Powers Lake

DNR ID #82-0092 Municipality: Woodbury
Surface Area: 56 Acres Watershed Area: 1,384 Acres
Mean Depth: 16 feet Maximum Depth: 41 feet
SWWD Maximum Allowable Phosphorus Load: 0.06
SWWD Trophic State Index (TSI) Goal: 50-55

Map 20: Powers Lake

Powers Lake (Map 20) is a 56 acre lake in SWWD's Northern watershed. SWWD completed a lake management plan (LMP) for Powers Lake in 2000 (Bonestroo, Rosene, Anderlik, & Associates). The City of Woodbury completed a LMP for Powers Lake in 2008. This historically high quality lake lies in a naturally land-locked basin with several inlets that receive runoff from developed areas (Map 1). A lift station was installed in 1995 and serves as an emergency outflow.

The natural watershed draining to Powers Lake has been significantly expanded at the same time that historical hydrological connections with Wilmes Lake have been severed. In 1999, the contributing watershed was 430 acres. Due to urbanization and expansion of the storm sewer network, the Powers Lake drainage is expected to ultimately reach approximately 1200 acres. Excluding the direct drainage immediately surrounding the lake, SWWD divides the Powers Lake drainage into 4 watersheds—Fox Run, Powers North, Powers East, and Powers West—for management purposes.

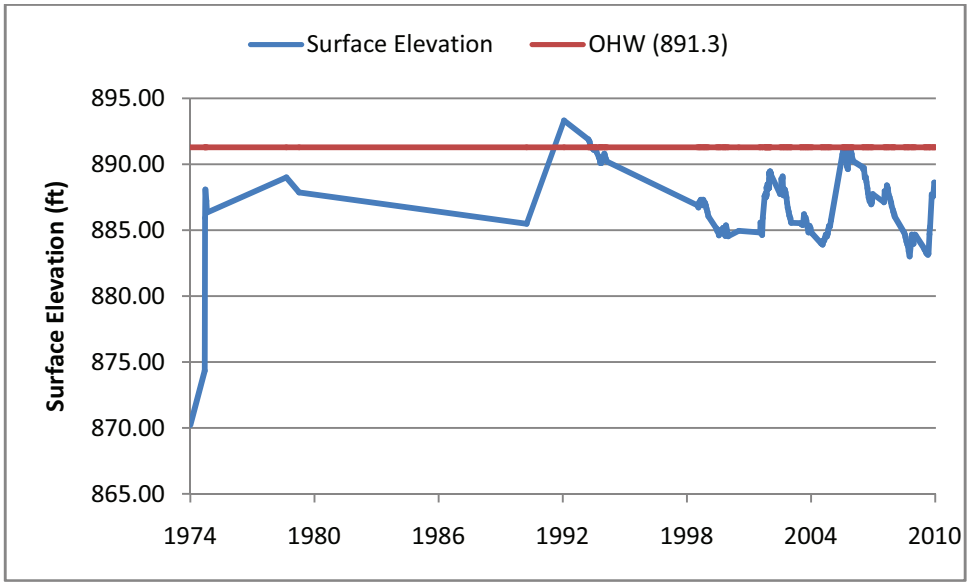
Powers Lake has a maximum depth of 41 feet and a littoral zone covering about 48 percent of its surface. Eurasian water milfoil and curly-leaf pondweed, invasive aquatic plants, dominate the aquatic plant community. The City of Woodbury has established a shore line preservation zone for the lake to ensure the lake has sufficient natural buffer around the perimeter. DNR fishery surveys were conducted in 1977, 1984, 1992, and 2007. Historically, the DNR has not conducted stocking due to a lack of public access. A public access fishing pier was added in 2004 just east of County Road 19 and the Woodbury Rotary Club purchased and stocked 2000 walleye yearling in 2007.

Results

In Lake Water Quality

Lake level has been recorded at Powers Lake since 1974 and are shown in Figure 39. Lake water quality was generally monitored twice monthly April through October in 2010. Water Quality results are below in Table 28. Annual growing season averages of total phosphorus, chlorophyll a, and secchi transparency are shown graphically in Figures 40-42. Powers Lake's 2010 trophic status and historical lake grades are presented in Table 29Table .

