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Henderson Lake, Southern Alberta, Canada.

Application dates: 25th- 29th April 2016

Summary

Aim: To bind the soluble phosphorus in Henderson Lake, reducing the frequency of algal blooms and significantly improving the aesthetics of the water body.

Description: 100yr old manmade lake

Size (m^2): 250 000 (25 ha)

Average depth (m): 2.6

Conductivity (µS/cm): 30 000 (0.3 dS/m)

Dosage (tonnes): 64

The Lake

Henderson Lake is an urban water body located in Henderson Park in the eastern suburbs of the City of Lethbridge, Southern Alberta. The lake is of high recreational and aesthetic value and many amenities for residents have been developed around it. They include parklands, walkways, Japanese gardens and a golf course. Henderson lake is heavily enriched with phosphorus. This has led to a high incidence of cyanobacterial (blue green algal) blooms and prolific macrophyte growth.

Figure 1: Aerial photo of Henderson Lake, Canada (image from Google Earth, 2017).

Henderson Lake receives regular inputs of water from the St. Mary River Irrigation System and from water pumped from the surrounding area (including the golf course, parklands and bowling greens). During extreme rainfall events, the city's storm water flows into the lake. Due to the influence of water from non-point source locations, Henderson Lake has historically suffered from eutrophication. Water quality monitoring indicated that the lake is heavily enriched with phosphorus; which has led to a high incidence of cyanobacterial (blue green algal) blooms and prolific macrophyte growth. In recent years, a number of measures have been taken by the City of Lethbridge to reduce the frequency and severity of these blooms and control the growth of macrophytes. These included live liquid microorganisms, solar bees (mechanical mixers), grass carp, and aeration. However phosphorus levels remain high, and cyanobacteria continue to have a negative impact on water quality and the overall ecological condition of the lake. Due to the importance of the lake to Lethbridge residents, the City was interested in implementing further measures aimed at improving water quality and ecological conditions; hence the use of Phoslock in 2016.

Figure 2: Henderson Lake (photo from Phoslock Water Solutions Ltd internal report 2014).

The Treatment

The Phoslock application commenced at 8am on the 25th of April 2016. Prior to the application, the site was prepared to ensure all equipment was at the job site and placed correctly. Fencing was installed in a section of the parking lot to store pallets of Phoslock and valuable equipment. A site survey was conducted along with a safety briefing before commencing the application. A site safety/planning meeting took place each day during the five day application period.

During these meetings the crew were updated on application locations along with any changes to the site or equipment. The Phoslock was delivered to the site on a daily basis and the application took the full day.

The Phoslock application of 64 tonnes was completed on the 29th of April at 6:30pm and site clean up finished on May 30th 2016.

Figure 3: Phoslock application on Henderson Lake (photo taken by Phoslock Water Solutions Ltd).

Henderson Lake

Results

The City of Lethbridge undertook an extensive monitoring program before and after the Phoslock application (from Apr 19th April 2016 to the 15th September 2016; City of Lethbridge, 2016). Monitoring included the collection of water samples at 5 sites (Figure 4) and 2 depths (0.1 m below surface and 0.1 m above bottom) These samples were analysed for nutrients, metals, and other chemical compounds.

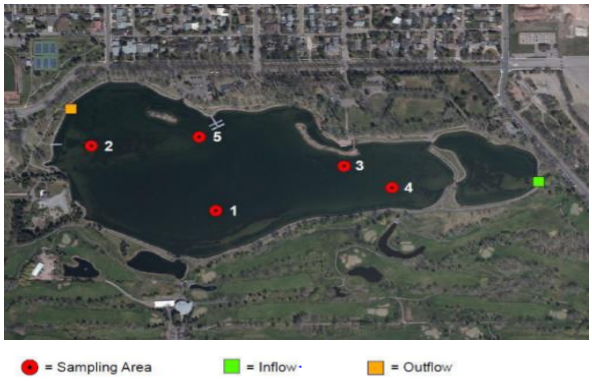

Figure 4: Water quality monitoring sites at Henderson Lake (aerial photograph from Nürnberg, G. and LaZerte, B. Henderson lake Report, 2017).

Samples taken from the lake before and after the Phoslock treatments (Table 1) show that total phosphorus (TP) concentrations decreased from a mean of 0.224 mg/L (Nürnberg, 2016) to 0.0244 mg/L (surface) and 0.0284 mg/L (bottom) after application in 2016. The concentration of TP in the surface water samples reduced by about 90%.

As well as the significant reduction of internal phosphorus measured in Henderson Lake, there was a notable reduction in odour. The bad smell associated with the lake had been a major concern to patrons of the park. It had been attributed to high algal and macrophyte productivity within the lake, and the dominance of specific cyanobacterial species which can cause foul taste and odours associated with the lake water. This was particularly noticeable in late summer when there was dieback and degradation of the aquatic plants and algae.

Period	Location, agency	TP (mg/L)	n
	Pre-treatment		
2000-15, Growing period	Stn 1, Lethbridge College	0.224*	136
2000-15, May	Stn 1, Lethbridge College	0.093*	23
2016, April 18, 25	City, Stn 1 to Stn 5	0.025	10
Apr 25	Nowak, Stn 1, Apr 25	0.038	1
	Post-treatment		
2016, May-Sep	City, Stn 1 to Stn 5	0.024	50
Jun 3	Nowak, Stn 1	0.018	1

*Computed from TRP by multiplication with 1.3 (Phase 1 Report)

Table 1: Data displaying the before and after concentrations of total phosphorus (TP). Table taken from Nürnberg, G. and LaZerte, B. Henderson lake Report, 2017.

Phoslock successfully reduced the amount of phosphorus in the lake that was available for algae to synthesise. This in turn caused a significant reduction in cyanobacteria and a flow on effect of a summer without odour being present at the lake, or any complaints from the general public.

Conclusion

The application of Phoslock to Henderson Lake proved to be successful in significantly reducing the concentration of phosphorus. This in turn has reduced the abundance of cyanobacteria (reducing the total phosphorus concentration) and halted the occurrence of algal blooms. The water quality and clarity significantly improved.

By collating the mean total phosphorus, Secchi depth, and chlorophyll-a levels, the lake is now classified as a meso-oligotrophic system. This is a significant change from previous years when the lake was classified as being hyper-eutrophic.

The City of Lethbridge concluded that the application was successful in significantly improving the water quality. This occurred in a relatively short period of time. The water will continue to be monitored, however results are positive and shows that Phoslock helped in reversing historically detrimental water quality trends in the lake. It was also concluded that phosphorus was bound and levels were maintained within the lake throughout the summer.

The City of Lethbridge confirmed that Phoslock was effective at preventing eutrophication within Henderson Lake in 2016.

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