Gold Bar Wastewater Treatment Plant expansion an example for all

By Tonia Jurbin

With a bold plan in place to cope with an issue facing hundreds of North American cities, the City of Edmonton with a population nearing 750,000 is expanding its multi-award winning Gold Bar Wastewater Treatment Plant to handle most of the combined sewer overflow (CSO) currently being released into the North Saskatchewan River. To do this, they are adding state-of-the-art high-rate Enhanced Primary Treatment (EPT) facilities on a scale that is larger than anything else out there, making this expansion a world-class facility. Add a creative environmental compensation program, pioneering work in optimizing inclined plates in settling tanks, pleasing architectural features and the considerable skill needed to manage a significant expansion in a congested operating plant, and this latest effort becomes an example for other jurisdictions.

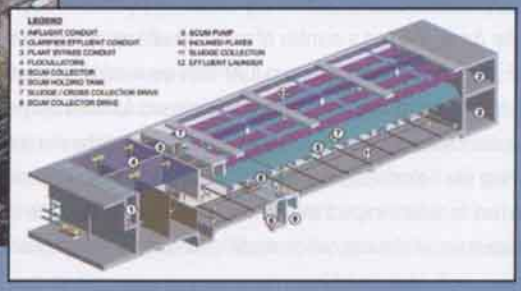
The Gold Bar Wastewater Treatment Plant was commissioned in 1956 as a conventional activated sludge plant. Expansions in the 1960s and the 1980s increased plant capacity to meet a growing population and, in 1996, the secondary treatment process was converted to biological nutrient removal (BNR). A year later, an ultraviolet disinfection (UV) unit was added. With other expansions, upgrades and retrofits, Gold Bar became an advanced tertiary treatment plant.

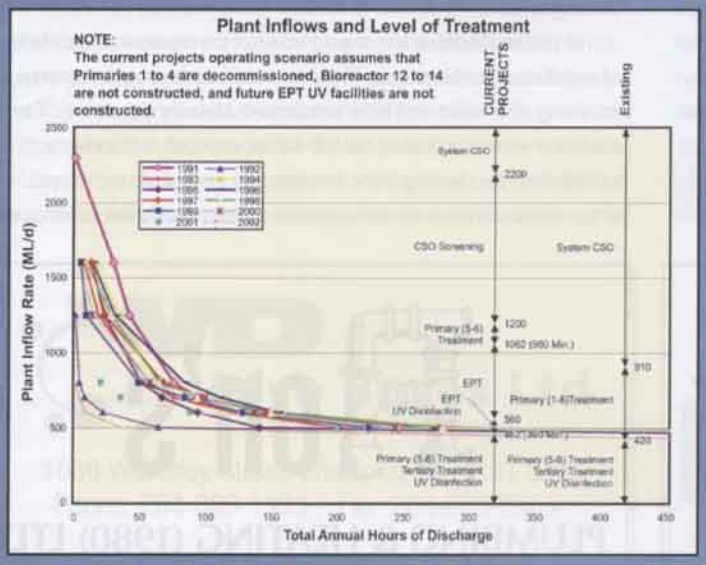
The existing plant capacity for screening is 1,200 ML/d and 600 ML/d for primary treatment. Secondary treatment at Gold Bar (which includes BNR and UV and has 97% solids removal efficiency) is 420ML/d. Later this year when the EPT upgrade is commissioned, the pollutant loading on the river will be dramatically reduced, as the plant will be able to treat up to 2,200 ML/d.

Project highlights include construction of a new inlet diversion facility, a 325m^2 chemical building over five stories, four 150-million-litres-per-day (ML/d) capacity EPT clarifiers with odour controlling enclosures, an effluent conduit, an outfall structure and modifications to the scrubber building and scrubber systems. The expansion was tendered at $42 million, with construction to last 20 months; but a continent-wide cement shortage, an Alberta-wide shortage of skilled trades, and additions extended project completion to September 2006.

Edmonton started building separate sanitary and storm sewers in 1964. Today, about 27% of its sewers remain combined. These, being located in older parts of the city, are impractical to separate. About 55% of the combined sewer flows are treated before release to the river; however there are 89 annual occurrences of untreated effluent release from this source. Upon completion of the expansion, 85% of the flow will be treated reducing overflow occurrences to 46.

EPT Clarifier





Wastewater Treatment Plant

City staff started developing a plan for dealing with CSO in 1994. By June of 2000, City Council and Alberta Environment blessed it and an implementation strategy was crystallized. They recognized that they had to capitalize on the existing treatment infrastructure. Dr. John Hodgson, Director of Drainage Services for the City of Edmonton, explains: "We looked at a number of options for treating the overflows. Building localized satellite treatment centres would have cost $300 to $500 million and the waste could not be treated with the same level of expertise that we had at Gold Bar. We also looked at total separation even though our research indicated that few jurisdictions had gone this route. Estimates showed that separation would have cost $2.5 billion and taken up to 100 years. We felt we could get the same environmental benefit by expanding our treatment facilities for about $150 million over 15 years. Of course, where practical, we continue to separate the sewers."

The new facilities will provide varying levels of treatment depending on the pollutant loading of the influent. On a wet day, the first 420 ML/d into the plant will be screened, undergo conventional primary treatment, and go onto the secondary BNR process and finally to UV disinfection before discharge. The second 600 ML/d entering the plant will go through screening then onto the new EPT clarifier flocculation chambers where alum and polymer will be mixed with the wastewater to form large particles that will accelerate settling. The wastewater will then be routed to the EPT clarifiers or large setting tanks. These tanks have inclined plates that increase the settling area by 600%, thus providing high rate clarification. This process is expected to achieve 98% TSS and BOD removal. From there the first 200 ML/d of EPT effluent will be pumped to the existing UV facility that has excess capacity and the remaining 400 ML/d will be discharged. With UV disinfection, the colliform unit (CFU) in the final EPT effluent is expected to drop from 100 to 25 CFU. The last very diluted 1,000 ML/d entering the plant will only undergo screening before discharge.