Figure 39: Powers Lake Surface Elevation, 1974-2010



Date	Secchi Depth (m)	Surface Temperature (°C)	Pheophytin a Corrected Chlorophyll a (ug/L)	Trichromatic Uncorrected Chlorophyll a (ug/L)	TKN (mg/L)	Hypolimnetic TKN (mg/L)	TP (mg/L)	Hypolimnionetic TP (mg/L)	Hypolimnetic Orthophosphorus (mg/L)
***04/13/10**	2.59	12	17	19	0.98	1.5	0.042	0.12	0.005
***04/28/10**	7.16	14.6	4.3	4.7	1.3	1.5	0.032	0.077	0.005
05/10/10	4.88	13.5	9.8	11	0.85	2	0.024	0.242	0.157
05/24/10	4.27	20.8	12	13	0.81		0.022		0.015
06/07/10	2.9	21.8	13	14	0.87	2.1	0.025	0.321	0.015
06/21/10	1.22	23.6	30	31	1.1	8.3	0.022	0.451	0.39
07/06/10	0.91	26.1	47	49	1.2	3.4	0.038	0.492	0.037
07/19/10	1.07	26	41	43	3.3	1.4	0.408	0.042	0.028
08/02/10	0.91	26.7	50	50	1.7	3	0.035	0.454	0.039
08/16/10	0.91	25.1	27	28	1.4	4.6	0.05	0.482	0.036
08/30/10	0.76	24.8	49	49	7.3	1.7	0.579	0.036	0.229
09/13/10	1.52	19.3	15	17	1.8	4.9	0.072	0.507	0.437
09/27/10	2.44	16.6	22	24	1.9	2.8	0.074	0.387	0.306
***10/11/10**	2.9	17.4	15	16	3.9	5.9	0.169	1.26	

***Sample was taken outside of growing season and not included when computing growing season average.**

Table 28: Powers Lake 2010 Water Quality Results From the Met Council Citizen Assisted Monitoring Program (CAMP)

Figure 40: Powers Lake Historical Mean Growing Season Total Phosphorus Concentration

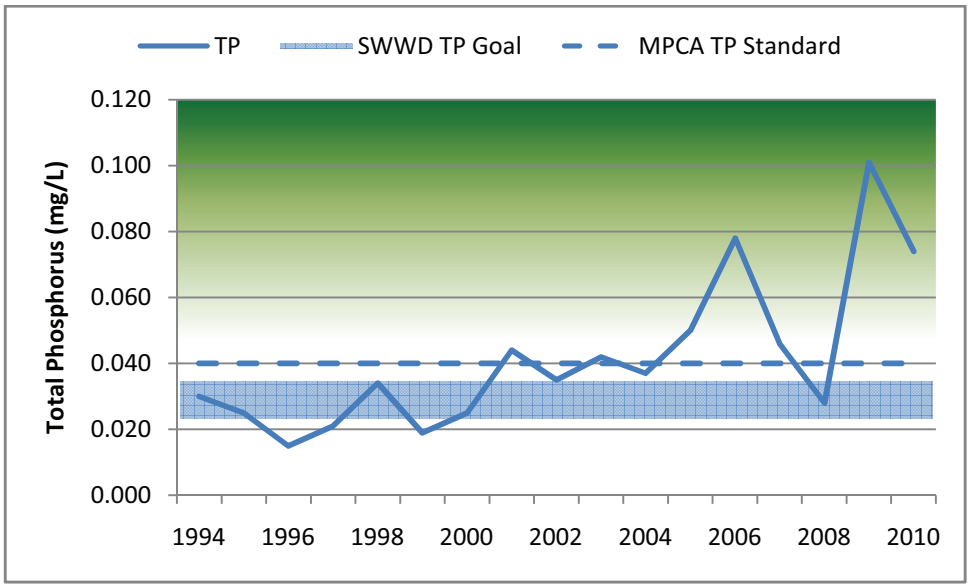


Figure 41: Powers Lake Historical Mean Growing Season Chlorophyll a[1] Concentration

