2017 Water Quality Report

Prepared for the City of Plymouth

Prepared by: Three Rivers Park District
DEPARTMENT OF WATER RESOURCES

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1.0 INTRODUCTION

This report summarizes the water quality monitoring conducted by the Three Rivers Park District Water Resources Department for the City of Plymouth during the 2017 calendar year. Eleven stormwater sites and a rain garden were monitored. Each site was equipped to measure flow of water using ISCO flow meters and to take water samples during storm events using ISCO samplers. In addition, water samples were taken on a bi-weekly basis to characterize base flow. Stormwater sites were monitored from the beginning of April to the end of October.

Water samples were analyzed at Three Rivers Park Districts' certified laboratory for: Total Phosphorus (TP), Soluble Reactive Phosphorus (SRP), Total Nitrogen (TN), Total Suspended Solids (TSS) and, at select sites, Chlorides (Cl).

2.0 PRECIPITATION

Precipitation data was collected using a tipping bucket rain gauge located at the City of Plymouth Maintenance facility on 23rd Avenue North between Niagara Lane North and Fernbrook Lane North. During the sampling period of April 4th to October 30th, there were 26.08 inches of rain which accounted for 94% of the total 27.79 inches of precipitation for the year. Typically, the monitoring period only represents about 70-80% of the total precipitation. The 2017 total precipitation was a little less than the 17 year average of 29.7 inches at the Plymouth rain gauge.

The largest single day precipitation event occurred on 10/2/2017 when there was 2.2 inches of rain. The other large precipitation event, which resulted in high flows at the monitoring sites, occurred over several days (May 17-May 20) when a total of 3.19 inches of rain fell.

3.0 MONITORING

In the following report, each watershed has five sections. In the Watershed section, there is a description of the watershed, map of monitoring sites with watershed boundary, and list of any water quality impairments. In the Stormwater Monitoring section, there are monitoring location descriptions and a summary of the monitored watershed acres and impervious acres. In the Measured Flow section, there is a graph showing the daily flow during the monitoring season at the monitoring site along with precipitation. In the Concentrations section, the average concentrations of all the samples collected are reported and discussed. In the Loading section, there is a summary of the annual load estimates (lbs/year), flow-weighted

concentrations, annual flow estimate, and the unit area loads (lbs/acre) for each parameter since monitoring began.

To estimate monitoring site loading, the U.S. Army Corps of Engineer's FLUX model version 3.35 was used (Soballe, 2007). The sampling period loading is dependent upon the nutrient concentrations and the sampling period flow. The sampling period loading is extrapolated to the yearly load based on precipitation. The unit area loads (UAL) are determined by converting the yearly loading to a per acre ratio. The UAL can then be compared to the MPCA Stormwater Manual (MPCA, 2017) typical unit area loads for TP and TSS based on land use (Table 3. 1 and Table 3. 2)

Table 3. 1 MPCA Stormwater manual typical values for Total Phosphorus unit area loads by land use and common range of runoff concentrations by land use (MPCA, 2017).

Typical Total Phosphorus values as stated in the MN Stormwater Manual				
Land Use	Unit Area Loads (lbs/ac)	Median Concentration (mg/L)	Minimum Concentration (mg/L)	Maximum Concentration (mg/L)
Residential	1.35	0.26	< 0.01	19.90
Commercial	2.25	0.20	< 0.01	4.27
Industrial	--	0.23	< 0.02	7.90
Freeway	3.50	--	--	--
Open Space	--	0.13	< 0.01	0.76

Table 3. 2 MPCA Stormwater manual typical values for Total Suspended Sediments unit area loads by land use and common range of runoff concentrations by land use (MPCA, 2017).

Typical Total Suspended Solids values as stated in the MN Stormwater Manual				
Land Use	Unit Area Loads (lbs/ac)	Median Concentration (mg/L)	Minimum Concentration (mg/L)	Maximum Concentration (mg/L)
Residential	76	58	< 0.5	4,168
Mixed Residential	111	--	--	--
Commercial	221	52	< 0.5	2,385
Industrial	193	75	< 1	2,490
Freeway	560	--	--	--
Open Space	35	58	< 1	4,168

3.1. Parkers Lake Watershed

The Parkers Lake Watershed is 1,150 acres and is located entirely within the City of Plymouth. Two stormwater tributaries to Parker's Lake were monitored at sites PL1 and PL2 (Figure 3.1.1). The two monitoring sites capture almost 40% of the watershed area contributing to Parkers Lake. Parkers Lake has been listed as impaired for Chlorides since 2014.

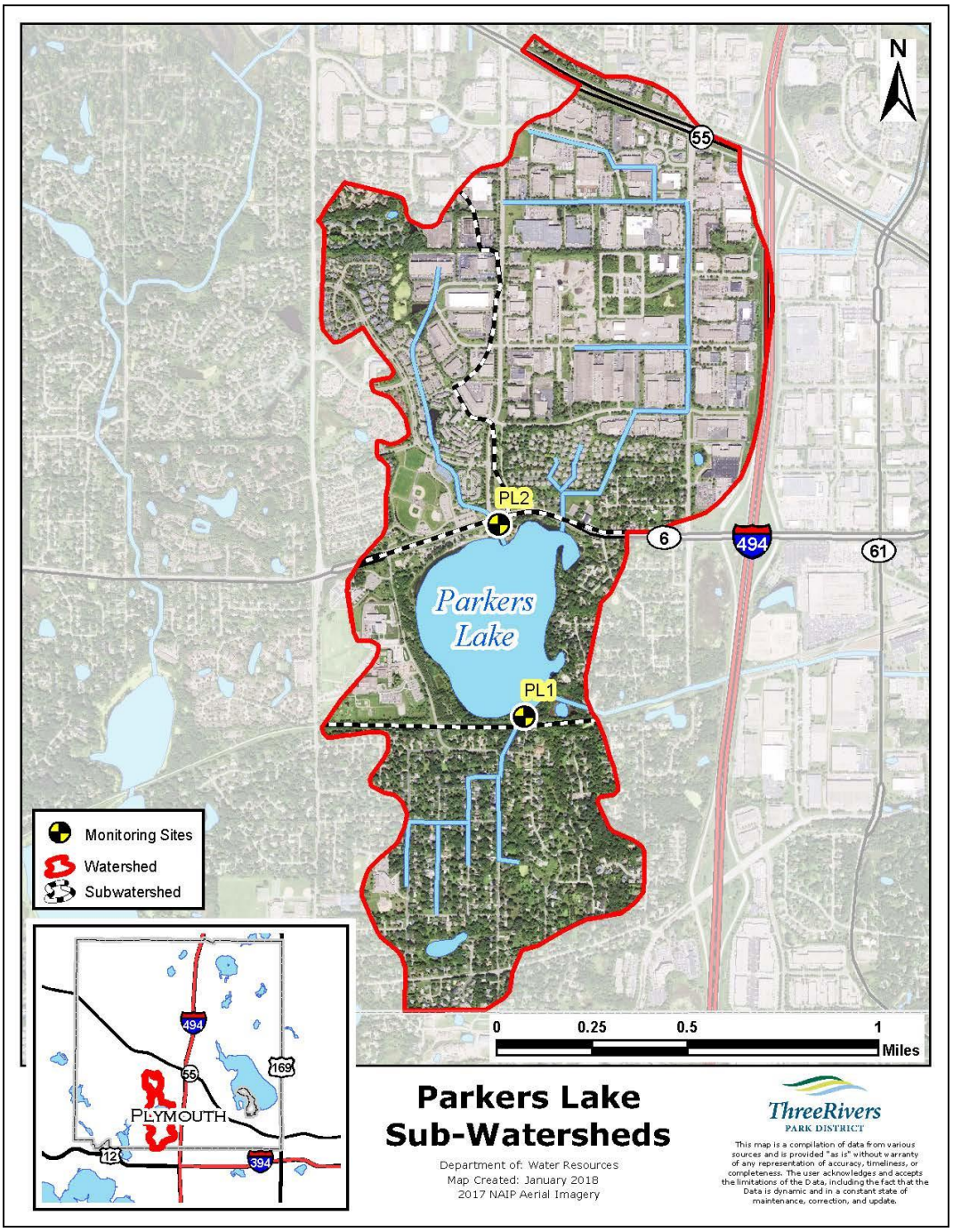

Figure 3.1.1 Parkers Lake sub-watershed map

3.1.1. Stormwater Monitoring Sites

Each of the monitored sites has a 48 inch round stormwater culvert. Site PL1 (Parkers Lake site 1) monitors 258 acres and is located on the south side of the lake off the north side of the Luce Line State Trail. The watershed is about 19% impervious and primarily residential land use. Site PL2 (Parkers Lake site 2) is smaller than PL1 and monitors 189 acres. This site is located on the northwest portion of the lake, west of the public boat access. Site PL2 monitors a watershed that is about 49% impervious and the land use is primarily multi-family residential and industrial (Table 3.1.1).

Table 3.1.1 Summary of watershed characteristics for sites PL1 and PL2

Site	*Subwatershed Area (acres)*	*% impervious (acres)[1]*	*% of Parkers Lake Watershed*	*Dominant land uses[2]*
PL1	258	19% (48 ac.)	22%	Residential
PL2	189	49% (92 ac.)	16%	Multi-family Residential, Industrial

[1] % impervious area determined using the 2016 University of Minnesota TCMA 1-meter land cover classification GIS layer

[2] Dominant Land Uses determined using GIS layer obtained from the City of Plymouth

3.1.2. Measured Flow

Both sites, PL1 and PL2, respond quickly to precipitation intensity and duration since the watersheds are small and developed. Even though PL2 has a smaller watershed than PL1, the watershed soils, slopes and impervious areas cause there to be more runoff resulting in higher flows at the PL2 site compared to the PL1 site. At the PL1 monitoring site, there is intermittent flow only in response to rain events (Figure 3.1.2). The PL1 watershed has less impervious area along with sandier soils and flatter topography which allows for more rainfall infiltration. The PL2 monitoring site typically has a base flow but during longer periods without rain, the site will have very little to no flow (Figure 3.1.3). The PL2 watershed has steep elevation changes and more impervious area which leads to more base flow.

The largest daily flow pulses for both sites occurred during the May 17-20th precipitation events of 3.19 inches. At PL1, the combined storms led to the highest average daily flow pulse of 2.18 cfs on May 21st and at PL2, the highest daily average flow pulse was 8.88 cfs. On the largest single day precipitation event, October 2nd, PL1 had an average daily flow of 1.65 cfs while PL2 had an average daily flow pulse of 7.6 cfs.

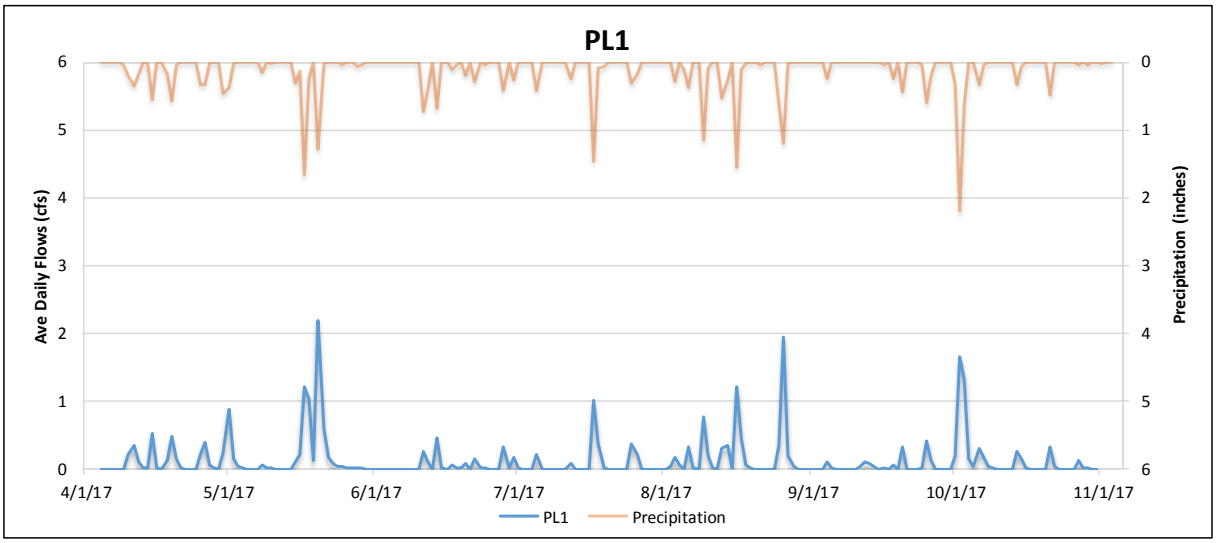

Figure 3.1.2 Average daily flow for Parkers Lake site 1 (PL1)

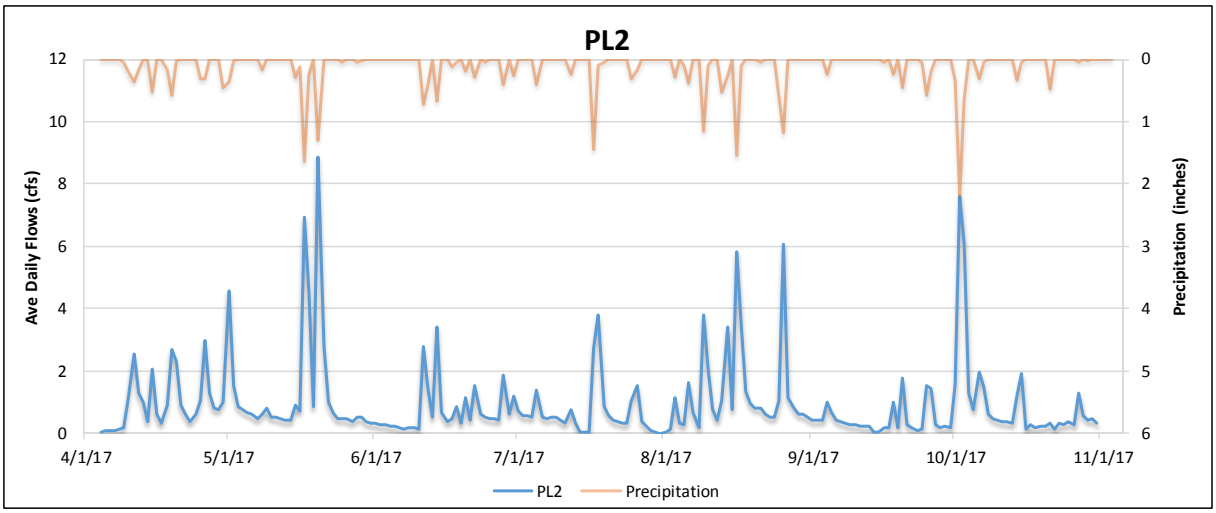

Figure 3.1.3 Average daily flow for Parkers Lake site 2 (PL2)

3.1.3. Concentrations

At PL1, 10 water samples were collected over the season. Typically, more water samples are collected at this location in a year, but due to equipment issues, there were a limited number of samples. Since this site is typically dry, samples were only collected during runoff events. At PL2, 27 water samples were collected over the season.

Concentrations of TP, SRP and TN were almost double at PL1 compared to PL2. This could be due to dilution at PL2 since it has higher flows. The TSS had similar concentrations at PL1 and PL2. The Chlorides concentrations were 4 times higher at PL2 compared to PL1, which may be

due to the higher percentage of impervious area that receives salt during the winter leading to higher concentrations of chlorides. On average, the SRP made up 46% of the TP at PL1 and at PL2, on average, the SRP made up 42% of the TP (Table 3.1.2 and Figure 3.1.4).

Table 3.1.2 Summary of average, minimum and maximum concentrations for TP, SRP, TN, TSS and Cl at PL1 and PL2

Site	Avg TP (min-max) µg/L	Avg SRP (min-max) µg/L	Avg TN (min-max) mg/L	Avg TSS (min-max) mg/L	Avg Cl (min-max) mg/L
PL1	295 (131 - 607)	145 (47 - 385)	2.7 (0.7 - 9.5)	44 (2.6 - 203)	24 (3 - 73)
PL2	182 (82 - 618)	65 (15 - 174)	1.4 (0.7 - 4.2)	43 (0.4 - 248)	105 (37 - 390)

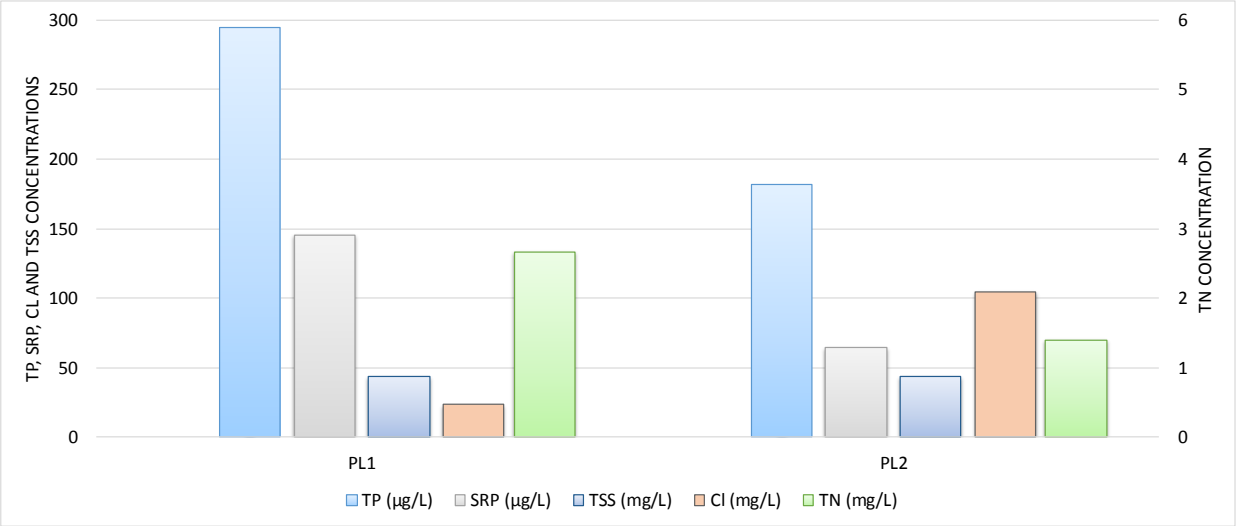

Figure 3.1.4 Histogram of average TP, SRP, TN, TSS and Cl concentrations for PL1 and PL2

3.1.4. Loading

The loading of each parameter at PL1 is about one sixth of the loading at PL2 due to the lower amount of water flowing through the culverts. PL1 has almost six times less water than at PL2, so even though the concentrations of the parameters are higher at PL1, the overall loading is lower.

PL1

At PL1, data has been collected since 2000. In 2005, there was an installation of ponds and curbs in the watershed. The data in Table 3.1.3 is segmented to reflect the concentrations and loading before and after the installation of the ponds and curbs. The curbs affected runoff by not allowing water to run into ditches and infiltrate. The flows increased by 80% which caused there to be about a 50% increase in phosphorus loading and a 98% increase in nitrogen loading

since there was not a significant change in the phosphorus or nitrogen concentrations. The ponds seemed to allow sediment settling since there was a 40% reduction in TSS concentration that led to a 5% decrease in TSS loading. In 2017, the chloride concentration was two to four times higher than the past 4 years (Table 3.1.4). Typically, the higher chloride concentrations in runoff are in April when there may still be road salt that can be washed into the streams. The timing and intensity of the April storms seems to be the main driver of the loading that occurs for the watershed each year.

The unit area loads (UAL) by year for PL1 are listed in Table 3.1.5. The average TP UAL of 0.13 lbs/acre is lower than the MPCA Stormwater manual residential UAL of 1.35 lbs/acre. The TSS UAL was higher than the MPCA Stormwater manual UAL of 77 lbs/acre for residential land in 2 of the 14 monitored years (2005 and 2014).

