ISL Engineering and Land Services

Inspiring sustainable thinking

CANADIAN CONSULTING ENGINEERING AWARDS 2012

Thorsby Water Treatment Plant

Category: Project Management

Client/Owner: The Village of Thorsby

Subconsultants: Manasc Isaac Architects Ltd
Canadian Consulting Group Partnership
Hoggan Engineering & Testing (1980) Ltd.
Cascade Engineering Group
Altus Geomatics Limited Partnership
Scott Land & Lease Ltd.

Contractor: Nason Contracting Group Ltd.

May 2012

Aerial view of Thorsby, Alberta

Thorsby Water Treatment Plant:
From Village to Regional Water Hub

INTRODUCTION

The Village of Thorsby in central Alberta had excellent infrastructure for storing and moving water but problems with its old water treatment facility. Residents complained about the quality of water. The facility did not meet current regulations for this or waste stream management and it could not provide enough treatment capacity to meet projected demand. Its indoor layout also impeded efficient work flow and risked operator health and safety. Located in a floodplain, expensive flood damage and water contamination were constant risks.

Thorsby selected *ISL Engineering and Land Services (ISL)* to design and build a new water treatment facility in a new location. ISL helped secure 75 per cent of the cost from Government of Alberta municipal partnership funding; the remaining amount came from Village revenues and grants. There was little buffer for changes in scope given the size of the capital expenditure but ISL worked with the Village to maximize the dollars, incorporating sustainability features in the building as the Village's new Sustainability Plan was adopted, and helping position Thorsby as a regional water provider as part of a business growth strategy.

ISL used rigorous evaluation processes to select the site and treatment technology, and then began designing the facility around the operators' needs for safe and efficient work flow. This was a surprisingly innovative approach. By properly maintaining the water treatment process, the operators' essentially provide for the health of the community. Yet, visits to the old facility and the toured facility showed design features that made it more difficult for them to do their jobs. Before detailed design, the operators and the supplier of the treatment technology were involved in a tour of another facility with the chosen advanced treatment technology. A subsequent workshop improved design of floor plans and treatment equipment, achieving further functionality for the operators.

Delivered approximately $160,000 under budget, the new facility also provides a great return on investment. It serves multiple purposes: water treatment, watershed protection, a sustainable building demonstration project, a vocational training stop for future operators and a Village revenue stream. Companies such as Arctic Spas, ARRGO and Westower have already set up shop and the hope is that more big industry will follow in time. Since it began operating in December 2011, and the main operator has noted the improved water quality and the disappearance of water quality complaints.

BACKGROUND

A Regional Water Hub in the Making

The small rural community of Thorsby is located just 45 minutes southwest of Alberta's capital, in Central Alberta. Like several other small communities in rural Canada, the Village of Thorsby is working hard to create a thriving rural centre. Despite a growth in population from 2001 to 2006, census results from 2006 to 2011 showed a 15.7% decline in population (Statistics Canada 2011 Census). With a largely residential tax base, Village Mayor Barry Rasch has said "We know that the focus of our community has to be more aggressive business attraction."

In considering economic development opportunities, the Mayor acknowledged "we have to be proactive in trying to find solutions that can complement the community" (*December 2011, County Market magazine*). The hope is that new capital projects will promote Thorsby as a regional centre. A major component of this strategy is the new water treatment plant (*The Leduc Rep, June 2011*). Thorbsy is positioning itself as a regional water provider that could help these other communities with their water supply issues. Thorsby is well placed in this regard because of its central location, access to good water and electricity supplies.

Anecdotal reports from representatives of regulatory authorities indicate that many of the communities near Thorsby do not have a good supply of quality potable water. Thorsby is located on the Canadian Pacific Railway line right-of-way and many of the communities in the surrounding area are connected to Thorsby via the railway right-of-way. It would be relatively easy to transport water in bulk to these communities or by piped delivery through a pressurized water transmission system.

In addition to the advantages of Thorsby's location, the Village is blessed with existing ample capacity in its raw water transmission and storage infrastructure. Thorsby already has an excellent intake and two generously sized raw water storage cells. With the new water treatment plant and raw water pumphouse planned in this project, Thorsby can also begin to offer excellent water quality.

Thorbsy is positioning itself as a regional water provider that could help other communities with their water supply issues.

North Saskatchewan River—intake for Thorsby Water Treatment Plant

Former facility beside Weed Creek.

Problems with the Existing Facility: Regulations, Capacity, Operation

Before this project, the Village of Thorsby had a conventional water treatment facility located on the north side of the village and adjacent to Weed Creek. The facility was constructed in 1976 and upgraded in 1995. During certain times of the year, residents complained about the water quality.

ISL completed an assessment of the former plant in September 2007. The assessment found the 31-year old plant was no longer treating water to the quality required by current regulations. Waste streams from the water treatment process were also being released untreated into the creek. More capacity was needed to be added to meet projected demand but there was no way to add the required additional treatment processes due to both the set-up of the existing treatment system and the space limitations of the site. A more significant site issue was the facility's location in a floodplain; this placed the facility at risk of expensive flood damage and also risked serious water contamination issues. A new facility and a new location would be needed.

For the two operators, the facility layout also had some significant problems that risked their health and safety and impeded efficient work flow. The facility did not have capability to store chemicals properly in accordance with current standards, i.e. there was no secondary containment in case of spills or accidents.