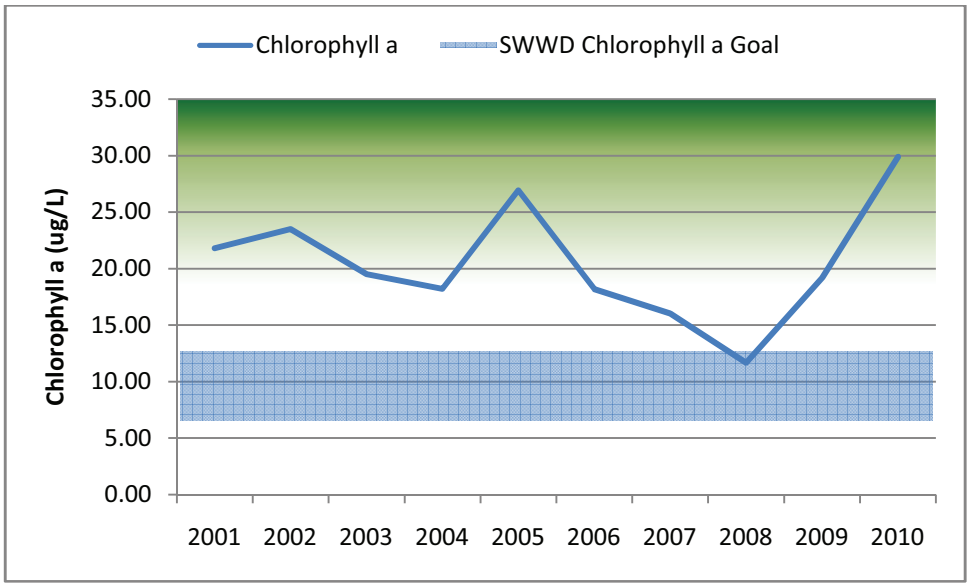
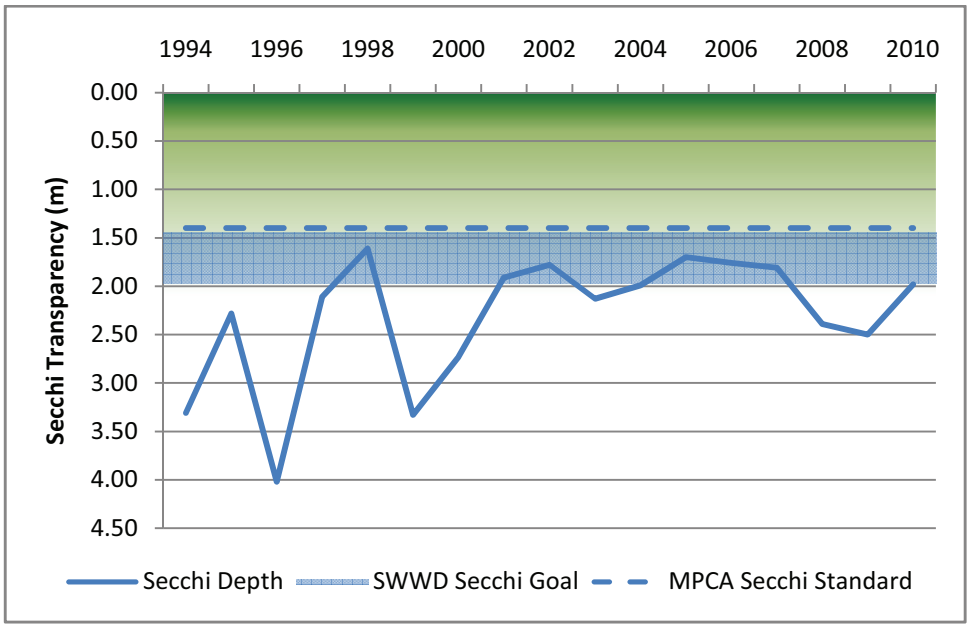


Figure 42: Powers Lake Historical Mean Growing Season Secchi Transparency



Parameter	Trophic Status	Lake Grades																
		94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Total Phosphorus	Eutrophic	B	B	A	A	B	A	B	C	C	C	C	C	D	C	B	D	D
Chlorophyll a	Eutrophic								C	C	B	B	C	B	B	B	B	C
Secchi Transparency	Eutrophic	A	B	A	C	C	A	B	C	C	C	C	C	C	C	B	B	C
Overall	Eutrophic	A	B	A	B	B	A	B	C	C	C	C	C	C	C	B	C	C