Table 3.1.3 Loading and flow weighted concentrations for TP, SRP, TN and TSS at PL1. The data is segmented based on the before and after of the installation of a pond and curbs. The % change compares the average loadings and concentrations before and after restoration work

PL1 - Parkers Lake - Site 1										
	Nutrient Loading				Nutrient Concentration					
Year	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Flow Volume (x 10^6 M^3)	Annual Precipitation (inches)
Data Collected before Installation of Water Quality Pond and Curb/Gutter										
2000	6	2	42	1,304	243	89	1.50	48	0.01	32.3
2001	11	6	58	1,392	293	157	1.60	39	0.01	34.6
2002	40	16	225	11,365	318	124	1.80	91	0.05	38.1
2003	39	21	215	12,139	308	165	1.70	95	0.06	25.8
2004	23	14	140	5,531	272	138	1.40	62	0.04	32.1
2005	35	10	230	23,196	377	108	2.60	252	0.04	32.6
Average	26	12	152	9,155	302	130	1.77	98	0.04	32.6
Data Collected after Installation of Water Quality Pond and Curb/Gutter										
2006	27	12	119	10,003	343	169	1.50	126	0.04	29.1
2007	22	8	136	4,419	232	82	1.40	47	0.04	31.1
2009	22	15	75	1,246	291	191	1.00	17	0.03	19.6
2013	49	23	392	10,663	248	119	1.98	54	0.09	31.6
2014	63	37	763	18,517	264	132	2.71	66	0.13	27.5
2015	34	12	241	6,536	302	107	2.15	58	0.04	29.1
2016	59	21	389	10,125	296	103	1.96	51	0.08	38.6
2017	41	17	286	8,269	269	110	1.87	54	0.07	27.8
Average	40	18	300	8,722	281	127	1.82	59	0.07	29.3
% Change	54	57	98	-5	-7	-3	3	-40	80	-10

Table 3.1.4 Loading and flow weighted concentration of chlorides at PL1 and PL2

	PL1		PL2	
	Chloride		Chloride	
Year	Loading (lbs/Yr)	Concentration (mg/L)	Loading (lbs/Yr)	Concentration (mg/L)
2013	3,239	16.4	105,991	123.0
2014	1,158	9.1	55,650	103.0
2015	1,052	9.4	161,814	120.0
2016	1,797	8.3	66,855	68.1
2017	4,904	32.0	122,460	105.0

Table 3.1.5 Unit area loads for TP, SRP, TN, TSS and Chlorides at PL1

PL1 - Parkers Lake - Site 1					
	Load/Acre				
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)	Cl (lbs/acre)
2000	0.02	0.01	0.16	5	
2001	0.04	0.02	0.22	5	
2002	0.16	0.06	0.87	44	
2003	0.15	0.08	0.83	47	
2004	0.09	0.05	0.54	21	
2005	0.14	0.04	0.89	90	
2006	0.10	0.05	0.46	39	
2007	0.09	0.03	0.53	17	
2009	0.09	0.06	0.29	5	
2013	0.19	0.09	1.52	41	12.6
2014	0.24	0.14	2.96	72	4.5
2015	0.13	0.05	0.93	25	4.1
2016	0.23	0.08	1.51	39	7.0
2017	0.16	0.07	1.11	32	19.0
Average	0.13	0.06	0.92	34.5	9.4

PL2

The PL2 site was monitored from 2000-2008 and commenced again from 2013-2017. Comparing the average data between the two monitoring periods, all parameters increased in loading and concentration. There was an increase in flow of about 38%, even though there was very little difference in the average precipitation (Table 3.1.6). Along with the increased flow, there was about a 50% increase in TSS concentration, 25% increase in TP and SRP concentrations and a slight increase in TN concentrations. The combination of flow and concentration increases led to 57-90% increases in loadings. In 2017, the chloride concentration

and loading were higher than in 2016, but still similar to 2013-2017 concentrations (Table 3.1.4).

The unit area loads (UAL) by year are listed in Table 3.1.7. At PL2, the overall average UAL for TP is 0.79 lbs/acre. Most years, the TP UAL at PL2 is lower than the MPCA Stormwater manual residential UAL of 1.35 lbs/acre, but the past 3 years were close to 1.35 lbs/acre. The average TSS UAL of 243 lbs/acre is much higher than the MPCA Stormwater manual Mixed residential UAL of 111 lbs/acre and higher than the UAL for Industrial landuse of 193 lbs/acre. Since this watershed is about 30% industrial and 49% mixed residential (47% multi-family and 3% single family), the TSS loading is still higher than the typical loading for these land uses.

Table 3.1.6 Loading and flow weighted concentrations of TP, SRP, TN and TSS at PL2. Data is segmented by a break in data collection from 2009-2012.

PL2 - Parkers Lake - Site 2										
	Nutrient Loading				Nutrient Concentration					
Year	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Flow Volume (x 106 M3)	Annual Precipitation (inches)
2000-2008										
2000	18	5	219	2,459	125	39	1.50	17	0.06	32.3
2001	125	43	1,132	24,170	160	56	1.50	31	0.33	34.6
2002	124	36	1,217	45,038	148	143	1.40	54	0.36	38.1
2003	80	42	882	31,784	121	63	1.30	48	0.30	25.8
2004	117	45	1,131	33,485	136	53	1.30	39	0.39	32.1
2005	126	50	1,243	40,351	125	50	1.20	40	0.45	32.6
2006	176	54	1,632	33,941	153	47	1.40	30	0.52	29.1
2007	255	118	1,780	107,627	239	110	1.70	101	0.48	31.1
2008	48	7	392	2,901	277	39	2.28	17	0.08	20.8
Average	119	44	1,070	35,751	165	67	1.51	42	0.33	30.7
2013-2017										
2013	145	73	1,299	50,840	169	85	1.51	59	0.39	31.6
2014	182	100	1,980	73,498	152	84	1.66	62	0.54	27.5
2015	221	85	1,776	68,765	234	90	1.88	73	0.42	29.1
2016	262	95	1,648	65,665	272	99	1.71	67	0.44	38.6
2017	219	72	1,716	61,684	188	62	1.48	53	0.49	27.8
Average	206	85	1,684	64,090	203	84	1.65	63	0.46	30.9
% Change	73	91	57	79	23	26	9	50	38	0.67

Table 3.1.7 Unit area loading for TP, SRP, TN, TSS and Chlorides for PL2

PL2 - Parkers Lake - Site 2					
	Load/Acre				
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)	Cl (lbs/acre)
2000	0.10	0.03	1.16	13	
2001	0.66	0.23	5.99	128	
2002	0.66	0.19	6.44	238	
2003	0.42	0.22	4.67	168	
2004	0.62	0.24	5.98	177	
2005	0.67	0.26	6.58	213	
2006	0.93	0.29	8.63	180	
2007	1.35	0.62	9.42	569	
2008	0.25	0.04	2.07	15	
2013	0.77	0.39	6.87	269	561
2014	0.96	0.53	10.48	389	294
2015	1.17	0.45	9.40	364	856
2016	1.39	0.50	8.72	347	354
2017	1.16	0.38	9.08	326	648
Average	0.79	0.31	6.82	243	543

3.2. Medicine Lake Watershed

The Medicine lake watershed is 11,666 acres that consists of several municipalities. Most of the watershed resides in the City of Plymouth (10,268 acres). The City of Plymouth contracted TRPD to monitor three sites that drain directly to Medicine Lake as well as two sites that drain to Parkers Lake. These monitoring sites account for 56% of the watershed drainage acreage to Medicine Lake (Figure 3.2.1). Medicine Lake was been classified as impaired for excess nutrients since 2004.

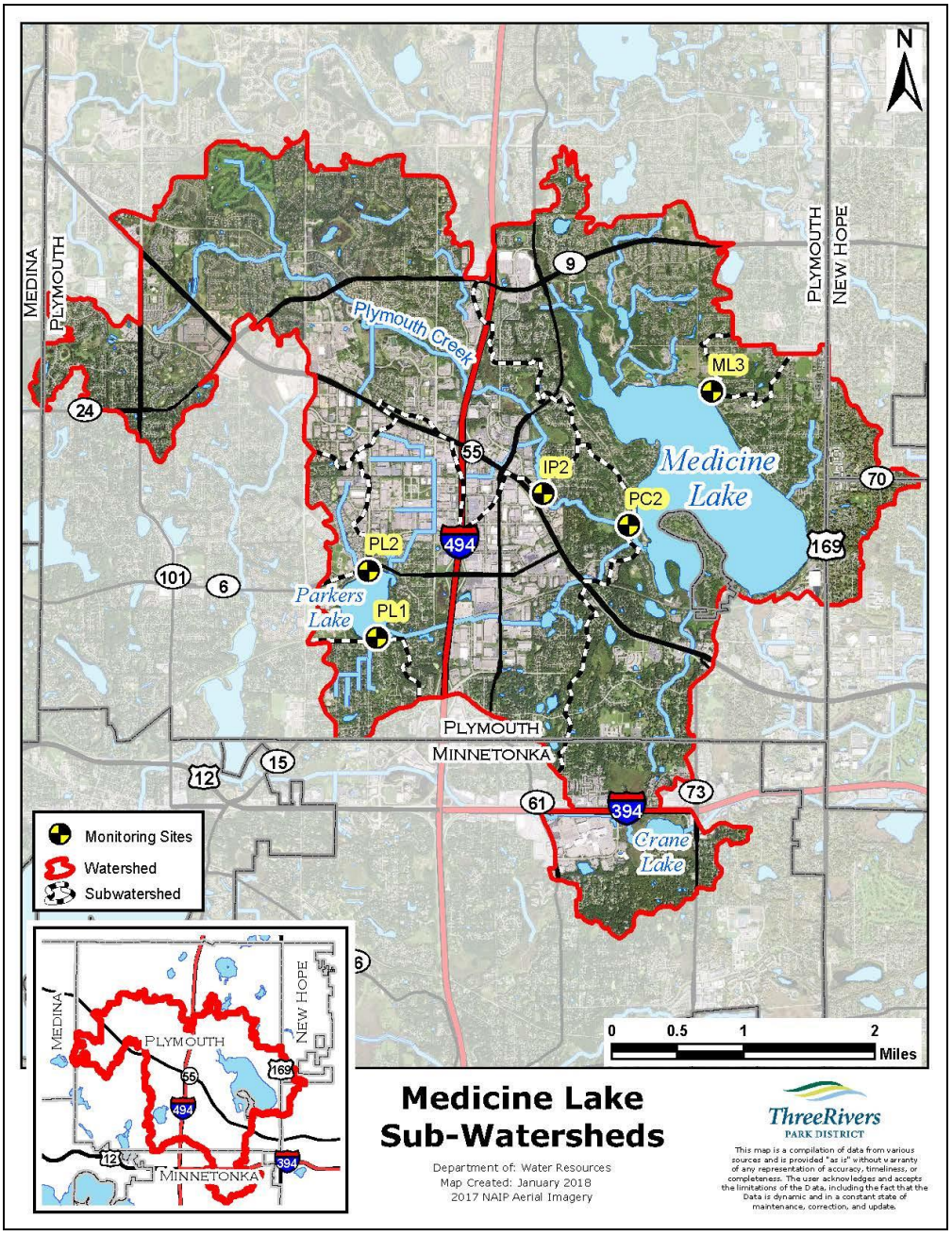

Figure 3.2.1 Medicine Lake sub-watershed map

3.2.1. Stormwater Monitoring Sites

Two of the monitored stormwater sites, IP2 (Industrial Park site 2) and PC2 (Plymouth Creek Site 2) are on the west side of Medicine Lake at the outlet of Plymouth Creek into Medicine Lake. Plymouth Creek was classified as impaired for Chlorides and *E. Coli* in 2014. A site, ML3 (Medicine Lake site 3) on the east side of Medicine Lake, monitors Wood Creek which has had some stream restoration.

The IP2 monitoring site is located at a 14 foot wide weir structure on Plymouth Creek behind an industrial building (12940 Teakwood Ln N) approximately ¼ mile northeast of the intersection of Highway 55 and Industrial Park Boulevard. The site has a sub-watershed acreage of 3,725 which makes up 32% of the Medicine Lake watershed in Plymouth. This site is located to assess the nutrient loading from the upstream portions of Plymouth Creek prior to discharging into a wetland complex that flows to Medicine Lake. The watershed is about 34% impervious and primarily residential land use (Table 3.2.1).

The PC2 monitoring site is the furthest downstream sampling site on Plymouth Creek. The site is located downstream of IP2 and also includes the drainage coming from Parkers Lake. The site is an open channel located downstream of a detention pond where Plymouth Creek intersects Medicine Lake Drive West. The watershed is 6,390 acres and accounts for 55% of the Medicine Lake watershed in the City of Plymouth. Two detention ponds were constructed from 2009-2010 to reduce nutrient loading and a stream restoration project occurred from 2010 through 2011. The watershed is 37% impervious and primarily residential and commercial land uses (Table 3.2.1).

The ML3 monitoring site is in an open channel of Wood Creek about ¼ mile northeast of the intersection of East Medicine Lake Boulevard and 34th Ave N. The watershed is 137 acres on the east side of the lake that consists of residential and commercial land uses and is 28% impervious surface (Table 3.2.1). A stream bank stabilization project was completed in 2008 on Wood Creek to reduce erosion and nutrient loading.

Table 3.2.1 Summary of watershed characteristics for sites IP2, PC2 and ML3

Site	*Subwatershed Area (acres)*	*% impervious (acres)*[1]	*% of Medicine Lake Watershed*	*Dominant land uses*[2]
IP2	3,725	34% (1,279 ac.)	32%	Residential
PC2	6,390	37% (2,363 ac.)	55%	Residential, commercial
ML3	137	28% (38 ac.)	1.2%	Residential, commercial

[1] % Impervious area determined using the 2016 University of Minnesota TCMA 1-meter land cover classification GIS layer

[2] Dominant Land Uses determined using GIS layer obtained from the City of Plymouth

3.2.2. Measured Flow

With IP2 monitoring a 3,725 acre watershed that has several large wetlands in the watershed, there is a lag time before the flow pulses after a precipitation event. There is a lag time at downstream PC2 also since the watershed is larger and has detention ponds. The flow at IP2 can be higher than the flow at downstream PC2 due to the constructed retention ponds and wetland areas that increase infiltration and evapotranspiration along with providing storage between IP2 and PC2. The falling limbs of the hydrographs at PC2 are more drawn out than at IP2 due to the lake effect caused by proximity to Medicine Lake. At ML3, the stream is very flashy and responds quickly to precipitation intensity and duration and typically returns to baseflow within the same day.

For each site, different storm events caused the largest flow pulse. For IP2, the largest average daily flow pulse of 68 cfs occurred on May 21st after the cumulative precipitation events from May 17-20th of 3.19 inches of rain (Figure 3.2.2). PC2 had its largest flow pulse on October 2nd with 66 cfs after 2 days of precipitation led to 2.5 inches of rain (Figure 3.2.2). The largest ML3 flow pulse was after the rain event on May 17th with a flow of 3.3 cfs on May 17th (Figure 3.2.3).

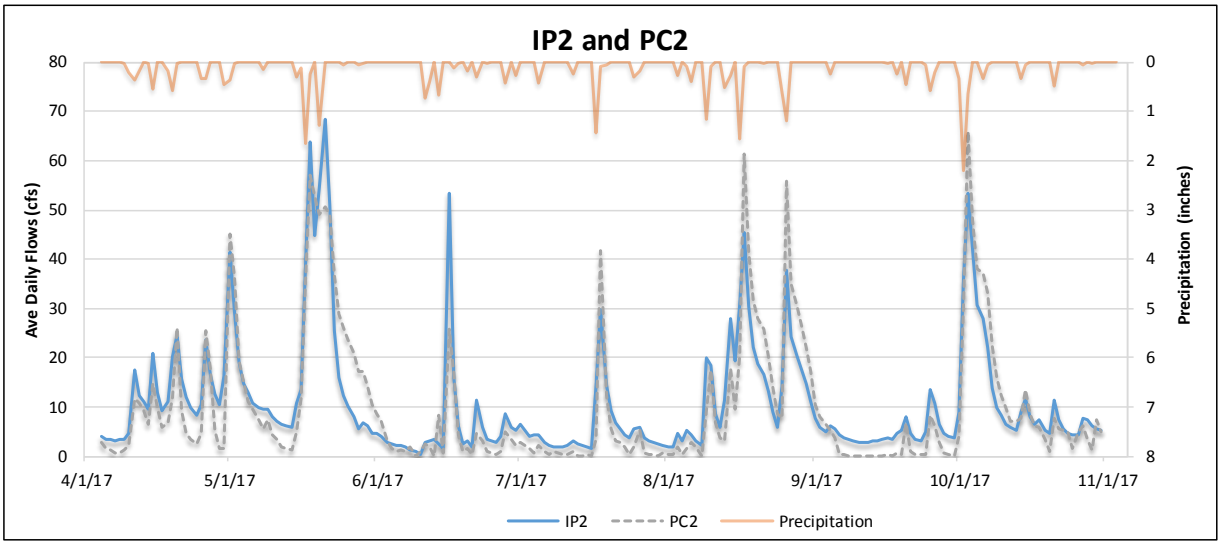

Figure 3.2.2 Average daily flow for Industrial Park site 2 (IP2) and downstream Plymouth Creek Site 2 (PC2)

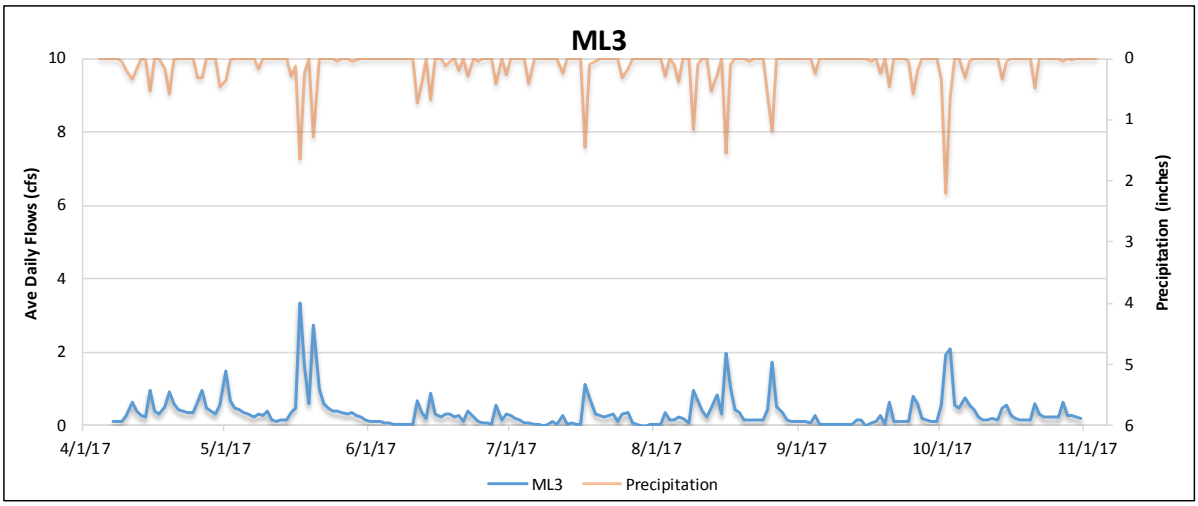

Figure 3.2.3 Average daily flow for Medicine Lake site 3 (ML3)

3.2.3. Concentrations

A summary of the average sample concentrations for TP, SRP, TN, TSS and Cl at IP2, PC2 and ML3 are in Table 3.2.2 and Figure 3.2.4.

At IP2, 29 water samples were collected over the season. On average, the SRP was 30% of the TP.

At PC2, 20 water samples were collected over the season. On average, the SRP was 33% of TP. This year, and in most recent years, concentrations at IP2 were higher than PC2 for TP, TN, TSS, and Chloride. SRP remained about the same. The lower concentrations may be attributed to the stream stabilization and ponds.

At ML3, 26 water samples were collected over the season. On average, the SRP was 54% of TP. The ML3 site was affected by an illicit discharge from around 9/28/2017-10/3/2017. The nearby Armstrong High School had a sewer blockage which caused sewage to overflow to a nearby pond and ultimately Wood Creek and Medicine Lake. The blockage was removed on 10/2/2017 and the MPCA was involved with determining corrective actions. There were above average nutrient concentrations for the grab sample on September 25th, which may be the first signs of the sewage spill that continued into October at the Armstrong High School.

Table 3.2.2 Summary of sample average, minimum and maximum concentrations for TP, SRP, TN, TSS and Cl at IP2, PC2 and ML3

Site	Avg TP (min-max) µg/L	Avg SRP (min-max) µg/L	Avg TN (min-max) mg/L	Avg TSS (min-max) mg/L	Avg Cl (min-max) mg/L
IP2	138 (64 - 295)	41 (17 - 91)	1.5 (1.0 - 3.0)	18.6 (1.2 - 133)	138 (36 - 295)
PC2	126 (63 - 213)	41 (11 - 82)	1.3 (0.8 - 2.5)	17.8 (2.6 - 62)	111 (48 - 185)
ML3	351 (171 - 717)	190 (12 - 527)	2.5 (1.2 - 6.2)	115 (0.5 - 878)	

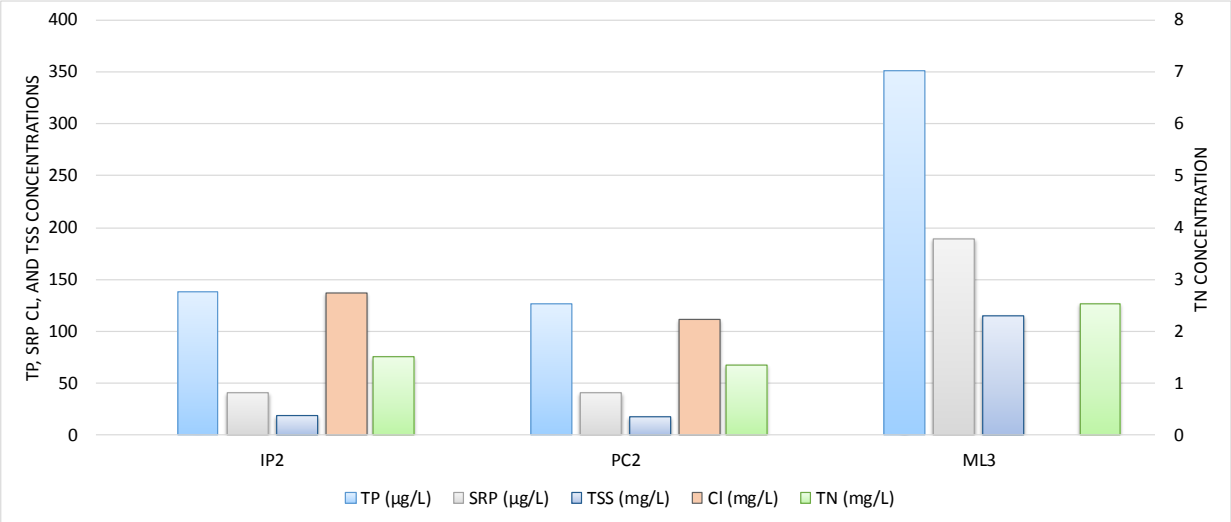

Figure 3.2.4 Average concentrations of TP, SRP, TSS and TN for the Medicine Lake Watershed sites including: IP2, PC2 and ML3

3.2.4. Loading

IP2

At IP2, data was collected since 2004 with breaks in 2007, 2010, and 2011. Over the period of record, flows at IP2 remain proportional to annual precipitation without major deviation (Table 3.2.3). TP, SRP, TN, and TSS load and flow weighted average concentrations were lower than the previous year, which was exceptionally wet, and lower than the average load and concentration of the past five years. Continued monitoring will determine if this trend will continue. Four years of data were collected for chlorides and 2017 had the lowest total load and flow weighted average concentration of those years monitored (Table 3.2.4).