Also, the storage location did not have adequate light and was a confined space so it was not easy for the operator to service the equipment. The chemical pumps were on the other side of the room from the delivery door so the operator had to move the barrels of chlorine across the floor and around a giant, immovable fire pump in the middle of the room. The risk was that if the equipment could not be accessed easily, it would be difficult to maintain and could break down.

For the new facility, ISL would work to ensure it was designed around the people using it (the operators), as well as meeting the technical water treatment needs.

ISL's Approach to Project Management

ISL's project management approach involved harnessing the knowledge of the Client, including the operators (as the facility users), as part of the project team. From pre-design steps to the March 2009 contract and the new facility opening in December 2011, the Client was involved every step of the way. These steps included evaluating site options, selecting a suitable site, securing funding, selecting the most appropriate technology to treat the water issues, selecting the supplier, pilot testing by the supplier to ensure the treatment technology would work with the raw water source, assessing the function and layout of a sample facility via a tour and workshop process, refining the treatment technology design with the supplier, refining the facility layout for efficiency and usability, and working with the architects to further meet Village sustainability goals in the building envelope.

This close collaboration with the Client meant the engineers designed the project to maximize the dollar outcomes of this major project. The facility was designed around operation, maintenance and long term costs, rather than only considering the technology and process for water treatment and the initial capital outlay. It also meant any issues were dealt with as they came up. In fact, a lot of attention was given to mitigating risks early on through the design and tendering process to ensure there were not more costly impacts at the construction, or maintenance and operation phases. Through careful project management and this early risk mitigation, the project was completed on time and stayed under the construction budget.

COMPLEX PROBLEM SOLVING

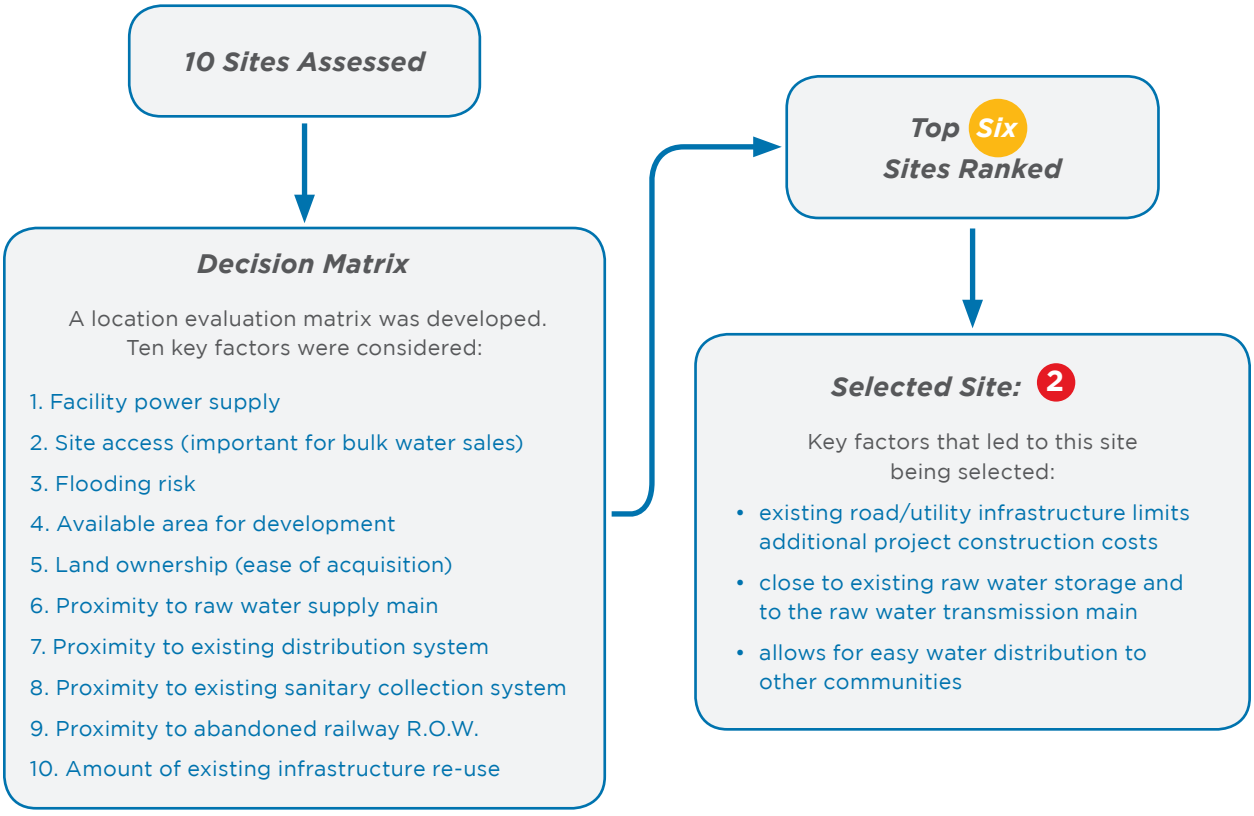
Before design of a new water treatment facility could get underway, funding needed to be secured. However, to identify full costs of the project, a site had to be selected first.

Selecting a Site

The first step in the project was selecting a suitable site for the new plant. ISL's thorough approach included modelling the pumping and distribution systems to determine locations for the plant that would enable it to more easily tie into the existing infrastructure. Ten sites were picked that showed potential and an evaluation matrix was established based on the site selection criteria (below).