Table 29: Powers Lake 2010 Trophic Status and Historical Lake Grades

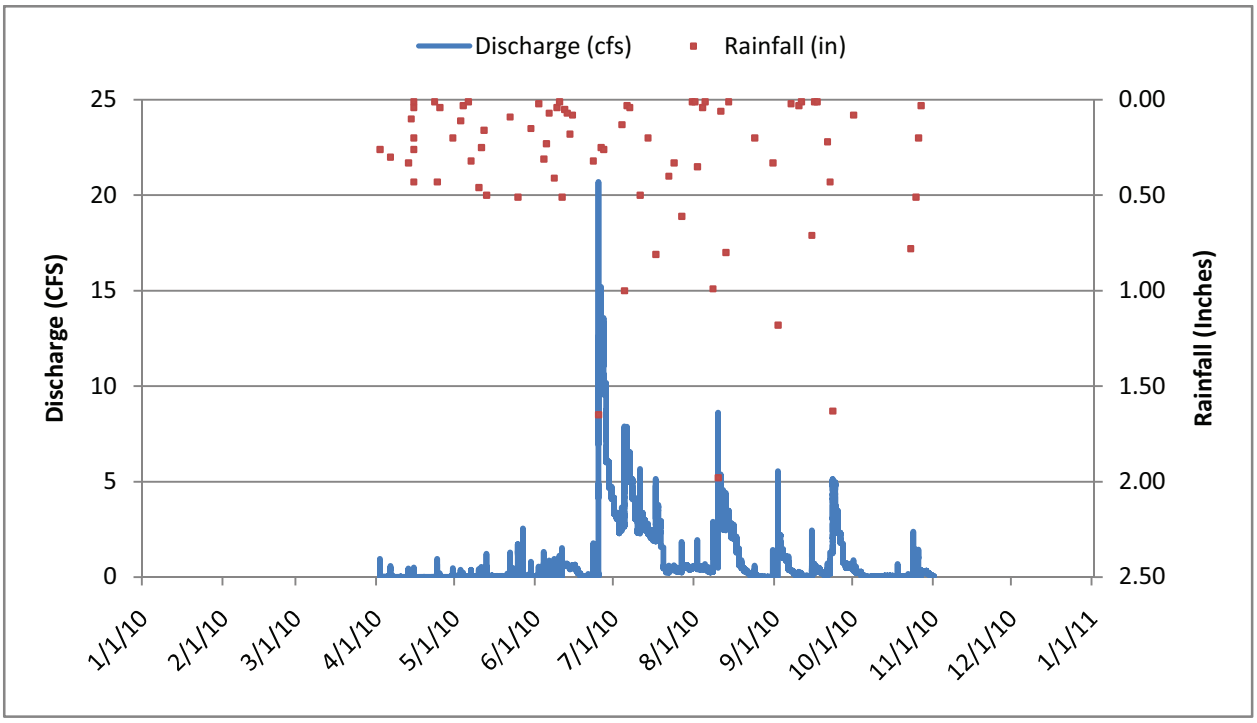
Powers Lake East

Flow measurements were collected at the Powers East site every 15 minutes from March 30 at 10:00 to November 1 at 11:45. Discharge was calculated using an area velocity relationship, which is the cross sectional area of the water channel as determined by the water level within the pipe multiplied by the measured velocity. A rain gauge was also installed throughout the monitoring season. Average daily discharge and daily rainfall is shown in Figure 43.

Up to seven types of samples are collected at Regional Assessment Locations; snowmelt grab, snowmelt composite, baseflow grab, baseflow composite, stormflow grab, stormflow composite, and bacteria grab. In 2010, 1 snowmelt grab sample, 2 baseflow grab samples, 8 stormflow composite samples, and 2 bacteria grab sample were collected at the Powers East site. All samples were analyzed at the Metropolitan Council Environmental Services Lab. Water quality results are reported in Table 32.

The 2010 growing season loading summary is reported in Table 30. Reported values reflect loading during the May 1 to September 30 growing season. Additional year to year analyses are performed for odd monitoring years.