The unit area loads (UAL) by year are listed in Table 3.2.5. The TP UAL's at IP2 have an average of 0.54 lbs/acre and have been lower than the MPCA Stormwater manual of 1.35 lbs/acre for

residential land use since monitoring began. The average TSS UAL of 80 lbs/acre is slightly over the MPCA Stormwater manual value of 77 lbs/acre for residential land use.

A capital improvement project is set to begin winter of 2017 and finish in 2018 that will include streambank stabilization upstream of IP2. It is anticipated that this project would reduce nutrient loading.

Table 3.2.3 Loading and flow weighted concentrations for IP2.

IP2 - Industrial Park site 2										
	Nutrient Loading				Nutrient Concentration					
Year	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Flow Volume (x 10^6 M^3)	Annual Precipitation (inches)
2004	1,716	1,081	13,441	189,407	128	81	1.00	14	6.04	32.1
2005	1,785	816	13,080	348,060	144	66	1.06	24	4.69	32.6
2006	1,768	558	15,039	497,672	147	46	1.25	41	5.47	29.1
2008	1,228	265	9,131	183,900	147	36	1.20	25	3.35	20.8
2009	713	338	5,520	52,461	127	61	0.99	9	2.54	19.6
2012	2,168	920	20,615	392,171	171	73	1.62	31	5.75	26.7
2013	2,812	1,438	25,699	338,965	161	82	1.47	19	7.93	31.6
2014	2,153	882	24,143	405,612	161	66	1.81	30	6.06	27.5
2015	2,237	693	17,870	164,959	191	59	1.53	14	5.67	29.1
2016	3704	1403	33662	412583	183	70	1.67	20	9.16	38.6
2017	1,864	569	19,240	273,001	142	43	1.47	21	5.94	27.8

Table 3.2.4 Loading and flow weighted chlorides at IP2 and PC2.

	IP2		PC2	
	Chloride		Chloride	
	Loading	Concentration	Loading	Concentration
Year	(lbs/Yr)	(mg/L)	(lbs/Yr)	(mg/L)
2014	1,651,825	124	3,482,178	127
2015	2,038,841	174	1,512,773	154
2016	2,492,823	123	2,472,477	95
2017	1,515,227	115	1,153,509	96

Table 3.2.5 Unit area loads for TP, SRP, TN, TSS and Chlorides at IP2

Industrial Park - Site 2					
	Load/Acre				
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)	Cl (lbs/acre)
2004	0.46	0.29	3.61	51	
2005	0.48	0.22	3.51	93	
2006	0.47	0.15	4.04	134	
2008	0.33	0.07	2.45	49	
2009	0.19	0.09	1.48	14	
2012	0.58	0.25	5.53	105	
2013	0.75	0.39	6.90	91	
2014	0.58	0.24	6.48	109	443
2015	0.60	0.19	4.80	44	547
2016	0.99	0.38	9.04	111	669
2017	0.50	0.15	5.17	73	407
Average	0.54	0.22	4.82	80	517

PC2

At PC2, data was collected since 2001. In 2010 and 2011, restoration work included adding several settling ponds and a stream bank stabilization along Plymouth Creek between sites IP2 and PC2 to improve the conveyance of water and reduce flooding impacts. Pre and post construction data are compared for PC2 in Table 3.2.6. After the stabilization, there was an 89% increase in flow with reductions in average concentrations of TSS by 67%, TP concentrations by 31%, SRP concentrations by 29% and TN concentrations by 9%. Even with reduced concentrations of TP, SRP and TN, the large increase in flow caused increases in loadings of 11%, 28% and 56%, respectively. The decrease in TSS concentration, however, was large enough to decrease TSS loading by 32%.

Comparing 2017 data to 2016, the loading for each parameter was much lower in 2017 than in 2016 due to the decrease in precipitation. Comparing 2017 loading and flow values to 2014 values, when there were similar precipitation amounts, 2017 had half the flow and loading of all parameters as 2014. Typically, after a restoration, about 5 years are needed to see the restoration effects. Continued monitoring will determine if lower concentrations will continue. Four years of data have been collected for Chlorides and 2017 had the lowest chloride loading since monitoring began (Table 3.2.4).

The unit area loads (UAL) by year are listed in Table 3.2.7. The TP UAL's at PC2 have an average of 0.35 lbs/acre and have been lower than the MPCA Stormwater manual of 1.35 lbs/acre for residential land use since monitoring began. The average TSS UAL of 76 lbs/acre is similar to the MPCA Stormwater manual values of 77 lbs/acre for residential land use.

Table 3.2.6 Loading and flow weighted concentrations for TP, SRP, TN and TSS at PC2. The data is segmented based on the before and after of pond installation and stream stabilization. The % change compares the average loadings and concentrations before and after the restoration work

PC2 - Plymouth Creek Site 2										
	Nutrient Loading				Nutrient Concentration					
Year	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Flow Volume (x 106 M3)	Annual Precipitation (inches)
2001	1,484	534	7,416	95,455	236	85	1.20	15	2.92	34.6
2002	3,931	1,761	21,261	316,003	212	110	1.30	20	8.41	38.1
2003	2,274	1,125	11,040	208,858	216	107	1.05	20	4.76	25.8
2004	2,306	1,052	12,630	490,844	182	83	1.00	42	5.73	32.1
2005	1,327	783	10,761	421,668	161	95	1.30	51	3.14	32.6
2006	2,619	983	22,491	1,623,423	272	102	2.34	169	4.42	29.1
2007	3,157	1,244	23,625	1,319,995	275	108	2.06	115	5.22	31.1
2008	969	191	9,925	827,829	206	105	2.10	175	2.14	20.8
2009	496	222	4,834	121,726	131	59	1.28	32	1.71	19.6
2010	1,588	790	12,118	80,263	134	67	1.02	7	5.40	31.2
2011	2,737	851	30,284	468,328	148	46	1.64	25	8.37	26.3
Average	2,081	867	15,126	543,127	198	88	1.48	61	4.75	29.2
After ponds and stream restoration										
2012	2,049	740	19,555	273,588	149	54	1.42	20	6.25	26.7
2013	2,487	1,198	22,839	395,732	157	76	1.44	25	13.75	31.6
2014	2,920	1,602	35,271	686,184	125	59	1.29	25	12.42	27.5
2015	1,289	599	12,577	104,856	131	61	1.28	11	4.46	29.1
2016	3,846	1,899	35,957	494,863	147	73	1.37	19	11.88	38.6
2017	1,323	622	15,689	255,076	110	52	1.30	21	5.13	27.8
Average	2,319	1,110	23,648	368,383	137	62	1.35	20	8.98	30.2
% Change	11	28	56	-32	-31	-29	-9	-67	89	3

Table 3.2.7 Unit area loads for TP, SRP, TN, TSS and Chlorides at PC2

Plymouth Creek Site 2 - PC2					
	Load/Acre				
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)	Cl (lbs/acre)
2001	0.23	0.08	1.16	15	
2002	0.62	0.28	3.33	49	
2003	0.36	0.18	1.73	33	
2004	0.36	0.16	1.98	77	
2005	0.21	0.12	1.68	66	
2006	0.41	0.15	3.52	254	
2007	0.49	0.19	3.70	207	
2008	0.15	0.03	1.55	130	
2009	0.08	0.03	0.76	19	
2010	0.25	0.12	1.90	13	
2011	0.43	0.13	4.74	73	
2012	0.32	0.12	3.06	43	
2013	0.39	0.19	3.57	62	
2014	0.46	0.25	5.52	107	545
2015	0.20	0.09	1.96	16	324
2016	0.60	0.30	5.63	77	387
2017	0.21	0.10	2.46	40	181
Average	0.35	0.15	2.91	76	359

ML3

The ML3 sampling site has been monitored since 2002. There was no monitoring in 2008 due to steam stabilization work and work on the storm sewer pipe. The loading data compares the pre and post stream bank stabilization project, and 6-9 years post stabilization project (Table 3.2.8). For some stream stabilization projects, it can take five years to see the effects of the completed work. At ML3, there were loading increases following the stream bank stabilization projects for the first five years. The percent change compares the last four years to pre-restoration work. There has been an increase in loading for all parameters except for TSS which saw an 8% decrease. When comparing the loading from 2014-2017 to within five years after restoration, there was a decrease in loading with the exception of 2016. The loading in 2016 corresponds with the highest precipitation recorded since monitoring began in 2002. In 2017, the loading for all parameters was much lower than in 2016 due to the decrease in precipitation. Continued monitoring will determine if loading will decrease.

The unit area loads (UAL) by year are listed in Table 3.2.9. At ML3, the average TP UAL of 1.28 lbs/acre is similar to the MPCA Stormwater Manual residential UAL's of 1.35 lbs/acre. The average TSS UAL of 347 lbs/acre is much higher than the MPCA Stormwater Manual residential UAL of 77 lbs/acre or the commercial UAL of 221 lbs/acre. Since this watershed is more

residential (61%) than commercial (36%), the TSS loading is much higher than the typical loading from these land uses.

Table 3.2.8 Loading and flow weighted concentrations for TP, SRP, TN and TSS at ML3. The data is segmented based on the before storm sewer installation, 5years after the stream stabilization and 6-9 years after restoration. The % change compares the average loadings and concentrations before the restoration to 6-9 years after restoration

ML3 - Medicine Lake Subwatershed 3										
	Nutrient Loading				Nutrient Concentration					
Year	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Flow Volume (x 106 M3)	Annual Precipitation (inches)
2002	258	117	1,903	91,102	231	105	1.7	82	0.49	38.1
2003	183	76	1,051	40,866	259	108	1.49	58	0.32	25.8
2004	208	92	1,148	100,836	276	125	1.52	134	0.33	32.1
2005	84	49	501	70,910	216	124	1.47	215	0.13	32.6
2006	60	24	298	47,291	319	129	1.59	253	0.09	29.1
2007	43	11	140	15,648	376	97	1.22	136	0.05	31.1
Average	139	62	840	61,109	280	115	1.50	146	0.24	31.5
1-5 years after channel stabilization										
2009	56	46	257	6,405	343	265	1.59	40	0.08	19.6
2010	132	81	540	34,632	381	234	1.56	100	0.16	31.2
2011	293	259	1,936	36,875	315	279	2.08	40	0.43	26.3
2012	263	174	1,469	27,549	334	220	1.86	35	0.36	26.7
2013	290	223	1,899	15,929	399	308	2.62	22	0.33	31.6
Average	207	157	1,220	24,278	354	261	1.94	47	0.27	27.1
6-9 years after channel stabilization										
2014	159	90	1,095	76,003	342	194	2.36	164	0.21	27.5
2015	46	24	313	9,741	298	154	2.02	63	0.07	29.1
2016	414	136	2,273	106,165	434	143	2.38	111	0.43	38.6
2017	150	72	1,100	32,285	363	174	2.67	78	0.18	27.8
Average	192	80	1,195	56,048	359	166	2.36	104	0.22	30.7
% Change	38	31	42	-8	29	45	57	-29	-5.3	-2.3

Table 3.2.9 Unit area loads for TP, SRP, TN and TSS at ML3.

Medicine Lake - Site 3				
	Load/Acre			
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)
2002	1.88	0.85	13.89	665
2003	1.34	0.55	7.67	298
2004	1.52	0.67	8.38	736
2005	0.61	0.36	3.66	518
2006	0.44	0.18	2.18	345
2007	0.31	0.08	1.02	114
2009	0.41	0.34	1.88	47
2010	0.96	0.59	3.94	253
2011	2.14	1.89	14.13	269
2012	1.92	1.27	10.72	201
2013	2.12	1.63	13.86	116
2014	1.16	0.66	7.99	555
2015	0.34	0.18	2.28	71
2016	3.02	0.99	16.59	775
2017	1.09	0.52	8.03	236
Average	1.28	0.72	7.75	347

3.3. Northwood Lake Sub-watershed

The Northwood Lake Sub-watershed creates the headwaters of the North Branch of Bassett Creek. The monitored site's watershed is located entirely within the City of Plymouth and is upstream of Northwood Lake, which is in the City of New Hope (Figure 3.3.1). The level in Northwood Lake is controlled by a 10' wide weir outlet structure along Boone Ave. This weir causes the water to back up to the monitoring station in the City of Plymouth. In 2016-2017, the City of New Hope installed several improvements around the lake to reduce the phosphorus loading. More information about these BMP improvements can be found at the City of New Hope's website. Northwood Lake has been classified as impaired for excess nutrients since 2004.

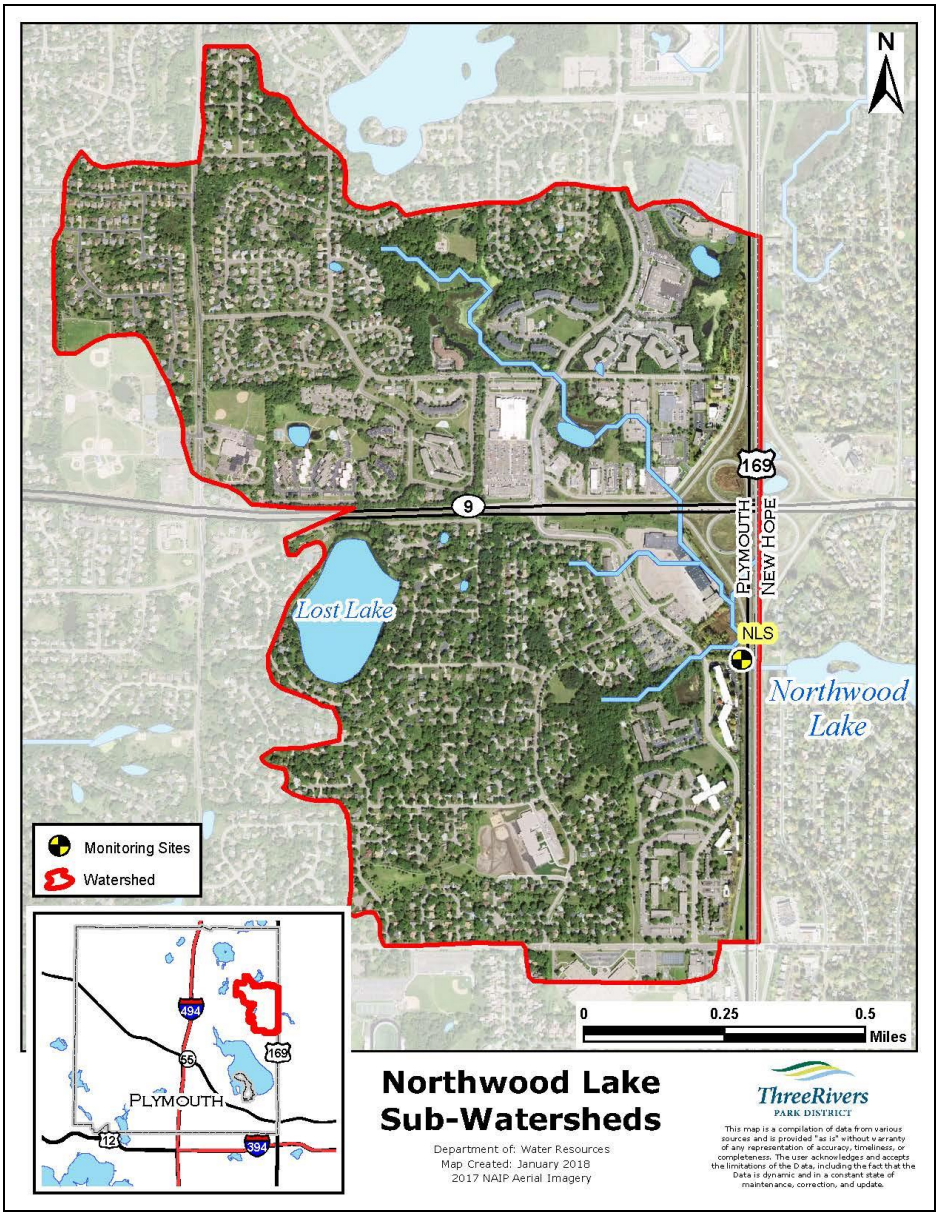

Figure 3.3.1 Northwood Lake Sub-watershed map

3.3.1. Stormwater Monitoring Site

The Northwood Lake Sub-watershed (NLS) monitoring site is located at the edge of the City of Plymouth. The site monitors flow from 835 acres which is 34% impervious. The sampling site is east of Lancaster Lane North and south of County Road 9 behind an apartment complex. The site is located in a six foot culvert just before the stream flows under Highway 169. The site receives runoff from two tributaries. One branch from the north and the other from the west (Figure 3.3.1).

Table 3.3.1 Summary of watershed characteristics for NLS

Site	*Subwatershed Area (acres)*	*% impervious (acres)*[1]	*% of Watershed in Plymouth*	*Dominant land uses*[2]
NLS	835	34% (285 ac.)	100%	Residential

[1] % impervious area determined using the 2016 University of Minnesota TCMA 1-meter land cover classification GIS layer

[2] Dominant Land Uses determined using GIS layer obtained from the City of Plymouth

3.3.2. Measured Flow

Due to the outlet of Northwood Lake being a weir, the NLS site typically goes stagnant at a level of about 1.3 feet on the staff gage. Being at the headwaters of the North Branch of Bassett Creek, this site it is quite flashy and responds quickly to precipitation intensity and duration. During the sampling period, four different precipitation events of about 1.7 inches each produced flows of about 27 cfs (Figure 3.3.2).

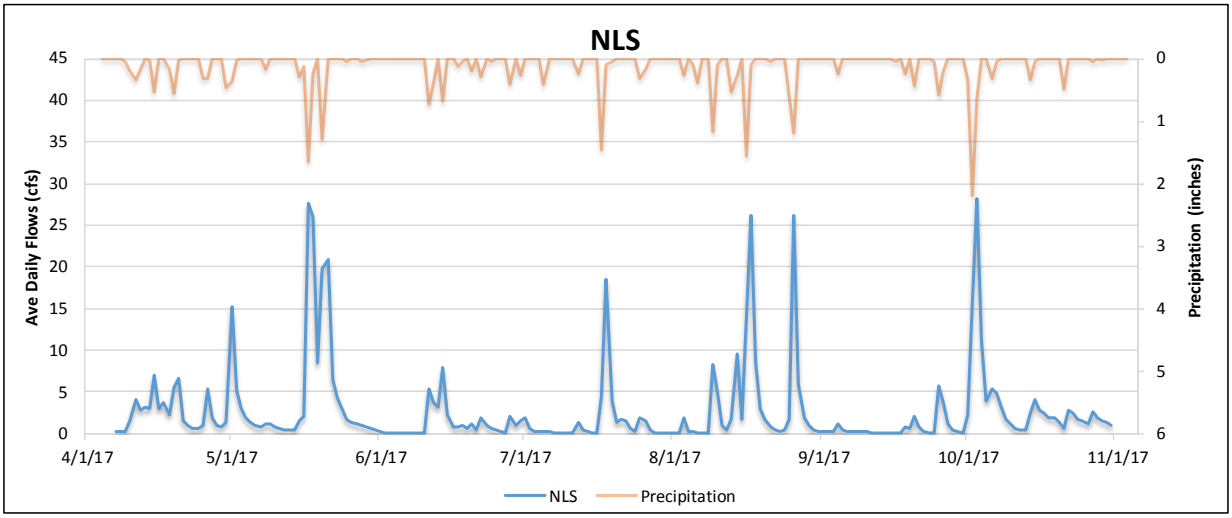

Figure 3.3.2 Average daily flow for Northwood Lake Sub-watershed (NLS)

3.3.3. Concentrations

At NLS, 25 water samples were collected over the season. On average, the SRP was 27% of TP.

Table 3.3.2 Summary of average, minimum and maximum concentrations for TP, SRP, TN and TSS at NLS

Site	Avg TP (min-max) µg/L	Avg SRP (min-max) µg/L	Avg TN (min-max) mg/L	Avg TSS (min-max) mg/L
NLS	283 (82 - 799)	77 (5 - 388)	2.3 (0.8 - 8.4)	106 (1.6 - 499)

3.3.4. Loading

At NLS, data was collected since 2012. In 2016 and 2017, monitored flows may have been impacted by several stormwater infrastructure projects adjacent to Northwood Lake. The flows appear to be stagnant despite higher than average flows in 2016. While the flow weighted concentrations and loadings of TP, SRP and TN in 2017 were within the ranges of previous years' measurements, the TSS had concentrations and loadings that were the highest in 2017. There were observations in the field of new sediment erosion flowing into the stream from the south along Highway 169. Along with the erosion coming from the south, the apartment complex adjacent to the stream was renovating the parking lot and may have contributed to sediment loading. Typically, during rain events, this site will have more visually turbid water coming from the west tributary than from the north tributary.

