Ferric Chloride Water Treatment Facility
2013 Annual Report
NPDES/SDS Permit No. MN0067377

Mailed to:
Submittals Center
Minnesota Pollution Control Agency
520 Lafayette Road North
Saint Paul, MN 55155

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PRIOR LAKE - SPRING LAKE
WATERSHED DISTRICT

Background

Spring Lake is a recreational lake located in central Scott County, Minnesota. The lake is listed on the State Impaired Waters List as impaired for aquatic recreation due to excess nutrients. Monitoring completed by the Prior Lake-Spring Lake Watershed District (PLSLWD) in the 1990's identified phosphorus as the nutrient most contributing to water quality impairment and algae blooms. That study also noted that a significant portion of the phosphorus entering Spring Lake was in the form of dissolved phosphorus (soluble reactive phosphorus, or SRP) thus making it readily available for algal uptake. Spring Lake flows directly into Upper Prior Lake, which is also listed as impaired due to excess nutrients.

In 1998, the PLSLWD constructed a ferric chloride ($FeCl_3$) treatment system to precipitate SRP out of stormwater from County Ditch 13, the main inflow to Spring Lake. The system was constructed as part of a Minnesota Pollution Control Agency (MPCA) Clean Water Partnership Implementation Project. The treatment system began operating under a permit from the Department of Natural Resources. In 2004, the treatment system permit was renewed as a National Pollutant Discharge Elimination System permit administered by the MPCA. The District applied to the MPCA for a renewed permit in 2009. That permit was approved in 2012.

The treatment system involves the injection of 32.5% liquid $FeCl_3$ solution into a stormwater pond, or desiltation basin. The iron within the $FeCl_3$ binds with the dissolved phosphorus in the water and creates colloidal particles (floc) which settle at the bottom of the basin. The treated water then flows downstream into Spring Lake.

Prior to 2013, the $FeCl_3$ system had not operated since 2011. During this time, the District was working toward a design that would meet requirements of the new MPCA permit. In 2013, the treatment facility began operating on July 15 as the facility was retrofitted to meet new MPCA permit requirements during the first half of the year. The old system injected $FeCl_3$ directly into the channel immediately downstream of the weir on the south side of Highway 13 where it would mix until reaching the desiltation pond. The new design transfers $FeCl_3$ from the treatment building through a double walled pipe to a culvert north of Highway 13 that flows directly into the desiltation basin (see Figure 1). The new design addresses the previous concerns of the MPCA by avoiding direct discharge into a water of the state, and instead, directly into a stormwater pond. A new pump was also installed by Vessco in 2013 in order to accommodate the new pumping requirements.

The retrofit project was designed by consultants Bolton and Menk, Inc. and installed by S.M. Hentges & Sons, Inc. The new design allowed for more water to be treated as compared to the old system. With the old system, high flows could re-suspend phosphorus-iron flocculants within the basin and flush the flocculent downstream and into Spring Lake. The new system was designed to overtop a bypass weir (and flow around the desiltation basin) once the flow reached 30 cfs. This allows for the maximum amount of phosphorus to be treated without re-suspending the material in the desiltation basin.

Some final elements of the project are under review before final closeout by the District. The District is also looking at additional next steps to potentially improve the efficiency even further.

Figure 1 Map of Ferric Chloride Treatment System

Summary of Results

In 2013, the Prior Lake-Spring Lake Watershed District (PLSLWD) started injecting $FeCl_3$ into the stormwater pond on July 15. The ditch stopped flowing and thus treatment discontinued in the middle of August, so the treatment facility only operated for approximately one month in 2013.

During the month of operation in 2013, the system treated approximately 634.80 million gallons (MG) of water. The system reduced the average concentration of Total Phosphorus (TP) by 0.19 mg/L and removed a calculated 449.1 pounds of phosphorus. The concentration of SRP was reduced by an average of 0.12 mg/L and approximately 323.28 pounds of SRP were removed from the system.

Site SW-001 is located upstream of the treatment system and site SD-002 is located downstream of the treatment system. See Table 1 for a summary of the phosphorus reductions in 2013.

