Association of Consulting Engineering Companies - Canada
Canadian Consulting Engineering Awards 2015
Water Resources Category

Municipality of Sioux Lookout

Water Treatment Plant Process Wastewater Treatment

Submitted by
JR Cousin Consultants Ltd.

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Water Treatment Plant
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Full Project Description

Submitted to
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FULL PROJECT DESCRIPTION

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1.0 75-Word Summary

Sioux Lookout's WTP process wastewater, equal to 18.8% of the raw water flow, was stressing its sewer system capacity. To reduce loading to the sewer system, JRCC designed and administered construction of an ultrafiltration treatment system to treat the process wastewater. The process wastewater was reclaimed as potable water, reducing the water treatment process discharge by 75%. The project was completed under budget, allowing a UV upgrade to service the entire water supply.

2.0 Project Description

2.1 Innovation

Briefly introduce your project, i.e. what was done and why? Then explain how it demonstrates the innovative application of engineering principles or techniques. How is it distinguishable from similar projects of its type?

The Municipality of Sioux Lookout needed to reduce the amount of process wastewater being discharged to the sewer system from the water treatment plant. The existing GE membranes produced a continuous reject stream of process wastewater to remove accumulated contaminants. Of the raw water entering the plant, approximately 18.8% was process wastewater, more than double the rate of a typical plant of this type. This was putting a strain on the sewer system.

JR Cousin Consultants Ltd. (JRCC) designed an ultrafiltration (UF) membrane system with ultraviolet (UV) disinfection and was able to reclaim most of the process wastewater from the WTP and treat it to become potable water. A six week pilot was conducted onsite to determine the feasibility of UF treatment of process wastewater. The pilot skid was fully automatic and operating parameters were optimized to improve, recover, and enhance membrane cleaning effectiveness. The goal of the pilot was 70% recovery, however, through the optimization process the recovery rate was increased to 75% while maintaining adequate suspended solids removal, and minimal fouling with effective membrane cleaning.

Water conservation has become increasingly important as has environmental responsibility. Traditionally, reject water and backwash water from a water treatment process is directed to a wastewater treatment facility, either a mechanical plant or lagoon. It is not common practice to treat wastewater for return to the system as potable water.

The process wastewater receives full treatment to meet Guidelines for Canadian Drinking Water Quality (GCDWQ) via the UF membranes, reducing colour, turbidity, aluminum, iron, high amounts of suspended solids, DOC and TOC, and to address high Cryptosporidium levels. Permeate from the UF passes through the UV disinfection system and then is discharged to the reservoir as potable water. The system reduces the loading to the sewage treatment plant by 75% and increases treated water capacity by 8.52 L/s. Project cost savings allowed the UV system to be expanded and sized to 65 L/s, capable of disinfecting the permeate water from the GE membranes and from the UF membranes, which improved the overall potable water quality.

The following table shows the quality of reject water from the GE membranes and from the UF membranes.

PARAMETER	WTP RAW	WTP GE FILTRATE	UF RAW	UFFILTRATE
Colour, True	44.8	<5.0	<5.0	<5.0
pH	7.25	6.56	6.47	6.52
UV Transmittance	42.8	86.8	0	87.8
Turbidity	0.795	0.042	92	0.076
Dissolved Organic Carbon	11.5	4.2	6.6	4.4
Total Organic Carbon	11.6	4.1	81.9	6.5
Total THM Formation Potential	-	0.148	-	0.143

To avoid a costly and difficult building expansion, JRCC designed the system to fit within the available WTP footprint. To obtain space the existing genset was removed and a new 300 kW diesel generator installed outside in an all-weather enclosure. An unused sodium hypochlorite bulk tank was removed for the installation of the UV disinfection system and new chemical feed system. The UF system designed by JRCC treats a poorer quality of water than the existing treatment unit, at a rate of 63% more flow per square metre of floor space.

The Sioux Lookout Water Treatment Plant Process Wastewater Treatment project was the recipient of a 2015 ACEC-Canada Award of Merit in the Municipal and Water Technology Category.

2.2 Complexity

Explain the complex nature of your project and any extraordinary problems and conditions that were overcome.

Determining the best option to meet the client's needs while meeting established guidelines created a complex project. The initial scope of the project was to reduce the loading to the sewer system with the discharge piped to Pelican Lake. The Ministry of Environment (MOE) indicated that process wastewater was not considered sewage; there were no specific regulatory requirements. The wastewater discharged would have to meet quality requirements for effluent being returned to a source water body. As Pelican Lake is environmentally sensitive, a Total Suspended Solids limit of 15 mg/L could be requested. Chlorine and other oxidants or cleaning agents would need to be neutralized before discharge.

MOE indicated that Pelican Lake has high levels of Cryptosporidium and recommended a minimum of 5-log removal or inactivation for treated water. However, if Sioux Lookout installed the recommended process of UF with discharge to the potable water reservoir, MOE stated the system must provide minimum 6-log removal or inactivation of Cryptosporidium, as the existing GE membrane process will concentrate the Cryptosporidium in its process wastewater an additional ten-fold. To achieve removal or inactivation requirements, UV disinfection would be required in conjunction with ultrafiltration.

Although recommended by others, a WTP building expansion would have been difficult and costly due to limited land availability and the unique architectural features of the building. JRCC worked with suppliers and operators to design a system to fit within the available footprint and to be delivered through the existing overhead door, preserving the existing building and reducing costs.

2.3 Social and/or Economic Benefits

Explain the social and economic benefits to society derived from your project. Be specific and provide both qualitative and quantitative information.