The unit area loads (UAL) by year are listed in Table 3.3.4. At NLS, the average TP UAL of 1.01 lbs/acre is lower than the MPCA Stormwater Manual residential UAL of 1.35 lbs/acre. The average TSS UAL of 329 is much higher than the MPCA Stormwater Manual residential UAL of 77 lbs/acre.

Table 3.3.3 Loading and flow weighted concentrations of TP, SRP, TN and TSS at NLS.

NLS - Northwood Lake Subwatershed										
	Nutrient Loading				Nutrient Concentration					
Year	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Flow Volume (x 10^6 M^3)	Annual Precipitation (inches)
2012	641	254	6,198	98,605	153	61	1.48	24	1.90	26.7
2013	821	361	7,492	225,785	185	83	1.71	52	1.99	31.6
2014	1,279	589	12,748	377,933	265	122	2.64	78	1.87	27.5
2015	933	296	8,142	266,447	214	68	1.87	61	1.97	29.1
2016	585	195	5,211	240,786	278	93	2.47	114	0.95	38.6
2017	803	210	7,401	439,568	254	66	2.34	139	1.35	27.8

Table 3.3.4 Unit area loading for TP, SRP, TN and TSS at NLS.

NLS - Northwood Lake Subwatershed				
	Load/Acre			
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)
2012	0.77	0.30	7.42	118
2013	0.98	0.43	8.97	270
2014	1.53	0.71	15.26	453
2015	1.12	0.35	9.75	319
2016	0.70	0.23	6.24	288
2017	0.96	0.25	8.86	526
Average	1.01	0.38	9.42	329

3.4. Bass Lake Watershed

The Bass Lake watershed is 3,105 acres and is located entirely within the City of Plymouth. The largest subwatershed of Bass Lake is monitored at BL3 (Bass Lake site 3), accounting for about 59% of the Bass Lake watershed area, (Figure 3.4.1). Bass Lake has been classified as impaired for excess nutrients since 2002.

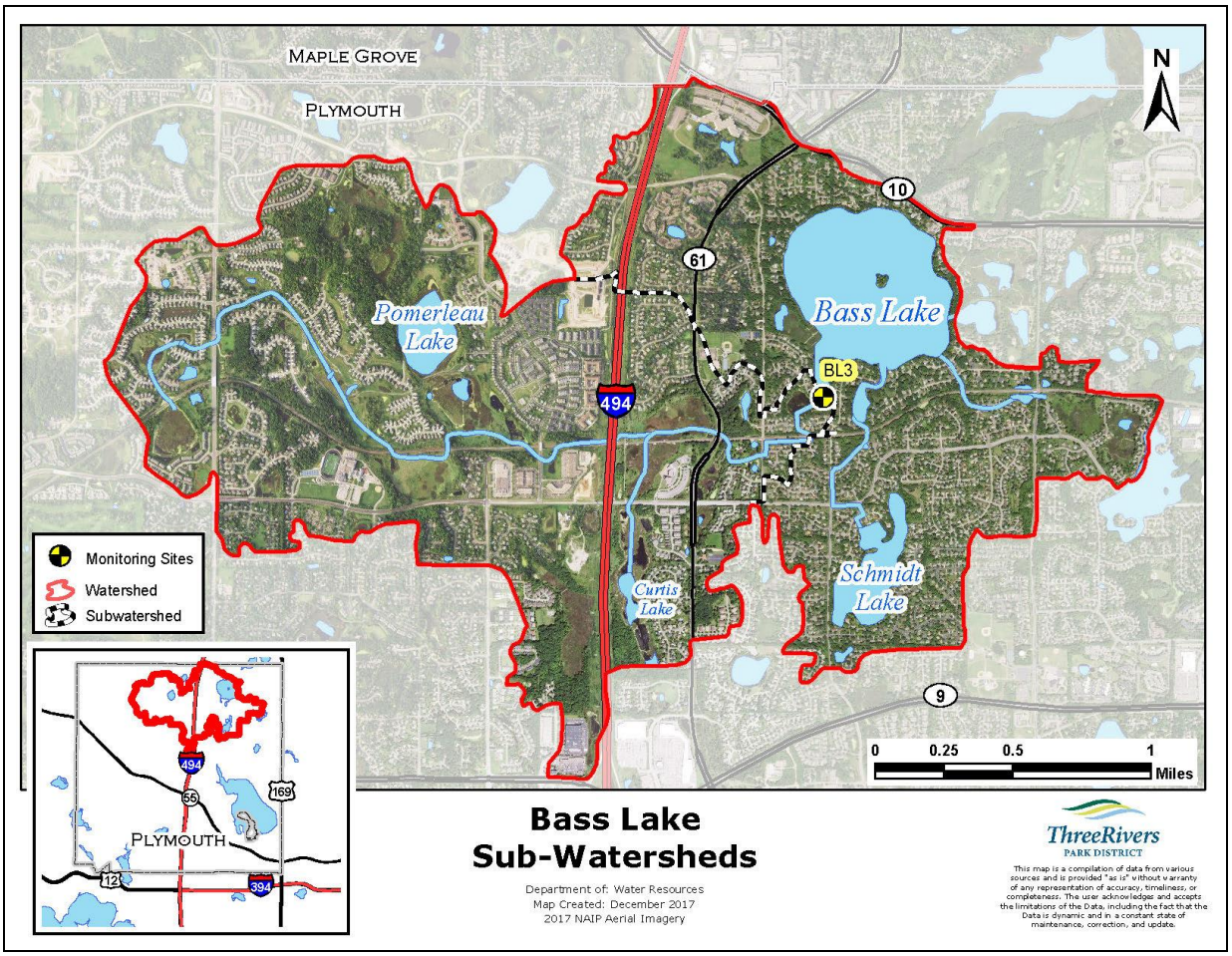

Figure 3.4.1 Bass Lake sub-watershed map

3.4.1. Stormwater Monitoring Site

The BL3 sampling site is located 0.1 miles southeast of the 54th Ave N and Norwood Lane North intersection. The site receives runoff from 1,846 acres, of which 28% is impervious surface (Table 3.4.1). The site is downstream of a 6.5 acre pond that attenuates flow and allows settling of particulates. There are two adjacent 24 inch round culverts at the BL3 sampling site referred to as "east" and "west". Flow measurements are taken in both culverts while water samples are

only taken in the west culvert. Since the culverts receive water from the same subwatershed, nutrient concentrations from the west culvert were used to estimate nutrient loading for both culverts.

Table 3.4.1 Summary of watershed characteristics for site BL3

Site	*Subwatershed Area (acres)*	*% impervious (acres)*[1]	*% of Bass Lake Watershed*	*Dominant land uses*[2]
BL3	1,846	28% (511 ac.)	59%	Residential

[1] % impervious area determined using the 2016 University of Minnesota TCMA 1-meter land cover classification GIS layer

[2] Dominant Land Uses determined using GIS layer obtained from the City of Plymouth

3.4.2. Measured Flow

The measured flow of the east culvert was 14% lower than the measured flow for the west culvert. The west culvert sits a little lower than the east culvert, resulting in slightly more flow. The pond on the upstream side of the culvert causes a delay in the flow hydrograph after precipitation events.

The largest flow pulse in each culvert was about 12 cfs and occurred May 21st after the combined May 17th-20th rain events of 3.77 inches (Figure 3.4.2).

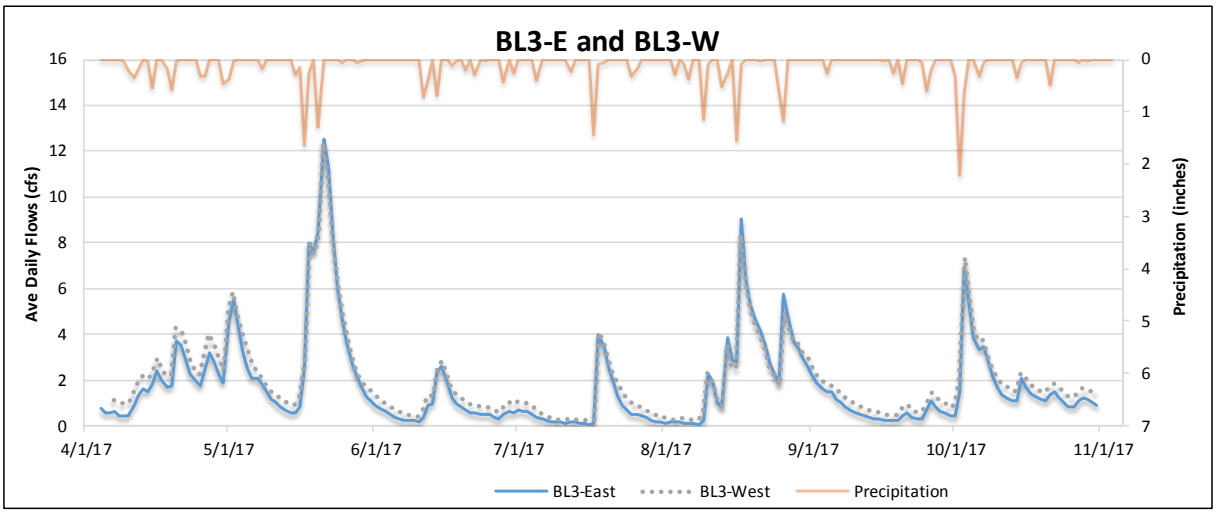

Figure 3.4.2 Average daily flow for Bass Lake site 3 East and West (BL3-E and BL3-W)

3.4.3. Concentrations

At BL3-W, 27 water samples were collected over the season. The average concentrations are listed in Table 3.4.2. On average, the SRP was 30% of TP.

Table 3.4.2 Summary of average, minimum and maximum concentrations for TP, SRP, TN and TSS at BL3-W

Site	Avg TP (min-max) µg/L	Avg SRP (min-max) µg/L	Avg TN (min-max) mg/L	Avg TSS (min-max) mg/L
BL3-W	92 (38 - 284)	28 (14 - 69)	1.3 (0.7 - 3.0)	3.5 (0.8 - 10.8)

3.4.4. Loading

At BL3, data has been collected since 2015 (Table 3.4.3). In 2017, the flow volume and nutrient concentrations were the lowest since monitoring began. Due to the lower flows and concentrations, the loading was also the lowest it has been in the 3 years of monitoring.

The unit area loads (UAL) by year are listed in Table 3.4.4. At BL3, the average TP UAL of 0.40 lbs/acre is much lower than the MPCA Stormwater Manual residential UAL of 1.35 lbs/acre. The average TSS UAL of 15 is also much lower than the MPCA Stormwater Manual residential UAL of 77 lbs/acre.

Table 3.4.3 Loading and flow weighted concentrations of TP, SRP, TN and TSS at BL3

BL3 - Bass Lake Site 3										
	Nutrient Loading				Nutrient Concentration					
Year	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Flow Volume (x 10^6 M^3)	Annual Precipitation (inches)
2015	1,079	396	9,546	40,986	172	63	1.52	6.5	2.84	29.1
2016	800	368	8,774	24,015	111	51	1.22	3.3	3.27	38.6
2017	316	121	4,739	17,210	69	26	1.04	3.8	1.04	27.8

Table 3.4.4 Unit area loading for TP, SRP, TN and TSS at BL3

Bass Lake - Site 3				
	Load/Acre			
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)
2015	0.58	0.21	5.17	22
2016	0.43	0.20	4.75	13
2017	0.17	0.07	2.57	9
Average	0.40	0.16	4.16	15

3.5. Gleason Lake Watershed

The Gleason Lake Watershed is 2,643 acres with 93% of the watershed in the City of Plymouth (Figure 3.5.1). One monitoring location was installed upstream of Gleason Lake along Gleason Creek (GC-1). This site receives runoff from 62% of the watershed area. Gleason Lake has been classified as impaired for excess nutrients since 2010.

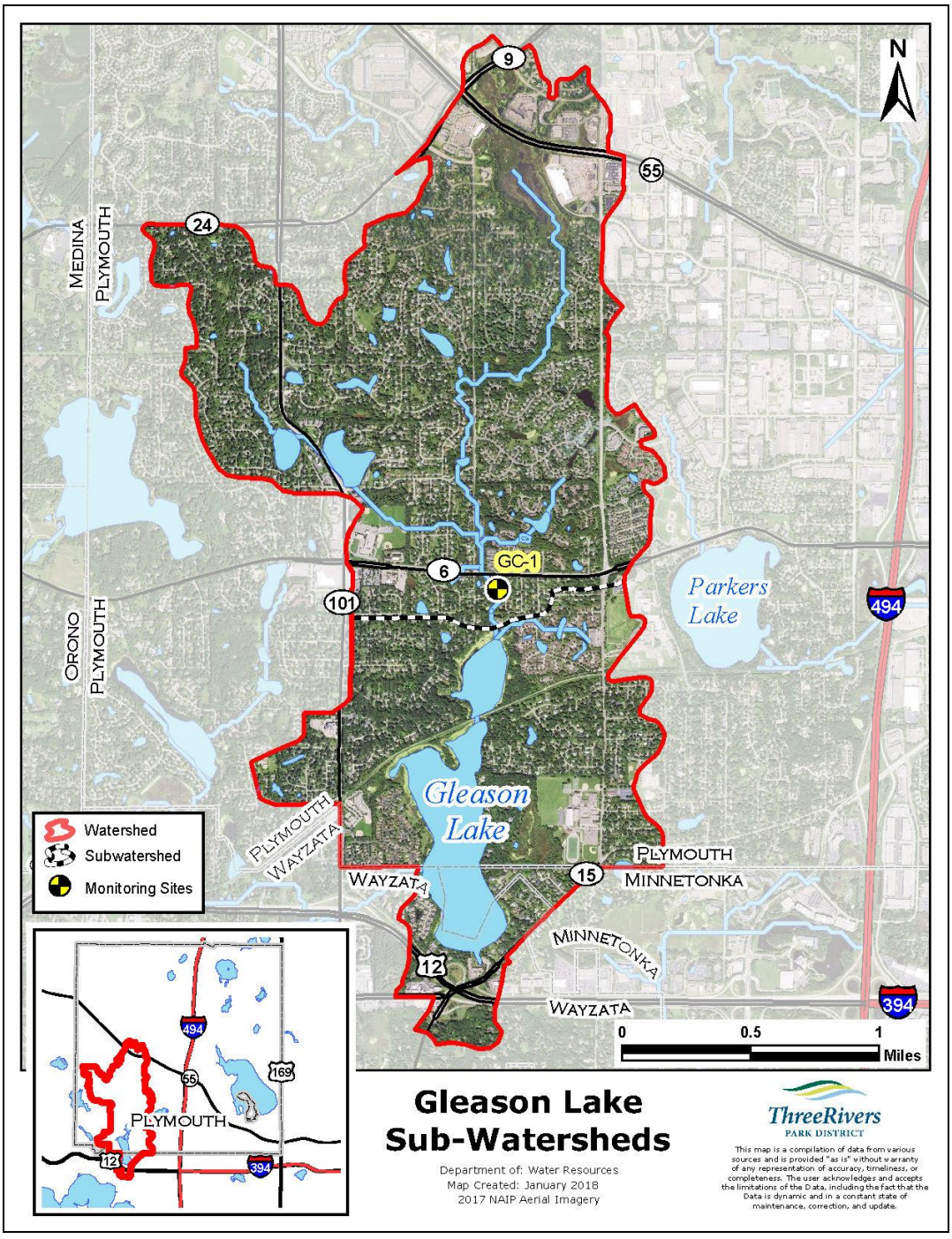

Figure 3.5.1 Gleason Creek sub-watershed map

3.5.1. Stormwater Monitoring

This was the first year Gleason Creek was monitored at the location GC-1 (Gleason Creek site 1) by Three Rivers Park District. The site is an open channel just north of Gleason Lake off a bike path that connects Highway 6 and Black Oaks Lane North. The watershed is about 28% impervious and primarily residential land use (Table 3.5.1).

Table 3.5.1 Summary of watershed characteristics for sites GC-1

Site	*Subwatershed Area (acres)*	*% impervious (acres)*[1]	*% of Gleason Lake Watershed*	*Dominant land uses*[2]
GC-1	1,650	28% (454 ac.)	67%	Residential

[1] % impervious area determined using the 2016 University of Minnesota TCMA 1-meter land cover classification GIS layer

[2] Dominant Land Uses determined using GIS layer obtained from the City of Plymouth

3.5.2. Measured Flow

The GC-1 hydrograph has flow responses that increase immediately following precipitation, but there is a delayed hydrograph response following storm events that persist for several days. During the sampling period, two large flow pulses of approximately 16 cfs for the average daily flows, occurred during the two largest precipitation events that occurred at the end of May and the beginning of October (Figure 3.5.2).

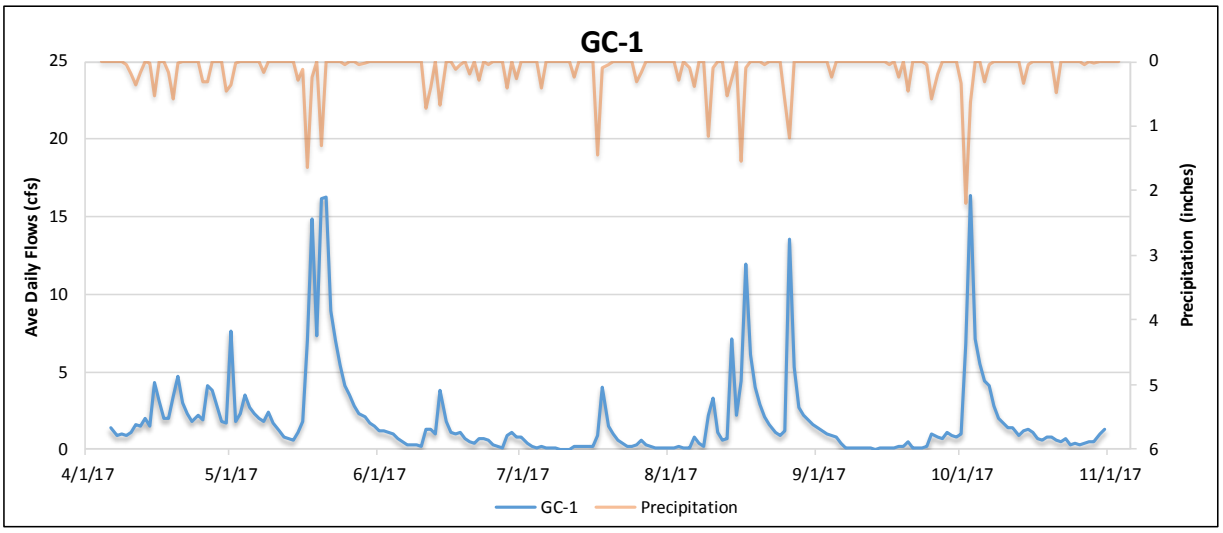

Figure 3.5.2 Average daily flow for Gleason Creek site 1 (GC-1)

3.5.3. Concentrations

At GC-1, 28 water samples were collected over the season. The average TP, SRP, TN and TSS concentrations are listed in Table 3.5.2. On average, the SRP was 22% of TP.

Table 3.5.2 Summary of average, minimum and maximum concentrations for TP, SRP, TN and TSS at GC-1

Site	Avg TP (min-max) µg/L	Avg SRP (min-max) µg/L	Avg TN (min-max) mg/L	Avg TSS (min-max) mg/L
GC-1	189 (67 - 516)	41 (7 - 119)	1.6 (0.8 - 3.2)	34 (1.2 - 143)

3.5.4. Loading

At GC-1, this was the first year of data collected by Three Rivers Park District (TRPD). In 2005 and from 2007-2016, Minnehaha Creek Watershed District (MCWD) collected flow and concentration data and calculated loading. The loading and flow-weighted results are listed in Table 3.5.3, but caution should be exercised when comparing TRPD results to MCWD results since methodology was different. MCWD focused on collecting bi-weekly and weekly grabs, while TRPD collected bi-weekly grabs along with storm event samples which would explain the higher TP and TSS concentrations in 2017. In addition, the loading calculated by MCWD is for the sampling period while TRPD extrapolated the loading to the full year based on precipitation. More monitoring data will help determine if there are any trends between concentration, flow or loading.

The unit area loads (UAL) for 2017 are listed in Table 3.5.4. At GC-1, the TP UAL of 0.29 lbs/acre is much lower than the MPCA Stormwater Manual residential UAL of 1.35 lbs/acre. The TSS UAL of 73 is similar to the MPCA Stormwater Manual residential UAL of 77 lbs/acre.

