.0056	0.025	<0.0005	0.0079	4	<0.03	0.3	0.08	48
Base Grab	9/10/08 12:35	9/10/08 12:35	0.0031	0.0026	0.0015	0.0023	<0.0005	<0.003	45	<0.03	0.39	~0.02	148

No Exceedance Determinable
Exceeds Chronic Standard
Exceeds Max Standard
Exceeds Final Acute Standard

Powers Lake North Tributary

The hydrograph for the Powers Lake North Tributary site shows flow between April 9-November 4, 2008 (Figure 5). Total discharge during this period was 3,614,867 cf or 83 acre-ft. Peak discharge was 7.9 cfs on August 28, 2008 from a storm precipitation of 2.98 inches that fell at the Powers Lake East site. No precipitation data was collected at this site.

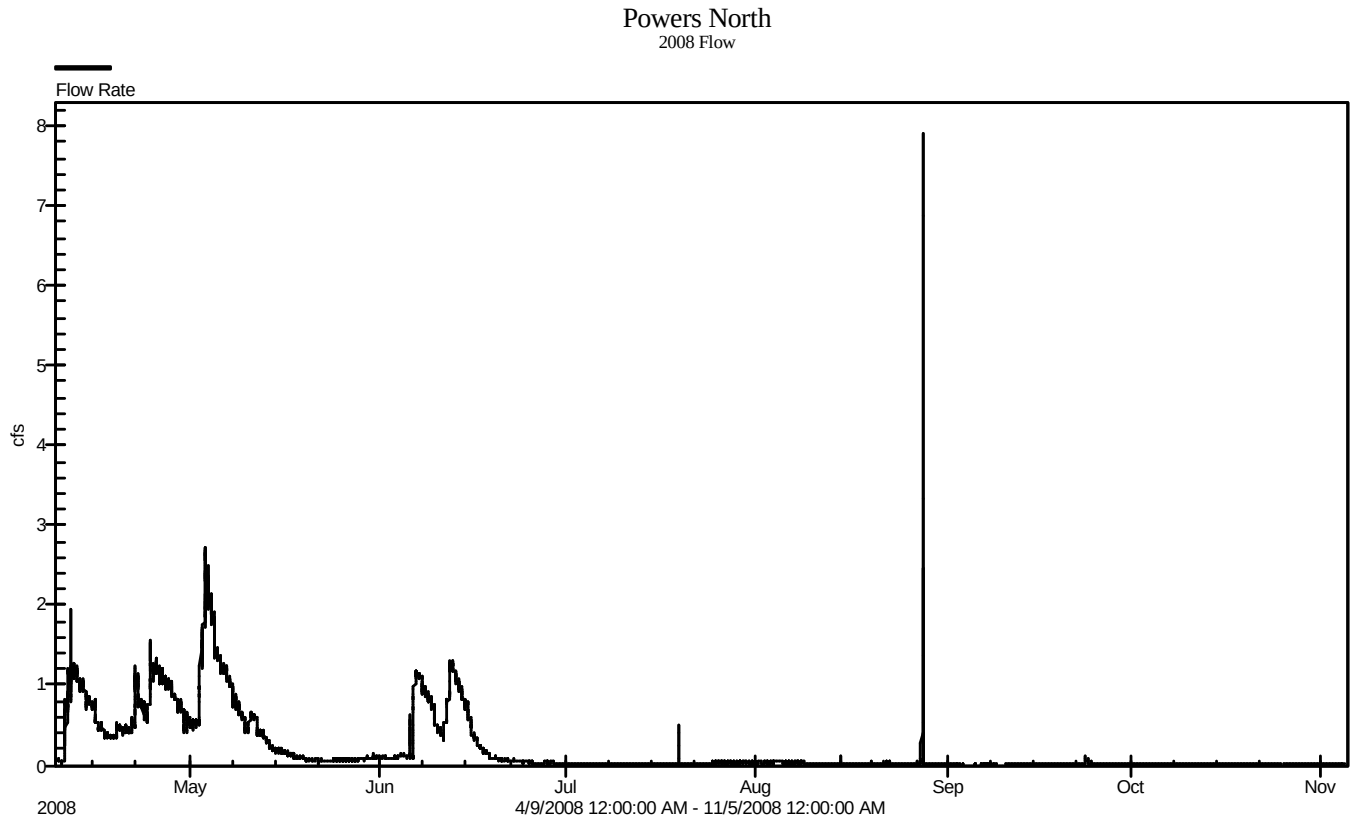


Figure 5. Powers Lake North Tributary 2008 Flow

Table 11. Powers Lake North Tributary Stormwater Total Phosphorus and Total Suspended Solids Loading Table

	Sample Collection Time				Loading Interval					
Sample Type	Start	End	TSS (mg/L)	TP (mg/L)	Start	End	Interval Volume (cf)	Interval Volume (ac-ft)	Interval TSS (lb)	Interval TP (lb)
*Base***			*18*	*0.117*	*1/1/2008 0:00*	*4/9/2008 15:15*	*860,850*	*19.77*	*967.3*	*6.3*
Base			*18*	*0.117*	*4/9/2008 15:15*	*4/21/2008 23:15*	*630,370*	*14.48*	*708.3*	*4.6*
Storm			*33*	*0.168*	*4/21/2008 23:15*	*4/24/2008 0:15*	*144,065*	*3.31*	*296.8*	*1.5*
Storm			*33*	*0.168*	*4/24/2008 0:15*	*4/25/2008 23:15*	*179,624*	*4.13*	*370.0*	*1.9*
Base			*18*	*0.117*	*4/25/2008 23:15*	*5/2/2008 13:15*	*441,001*	*10.13*	*495.5*	*3.2*
Storm			*33*	*0.168*	*5/2/2008 13:15*	*5/6/2008 20:15*	*603,713*	*13.87*	*1243.7*	*6.3*
Base Grab	5/20/08 10:22	5/20/08 10:22	5	0.060	5/6/2008 20:15	5/25/2008 9:15	483,309	11.10	150.9	1.8
Base			*18*	*0.117*	*5/25/2008 9:15*	*6/5/2008 16:15*	*81,222*	*1.87*	*91.3*	*0.6*
Storm Composite	6/6/08 11:55	6/7/08 11:55	8	0.138	6/5/2008 16:15	6/11/2008 10:15	350,844	8.06	175.2	3.0
Storm Composite	6/12/08 10:24	6/13/08 21:31	9	0.096	6/11/2008 10:15	6/16/2008 16:15	368,282	8.46	206.9	2.2
Base			*18*	*0.117*	*6/16/2008 16:15*	*6/24/2008 16:15*	*64,558*	*1.48*	*72.5*	*0.5*
Base Grab	6/25/08 9:52	6/25/08 9:52	26	0.180	6/24/2008 16:15	7/2/2008 16:15	20,421	0.47	22.9	0.1
Base			*26*	*0.117*	*7/2/2008 16:15*	*7/19/2008 14:15*	*31,450*	*0.72*	*51.0*	*0.2*
Storm			*33*	*0.168*	*7/19/2008 14:15*	*7/21/2008 8:15*	*4,458*	*0.10*	*9.2*	*0.0*
Base			*18*	*0.117*	*7/21/2008 8:15*	*8/4/2008 0:15*	*35,843*	*0.82*	*40.3*	*0.3*
Storm			*33*	*0.168*	*8/4/2008 0:15*	*8/5/2008 7:15*	*5,234*	*0.12*	*10.8*	*0.1*
Base Grab	8/5/08 13:10	8/5/08 13:10	16	0.109	8/5/2008 7:15	8/15/2008 7:15	26,850	0.62	26.8	0.2
Base			*18*	*0.117*	*8/15/2008 7:15*	*8/27/2008 22:15*	*29,815*	*0.68*	*33.5*	*0.2*
Storm Composite	8/28/08 1:29	8/28/08 2:21	145	0.478	8/27/2008 22:15	8/28/2008 10:15	23,350	0.54	211.4	0.7
Base			*18*	*0.117*	*8/28/2008 10:15*	*9/9/2008 10:15*	*6,443*	*0.15*	*7.2*	*0.0*
Base Grab	9/10/08 12:20	9/10/08 12:20	24	0.117	9/9/2008 10:15	9/15/2008 10:15	6,846	0.16	10.3	0.1
Base			*18*	*0.117*	*9/15/2008 10:15*	*11/4/2008 12:15*	*77,170*	*1.77*	*86.7*	*0.6*
*Base***			*18*	*0.117*	*11/4/2008 12:15*	*1/1/2009 0:00*	*49,670*	*1.14*	*55.8*	*0.4*
Storm Average			54	0.237						
Base Average			18	0.117						
All Average			33	0.168						
Total							**4,525,388**	**104**	**5,344**	**35**
SWWD Major Subwatershed Total Acres							233			
Total TP/TSS(lb/ac/yr)									22.90	0.15
Total TP/TSS (kg/ha/yr)									25.67	0.17

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

**Inverval volumes between 1/1/08-4/9/08 and 11/4/08-1/1/09 were estimated based upon base flow

***Average for all sampled events was applied to storm intervals to better estimate actual conditions

Grab and flow weighted composite samples were collected at the Powers Lake North Tributary site in 2008. The TSS, TKN, TP, VSS, TDP, and *E. coli* results from all collected samples are listed in Table 12. The highest TSS, VSS, TKN, and TP concentrations came from the August 28, 2008 storm composite. Three of the four *E. coli* samples collected exceeded water quality standards. Metals, chloride, hardness, and other Nitrogen species chemical concentrations are listed in Table 13. Water quality standard exceedences were included in Table 13. No samples exceeded any chronic standards and exceedances could not be determined for the last base grab collected due to a missing hardness result.

Table 12. Powers Lake North Tributary 2008 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)	TDP (mg/L)
Base Grab	5/20/08 10:22	5/20/08 10:22	5	~2	0.48	0.060		<0.010
Storm Composite	6/6/08 11:55	6/7/08 11:55	8	~2	1.1	0.138		0.094
E.Coli Grab	6/12/08 10:15	6/12/08 10:15					411	
Storm Composite	6/12/08 10:24	6/13/08 21:31	9	~2	0.96	0.096		0.073
Base Grab	6/25/08 9:52	6/25/08 9:52	26	6	0.35	0.180		<0.010
E.Coli Grab	7/23/08 10:30	7/23/08 10:30					101	
Base Grab	8/5/08 13:10	8/5/08 13:10	16	3	0.5	0.109		<0.010
E.Coli Grab	8/7/08 9:30	8/7/08 9:30					225	
E.Coli Grab	8/28/08 9:40	8/28/08 9:40					1733	
Storm Composite	8/28/08 1:29	8/28/08 2:21	145	29	4	0.478		
Base Grab	9/10/08 12:20	9/10/08 12:20	24	~6				<0.010

Exceeds Water Quality Standards

Table 13. Powers Lake North Tributary 2008 Sample Metals and Nitrogen Species Chemical Results including Exceeded MPCA 7050 Water Quality Standards

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)	Hardness
Base Grab	5/20/08 10:22	5/20/08 10:22	0.0013	0.0031	<0.0001	0.0175	<0.0005	<0.003	64	<0.03	0.49	~0.02	196
Storm Composite	6/6/08 11:55	6/7/08 11:55	0.0048	0.002	0.0005	0.0074	<0.0005	<0.004	70	<0.03	0.05	0.07	120
E.Coli Grab	6/12/08 10:15	6/12/08 10:15											
Storm Composite	6/12/08 10:24	6/13/08 21:31	0.0032	0.0021	0.0004	0.0061	<0.0005	<0.004	63	<0.03	<0.05	~0.04	258
Base Grab	6/25/08 9:52	6/25/08 9:52	0.0022	0.0033	0.0005	0.0173	<0.0005	<0.005	66	<0.03	0.32	~0.03	200
E.Coli Grab	7/23/08 10:30	7/23/08 10:30											
Base Grab	8/5/08 13:10	8/5/08 13:10	0.0013	0.0063	0.0001	0.0158	<0.0005	<0.004	63	<0.03	0.12	~0.05	212
E.Coli Grab	8/7/08 9:30	8/7/08 9:30											
E.Coli Grab	8/28/08 9:40	8/28/08 9:40											
Storm Composite	8/28/08 1:29	8/28/08 2:21											
Base Grab	9/10/08 12:20	9/10/08 12:20	0.0012	0.0033	0.0002	0.0052	<0.0005	<0.003	64	<0.03	0.08	~0.05	

No Exceedance Determinable
Exceeds Chronic Standard
Exceeds Max Standard
Exceeds Final Acute Standard

Colby Lake West Tributary

The 2008 season was the first year of monitoring at Colby Lake West Tributary. The hydrograph for this site shows flow between April 30-November 4, 2008 (Figure 6). Total discharge during this period was 1,999,458 cf or 46 acre-ft. Peak discharge was 76.8 cfs on July 19, 2008. No precipitation data was collected at this site.

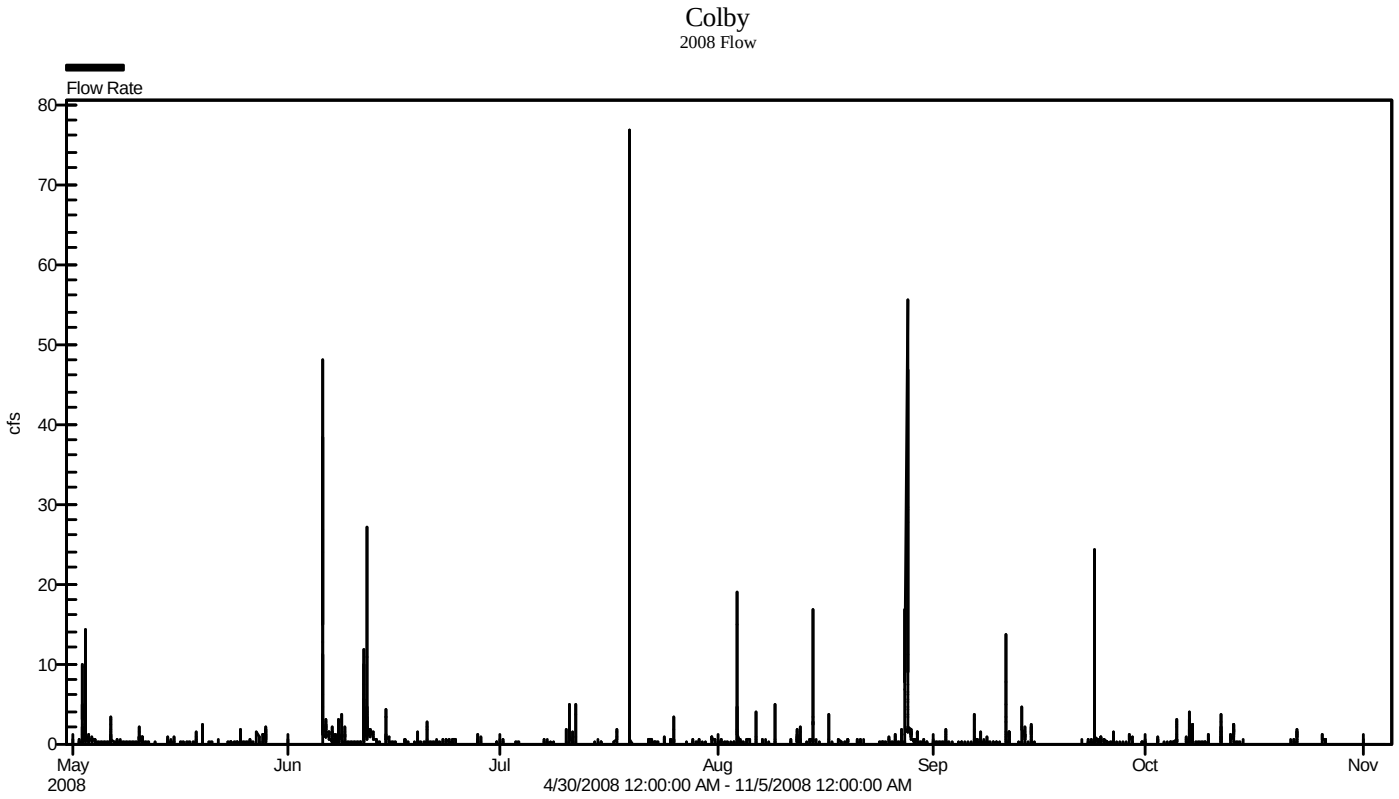


Figure 6. Colby Lake West Tributary 2008 Flow

Table 14. Colby Lake West Tributary Stormwater Total Phosphorus and Total Suspended Solids Loading Table

	Sample Collection Time				Loading Interval					
Sample Type	Start	End	TSS (mg/L)	TP (mg/L)	Start	End	Interval Volume (cf)	Interval Volume (ac-ft)	Interval TSS (lb)	Interval TP (lb)
*Base***			*5*	*0.192*	*1/1/2008 0:00*	*4/30/2008 15:15*	*208,458*	*4.79*	*65.1*	*2.5*
Base			*5*	*0.192*	*4/30/2008 15:15*	*5/2/2008 11:30*	*1,957*	*0.04*	*0.6*	*0.0*
Storm Composite	5/2/08 12:06	5/2/08 12:23	328	0.343	5/2/2008 11:30	5/2/2008 17:30	36,590	0.84	749.2	0.8
Storm			*64*	*0.225*	*5/2/2008 17:30*	*5/3/2008 0:30*	*59,993*	*1.38*	*239.7*	*0.8*
Base			*5*	*0.192*	*5/3/2008 0:30*	*6/5/2008 17:00*	*153,135*	*3.52*	*47.8*	*1.8*
Storm Composite	6/5/08 21:01	6/8/08 6:51	59	0.241	6/5/2008 17:00	6/5/2008 23:30	192,300	4.42	708.3	2.9
Base			*5*	*0.192*	*6/5/2008 23:30*	*6/11/2008 10:00*	*162,665*	*3.74*	*50.8*	*1.9*
Storm Composite	6/11/2008 10:22	6/11/2008 16:20	46	0.127	6/11/2008 10:00	6/12/2008 7:00	177,034	4.07	508.4	1.4
Base			*5*	*0.192*	*6/12/2008 7:00*	*6/14/2008 21:30*	*93,224*	*2.14*	*29.1*	*1.1*
Storm			*64*	*0.225*	*6/14/2008 21:30*	*6/15/2008 2:30*	*14,872*	*0.34*	*59.4*	*0.2*
Base			*5*	*0.192*	*6/15/2008 2:30*	*7/10/2008 13:00*	*35,551*	*0.82*	*11.1*	*0.4*
Storm			*64*	*0.225*	*7/10/2008 13:00*	*7/11/2008 22:30*	*18,554*	*0.43*	*74.1*	*0.3*
Base			*5*	*0.192*	*7/11/2008 22:30*	*7/19/2008 15:30*	*5,651*	*0.13*	*1.8*	*0.1*
Storm			*64*	*0.225*	*7/19/2008 15:30*	*7/19/2008 18:00*	*110,887*	*2.55*	*443.0*	*1.6*
Base			*5*	*0.192*	*7/19/2008 18:00*	*8/3/2008 23:30*	*39,297*	*0.90*	*12.3*	*0.5*
Storm			*64*	*0.225*	*8/3/2008 23:30*	*8/4/2008 2:30*	*39,452*	*0.91*	*157.6*	*0.6*
Base Grab	8/5/2008 11:30	8/5/2008 11:30	5	0.192	8/4/2008 2:30	8/6/2008 16:00	11,200	0.26	3.5	0.1
Storm			*64*	*0.225*	*8/6/2008 16:00*	*8/6/2008 19:00*	*4,765*	*0.11*	*19.0*	*0.1*
Base			*5*	*0.192*	*8/6/2008 19:00*	*8/12/2008 7:00*	*15,030*	*0.35*	*4.7*	*0.2*
Storm			*64*	*0.225*	*8/12/2008 7:00*	*8/13/2008 1:30*	*17,925*	*0.41*	*71.6*	*0.3*
Base			*5*	*0.192*	*8/13/2008 1:30*	*8/14/2008 14:00*	*4,159*	*0.10*	*1.3*	*0.0*
Storm			*64*	*0.225*	*8/14/2008 14:00*	*8/14/2008 18:30*	*26,052*	*0.60*	*104.1*	*0.4*
Base			*5*	*0.192*	*8/14/2008 18:30*	*8/16/2008 18:30*	*1756.8*	*0.04*	*0.5*	*0.0*
Storm			*64*	*0.225*	*8/16/2008 18:30*	*8/16/2008 20:30*	*4,171*	*0.10*	*16.7*	*0.1*
Base			*5*	*0.192*	*8/16/2008 20:30*	*8/27/2008 20:30*	*35,725*	*0.82*	*11.2*	*0.4*
Storm Composite	8/27/2008 22:48	8/28/2008 9:30	88	0.187	8/27/2008 20:30	8/28/2008 4:30	275,471	6.33	1513.3	3.2
Base			*5*	*0.192*	*8/28/2008 4:30*	*9/6/2008 19:00*	*125,815*	*2.89*	*39.3*	*1.5*
Storm			*64*	*0.225*	*9/6/2008 19:00*	*9/7/2008 0:30*	*12,017*	*0.28*	*48.0*	*0.2*
Base			*5*	*0.192*	*9/7/2008 0:30*	*9/11/2008 4:00*	*11,695*	*0.27*	*3.7*	*0.1*
Storm			*64*	*0.225*	*9/11/2008 4:00*	*9/11/2008 6:30*	*33,006*	*0.76*	*131.9*	*0.5*
Base			*5*	*0.192*	*9/11/2008 6:30*	*9/13/2008 15:00*	*12,252*	*0.28*	*3.8*	*0.1*
Storm			*64*	*0.225*	*9/13/2008 15:00*	*9/13/2008 20:00*	*17,412*	*0.40*	*69.6*	*0.2*
Base			*5*	*0.192*	*9/13/2008 20:00*	*9/14/2008 14:00*	*1,230*	*0.03*	*0.4*	*0.0*
Storm			*64*	*0.225*	*9/14/2008 14:00*	*9/14/2008 19:00*	*15,267*	*0.35*	*61.0*	*0.2*
Base			*5*	*0.192*	*9/14/2008 19:00*	*9/23/2008 17:30*	*4,070*	*0.09*	*1.3*	*0.0*
Storm			*64*	*0.225*	*9/23/2008 17:30*	*9/23/2008 21:30*	*42,513*	*0.98*	*169.9*	*0.6*
Base			*5*	*0.192*	*9/23/2008 21:30*	*10/7/2008 1:00*	*53,668*	*1.23*	*16.8*	*0.6*
Storm			*64*	*0.225*	*10/7/2008 1:00*	*10/7/2008 23:30*	*55,526*	*1.28*	*221.8*	*0.8*
Base			*5*	*0.192*	*10/7/2008 23:30*	*10/13/2008 9:30*	*22,148*	*0.51*	*6.9*	*0.3*
Storm			*64*	*0.225*	*10/13/2008 9:30*	*10/13/2008 20:00*	*31,705*	*0.73*	*126.7*	*0.4*
Base			*5*	*0.192*	*10/13/2008 20:00*	*11/4/2008 11:45*	*23,720*	*0.54*	*7.4*	*0.3*
*Base***			*64*	*0.192*	*11/4/2008 11:45*	*1/1/2009 0:00*	*198,756*	*4.57*	*794.1*	*2.4*
Storm Average			64	0.225						
Base Average			5	0.192						
All Average			50	0.218						
Total							**2,406,672**	**55**	**6,606**	**30**
SWWD Major Subwatershed Total Acres							10,174			
Total TP/TSS(lb/ac/yr)									0.65	0.00
Total TP/TSS (kg/ha/yr)									0.73	0.00

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

**Interval volumes from 1/1/08 to 4/30/08 and 11/4/08 to 1/1/09 were estimated based on base flow

Grab and flow weighted composite samples were collected at the Colby Lake West Tributary site in 2008. The TSS, TKN, TP, VSS, TDP, and *E. coli* results from all collected samples are listed in Table 15. The highest TSS, VSS, and TP concentrations were from a storm composite sample collected on May 2, 2008. The highest TKN concentration was from a storm composite collected on June 5, 2008. All three of the *E. coli* samples collected exceeded the water quality standards. Metals, chloride, hardness, and other nitrogen species concentrations are listed in Table 16. Water quality standard exceedences are included in Table 16. All four of the storm composite samples collected exceeded the chronic standard for lead, while three exceeded the chronic standard for cadmium, and one exceeded the chronic standard for copper. Only the storm composite sample collected on August 27, 2008 exceeded the chronic standard for all three metals. The May 2, 2008 storm composite sample collected exceeded the final acute standard for zinc.

