Eighty-eight kilometre long water pipeline installed by HDD in rural Alberta

In early 2006, the Province of Alberta announced its decision to begin twinning Highway 63, the province's deadliest road. This two-lane undivided highway is the only all-weather road that connects booming Fort McMurray to its southern neighbours.

In order to accommodate the widening, the Village of Wandering River's existing water treatment plant had to be demolished. This meant creating a new potable water supply source for the community.

Wandering River is located in northeastern Alberta, 95 km from the Town of Athabasca and 200 km from Fort McMurray. Despite Wandering River's population of approximately 100 people, its relative remoteness along Highway 63 makes it of strategic importance to the 11,000 vehicles that travel to and from the Alberta oil sands region daily.

Athabasca County and Alberta Transportation determined that a regional potable water supply would be the most appropriate replacement water source, due to a combination of factors. These included the quality of water available through the recently constructed Aspen Regional Water system, the remoteness of the community relative to the population, the high demand for qualified water treatment plant operators, future demand projections for the community and changing standards for drinking water quality in Alberta.

In addition to being a net benefit to the community of Wandering River, a regional water system extension also enabled a connection to the community of Grassland, 55 km to the south. Farms and acreage owners along the proposed system would also receive water service connections.

This new regional line would be 88 km in length, extending from Boyle to Wandering River via Grassland, including a new potable water reservoir at Wandering River and reservoir modifications at Grassland.

The pump room in the new Wandering River reservoir building.

Design-build process

In order to achieve cost and schedule certainty on this time and budget sensitive project, the County and Alberta Transportation elected to proceed with a design-build delivery model, the first of its kind in the province. This approach allowed the owner to reduce overall delivery timelines of the project by as much as 50 per cent. This project was also seen as a test case for the application of the design-build process in future regional water systems in Alberta.

Through a five month process that began in 2011 and included pre-qualification, submittal of proposals by design-build proponents, interviews and due diligence, Athabasca County selected Graham Design Builders, along with their key partners Stantec Consulting Ltd. and Pidherney's Inc. The design-build team was awarded the project in late July 2011. Pipeline construction began in early September of that year, with a contract mandated completion of December 2012.

Terms of reference

With a 16 month design and construction period, the project was split into three segments with separate internal deadlines. The first segment consisted of a 33 km pipeline from Boyle to Grassland, with the second segment being the remaining 55 km of pipeline from Grassland to Wandering River. The Wandering River reservoir/pump house made up the final segment of the project. The owner's engineer, Associated Engineering, supplied Terms of Reference for the project, which aided in streamlining the design process. These included several key parameters for the project including:

- An alignment that extended primarily along municipal road allowances, with an additional 5 m right of way added to each side of the road.
- System supply pressures, ranging from 98 to 560 kPa.
- A minimum waterline internal diameter of 155 mm.
- A minimum line pressure of 98 kPa at any point in the system.
- A pipeline design flow of 2.5 L/s for Grassland and 1.5 L/s for Wandering River.
- A 520 m^3 two cell reservoir at Wandering River, with peak hour distribution pumping capacity of 2.34 L/s and

a distribution system ranging in pressure from 350 – 550 kPa.
- Truck-fill systems at Grassland and Wandering River, each with a capacity of 14 L/s.

The pipeline

Horizontal directional drilling (HDD) was selected as the choice method of installation for the pipeline, due to the tight timelines of this project. Drilling greatly reduces potential environmental impacts through minimum disturbance during construction activities. It is exempt from the requirement to obtain an approval under the *Environmental Protection and Enhancement Act* (EPEA). This exemption allowed for a reduction in the overall project timeline of up to six months.

While scheduling impacts were the driving factor in the selection of HDD installation, it was also recognized that this method added value to the project in other areas. HDD reduced disturbed lands by approximately 90 per cent. This minimized top soil salvage, subsoil excavation, add-mixing of soils, re-vegetation, erosion, and crop damage, while preserving the natural habitat for wildlife. In cultivated areas it minimized crop damage and reclamation required by private land owners.

As a large portion of the waterline was installed within County road rights-of way, this approach also minimized disruption to motorists and limited the need to disturb private lands.

Pipe selection

High density polyethylene (HDPE) pipe is more commonly used in HDD installations. However, in this case the larger internal diameter of fusible polyvinyl chloride (FPVC) pipe allowed the use of 150mm nominal diameter pipe (155mm internal diameter). The greater wall thickness of HDPE pipe would have required the use of 200mm nominal diameter pipe. By downsizing the pipe diameter, the project was able to offer a cost savings to the client. FPVC Dimension Ration 26 pipe was suitable for HDD installation, providing the hydraulics required for the system and suitable pull strength to achieve cost-effective drill length. The pipe was manufactured by IPEX at its plant in Edmonton, Alberta, and delivered to the site over a four month period beginning in September 2011.