Table 3.5.3 Loading and flow weighted concentrations of TP, SRP, TN and TSS at GC-1. Data is a compilation from Three Rivers Park District and Minnehaha Creek Watershed District and caution should be used when assessing the data for trends since different methodologies were used by the two agencies. In addition, loading from 2005-2016 is for the sampling period while the loading listed for 2017 is for the year

GC1 - Gleason Lake Subwatershed										
	Nutrient Loading				Nutrient Concentration				Flow Volume (x 106 M3)	Annual Precipitation (inches)
Year	TP (lbs)	SRP (lbs)	TN (lbs)	TSS (lbs)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)		
2005*	156	34	1,031	15,376	197	42	1.30	19	0.77	32.6
2007*	456	72	2,621	39,107	228	36	1.31	17	1.64	31.1
2008*	75	15	854	10,337	123	24	1.39	17	0.58	20.8
2009*	35	7	283	2,487	129	26	1.03	9	0.23	19.6
2010*	232	100	2,095	7,377	123	53	1.12	4	1.46	31.2
2011*	387	133	3,537	43,103	143	49	1.31	16	2.10	26.3
2012*	214	75	1,004	14,450	149	52	0.70	10	1.58	26.7
2013*	583	297	1,691	28,555	194	99	0.56	10	2.84	31.6
2014*	576	308	4,978	15,477	147	79	1.27	4	3.59	27.5
2015*	331	137	1,648	25,900	161	67	0.80	13	1.51	29.1
2016*	266	104	1,914	11,035	143	56	1.03	6	1.24	38.6
2017	479	85	4,194	120,809	211	37	1.85	53	0.97	27.8

*** Data collected by Minnehaha Creek Watershed District (MCWD) [1]**

Table 3.5.4 Loading per acre for TP, SRP, TN and TSS for GC-1

GC-1				
	Load/Acre			
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)
2017	0.29	0.05	2.54	73

[1] MCWD Disclaimer: The data to which this notice is attached are made available pursuant to the Minnesota Government Data Practices Act (Minnesota Statutes Chapter 13). THE DATA ARE PROVIDED TO YOU AS IS AND WITHOUT ANY WARRANTY AS TO THEIR PERFORMANCE, MERCHANTABILITY, OR FITNESS FOR ANY PARTICULAR PURPOSE. These data were developed by the Minnehaha Creek Watershed District for its own business purposes. The Minnehaha Creek Watershed District (MCWD) makes every effort to assure that the data and the associated documentation are error-free, complete, current, and accurate; however, the Minnehaha Creek Watershed District does not guarantee this. The Minnehaha Creek Watershed District is NOT responsible for any consequences resulting from your use of the data. You should consult the available online documentation or contact the staff contact listed in the MCWD's website to determine the limitations of the data. If you transmit or provide the data (or any portion of it) to another user, the data must include a copy of this disclaimer.

3.6. Elm Creek Watershed

A portion of Elm Creek runs through the northwest corner of the City of Plymouth (Figure 3.6.1). A TMDL (Total Maximum Daily Load) report has been completed for the Elm Creek watershed and was approved by the EPA in 2017. Elm Creek was listed as impaired for Chlorides and Dissolved Oxygen in 2014 and *E. Coli* in 2010. Several lakes in the watershed are also listed as impaired for excess nutrients. Along the segment of Elm Creek that runs through the City of Plymouth, several BMP's were installed in 2016 to reduce nutrient loading including: stream restoration, retention ponds and iron enhanced benches within a retention pond.

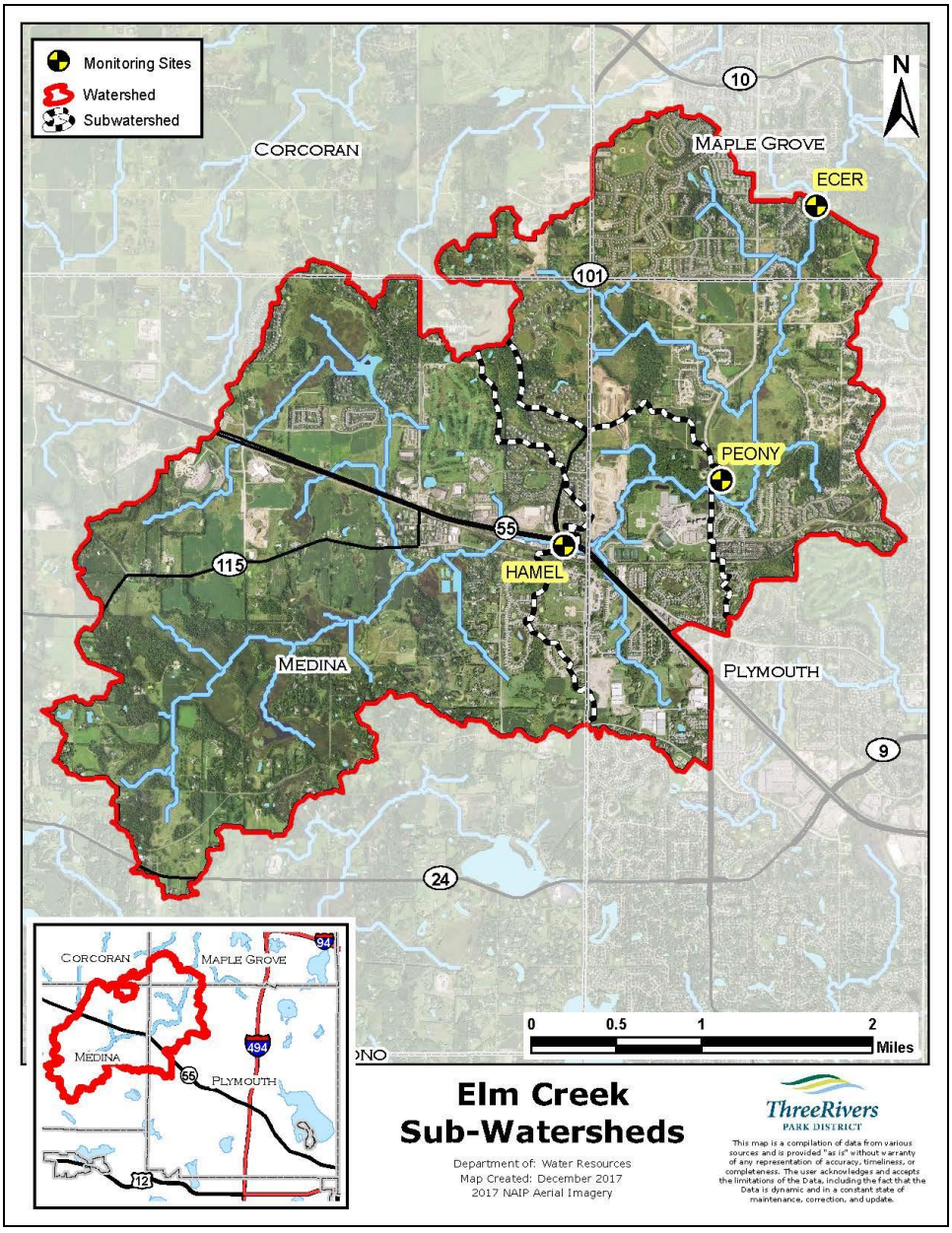

Figure 3.6.1 Elm Creek sub-watershed map

3.6.1. Stormwater Monitoring Sites

To monitor the portion of Elm Creek that flows through Plymouth, three monitoring stations were set up. One before Elm Creek reaches the City of Plymouth (Hamel), another mid-way through the City of Plymouth (Peony) and the final one after Elm Creek leaves the City of Plymouth and flows into Maple Grove (ECER). The percent of total watershed in the City of Plymouth is summarized in Table 3.6.1.

The uppermost site, Hamel, is located at the intersection of Hamel Road and Hwy 55. It is an eight foot wide by four foot tall culvert. The Peony site is in an open channel just downstream of several BMP improvements near the Wayzata High School off Peony Lane N. While the Peony site is in an area that does not flood, it is surrounded by floodplain and when the stream rises to about 2.2 feet, a side channel forms and some of the flow bypasses the main stream channel. The furthest downstream monitoring site, ECER, is in an open channel along a walking path off Elm Road. This site is downstream of a 210 acre wetland complex that allows for the settling of sediments.

Table 3.6.1 Summary of Elm Creek watershed characteristics for sites Hamel, Peony and ECER

Site	*Subwatershed Area (acres)*	*% impervious (acres)*[1]	*% of Total Watershed in Plymouth*
Hamel	4,272	12% (506 ac.)	0%
Peony	5,429	15% (811 ac.)	17%
ECER	7,921	18% (1,414 ac.)	29%

[1] % impervious area determined using the 2016 University of Minnesota TCMA 1-meter land cover classification GIS layer

3.6.2. Measured Flow

Since these three sites are cumulative, the flow increases with distance downstream and there is an increase in the lag time of the flow pulse after a precipitation event. The largest flow pulses occurred after the precipitation events from May 17th–May 20th. These combined storms led to the largest average daily flow pulses on May 21st of 53 cfs at Hamel, 67 cfs at Peony and 85 cfs on May 22nd at ECER (Figure 3.6.2).

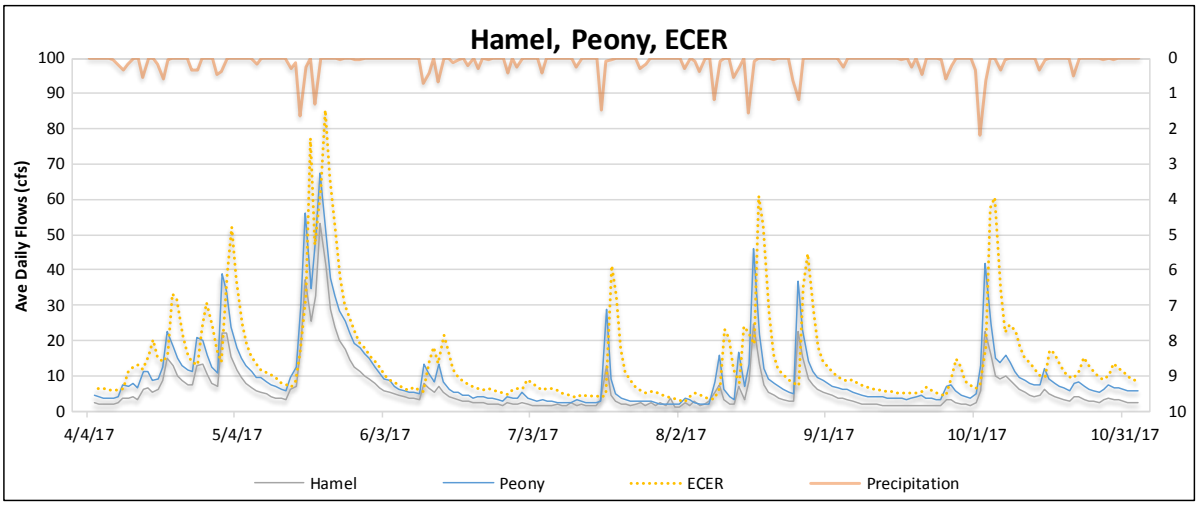

Figure 3.6.2 Average daily flow for Elm Creek watershed sites: Hamel, Peony and ECER

3.6.3. Concentrations

A summary of the TP, SRP, TN and TSS average concentrations for the Elm Creek monitoring sites is displayed in Table 3.6.2 and Figure 3.6.3. In general, the parameters increase in concentration between Hamel and Peony and then decrease between Peony and ECER.

At Hamel, 28 water samples were collected over the season. On average, the SRP was 27% of TP. At Peony, 30 water samples were collected over the season. On average, the SRP was 48% of TP. The average concentrations for TP, SRP and TSS were higher than the average concentrations at upstream Hamel. These higher concentrations are due to the construction at Wayzata High School and because the stream bank restoration area has not fully stabilized. The Peony site is located downstream of the high school. At ECER, 27 water samples were collected over the season. On average, the SRP was 58% of TP. In the wetland complex between Peony and ECER, much of the sediments settled out causing the TSS concentration to be 10 times lower and the TP, SRP and TN concentrations to be 1.5 times lower at ECER compared to upstream Peony.

Table 3.6.2 Summary of average, minimum and maximum concentrations for TP, SRP, TN and TSS at Hamel, Peony and ECER

Site	Avg TP (min-max) µg/L	Avg SRP (min-max) µg/L	Avg TN (min-max) mg/L	Avg TSS (min-max) mg/L
HAMEL	233 (64 - 800)	63 (18 - 113)	2.2 (1.1 - 7.9)	64 (2.2 - 428)
PEONY	309 (134 - 529)	148 (60 - 252)	2.1 (1.1 - 7.2)	250 (3.0 - 3396)
ECER	179 (66 - 393)	104 (38 - 179)	1.5 (0.8 - 4.1)	23 (1.4 - 120)

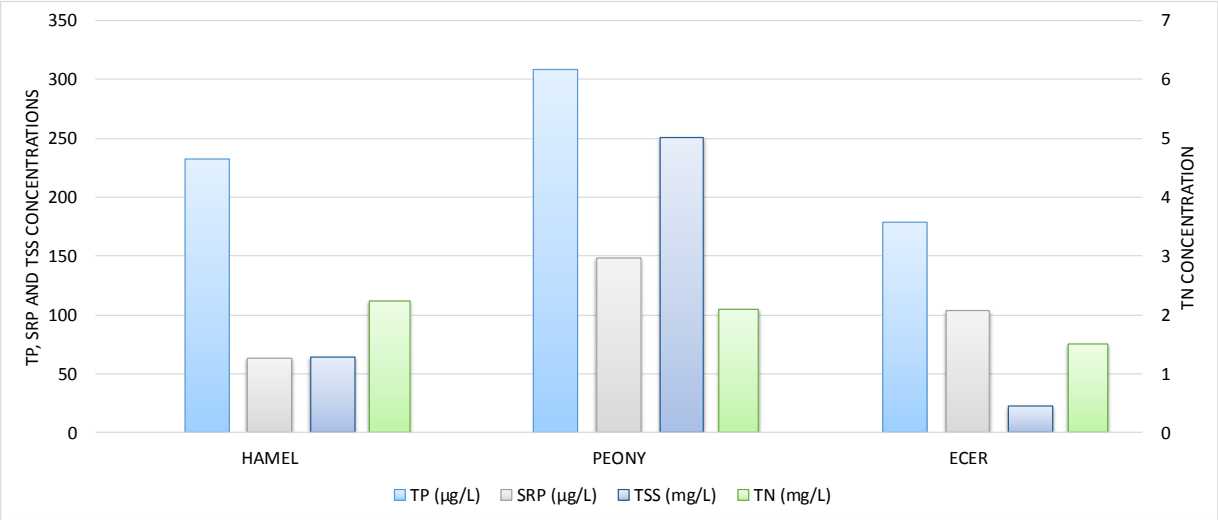

Figure 3.6.3 Average concentrations of TP, SRP, TSS and TN for the Elm Creek Watershed sites including: Hamel, Peony and ECER

3.6.4. Loading

The loading along Elm Creek has been monitored since 2000 at the Hamel site and the downstream site of ECER. The Peony site was added in 2016 to monitor between Hamel and ECER as well as get a better idea of the effects of nearby upstream retention ponds, stream restoration and iron enhanced retention ponds. Nutrient and sediment loading was greater at ECER than Hamel every year due to increased watershed sized and flow volumes. However, because of a large wetland complex in between these sites, the nutrient and sediment concentrations are reduced at ECER compared with Hamel.

Hamel

At Hamel, data has been collected since 2000 except for 2004-2006 and 2013-2015 (Table 3.6.3). Immediately adjacent to the monitored stream section, a stream restoration project was completed in 2015. The project included the construction of a small retention pond and planting of native species on the stream banks. In 2017, the loading of nutrients and TSS were much lower than in 2016, but 2016 had the highest loading due to the higher precipitation and five times as much flow in 2016 compared to 2017. The nutrient loading in 2017 was lower in comparison to those years with similar precipitation (2011 and 2012) while the TSS was similar to years with comparative precipitation. Continued monitoring will assess the loading before Elm Creek reaches the City of Plymouth.

The unit area loads (UAL) by year are listed in Table 3.6.4. At Hamel, the average TP UAL of 0.55 lbs/acre is lower than the MPCA Stormwater Manual residential UAL of 1.35 lbs/acre. The average TSS UAL of 91 is higher than the MPCA Stormwater Manual residential UAL of 77 lbs/acre. The TSS UAL in the last 3 monitored years (2012, 2016 and 2017) were higher than the previous 5 years of monitoring which could be due to the stream restoration and construction work that occurred close to the stream.

Table 3.6.3 Loading and flow weighted concentrations of TP, SRP, TN and TSS at Hamel.

Hamel										
	Nutrient Loading				Nutrient Concentration					
Year	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Flow Volume (x 10^6 M^3)	Annual Precipitation (inches)
2000	195	73	1,288	32,551	304	113	2.00	54	0.31	32.3
2001	1,164	533	5,922	39,637	354	162	1.80	12	1.97	34.6
2002	5,967	2,769	30,496	771,083	378	175	1.90	49	7.14	38.1
2003	1,233	703	9,442	141,995	234	133	1.80	27	2.39	25.8
2007	308	171	4,268	155,002	158	88	2.19	98	0.88	31.1
2008	798	261	7,111	246,323	208	68	1.85	76	3.22	20.8
2009	280	122	3,425	40,295	187	82	2.29	30	0.68	19.6
2010	2,157	721	9,810	166,074	331	111	1.51	25	2.95	31.2
2011	4,021	1,004	36,604	365,365	301	75	2.74	27	6.07	26.3
2012	2,459	853	20,583	645,515	349	121	2.92	92	3.20	26.7
2016	7,803	1,877	50,003	1,377,750	435	103	2.74	76	15.10	38.6
2017	1,601	475	16,871	670,208	214	64	2.25	90	3.19	27.8

Table 3.6.4 Unit area loading for TP, SRP, TN and TSS at Hamel

Hamel				
	Load/Acre			
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)
2000	0.05	0.02	0.30	8
2001	0.27	0.12	1.39	9
2002	1.40	0.65	7.14	180
2003	0.29	0.16	2.21	33
2007	0.07	0.04	1.00	36
2008	0.19	0.06	1.66	58
2009	0.07	0.03	0.80	9
2010	0.50	0.17	2.30	39
2011	0.94	0.24	8.57	86
2012	0.58	0.20	4.82	151
2016	1.83	0.44	11.70	323
2017	0.37	0.11	3.95	157
Average	0.55	0.19	3.82	91

Peony

At Peony, data has been collected since 2016 (Table 3.6.5). Between Hamel and Peony, there have been improvements to the watershed including holding ponds, iron bench retention ponds and stream restoration. There have also been other construction activities close to the stream not related to best management practices for the watershed. In 2017, the loading of nutrients was much lower than in 2016 primarily due to the lower precipitation and three times lower flow in 2017. The TSS increased which could be due to construction in the area and the stream restoration project still stabilizing. Spotty areas of bare soil were observed along the stream restoration at the beginning of the sampling period. Continued monitoring just past the improvements will assess the effects of the improvements.

The unit area loads (UAL) by year are listed in Table 3.6.6. At Peony, the average TP UAL of 1.40 lbs/acre is similar to the MPCA Stormwater Manual residential UAL of 1.35 lbs/acre. The average TSS UAL of 868 lbs/acre is significantly higher than the MPCA Stormwater Manual residential UAL of 77 lbs/acre.

The UAL's were also assessed as loading between Hamel and Peony by subtracting the Hamel load from the Peony load and assessing the loading for the acres in between Hamel and Peony. This shows how concentrated the loading of sediment and phosphorus are between Hamel and Peony since the TP and SRP UALs are double and the TSS UAL is almost four times higher in the additional 1,000 acres of land between Hamel and Peony. The average TN UAL decreases since more of the TN load is coming from above the Hamel site.

Table 3.6.5 Loading and flow weighted concentrations of TP, SRP, TN and TSS at Peony.

Peony										
	Nutrient Loading				Nutrient Concentration					
Year	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Flow Volume (x 10^6 M^3)	Annual Precipitation (inches)
2016	11,470	2,575	54,362	4,284,931	643	144	3.05	240	15.61	31.2
2017	3,734	1,549	22,516	5,139,148	317	127	1.85	422	5.19	27.8

Table 3.6.6 Unit area loads for TP, SRP, TN and TSS at Peony along with the unit area loads at Peony adjusted for the Hamel loading

	Peony				Peony adjusted for Hamel loading			
	Load/Acre				Load/Acre			
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)
2016	2.11	0.47	10.01	789	3.17	0.60	3.77	2513
2017	0.69	0.29	4.15	947	1.84	0.93	4.88	3863
Average	1.40	0.38	7.08	868	2.51	0.77	4.32	3188

ECER

At ECER, data has been collected since 2000 except for 2004-2006 and 2013-2015 (Table 3.6.7). In 2017, the loading of nutrients and TSS are about half of the 2016 loading primarily due to the lower precipitation and three times less flow in 2017. The nutrient loadings in 2017 were similar to those years with comparative precipitation (2011 and 2012), however the TSS load in 2017 was about two times higher compared to those years with similar precipitation. Continued monitoring will assess the loading that leaves the City of Plymouth in Elm Creek.

The unit area loads (UAL) by year are listed in Table 3.6.8. At ECER, the average TP UAL of 0.43 lbs/acre is lower than the MPCA Stormwater Manual residential UAL of 1.35 lbs/acre. The average TSS UAL of 55 is also lower than the MPCA Stormwater Manual residential UAL of 77 lbs/acre.

The UAL's were also assessed as loading between Peony and ECER by subtracting the Peony load from the ECER load and assessing the loading for the 1,157 acres in between Peony and ECER. Between Peony and ECER, the UAL for TP and TSS decreased, while the UAL for SRP and TN increased. The main driver of these interactions is that Elm Creek flows through a 210 acre wetland complex. The wetland removes TP and TSS by filtering/settling of suspended sediments. The decomposition of organic material in the wetland may be a source of SRP and TN release.

Table 3.6.7 Loading and flow weighted concentrations of TP, SRP, TN and TSS at ECER.