Table 15. Colby Lake West Tributary 2008 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)	TDP (mg/L)
Storm Composite	5/2/08 12:06	5/2/08 12:23	328	92	2	0.343		~0.031
Storm Composite	6/5/08 21:01	6/8/08 6:51	59	25	4	0.241		0.07
Storm Composite	6/11/08 10:22	6/11/08 16:20	46	16	0.83	0.127		~0.046
E. Coli Grab	6/12/08 10:00	6/12/08 10:00					2420	
Base Grab	8/5/08 11:30	8/5/08 11:30	5	~2	0.9	0.192		0.14
E. Coli Grab	8/7/08 9:10	8/7/08 9:10					>2420	
Storm Composite	8/27/08 22:48	8/28/08 2:01	88	24	1	0.187		0.073
E. Coli Grab	8/28/08 9:30	8/28/08 9:30					>2420	

Exceeds Water Quality Standards

Table 16. Colby Lake West Tributary 2008 Sample Metals and Nitrogen Species Chemical Results including Exceeded MPCA 7050 Water Quality Standards

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)	Hardness
Storm Composite	5/2/08 12:06	5/2/08 12:23	0.0165	0.0075	0.01	0.0844	<0.0005	0.0084	2	<0.03	0.16	0.31	26
Storm Composite	6/5/08 21:01	6/8/08 6:51	0.0177	0.0023	0.001	0.0333	<0.0005	<0.004	20	0.06	0.32	0.46	36
Storm Composite	6/11/08 10:22	6/11/08 16:20	0.005	0.0018	0.0015	0.0217	<0.0005	<0.004	2	<0.03	0.35	0.37	16
E. Coli Grab	6/12/08 10:00	6/12/08 10:00											
Base Grab	8/5/08 11:30	8/5/08 11:30	0.0043	0.0027	0.0001	0.006	<0.0005	<0.005	29	<0.03	0.26	~0.03	252
E. Coli Grab	8/7/08 9:10	8/7/08 9:10											
Storm Composite	8/27/08 22:48	8/28/08 2:01	0.0058	0.0021	0.0016	0.0194	<0.0005	<0.005	2	<0.03	0.38	0.25	34
E. Coli Grab	8/28/08 9:30	8/28/08 9:30											

No Exceedance Determinable
Exceeds Chronic Standard
Exceeds Max Standard
Exceeds Final Acute Standard

100th Street (Cottage Grove)

The hydrograph for the 100th Street site shows flow recorded between April 3-November 5, 2008 (Figure 7). Total discharge during this period was 4,364,515 cf or 100 acre-ft. Peak discharge was 4.9 cfs on June 5, 2008 from a storm rainfall of 1.70 inches. This storm event and another on May 4, 2008 both had the highest precipitation for the season of 1.70 inches of rain. This site was dry from July 11 to the end of the season, with one exception of a minor storm event on July 19.

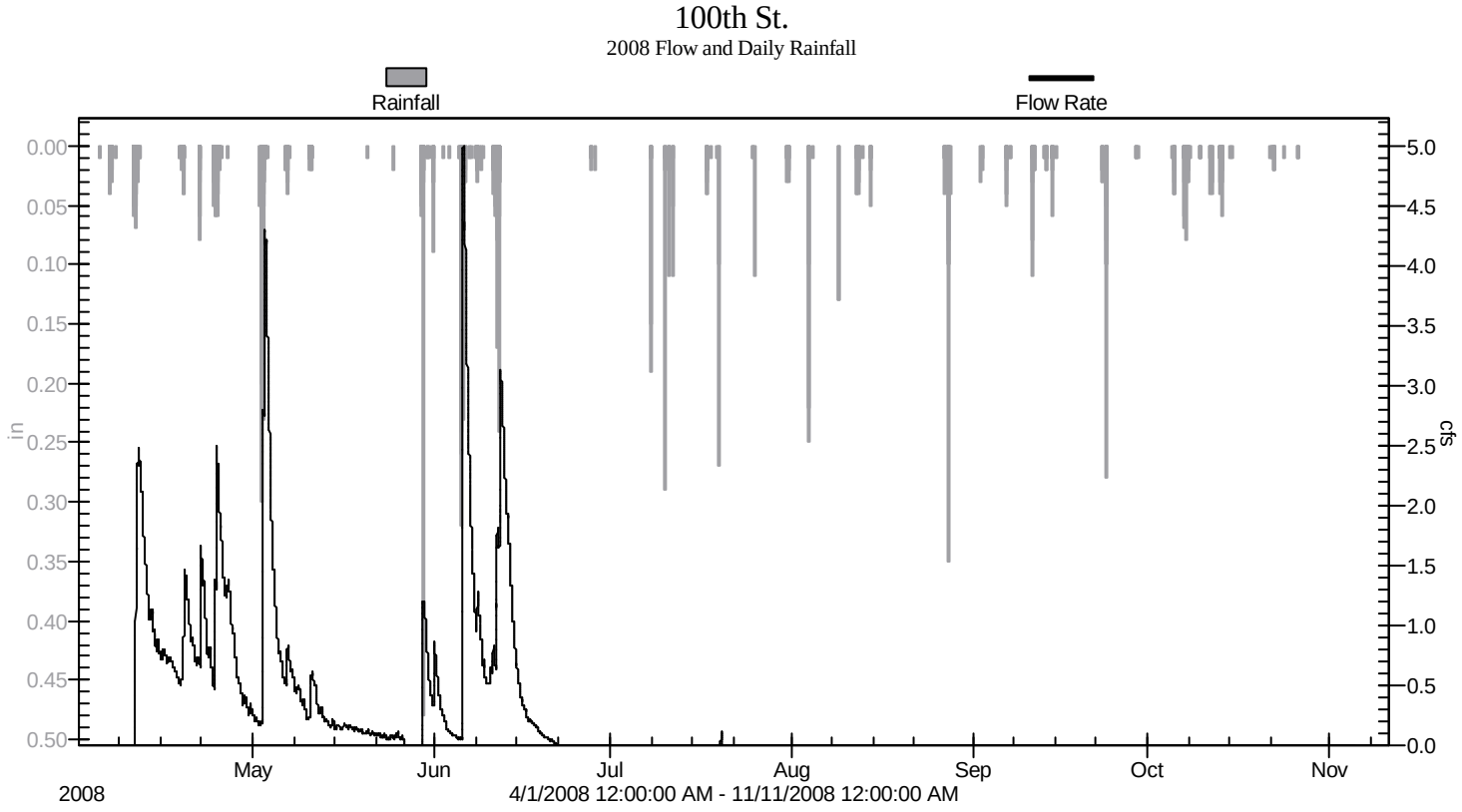


Figure 7. 100th Street 2008 Flow and Daily Rainfall

Table 17. 100th Street Stormwater Total Phosphorus and Total Suspended Solids Loading Table

	Sample Collection Time				Loading Interval					
Sample Type	**Start**	**End**	**TSS (mg/L)**	**TP (mg/L)**	**Start**	**End**	**Interval Volume (cf)**	**Interval Volume (ac-ft)**	**Interval TSS (lb)**	**Interval TP (lb)**
*Base***			*1.0*	*0.037*	*1/1/2008 0:00*	*4/3/2008 11:30*	*0*	*0.00*	*0.0*	*0.0*
Base			*1.0*	*0.037*	*4/3/2008 11:30*	*4/10/2008 18:30*	*0*	*0.00*	*0.0*	*0.0*
Storm Composite	4/10/2008 20:18	4/10/2008 21:35	8.0	0.206	4/10/2008 18:30	4/12/2008 14:30	301,099	6.92	150.4	3.9
Base			*1.0*	*0.037*	*4/12/2008 14:30*	*4/18/2008 16:30*	*424,904*	*9.76*	*26.5*	*1.0*
Storm			*5.8*	*0.093*	*4/18/2008 16:30*	*4/20/2008 1:30*	*128,312*	*2.95*	*46.5*	*0.7*
Base			*1.0*	*0.037*	*4/20/2008 1:30*	*4/21/2008 22:30*	*127,109*	*2.92*	*7.9*	*0.3*
Storm			*5.8*	*0.093*	*4/21/2008 22:30*	*4/22/2008 18:30*	*96,677*	*2.22*	*35.0*	*0.6*
Base			*1.0*	*0.037*	*4/22/2008 18:30*	*4/24/2008 7:30*	*97,705*	*2.24*	*6.1*	*0.2*
Storm Composite	4/24/2008 18:43	4/25/2008 8:38	7.0	0.072	4/24/2008 7:30	4/26/2008 23:30	353,904	8.13	154.6	1.6
Base			*1.0*	*0.037*	*4/26/2008 23:30*	*5/2/2008 11:30*	*211,861*	*4.87*	*13.2*	*0.5*
Storm Composite	5/2/2008 13:14	5/2/2008 23:23	10.0	0.079	5/2/2008 11:30	5/4/2008 7:30	459,170	10.55	286.6	2.3
Base Grab	5/20/2008 11:03	5/20/2008 11:03	1.0	0.037	5/4/2008 7:30	5/29/2008 15:30	546,161	12.54	34.1	1.3
Storm Composite	5/29/2008 23:34	5/30/2008 13:16	3.0	0.090	5/29/2008 15:30	6/1/2008 20:30	169,825	3.90	31.8	1.0
Base			*1.0*	*0.037*	*6/1/2008 20:30*	*6/5/2008 4:30*	*43,640*	*1.00*	*2.7*	*0.1*
Storm Composite	6/5/08 18:15	6/6/08 6:41	3.0	0.057	6/5/2008 4:30	6/7/2008 4:30	426,474	9.80	79.9	1.5
Base			*1.0*	*0.037*	*6/7/2008 4:30*	*6/11/2008 10:30*	*323,112*	*7.42*	*20.2*	*0.7*
Storm Composite	6/11/08 16:41	6/12/08 19:06	4.0	0.053	6/11/2008 10:30	6/13/2008 15:30	408,147	9.37	101.9	1.4
Base			*1.0*	*0.037*	*6/13/2008 15:30*	*7/11/2008 20:30*	*244,751*	*5.62*	*15.3*	*0.6*
Storm			*5.8*	*0.093*	*7/11/2008 20:30*	*7/12/2008 20:30*	*0*	*0.00*	*0.0*	*0.0*
Base			*1.0*	*0.037*	*7/12/2008 20:30*	*7/19/2008 20:30*	*0*	*0.00*	*0.0*	*0.0*
Storm			*5.8*	*0.093*	*7/19/2008 20:30*	*7/20/2008 16:30*	*1,665*	*0.04*	*0.6*	*0.0*
Base			*1.0*	*0.037*	*7/20/2008 16:30*	*8/27/2008 21:30*	*0*	*0.00*	*0.0*	*0.0*
Storm			*5.8*	*0.093*	*8/27/2008 21:30*	*8/28/2008 3:30*	*0*	*0.00*	*0.0*	*0.0*
Base			*1.0*	*0.037*	*8/28/2008 3:30*	*9/23/2008 9:30*	*0*	*0.00*	*0.0*	*0.0*
Storm			*5.8*	*0.093*	*9/23/2008 9:30*	*9/23/2008 20:30*	*0*	*0.00*	*0.0*	*0.0*
Base			*1.0*	*0.037*	*9/23/2008 20:30*	*11/5/2008 11:30*	*0*	*0.00*	*0.0*	*0.0*
*Base***			*1.0*	*0.037*	*11/5/2008 11:30*	*1/1/2009 0:00*	*0*	*0.00*	*0.0*	*0.0*
Storm Average			5.8	0.093						
Base Average			1.0	0.037						
All Average			5.1	0.085						
Total							**4,364,515**	**100**	**1,013**	**18**
SWWD Major Subwatershed Total Acres							8,046			
Total TP/TSS(lb/ac/yr)									0.13	0.00
Total TP/TSS (kg/ha/yr)									0.14	0.00

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

**Interval volumes from 1/1/08-4/3/08 and 11/5/08 to 1/1/09 were estimated based upon base flow

Grab samples and flow weighted composite samples were taken at the 100th Street site. The TSS, TKN, TP, VSS, TDP, and *E. coli* results from all collected samples are listed in Table 18. The highest concentrations of TSS and VSS were collected in a storm composite on May 2, 2008. The highest TKN and TP concentrations were collected from the April 10, 2008 storm composite. Metals, chloride, hardness, and other nitrogen species concentrations are listed in Table 19. Water quality standards were included in Table 19. None of the samples collected exceeded the water quality standards established by the Minnesota Pollution Control Agency.

Table 18. 100th Street 2008 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)	TDP (mg/L)
Storm Composite	4/10/08 20:18	4/10/08 21:35	8	5	3.3	0.206		0.096
Storm Composite	4/24/08 18:43	4/25/08 8:38	7	4	1.7	0.072		~0.010
Storm Composite	5/2/08 13:14	5/2/08 23:23	10	5	1.4	0.079		~0.015
Base Grab	5/20/08 11:03	5/20/08 11:03	~1	~1	0.75	~0.037		~0.037
Storm Composite	5/29/08 23:34	5/30/08 13:16	3	~2	1.3	0.090		~0.043
E. Coli Grab	6/5/08 10:00	6/5/08 10:00					<1.0	
Storm Composite	6/5/08 18:15	6/6/08 6:41	3	~2	0.52	0.057		~0.015
Storm Composite	6/11/08 16:41	6/12/08 19:06	4	~2	0.96	0.053		~0.019

Exceeds Water Quality Standards

Table 19. 100th Street 2008 Sample Metals and Nitrogen Species Chemical Results including Exceeded MPCA 7050 Water Quality Standards

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)	Hardness
Storm Composite	4/10/08 20:18	4/10/08 21:35	0.0035	0.0026	0.0007	0.026	<0.0005	0.0013	134	<0.03	1.4	0.24	184
Storm Composite	4/24/08 18:43	4/25/08 8:38	0.0019	0.0024	0.0004	0.0059	<0.0005	<0.004	91	<0.03	0.8	0.11	216
Storm Composite	5/2/08 13:14	5/2/08 23:23	0.0021	0.0025	0.0006	0.0065	<0.0005	0.0011	85	0.03	0.68	0.29	188
Base Grab	5/20/08 11:03	5/20/08 11:03	0.0014	0.0019	<0.0001	0.0013	<0.0005	<0.003	80	<0.03	<0.05	0.13	176
Storm Composite	5/29/08 23:34	5/30/08 13:16	0.0013	0.0024	0.0003	0.004	0.0007	<0.003	119	<0.03	0.22	<0.02	226
E. Coli Grab	6/5/08 10:00	6/5/08 10:00											
Storm Composite	6/5/08 18:15	6/6/08 6:41	0.0016	0.0017	0.0003	0.0044	<0.0005	<0.004	54	0.04	0.32	~0.05	142
Storm Composite	6/11/08 16:41	6/12/08 19:06	0.0015	0.0022	0.0003	0.0047	<0.0005	<0.004	70	<0.03	0.34	<0.02	162

No Exceedance Determinable
Exceeds Chronic Standard
Exceeds Max Standard
Exceeds Final Acute Standard

Newport

The hydrograph for the Newport site shows flow from April 9-October 14, 2008 (Figure 8). Total discharge during this period was 2,035,125 cf or 47 acre-ft. The peak discharge of 4.54 cfs occurred on June 5, 2008. No precipitation data was collected at this site.

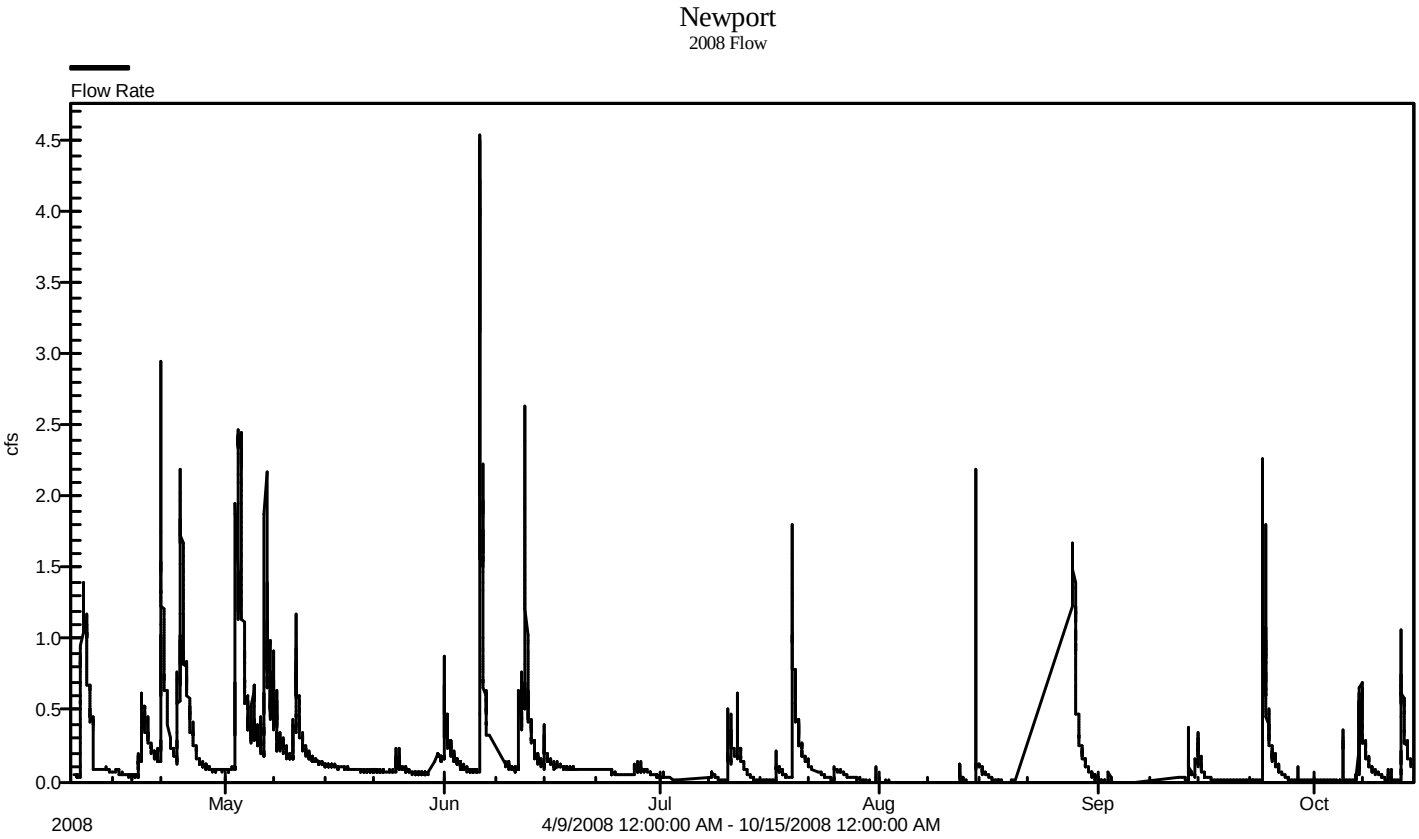


Figure 8. Newport 2008 Continuous Flow

Table 20. Newport Stormwater Total Phosphorus and Total Suspended Solids Loading Table

