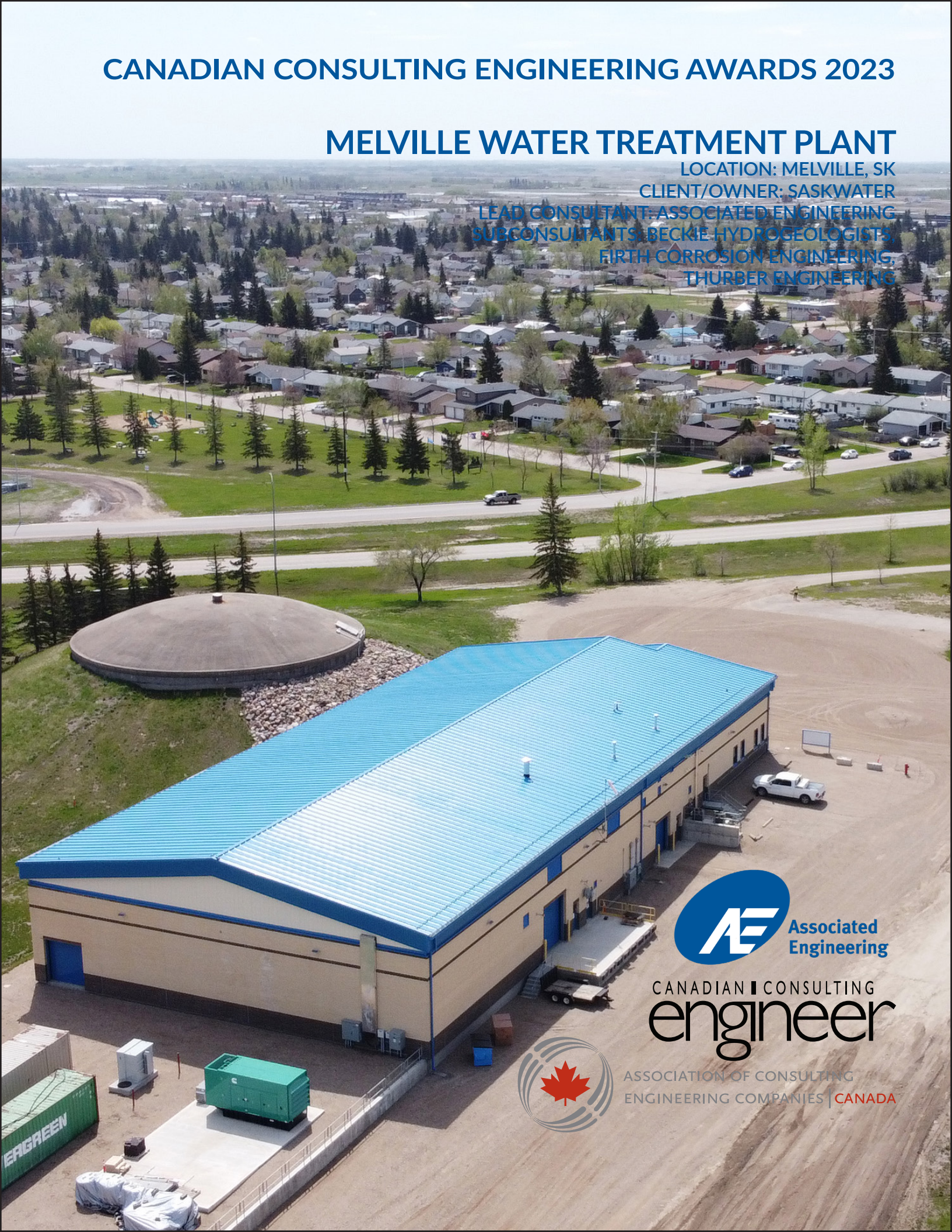
CANADIAN CONSULTING ENGINEERING AWARDS 2023