This application of FPVC pipe represents both the largest project by length of directionally drilled FPVC and length of FPVC installed to date in the world.

Fusing in winter

As construction of the pipeline began in September, fusing of the FPVC pipe was scheduled to continue through Alberta's winter months, which resulted in less than ideal fusing conditions. To address this, pipe fusing operations occurred inside a pair of retrofitted insulated shipping containers. Set end-to-end, this allowed for a temperature controlled environment for fusing operations, pipe cooling and data collection. Fusing generally took place one to two weeks in advance of pipeline installation, and the shipping container shelter was relocated as needed.

Wandering River Reservoir

The new Wandering River Reservoir

was designed to meet the minimum requirement of 520m^3 of active storage, with a two cell configuration. This provided the capability to isolate a cell for cleaning or other maintenance, without disrupting operations. Also included in the reservoir design was a truck-fill system, a lab, a standby generator, three distribution pumps designed to provide 25-year peak flow demands and a standby pump. Space was allocated for a fire pump, should Wandering River's distribution system be upgraded in the future to enable fire flow delivery.

Additional future planning was incorporated into the design, allowing for a twinning of the reservoir, should the community grow beyond its 25-year design horizon.

Shipping container shelter configuration used for fusing in winter conditions.

Grassland Fill Point

The Grassland Fill Point component of the project consisted of a retrofit of the existing Grassland Water Treatment Plant and potable water storage reservoir. The project included removal of existing water treatment plant equipment, the addition of a metering-run for water from the new regional system, a truck-fill station and ancillary SCADA and communications systems. The plant's existing filter backwash pump was converted for use in the truck-fill station.

In May 2012, the owner approached the design-build team about the addition of a chloramine booster station, within the Grassland Fill Point. It was desired primarily to increase active chorine residual in the new water line between Grassland and Wandering River. The line runs for approximately 55 km, with an estimated travel time in the order of two weeks, under average day demand conditions.

This change presented substantial design challenges due to the high pressure in the system (>700 kPa) at the injection point, the low flow in the line and the required additions of both chlorine and ammonia at Grassland to achieve a higher chloramine concentration. The low ammonia dosing was especially problematic, as ammonia solutions were not commercially available in concentrations low enough to accommodate system flows.

Ultimately, it was determined that the most operationally efficient and cost-effective method to achieve the desired level of chloramine dosing in the system was to mix an ammonia solution on-site, using ammonia in powder form. A two week supply of dosing solution is stored in distribution containers. The chloramine booster systems were designed to be located within the footprint of the unused water treatment plant clarifiers and filters.

Project execution

One of the unique characteristics of this project is that it was designed, constructed and put into operation, in just 13 months. The quick turnaround between award and construction startup, was attributed to a fast-tracking of many of the design and regulatory approval

activities. For example, many approvals for crossing of foreign highways and pipelines and powerlines, as well as environmental features were sought concurrently.

Construction proceeded in areas where approvals were in place, even if approvals were still outstanding in nearby areas. While this approach led to several remobilizations across the alignment in the early months of construction, it was considered necessary to ensure project timelines were met.

Overall, the directional drilling component of the project proceeded well, finishing in April 2012, two months ahead of schedule. Commissioning of the work was completed in segments, first with "bump tests", or short duration pressure tests, undertaken in advance of system swabbing. This was followed by full length pressure testing and disinfection.

Commissioning of the first segment of the line, from Boyle to Grassland occurred over a six week period in January and February. It was brought into service in mid-February. Commissioning of the second segment, from Grassland to Wandering River was completed in July 2012, five months ahead of schedule.

Warmer than average temperatures in January and February 2012 allowed for construction of the reservoir to begin ahead of schedule. Though there were a number of small delays common to the region, such as the delay in installation of the gas utility, temperature fluctuations during reservoir leakage testing and a number of truck-fill re-designs, construction proceeded smoothly. Despite the challenges, the reservoir was completed and put into service in September 2012, three months ahead of schedule.

Reservoir commissioning with the majority of stakeholders represented.

With this project, Alberta embarked on a significant new chapter in the construction of potable water systems. The design-build team undertook this project with the understanding that success or failure here would directly impact future opportunities to carry forward the design-build methodology for other municipal water systems. Through a committed team effort from the owners, operators, designers, contractors, sub-contractors and others, this project was a definite success.

The innovative technologies employed in the completion of this project served to reduce costs, decrease construction timelines, minimize environmental impacts, and reduce disturbance to private land owners and motorists.

Wandering River's Pipeline/Reservoir provides a long-term, reliable solution for clean and safe drinking water to key communities along the Alberta energy corridor and the rural residents in between for many years to come. It was completed on budget and ahead of schedule.

Recognition

The project won a 2014 Award of Excellence for Water Resources and Energy Production from the Consulting Engineers of Alberta, and 2013 Project of the Year from the Alberta Public Works Association.

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