	Sample Collection Time				Loading Interval					
Sample Type	Start	End	TSS (mg/L)	TP (mg/L)	Start	End	Interval Volume (cf)	Interval Volume (ac-ft)	Interval TSS (lb)	Interval TP (lb)
*Base***			*11*	*0.129*	*1/1/2008 0:00*	*3/12/2008 11:45*	*679,437*	*15.61*	*466.6*	*5.47*
Snowmelt Grab	3/12/08 12:40	3/12/08 12:40	13	0.144	3/12/2008 11:45	3/15/2008 11:45	228,096	5.24	185.1	2.05
*Base***			*11*	*0.129*	*3/15/2008 11:45*	*4/2/2008 11:45*	*171,072*	*3.93*	*117.5*	*1.38*
Snowmelt Grab	4/2/08 13:10	4/2/08 13:10	20	0.240	4/2/2008 11:45	4/5/2008 11:45	228,096	5.24	284.8	3.42
*Base***			*11*	*0.129*	*4/5/2008 11:45*	*4/9/2008 11:45*	*38,016*	*0.87*	*26.1*	*0.31*
Base			*11*	*0.129*	*4/9/2008 11:45*	*4/10/2008 13:45*	*3,802*	*0.09*	*2.6*	*0.03*
Storm Composite	4/10/08 19:46	4/10/08 22:34	32	0.194	4/10/2008 13:45	4/12/2008 6:45	121,899	2.80	243.5	1.48
NO DATA					**4/12/2008 6:45**	**4/14/2008 9:45**				
Base			*11*	*0.129*	*4/14/2008 9:45*	*4/18/2008 13:45*	*19,794*	*0.45*	*13.6*	*0.16*
Storm			*49*	*0.192*	*4/18/2008 13:45*	*4/19/2008 23:45*	*41,140*	*0.94*	*125.8*	*0.49*
Base			*11*	*0.129*	*4/19/2008 23:45*	*4/21/2008 21:45*	*32,659*	*0.75*	*22.4*	*0.26*
Storm			*49*	*0.192*	*4/21/2008 21:45*	*4/22/2008 21:45*	*72,597*	*1.67*	*222.1*	*0.87*
NO DATA					**4/22/2008 21:45**	**4/23/2008 9:45**				
Base			*11*	*0.129*	*4/23/2008 9:45*	*4/24/2008 6:45*	*14,485*	*0.33*	*9.9*	*0.12*
Storm			*49*	*0.192*	*4/24/2008 6:45*	*4/26/2008 3:45*	*132,426*	*3.04*	*405.1*	*1.59*
Base			*11*	*0.129*	*4/26/2008 3:45*	*5/2/2008 11:45*	*62,969*	*1.45*	*43.2*	*0.51*
Storm Composite	5/2/08 13:06	5/2/08 14:50	495	0.706	5/2/2008 11:45	5/3/2008 17:45	168,283	3.87	5200.1	7.42
Base			*11*	*0.129*	*5/3/2008 17:45*	*5/6/2008 10:45*	*83,324*	*1.91*	*57.2*	*0.67*
Storm			*49*	*0.192*	*5/6/2008 10:45*	*5/6/2008 21:45*	*29,765*	*0.68*	*91.0*	*0.36*
Base			*11*	*0.129*	*5/6/2008 21:45*	*5/10/2008 12:45*	*106,089*	*2.44*	*72.8*	*0.85*
Storm			*49*	*0.192*	*5/10/2008 12:45*	*5/11/2008 14:45*	*47,769*	*1.10*	*146.1*	*0.57*
Base Grab	5/20/08 13:07	5/20/08 13:07	8	0.064	5/11/2008 14:45	5/29/2008 7:45	149,273	3.43	74.5	0.60
NO DATA					**5/29/2008 7:45**	**5/30/2008 16:45**				
Base			*11*	*0.129*	*5/30/2008 16:45*	*5/31/2008 18:45*	*15,762*	*0.36*	*10.8*	*0.13*
Storm			*49*	*0.192*	*5/31/2008 18:45*	*6/1/2008 16:45*	*28,236*	*0.65*	*86.4*	*0.34*
Storm Composite	6/5/08 17:22	6/6/08 3:35	59	0.168	6/1/2008 16:45	6/6/2008 14:45	171,975	3.95	633.4	1.80
Base			*11*	*0.129*	*6/6/2008 14:45*	*6/6/2008 21:45*	*10,342*	*0.24*	*7.1*	*0.08*
NO DATA					**6/6/2008 21:45**	**6/9/2008 14:45**				
Base			*11*	*0.129*	*6/9/2008 14:45*	*6/11/2008 9:45*	*14,723*	*0.34*	*10.1*	*0.12*
Storm Composite	6/12/08 4:26	6/12/08 7:46	21	0.140	6/11/2008 9:45	6/12/2008 19:45	89,436	2.05	117.2	0.83
Base			*11*	*0.129*	*6/12/2008 19:45*	*6/19/2008 5:45*	*79,620*	*1.83*	*54.7*	*0.64*
NO DATA					**6/19/2008 5:45**	**6/24/2008 9:45**				
Base Grab	6/24/08 9:40	6/24/08 9:40	7	0.184	6/24/2008 9:45	6/27/2008 16:45	13,156	0.30	5.7	0.15
Storm			*49*	*0.192*	*6/27/2008 16:45*	*6/28/2008 22:45*	*8,756*	*0.20*	*26.8*	*0.10*
Base			*11*	*0.129*	*6/28/2008 22:45*	*7/3/2008 5:45*	*13,969*	*0.32*	*9.6*	*0.11*
NO DATA					**7/3/2008 5:45**	**7/8/2008 9:45**				
Base			*11*	*0.129*	*7/8/2008 9:45*	*7/10/2008 12:45*	*3,925*	*0.09*	*2.7*	*0.03*
Storm			*49*	*0.192*	*7/10/2008 12:45*	*7/12/2008 18:45*	*41,227*	*0.95*	*126.1*	*0.49*
Base			*11*	*0.129*	*7/12/2008 18:45*	*7/17/2008 10:45*	*10,357*	*0.24*	*7.1*	*0.08*
Storm			*49*	*0.192*	*7/17/2008 10:45*	*7/17/2008 22:45*	*3,877*	*0.09*	*11.9*	*0.05*
Base			*11*	*0.129*	*7/17/2008 22:45*	*7/19/2008 15:45*	*6,647*	*0.15*	*4.6*	*0.05*
Storm Composite	7/19/08 17:14	7/20/08 8:35	99	0.215	7/19/2008 15:45	7/21/2008 4:45	69,690	1.60	430.7	0.94
Base			*11*	*0.129*	*7/21/2008 4:45*	*7/22/2008 9:45*	*13,944*	*0.32*	*9.6*	*0.11*
NO DATA					**7/22/2008 9:45**	**7/23/2008 9:45**				
Base			*11*	*0.129*	*7/23/2008 9:45*	*7/25/2008 16:45*	*6,509*	*0.15*	*4.5*	*0.05*
Storm			*49*	*0.192*	*7/25/2008 16:45*	*7/25/2008 22:45*	*1,557*	*0.04*	*4.8*	*0.02*
Base			*11*	*0.129*	*7/25/2008 22:45*	*7/31/2008 9:45*	*12,429*	*0.29*	*8.5*	*0.10*
Storm			*49*	*0.192*	*7/31/2008 9:45*	*7/31/2008 20:45*	*558*	*0.01*	*1.7*	*0.01*
Base			*11*	*0.129*	*7/31/2008 20:45*	*8/2/2008 22:45*	*82*	*0.00*	*0.1*	*0.00*
Base Grab**	8/5/08 10:00	8/5/08 10:00	17	0.138	8/2/2008 22:45	8/8/2008 9:45	2,358	0.05	2.5	0.02
Base			*11*	*0.129*	*8/8/2008 9:45*	*8/12/2008 6:45*	*0*	*0.00*	*0.0*	*0.00*
Storm			*49*	*0.192*	*8/12/2008 6:45*	*8/13/2008 2:45*	*1,621*	*0.04*	*5.0*	*0.02*
Base			*11*	*0.129*	*8/13/2008 2:45*	*8/14/2008 14:45*	*0*	*0.00*	*0.0*	*0.00*
Storm			*49*	*0.192*	*8/14/2008 14:45*	*8/14/2008 23:45*	*5,615*	*0.13*	*17.2*	*0.07*
Base			*11*	*0.129*	*8/14/2008 23:45*	*8/20/2008 3:45*	*10,126*	*0.23*	*7.0*	*0.08*
NO DATA					**8/20/2008 3:45**	**8/28/2008 8:45**				
Storm Composite	8/28/08 8:14	8/28/08 20:01	31	0.128	8/28/2008 8:45	8/29/2008 15:45	56,473	1.30	109.3	0.45
Base			*11*	*0.129*	*8/29/2008 15:45*	*9/5/2008 17:45*	*14,362*	*0.33*	*9.9*	*0.12*
NO DATA					**9/5/2008 17:45**	**9/12/2008 8:45**				
Base			*11*	*0.129*	*9/12/2008 8:45*	*9/13/2008 11:45*	*2,207*	*0.05*	*1.5*	*0.02*
Storm			*49*	*0.192*	*9/13/2008 11:45*	*9/13/2008 21:45*	*2,248*	*0.05*	*6.9*	*0.03*
Base			*11*	*0.129*	*9/13/2008 21:45*	*9/14/2008 13:45*	*2,328*	*0.05*	*1.6*	*0.02*
Storm			*49*	*0.192*	*9/14/2008 13:45*	*9/15/2008 12:45*	*13,659*	*0.31*	*41.8*	*0.16*
Base			*11*	*0.129*	*9/15/2008 12:45*	*9/23/2008 16:45*	*5,729*	*0.13*	*3.9*	*0.05*
Storm Composite	9/23/08 18:12	9/24/08 11:23	49	0.216	9/23/2008 16:45	9/25/2008 21:45	110,781	2.54	338.9	1.49
Base			*11*	*0.129*	*9/25/2008 21:45*	*10/5/2008 6:45*	*10,430*	*0.24*	*7.2*	*0.08*
Storm			*49*	*0.192*	*10/5/2008 6:45*	*10/5/2008 13:45*	*1,459*	*0.03*	*4.5*	*0.02*
Base			*11*	*0.129*	*10/5/2008 13:45*	*10/6/2008 22:45*	*595*	*0.01*	*0.4*	*0.00*
Storm			*49*	*0.192*	*10/6/2008 22:45*	*10/9/2008 1:45*	*44,260*	*1.02*	*135.4*	*0.53*
Base			*11*	*0.129*	*10/9/2008 1:45*	*10/9/2008 22:45*	*5,176*	*0.12*	*3.6*	*0.04*
Storm			*49*	*0.192*	*10/9/2008 22:45*	*10/10/2008 7:45*	*1,860*	*0.04*	*5.7*	*0.02*
Base			*11*	*0.129*	*10/10/2008 7:45*	*10/11/2008 15:45*	*2,872*	*0.07*	*2.0*	*0.02*
Storm			*49*	*0.192*	*10/11/2008 15:45*	*10/12/2008 0:45*	*846*	*0.02*	*2.6*	*0.01*
Base			*11*	*0.129*	*10/12/2008 0:45*	*10/13/2008 8:45*	*1,395*	*0.03*	*1.0*	*0.01*
Storm			*49*	*0.192*	*10/13/2008 8:45*	*10/14/2008 19:45*	*35,680*	*0.82*	*109.1*	*0.43*
*Base***			*11*	*0.129*	*10/14/2008 19:45*	*1/1/2009 0:00*	*742,995*	*17.07*	*510.2*	*5.98*
Storm Average			49	0.178						
Base Average			11	0.129						
Snowmelt Average			17	0.192						
All Average			32	0.167						
Total							**4,122,837**	**95**	**10,711**	**45**
Storm Total							**1,303,692**	**30**	**8,649**	**21**
SWWD Major Subwatershed Total Acres							NA			
Total TP/TSS(lb/ac/yr)									NA	NA
Total TP/TSS (kg/ha/yr)									NA	NA

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

** Indicates that flow intervals are estimated, based on average base and storm flows

Grab and flow weighted composite samples were taken at the Newport site to determine water quality. The TSS, TKN, TP, TDP, VSS, and *E. coli* concentrations from all collected samples are listed in Table 21. The highest TSS, VSS, TKN, and TP concentrations were all from a storm composite sample collected on May 2, 2008. Two of the three *E. coli* samples collected exceeded water quality standards. Metals, chloride, hardness, and other nitrogen species concentrations are listed in Table 22. Water quality standard exceedances were also included in Table 22, as set by the Minnesota Pollution Control Agency. The first three samples collected for the season, March-April, each exceeded the chronic standard for chloride. This may have been due to the use of road salt in the area. The chronic standard for lead was exceeded in a storm composite collected on July 19, 2008. A storm composite collected on May 2, 2008 exceeded the maximum standards for copper, lead, and zinc.

Table 21. Newport 2008 Chemical Results

Sample Type	Start Date	End Date	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	E. Coliform (#/100 mL)	TDP (mg/L)
Snowmelt Grab	3/12/08 12:40	3/12/08 12:40	13	6	3.8	0.144		~0.049
Snowmelt Grab	4/2/08 13:10	4/2/08 13:10	20	9	4.2	0.240		0.096
Storm Composite	4/10/08 19:46	4/10/08 22:34	32	9	3.8	0.194		~0.046
Storm Composite	5/2/08 13:06	5/2/08 14:50	495	175	5.8	0.706		0.119
Base Grab	5/20/08 13:07	5/20/08 13:07	8	4	0.98	0.064		<0.010
Storm Composite	6/5/08 17:22	6/6/08 3:35	59	13	1.6	0.168		~0.010
E.Coli Grab	6/12/08 9:30	6/12/08 9:30					179	
Storm Composite	6/12/08 4:26	6/12/08 7:46	21	10	1.4	0.149		~0.037
Base Grab	6/24/08 9:40	6/24/08 9:40	7	~4	1	0.184		0.05
Storm Composite	7/19/08 17:14	7/20/08 8:35	99	32	1.8	0.215		~0.040
E.Coli Grab	7/23/08 9:30	7/23/08 9:30					27	
Base Grab	8/5/08 10:00	8/5/08 10:00	17	14	2.3	0.138		~0.011
Storm Composite	8/28/08 8:14	8/28/08 20:01	31	17	2.7	0.128		~0.010
E.Coli Grab	8/28/08 8:15	8/28/08 8:15					317	
Storm Composite	9/23/08 18:12	9/24/08 11:23	49	28	3.1	0.216		<0.010

Exceeds Water Quality Standards

Table 22. Newport 2008 Sample Metals, Chloride, Hardness, and Nitrogen Species Chemical Results including Exceeded MPCA 7050 Water Quality Standards

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)	Hardness
Snowmelt Grab	3/12/08 12:40	3/12/08 12:40	0.0065	0.0045	0.0012	0.0206	<0.0005	0.0013	348	<0.03	0.16	1.51	260
Snowmelt Grab	4/2/08 13:10	4/2/08 13:10	0.0051	0.0031	0.0017	0.0167	<0.0005	0.0016	279	0.03	0.29	0.72	172
Storm Composite	4/10/08 19:46	4/10/08 22:34	0.0054	0.0027	0.0026	0.0195	<0.0005	0.0015	281	<0.03	0.21	0.75	128
Storm Composite	5/2/08 13:06	5/2/08 14:50	0.0163	0.0057	0.0125	0.192	0.0014	0.0054	56	0.03	0.21	1.1	88
Base Grab	5/20/08 13:07	5/20/08 13:07	0.0015	0.002	0.0007	0.004	<0.0005	<0.003	88	<0.03	0.09	~0.02	120
Storm Composite	6/5/08 17:22	6/6/08 3:35	0.0058	0.0032	0.004	0.0383	<0.0005	<0.004	69	<0.03	0.15	0.14	344
E.Coli Grab	6/12/08 9:30	6/12/08 9:30											
Storm Composite	6/12/08 4:26	6/12/08 7:46							62	<0.03	0.08	0.19	
Base Grab	6/24/08 9:40	6/24/08 9:40	0.0011	0.0018	0.0005	0.0073	<0.0005	<0.005	61	<0.03	0.18	0.26	156
Storm Composite	7/19/08 17:14	7/20/08 8:35	0.0056	0.0036	0.0046	0.0343	<0.0005	<0.004	58	<0.03	0.07	0.27	116
E.Coli Grab	7/23/08 9:30	7/23/08 9:30											
Base Grab	8/5/08 10:00	8/5/08 10:00	0.0013	0.0015	0.0003	0.0042	<0.0005	<0.004	56	<0.03	0.08	~0.05	110
Storm Composite	8/28/08 8:14	8/28/08 20:01	0.002	0.0026	0.0009	0.0082	<0.0005	<0.005	45	<0.03	0.17	0.43	96
E.Coli Grab	8/28/08 8:15	8/28/08 8:15											
Storm Composite	9/23/08 18:12	9/24/08 11:23	0.0039	0.0026	0.0021	0.0476	0.0009	<0.003	38	<0.03	0.14	<0.02	98

No Exceedance Determinable
Exceeds Chronic Standard
Exceeds Max Standard
Exceeds Final Acute Standard

Saint Paul Park

The hydrograph for the Saint Paul Park site shows flow from April 14-October 17, 2008 (Figure 9). Total discharge during this period was 692,394 cf or 16 acre-ft. Peak discharge was 8.18 cfs, which occurred on June 5, 2008. There was another discharge close to the peak of 8.16 cfs on September 23, 2008. Precipitation was not collected at this site.

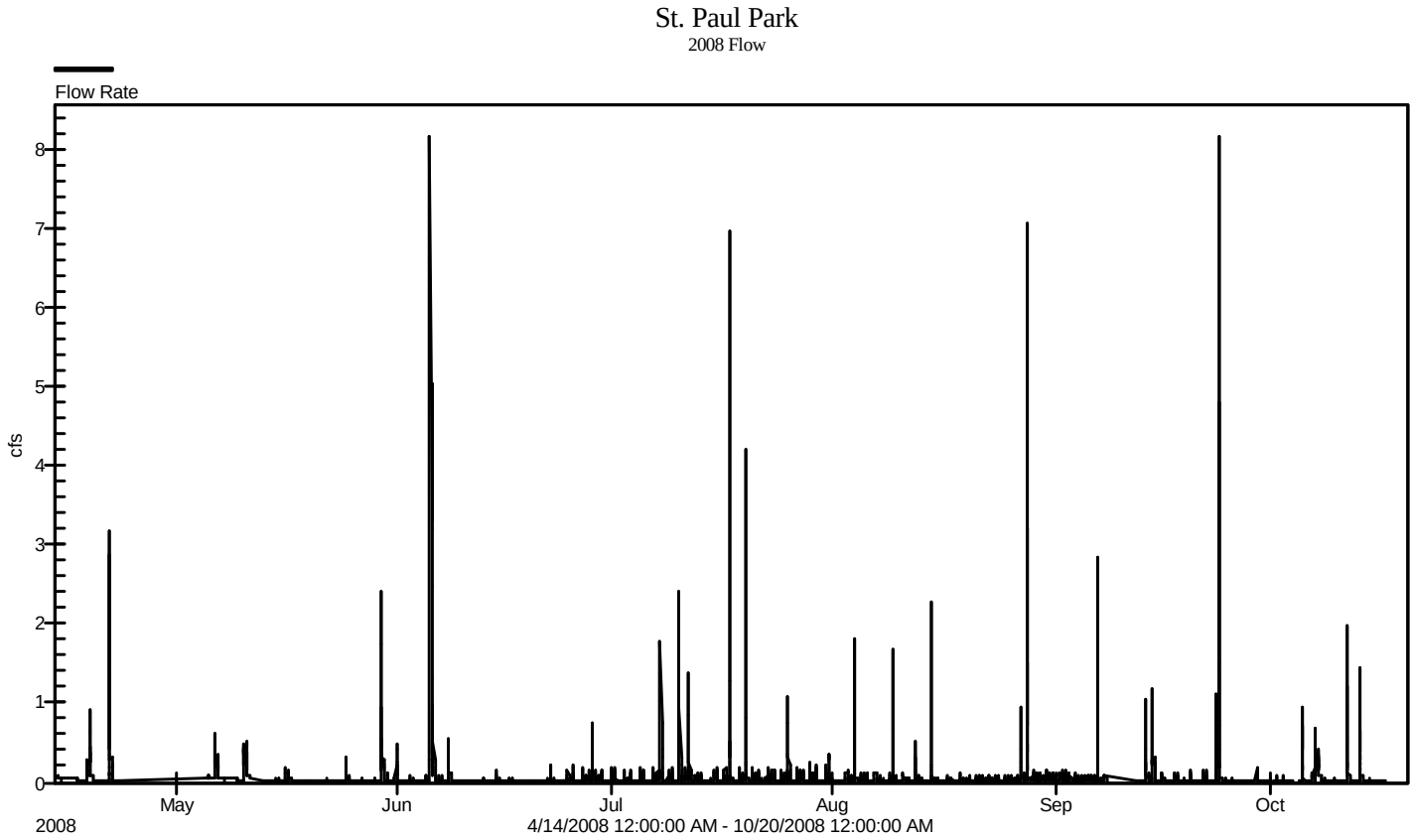


Figure 9. Saint Paul Park 2008 Continuous Flow

Table 23. St Paul Park Stormwater Total Phosphorus and Total Suspended Solids Loading Table