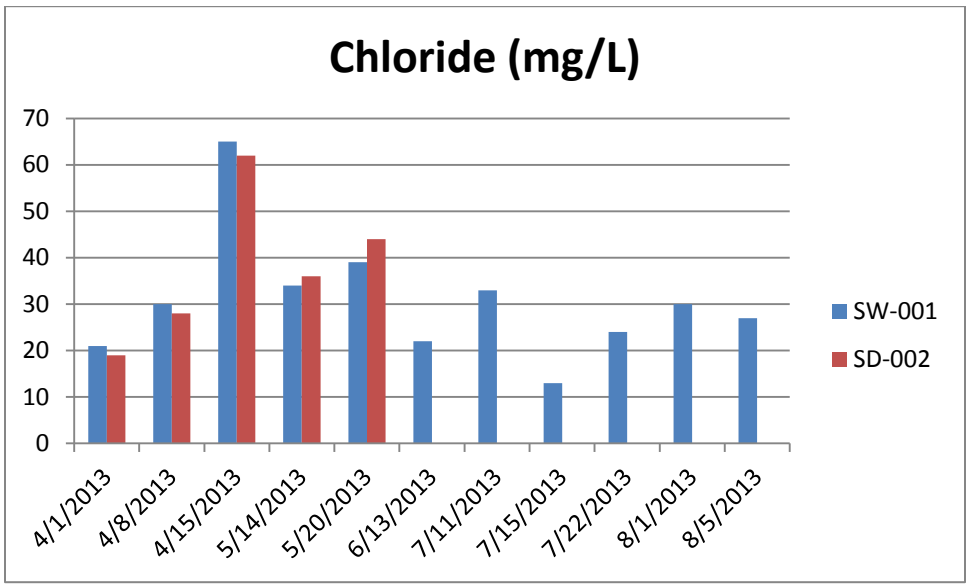
Table 1 – Summary of phosphorus and flow while treatment system was operating

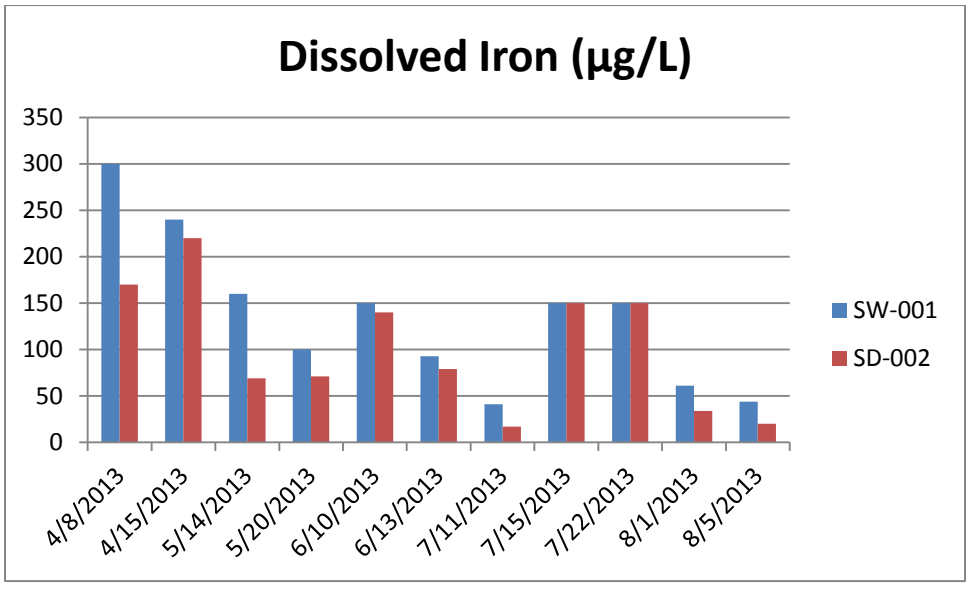
		SW-001	SD-002
July	Average TP (mg/L)	0.31	0.23
	Average SRP (mg/L)	0.20	0.14
	Average Daily Flow (MG)	20.30	20.30
	TP Load (pounds)	1642.74	1207.14
	SRP Load (pounds)	1049.67	734.77
August	Average TP (mg/L)	0.42	0.13
	Average SRP (mg/L)	0.22	0.04
	Average Daily Flow (MG)	0.18	0.18
	TP Load (pounds)	19.53	6.05
	SRP Load (pounds)	10.24	1.86