All 10 options were evaluated against these considerations and ranked to select the top six with the highest scores. Factored into the site choice was the desire to limit the amount of additional construction for the project. More construction for utilities and an access road would add costs to the overall project budget.

ISL selected the final site (Site #2) in liaison with Thorsby's Director of Public Works (one of the two operators) and the Council. The chosen site met all the criteria. It was a previously developed site (with only an abandoned and dilapidated building). This meant it was already plugged into the Village's road network, power supply, sanitary collection and water distribution systems. Compared to the former facility's site, the new site was also closer to the existing raw water storage and closer to the raw water transmission main that comes from the low lift pumphouse at the river intake. The team was cognizant that changes in any of these factors would have added to the project's capital or lifecycle costs. The selected site undoubtedly helped save the Village money. The project would also clean up a site that had been an eyesore within the village.



The facility's proposed location would also help Thorsby meet its strategic business objective to position itself as a regional water provider. A truckfill station could easily be incorporated in an adjacent vacant lot, facilitating bulk distribution of potable water. It was also close to the railway right-of-way for easy distribution to other communities in the region.

As part of the site selection stage, ISL worked with the Village to organize the appraisal and purchase of the land and subconsultants Hoggan Engineering & Testing carried out a Phase 1 environmental assessment to check the land was free of contamination (no issues were found).

Securing Funding

With the site selected and costs identified, funding for this large capital project needed to be secured. ISL assisted the Village by identifying funding opportunities and completing a funding application to the Alberta Municipal Water/Wastewater Partnership Program. The funding program supports municipalities with capital projects to provide safe drinking water and reliable, quality water supplies for a sustainable economy. It also encourages regional systems. The funding application was successful.

In March 2009, the Village of Thorsby retained ISL for design and development of the new Thorsby water treatment facility. The project had a 7.8 million dollar construction budget and was Thorsby's largest capital project to date. Seventy-five per cent of this amount came from the Province and the remaining 25 per cent was gathered from Village revenues and smaller government grants. It was Thorsby's single largest capital expenditure, which left little buffer for any changes to scope or other factors.

Aerial view of Thorsby depicting the top six site locations; Site#2 was selected as the final site.

At the time that the funding was approved, there were two main project goals: provide a new water treatment plant to meet current water quality guidelines; and provide the Village with capacity to meet its potable water needs well into the future. As the project progressed, the scope changed. The Village became more aware of its potential as a regional hub, and the team was asked to consider how the water treatment facility could be designed to also provide clean water for the region. The Village also adopted a new Sustainability Plan and sought opportunities to demonstrate sustainable practices in this municipal infrastructure project, which ultimately added sustainability features to the building envelope.

Given the size of the capital expenditure for the small community, project management and ongoing client liaison was even more critical. ISL worked to ensure the Village Administration, Public Works Manager and Operating staff felt involved throughout the project as an important part of the project team.

From Conventional to Advanced Treatment: Selecting the Treatment Technology

With the site selected and the funding secured, the next step was selecting the treatment technology. The water issues for treatment were fairly standard: turbidity reduction and the need for pathogen destruction. An ultrafiltration membrane technology was selected primarily due to the ease of operation it provides compared with other technologies for treating these water issues. The selected technology would simplify the treatment process when compared to the conventional water treatment process used in the old facility.

The old facility had used the standard water treatment process of coagulation, flocculation, sedimentation, filtration and disinfection. The new treatment technology effectively replaced the process components for flocculation, sedimentation and filtration with the ultrafiltration membrane system. The old facility's above-ground storage reservoir would also be replaced in the project with a new underground storage reservoir, located below the new water treatment facility. Locating it below the facility is standard practice now both for convenient access and also to maximize use of the land, thereby reducing the development footprint for water treatment.

For the two operators, the whole treatment process was much easier to work with and monitor than what they had previously in the old Thorsby treatment facility. The new Z-box™ ultrafiltration membrane had reduced the number of infrastructure components and simplified the treatment process.

