Clearflow Group products leverage existing infrastructure to protect lake from stormwater pollutants.

Innisfil Ontario erosion control and advanced sedimentation pilot project.

Innisfil, Ontario, located on the southwestern shore of Lake Simcoe, needed to find innovative ways to protect the lake from silt pollution and associated phosphorus in stormwater entering the lake from the community. For this reason, the Town of Innisfil and Greenland Engineering sought to conduct a pilot project to identify and evaluate new technologies capable of achieving reductions in these pollutants.

A $500,000 federal grant was provided by the Federation of Canadian Municipalities (FCM) Municipal Green Fund for the pilot scheme. A total budget of 2 million dollars was secured, and Greenland Engineering selected Clearflow Groups Gel Flocculants as the Advanced Sedimentation Technology (AST) to be piloted over an 18-month period. Greenland would gather data to assess the Gel's ability to remove Total Suspended Solids (TSS) less than 40 microns in size, along with the nutrient phosphorus. The new Sleeping Lion subdivision was chosen as the pilot site, and three stormwater management facilities (SWMFs) under various stages of construction would be used. Water flowing into Lake Simcoe is regulated by the Lake Simcoe Protection Plan (LSPP).

The LSPP and the Lake Simcoe phosphorus offsetting policy.

Protecting Lake Simcoe is the responsibility of the Lake Simcoe Region Conservation Authority (LSRCA). The conservation authority has a very clear vision: "…*that the lake is life, and the health of the lake determines the quality of life*…" Research conducted over 40 years clearly indicates that human activities have impaired the health of Lake Simcoe. Water in the lake has been degraded through excessive nutrients such as phosphorus, contaminants like TSS, and heavy metals and pathogens (bacteria, viruses). To reduce human impact, the LSCRA enacted the Lake Simcoe Phosphorus Offsetting Policy with two stated goals: to maintain or improve water quality and assist the LSPP in achieving a target of 7 mg/L of dissolved oxygen and an annual phosphorus load of 44 metric tons. New developments like the Sleeping Lion Subdivision would need to meet a **Zero Phosphorus** release. If they could not achieve zero discharge, a phosphorus offsetting fee would be levied. The following calculation would be used to attach real money to an unseen pollutant.

Offset Ratio = 2.5:1

Offset Value = $35770.00/KG/YR (reviewed annually)

Offset Calculation = (2.5) x P load in KG x $35770.00)

The importance of advanced sedimentation technologies.

Stormwater management facility design criteria can differ from jurisdiction to jurisdiction. In Ontario, the guidelines state that a SWMF should be effective at removing sediment 40 microns and larger. This is inadequate, as particles are often much smaller, remain in suspension, and move directly through SWMFs, especially during high flow periods. Additionally, many pollutants, including phosphorus, can be completely dissolved, meaning they are less than 2 microns in size. It is for this

reason that water treatment becomes necessary. Having the ability to convert some dissolved factions and ultra-fine suspended materials into larger particles would transform SWMF's into Stormwater Treatment Facilities. AST's like Clearflow Gel Floc play a pivotal role in the transition. With the ability to integrate into existing infrastructure, meeting new regulatory regimes becomes achievable and less costly. As many local governments struggle to maintain services, the construction and operation of stormwater treatment infrastructure will quickly exceed the capacity of municipal budgets.

Clearflow Gel Flocculants – Doing more with less

For nearly two decades, Clearflow Gel Flocculants have been used by various industries. Companies that are required to meet stringent regulations for release water also have a responsibility to generate returns for shareholders. Providing a solution that has a low cost of treatment, a minimal carbon footprint, works passively, and is effective makes Gel Floc ideal. Environmental sustainability is a core tenant of Clearflow Group, as is protecting fish and aquatic habitat. Porting all these benefits to a municipal application is a natural progression for the technology. New and upcoming regulations will necessarily push stormwater departments into finding unique and innovative products to avoid exceedances and fines. With Gel Floc, stormwater treatment only requires leveraging existing infrastructure. Easily placed in large-diameter stormwater mains directly upstream of SWMF's, treatment begins, and increased settling in the pond is accomplished. The advantage of the Gel's passive treatment, which requires only gravity's flow energy to affect the release of the flocculant, is ideal. Take away the flow, and the product remains mostly intact, swelling slightly as hydration of the Gel Floc occurs. The simplicity and effectiveness of the Clearflow products make them a budget-friendly solution.