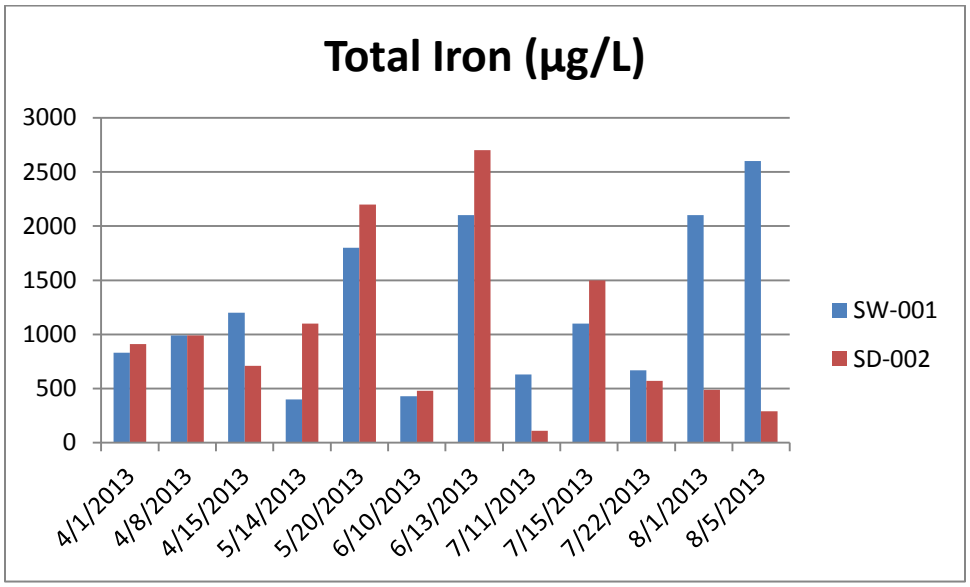
Flow was not able to be calculated accurately for site SD-002 due to construction on-going in the stream channel. It was assumed that the flow at site SW-001 and SD-002 was the same for these calculations. In 2014, construction should be finished and more accurate calculations will be made.

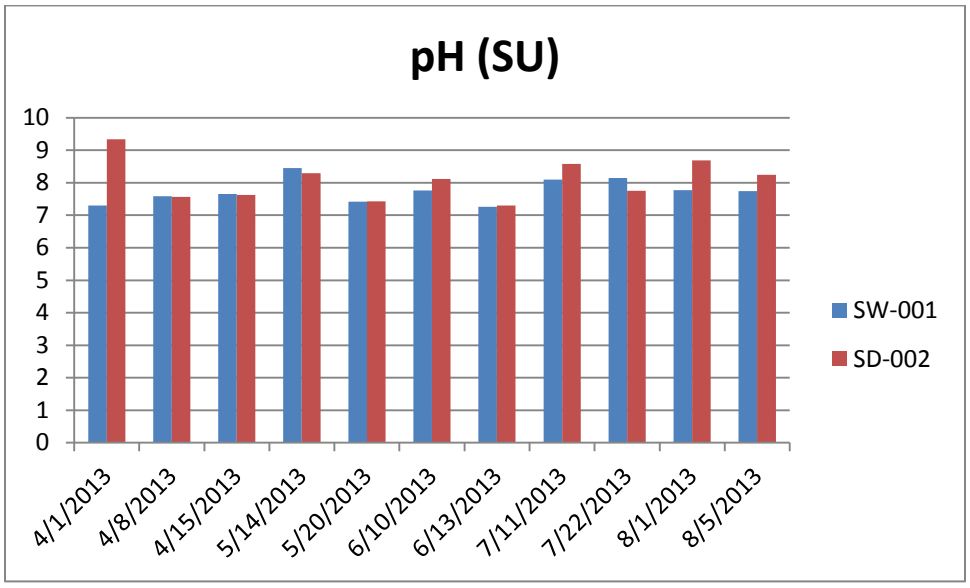
Data Graphs

The following graphs represent the samples taken in 2013 at site SW-001 (upstream of treatment) and SD-002 (downstream of treatment).