MELVILLE WATER TREATMENT PLANT

LOCATION: MELVILLE, SK
CLIENT/OWNER: SASKWATER
LEAD CONSULTANT: ASSOCIATED ENGINEERING
SUBCONSULTANTS: BECKIE HYDROGEOLOGISTS, FIRTH CORROSION ENGINEERING, THURBER ENGINEERING



Associated Engineering

CANADIAN CONSULTING engineer

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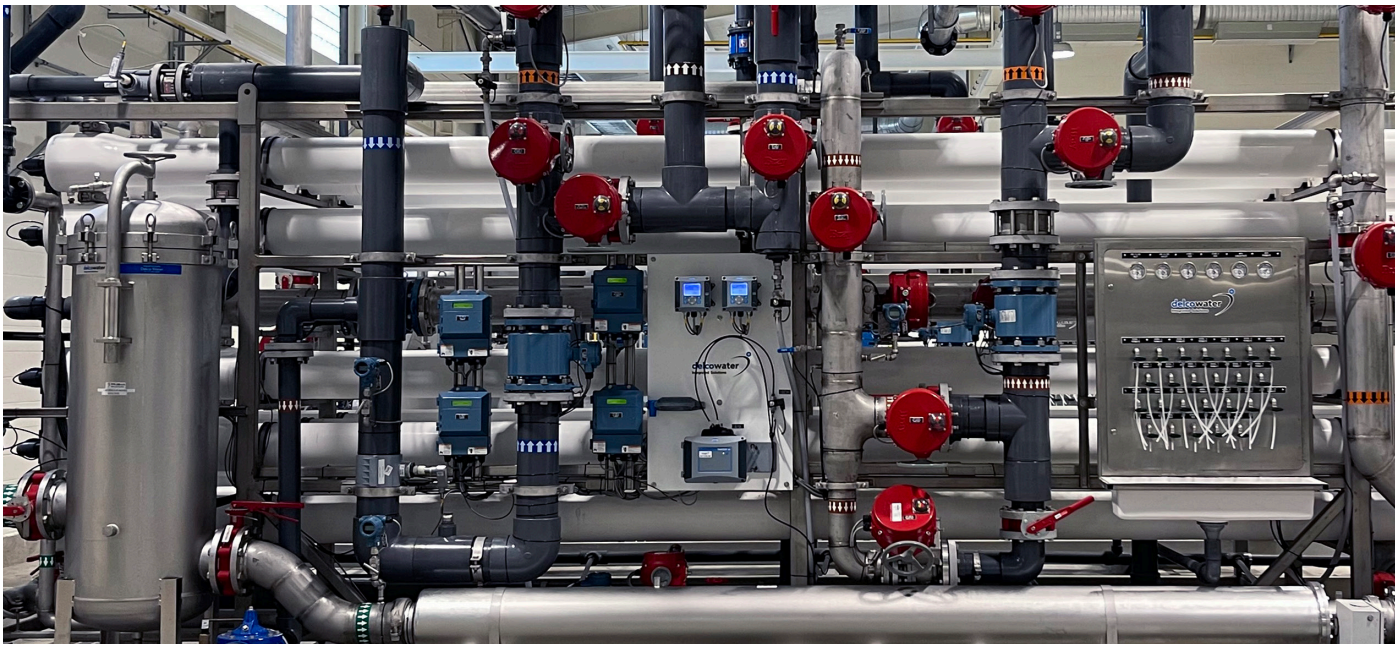
PROJECT SUMMARY

SaskWater faced challenges providing sufficient, quality drinking water to the City of Melville due to its aging water treatment plant. Seeking a sustainable solution, SaskWater engaged Associated Engineering to design and oversee construction of a new treatment plant. Associated's design employs reverse osmosis treatment technology with tailored pre- and post-treatment processes. Sustainable by design, the plant integrates existing infrastructure, solar energy, and environmentally safe, process wastewater disposal to support Melville's current needs and future growth.