ECER - Elm Creek @ Elm Road										
	Nutrient Loading				Nutrient Concentration					
Year	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Flow Volume (x 10^6 M^3)	Annual Precipitation (inches)
2000	869	261	6,415	104,191	232	70	1.70	28	1.62	32.3
2001	4,408	1,946	26,544	342,708	289	131	1.80	23	5.37	34.6
2002	7,994	2,911	30,541	838,460	416	151	1.60	44	8.72	38.1
2003	2,218	968	12,840	215,520	263	115	1.50	26	3.82	25.8
2007	659	583	8,238	390,206	227	201	2.84	134	2.29	31.1
2008	941	576	8,744	473,456	261	160	2.43	131	2.25	20.8
2009	654	372	4,539	65,183	232	132	1.61	23	1.42	19.6
2010	3,601	2,063	19,074	728,546	381	218	2.02	77	5.19	31.2
2011	5,615	2,753	18,313	147,238	287	141	1.98	16	9.81	26.3
2012	2,784	1,890	22,641	284,335	209	142	1.70	21	7.08	26.7
2016	8,214	2,731	54,385	1,198,469	333	111	2.20	49	21.29	38.6
2017	3,281	1,889	26,705	460,503	184	106	1.5	26	7.60	27.8

Table 3.6.8 Unit area loads for TP, SRP, TN and TSS at ECER along with loadings adjusted for Peony loading

	ECER				ECER adjusted for Peony loading			
	Load/Acre				Load/Acre			
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)
2000	0.11	0.03	0.81	13				
2001	0.56	0.25	3.35	43				
2002	1.01	0.37	3.86	106				
2003	0.28	0.12	1.62	27				
2007	0.08	0.07	1.04	49				
2008	0.12	0.07	1.10	60				
2009	0.08	0.05	0.57	8				
2010	0.45	0.26	2.41	92				
2011	0.71	0.35	2.31	19				
2012	0.35	0.24	2.86	36				
2016	1.04	0.34	6.87	151	-1.31	0.06	0.01	-1239
2017	0.41	0.24	3.37	58	-0.18	0.14	1.68	-1877
Average	0.43	0.20	2.51	55	-0.74	0.10	0.84	-1558

3.7. Ponderosa Rain Garden (PRG)

An iron enhanced rain garden was installed near 2625 Garland Lane North in the summer of 2016. Water samples were collected from street runoff flowing into the rain garden (PRG-In). The outlet of the rain garden is a perforated pipe that runs under the rain garden to a nearby storm drain (PRG-Out).

3.7.1. Concentration

There were 11 samples collected during rain events. At PRG-In there were five samples and at PRG-Out there were six samples (Figure 3.7.1). There is one less inlet sample because the rain event had ended, but there was still water flowing out of the rain garden. On average, the SRP was 38% of TP for the PRG-In samples and 81% of the PRG-out samples.

Table 3.7.1 Summary of average, minimum and maximum concentrations for TP, SRP, TN and TSS at the Ponderosa rain garden for ingoing water and outgoing water

Site	Avg TP (min-max) µg/L	Avg SRP (min-max) µg/L	Avg TN (min-max) mg/L	Avg TSS (min-max) mg/L
PRG-IN	103 (18 - 156)	39 (8 - 101)	1.3 (0.3 - 2.0)	22 (3.2 - 55)
PRG-OUT	383 (244 - 586)	309 (164 - 497)	2.0 (1.4 - 3.2)	7.1 (1.7 - 21)

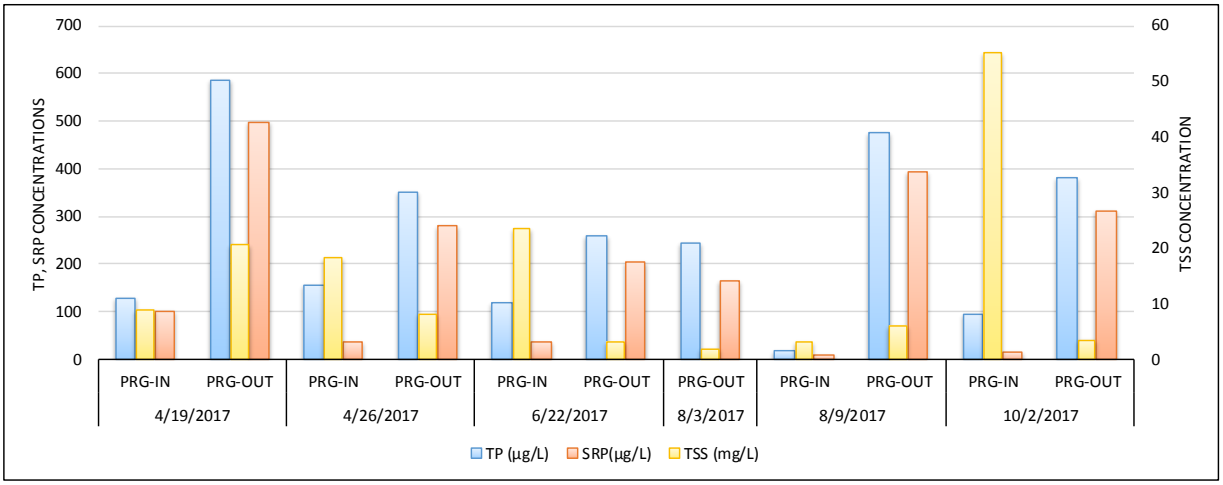

Figure 3.7.1 Concentrations of TP, SRP and TSS for the Ponderosa Rain Garden inlet versus outlet for each sampling occurrence - TN not included since values were fairly similar

3.7.2. Observations

It appears the iron enhanced sand rain garden did not remove TP or SRP but resulted with an increase in nutrients as water filtered through the rain garden. Despite the increase in nutrients, the rain garden was effective at removing/filtering sediments. These results were not anticipated. The below observations may provide an explanation for the poor performance of the rain garden.

- Large increases in phosphorus could be attributed to:
    - The soils and plants still getting established since this is a new development – but by mid-year the plants were established
    - The soil/compost used in the rain garden may have too high of phosphorus content and therefore releases the phosphorus into the water while moving through the rain garden. Soil samples should be tested to determine how much phosphorus is attached to the sediments and how much phosphorus would be released.
    - Timing of events/samples: Due to timing of events, samples were not always collected in "first flush." If samples were during first flush, it is possible the inlet concentrations would be higher. According to the MPCA Stormwater Manual, the median TP concentration for residential areas is 260 µg/L (MPCA, 2017), which is at least double the concentrations measured in the runoff. The MPCA Stormwater manual also lists the range of TP concentrations from less than 10 to 19,900 µg/L so there is a wide range of TP concentrations for runoff (MPCA, 2017).
- The rain garden is generally reducing sediment loading
    - Most sampling days, there were decreases in the TSS concentration which would be expected since the rain garden acts as a filter for particles. There were two sampling days where TSS was higher coming out of the rain garden.
        - On April 19th, the water sample coming from the outlet of the rain garden had a reddish color – this could be attributed to the iron enhanced sand.
        - On August 9th, the outlet sample was very dark in color and had a hydrogen sulfide odor. This smell and color could be caused by a chemical interaction of iron and sulfur along with increased anaerobic bacteria activity breaking down organic material in the rain garden with the warmer temperatures of July and August. A soil test assessing the sulfate in the soil could be valuable.

4.0 CITATIONS

MPCA. (2017). *MN Stormwater Manual–Stormwater Pollutants.* Retrieved: February 12, 2018. https://stormwater.pca.state.mn.us/index.php?title=Stormwater_pollutants.

Soballe, Dave. (2007). Flux 32 (Version 3.35)[software]. US Army Corps of Engineers and MPCA.

5.0 AVERAGE DAILY FLOWS

Average daily flow in cfs for all sites along with precipitation in Plymouth, MN.

Date	BL3-East	BL3-West	ECER	GC-1	Hamel	IP2	ML3	NLS	PC2	Peony	PL1	PL2	Plymouth Precipitation
4/4/17	0.776					3.955			2.689		0	0.057	0
4/5/17	0.535				2.375	3.402			1.682	4.578	0	0.079	0
4/6/17	0.586		6.191	1.401	2.187	3.518			1.221	4.287	0	0.098	0
4/7/17	0.606	1.095	6.296	0.879	1.977	3.047	0.096	0.192	0.621	3.861	0	0.112	0
4/8/17	0.464	0.985	6.034	1.024	1.913	3.348	0.098	0.225	0.57	3.695	0	0.119	0
4/9/17	0.439	0.963	5.833	0.923	1.97	3.491	0.098	0.298	1.327	3.813	0	0.197	0.04
4/10/17	0.464	0.959	5.928	1.06	2.322	4.614	0.266	1.457	2.231	4.25	0.219	1.096	0.2
4/11/17	0.874	1.474	6.334	1.636	3.782	17.428	0.616	4.018	11.831	7.476	0.337	2.57	0.35
4/12/17	1.331	1.939	11.165	1.536	3.526	12.269	0.402	2.767	10.878	7.135	0.1	1.306	0.17
4/13/17	1.608	2.168	12.813	1.988	3.882	11.126	0.283	3.184	9.229	7.689	0.021	0.985	0
4/14/17	1.505	2.061	13.131	1.514	3.418	9.411	0.234	2.913	6.515	6.477	0.014	0.358	0.02
4/15/17	1.827	2.441	11.71	4.323	6.35	20.894	0.971	7.047	14.615	11.22	0.527	2.071	0.54
4/16/17	2.387	2.941	15.672	3.15	6.569	12.839	0.394	2.948	9.697	11.224	0.024	0.64	0
4/17/17	2.006	2.453	20.058	1.982	5.487	9.333	0.298	3.62	5.715	8.856	0	0.325	0
4/18/17	1.655	2.184	15.205	1.958	6.011	10.978	0.501	2.238	6.861	9.197	0.117	0.927	0.17
4/19/17	1.744	2.253	13.915	3.437	8.542	20.23	0.9	5.51	11.858	12.631	0.48	2.687	0.57
4/20/17	3.688	4.261	16.4	4.707	15.028	24.413	0.589	6.609	25.971	22.58	0.15	2.29	0.03
4/21/17	3.547	4.122	33.241	3.005	13.072	15.607	0.428	1.465	9.302	18.335	0.015	0.895	0
4/22/17	2.927	3.523	31.388	2.303	10.093	12.129	0.396	0.902	4.652	14.915	0.001	0.599	0
4/23/17	2.276	2.749	21.694	1.84	8.727	9.863	0.351	0.669	3.259	13.082	0	0.39	0
4/24/17	1.975	2.418	16.363	2.192	7.473	8.297	0.333	0.599	2.436	11.759	0	0.599	0
4/25/17	1.741	2.248	14.064	1.917	7.363	10.333	0.649	0.954	4.636	11.417	0.206	1.059	0.32
4/26/17	2.443	3.151	13.046	4.147	12.702	23.68	0.944	5.254	25.457	20.696	0.392	2.995	0.32

Date	BL3-East	BL3-West	ECER	GC-1	Hamel	IP2	ML3	NLS	PC2	Peony	PL1	PL2	Plymouth Precipitation
4/27/17	3.188	3.999	23.564	3.808	13.251	16.731	0.458	1.803	17.758	20.077	0.067	1.294	0.01
4/28/17	2.797	3.489	30.578	2.821	10.389	12.699	0.371	0.994	5.209	15.905	0.01	0.834	0
4/29/17	2.248	2.907	23.878	1.807	7.948	10.378	0.307	0.714	1.464	12.62	0.001	0.762	0
4/30/17	1.846	2.463	17.321	1.65	6.927	16.412	0.556	1.365	1.526	10.96	0.235	1.029	0.47
5/1/17	4.551	5.157	13.911	7.668	22.002	41.534	1.481	15.257	45.197	38.867	0.873	4.572	0.37
5/2/17	5.546	5.876	39.284	1.841	22.138	29.264	0.651	5.131	36.245	34.046	0.158	1.516	0.02
5/3/17	4.389	4.89	52.202	2.313	15.298	19.142	0.478	2.965	19.446	23.811	0.043	0.885	0
5/4/17	3.250	3.892	37.385	3.496	11.75	14.753	0.409	1.816	15.007	18.075	0.015	0.769	0
5/5/17	2.538	3.257	24.833	2.727	9.594	12.772	0.348	1.377	11.14	14.981	0.004	0.691	0
5/6/17	2.064	2.693	18.828	2.325	7.92	10.913	0.291	1.021	9.404	12.79	0	0.629	0
5/7/17	2.097	2.341	15.585	2.04	6.522	9.769	0.24	0.835	7.314	11.103	0	0.489	0
5/8/17	1.794	2.077	13.198	1.808	5.556	9.562	0.311	1.147	5.615	9.75	0.065	0.635	0.16
5/9/17	1.469	1.768	11.282	2.373	5.359	9.467	0.282	1.113	7.347	9.564	0.021	0.809	0
5/10/17	1.183	1.523	11.078	1.725	4.803	7.985	0.369	0.726	4.314	8.44	0.007	0.549	0.01
5/11/17	0.990	1.339	10.288	1.229	4.289	7.215	0.137	0.531	3.369	7.562	0	0.509	0
5/12/17	0.813	1.19	9.383	0.798	3.81	6.577	0.122	0.453	1.971	6.995	0	0.473	0
5/13/17	0.687	1.082	8.255	0.653	3.475	6.103	0.126	0.382	1.675	6.339	0	0.436	0
5/14/17	0.575	0.95	7.716	0.559	3.185	5.732	0.135	0.33	1.3	5.652	0	0.434	0
5/15/17	0.556	0.916	6.908	1.113	6.187	10.712	0.327	1.503	5.087	9.535	0.108	0.897	0.3
5/16/17	0.846	1.28	8.378	1.809	7.116	13.498	0.45	1.999	11.673	12.302	0.216	0.73	0.13
5/17/17	2.564	2.947	16.446	7.021	18.357	39.139	3.345	27.59	36.284	29.645	1.216	6.935	1.65
5/18/17	8.014	7.993	32.888	14.894	37.129	63.704	1.587	25.938	56.97	56.328	1.042	4.516	0.25
5/19/17	7.597	7.523	77.303	7.296	25.65	44.647	0.581	8.385	52.61	34.685	0.119	0.886	0
5/20/17	8.422	8.341	47.041	16.125	32.717	54.361	2.728	19.8	49.11	48.893	2.18	8.883	1.29
5/21/17	12.534	12.363	62.881	16.308	53.295	68.309	0.988	20.864	50.726	67.375	0.599	2.779	0.01
5/22/17	11.256	10.922	85.48	8.956	41.107	50.869	0.582	6.381	48.975	50.398	0.176	1.009	0
5/23/17	8.297	8.292	66.274	6.993	28.95	25.389	0.46	4.296	36.869	37.494	0.078	0.675	0

Date	BL3-East	BL3-West	ECER	GC-1	Hamel	IP2	ML3	NLS	PC2	Peony	PL1	PL2	Plymouth Precipitation
5/24/17	6.014	6.07	50.264	5.38	23.62	16.122	0.405	2.894	28.943	32.581	0.045	0.458	0
5/25/17	4.714	4.869	37.794	4.111	20.011	12.238	0.382	1.676	26.032	28.49	0.038	0.465	0.05
5/26/17	3.643	3.849	30.119	3.456	17.329	10.03	0.353	1.288	23.6	25.703	0.022	0.501	0
5/27/17	2.693	3.012	25.882	2.822	14.538	7.953	0.301	1.089	20.835	22.237	0.005	0.396	0
5/28/17	2.109	2.393	22.209	2.333	12.576	5.621	0.327	0.975	17.341	19.319	0.013	0.506	0.06
5/29/17	1.648	2.008	19.332	2.056	11.408	6.799	0.275	0.82	17.093	17.771	0.005	0.506	0.03
5/30/17	1.270	1.725	17.565	1.742	10.025	6.311	0.213	0.515	14.083	16.192	0	0.389	0
5/31/17	1.067	1.507	15.771	1.478	9.207	4.784	0.146	0.424	10.596	15.027	0	0.328	0
6/1/17	0.904	1.299	14.351	1.196	7.881	4.719	0.12	0.217	8.688	12.46	0	0.312	0
6/2/17	0.753	1.122	12.248	1.158	6.733	3.965	0.101	0.069	7.223	10.698	0	0.28	0
6/3/17	0.612	0.997	10.028	1.066	5.9	2.827	0.091	0.052	2.959	9.286	0	0.268	0
6/4/17	0.481	0.837	8.801	0.999	5.3	2.539	0.078	0.021	1.516	8.786	0	0.229	0
6/5/17	0.374	0.696	8.247	0.741	4.736	2.276	0.047	0	0.839	7.019	0	0.216	0
6/6/17	0.296	0.601	7.336	0.473	4.365	2.128	0.032	0	1.398	6.377	0	0.189	0
6/7/17	0.254	0.518	6.471	0.264	4.062	1.776	0.024	0	0.91	5.957	0	0.164	0
6/8/17	0.236	0.497	6.145	0.285	3.839	1.334	0.032	0	1.748	5.49	0	0.19	0
6/9/17	0.212	0.455	6.91	0.285	3.604	1.019	0.033	0	0.05	5.288	0	0.2	0
6/10/17	0.184	0.407	6.105	0.224	3.412	0.402	0.031	0	0.832	5.016	0	0.157	0
6/11/17	0.355	0.639	5.616	1.331	7.981	2.681	0.659	5.278	2.494	13.125	0.264	2.773	0.73
6/12/17	0.893	1.286	13.818	1.331	6.601	3.095	0.345	3.735	1.857	10.823	0.093	1.449	0.4
6/13/17	0.929	1.338	18.298	1.041	5.546	3.302	0.188	3.225	0.091	8.305	0.001	0.52	0
6/14/17	2.329	2.636	13.602	3.766	7.128	2.565	0.89	7.922	8.339	13.183	0.458	3.401	0.68
6/15/17	2.584	2.851	21.474	1.774	5.285	1.5	0.29	2.239	0.746	8.196	0.007	0.692	0
6/16/17	1.874	2.212	16.816	1.111	4.278	53.259	0.243	0.844	25.923	6.179	0	0.393	0
6/17/17	1.248	1.655	11.675	0.97	3.617	16.007	0.287	0.784	16.86	5.282	0.049	0.472	0.11
6/18/17	0.968	1.378	9.336	1.131	3.306	6.022	0.298	1.003	4.305	5.164	0.015	0.872	0.04
6/19/17	0.811	1.216	8.476	0.685	2.826	2.617	0.216	0.576	1.017	4.416	0.008	0.353	0

Date	BL3-East	BL3-West	ECER	GC-1	Hamel	IP2	ML3	NLS	PC2	Peony	PL1	PL2	Plymouth Precipitation
6/20/17	0.685	1.076	7.554	0.481	2.729	3.1	0.272	1.092	1.603	4.4	0.083	1.129	0.19
6/21/17	0.560	0.936	6.87	0.374	2.3	1.879	0.106	0.476	0.233	3.876	0	0.429	0
6/22/17	0.531	0.888	6.347	0.657	2.39	11.489	0.403	1.904	4.582	4.005	0.155	1.516	0.29
6/23/17	0.527	0.865	6.178	0.727	2.216	5.935	0.222	0.905	3.182	4.026	0.005	0.62	0
6/24/17	0.524	0.853	6.277	0.551	2.09	3.36	0.085	0.586	1.067	3.685	0.006	0.503	0.04
6/25/17	0.491	0.798	6.03	0.247	1.957	3.029	0.074	0.372	0.742	3.485	0	0.47	0
6/26/17	0.393	0.683	5.612	0.165	1.796	2.684	0.077	0.176	0.48	3.27	0.002	0.469	0
6/27/17	0.318	0.593	5.191	0.139	1.685	3.987	0.028	0.077	0.929	3.027	0.001	0.446	0
6/28/17	0.489	0.838	4.842	0.878	2.278	8.508	0.532	2.085	4.877	4.267	0.333	1.896	0.42
6/29/17	0.647	1.032	6.005	1.072	1.866	6.01	0.163	1.014	3.418	3.774	0.011	0.604	0
6/30/17	0.562	0.904	6.37	0.824	2.066	5.19	0.305	1.585	2.168	3.48	0.166	1.203	0.26
7/1/17	0.700	1.061	6.324	0.794	2.415	6.497	0.274	1.859	2.906	5.351	0.026	0.738	0
7/2/17	0.651	1.019	8.951	0.381	1.904	5.189	0.191	0.651	2.065	3.603	0.002	0.557	0
7/3/17	0.607	0.997	7.949	0.148	1.754	3.994	0.164	0.273	1.53	3.217	0.002	0.571	0
7/4/17	0.473	0.834	6.93	0.123	1.655	4.269	0.044	0.146	0.647	2.953	0.001	0.527	0
7/5/17	0.382	0.692	6.171	0.234	1.662	4.28	0.082	0.285	2.228	3.308	0.222	1.381	0.41
7/6/17	0.291	0.558	6.568	0.122	1.607	2.832	0.023	0.15	1.079	2.909	0.001	0.504	0
7/7/17	0.220	0.442	6.342	0.078	1.516	2.261	0.013	0.022	0.487	2.668	0	0.468	0
7/8/17	0.177	0.358	5.798	0.046	1.859	1.984	0.001	0	0.839	2.485	0	0.516	0
7/9/17	0.155	0.299	5.159	0.036	1.5	1.936	0.013	0.025	0.511	2.397	0	0.511	0
7/10/17	0.137	0.274	4.608	0.036	1.454	1.985	0.084	0.022	0.241	2.387	0	0.448	0
7/11/17	0.089	0.238	4.303	0.025	2.263	2.093	0.012	0	0.317	2.335	0	0.312	0
7/12/17	0.150	0.302	3.995	0.16	1.76	3.094	0.276	1.378	1.003	3.22	0.073	0.785	0.24
7/13/17	0.137	0.289	4.533	0.171	1.801	2.533	0.038	0.371	0.084	2.744	0	0.343	0
7/14/17	0.128	0.28	4.371	0.179	1.612	2.192	0.046	0.146	0.044	2.615	0	0.056	0
7/15/17	0.108	0.258	4.303	0.178	1.576	1.944	0.019	0.04	0.219	2.496	0	0.02	0
7/16/17	0.064	0.22	4.171	0.171	1.414	1.708	0.004	0	0.082	2.302	0	0.024	0