Total Iron (µg/L)
3000
2500
2000
1500
1000
500
0
4/1/2013
4/8/2013
4/15/2013
5/14/2013
5/20/2013
6/10/2013
6/13/2013
7/11/2013
7/15/2013
7/22/2013
8/1/2013
8/5/2013
SW-001
SD-002


pH (SU)
10
9
8
7
6
5
4
3
2
1
0
4/1/2013
4/8/2013
4/15/2013
5/14/2013
5/20/2013
6/10/2013
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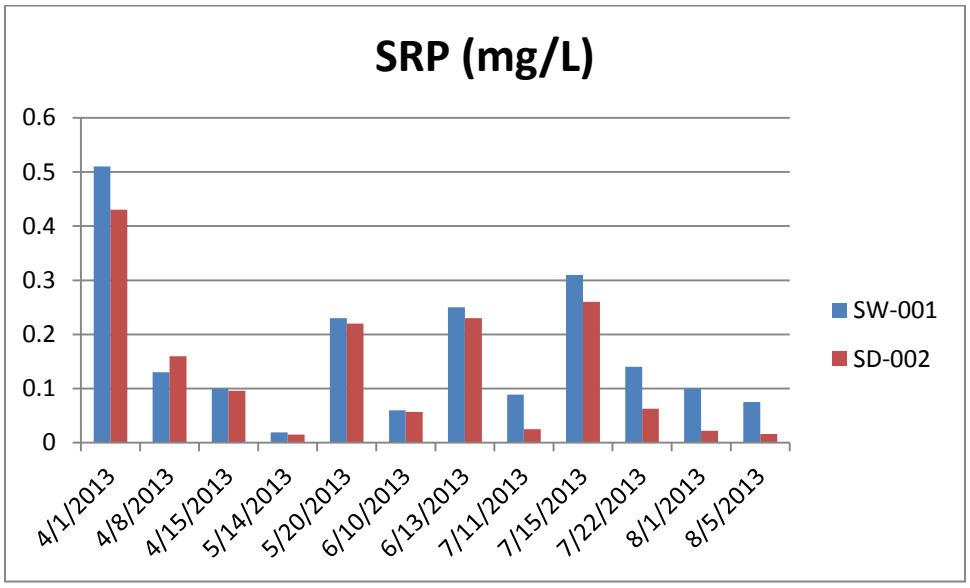
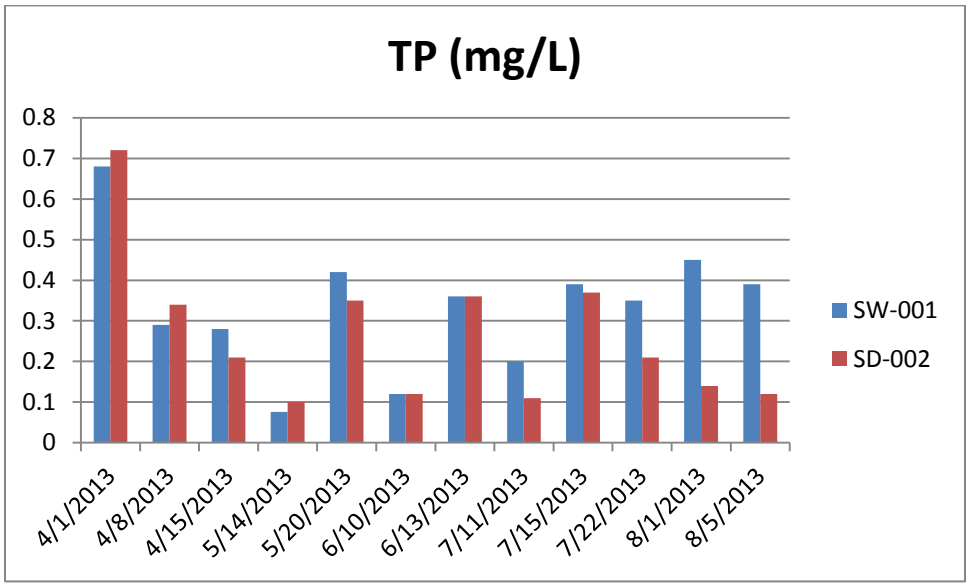
7/11/2013
7/22/2013
8/1/2013
8/5/2013
SW-001
SD-002


SRP (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
4/1/2013
4/8/2013
4/15/2013
5/14/2013
5/20/2013
6/10/2013
6/13/2013
7/11/2013
7/15/2013
7/22/2013
8/1/2013
8/5/2013
SW-001
SD-002


TP (mg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
4/1/2013
4/8/2013
4/15/2013
5/14/2013
5/20/2013
6/10/2013
6/13/2013
7/11/2013
7/15/2013
7/22/2013
8/1/2013
8/5/2013
SW-001
SD-002