The process wastewater treatment system improves quality of life, supports continued growth of the community, and incorporates water and energy conservation. The design and construction of the process wastewater treatment system was an economical and effective solution to address the significant loadings that were being placed on the sewer system. Of the seven options JRCC evaluated, the UF membrane filtration with UV disinfection offered the most economical solution with the lowest capital cost, O&M costs, and life cycle costs. Utilizing existing equipment, re-purposing areas of the existing plant, relocating major equipment, and eliminating the need to expand the building all had a positive impact on the economical performance of the project. By reclaiming the process wastewater, electricity demand on the facility is reduced as less raw water needs to be pumped from the source and less pumping is required in the sewage collection and treatment system.

With the increased water treatment capacity and quality, and reduced sewage system loadings, Sioux Lookout has added years of service life to its sewer and water systems, reducing the need for expensive infrastructure upgrades.

The improved quality of the water that is now available to the residents of Sioux Lookout encourages families and businesses to remain in the community, supporting the economical stability of the area. Reliable infrastructure systems attract future developments and stimulate growth in residential, commercial, and industrial sectors, contributing to the economy.

2.4 Environmental Benefits

Explain how your project addresses environmental/sustainability issues.

Various environmental benefits were realized through the Sioux Lookout project. The most significant was water conservation. The Sioux Lookout water treatment plant had been producing process wastewater at an average rate of 557 m^3/day, or 18.8% of the raw water. The reject rate is nearly double that of similar treatment units. With the process wastewater treatment project, the overall process wastewater is reduced to 139 m^3/day, or only 4.7% of the raw water. The majority of the process wastewater is treated to acceptable GCDWQ and returned to the system as potable water, meaning Sioux Lookout decreased the loading on the sewer system, and increased the amount of potable water available to the community, all without increasing the volume taken from Pelican Lake.

With the exception of the relocation of the genset to an outdoor weather-resistant enclosure, all construction works were contained within the building. The remaining process wastewater was discharged to the sewage treatment plant, thus a direct discharge pipe to Pelican Lake was not required. The design eliminated any impact on the environment from construction activities.

The Sioux Lookout project has set a precedent for conserving water by reclaiming process wastewater. The reclamation of water decreases the raw water required, and reduces energy consumption.

2.5 Meeting Client's Needs

Explain the client's main project goals and how you met them.

The Municipality of Sioux Lookout's sewer system was nearing capacity and an expansion would be needed in the near future unless the loading on the system could be reduced. By treating and reclaiming the process wastewater, JRCC met the initial need of reducing wastewater loadings, eliminating the need for expansion. However, through innovative design, and within the original budget, JRCC was also able to meet additional needs such as increased potable water, UV disinfection for the entire plant, which improved water quality, and a new genset to replace the original. Costs were reduced such that additional treatment and upgrade works were completed beyond the original scope. Sioux Lookout was able to extend the service lives of both their sewer and water systems, increase its treated water capacity, and deliver a higher quality water. The community is able to support the current growth and encourage future development. To meet funding requirements the project was tendered, constructed, and commissioned within four months. In anticipation of time restraints, JRCC pre-ordered the membrane units and the genset. Works were completed in three 4-hour shutdown periods to ensure the plant was still able to produce water during construction.

Meeting the needs of the client is foremost in any project. JRCC is proud to have worked with the Municipality of Sioux Lookout. In their dedication to the completion of this project, they have paved the way for other communities to incorporate water conservation measures through reclaimed water treatment plant process wastewater and to extend the service lives of their water and sewer infrastructure systems.

2.0 Project Photographs

1. Sioux Lookout Water Treatment Plant

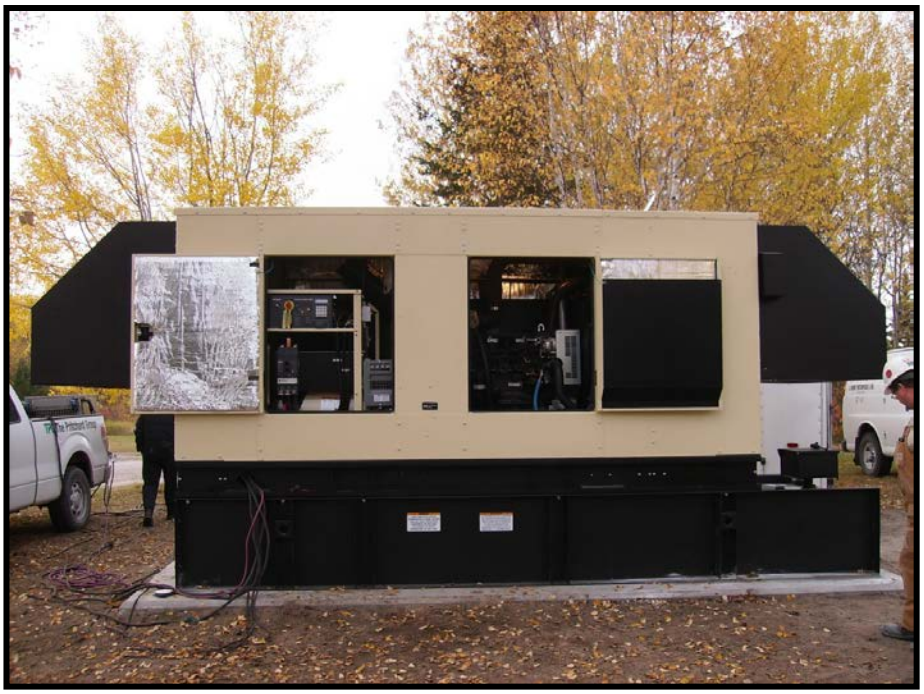
2. Pilot Testing

3. Pilot Raw Water

4. Original Genset Location

5. Ultrafiltration Membrane Treatment Unit

6. Ultrafiltration Membrane Treatment Unit



7. New Genset

8. UV Disinfection