Date	BL3-East	BL3-West	ECER	GC-1	Hamel	IP2	ML3	NLS	PC2	Peony	PL1	PL2	Plymouth Precipitation
7/17/17	0.087	0.244	3.889	0.873	3.23	13.987	1.115	4.475	3.522	3.01	1.008	2.764	1.45
7/18/17	3.969	4.103	4.907	3.973	12.832	29.917	0.738	18.46	41.601	28.65	0.381	3.823	0.09
7/19/17	3.443	3.681	41.164	1.479	4.563	14.544	0.312	3.934	12.386	8.96	0.025	0.844	0.06
7/20/17	2.548	2.958	32.882	0.949	2.651	9.208	0.273	1.367	5.61	4.859	0.001	0.582	0
7/21/17	1.916	2.321	17.803	0.565	2.055	6.893	0.242	1.711	3.06	3.837	0.002	0.429	0
7/22/17	1.306	1.796	10.926	0.404	1.804	5.557	0.268	1.432	2.738	3.378	0.001	0.393	0
7/23/17	0.900	1.438	8.474	0.17	1.635	4.466	0.286	0.523	1.823	2.964	0	0.336	0
7/24/17	0.669	1.096	6.826	0.213	1.989	3.702	0.118	0.304	0.392	2.755	0	0.321	0
7/25/17	0.514	0.977	5.875	0.29	2.23	5.458	0.295	1.859	2.011	2.63	0.361	1.068	0.31
7/26/17	0.485	0.893	5.275	0.565	1.64	5.781	0.337	1.49	5.155	2.969	0.215	1.542	0.17
7/27/17	0.403	0.768	5.627	0.278	2.552	3.85	0.057	0.343	0.79	2.647	0.003	0.393	0
7/28/17	0.334	0.676	5.394	0.144	1.51	3.225	0.013	0.054	0.328	2.363	0.001	0.248	0
7/29/17	0.255	0.575	4.879	0.081	2.476	2.819	0	0	0.258	2.182	0	0.074	0
7/30/17	0.191	0.486	4.323	0.073	1.604	2.341	0.001	0	0.042	2.049	0	0.026	0
7/31/17	0.152	0.433	3.721	0.071	3.478	2.13	0.02	0	0.591	1.932	0	0.012	0
8/1/17	0.122	0.347	3.256	0.069	1.348	1.889	0.012	0	0.412	1.921	0	0.032	0
8/2/17	0.159	0.277	2.872	0.068	1.059	1.733	0.013	0	0.2	1.881	0.03	0.158	0
8/3/17	0.145	0.293	2.691	0.173	2.23	4.548	0.364	1.941	1.738	3.642	0.172	1.146	0.28
8/4/17	0.142	0.356	4.13	0.095	1.539	3.027	0.131	0.269	0.353	3.074	0.05	0.315	0
8/5/17	0.126	0.305	5.264	0.087	2.831	5.224	0.139	0.143	1.498	2.359	0.001	0.262	0.1
8/6/17	0.126	0.274	4.574	0.763	1.444	4.199	0.219	0.103	2.751	2.187	0.33	1.63	0.38
8/7/17	0.105	0.29	3.93	0.382	1.79	3.018	0.182	0.018	1.843	2.192	0.026	0.658	0
8/8/17	0.045	0.268	3.586	0.159	2.75	2.207	0.052	0	0.143	2.05	0	0.176	0
8/9/17	0.262	0.52	3.248	2.15	5.146	20.022	0.965	8.321	9.235	8.323	0.78	3.78	1.16
8/10/17	2.273	2.294	6.988	3.267	7.416	18.398	0.668	4.96	17.443	15.674	0.198	2.078	0.09
8/11/17	1.972	1.873	23.329	1.059	3.162	8.664	0.375	0.871	6.666	6.338	0.008	0.764	0
8/12/17	1.009	1.054	20.602	0.622	1.988	5.815	0.244	0.345	3.67	4.075	0	0.452	0

Date	BL3-East	BL3-West	ECER	GC-1	Hamel	IP2	ML3	NLS	PC2	Peony	PL1	PL2	Plymouth Precipitation
8/13/17	0.820	0.85	12.02	0.674	1.874	11.415	0.47	1.612	3.133	3.445	0.297	1.065	0.53
8/14/17	3.877	3.522	8.131	7.112	7.045	28.08	0.846	9.55	17.802	16.883	0.344	3.415	0.27
8/15/17	2.836	2.587	24.003	2.151	3.267	19.404	0.304	1.731	9.611	7.014	0.008	0.749	0
8/16/17	2.766	2.51	22.536	4.413	8.794	30.745	1.982	13.887	20.31	13.519	1.22	5.847	1.55
8/17/17	9.061	8.316	19.083	11.96	24.457	45.407	1.048	26.116	61.31	45.852	0.453	3.459	0.1
8/18/17	6.394	5.986	61.01	6.146	13.152	30.533	0.437	8.592	41.371	21.606	0.066	1.345	0.01
8/19/17	5.323	4.962	52.675	4.035	7.261	22.255	0.354	3	31.57	12.084	0.017	0.958	0
8/20/17	4.700	4.318	27.905	2.883	5.31	18.786	0.157	1.614	27.999	8.933	0.002	0.808	0
8/21/17	4.123	3.852	16.204	2.05	4.427	16.665	0.14	0.828	25.651	7.676	0.004	0.832	0.04
8/22/17	3.551	3.341	11.838	1.629	3.871	13.349	0.136	0.458	20.399	7.042	0	0.638	0
8/23/17	2.742	2.595	10.21	1.101	3.28	8.891	0.133	0.282	13.815	6.183	0	0.548	0
8/24/17	2.296	2.136	8.747	0.913	2.825	5.989	0.13	0.335	8.63	5.539	0	0.517	0
8/25/17	1.888	1.779	7.916	1.146	2.73	14.097	0.41	1.749	7.749	5.021	0.348	1.062	0.61
8/26/17	5.722	4.941	7.209	13.586	22.415	37.722	1.729	26.265	55.959	36.965	1.951	6.062	1.19
8/27/17	4.754	4.274	35.408	5.294	15.345	24.149	0.488	5.843	34.996	22.971	0.182	1.142	0.01
8/28/17	3.670	3.657	44.733	2.751	9.208	20.146	0.361	1.887	30.493	14.065	0.037	0.805	0
8/29/17	3.364	3.608	28.374	2.195	7.295	17.455	0.155	0.971	26.45	11.273	0	0.631	0
8/30/17	2.947	3.253	18.188	1.911	6.291	14.832	0.116	0.461	21.971	9.495	0	0.611	0
8/31/17	2.617	2.97	14.318	1.625	5.513	11.218	0.097	0.292	17.064	8.517	0	0.536	0
9/1/17	2.203	2.53	12.279	1.368	4.884	7.605	0.093	0.224	10.422	7.735	0	0.451	0
9/2/17	1.877	2.195	10.955	1.162	4.4	5.864	0.112	0.196	8.034	7.178	0	0.452	0
9/3/17	1.593	1.962	9.875	0.973	3.776	5.044	0.073	0.177	6.39	6.425	0	0.415	0
9/4/17	1.481	1.832	8.928	0.928	3.523	6.139	0.249	1.124	5.294	6.16	0.109	1.024	0.25
9/5/17	1.460	1.773	8.341	0.834	3.287	5.48	0.039	0.492	3.726	6.183	0.011	0.661	0
9/6/17	1.186	1.562	8.828	0.391	2.784	4.351	0.021	0.204	0.384	5.5	0.001	0.421	0
9/7/17	0.992	1.421	8.001	0.138	2.417	3.725	0.024	0.209	0.212	4.919	0	0.377	0
9/8/17	0.827	1.212	7.299	0.071	2.143	3.342	0.009	0.197	0.165	4.491	0	0.339	0

Date	BL3-East	BL3-West	ECER	GC-1	Hamel	IP2	ML3	NLS	PC2	Peony	PL1	PL2	Plymouth Precipitation
9/9/17	0.692	1.077	6.764	0.059	1.989	3.125	0.005	0.165	0.102	4.235	0	0.294	0
9/10/17	0.589	0.958	6.28	0.074	1.878	2.941	0.004	0.16	0.152	4.153	0	0.271	0
9/11/17	0.520	0.858	5.995	0.102	1.813	2.737	0.01	0.109	0.056	3.997	0.038	0.254	0
9/12/17	0.455	0.777	5.787	0.057	1.767	2.837	0.03	0.09	0.01	3.879	0.106	0.248	0
9/13/17	0.382	0.694	5.599	0.025	1.712	3.1	0.15	0.074	0	3.719	0.092	0.221	0
9/14/17	0.329	0.617	5.493	0.059	1.657	3.123	0.125	0.067	0	3.562	0.04	0.061	0
9/15/17	0.283	0.583	5.286	0.083	1.624	3.363	0.001	0.057	0.014	3.475	0	0.033	0
9/16/17	0.261	0.517	5.05	0.073	1.606	3.669	0.06	0.063	0.441	3.467	0.016	0.185	0.04
9/17/17	0.224	0.433	5.082	0.07	1.599	3.498	0.097	0.014	0.053	3.438	0	0.204	0
9/18/17	0.218	0.454	5.052	0.168	1.664	4.653	0.262	0.701	0.773	3.675	0.066	1.03	0.25
9/19/17	0.231	0.456	5.234	0.232	1.643	5.13	0.029	0.621	0.196	4.051	0	0.195	0
9/20/17	0.459	0.828	5.765	0.472	1.775	8.093	0.643	2.057	6.639	4.5	0.319	1.787	0.45
9/21/17	0.546	0.894	6.736	0.107	1.629	4.506	0.116	0.781	0.986	3.835	0.002	0.265	0
9/22/17	0.392	0.68	6.025	0.084	1.6	3.467	0.088	0.251	0.203	3.473	0	0.166	0
9/23/17	0.314	0.604	5.179	0.086	1.595	3.125	0.092	0.063	0.371	3.273	0	0.114	0
9/24/17	0.279	0.578	4.587	0.144	1.725	4.934	0.113	0.069	0.297	3.342	0.024	0.154	0.05
9/25/17	0.662	0.933	4.386	0.976	3.058	13.384	0.803	5.74	8.297	6.902	0.413	1.514	0.59
9/26/17	1.094	1.46	9.894	0.762	3.365	10.813	0.591	3.771	6.309	7.364	0.127	1.435	0.2
9/27/17	0.851	1.26	14.689	0.648	2.539	6.347	0.185	1.223	2.83	5.794	0.002	0.28	0
9/28/17	0.657	1.066	12.506	1.109	2.034	4.735	0.133	0.471	0.683	4.666	0	0.19	0
9/29/17	0.567	0.964	8.532	0.925	1.824	3.912	0.095	0.175	0.218	4.155	0	0.217	0
9/30/17	0.433	0.803	7.026	0.822	1.683	3.742	0.087	0.12	0.093	3.838	0	0.208	0
10/1/17	0.453	0.906	6.199	0.961	2.25	9.019	0.533	2.3	3.866	4.978	0.197	1.609	0.33
10/2/17	1.488	1.985	7.336	6.816	5.931	35.986	1.931	15.561	30.404	13.046	1.652	7.635	2.2
10/3/17	6.942	7.343	18.221	16.327	22.757	53.505	2.095	28.168	66.028	41.891	1.321	6.086	0.63
10/4/17	5.434	5.652	57.67	7.149	15.919	42.029	0.533	11.148	47.891	24.592	0.147	1.283	0
10/5/17	3.846	4.147	60.595	5.544	9.94	30.779	0.455	3.921	38.079	15.21	0.046	0.756	0

Date	BL3-East	BL3-West	ECER	GC-1	Hamel	IP2	ML3	NLS	PC2	Peony	PL1	PL2	Plymouth Precipitation
10/6/17	3.334	3.688	34.462	4.398	9.002	27.87	0.739	5.316	37.058	13.819	0.3	1.974	0.32
10/7/17	3.433	3.767	22.263	4.128	10.166	22.197	0.564	4.838	33.126	16.043	0.167	1.466	0.05
10/8/17	2.770	3.067	24.524	2.82	8.89	13.954	0.417	3.084	22.285	13.666	0.038	0.622	0
10/9/17	2.107	2.476	22.736	2.008	7.265	9.857	0.231	1.684	16.091	11.114	0.007	0.462	0
10/10/17	1.658	2.049	18.215	1.671	6.072	8.198	0.161	1.081	12.392	9.667	0.002	0.425	0
10/11/17	1.380	1.788	15.262	1.411	5.201	6.573	0.153	0.68	9.962	8.687	0	0.382	0
10/12/17	1.234	1.719	13.47	1.353	4.626	5.819	0.168	0.485	7.142	7.987	0	0.36	0
10/13/17	1.104	1.542	11.867	0.913	4.207	5.186	0.153	0.344	7.021	7.466	0	0.34	0
10/14/17	1.097	1.51	10.21	1.202	4.301	8.829	0.455	2.384	7.688	7.594	0.251	1.191	0.34
10/15/17	2.054	2.314	9.872	1.334	6.247	11.644	0.529	4.07	13.608	12.107	0.139	1.911	0.06
10/16/17	1.701	2.033	17.323	1.075	4.888	7.856	0.285	2.763	8.488	9.318	0.008	0.15	0
10/17/17	1.411	1.756	16.606	0.677	4.131	6.38	0.193	2.361	6.317	7.82	0.001	0.305	0
10/18/17	1.268	1.616	13.069	0.549	3.683	7.367	0.162	1.918	5.777	7.064	0	0.202	0
10/19/17	1.127	1.501	11.086	0.777	3.17	5.264	0.15	1.825	3.408	6.412	0	0.229	0
10/20/17	1.069	1.443	9.592	0.819	2.784	4.779	0.156	1.346	0.834	5.876	0	0.225	0
10/21/17	1.321	1.695	9.405	0.588	4.193	11.428	0.603	0.646	7.623	8.042	0.324	0.328	0.49
10/22/17	1.469	1.87	11.262	0.453	4.076	7.506	0.324	2.853	5.487	8.459	0.033	0.146	0
10/23/17	1.230	1.674	15.071	0.683	3.283	5.638	0.233	2.329	5.152	6.881	0.003	0.313	0
10/24/17	1.042	1.456	13.017	0.334	3.021	4.705	0.22	1.755	5.08	6.199	0	0.282	0
10/25/17	0.857	1.248	11.112	0.344	2.81	4.452	0.229	1.53	1.496	5.93	0	0.362	0
10/26/17	0.844	1.236	9.742	0.32	2.536	4.303	0.237	1.077	4.863	5.535	0	0.307	0
10/27/17	1.074	1.46	8.975	0.39	3.179	7.85	0.64	2.61	6.123	6.385	0.134	1.284	0.05
10/28/17	1.238	1.647	10.167	0.446	3.496	7.367	0.278	1.788	3.528	7.466	0.025	0.554	0
10/29/17	1.128	1.525	13.578	0.513	3.082	6.019	0.258	1.485	1.205	6.6	0.006	0.413	0.03
10/30/17	0.997	1.499	12.388	0.95	3.068	5.583	0.217	1.341	7.261	6.507	0.003	0.498	0
10/31/17	0.890	1.397	11.164	1.304	2.731	5.115	0.181	0.972	4.825	6.082	0	0.315	0
11/1/17			9.632		2.513					5.712			0.01

Date	BL3-East	BL3-West	ECER	GC-1	Hamel	IP2	ML3	NLS	PC2	Peony	PL1	PL2	Plymouth Precipitation
11/2/17			8.844		2.542					5.718			0
11/3/17			8.649		2.476					5.576			0
Total Flow	365.332	424.561	3103.070	395.140	1302.473	2283.295	71.679	550.595	2096.739	2119.837	26.640	202.021	

6.0 WATER SAMPLE DATA

All collected samples from the sites are listed here.

Site	Date	Flow (cfs)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl (mg/L)	Type
BL3-W	4/11/2017	1.38	64.27	15.11	1.08	2.4		GRAB
BL3-W	4/24/2017	2.40	49.61	13.64	0.9	6.4		GRAB
BL3-W	4/27/2017	4.24	57.98	17.93	0.96	1.6		GRAB
BL3-W	5/8/2017	2.03	38.15	14.49	0.92	1.2		GRAB
BL3-W	5/17/2017	2.00	77.42	17.71	1.1	5		COMP
BL3-W	5/22/2017	10.57	46.4	28.8	0.72	7		GRAB
BL3-W	6/5/2017	0.73	58.2	20.65	1.02	0.8		GRAB
BL3-W	6/12/2017	1.28	91.42	22.98	1.77	5.2		COMP
BL3-W	6/14/2017	2.92	80.17	26.58	1.31	2.4		COMP
BL3-W	6/19/2017	1.26	150.4	50.88	1.83	2.6		GRAB
BL3-W	6/28/2017	0.71	112.4	29.58	1.53	6		GRAB
BL3-W	7/5/2017	0.72	114.7	28.35	1.61	1.6		GRAB
BL3-W	7/17/2017	0.20	264.4	68.78	2.97	5.2		GRAB
BL3-W	7/18/2017	2.73	116.4	29.82	1.61	5.8		COMP
BL3-W	7/20/2017	3.08	70.25		1	3.6		COMP
BL3-W	7/31/2017	0.41	283.6	35.24	2.96	10.8		GRAB
BL3-W	8/10/2017	1.86	126.8	34.48	1.4	6.6		COMP
BL3-W	8/13/2017	3.67	99.44	30.76	1.16	3		COMP
BL3-W	8/14/2017	4.29	80.84	28.54	1.05	2.2		GRAB
BL3-W	8/16/2017	4.54	59.76	23.68	0.69	4.6		COMP
BL3-W	8/28/2017	3.50	55.35	30.32	0.82	0.8		GRAB
BL3-W	9/11/2017	0.86	56.1	16.64	1.05	1.4		GRAB
BL3-W	9/25/2017	0.78	98.75	32.81	1.38	2.6		GRAB
BL3-W	10/2/2017	1.39	61.21	26.91	0.88	2		COMP
BL3-W	10/3/2017	2.88	55.34	30.96	0.87	1		COMP
BL3-W	10/16/2017	2.05	58.67	18.22	0.74	1		GRAB
BL3-W	10/30/2017	1.52	52.3	33.23	0.82	2		GRAB
ECER	8/17/2017	43.55	392.5	151.97	2.7	106		COMP
ECER	10/3/2017	31.31	373.9	139.34	2.21	62		COMP
ECER	5/17/2017	24.79	350.5	95.29	2.34	61		COMP
ECER	7/18/2017	32.41	280	179.15	2.34	119.5		COMP
ECER	6/14/2017	21.66	245.9	141.57	1.7	22		COMP
ECER	8/10/2017	22.17	212.5	100.35	1.78	17		GRAB
ECER	9/25/2017	10.12	203.6	142.67	1.48	4.2		GRAB
ECER	7/17/2017	3.65	200.1	166.64	1.29	6.2		GRAB
ECER	8/16/2017	27.38	199.3	122.9	1.11	22.2		COMP