Selecting the Supplier

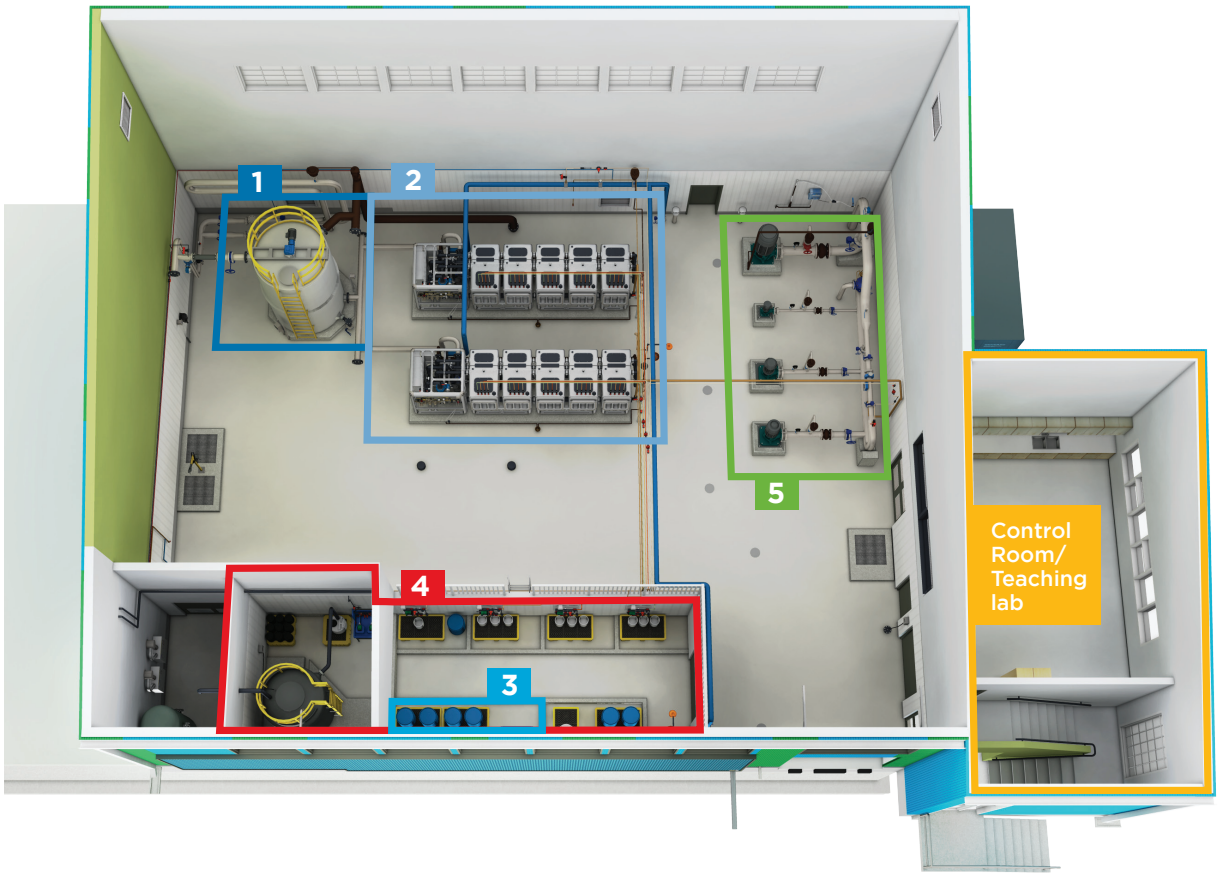
Once the ultrafiltration membrane had been chosen as the treatment technology, ISL prepared a Request for Proposals (RFP) and an associated evaluation matrix to select the supplier. Unusually, rather than focus on the upfront capital costs, the RFP focused on suppliers demonstrating the ease of operation and lower long term operation costs of their ultrafiltration membrane technology. The supplier was chosen based on the ranking of their equipment against expected long term operation costs (including low energy and low chemical use), ease of operation, maintenance, and the pre-treatment systems required.

This resulted in selection of the Z-box™ ultrafiltration membrane technology from GE Water and Process Technologies. The Z-box™ both treats the water issues and meets the above criteria. Compact and easy to expand, the Z-box™ also helps Thorsby meet its goal of becoming a regional water provider. If more capacity is required, the Village need only add more membrane cassettes to each treatment tank without having to add new infrastructure.

Pilot Testing

When the Thorsby water treatment facility was being designed, the Z-box™ ultrafiltration technology was relatively new. Just four facilities with this technology existed in Western Canada, and only two of these were finished. Consequently, to ensure that the Z-box™ technology would be a good fit for Thorsby, the contract with the supplier included pilot testing at the former treatment facility in Thorsby. This pilot testing was carried out by GE Water and Process Technologies during the months of September and November 2009.

Floor Plan view of Treatment Trains



New Treatment Process

1 Membrane Flocculation
pre-treatment for pin-floc

2 Z-box™ Ultrafiltration Membrane

3 Disinfection
chlorine storage and injection

4 Chemical Storage and Injection Area

5 Distribution Pumping

Z-box™ technology simplifies the treatment process

Flocculation
forming large floc

Sedimentation

Filtration

Disinfection & Treated Water Storage

Old Treatment Process

DESIGNING FOR THE OPERATOR:

AN INNOVATIVE CONCEPT AND APPROACH

Designing for Layout and Function

The approach to designing the facility was surprisingly innovative. Rather than design the facility just around the technology, the engineers worked to design the facility around the operators.

Thorsby's two operators essentially provide for the health of the community by properly maintaining the water treatment process. Yet, the layout of the former Thorsby facility effectively made the operators' jobs more difficult and risked health and safety. Surprisingly, this situation is not uncommon in many water treatment facilities across the country. For ISL's team, it was important to consider: *how can we learn from what's been done previously in facility layout and design and make it better? How can we enhance the work flow for the plant operators?*

ISL's approach took into account the operators' experience with the former Thorsby facility and as well as considering other facilities that incorporated the Z-box™ membrane technology. ISL organized a tour of one of the existing facilities that used a Z-box™ in Western Canada: the Nordic Centre in the Whistler, British Columbia. This tour proved very valuable as it allowed the team to consider what improvements could be made to integrate this Z-box™ technology into the facility layout before the team embarked on more detailed design work.

Benefits for the Operator

Familiarity

ISL was aware that the Contract Operator also worked at another water treatment facility in the region where the Z-box™ was used. Consequently, ISL didn't change the membrane treatment process (what the main operator was used to) but enhanced it to make it easier to operate.