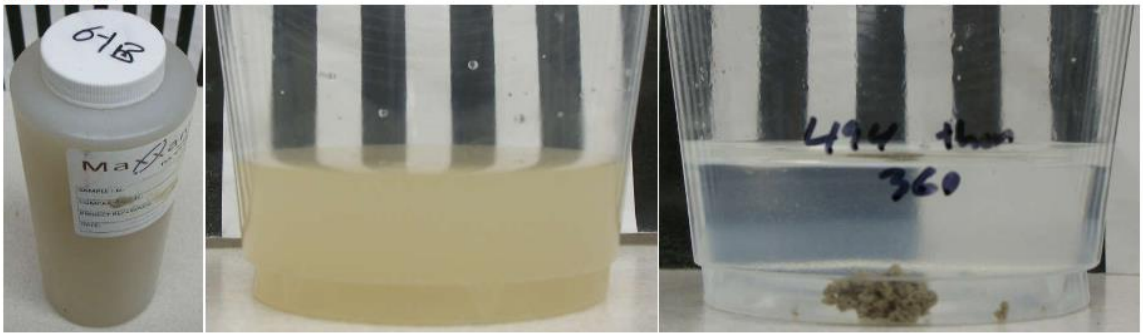
The Innisfil pilot sampling and installation criteria.

Greenland Engineering, in consultation with Clearflow Group, was responsible for supervising the installation for the Innisfil pilot. Before any site work could start, it was necessary to have samples of the water flowing into the three stormwater ponds. The Gel Floc products are not one size fits all but are chosen through laboratory testing to ensure the most effective chemistries are used. This testing was completed at Clearflow Group by a professional chemist, with a report provided showing the results and prescribing the appropriate Gel Floc type.

Greenland; Innisfil Test results; Dec 6, 2018

ClearFlow REFERENCE NUMBER	DATE	LOCATION		PURPOSE	PRODUCT	TURBIDITY (NTU)		MIX TIME (sec)	COMMENTS
		Region	Site			start	end		
18-12-0061	06-Dec-18	ON	Sample 6-1B	Clarify	GFB 494 then GFB 360	802	11.28	30 & 30	large tight flocs