Figure 43: Powers Lake East Average Daily Discharge and Recorded Rainfall



Year	Growing Season Observed Rainfall (inches)	Growing Season Observed Runoff Volume (acre-feet)	Projected Annual Runoff Volume (acre-feet)	Total Phosphorus (lbs)	Total Phosphorus (lbs/ac/yr)	Total Suspended Solids (lbs)	Total Suspended Solids (lbs/ac/yr)
2010	20.14	348	357	281	0.55	Not Enough Data	

Table 30: Powers East Annual Loading Summary

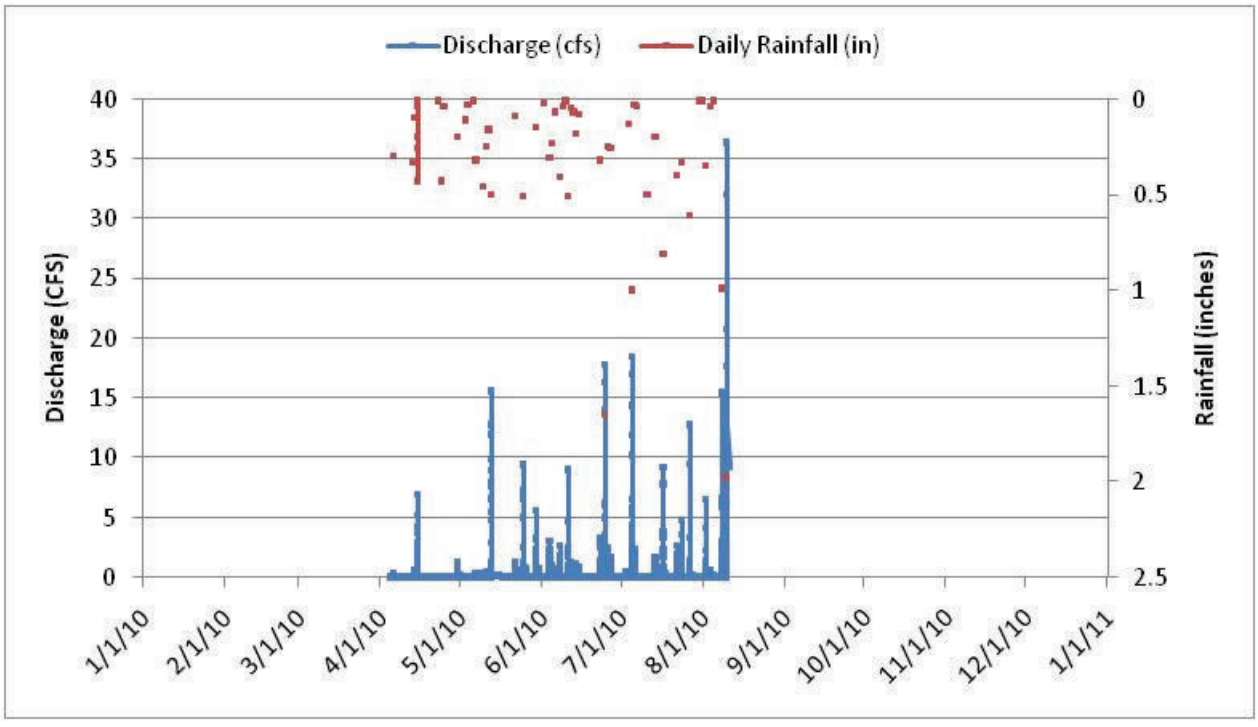
Powers Lake West

Flow measurements were collected at the Powers West site every 15 minutes from April 5 at 10:00 to August 12 at 10:30. Discharge was calculated using an area velocity relationship, which is the cross sectional area of the water channel as determined by the water level within the culvert at Powers West multiplied by the measured velocity. Measured discharge and daily rainfall (as measured at Powers East) is shown in Figure 44.

Up to seven types of samples are collected at Regional Assessment Locations; snowmelt grab, snowmelt composite, baseflow grab, baseflow composite, stormflow grab, stormflow composite, and bacteria grab. In 2009, 3 baseflow grab samples, 1 storm flow grab sample, 2 stormflow composite samples, and 3 bacteria grab sample were collected at the Powers North site. All samples were analyzed at the Metropolitan Council Environmental Services Lab for nutrients and metals. Water quality results are reported in Table 33. One early season storm flow grab sample exceeded state water quality standards for cadmium, chromium, copper, lead, nickel, and zinc. One bacteria grab sample exceeded state water quality standards for E. coli. No other samples exceeded water quality standards.

Loading was not modeled for the Powers Lake site. Due to the increased surface elevation at Powers Lake, the pond monitored at Powers West became fully connected with the lake on or near August 11.