Manual Chemical Addition (Z box™ Design Enhancement)

As a result of the tour, the supplier actually refined the design of the Z box™ technology to add a manual chemical fill port to the membrane tanks. A simple screw-on cap was incorporated to give the operators the option of adding cleaning chemicals manually, and doing so with greater ease (and safety). Without this port, the Operator would have had to unbolt a large panel with several screws in order to add the chemical.

Chemical fill ports with easy screw-on cap.

STEP 1

Tour of Another Z-box™ Facility

A two-day visit occurred in September 2009 and included Thorsby's Director of Public Works (also the local operator), the contract operator (who was the main operator for the facility), as well as the membrane supplier and a representative from Alberta Environment.

During the first day, the group toured the Nordic Centre facility, taking detailed notes on what could be changed and improved upon in terms of how the facility was laid out around the Z-box™ treatment technology.

STEP 2

Workshop to Review Draft Plans

The second day involved a workshop in which the draft plans for the facility (at 50% design complete) were discussed in relation to the notes and photos taken from the Nordic Centre facility tour. At this workshop, the plans for the new Thorsby facility were adjusted based primarily on the operators' comments regarding the layout and functionality of the toured facility.

STEP 3

Full Scale Design Begins

Full-scale design of the facility began in November 2009, based on the design modifications that came out of the workshop.

Space to Service the Equipment

Another change came out of the Nordic Centre tour. All the Z-box™ units in that facility were crammed together and the operators commented that it would be harder to access components for maintenance. Consequently, the Thorsby design added more room around each unit for easier operator access.

Ample Lighting for Control Room

The design team took into account the operators' need for ample internal lighting in the control room. Natural lighting helps them with visual testing of the water during bench-scale testing of water quality, and this is typically done in that room. As a result, the design team located the control room against an external wall to take advantage of the natural light. The Control Room was designed to fulfill several functions: system control, lab for water testing, and teaching area.

Safe Chemical Storage

For health and safety, chemicals are contained in a separate Chemical Storage and Injection Systems Area.

All these considerations in the design will provide both efficiency on the job and a pleasant environment to work in, which in turn will help Thorsby retain existing operators (and attract others when the time comes).

Operator Training: A New Regional Hub

The team wanted to maximize the funding dollars to provide a sound return on investment for everyone. One of the outcomes of the earlier workshops between the client and ISL was to re-evaluate the goals of the water treatment plant: *what else did the client want to get out of the facility? What opportunities were there to get the most out of this major capital project?*

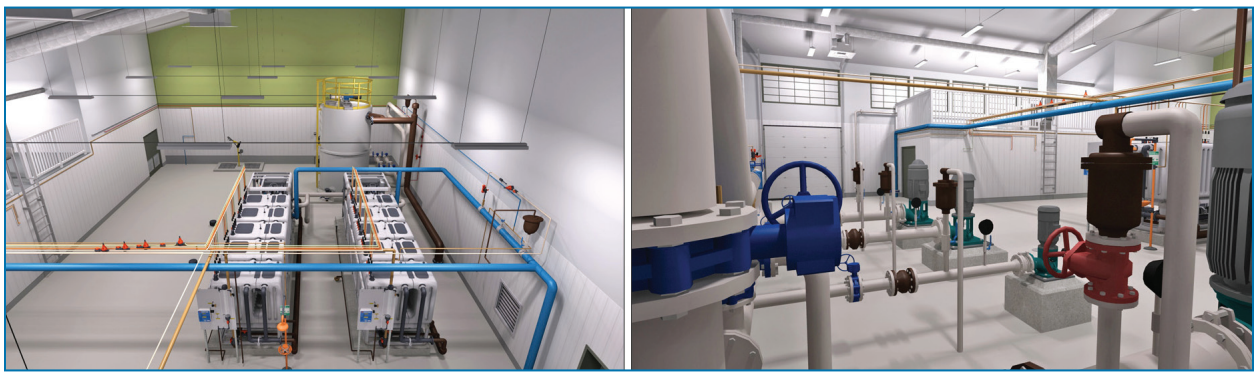
Attracting and retaining qualified operators is an issue for most small municipalities. This situation is expected to get worse. According to Alberta's Occupational Demand and Supply Outlook 2011 2021, Alberta is expecting a shortage of operators (Government of Alberta, 2012); this reflects a trend of labour shortages across Canada as baby boomers retire.

The team realized that they were going to be building quite a unique facility in Thorsby, one that was more user-friendly for the operator. This would also be a facility where people would want to come and work! Here was an opportunity to proactively manage a future need for the Village, *i.e.,* retaining and attracting operators.

ISL was aware of a water and wastewater technology program at the Northern Alberta Institute of Technology (NAIT), headquartered in Edmonton. There are few facilities in the province for students training to be facility operators to experience a real water treatment facility. The Director of NAIT's program confirmed this and was delighted that Thorsby would now be included in the student's program as an example of a user-friendly water treatment facility in the region. The new Thorsby facility will provide opportunities for students to come and experience a state-of-the-art water treatment facility for themselves and see what is required to operate it.

The Thorsby water treatment facility is designed to serve a training function. The control room includes additional space so that it can function as a teaching environment. A spare membrane cassette was also supplied as part of training process for the Operators, providing an opportunity for hands-on understanding of the membrane technology. This also helps with current operations, serving as a visual reference to help understand membrane maintenance and repair.