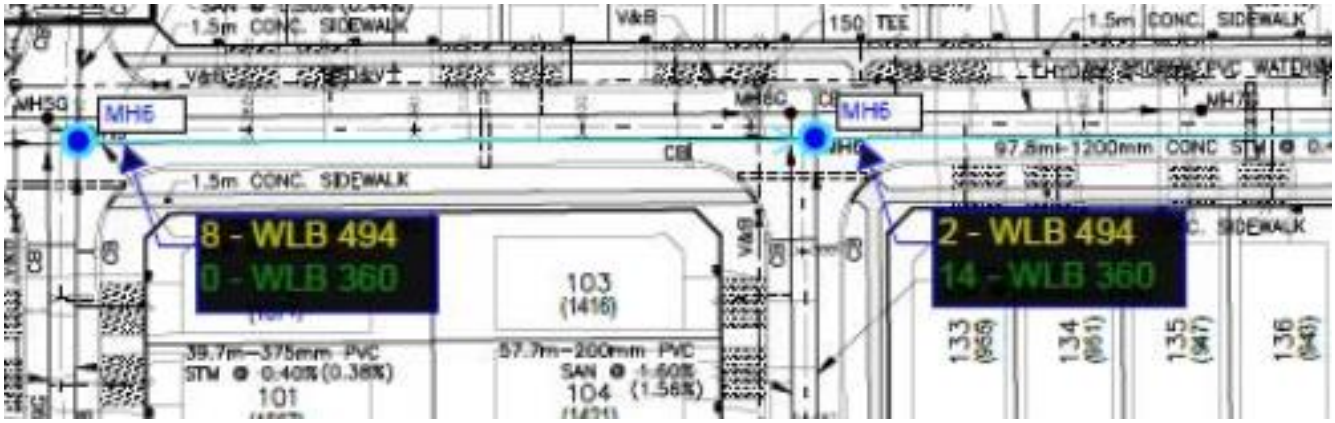
Sample 6-1B



Having identified Gel Floc types 494 and 360 as being most effective, plans for the number of blocks required, and where they would be positioned were created. Because the Gel Floc uses flow energy, understanding the desired flow rate to be treated is imperative. Innisfil indicated a 25mm to 5-year event was the desired baseline. Gel Floc Blocks are normally prescribed at a rate of 1 block for every 50 gpm or 3 L/sec of flow. However, several factors can alter this calculation. First, the velocity of the water is important. Water moving less than 10 fps or 0.3 m/sec drastically slows or stops the release of the product. Second, the size, shape, and amount of the particles in the water will change the scouring effect as water flows across the block surface. Thirdly, the water temperature plays a role. Water below 40 °F or 5 °C will slow the reaction, and temperatures over 75 °F or 24 °C will speed up consumption. Because Innisfil is in Canada, water temperatures would likely be very low in the spring and moderate during the summer.

Gel Floc Blocks must be positioned in the stormwater collection system upstream of the SWMF. The minimum transit time of the water after crossing the blocks until it enters the pond is 2-4 minutes. This time allows for particles to mix and bind, making them large and heavy, to create something that will settle quickly in the less energetic flow of the pond. Ideally, the pond has a forebay to capture the settling matter, and because the Sleeping Lion subdivision was newly constructed, all three ponds had forebays. Installing the Gel Floc Blocks was easy and straightforward once the locations and number of blocks were identified. Clearflow Group prepared

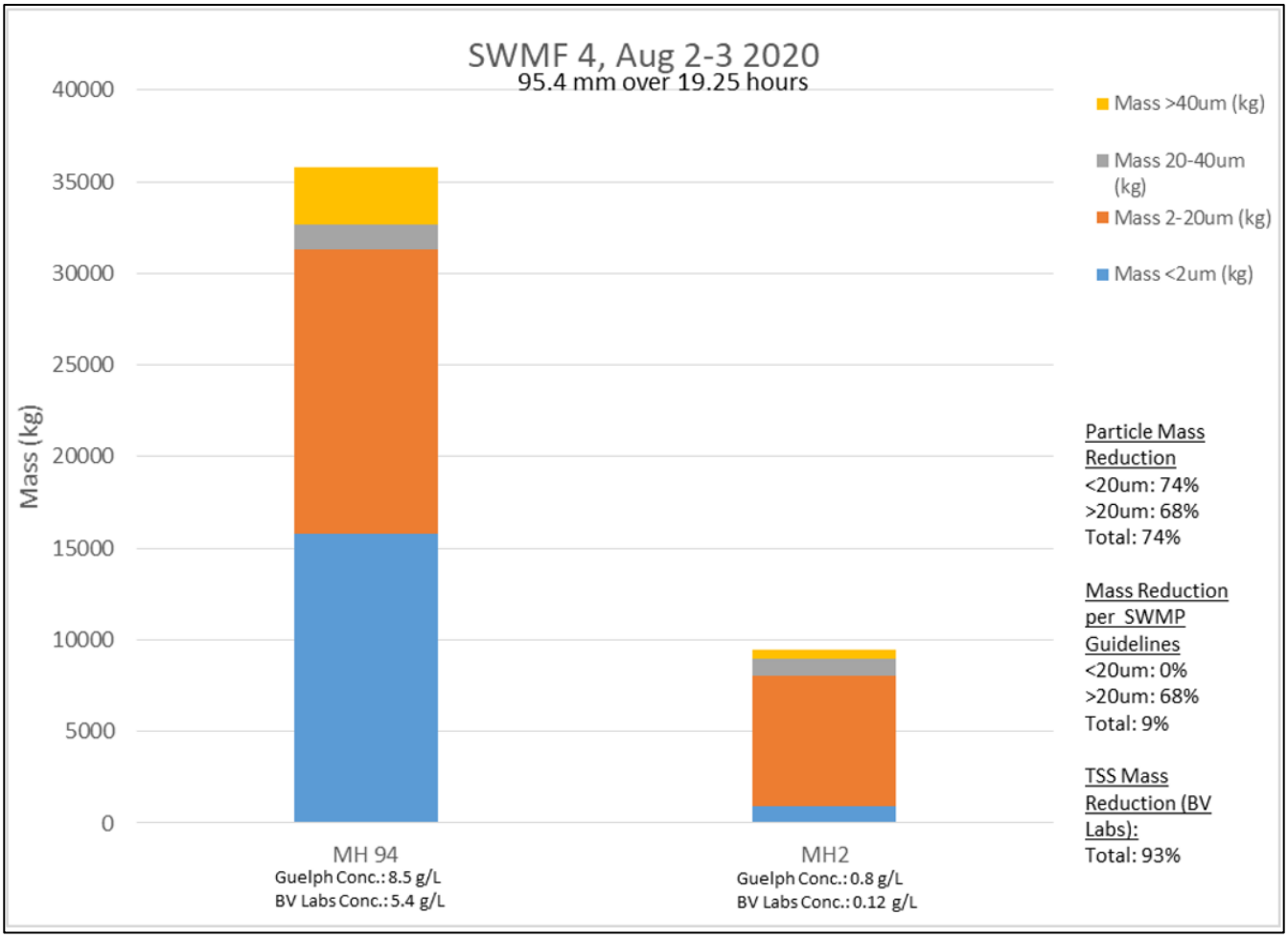
and shipped strings of blocks to be secured inside existing manholes. The flocculants were strung together using polyethylene rope and carabiners and attached to the bottom ladder rung. Water was then dumped upstream to float the strings downstream into the storm main.