	Sample Collection Time				Loading Interval					
Sample Type	Start	End	TSS (mg/L)	TP (mg/L)	Start	End	Interval Volume (cf)	Interval Volume (ac-ft)	Interval TSS (lb)	Interval TP (lb)
Base **			*2*	*0.078*	*1/1/2008 0:00*	*4/2/2008 12:45*	*159,894*	*3.67*	*20.0*	*0.8*
Snowmelt Grab**	4/2/08 12:45	4/2/08 12:45	2	0.056	4/2/2008 12:45	4/3/2008 12:45	8,640	0.20	1.1	0.0
Base **			*2*	*0.078*	*4/3/2008 12:45*	*4/14/2008 13:00*	*19,026*	*0.44*	*2.4*	*0.1*
Base			*2*	*0.078*	*4/14/2008 13:00*	*4/21/2008 22:00*	*35,976*	*0.83*	*4.5*	*0.2*
Storm Composite	4/21/08 22:38	4/22/08 12:04	636	0.492	4/21/2008 22:00	4/22/2008 14:30	15,928	0.37	632.4	0.5
Base			*2*	*0.078*	*4/22/2008 14:30*	*4/23/2008 8:45*	*1,599*	*0.04*	*0.2*	*0.0*
NO DATA					**4/23/2008 8:45**	**5/2/2008 12:00**				
Storm Composite	5/2/08 12:03	5/2/08 13:08	293	0.291	5/2/2008 12:00	5/2/2008 13:30	540	0.01	9.9	0.0
NO DATA					**5/2/2008 13:30**	**5/5/2008 10:30**				
Base			*2*	*0.078*	*5/5/2008 10:30*	*5/10/2008 13:30*	*6,291*	*0.14*	*0.8*	*0.0*
Storm			*326*	*0.297*	*5/10/2008 13:30*	*5/11/2008 16:45*	*39,817*	*0.91*	*810.3*	*0.7*
NO DATA					**5/11/2008 16:45**	**5/13/2008 10:15**				
Base			*2*	*0.078*	*5/13/2008 10:15*	*5/29/2008 17:30*	*21,410*	*0.49*	*2.7*	*0.1*
Storm			*326*	*0.297*	*5/29/2008 17:30*	*5/30/2008 5:00*	*20,469*	*0.47*	*416.6*	*0.4*
Base			*2*	*0.078*	*5/30/2008 5:00*	*5/31/2008 19:00*	*22,672*	*0.52*	*2.8*	*0.1*
Storm			*326*	*0.297*	*5/31/2008 19:00*	*6/1/2008 2:30*	*22,672*	*0.52*	*461.4*	*0.4*
Base			*2*	*0.078*	*6/1/2008 2:30*	*6/5/2008 16:30*	*2,242*	*0.05*	*0.3*	*0.0*
Storm Composite	6/5/08 17:02	6/5/08 17:44	470	0.328	6/5/2008 16:30	6/6/2008 13:00	55,063	1.26	1615.6	1.1
Base				*0.067*	*6/6/2008 13:00*	*6/9/2008 14:15*	*22,672*	*0.52*	*0.0*	*0.1*
NO DATA					**6/9/2008 14:15**	**6/12/2008 14:00**				
Base			*2*	*0.078*	*6/12/2008 14:00*	*7/7/2008 20:30*	*32,661*	*0.75*	*4.1*	*0.2*
Storm Composite	7/7/08 21:18	7/7/08 22:06	144	0.253	7/7/2008 20:30	7/8/2008 5:00	4,323	0.10	38.9	0.1
Base			*2*	*0.078*	*7/8/2008 5:00*	*7/10/2008 13:00*	*4,110*	*0.09*	*0.5*	*0.0*
Storm			*326*	*0.297*	*7/10/2008 13:00*	*7/11/2008 23:30*	*12,466*	*0.29*	*253.7*	*0.2*
Base			*2*	*0.078*	*7/11/2008 23:30*	*7/13/2008 17:30*	*2,872*	*0.07*	*0.4*	*0.0*
NO DATA					**7/13/2008 17:30**	**7/15/2008 9:30**				
Base			*2*	*0.078*	*7/15/2008 9:30*	*7/17/2008 17:00*	*4,773*	*0.11*	*0.6*	*0.0*
Storm			*326*	*0.297*	*7/17/2008 17:00*	*7/18/2008 18:00*	*12,022*	*0.28*	*244.7*	*0.2*
Base			*2*	*0.078*	*7/18/2008 18:00*	*7/19/2008 17:00*	*3,765*	*0.09*	*0.5*	*0.0*
Storm			*326*	*0.297*	*7/19/2008 17:00*	*7/19/2008 21:00*	*7,205*	*0.17*	*146.6*	*0.1*
Base			*2*	*0.078*	*7/19/2008 21:00*	*7/25/2008 17:00*	*14,200*	*0.33*	*1.8*	*0.1*
Storm			*326*	*0.297*	*7/25/2008 17:00*	*7/25/2008 20:30*	*4,182*	*0.10*	*85.1*	*0.1*
Base			*2*	*0.078*	*7/25/2008 20:30*	*8/4/2008 0:00*	*21,633*	*0.50*	*2.7*	*0.1*
Storm			*326*	*0.297*	*8/4/2008 0:00*	*8/4/2008 3:00*	*3,455*	*0.08*	*70.3*	*0.1*
Base Grab	8/5/08 9:15	8/5/08 9:15	2	0.078	8/4/2008 3:00	8/9/2008 2:30	6,166	0.14	0.8	0.0
Storm			*326*	*0.297*	*8/9/2008 2:30*	*8/9/2008 4:30*	*4,169*	*0.10*	*84.9*	*0.1*
Base			*2*	*0.078*	*8/9/2008 4:30*	*8/14/2008 14:30*	*7,723*	*0.18*	*1.0*	*0.0*
Storm			*326*	*0.297*	*8/14/2008 14:30*	*8/14/2008 17:00*	*4,590*	*0.11*	*93.4*	*0.1*
Base			*2*	*0.078*	*8/14/2008 17:00*	*8/27/2008 6:30*	*13,788*	*0.32*	*1.7*	*0.1*
Storm Composite	8/27/08 20:30	8/28/08 1:01	152	0.174	8/27/2008 6:30	8/28/2008 5:00	27,532	0.63	261.2	0.3
Base			*2*	*0.078*	*8/28/2008 5:00*	*9/6/2008 19:00*	*27,832*	*0.64*	*3.5*	*0.1*
Storm			*326*	*0.297*	*9/6/2008 19:00*	*9/6/2008 20:15*	*5,449*	*0.13*	*110.9*	*0.1*
Base			*2*	*0.078*	*9/6/2008 20:15*	*9/7/2008 19:30*	*1,488*	*0.03*	*0.2*	*0.0*
NO DATA					**9/7/2008 19:30**	**9/12/2008 9:00**				
Base			*2*	*0.078*	*9/12/2008 9:00*	*9/13/2008 14:30*	*1,769*	*0.04*	*0.2*	*0.0*
Storm			*326*	*0.297*	*9/13/2008 14:30*	*9/14/2008 19:30*	*12,319*	*0.28*	*250.7*	*0.2*
Base			*2*	*0.078*	*9/14/2008 19:30*	*9/23/2008 9:00*	*13,814*	*0.32*	*1.7*	*0.1*
Storm Composite	9/23/08 11:38	9/23/08 19:33	261	0.246	9/23/2008 9:00	9/24/2008 1:00	22,847	0.52	372.3	0.4
Base			*2*	*0.078*	*9/24/2008 1:00*	*10/5/2008 9:00*	*6,631*	*0.15*	*0.8*	*0.0*
Storm			*326*	*0.297*	*10/5/2008 9:00*	*10/5/2008 15:30*	*22,672*	*0.52*	*461.4*	*0.4*
Base			*2*	*0.078*	*10/5/2008 15:30*	*10/6/2008 23:30*	*22,672*	*0.52*	*2.8*	*0.1*
Storm			*326*	*0.297*	*10/6/2008 23:30*	*10/7/2008 23:30*	*22,672*	*0.52*	*461.4*	*0.4*
Base			*2*	*0.078*	*10/7/2008 23:30*	*10/11/2008 16:30*	*2,179*	*0.05*	*0.3*	*0.0*
Storm			*326*	*0.297*	*10/11/2008 16:30*	*10/12/2008 5:00*	*24,323*	*0.56*	*495.0*	*0.5*
Base			*2*	*0.078*	*10/12/2008 5:00*	*10/13/2008 9:00*	*22,672*	*0.52*	*2.8*	*0.1*
Storm			*326*	*0.297*	*10/13/2008 9:00*	*10/13/2008 23:00*	*1,395*	*0.03*	*28.4*	*0.0*
Base			*2*	*0.078*	*10/13/2008 23:00*	*10/17/2008 1:00*	*22,672*	*0.52*	*2.8*	*0.1*
Base **			*2*	*0.078*	*10/17/2008 1:00*	*1/1/2009 0:00*	*196,884*	*4.52*	*24.6*	*1.0*
Storm Average			326	0.297						
Base Average			2	0.078						
Snowmelt Average			2	0.056						
All Average			245	0.240						
Total							**1,076,838**	**25**	**7,493**	**10**
Storm Total							**346,112**	**8**	**7,405**	**6**
SWWD Major Subwatershed Total Acres							NA			
Total TP/TSS(lb/ac/yr)									NA	NA
Total TP/TSS (kg/ha/yr)									NA	NA

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

*TP and TSS concentrations from the 9/30 storm sample were applied to base periods (lowest concentration)

**Interval volumes between 1/1/08-4/14/08 and 10/17/08-1/1/09 were estimated based upon base flow

Grab samples and flow weighted composite samples were taken at the Saint Paul Park site to determine water quality. The TSS, TKN, TP, VSS, TDP, and *E. coli* results from all collected samples are listed in Table 24. The highest concentrations for TSS, VSS, and TP were from a storm composite sample collected on April 21, 2008. The highest TKN concentration was from a storm composite collected on July 7, 2008. Both of the *E. coli* samples collected exceeded water quality standards. Metals, chloride, hardness, and other nitrogen species concentrations are listed in Table 25. Water quality standard exceedences were also included in Table 25. Three samples collected exceeded the chronic standard for cadmium, four exceeded the chronic standard for lead, and one exceeded the chronic standard for copper. Three samples exceeded the max standard for zinc, two exceeded the max standard for lead, and one exceeded the max standard for copper. Four samples exceeded the final acute standard for copper and one exceeded the final acute standard for zinc.

Table 24. Saint Paul Park 2008 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)	TDP (mg/L)
Snowmelt Grab	4/2/08 12:45	4/2/08 12:45	~2	~1	0.18	0.056		~0.010
Storm Composite	4/21/08 22:38	4/22/08 12:04	636	174	2.1	0.492		~0.030
Storm Composite	5/2/08 12:03	5/2/08 13:08	293	53	1.3	0.252		~0.023
Storm Composite	6/5/08 17:02	6/5/08 17:44	470	134	2.1	0.328		~0.026
E. Coli Grab	6/12/08 9:15	6/12/08 9:15					1013	
Storm Composite	7/7/08 21:18	7/7/08 22:06	144	45	2.2	0.253		~0.041
Base Grab	8/5/08 9:15	8/5/08 9:15	~2	~2	0.85	0.078		0.058
Storm Composite	8/27/08 20:30	8/28/08 1:01	152	37	1	0.174		0.05
E. Coli Grab	8/28/08 8:45	8/28/08 8:45					517	
Storm Composite	9/23/08 11:38	9/23/08 19:33	261	41	0.95	0.246		~0.048

Exceeds Water Quality Standards

Table 25. Saint Paul Park 2008 Sample Metals, Chloride, Hardness, and Nitrogen Species Chemical Results including Exceeded MPCA 7050 Water Quality Standards

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)	Hardness
Snowmelt Grab	4/2/08 12:45	4/2/08 12:45	0.0012	0.0035	0.0004	0.0189	<0.0005	0.001	21	<0.03	1.68	~0.05	98
Storm Composite	4/21/08 22:38	4/22/08 12:04	0.0287	0.0119	0.0235	0.132	<0.0005	0.0109	3	0.03	0.4	0.24	32
Storm Composite	5/2/08 12:03	5/2/08 13:08	0.0158	0.0062	0.014	0.074	<0.0005	0.0065	2	<0.03	0.28	0.36	36
Storm Composite	6/5/08 17:02	6/5/08 17:44	0.0165	0.0059	0.0162	0.0928	<0.0005	0.0068	2	<0.03	0.39	0.2	36
E. Coli Grab	6/12/08 9:15	6/12/08 9:15											
Storm Composite	7/7/08 21:18	7/7/08 22:06	0.0147	0.0048	0.0079	0.06	0.0011	0.0037	14	0.11	1.33	0.3	96
Base Grab	8/5/08 9:15	8/5/08 9:15	0.0021	0.0041	0.0001	0.0072	<0.0005	<0.004	27	<0.03	0.68	~0.05	288
Storm Composite	8/27/08 20:30	8/28/08 1:01	0.0148	0.0042	0.0131	0.0524	<0.0005	0.0035	2	<0.03	0.65	0.55	34
E. Coli Grab	8/28/08 8:45	8/28/08 8:45											
Storm Composite	9/23/08 11:38	9/23/08 19:33	0.0127	0.0056	0.0132	0.0557	<0.0005	0.0043	4	<0.03	0.47	0.16	54

No Exceedance Determinable
Exceeds Chronic Standard
Exceeds Max Standard
Exceeds Final Acute Standard

Flow-only Sites: Fox Run, Tamarack Road, 80th Street, 90th Street, Bailey Lake (at Lift Station), West Draw 1 and West Draw 3

Fox Run

The Fox Run stormwater site recorded stage, velocity, and flow between April 10-October 13, 2008 (Figure 10). There was a period of data loss between April 30 and June 11. The total discharge for this period was 907,173 cf or 21 acre-ft. The highest recorded flow was 2.18 cfs on April 11, 2008, with the second highest flow at 2.16 on August 28, 2008. There was no precipitation gage and no chemistry data was collected at this site.

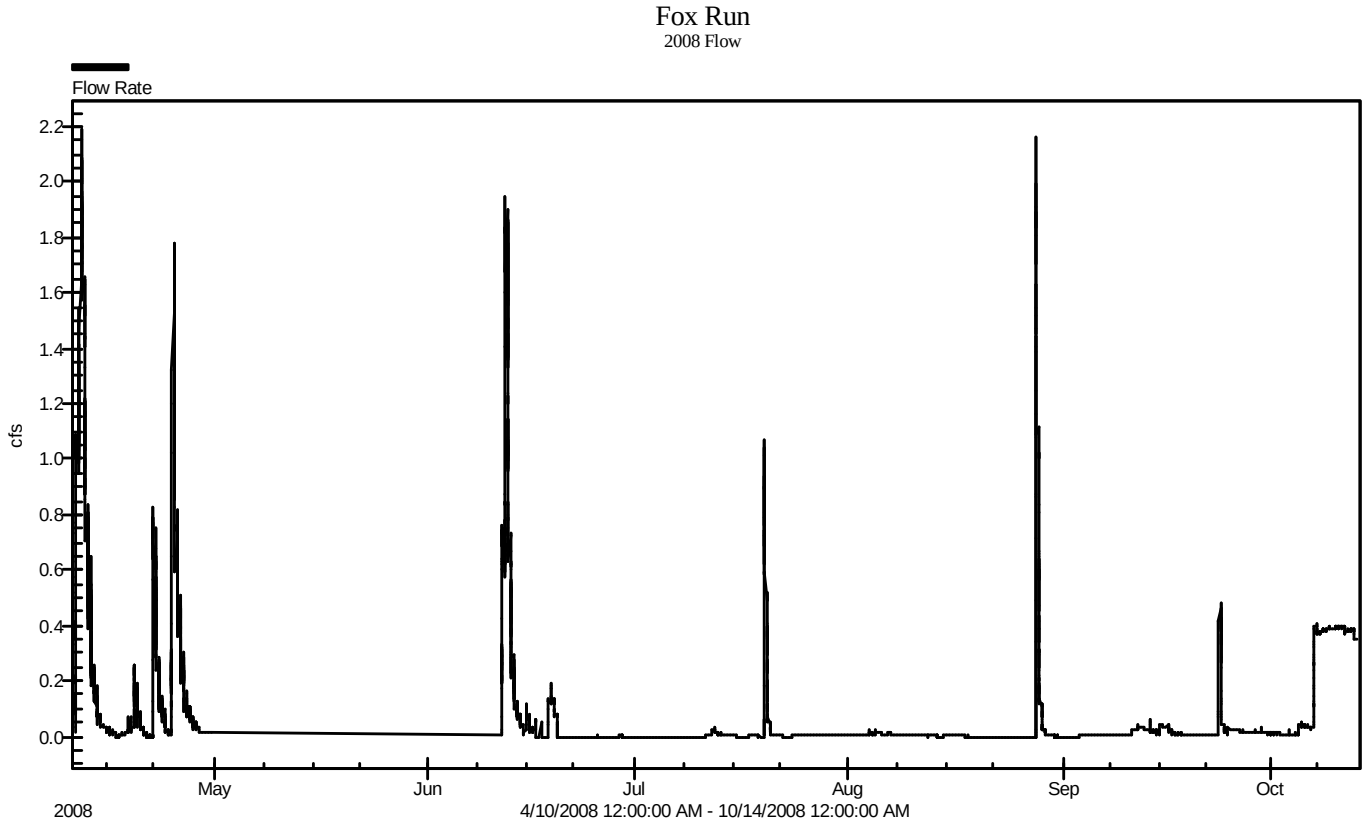


Figure 10. Fox Run 2008 Continuous Flow

Tamarack Road

The Tamarack Road stormwater site recorded stage, velocity, and flow between June 11-October 14, 2008 (Figure 11). The site this year was located in the outlet structure of a newly constructed stormwater pond. The total discharge for this period was 663,696 cf or 15 acre-ft. The highest discharge at this site was 8.13 cfs on July 19, 2008. There was no precipitation gage and no chemistry data was collected at this site.

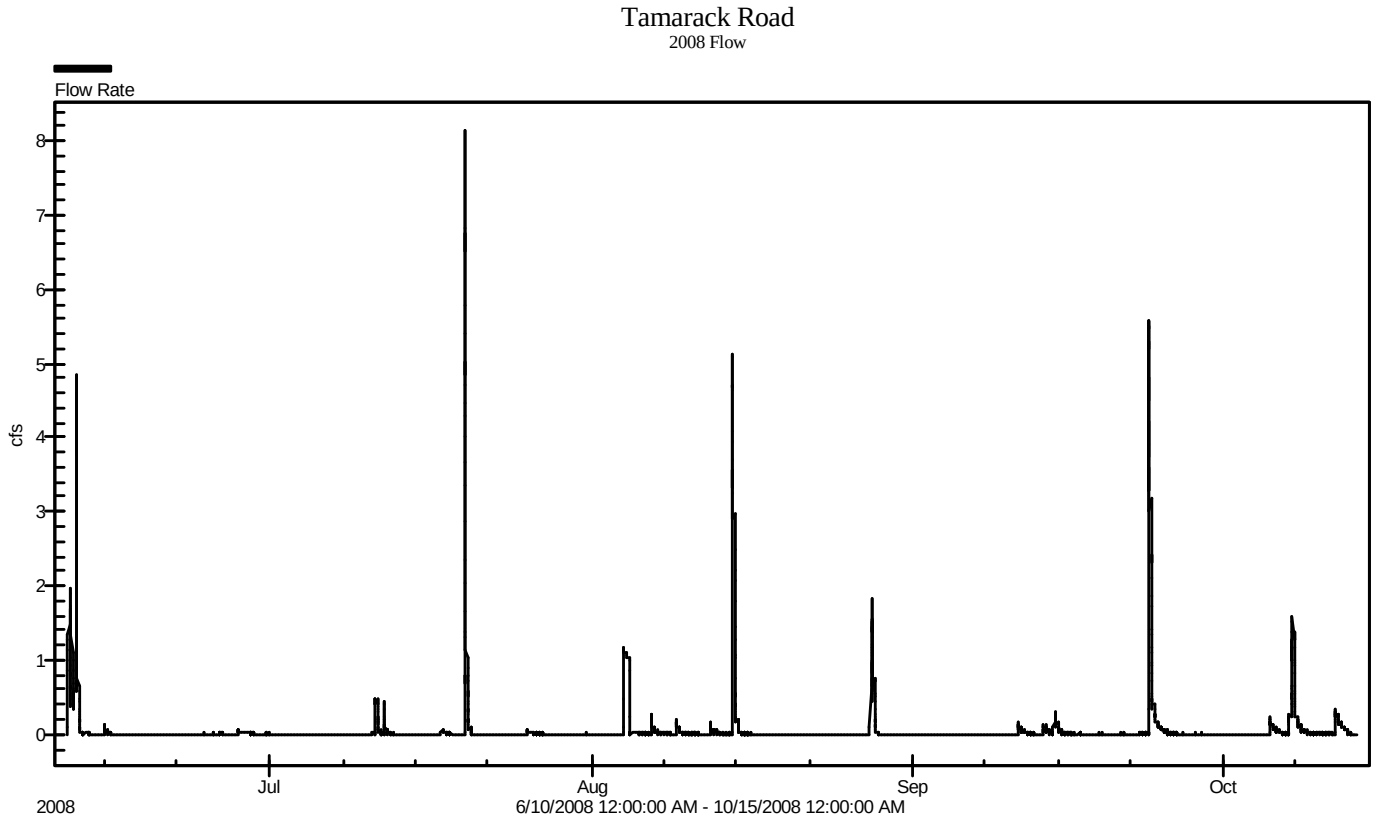


Figure 11. Tamarack Road 2008 Continuous Flow

80th Street

The 80th Street stormwater site recorded stage and flow between June 10-October 29, 2008 (Figure 12). This site was moved from the south side of 80th street to the north side on the outlet of the newly constructed stormwater pond. The total discharge for this period was 417,339 cf or 10 acre-ft. The peak discharge at this site was 2.64 cfs was on June 12, 2008. There was no precipitation gage and no chemistry data was collected at this site.

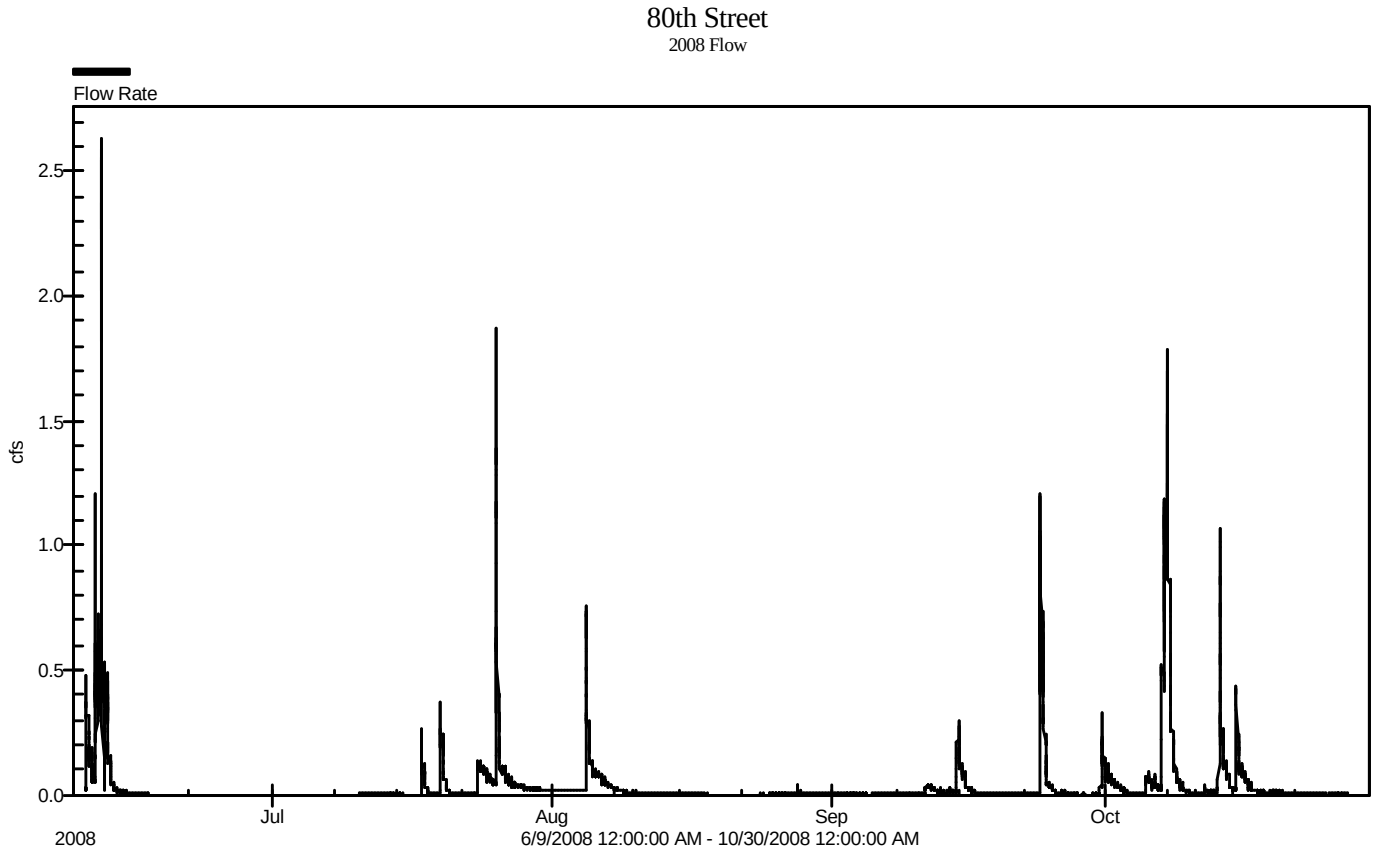


Figure 12. 80th Street 2008 Continuous Flow

90th Street

The 90th Street stormwater site recorded stage and flow between April 7-October 30, 2008 (Figure 13). There was a period of missing data from May 29 to June 11. The total discharge for this period was 1,063,836 cf or 24 acre-ft. The highest discharge was 3.39 cfs on May 2, 2008. There was no precipitation gage and no chemistry data was collected at this site.