Thorsby Water Treatment Plant is now a planned pit-stop on the program. This will make the village another kind of regional hub: an 'experiential' one for training future operators. (The facility even has the space to hold a community open house or school visits as part of public education about the value of clean water as a limited resource, or the impact of our activities on the watershed.)



Thorsby water treatment plant Z-Box™ ultrafiltration units and distribution pumps.

Extra space in the Control Room allows groups of students to observe the operator at work.

The new Thorsby facility will provide opportunities for students to come and experience a state-of-the-art water treatment facility for themselves and see what is required to operate it.

DESIGNING FOR SUSTAINABILITY

Over the course of the project, the Village adopted a Sustainability Plan and was now interested in demonstrating sustainability in its capital infrastructure projects.

Sustainability of the new water treatment facility had already been considered during site selection (choosing an already developed site and tying-in to existing infrastructure) and during selection of the treatment equipment (reducing chemical input requirements and lifecycle costs). These decisions will reduce environmental impacts and costs for the expected life of the facility.

Reducing Energy Needs through the Building Envelope

Thorsby's Sustainability Plan also emphasized energy efficiency for Village buildings. Compared with the standard facility for communities of this size, a less energy intensive building envelope needed to be designed.

Incorporating energy efficiency into the building design and features was a sure way to make this facility suitable for the cold winters and enable a reduction in the lifecycle cost associated with running the facility. Instead of the usual cold, poorly insulated metal building for a water treatment facility, this building envelope was architecturally designed by ISL's chosen architects, Manasc Isaac Architects. A number of innovative features were selected as they allow continuous energy-saving over the life of the facility, require little maintenance, and help make the building an aesthetically-pleasing anchor in the village. These strategies are particularly appropriate for use in smaller communities where simple, robust, economical and well-performing infrastructure facilities are needed.

For the Village, these strategies will mean significant cost savings for operations and maintenance over the life of the facility. Further, based on the model of a building similar in materials, structure and size, the architect expects that the Thorsby water treatment facility could operate (excluding process energy loads) using 62% less energy and 65% less cost than a comparable building using Model National Energy Code

For the Village, these strategies will mean significant cost savings for operations and maintenance over the life of the facility.

Strategy 1: **Reduce energy demand.**	**Strategy 2:** **Replace energy with renewable supply.**
Loss of heat through the building envelope is reduced through thermal insulation in windows (R12), walls (R36) and roofs (R60), plus a full air barrier in the building envelope and good air seals at the doors. The process and equipment spaces are also kept at a lower operating temperature, further reducing energy demand and associated costs. Only the operators' control room is being kept at a shirt-sleeve comfortable temperature throughout the year. Altogether, this reduces costs for heating and cooling the building.	The insulated, translucent glazing of windows placed high above the Process Room is very effective at bringing daylight into the facility. The sloped shape of the ceiling helps distribute the light throughout the main working area, enabling safe use of the space without unnecessary use of electric lights during the day. A solar air heating wall on the exterior of the building uses the sun's energy to pre-heat the ventilation air for the building, saving much of the gas normally burned for heating. The building also included design allowances for future photovoltaic cells.

for Buildings (MNECB) standards for construction. This would result in an annual GHG emission reduction of 24 tonnes of CO_2. These savings will, with a minimum amount of care of the building, last for the life of the building shell, 50 years or more. As the cost of energy increases, the savings will also increase.

For the operators, the overall result is a safe, warm (or cool) and well-lit facility that is durable, economical and easy to operate. This means that the operators can focus on managing the water treatment rather than maintaining the building.

Protecting the Watershed

Process waste from the old water treatment facility used to be released untreated into Weed Creek. With the new facility these discharges are being sent to the wastewater treatment facility for proper treatment first. In this way, Thorsby is also taking better care of the water quality and aquatic ecosystems in Weed Creek and in the larger North Saskatchewan River watershed.

A solar wall on the exterior helps reduce heating costs for the building. This rendering of the building depicts future landscaping.

Strategy 3: Use energy efficient mechanical and electrical equipment.	**Strategy 4:** Reduce embodied energy of building materials.	**Strategy 5:** Reduce maintenance energy and material use.
The electric lights are energy efficient and long-life T8 fluorescent tubes. Heating is provided by small gas-fired, instantaneous water heaters that operate on demand. Simple temperature controls sense the interior space temperature and call for heat only when the solar wall heated air isn't sufficient. Advanced induction ventilation units increase the amount of air circulated while using less fan energy.	Using wood for the building structure and sheathing achieves two important environmental tasks. Wood has a significantly lower embodied energy and water demand during manufacturing than alternate structures made of concrete and steel, and wood sequesters carbon when growing. This 'capture' of carbon will offset emissions from the use of mechanized equipment during construction.	Cladding the exterior with properly vented and galvanized metal roof and wall surfaces, and the interior with moisture resistant finishes, allows the building to function with little operator attention and effort. The durability of the building enables a reduction in the both maintenance material and energy use.

MANAGING COMPLEXITY IN CONSTRUCTION

Site Constraints in Construction

The construction site was surrounded by a railway right-of-way on one side and school yard on the other. School children had to be kept off the site during construction. Access to the site was also constrained by a busy gas station on the road.