Site	Date	Flow (cfs)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl (mg/L)	Type
ECER	6/11/2017	18.84	178.5	94.69	1.35	101		COMP
ECER	7/31/2017	3.27	175.2	137.93	4.12	2.6		GRAB
ECER	8/14/2017	24.50	172.4	100.34	1.43	13.2		GRAB
ECER	8/28/2017	28.19	171	117.22	1.05	5		GRAB
ECER	6/5/2017	7.52	168.5	91.53	1.12	4.2		GRAB
ECER	10/2/2017	14.90	166.6	142.98	1.78	15.4		COMP
ECER	6/19/2017	7.70	156.6	103.44	1.49	2.4		GRAB
ECER	7/5/2017	6.61	144.5	104.69	1.15	1.6		GRAB
ECER	6/28/2017	6.34	126.3	86.46	1.15	2.4		GRAB
ECER	10/15/2017	17.42	125.4	76.33	1.18	13.2		COMP
ECER	9/11/2017	5.89	115.7	109.44	1.04	1.4		GRAB
ECER	5/22/2017	66.47	114.3	82.29	0.84	7.8		GRAB
ECER	10/16/2017	17.12	108.9	72.37	0.91	1.8		GRAB
ECER	4/11/2017	11.42	106.1	38.9	1.17	6.8		GRAB
ECER	4/26/2017	23.84	104.4	61.31	1.2	7.3		GRAB
ECER	5/8/2017	11.42	90.86	51.5	0.91	2.8		GRAB
ECER	4/24/2017	14.19	77.3	52.0	0.79	3		GRAB
ECER	10/30/2017	11.73	65.62	38.16	0.77	2		GRAB
GC-1	10/3/2017	12.65	515.6	40.6	3.08	142.7		COMP
GC-1	7/18/2017	6.34	212	15.52	1.84	139		COMP
GC-1	8/16/2017	15.14	139.6	44.66	2.69	113.2		COMP
GC-1	8/15/2017	11.76	191.9	29.36	2.23	102.8		COMP
GC-1	6/11/2017	1.72	418.8	6.75	2.92	78		COMP
GC-1	7/26/2017	0.70	364.8	9.77	2.06	65.6		COMP
GC-1	6/14/2017	5.35	295.7	51.93	3.24	46		COMP
GC-1	8/9/2017	3.74	303	25.26	1.46	44		COMP
GC-1	9/24/2017	1.38	261.1	70.96	1.96	35.5		COMP
GC-1	5/9/2017	2.61	206.2	47.54	1.94	29.6		COMP
GC-1	10/2/2017	2.50	205.1	33.34	1.48	21.6		COMP
GC-1	8/14/2017	6.46	181.7	48.92	1.72	17.3		GRAB
GC-1	9/25/2017	1.25	313.7	49.31	2.08	16		GRAB
GC-1	5/17/2017	3.92	158.9	44.01	1.31	14.6		COMP
GC-1	4/24/2017	2.25	69.49	14.99	0.84	14.2		GRAB
GC-1	10/22/2017	0.40	163.8	60.23	1.15	12.8		COMP
GC-1	8/28/2017	2.61	139.1	27.93	1.36	11.2		GRAB
GC-1	4/26/2017	4.93	117.3	25.7	1.12	10.2		COMP
GC-1	5/22/2017	8.24	127.9	39.07	1.02	8.4		GRAB
GC-1	10/30/2017	0.62	78.93	35.89	0.87	8		GRAB
GC-1	10/29/2017	0.58	106.4	118.62	1.24	6		COMP
GC-1	6/5/2017	1.00	145.8	64.48	1.27	5.4		GRAB
GC-1	6/19/2017	0.84	151.1	68.18	1.28	5		GRAB

Site	Date	Flow (cfs)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl (mg/L)	Type
GC-1	10/16/2017	1.07	105.4	30.65	0.99	4.4		GRAB
GC-1	5/8/2017	1.67	67.2	20.4	0.82	4		GRAB
GC-1	7/5/2017	0.12	118.5	49.82	1.09	3.8		GRAB
GC-1	4/11/2017	1.27	67.87	22.61	0.79	3.2		GRAB
GC-1	9/11/2017	0.05	78.58	49	0.97	1.2		GRAB
HAMEL	7/16/2017	24.54	225.7	79.5	1.81	428.2		COMP
HAMEL	10/2/2017	8.40	799.9	65.8	7.91	358.8		COMP
HAMEL	8/16/2017	34.68	142.1	72.1	3.71	211.0		COMP
HAMEL	6/11/2017	11.30	220.1	78.8	3.37	120.0		COMP
HAMEL	10/1/2017	2.63	592.1	77.2	4.41	111.0		COMP
HAMEL	9/24/2017	2.84	303.3	107.4	2.36	109.3		COMP
HAMEL	5/17/2017	13.48	275.3	51.1	2.27	76		COMP
HAMEL	5/22/2017	66.97	176.8	42.2	1.81	59.4		GRAB
HAMEL	6/28/2017	3.27	458.4	59.7	2.16	54.8		COMP
HAMEL	8/9/2017	7.71	252.1	61.0	1.07	54.0		COMP
HAMEL	8/13/2017	10.34	148.2	64.9	1.65	48.4		COMP
HAMEL	7/12/2017	2.10	310.1	53.6	2.52	36.8		COMP
HAMEL	6/14/2017	8.40	408.1	103.1	2.93	31.2		COMP
HAMEL	4/25/2017	9.09	91.27	18.1	1.3	15.6		COMP
HAMEL	4/11/2017	4.35	96.93	22.24	1.56	10.6		GRAB
HAMEL	6/19/2017	2.92	366.6	103.6	2.74	9.4		GRAB
HAMEL	8/14/2017	6.92	160.7	72.6	1.54	8.6		GRAB
HAMEL	9/25/2017	3.49	209.6	112.9	1.73	8.0		GRAB
HAMEL	4/24/2017	7.51	69.53	22.68	1.18	6.2		GRAB
HAMEL	6/5/2017	4.81	207.2	81.4	2.28	5.0		GRAB
HAMEL	8/28/2017	9.05	121.9	65.2	1.44	4.4		GRAB
HAMEL	7/17/2017	0.95	205.6	86.5	1.87	4.2		GRAB
HAMEL	10/16/2017	4.87	85.7	46.3	1.26	4.0		GRAB
HAMEL	10/30/2017	3.03	67.0	19.3	1.25	4.0		GRAB
HAMEL	7/5/2017	1.66	172.6	68.9	1.84	3.4		GRAB
HAMEL	5/8/2017	5.59	63.62	19.84	1.11	3.4		GRAB
HAMEL	7/31/2017	3.59	175.7	61.4	2.06	2.7		GRAB
HAMEL	9/11/2017	1.83	106.8	50.4	1.45	2.2		GRAB
IP2	4/11/2017	32.85	146.0	28.4	1.73	21.8	294.9	GRAB
IP2	4/24/2017	8.40	119.6	19.5	1.28	9.0	184.9	GRAB
IP2	4/26/2017	16.93	125.7	19.8	1.75	13.6	179.9	COMP
IP2	5/8/2017	9.40	113.0	17.0	1.52	4.2	179.9	GRAB
IP2	5/17/2017	26.71	295.1	20.7	2.52	44.8	126.0	COMP
IP2	5/22/2017	56.11	94.0	38.8	1.07	7.0	76.0	GRAB
IP2	6/5/2017	2.06	142.8	39.2	2.25	5.0	225.9	GRAB
IP2	6/11/2017	2.87	244.5	19.2	3.02	37.0	146.0	COMP

Site	Date	Flow (cfs)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl (mg/L)	Type
IP2	6/13/2017	3.04	142.3	40.0	1.7	16.8	126.0	COMP
IP2	6/19/2017	2.62	166.7	49.7	2.0	5.0	156.0	GRAB
IP2	6/28/2017	9.28	107.3	18.68	1.53	6	157.95	GRAB
IP2	7/5/2017	4.47	111.3	37.46	1.2	2.8	151.95	GRAB
IP2	7/17/2017	1.65	109.9	56.65	1.23	3.8	279.91	GRAB
IP2	7/18/2017	38.00	153.9	25.89	1.93	133.1	65.98	COMP
IP2	7/31/2017	2.13	102.4	59.14	1.25	1.8	239.93	GRAB
IP2	8/3/2017	7.70	178.2	32.64	2.47	16	229.93	COMP
IP2	8/9/2017	28.00	232.4	36.26	1.03	40.4	67.98	COMP
IP2	8/14/2017	29.56	163.8	56.6	1.51	23	51.98	COMP
IP2	8/14/2017	29.84	143.4	70.41	1.01	5	75.98	GRAB
IP2	8/16/2017	47.51	105.5	53.57	1.63	66	35.99	COMP
IP2	8/28/2017	20.53	159.8	91.46	1.32	2.6	57.98	GRAB
IP2	9/11/2017	2.87	74.33	32.68	1.2	1.2	204.94	GRAB
IP2	9/25/2017	12.88	140.6	81.37	1.04	3.6	61.98	GRAB
IP2	10/1/2017	10.10	109.7	43.07	1.05	8	92.97	COMP
IP2	10/2/2017	47.74	157.2	61.88	1.58	41.6	39.99	COMP
IP2	10/15/2017	12.39	103.3	44.37	1.17	7.8	103.97	COMP
IP2	10/16/2017	8.13	80.25	28.24	0.98	3.2	99.97	GRAB
IP2	10/22/2017	9.77	109.6	45.41	1.11	7.7	114.96	COMP
IP2	10/30/2017	5.77	64.08	20.57	1.05	2	159.95	GRAB
ML3	4/10/2017	0.85	233.6	75.76	2.41	45.3		COMP
ML3	4/24/2017	0.33	170.8	78.22	1.97	7.6		GRAB
ML3	4/25/2017	1.53	439	72.26	2.95	105		COMP
ML3	5/8/2017	0.23	196.7	165.7	1.78	6.6		GRAB
ML3	5/9/2017	0.61	338.5	149.85	5.06	68.7		COMP
ML3	5/17/2017	9.46	450	97.9	6.23	878		COMP
ML3	5/22/2017	0.61	301.6	179.92	2.51	4.6		GRAB
ML3	6/11/2017	2.75	298.4	11.86	2.69	337.5		COMP
ML3	6/19/2017	0.22	716.7	526.57	1.52	0.8		GRAB
ML3	6/28/2017	1.01	220.4	114.8	1.41	15.6		GRAB
ML3	7/5/2017	0.09	414.3	214.19	1.53	1.2		GRAB
ML3	7/12/2017	0.58	256.8	98.39	3.53	75.6		COMP
ML3	7/17/2017	13.50	252.7	126.14	1.97	281		COMP
ML3	7/17/2017	0.07	428.9	395.19	1.44	1.6		GRAB
ML3	8/3/2017	1.19	337.5	132.47	2.52	70		COMP
ML3	8/10/2017	0.72	179.1		1.45	9.6		COMP
ML3	8/14/2017	0.58	535.6	243.51	3.11	139		GRAB
ML3	8/16/2017	1.80	314.9	123.3	2.19	86		COMP
ML3	8/17/2017	11.15	256.3	112.78	2.32	242		COMP
ML3	8/28/2017	0.37	376.8	312.37	1.19	3.6		GRAB

Site	Date	Flow (cfs)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl (mg/L)	Type
ML3	9/25/2017	2.05	384.6	174.84	2.76	53.5		COMP
ML3	9/25/2017	0.64	711.1	520.66	5.68	9		GRAB
ML3	10/1/2017	1.03	326.3	172.88	2.32	23.1		COMP
ML3	10/2/2017	6.60	265.4	101.43	2.49	532		COMP
ML3	10/16/2017	0.30	403.2	321.74	1.52	1.4		GRAB
ML3	10/30/2017	0.22	314.4	219.1	1.43	0.5		GRAB
NLS	4/11/2017	3.80	251.1	149.16	2.17	11.8		GRAB
NLS	4/25/2017	2.58	402.4	72.25	2.23	154		COMP
NLS	5/8/2017	1.94	799.4	387.92	1.92	50.6		GRAB
NLS	5/17/2017	20.20	397.9	110.98	8.44	499		COMP
NLS	5/22/2017	6.05	122.7	51.75	1.55	3.8		GRAB
NLS	6/11/2017	15.98	610.1	16.79	3.59	284		COMP
NLS	6/14/2017	9.13	331.2	101.92	2.11	31.2		COMP
NLS	6/18/2017	1.16	262.4	52.79	1.89	40.2		COMP
NLS	6/20/2017	2.65	405.7	74.99	3.17	71		COMP
NLS	6/25/2017	0.51	686.2		3.47	29.2		COMP
NLS	7/17/2017	32.24	184.4	71.63	1.88	292		COMP
NLS	7/25/2017	10.83	329.8	5.01	2.77	134.7		COMP
NLS	8/3/2017	6.96	316.5	98.23	3.33	80		COMP
NLS	8/13/2017	31.83	130.9	41.39	1.21	126		COMP
NLS	8/14/2017	9.04	142.3	62.16	1.26	5.6		GRAB
NLS	8/16/2017	17.38	164.7	49.99	1.25	109.2		COMP
NLS	8/17/2017	36.54	164.7	77.14	2.49	373		COMP
NLS	8/19/2017	10.69	197.4	31.1	1.2	81		COMP
NLS	8/28/2017	1.94	137.1	48.6	1.33	4.4		GRAB
NLS	9/25/2017	10.21	175.1	81.2	1.35	5.2		GRAB
NLS	10/1/2017	3.51	236.9	59.8	2.38	38.0		COMP
NLS	10/2/2017	30.00	172.7	70.0	2.95	119.3		COMP
NLS	10/16/2017	2.80	82.0	31.9	0.79	1.6		GRAB
NLS	10/30/2017	1.34	90.5	16.2	1.17	4.0		GRAB
PC2	4/11/2017	3.56	160.8	27.2	2.31	22.4		COMP
PC2	4/24/2017	6.70	75.8	14.1	0.98	6.2	184.9	GRAB
PC2	4/26/2017	10.47	87.5	28.0	1.22	8.2	146.0	GRAB
PC2	5/8/2017	12.25	105.1	11.0	1.09	7.4	181.9	GRAB
PC2	5/17/2017	12.85	207.6	30.8	2.47	36.6	138.0	COMP
PC2	5/22/2017	93.03	95.5	35.6	1.04	7.4	80.0	GRAB
PC2	6/5/2017	10.72	146.0	51.1	1.15	5.4	176.0	GRAB
PC2	6/19/2017	5.02	200.6	82.1	1.84	11.4	156.0	GRAB
PC2	6/28/2017	2.68	121.2	25.3	1.36	9.2	132.0	GRAB
PC2	7/5/2017	1.76	160.8	39.7	1.58	12.2	140.0	GRAB
PC2	8/10/2017	5.77	213.4	25.8	1.38	52.5	76.0	COMP

Site	Date	Flow (cfs)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl (mg/L)	Type
PC2	8/14/2017	5.04	134.7	67.1	1.04	6.8	78.0	GRAB
PC2	8/16/2017	5.76	127.9	57.7	1.16	18.4	62.0	COMP
PC2	8/17/2017	41.74	109.3	49.5	1.42	62.0	48.0	COMP
PC2	8/28/2017	24.90	128.7	76.2	1.07	3.4	66.0	GRAB
PC2	9/25/2017	3.26	116.4	41.0	1.15	8.0	66.0	GRAB
PC2	10/2/2017	3.83	114.3	40.4	1.08	15.2	65.0	COMP
PC2	10/3/2017	27.37	88.1	74.9	1.96	57.6	67.0	COMP
PC2	10/16/2017	9.29	63.1	26.8	0.75	2.6	100.0	GRAB
PC2	10/30/2017	3.15	66.9	18.5	0.91	4.0	148.0	GRAB
PEONY	8/17/2017	58.90	383.7	138.88	5.41	3396		COMP
PEONY	7/18/2017	33.95	418	120.14	1.97	1472		COMP
PEONY	6/11/2017	21.32	390.4	71.37	3.24	678		COMP
PEONY	8/10/2017	19.47	529.3	137.14	1.73	498		COMP
PEONY	6/14/2017	16.29	467.3	139.64	7.22	392		COMP
PEONY	8/13/2017	25.22	455.7	181.08	1.49	364		COMP
PEONY	10/3/2017	21.42	383.8	203.71	3.12	209		COMP
PEONY	8/3/2017	4.99	376.9	145.36	2.31	73.6		COMP
PEONY	5/17/2017	25.48	334.9	135.99	2.34	68		GRAB
PEONY	5/22/2017	50.60	203.4	86.75	1.74	54.6		GRAB
PEONY	4/26/2017	24.02	240.9	89.98	1.7	47		GRAB
PEONY	8/16/2017	9.08	361.9	251.71	3.7	38.3		COMP
PEONY	6/28/2017	6.12	321.4	105.12	2.1	35.6		COMP
PEONY	7/12/2017	4.07	366.9	193.18	2.06	25.6		COMP
PEONY	8/14/2017	17.86	381	252.28	1.54	25.3		GRAB
PEONY	9/24/2017	9.58	328.9	180.65	1.68	23.2		COMP
PEONY	10/2/2017	6.53	304.6	171.25	1.32	18.6		COMP
PEONY	4/24/2017	11.99	134.3	60.0	1.4	16.8		GRAB
PEONY	9/25/2017	8.90	322.6	184.87	1.6	14.2		GRAB
PEONY	8/28/2017	13.76	268.2	186.34	1.42	9.6		GRAB
PEONY	7/31/2017	1.94	306	186.42	1.61	9.2		GRAB
PEONY	4/11/2017	6.81	145.0	70.4	1.5	6.6		GRAB
PEONY	7/5/2017	3.32	276	147.14	1.41	5.8		GRAB
PEONY	6/5/2017	7.15	180.8	78.7	1.78	5.6		GRAB
PEONY	6/19/2017	4.50	294.8	164.95	1.74	4.8		GRAB
PEONY	7/17/2017	2.22	324.1	244.45	1.33	3.8		GRAB
PEONY	9/11/2017	4.04	278.3	205.1	1.17	3.6		GRAB
PEONY	10/16/2017	9.27	181.1	121.37	1.13	3.6		GRAB
PEONY	5/8/2017	9.95	151.7	105.94	1.07	3.6		GRAB
PEONY	10/30/2017	6.47	148.1	88.37	1.14	3		GRAB
PL1	4/11/2017	0.17	309.8	247.87	0.74	2.6	72.98	GRAB
PL1	4/26/2017	0.34	193.1	79.4	1.67	7	71.98	GRAB

Site	Date	Flow (cfs)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl (mg/L)	Type
PL1	6/20/2017	0.28	284.1	152.8	9.52	26.8	55.98	COMP
PL1	6/28/2017	0.51	202.7	72.4	1.75	12.0	7.0	GRAB
PL1	7/5/2017	0.46	272.1	98.8	2.41	60.0	8.0	COMP
PL1	8/14/2017	1.76	131.4	46.8	1.27	36.6	3.0	COMP
PL1	9/25/2017	0.60	413.4	167.3	3.24	58.5	3.0	COMP
PL1	10/2/2017	0.47	219.8	95.7	1.16	14.7	4.5	COMP
PL1	10/3/2017	8.47	316.8	107.6	2.88	203.0	3.5	COMP
PL1	10/22/2017	0.38	606.7	384.8	1.97	19.5	7.0	COMP
PL2	4/11/2017	2.90	116.7	33.2	1.01	12.0	389.9	GRAB
PL2	4/24/2017	1.63	109.5	15.4	0.97	8.2	209.9	GRAB
PL2	4/26/2017	2.90	126.4	17.3	1.20	15.0	187.9	COMP
PL2	5/8/2017	0.41	85.0	40.7	0.68	2.4	156.0	GRAB
PL2	5/9/2017	1.49	146.2	29.4	1.70	35.8	128.0	COMP
PL2	5/17/2017	3.96	254.2	50.8	2.32	77.4	128.0	COMP
PL2	5/22/2017	1.00	122.0	68.2	1.00	5.0	92.0	GRAB
PL2	6/5/2017	0.20	128.9	63.0	0.98	2.8	132.0	GRAB
PL2	6/11/2017	18.29	454.2	56.0	4.23	202.0	100.0	COMP
PL2	6/19/2017	0.42	164.4	88.6	1.13	3.2	118.0	GRAB
PL2	6/20/2017	2.20	284.9	77.6	2.24	49.7		COMP
PL2	6/28/2017	0.51	184.7	117.6	1.44	2.0	136.0	COMP
PL2	7/5/2017	0.77	143.6	84.9	1.02	2.8	102.0	GRAB
PL2	7/18/2017	34.62	617.5	69.7	2.78	238.7	46.0	COMP
PL2	7/31/2017	0.01	211.8	174.4	1.06	0.4	98.0	GRAB
PL2	8/13/2017	11.71	168.3	66.1	1.39	26.6	46.0	COMP
PL2	8/14/2017	1.56	123.8	69.5	0.91	2.6	52.0	GRAB
PL2	8/16/2017	3.64	141.9	71.4	1.82	12.6	46.0	COMP
PL2	8/17/2017	31.61	149.3	82.6	2.18	248.0	46.0	COMP
PL2	8/28/2017	0.65	114.1	80.5	0.93	1.4	56.0	GRAB
PL2	9/11/2017	0.28	96.3	81.5	0.73	1.0	70.0	GRAB
PL2	9/24/2017	2.60	170.5	50.4	1.20	17.4	62.0	COMP
PL2	9/25/2017	1.71	165.0	52.5	1.06	5.2	70.0	GRAB
PL2	10/1/2017	2.34	148.2	42.6	0.97	15.0	58.0	COMP
PL2	10/3/2017	25.11	305.8	66.7	1.55	181.3	37.0	COMP
PL2	10/16/2017	0.41	82.2	42.6	0.69	1.2	70.0	GRAB
PL2	10/30/2017	0.48	90.0	59.3	0.68	1.0	92.0	GRAB
PRG-IN	4/19/2017		129.0	100.6	0.84	8.8		GRAB
PRG-IN	4/26/2017		156.1	35.9	1.40	18.4		GRAB
PRG-IN	6/22/2017		118.5	35.5	1.90	23.5		GRAB
PRG-IN	8/9/2017		17.8	7.7	0.29	3.2		GRAB
PRG-IN	10/2/2017		95.1	15.6	1.97	55.2		GRAB
PRG-OUT	4/19/2017		586.4	496.6	2.12	20.7		GRAB

Site	Date	Flow (cfs)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl (mg/L)	Type
PRG-OUT	4/26/2017		350.8	281.6	1.55	8.0		GRAB
PRG-OUT	6/22/2017		258.7	205.2	1.35	3.0		GRAB
PRG-OUT	8/3/2017		244.1	164.0	2.14	1.7		GRAB
PRG-OUT	8/9/2017		475.6	392.9	1.74	6.0		GRAB
PRG-OUT	10/2/2017		380.3	311.1	3.20	3.4		GRAB