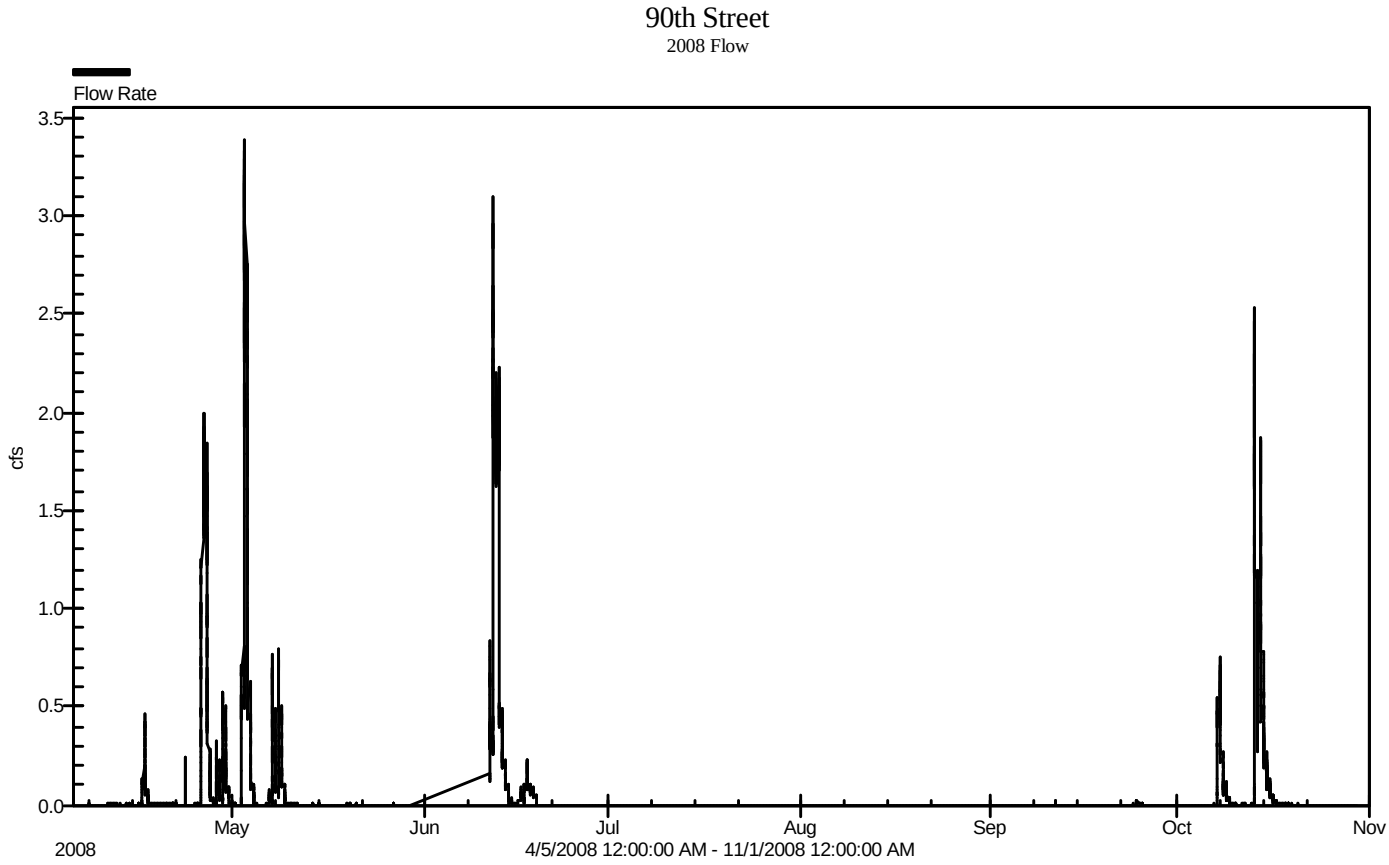


Figure 13. 90th Street 2008 Continuous Flow

Bailey Lift Station

Precipitation measurements were recorded every hour between April 14-October 30, 2008 at this site (Figure 14). Elevation measurements were recorded from April 14-October 30, 2008. The highest recorded elevation was 868.86 ft. recorded on May 7, 2008. The average stage during the monitoring season was 861.9 ft. The highest recorded daily rainfall was 1.63 inches recorded on June 5, 2008.

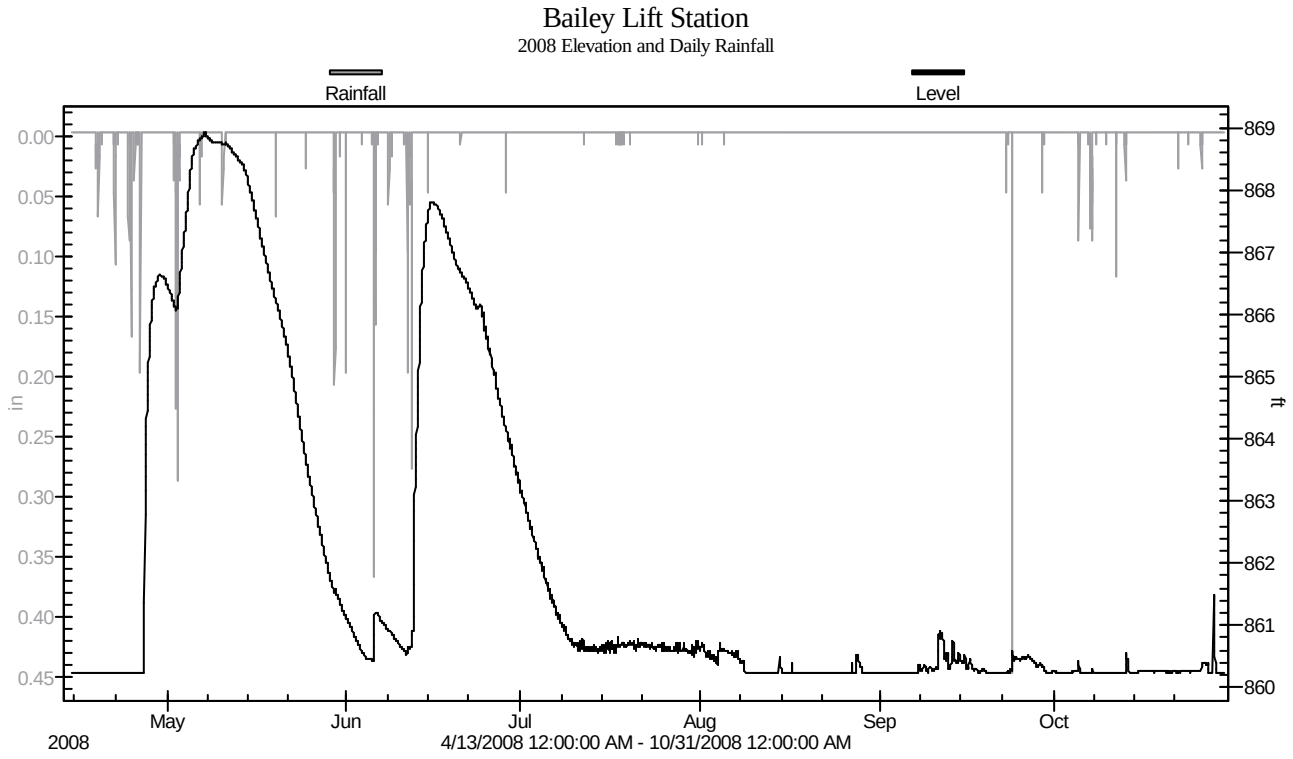


Figure 14. Bailey Lift Station 2008 Elevation and Daily Precipitation

West Draw 1

West Draw 1 site recorded flow between April 10-October 30, 2008 (Figure 15). There was a period of missing data between May 29 and June 11. The total discharge for this period was 587,970 cf or 13 acre-ft. The highest discharge at this site was 1.82 cfs on May 3, 2008. Elevation data was collected at the upstream pond from May 1 to October 29 (Figure 16) to measure bounce associated with storm events to further model calibration. Elevation of this pond has an assumed datum of 100 ft. There was no precipitation gage and no chemistry data was collected at this site.

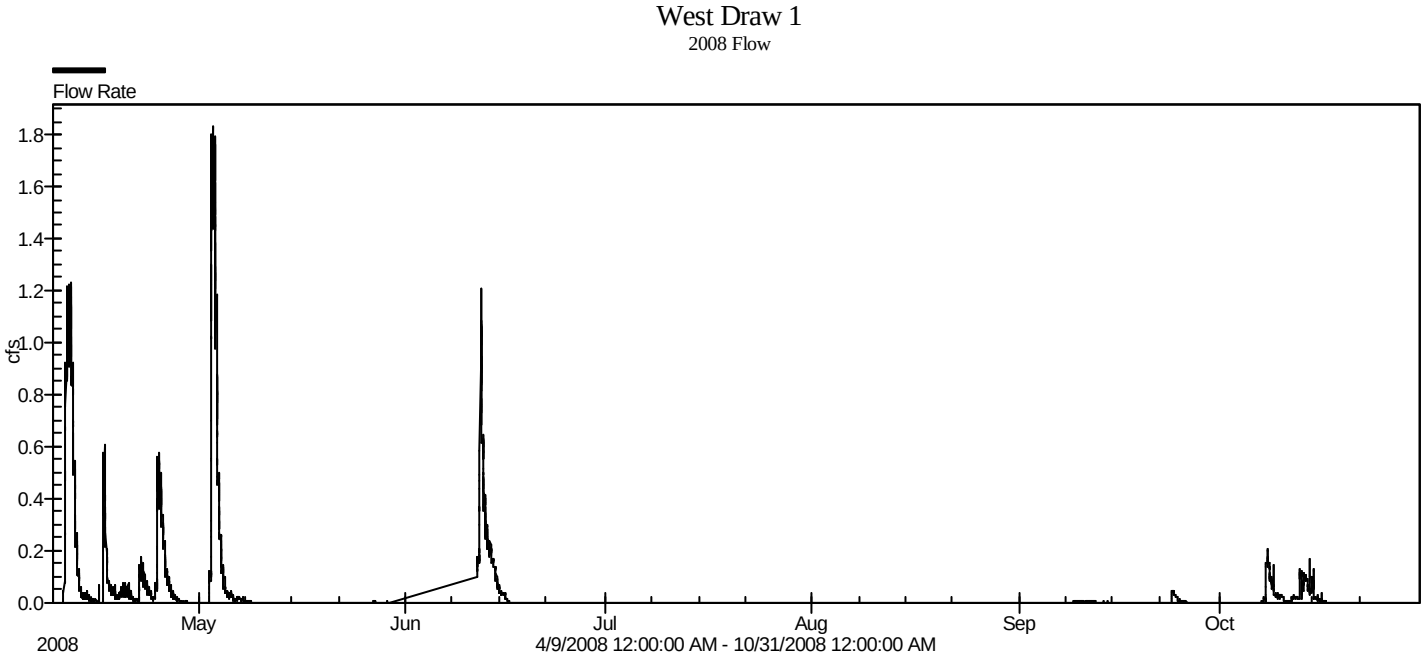


Figure 15. West Draw 1 2008 Continuous Flow

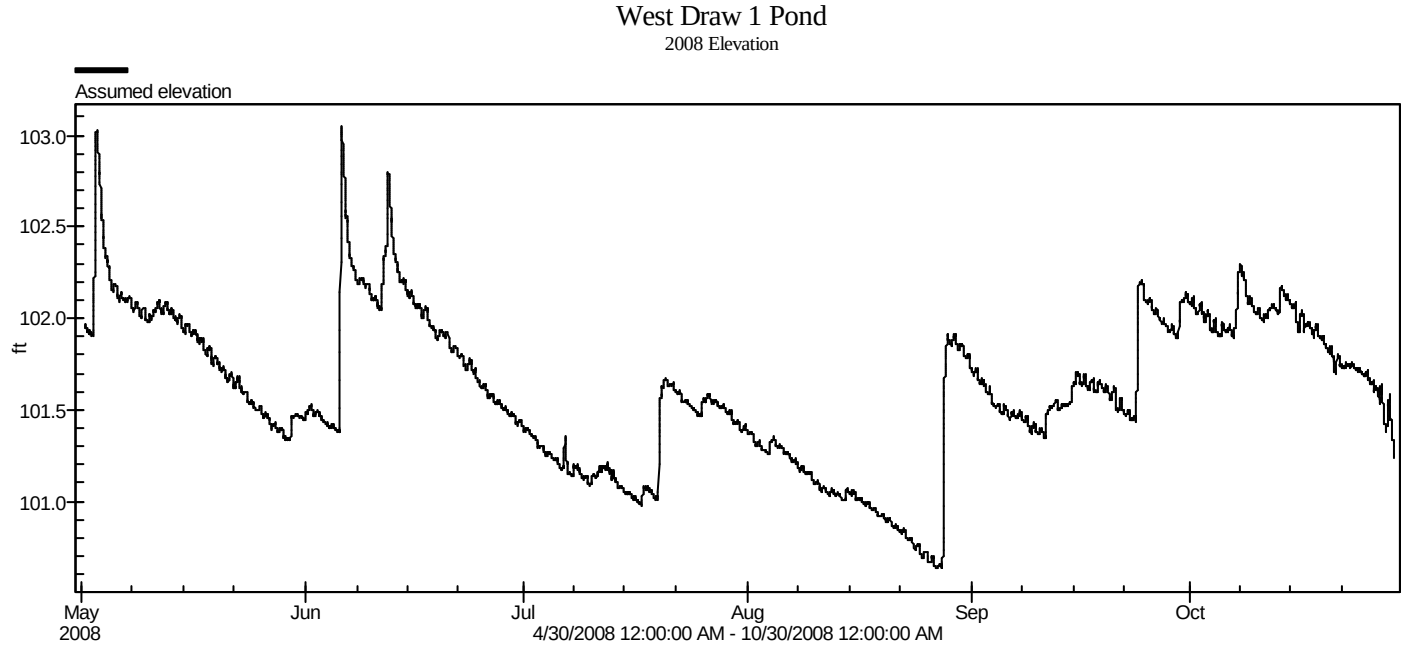


Figure 16. West Draw 1 Pond 2008 Elevation

West Draw 3

This was the first year of recording flow at this site. West Draw 3 site recorded flow between April 14-October 30, 2008 (Figure 17). There was a period of missing data between May 29 and June 11. This site was dry from June 17 to the end of the monitoring season. The total discharge for this period was 56,447 cf or 1.29 acre-ft. The highest discharge at this site was 0.33 cfs on May 3, 2008. Elevation data was collected at the upstream pond to measure bounce associated with storm events to further model calibration (Figure 18). Elevation of this pond has an assumed datum of 100 ft. There was no precipitation gage and no chemistry data was collected at this site.

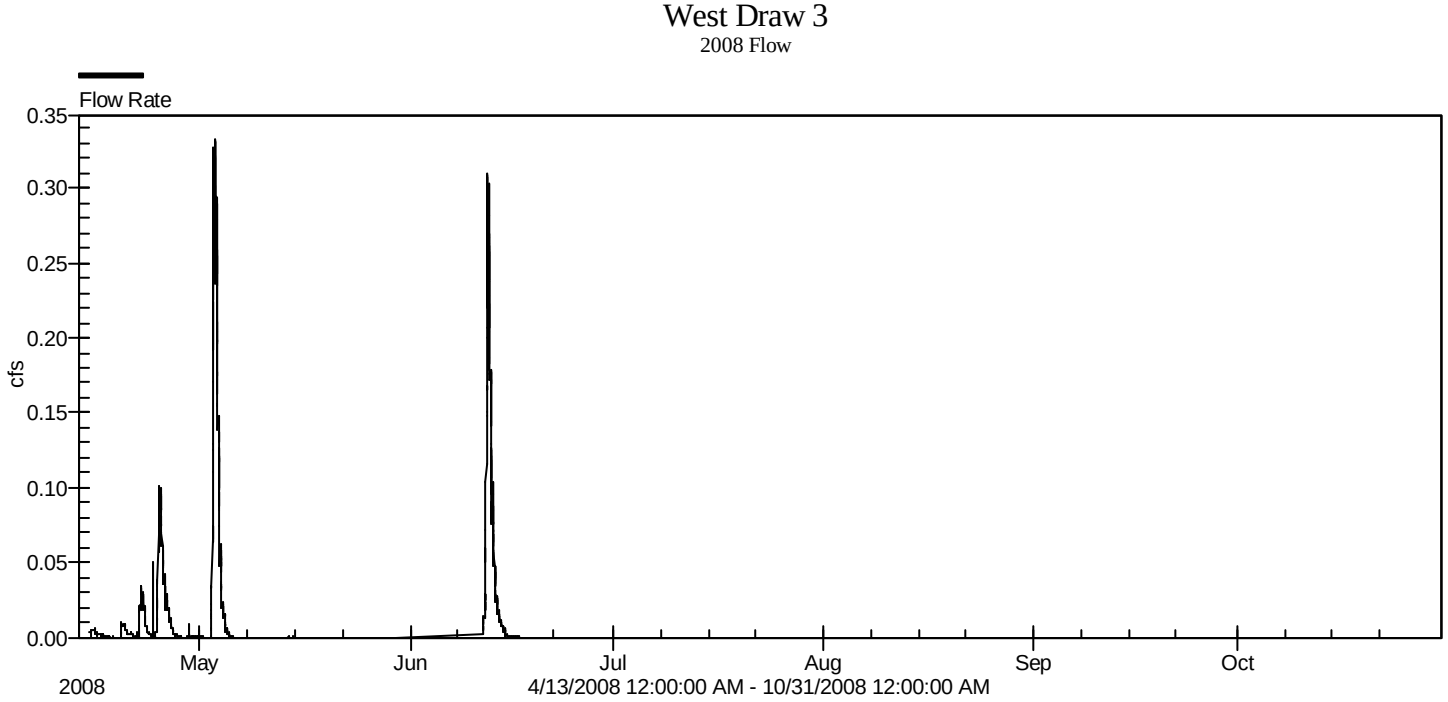


Figure 17. West Draw 3 2008 Continuous Flow

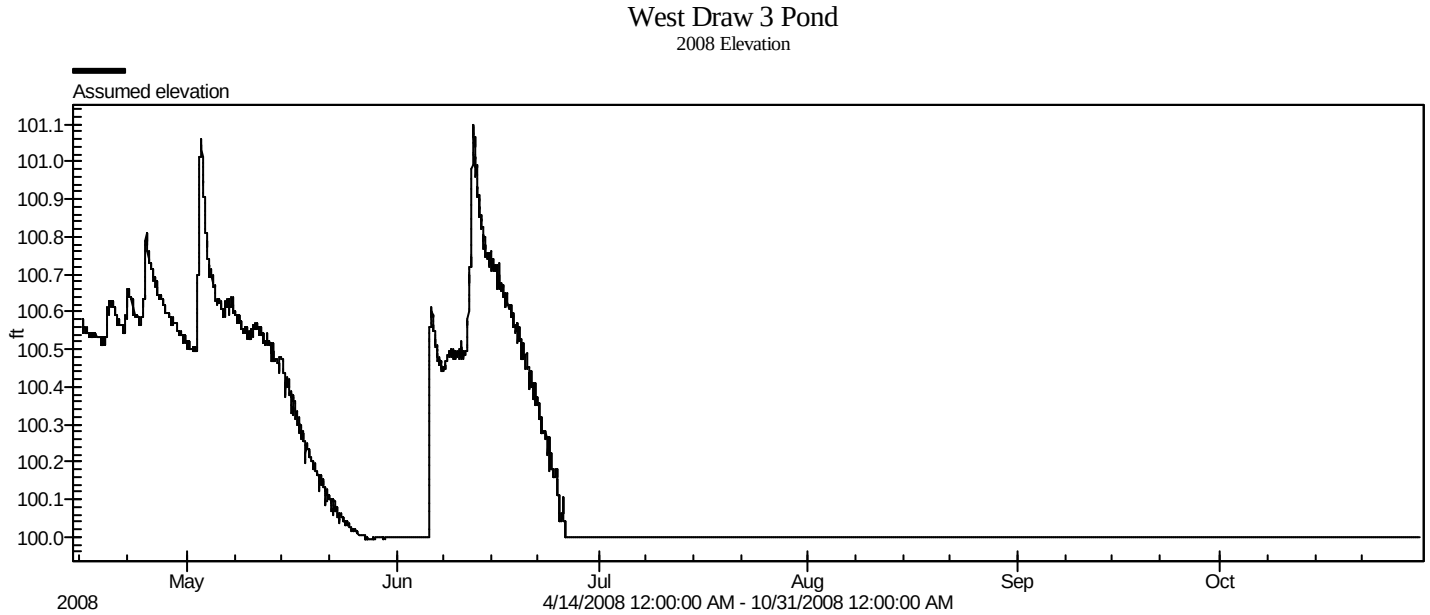
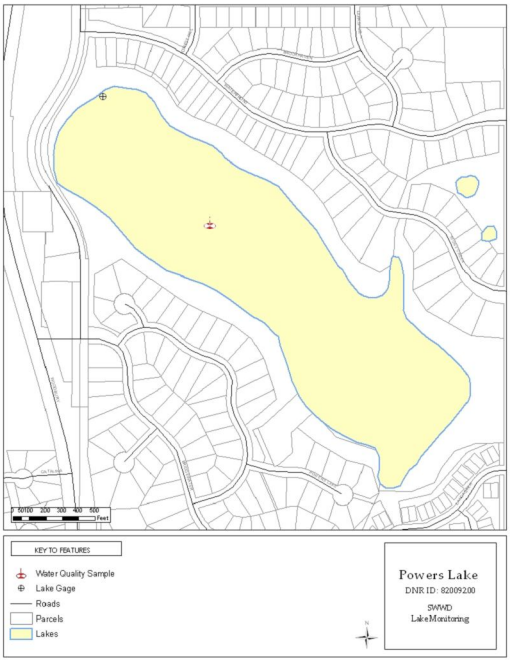