Figure 44: Powers West Average Daily Discharge and Powers East Observed Rainfall



Type	Sampled date	End sampling	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Total Phosphorus (mg/L)	Total Dissolved Phosphorus (mg/L)	E coli	Chloride ion (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Lead (mg/L)	Nickel (mg/L)	Zinc (mg/L)	Hardness (mg/L_CaCO3)	Ammonia Nitrogen (mg/L)	Nitrate N (mg/L)	Nitrite N (mg/L)
Snowmelt Grab	3/11/10 8:51	3/11/10 8:51	496	144	3.2	0.807	0.116		13	<0.0005	0.0233	0.0426	0.014	0.0206	0.197	52	0.37	0.63	<0.03
Storm Comp	6/11/10 7:26	6/11/10 7:26			3.4	2.76	0.112		10								<0.02	<0.05	0.21
Storm Comp	6/25/10 18:26	6/26/10 2:53	249	~25	2	0.472	0.052		41	<0.0005	0.0072	0.0097	0.0045	0.008	0.0245	56	0.16	<0.05	<0.03
Storm Comp	6/26/10 3:07	6/26/10 23:10	24	9	1.4	0.153	~0.030		47	<0.0005	<0.005	0.003	<0.0005	0.0017	<0.005	58	0.08	<0.05	<0.03
Storm Comp	7/5/10 16:03	7/6/10 22:03			1.9	0.365	~0.031		24	<0.0005	0.0071	0.0092	0.0037	0.0073	0.0197		<0.02	<0.05	<0.03
Storm Comp	7/17/10 21:08	7/17/10 22:09			1.9	0.683	0.057		11	<0.0005	0.0143	0.021	0.0103	0.0156	0.0459		<0.02	0.06	<0.03
Storm Comp	7/20/10 15:15	7/20/10 15:15			1.1	0.08	0.061		41	<0.0005	<0.005	0.0012	<0.0001	0.0014	<0.005	124	~0.06	0.05	<0.03
Base Grab	8/8/10 1:58	8/8/10 2:29			2.4	0.999	0.105		4								<0.02	0.13	<0.03
Storm Grab	8/9/10 9:22	8/9/10 9:22			1.5	0.118	~0.046		34	<0.0005	<0.005	0.0008	<0.0001	0.0012	<0.005	80	<0.02	<0.05	<0.03
Storm Comp	8/11/10 2:30	8/11/10 18:39			1.3	0.123	~0.028		21	<0.0005	<0.005	0.0019	0.0002	0.0014	<0.005	48	~0.05	<0.05	<0.03
Base Grab	8/23/10 13:03	8/23/10 13:03			1	0.1	0.05		27	<0.0005	<0.005	0.0018	0.0003	0.0017	0.0078	74	0.06	0.2	<0.03
E. Coli Grab	8/26/10 8:49	8/26/10 8:49						93											
Storm Comp	9/23/10 10:54	9/24/10 3:26			1	0.153	0.054		18	<0.001	<0.010	<0.010	<0.003	<0.020	<0.020	148	~0.03	<0.05	<0.03
E. Coli Grab	9/30/10 8:55	9/30/10 8:55						649											

Key: No Exceedance Determinable; Exceeds CS; Exceeds MS; Exceeds FAV; Exceeds E. Coli Standard for Individual Sample

Table 32: Powers East Water Quality Sample Results and MN Rule 7050.0222 Class 2B Water Quality Standard Exceedances