Going for Efficient Construction

Laminated Strand Lumber (LSL) was the selected construction material for the building envelope. The uniformity of this durable manufactured lumber provided an excellent product in construction. Going with this lumber also meant that the building's wood wall panels could be assembled on the ground and hoisted into place, which saved on large amounts of scaffolding and an awkward work-site. The use of LSL lumber made construction of the building envelope very efficient.

Solving a Different Water Issue

A significant challenge in construction was the depth required for the foundation and underground storage reservoir, coupled with the constant rain: this was filling the excavated area. A sump pump system designed for the facility was installed for use during construction. This helped avoid costly delays and allowed the work to proceed.

A sump system employed during construction for dewatering.

Ground-breaking for the new facility occurred on June 9, 2010, and involved Council members, Provincial MLA Diana McQueen and representative from the Provincial Government and Water for Life Program as key funders

CONCLUSION

"It's the latest and greatest you can have in a water treatment plant and we're building for the next 50 years or more." Thorsby Mayor, Barry Rasch

The main contract operator, has noted the improved water quality and the disappearance of water quality complaints since Thorsby's new water treatment facility began operating in December 2011.

ISL completed the project on time and approximately $160,000 under the anticipated construction budget; the final budget came in at $7,626,604. Although the initial outlay was significant, for its 25 per cent contribution, Thorsby got a great deal. The team worked to ensure the water treatment facility gave the Village a flexible platform to prepare itself for the future. The team also responded to the Village's needs as they became apparent: for regionalization and sustainability features in keeping with the Village's Sustainability Plan that was approved during the project.

Consequently, the facility serves multiple purposes: water treatment, watershed protection, Village revenue stream, a sustainable building demonstration project, and vocational training for future operators. The new water treatment facility has the capacity to support village growth and enable the Village to become a regional water provider. It provides water quality that exceeds water treatment regulations, manages waste streams, and meets current and future needs for ease of operation and reduced costs over its lifetime. The building's energy efficiency features help the Village demonstrate the application of its Sustainability Plan in a municipal building.

The result is a user-friendly water treatment facility that is designed to attract and retain operators with its pleasant, safe, and efficient working environment designed around the operator. Thorsby can expect to attract new operators in the face of an expected future labour shortage. With training links established with the college program, Thorsby is ahead of the game.

The project also provides an example to other engineers on how to best implement a design process where the design and functionality of the end facility is based around its Operator. ISL set out to use relatively new technology and design it around the operator and their use of the technology. This serves to remind other engineers: don't just design the process but design for the people that are going to run it.

Perhaps most important of all, through the project, water is being recognized as more of a vital asset in communities like Thorsby. These communities are starting to embrace clean water as a limited resource—and one that Thorsby can provide. As Thorsby positions itself as a regional water hub, companies such as Arctic Spas, ARRGO and Westower have already set up shop and the hope is that more big industry will follow in time.

THORSBY WATER TREATMENT PLANT AT A GLANCE

Complexity	• Site selection involved analysis of 10 sites, modelling of pumping and distribution systems, land purchase and environmental assessment • Suppliers were evaluated on their treatment technology for ease of operation and lifecycle costs rather than just capital costs • Facility designed around operator with improvements to layout and features after tour of another facility with same treatment technology • Construction site constraints included a school yard and railway R-O-W around site and road access by busy gas station • Size of capital expenditure meant little buffer for changes, heightening need for tight project management and team communications
Meeting Client's Needs	• Under overall budget (engineering and construction) by ~$160K • Project completed on time (by December of 2011) • Effective and efficient water treatment with Z-box™ ultra-filtration membranes and disinfection to treat turbidity and pathogens in water • Well thought-out, pleasant working environment helps with retention of operator staff for the facility • Energy efficient building showcased client's sustainability plan • Site and infrastructure help position client as future water supplier in region, diversifying and increasing the tax base • Local industry (Arctic Spas) chose Thorsby for main production facility; with improved water quality, Thorsby can attract other companies • Project received accolades from the Operator and appreciation from the Mayor and Council
Environmental Benefits	• Sustainable site selection for the new facility with redevelopment of an existing site • Energy efficient building features including roof design to harvest daylight, energy efficient lighting, and solar panel wall for heating • Waste discharges now treated before release into Weed Creek, protecting aquatic ecosystem and watershed health
Social and Economic Impact	• Residents no longer complain about the quality of the water • Students in related college training program can now experience the facility and see what is required to operate it • Diversified future tax base, through attracting more industry into the area, will help the Village provide for its residents • New facility provides an aesthetically pleasing anchor in the Village, replacing the previous derelict/rundown area
Innovation and Advancing Engineering	• Demonstrates how best to implement a design process where the design and functionality are based around the Operator's needs rather than just around the technology • Safe, easy to use manual chemical fill port for the membrane tanks allows the operator to add cleaning chemicals (identified improvement) • Facility also functions as a teaching environment with additional space in control room and spare membrane cassette as teaching aid (also a visual reference for maintenance and repair needs)

Thorsby Water Treatment Plant:

From Treating Water to Building a Stronger Rural Community

2 PAGE HIGHLIGHTS

BACKGROUND

The Village of Thorsby in central Alberta had excellent infrastructure for storing and moving water but problems with its old water treatment facility. Residents complained about water quality. The facility did not meet current regulations for this or waste stream management and could not provide enough treatment capacity to meet projected demand. Its indoor layout also impeded efficient work flow and risked operator health and safety. Located in a floodplain, expensive flood damage and water contamination were constant risks.