Figure 18. West Draw 3 Pond 2008 Elevation

Powers Lake

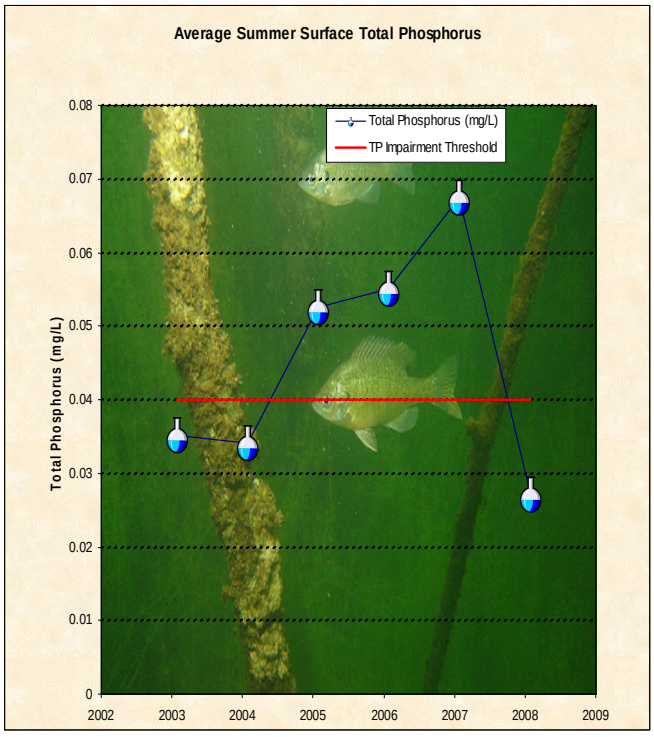
2008 Lake Grade: B

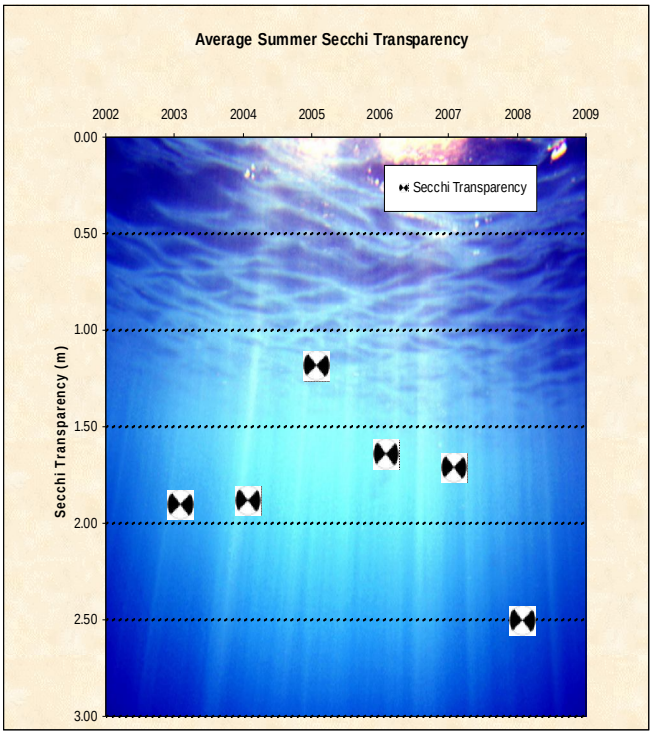
- DNR ID #: 82-0092
- Municipality: City of Woodbury
- Location: SW ¼ Sect. 11 T28 – R21
- Lake Size: 60 Acres
- Maximum Depth: 40 ft
- Ordinary High Water Mark: 891.3 ft
- 48%Littoral
  Note: Littoral area is the portion of the lake <15 ft and dominated by aquatic vegetation.



Summary Points

- Powers Lake was considered a eutrophic lake in 2008, based on the Carlson Trophic State Index.
- There is a statistically significant **declining** trend in the average Secchi disk transparency (water clarity), and at this time no trend for average total phosphorus can be determined.
- The major land use is urban/residential.
- **Eurasian Water Milfoil (an invasive aquatic plant) is present.**
- The lake stratified from May 21st to October 21st, 2008 with the thermocline varying in depth between 5 to 9 meters.





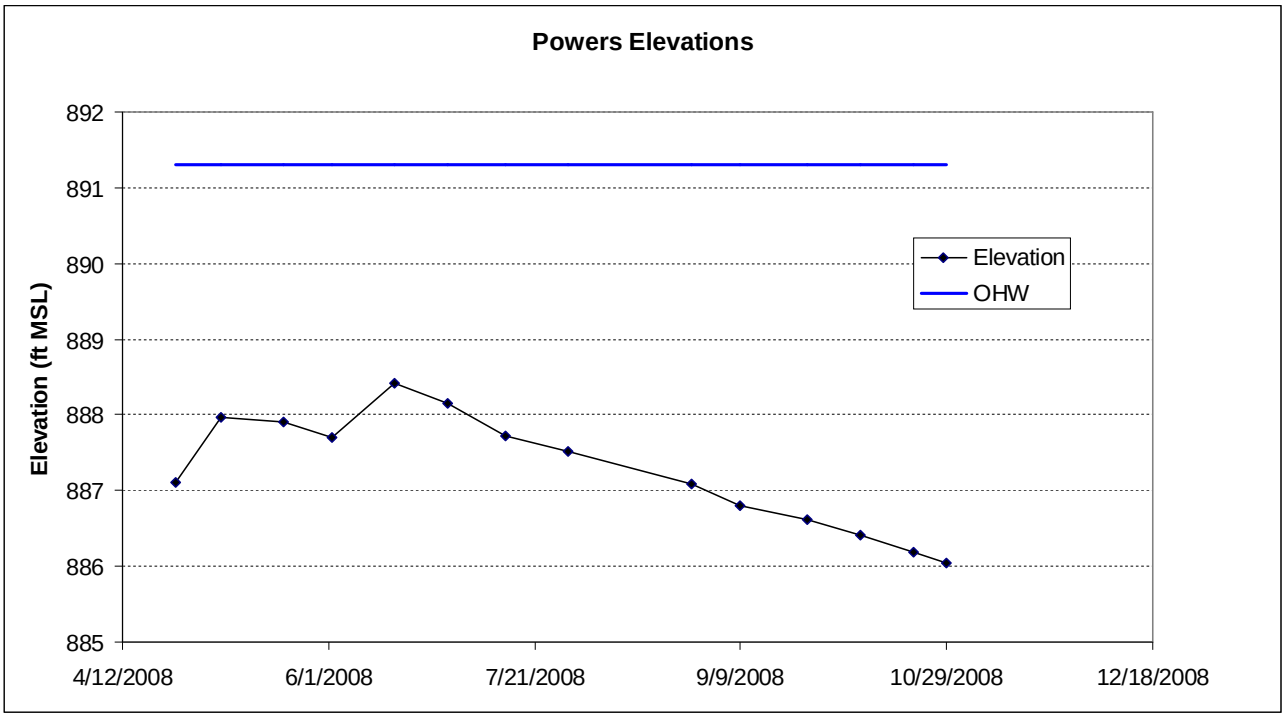
Date	Total Phosphorus (mg/L)	Chlorophyll-a (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Total Phosphorus (mg/L) (Hypolimnion)	Total Ortho-P (mg/L) (Hypolimnion)	Secchi Disk Depths (m)	Surface Dissolved Oxygen Levels (mg/L)	Surface Temperature Levels (Celsius)
4/23/2008	0.028	11	1.10	NA	0.016	1.98	11.17	7.9
5/6/2008	0.042	18	1.40	NA	0.005	1.83	11.73	13.7
5/21/2008	0.032	12	1.20	0.083	0.008	2.74	10.74	15.1
6/2/2008	0.028	12	1.20	0.168	0.017	3.35	9.28	19.7
6/17/2008	0.033	8	1.10	0.205	0.041	3.66	8.58	20.8
6/30/2008	0.031	13	1.20	0.252	0.139	1.98	9.89	23.5
7/14/2008	0.026	13	1.30	0.273	0.090	2.44	7.34	23.5
7/29/2008	0.027	11	1.10	0.340	0.162	2.90	8.46	26.9
8/13/2008	0.028	18	1.60	0.365	0.303	1.98	7.96	25.4
8/28/2008	0.028	15	1.30	0.556	0.323	1.83	6.08	23.0
9/9/2008	0.022	13	1.20	0.492	0.317	1.83	8.12	20.5
9/25/2008	0.021	11	1.30	0.597	0.432	2.59	7.39	19.7
10/8/2008	0.025	14	1.60	0.595	0.432	1.98	7.70	16.4
10/21/2008	0.024	13	1.10	0.577	0.472	2.29	8.27	13.0
2008 Average	0.028	13	1.26	0.38	0.20	2.38	8.77	19.2
2008 Summer Average	0.027	13	1.26	0.36	0.20	2.51	8.12	22.6

Water quality threshold is 0.04 mg/L TP or higher*

Shallow lake water quality threshold is 0.06 mg/L TP or higher*

	High	High Date	Low	Low Date	Average
2008 Elevation (ft)	888.41	6/17/2008	886.05	39750.00	887.26

*MPCA description of Impaired Lake's Listing criteria: "At a minimum, a decision that a given lake is impaired for the 303(d) list due to excessive nutrients will be supported by data for both causal and response factors. Data requirements for 303(d) listing consist of 12 or more TP measurements collected from June through September over the most recent 10-year period. Ideally this should represent 12 separate visits to the lake over teh course of two summers; however it might aslo reflect four monthly samples over the course of three years (a typical sampling regimen for many lake monitroing programs). In addition to exceeding the TP guikeline thresholds, lakes to be considered for 303(d) listing should have at least 12 Secchi measurements and 12 chlorophyll-a measurements. this amount of data will allow for at least one season (preferably more) of paired TP, chlorophyll-a, and Secchi disk data and provide a basis for evaluating their interrelationships and hence the trophic status of the lake."

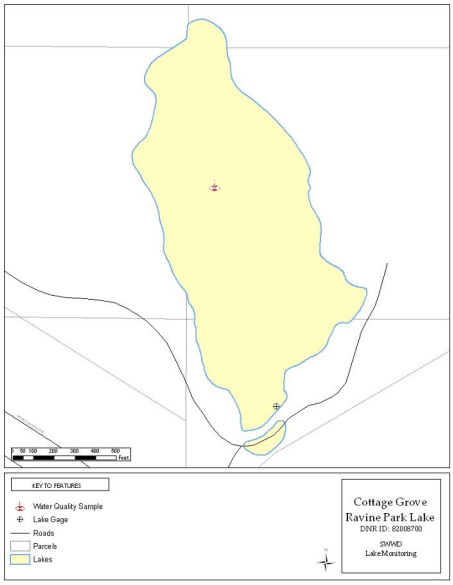


Lake Water Quality Summary	Trophic Status	Lake Grades					
	2008	2008	2007	2006	2005	2004	2003
Total Phosphorus (mg/l)	Mesotrophic	B	C	C	F	C	C
Chlorophyll-*a* (ug/l)	Eutrophic	B	C	C	C	C	C
Secchi depth (ft)	Mesotrophic	B	C	C	D	C	C
Overall	Eutrophic	B	C	C	D	C	C

Cottage Grove Ravine Regional Park Lake

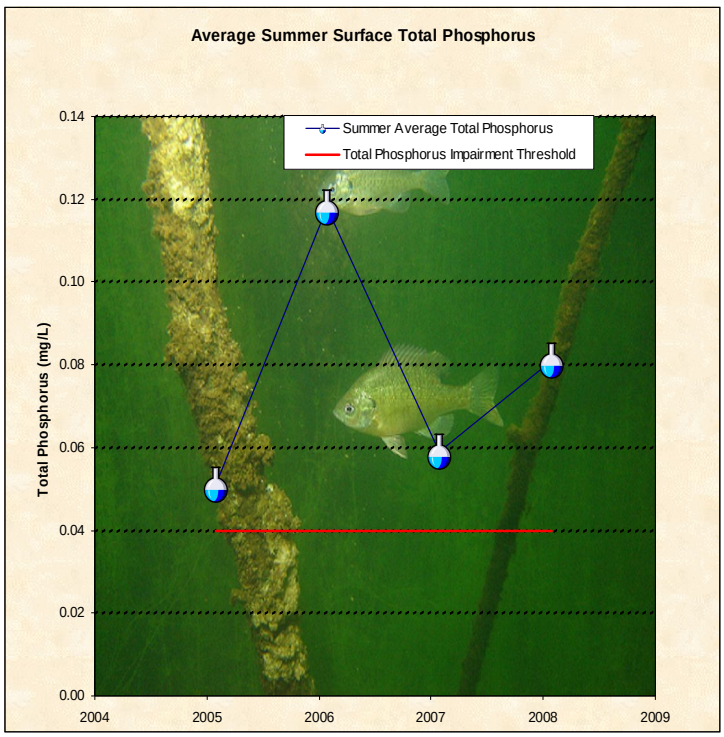
2008 Lake Grade: C

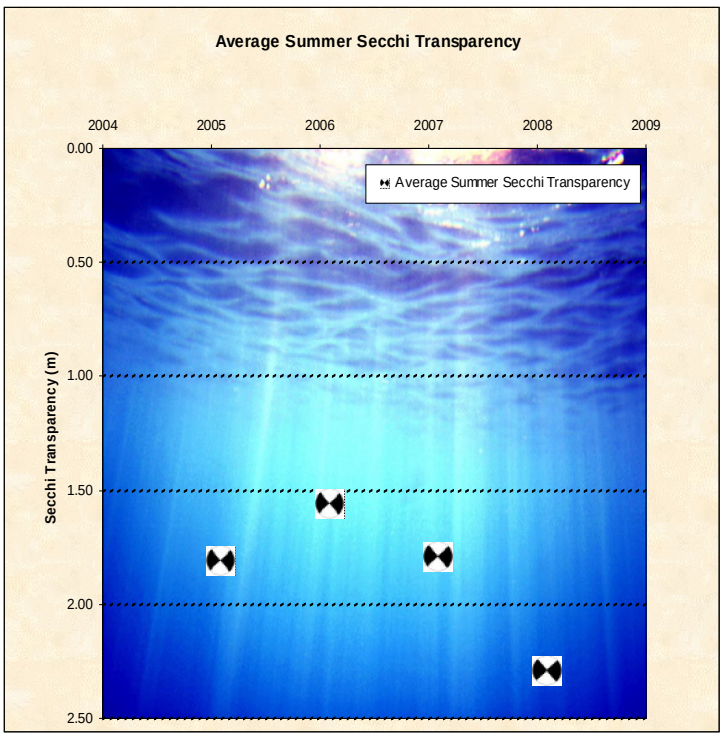
- DNR ID #: 820087
- Municipality: City of Cottage Grove
- Location: SW ¼ Sect. 23 T26&27 – R21
- Lake Size: 19.4 Acres
- Maximum Depth: 16 ft
- Ordinary High Water Mark: 770.7 ft
- Littoral area not known



Summary Points

- Cottage Grove Ravine Regional Park Lake was considered a eutrophic lake in 2008, based on the Carlson Trophic State Index.
- There is a statistically significant **improving trend** for both average Secchi transparency and average total phosphorus.
- The major land use is open space, forest, and agriculture.
- The lake was stratified from May 28th to September 3rd, 2008 with the thermocline varying in depth between 4 to 5 meters.





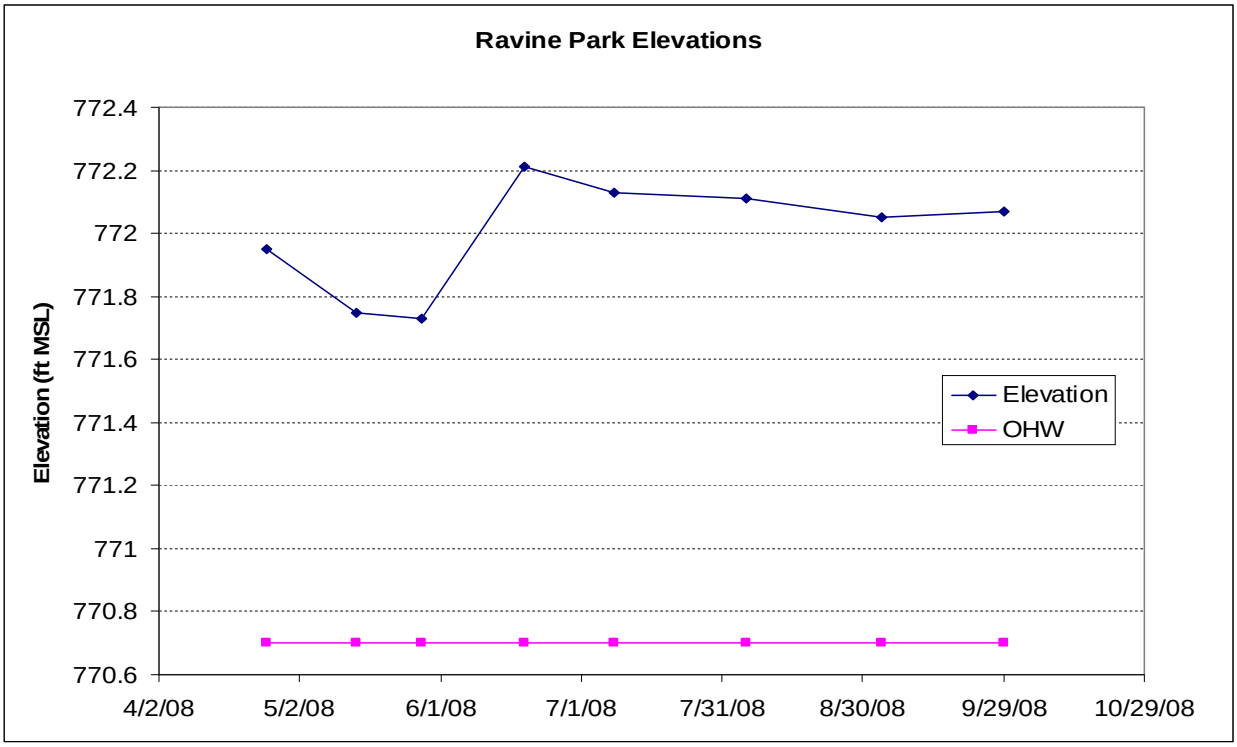
Date	Total Phosphorus (mg/L)	Chlorophyll-a (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depths (m)	Surface Dissolved Oxygen Levels (mg/L)	Surface Temperature Levels (Celsius)
5/14/2008	0.054	39	0.98	1.37	12.90	14.4
5/28/2008	0.075	7.4	1.30	2.59	8.82	18.4
6/19/2008	0.074	20	1.20	2.90	9.77	22.8
7/8/2008	0.111	47	1.60	1.22	10.45	25.1
8/5/2008	0.073	20	1.20	2.29	3.85	25.5
9/3/2008	0.091	23	1.50	2.90	5.71	22.2
9/29/2008	0.055	20	0.98	2.13	4.55	18.3
2008 Average	0.076	25	1.25	2.20	8.01	21.0
2008 Summer Average	0.081	26	1.30	2.29	6.87	22.8

Water quality threshold is 0.04 mg/L TP or higher*

Shallow lake water quality threshold is 0.06 mg/L TP or higher*

	High	High Date	Low	Low Date	Average
2008 Elevation (ft)	772.21	6/19/2008	771.73	5/28/2008	772.00

*MPCA description of Impaired Lake's Listing criteria: "At a minimum, a decision that a given lake is impaired for the 303(d) list due to excessive nutrients will be supported by data for both causal and response factors. Data requirements for 303(d) listing consist of 12 or more TP measurements collected from June through September over the most recent 10-year period. Ideally this should represent 12 separate visits to the lake over teh course of two summers; however it might aslo reflect four monthly samples over the course of three years (a typical sampling regimen for many lake monitroing programs). In addition to exceeding the TP guikeline thresholds, lakes to be considered for 303(d) listing should have at least 12 Secchi measurements and 12 chlorophyll-a measurements. this amount of data will allow for at least one season (preferably more) of paired TP, chlorophyll-a, and Secchi disk data and provide a basis for evaluating their interrelationships and hence the trophic status of the lake."



	Trophic Status	Lake Water Quality Summary Lake Grades							
	2008	2008	2007	2006	2005	2004	2003	2002	2001
Total Phosphorus (mg/l)	Hypereutrophic	D	C	D	F	NA	NA	NA	NA
Chlorophyll-*a* (ug/l)	Eutrophic	C	B	C	C	NA	NA	NA	NA
Secchi depth (ft)	Mesotrophic	B	C	C	C	NA	NA	NA	NA
Overall	Eutrophic	C	C+	C-	D+	NA	NA	NA	NA

Lake Gages

Lake gages were read biweekly on eleven lakes in SWWD from April 25-October 31, 2008. Table 26 lists the high, low, range and average elevations for each lake monitored in 2008. Figures 19-29 show the fluctuation in elevation for each lake monitored in 2008. For historical lake elevations visit the Lake Finder page on the MN DNR website http://www.dnr.state.mn.us/lakefind/index.html.