INNOVATION

Since 1908, the City of Melville has endured challenges providing reliable, quality drinking water to residents. The City's surface water supply was difficult to treat and the area is prone to droughts, causing supply issues. As a result, the City had to develop a supplemental groundwater supply. In 1989, the City implemented Canada's first electrodialysis reversal (EDR) process to treat its highly mineralized groundwater. In 2016, with this equipment nearing the end of its service life, SaskWater, the plant's owner/operator, engaged Associated Engineering to design and oversee construction of a new water treatment plant using only groundwater.

The new plant employs reverse osmosis technology (RO), which is a more effective and widely adopted demineralization technology than EDR. Associated designed a tailored pre-treatment process upstream of the RO system. The pre-treatment system comprises oxidation, detention, and gravity filtration to remove iron, manganese, and arsenic in the groundwater supply, thus extending the service life of the RO system, decreasing operating and maintenance costs, reducing wastewater generated, and enhancing water quality.

The team also designed a post-treatment process downstream of the RO system to further improve water quality. The post-treatment system encompasses pH correction and saturation index adjustment with partial RO bypass to maintain an appropriate level of mineralization to preserve downstream infrastructure from the corrosive effects of pure RO-treated water.

The new Melville Potable Water Supply System includes two new groundwater supply wells in the Hatfield Aquifer located 30 kilometres from the plant, a new raw water transmission line from the Hatfield Aquifer wellfield, re-use of two existing groundwater supply wells in the nearby Melville Aquifer and an associated raw water transmission line, the new water treatment plant in Melville, re-use of an existing 4,550 cubic metre gunite reservoir, repurposing of existing wastewater ponds, and potable water connections to the distribution system and water tower.

Associated Engineering's design allowed construction and commissioning to proceed without unplanned water supply service disruptions while fully integrating existing non-plant infrastructure, where possible. The design of the new plant facilitates raw water and treated water piping interconnections. The new process incorporates wastewater retention and disposal, reducing environmental impact and greenhouse gas emissions from the former deep well injection system. The plant also includes solar energy, further reducing greenhouse gas emissions.

One of the largest municipal RO installations in Saskatchewan, Melville's water treatment plant demonstrates the capability of RO for sustainable groundwater treatment for small and large communities.

COMPLEXITY

The complexity of the project lay in the development of a water treatment process that is sustainable, cost-effective, and easy to operate. Associated Engineering worked collaboratively with the City, SaskWater, WSA, funding agencies, vendors, and contractors to develop the process. The collaborative approach minimized issues and changes during design and construction, which helped to maintain the project schedule and budget.

Tying the new plant into the old gunite reservoir posed a challenge. Associated Engineering's design incorporated a new 300 millimetre fill line installed below the existing concrete floor, to prevent a wall penetration from damaging the reservoir wall.

Stagnation zones in the gunite reservoir resulted in water quality issues. The team's design of the fill pipe incorporated fill nozzles to promote mixing, eliminating stagnant water and improving water quality.

Another challenge was optimizing the pre-treatment chemical dosages for water coming from two different aquifers. The team designed the plant automation system to adjust chemical dosages in response to the unique characteristics of each aquifer, ensuring consistent treated water quality.

RO membranes are extremely efficient at removing dissolved minerals, and therefore are sensitive to scaling and fouling. The pre-treatment process lengthens membrane service life, reducing operating cost. The pre-treatment equipment was located within open-top concrete tanks designed into the building structure, facilitating monitoring, inspecting, and maintenance.

Treated water leaving the RO system is mineral-free and highly corrosive, which creates the potential to corrode downstream pipes. The post-treatment process safeguards public health and protects downstream infrastructure.

SOCIAL AND ECONOMIC BENEFITS

Associated Engineering's design featured a triple bottom line approach. The design concept focused on delivering safe, high quality water in a reliable and robust system that minimizes life-cycle costs and optimizes life expectancy of the infrastructure, while reducing greenhouse gas emissions and chemical dependency, and limiting negative impact on the downstream watershed.