Type	Sampled date	End sampling	Suspended solids (mg/L)	Volatile suspended solids (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Total Phosphorus (mg/L)	Total Dissolved Phosphorus (mg/L)	E coli	Chloride ion (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Lead (mg/L)	Nickel (mg/L)	Zinc (mg/L)	Hardness (mg/L_CaCO3)	Ammonia Nitrogen (mg/L)	Nitrate N (mg/L)	Nitrite N (mg/L)
Snowmelt Grab	3/11/10 11:08	3/11/10 11:08	127	43	1	0.299	0.135		90	<0.0005	0.0219	0.0478	0.0104	0.0116	0.203	52	0.35	0.5	<0.03
Storm Grab	6/8/10 10:29	6/8/10 10:29	6	3	1.1	0.041	<0.010		145	<0.0005	<0.005	0.0068	<0.0005	0.0017	0.0099	32	0.12	0.06	<0.03
Storm Comp	6/11/10 7:22	6/11/10 7:22			2.5	0.408	0.168		97								0.14	0.18	<0.03
Storm Comp	6/25/10 18:23	6/25/10 19:48	75	14	1.1	0.195	0.054		27	<0.0005	0.0084	0.0136	0.0037	0.0034	0.0451	22	0.24	0.16	<0.03
Storm Comp	7/5/10 15:06	7/5/10 16:28	21	7	1.4	0.137	0.064		14	<0.0005	0.0074	0.0097	0.001	0.0015	0.0238	20	0.58	0.12	<0.03
Storm Comp	8/8/10 1:54	8/8/10 2:31	13	6	0.76	0.074	0.024		14	<0.0005	<0.005	0.0042	0.0006	0.0012	0.0107	48	0.16	0.17	<0.03
Storm Comp	8/10/10 20:51	8/10/10 23:03	64	15	0.99	0.24	0.105		5	<0.0005	0.0052	0.0089	0.003	0.0025	0.0328	28	0.16	0.18	<0.03
Storm Comp	8/10/10 23:06	8/10/10 23:35	34	8	0.75	0.22	0.136		3	<0.0005	<0.005	0.0055	0.0028	0.002	0.0179	24			

Key: No Exceedance Determinable; Exceeds CS; Exceeds MS; Exceeds FAV; Exceeds E. Coli Standard for Individual Sample

Table 33: Powers West Water Quality Sample Results and MN Rule 7050.0222 Class 2B Water Quality Standard Exceedances

Discussion

Powers Lake behaves as expected for a closed basin system. Following wet years and extreme rain events (1991, 1993, 2002, Oct. 2005) the lake is at its highest levels (around 890 ft). Between wet years/extreme events surface elevations recede (to around 885 ft). In 2009, the lowest surface elevation since the mid-1970s was observed and in 2010, surface elevation rebounded dramatically. What isn't clear, though, is the importance of groundwater in maintaining elevations between wet years/extreme events, or how development and increased use of groundwater has impacted groundwater inflows.

Since Powers Lake lies in a closed basin, quality of inflows is especially important due to the increased nutrient/contaminant residence time. In its WMP, SWWD identified Powers Lake as a significant regional resource. With the goal of maintaining an in-lake trophic state index (TSI) of 50-55, the District has adopted a maximum allowable phosphorus load of 88 lbs/yr or 0.06 lbs/ac/yr throughout the Powers Lake watershed which corresponds to theoretical loading level based on original drainage area (430 acres) under natural conditions. TP concentration of Powers Lake is steadily rising and the highest ever recorded mean growing season concentration was observed in 2009, exceeding SWWD goals and state eutrophication standards. Similarly, chlorophyll a concentrations exceeded SWWD goals and state standards, reaching its highest recorded level in 2010. Secchi transparency of Powers Lake, however, continued to meet both SWWD goals and state eutrophication standards in 2010. Inconsistencies in the three eutrophication measures indicate a system where algae dominate light attenuation, but are otherwise limited in some way (i.e. zooplankton grazing or nitrogen limitation). Overall, it is clear that phosphorus inputs to the lake need to be addressed in order to maintain SWWD water quality goals.

Runoff from the Powers Lake watershed is generally fairly clean. However, in 2010 several samples from both the Powers East and West sites exceeded state standards for metals. 2010 was the first year of sampling at the Powers West site. Sampling was ended early due to the pond being incorporated with the lake with rising surface elevation. Loads were not modeled due to the eventual hydrologic connection between the pond and lake. While water quality at Powers West is a concern, the issue was at least partially addressed by the City in 2010. The pond had been the only source of treatment for runoff from CSAH 19. Now, runoff from the highway drains through a vegetated swale and additional detention pond prior to emptying into the Powers West pond. Despite the high metal concentrations sampled in 2010, phosphorus remains the primary concern for Powers Lake. Phosphorus loading from the Dancing Waters development was 0.55 lbs/ac/yr in 2010 and was the highest since major excavation ended in 2005. In order to meet SWWD loading standards and water quality goals for the lake, efforts need to be taken to decrease phosphorus loading throughout the Powers Lake watershed. SWWD in cooperation with the Washington Conservation District and City of Woodbury have completed a Subwatershed Retrofit Analysis that identifies the most cost-effective projects for reducing phosphorus loading to Powers Lake. Implementation of the identified projects is underway.