Table 26. SWWD 2008 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	4/25/08-9/29/08	8	771.73 5/28/2008	772.21 6/19/2008	0.48	772.00	770.70
Markgrafs	82-0089	4/25/08-10/29/08	14	924.83 8/13/2008	925.63 4/25/2008	0.80	925.22	925.30
Wilmes	82-0090	1/29/08-10/29/08	25	900.29 1/29/2008	903.48 8/29/2008	3.19	902.48	902.60
Powers	82-0092	4/25/08-10/29/08	14	886.05 10/29/2008	888.41 6/17/2008	2.36	887.26	891.30
Colby	82-0094	4/25/08-10/29/08	14	889.92 8/13/2008	891.20 4/25/2008	1.28	890.45	891.80
Bailey	82-0456	4/25/08-9/25/08	14	866.22 9/10/2008	868.58 5/9/2008	2.36	867.24	NA
Vandeberg	82-0084	5/9/08-10/29/08	17	833.16 10/29/2008	834.58 5/9/2008	1.42	833.89	NA
Fish	82-0093	4/25/08-10/31/08	12	914.60 7/15/2008	916.90 8/13/2008	2.30	915.13	916.40
Ria	82-0098	4/25/08-10/9/08	14	948.73 10/9/2008	950.49 5/9/2008	1.76	949.60	NA
La	82-0097	4/25/08-10/29/08	15	997.41 10/29/2008	998.75 5/9/2008	1.34	998.10	1000.60
Shepard's Pond	82-0083	4/23/08-8/13/08	9	920.11 8/13/2008	921.79 4/25/2008	1.68	920.97	NA

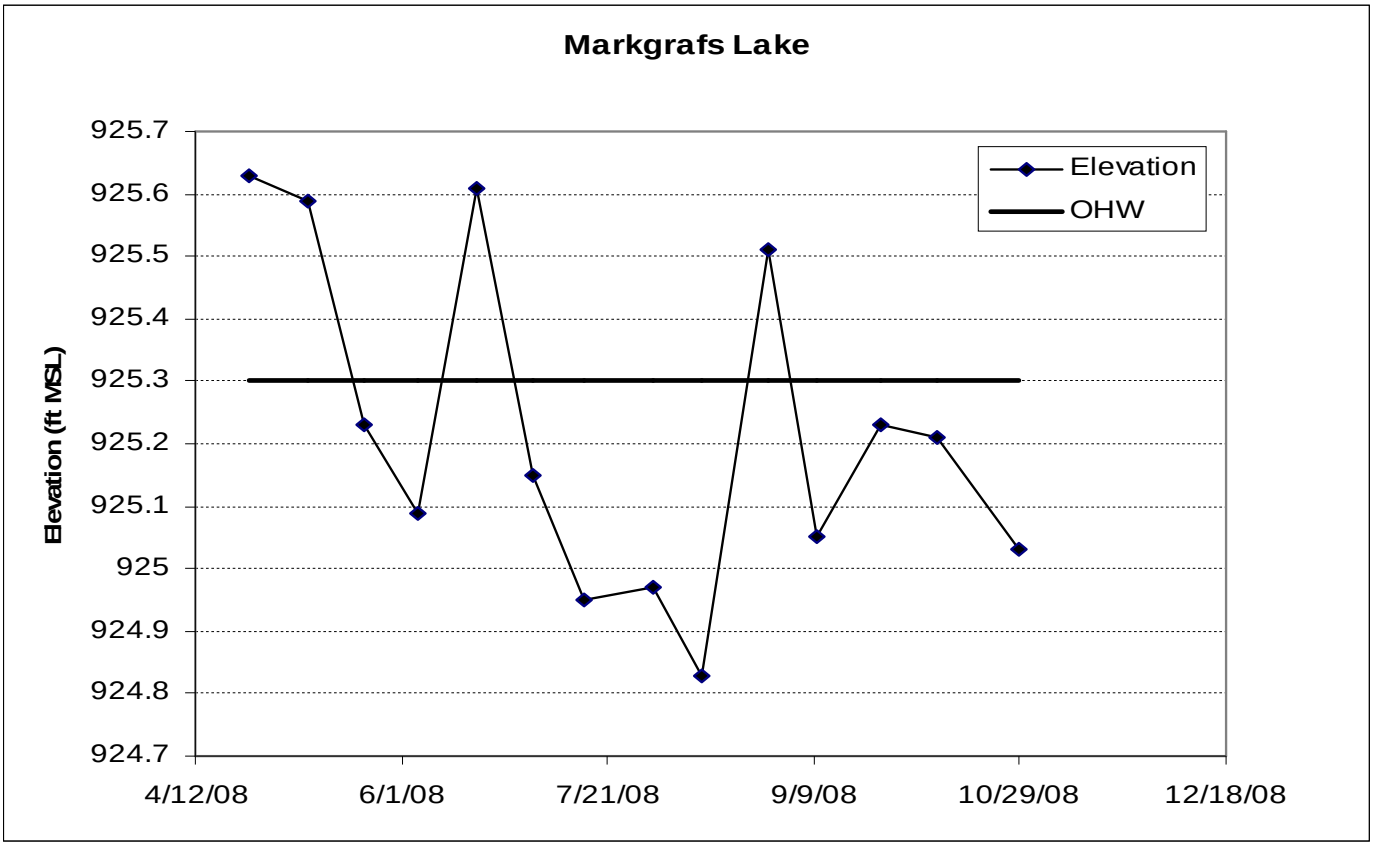


Figure 19. Markgrafs Lake Elevations and Ordinary High Water (OHW)

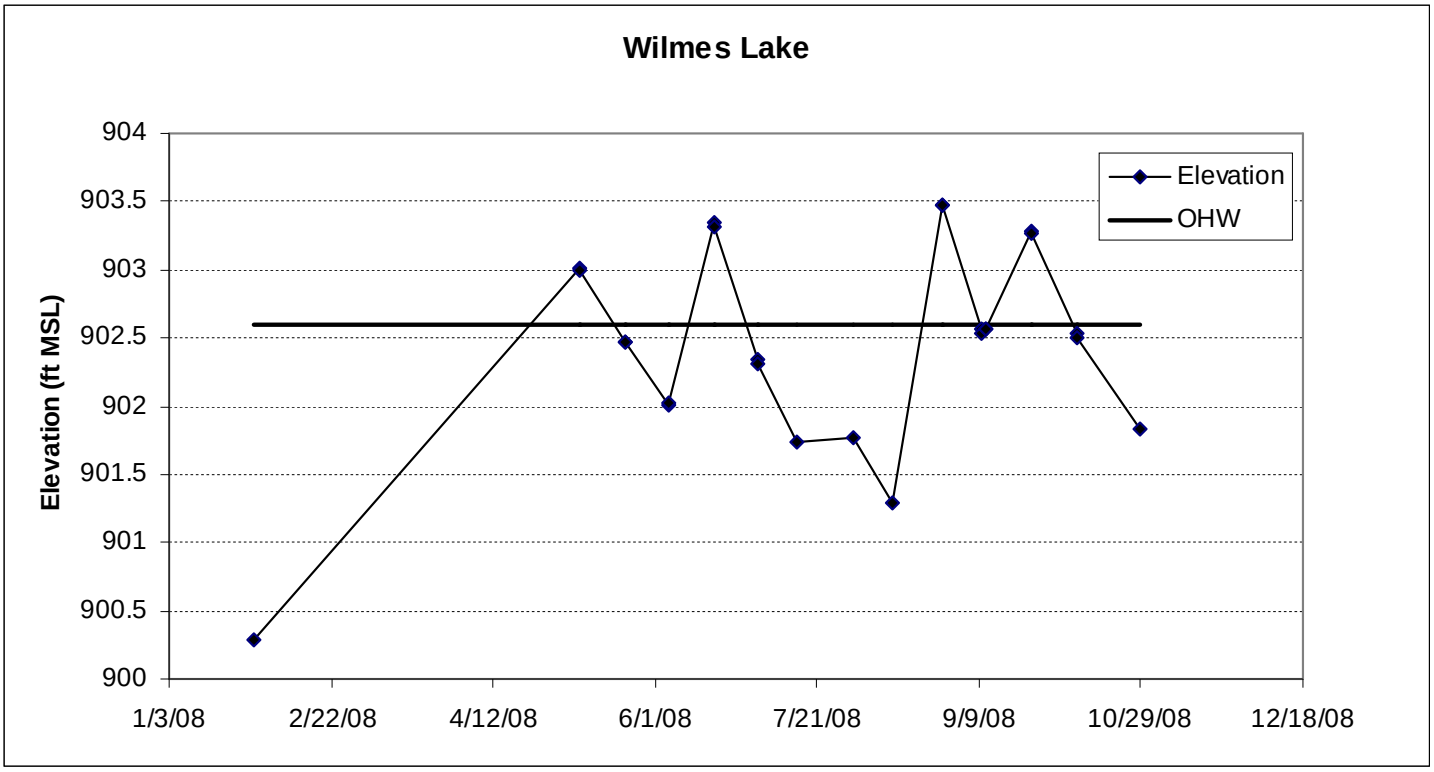


Figure 20. Wilmes Lake Elevations and Ordinary High Water (OHW)

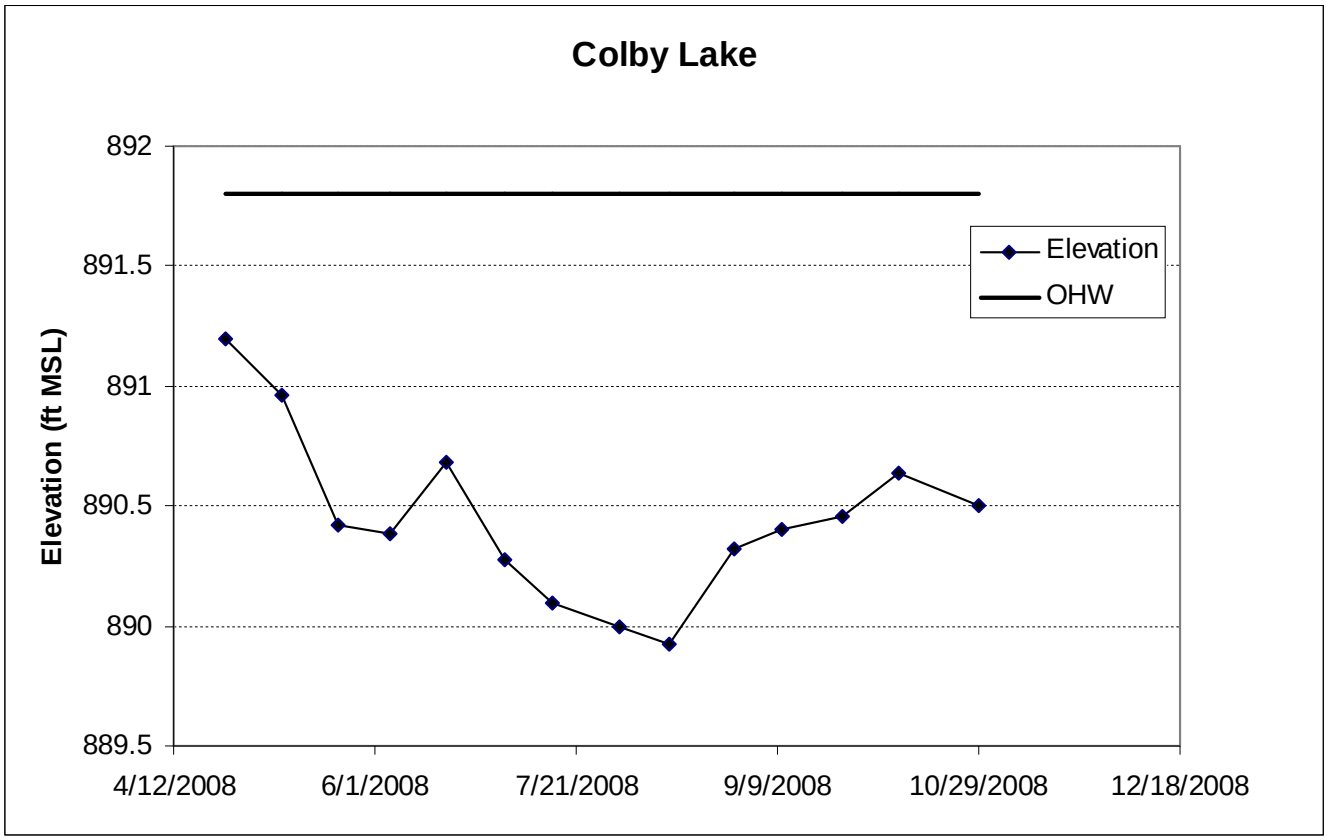


Figure 21. Colby Lake Elevations and Ordinary High Water (OHW)

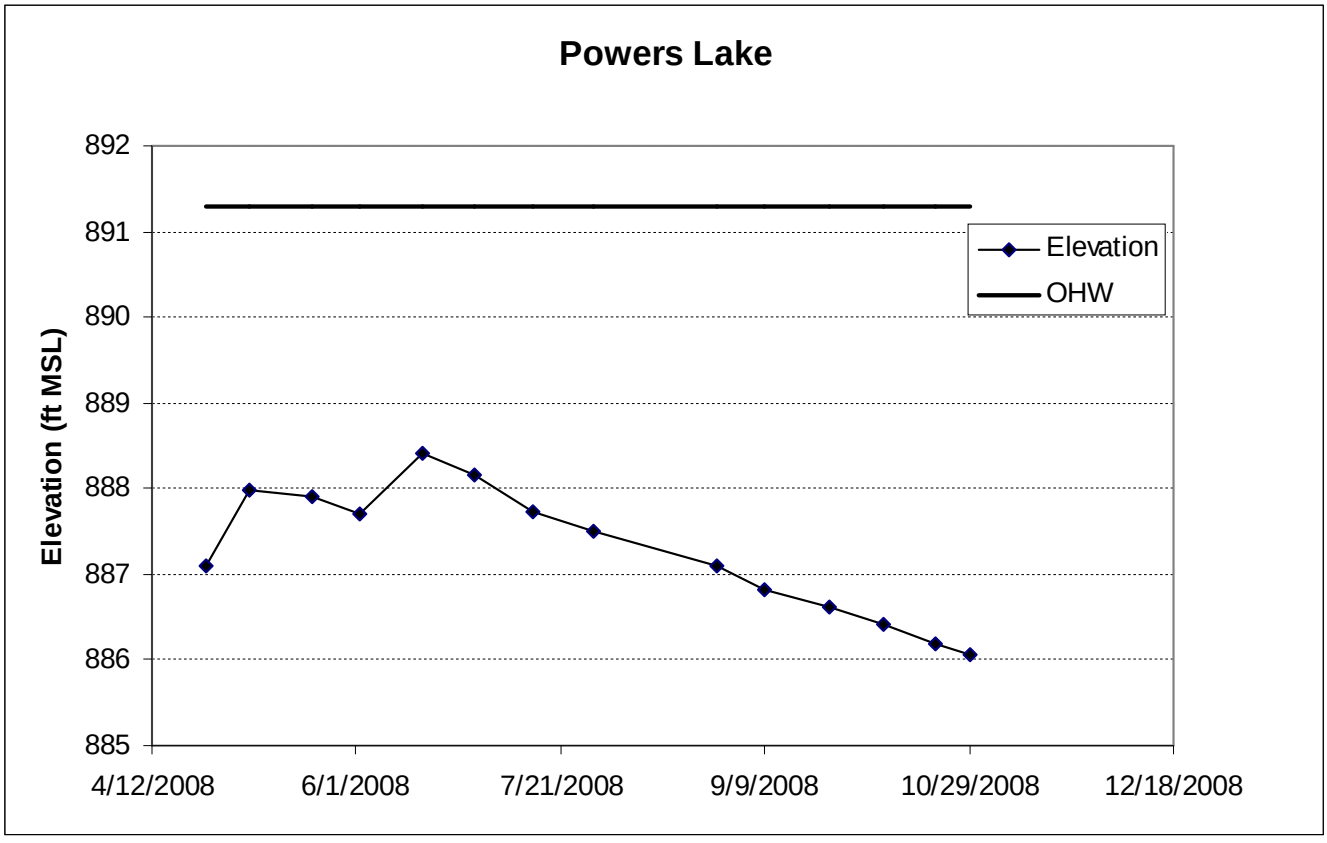


Figure 22. Powers Lake Elevations and Ordinary High Water (OHW)

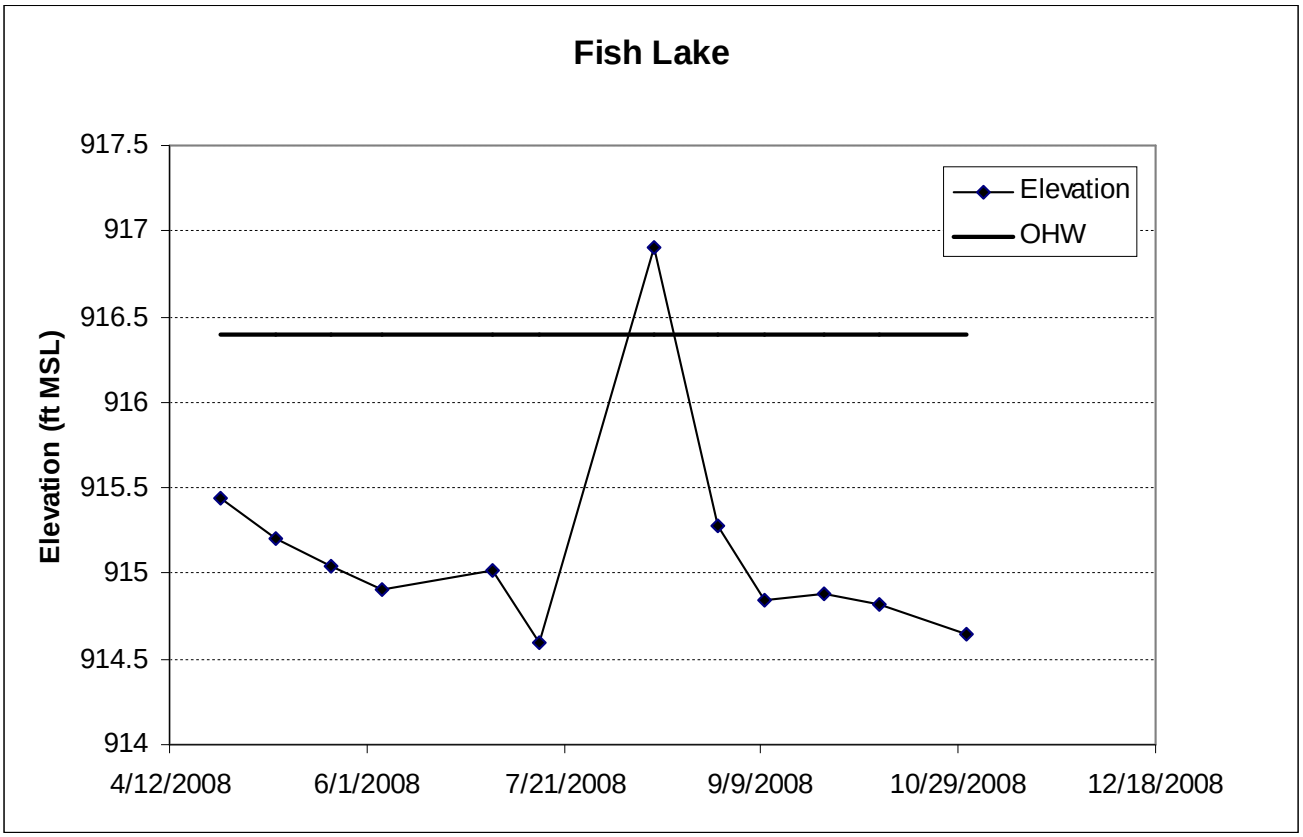


Figure 23. Fish Lake Elevations and Ordinary High Water (OHW)