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AN INNOVATIVE APPROACH:
DESIGNING THE FACILITY FOR THE OPERATOR

ISL worked closely with those running the plant to ensure the facility was also designed to provide safe and efficient work flow. This was a surprisingly innovative approach. By properly maintaining the water treatment process, the operators' essentially provide for the health of the community. Yet, visits to the old facility and a toured facility showed design features that made it more difficult for them to do their jobs. Compared to the old facility, the new facility added safety features including a separate containment area that housed the chemicals and injection systems.

Before detailed design, ISL's innovative approach involved the main operator and the supplier of the treatment technology in a tour of another facility that used the chosen Z-box™ ultrafiltration membrane, followed by a workshop. The workshop resulted in very useful design modifications to floor plans (more space for the operator to service each Z-box™ ultrafiltration unit) and even a refinement to the Z-box™ units (a chemical fill port was included to give the operator the option of manually adding cleaning chemicals to the membrane as needed).

The new treatment process was much easier to work with and monitor than what the operators had previously in the old Thorsby treatment facility. The Z-box™ ultrafiltration membrane system also served to reduce the treatment process from four stages to three, while providing effective treatment of the water issues.

The project helps advance engineering as it provides an example of how to implement a design process with the operator in mind. ISL set out to use relatively new treatment technology and then design the facility around the operator and their use of the technology. This serves to remind other engineers: don't just design the process but design for the people that are going to run it. These are the people that ensure the process works to provide clean water to the community.

MEETING CLIENT GOALS

Making a Regional Water Hub

Like several other small communities in rural Canada, the Village of Thorsby is working hard to create a thriving rural centre. With a largely residential tax base, Village Mayor Barry Rasch has said *"We know that the focus of our community has to be more aggressive business attraction…we have to be proactive in trying to find a solutions that will complement the community."* Building the new water treatment plant is a part of a strategy to promote the village as a regional centre and so diversify the Village's tax base and revenue sources. Regulatory authorities have indicated that many communities near Thorsby do not have a good supply of quality potable water. These same communities are also connected to Thorsby via the railway tracks or highway. The Village sought to position itself as a regional provider of quality water. It already had an excellent intake to access water and ample capacity in its raw water transmission and storage infrastructure to support such a role.

Through the new water treatment facility project, ISL helped the Village position itself as a future potable water supplier for the region. For example, in choosing the site, criteria were included that would facilitate bulk distribution of the treated water. The chosen Z-box™ treatment technology also helped; if more capacity is needed, the Village need only add more membrane cassettes to each treatment tank without having to add new infrastructure.

Maximizing Dollars and Return on Investment

ISL's thorough process for site selection undoubtedly saved the Village money. Site selection involved analysis of 10 sites, modelling of pumping and distribution systems, land purchase and environmental assessment. An already developed site with an abandoned building was selected. By making use of a site with existing access and municipal servicing infrastructure, ISL was able to reduce the need for additional construction costs in the project.

The process for selecting the best treatment technology was no less thorough. The Request for Proposals encouraged suppliers to demonstrate the ease of operation and reduced lifecycle costs of their ultrafiltration membranes and pre-treatment, rather than just initial capital outlay. This will save the Village money over the life of the facility.

Attracting and retaining qualified operators is an issue for most small municipalities. During workshops in the design process, the team recognized an opportunity to head off a future labour shortage in operators. ISL approached the director of a program to train new operators and established Thorsby as a featured water treatment centre within the training program. Students in the program can now experience the facility and see what is required to operate it. The facility is designed to function as a teaching environment with both additional space in the control room and a spare membrane cassette for a teaching aid (this also serves as a visual reference for operator' maintenance and repair needs).

The project was delivered on time and under the overall budget (engineering and construction) by approximately $160,000.

Delivering on the Village's Sustainability Plan

Over the course of the project, the Village adopted a Sustainability Plan and became more interested in demonstrating sustainability in its capital infrastructure projects. Sustainability of the water treatment facility was already being considered in terms of reducing costs and impact on the environment over the life of the facility, within decisions about site selection (choosing an already developed site), and selection of equipment and supplier (input requirements of the treatment technology, lifecycle costs). Waste discharges are also now treated before release into a nearby creek, protecting aquatic ecosystem and watershed health. The building envelope was also designed with energy efficient features that included a roof design to harvest daylight, energy efficient lighting, and a solar panel wall for heating the building.

CONCLUSION

Of the water treatment facility, Village Mayor Barry Rasch has said "It's the latest and greatest you can have in a water treatment plant and we're building for the next 50 years or more." The main contract operator has noted the improved water quality and the disappearance of water quality complaints since Thorsby's new water treatment facility began operating in December 2011.

Designed around the operator, the new water treatment facility provides a pleasant, safe, and efficient working environment. It has the capacity to support village growth and enable the Village to become a regional water provider. It provides water quality that exceeds water treatment regulations, manages waste streams, and meets current and future needs for ease of operation and reduced costs over its lifetime. The building's energy efficiency features help the Village demonstrate the application of its Sustainability Plan in a municipal building. Ultimately, it provides a great return on investment by serving multiple functions: water treatment, watershed protection, Village revenue stream, a sustainable building demonstration project, and vocational training for future operators. Companies such as Arctic Spas have already chosen Thorsby for their main production facility; ARRGO and Westower have also set up shop—with improved water quality the hope is that more big industry will follow in time.