A Saskatoon-based RO equipment vendor was selected to reduce the potential for supply chain issues, assuring availability of materials and equipment, and thus a more secure water supply. Selecting a local vendor provided local jobs, reduced cost for transportation, as well as greenhouse gas emissions associated with transporting equipment and materials.

The project was completed on time and under budget, with no major disruptions to the water service. After a year of operation, operating costs are 20-25% lower than the former plant; maintenance costs are significantly lower; and power consumption has been substantially reduced.

The plant classification has lowered from Class IV (the highest in terms of regulatory requirements and operational complexity) to Class III, made possible by eliminating the parallel groundwater and surface water treatment systems. As a Class III plant, recruiting qualified operators will be easier – an important consideration for a rural community such as Melville.

Melville's citizens and businesses are very pleased with the consistent high quality and reliable drinking water supply. There is ample plant capacity for new customers. Melville has already attracted the attention of businesses and industries who are now considering relocating to the community, contributing to the city's long-term economic growth.

ENVIRONMENTAL BENEFITS

Unplanned interruptions to a community's water supply are costly and inconvenient. Associated Engineering's design allowed construction and commissioning of the new plant to proceed with only necessary planned interruptions, and no unplanned interruptions to water supply. Melville residents have shared many positive comments on the consistently good water quality from the new plant.

Unlike the previous EDR treatment system, the reverse osmosis treatment process removes ammonia from groundwater, so residents no longer smell chloramine by-products in their drinking water. Disinfection effectiveness has been greatly improved, enhancing public health and safety. Chlorine usage has also been lowered, further reducing operating costs.

Where possible, existing infrastructure, including two wells and the reservoir, has been reused. The new plant uses solar photovoltaics to supplement its energy use.

To make the plant more environmentally-friendly and cost effective, Associated Engineering replaced the energy and maintenance intensive practice of deep well injection of brackish EDR wastewater with holding ponds for the RO wastewater. The ponds will also receive pre-treatment backwash wastewater to further dilute the brackish RO wastewater prior to discharge into Crescent Creek. Associated Engineering provided input to SaskWater's Downstream Usage Impact Study to ensure that the plant's wastewater released into Crescent Creek meets strict regulatory standards to protect the downstream environment. The holding ponds had been previously used for backwash wastewater only and are now re-purposed to handle all the plant process wastewater.

The Melville plant is SaskWater's premier plant and a model for reliable, cost-efficient, and environmentally responsible production of treated groundwater.

MEETING CLIENT'S NEEDS

SaskWater needed a new, affordable water treatment plant for the City of Melville that provides sustainable, reliable, high quality drinking water. Melville's new groundwater treatment plant meets these goals, providing the city with secure, consistent, high quality drinking water and supporting future growth and economic development.

SaskWater has a facility that is easier for operators to maintain and operate, with reduced long-term operating costs compared to the previous plant.

The cost for the new water treatment plant was well within the estimated capital cost of $22 million and annual operating cost of $725,000. Effective project management, including risk management, delivered project results exceeding SaskWater's expectations for performance, cost, and schedule.

Risk management was integrated into the design and construction. During design, Associated Engineering coordinated and led a risk analysis workshop with SaskWater focused on failure modes effects analysis (FMEA).

Various potential failure modes were presented by workshop participants and the Likelihood of Failure (LoF) discussed, together with the potential Consequences of Failure (CoF). If the resulting assigned risk rating was unacceptable, mitigating measures to reduce both the LoF and CoF were incorporated into the design to reduce the overall risk rating of each specific failure mode. For example, reliability of power supply was identified as a risk, and, as a result, the team added standby power to ensure reliable operations during a power outage.

Delivered on time and under budget, SaskWater's flagship water treatment facility in Melville is a model for cost-effective, sustainable groundwater treatment for small and large communities.


MELVILLE