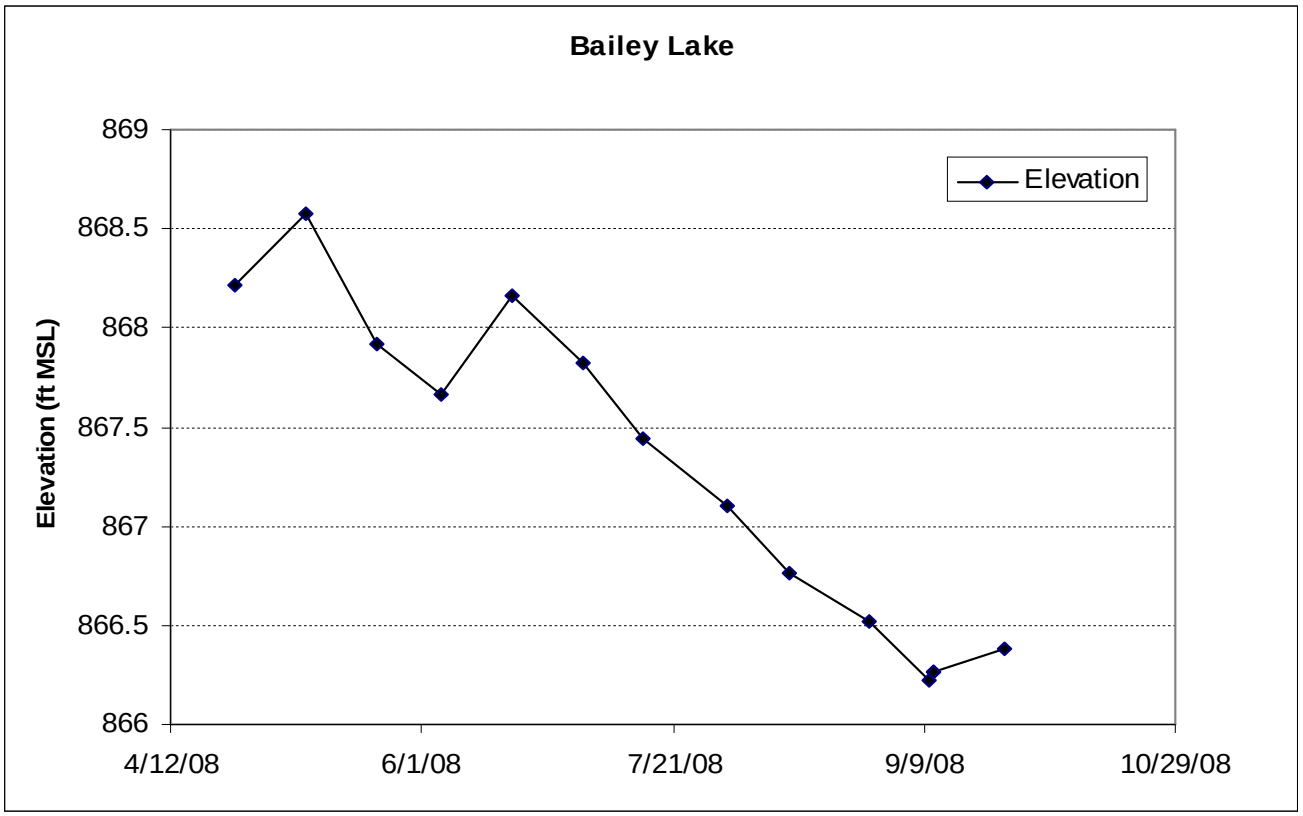


Figure 24. Bailey Lake Elevations

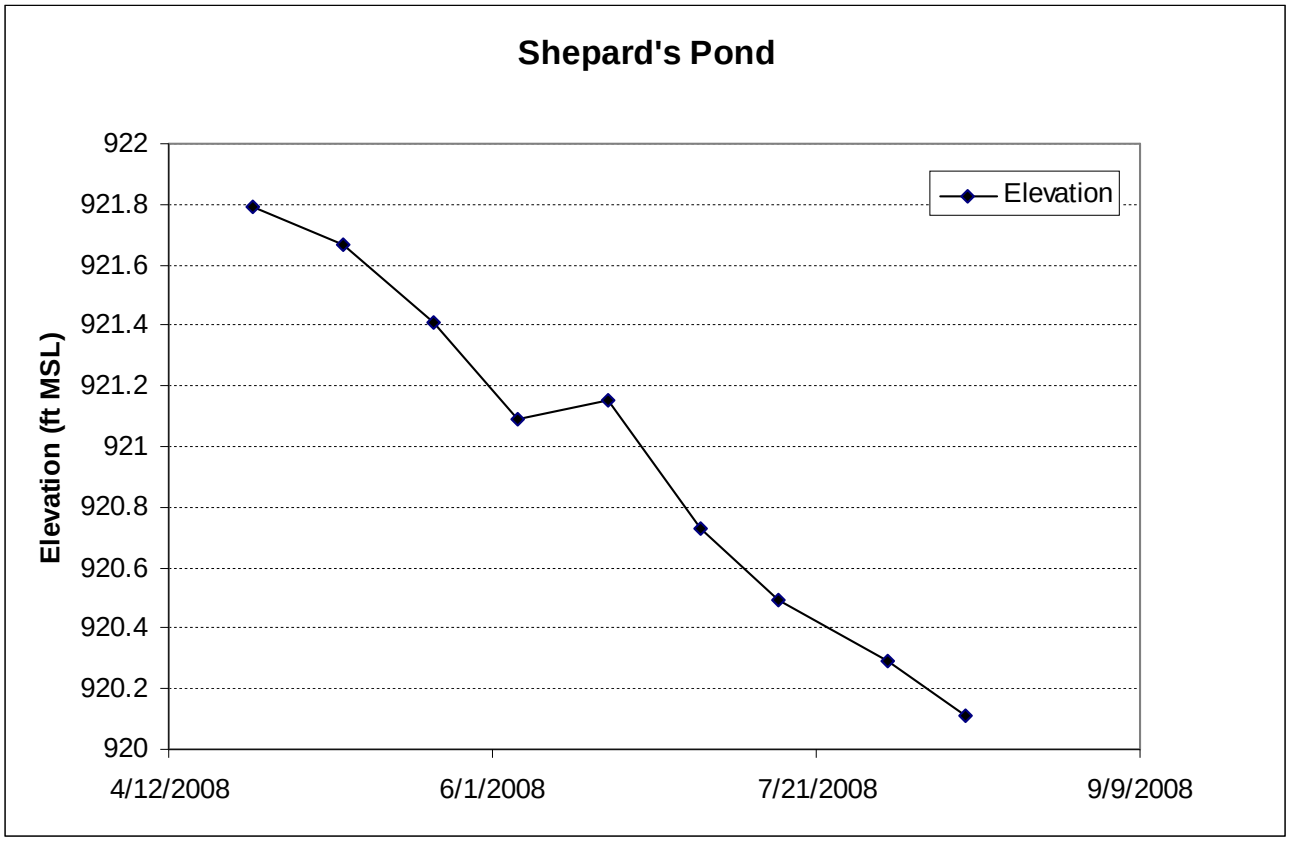


Figure 25. Shepard's Pond Elevations

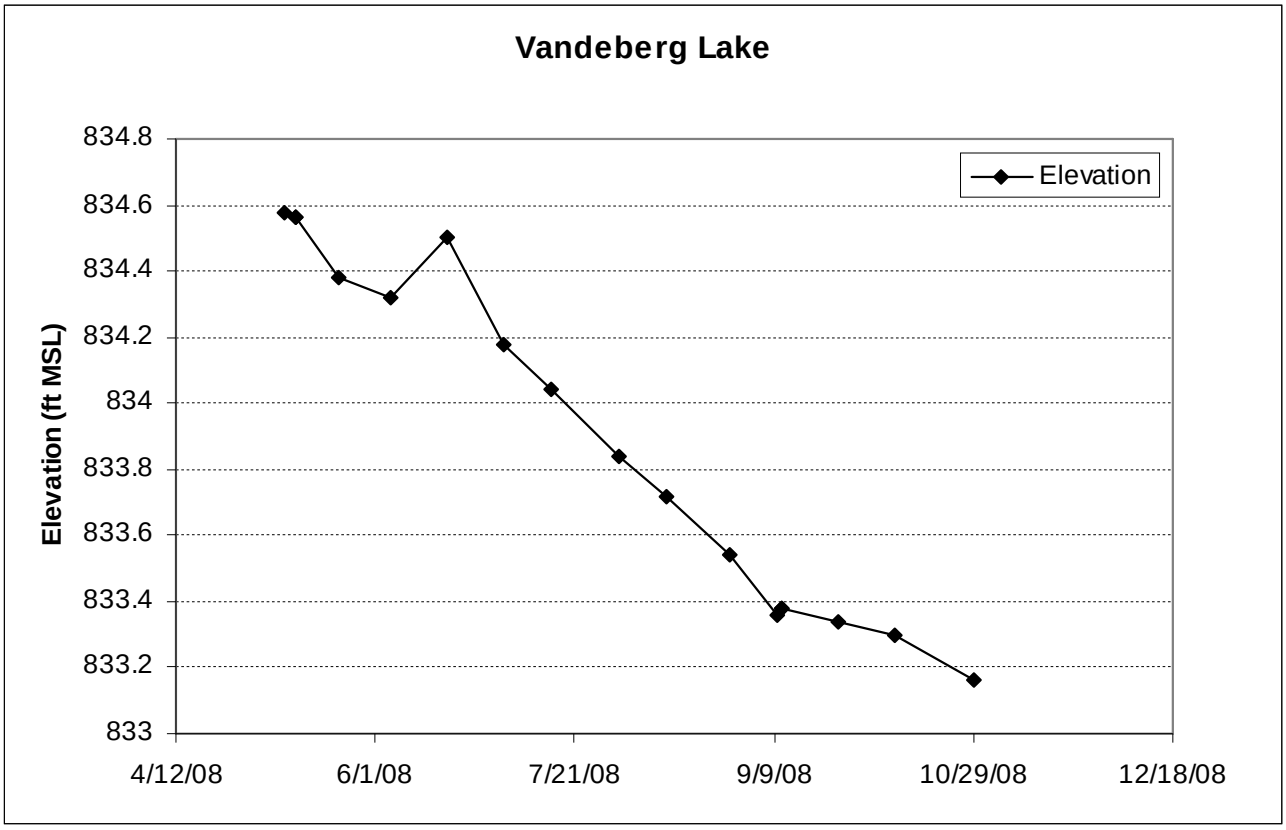


Figure 26. Vandeberg Lake Elevations

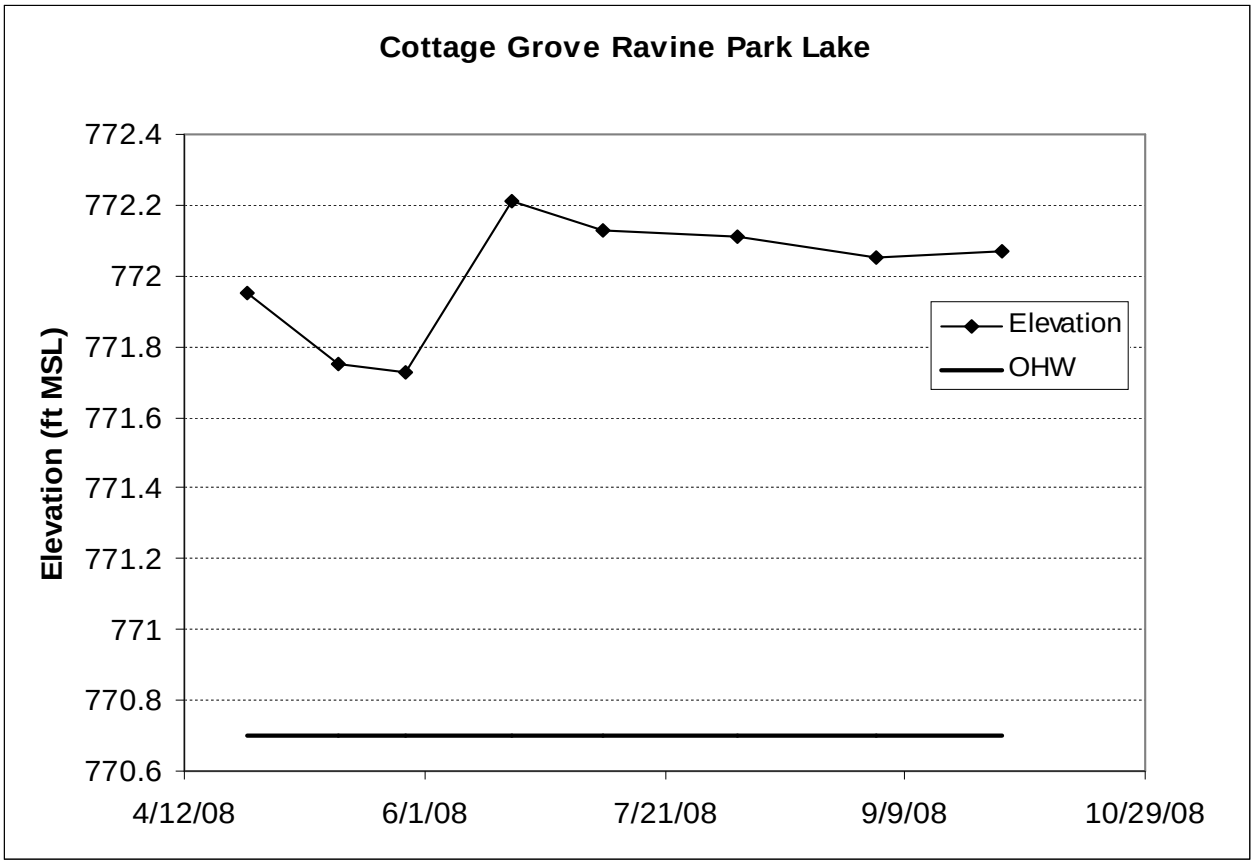


Figure 27. Cottage Grove Ravine Park Lake Elevations and Ordinary High Water (OHW)

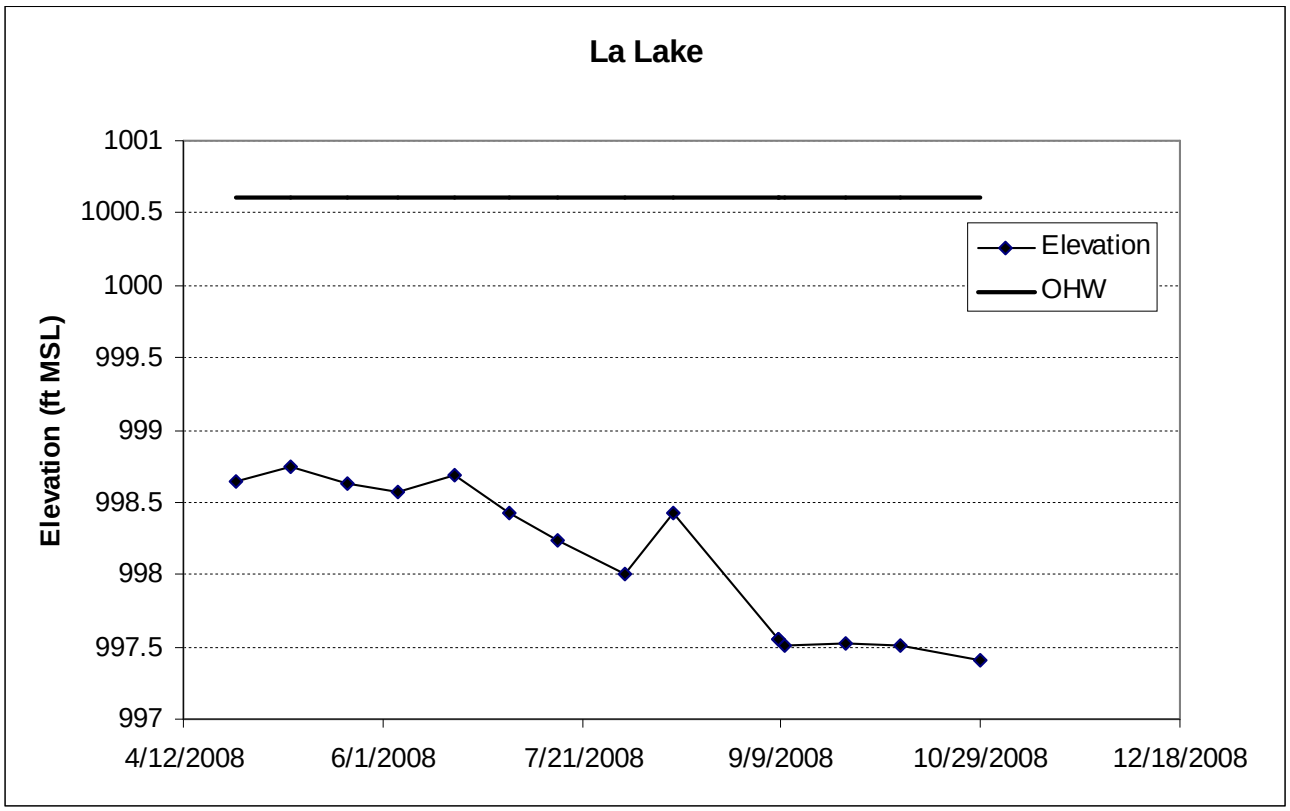


Figure 28. La Lake Elevations and Ordinary High Water (OHW)

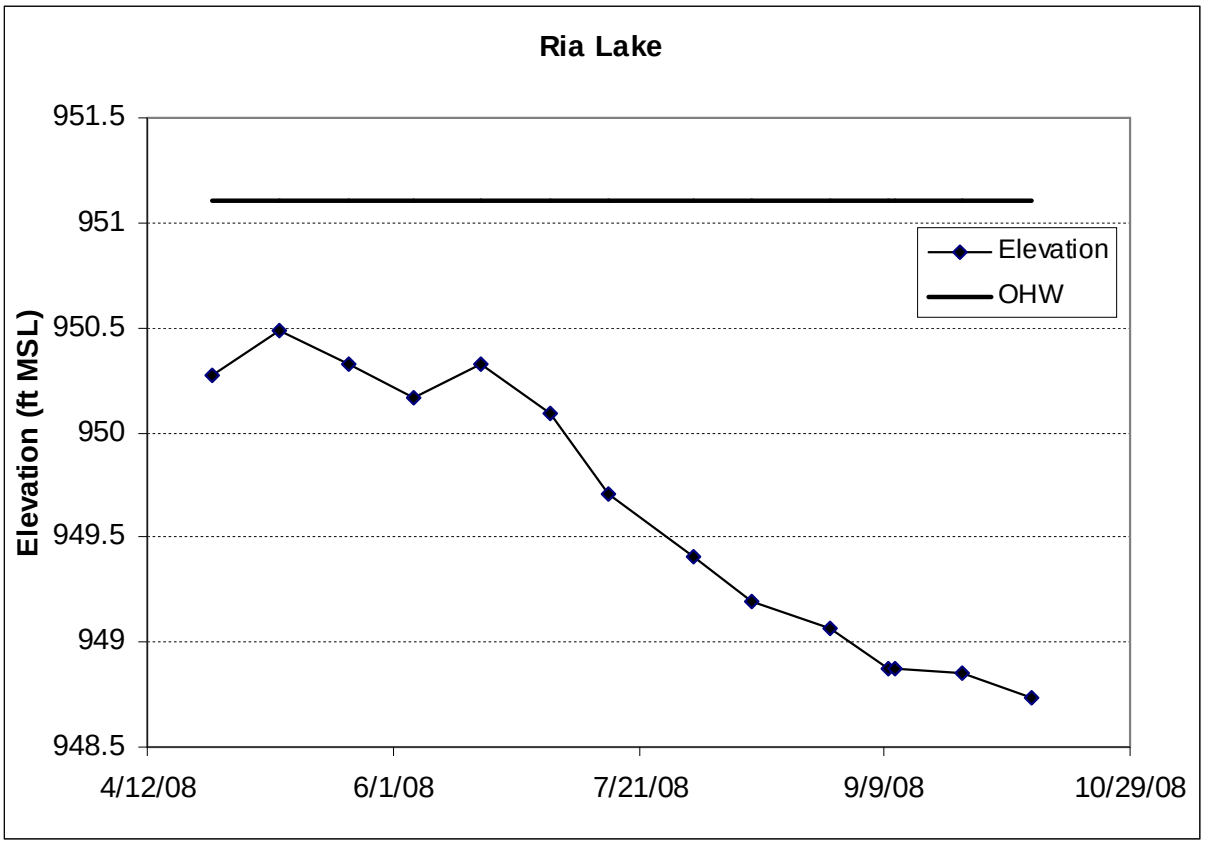


Figure 29. Ria Lake Elevations and Ordinary High Water (OHW)

Observation Wells

Six observation wells were monitored for elevation concurrently by the Washington Conservation District from January 31-December 19, 2008. Table 27 shows the high, low, range and average groundwater observations during the 2008 monitoring season. Figure 30 shows the fluctuation of the groundwater elevations for each well during the 2008 monitoring season. The highest water levels for observation wells varied through the year. Observation well #545604 had the highest recorded level for the year with 869.05 ft, and well #545603 had the largest range of elevation readings for the year with 10.04 ft. Low groundwater elevations occurred in December for all wells except for well #616497, which occurred in November. Wells #616493 and #616494 were dry during the 2008 monitoring season.

Table 27. SWWD 2008 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	1-31-08 to 12-19-08	11	889.25	813.65	12/19/2008	814.23	3/25/2008	0.58	814.00
545603	1-31-08 to 12-19-08	11	909.15	846.11	12/19/2008	856.15	6/25/2008	10.04	850.13
545604	1-31-08 to 12-19-08	11	906.70	859.16	12/19/2008	869.05	6/25/2008	9.89	862.75
616493	1-31-08 to 12-19-08	12	916.75	799.75	-	799.75	-	0	799.75
616494	1-31-08 to 12-19-08	12	916.95	836.95	-	836.95	-	0	836.95
616497	1-31-08 to 12-19-08	10	913.53	862.01	11/20/2008	862.1	8/20/2008	0.09	862.06

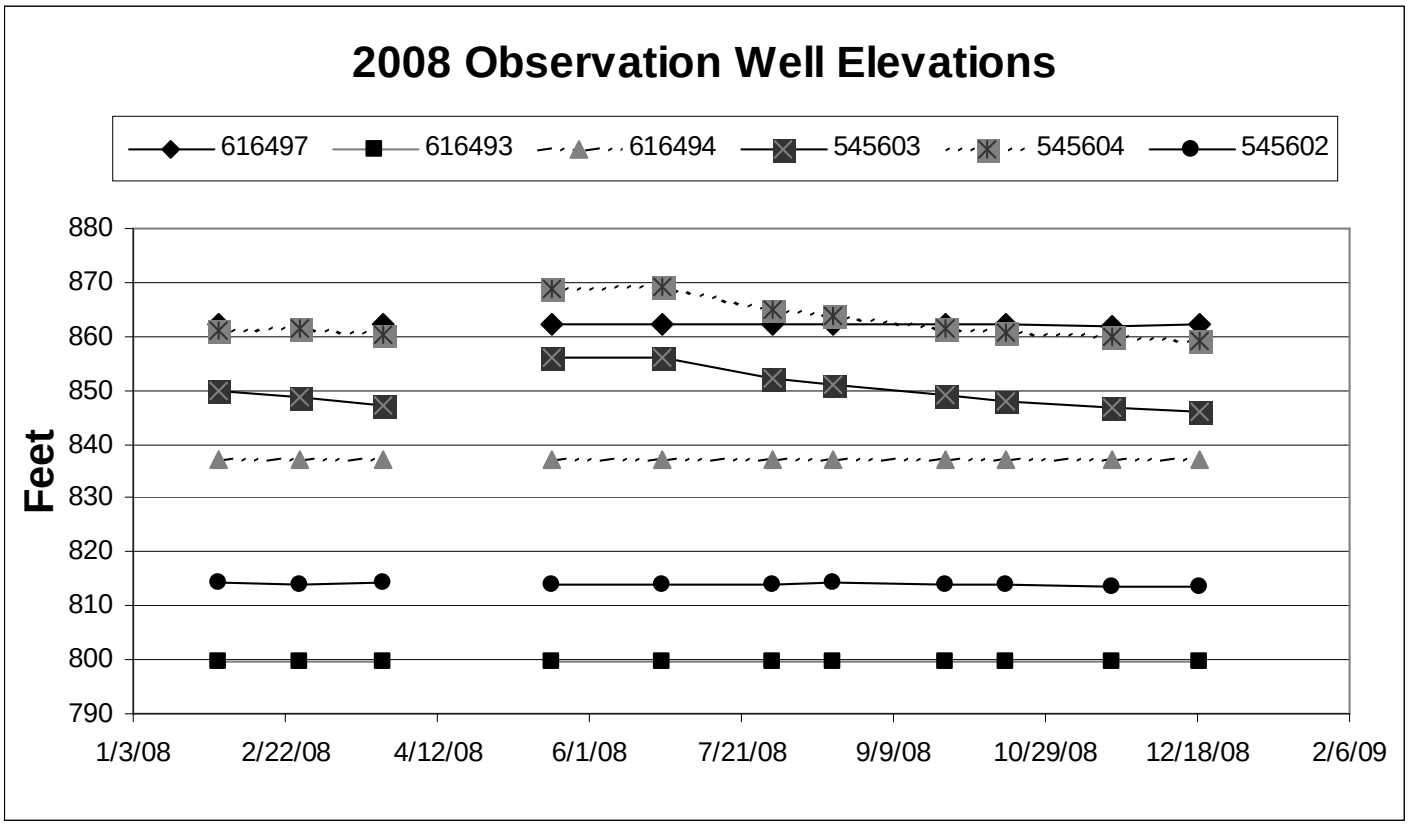


Figure 30. SWWD 2008 Observation Well Elevations