Data collected shows significant improvements.

Samples for TSS and phosphorus were collected by Greenland Engineering, with analysis completed at two local laboratories. The TSS results showed very interesting and unexpected findings. For example, during a close to 50 year rain event (95mm in 19 hours), approximately 36,000 KG of very fine sediments were washed from 20 hectares of stripped subdivision. Through particle analysis, only 9% of the 36,000 KG were found to be greater than 40 microns in size. That meant that 91% of the mass flowing into the pond was smaller than the design guidelines for sediment removal. Also of note was the mass of particles less than 2 microns, which can be considered as dissolved. At 44% of the total, this represents a significant potential source of harmful pollutants that would have no chance of settling.

However, because the Gel Flocculants were installed, that number was drastically reduced to just 3%, and overall, this pond saw a 74% reduction in the sediments leaving the pond during this extreme flow event.



Phosphorus, a nutrient that causes algae blooms, and cyanobacterial growth were reduced by an average of 90% across the three ponds. **When applied to the LSRCA Phosphorus Offsetting Policy, this represented a massive savings to the developer of 2 million dollars (US).**

	Average Phosphorus Removal
SWMF 4	94%
SWMF 6	80%
SWMF 7	98%

Creating a precedent for the future protection of natural habitats.

Water quality from the highly successful pilot project showed significant results from the use of Clearflow's Gel Flocculant technology. These innovative products enhanced both TSS and phosphorus removal to levels much higher than expected. The Town of Innisfil now has a powerful solution to de-risk potential fines, reduce infrastructure costs, and improve the overall quality of the lake water for recreational access. In strong support of the project's findings, Innisfil plans to add AST's to the development engineering specifications. Innisfil development engineer Glenn Switzer was also very pleased with the results and said that while "projects like these typically require substantial capital investment, using the Clearflow Gel flocculant [meant] we were able to optimize the use of our existing infrastructure. This saved time, money, and environmental impact. Treating stormwater has now become much more effective and affordable." According to Mark Palmer, president of Greenland Consulting Engineers, "This project has demonstrated what many practitioners in water resource engineering have thought for a longtime: that there are large amounts of sediment being discharged to waterbodies from development under construction. The good news is, this project has also shown there are engineering solutions to this problem, including the use of AST's available from the Clearflow Group that are easy to implement during the construction phase of development."