The project was complicated by the fact that $22 million of the federal funding through the Infrastructure Canada-Alberta Program (ICAP) was con-

tingent on meeting project milestones. Early on, the City recognized it would need to bring some talent to its team. Dr. Hodgson continues, "We needed a consultant who could do a thorough literature search, because when we were planning this expansion, the EPT we proposed would be the largest in the world. We also needed to have confidence that the firm we retained would be able to take on the computer modelling and design, build and operate the pilot plant, and later take on the construction management and contract administration duties."

Rick Prentice, VP of Stantec Consulting in Edmonton, picks up the story from here: "Once retained, we really had to 'step up' as ICAP officials had already shown concern that the City would not be able to meet scheduled tender dates. We had a number of meetings and arranged site tours for ICAP staff. We made a commitment to ICAP that we would find creative ways to get the project on track by pushing key elements forward. This expansion was also challenging because it was difficult to fit all the elements within existing site boundaries, and we had to use every available square metre. We also had to reduce impact on their operations by confining the expansion to the west end of the site, which made it awkward coming up with a layout. A number were considered."

Stantec started working on the pilot testing and the conceptual layout in the summer of 2002 and completed the design in the fall of 2003; and they assembled a dream team to do it. At least six sub-consultants with expertise ranging from geotech to UV disinfection to computerized fluid dynamic clarifier modelling were brought on board. Dan Chernishenko, Managing Principal of Stantec, elaborates: "It took a substantial effort to coordinate the team as we had members responsible for the delivery of major design components throughout Western Canada and the US all working aggressively to meet scheduled milestones. Ultimately, the team executed well, and with each milestone met, ICAP's confidence in the project escalated."

The in-ground work for the new chemical building had its challenges with some 2,000 cubic metres of concrete and forming for numerous waste chambers, as well as two 3.6-sq.m 200-metre-long sewage tunnels. This building will house four 4.3 x 4.3 x 6.0m-high concrete alum tanks, generator, mechanical, electrical, and chemical rooms, and other mechanical equipment. The weight of the alum tanks (alum being 1.3 times heavier than water) necessitated an unusually high percentage of steel in the basement slab, about 85 tonnes in a floor with a 20m x 10m footprint.

"The biggest challenge on this project was coordinating the critical items with low winter flows and managing the wastewater during construction, especially when we were breaking into the existing inlet structure to add screening and the new bypass," explains Rod Maloney, President of Sure-Form Construction Ltd. of Edmonton, Alberta. "To do this, we had to block off one of the inlet tunnels and divert all the flow to the other tunnel." This had to be done twice – once for each of the two inlet tunnels. Both times the work had to be done between November and February to take advantage of low winter flows. The first bypass involving 75% of the screening facility construction was completed in the winter of 2004-05, the second bypass the following winter.

The chemical building has only a fraction of the mechanical and electrical installations on this project. There were also numerous gates, pumps, and wiring, all of which had to be coordinated. Maloney elaborates, "There was lots of work coordinating the sub-trades, especially in the chemical building. Even the planning of the installation of the inclined settlement plates, aluminium handrails and walkways for the new clarifier buildings was complicated because everything had to be installed before the (precast) superstructure was built around it." During construction, the City secured additional funding to add a pumping station to convey 200ML/d from the EPT to the existing UV system. Although this further improves the effluent, it did hold up the concrete work for the last clarifier building. Rod continues, "We had trouble getting erection crews at times and other things made staging the work difficult too. Cement shortages meant we had to order concrete up to 10 days in advance, which meant continually tweaking the schedule to meet supply and not the other way around. A truck driver's strike made acquiring aggregates difficult, we had to constantly adjust our work plan to accommodate the needs of an operating plant, and we could have easily have used another 10 crewmen."

Maintaining strong community relations and mitigating environmental impact were high on the priority list. Environmental impact assessments and compensation programs for habitat disturbances figured prominently and in a forward thinking move, the City and the Department of Fisheries and Oceans agreed to combine several projects where compensation for fish habitat disturbance was required and create one large meaningful project – a sturgeon spawning ground to improve the plight of the endangered sturgeon population in the North Saskatchewan River. This is a first of its kind in Canada.

Air quality has also been at the forefront of community concerns and the promise that the expansion would not cause it to deteriorate was key in getting community buy-in. A zero net increase in odour emissions was targeted. To see how the expansion would impact air quality, an odour emissions model was constructed that could predict the impact on the surrounding area under various system configurations – for example, adding or removing clarifier covers. Predominant air streams, weather conditions, emission sources, odorous chemicals and topography were the input variables used to generate Isopleth (odour contours) maps. Based on these studies, the clarifiers would be enclosed, the odours captured and routed to the scrubber building. H_2S is monitored at seven stations around the plant and there is an odour hotline for residents to call.

Dr. Hodgson concludes, "We pride ourselves in that we had created the Community Liaison Committee in 1998 to deal with ongoing community concerns about infrastructure development. The city publishes an annual newsletter for committee and community members. Together, they have resolved a number of issues including dust, traffic, odour and construction noise, which is a particularly big issue as our contractor worked around the clock to capitalize on the low flows."

Keeping the neighbours happy is a tall order when you have a 19 hectare site undergoing significant expansions at both ends. Says Hodgson, "We had to negotiate a laydown area and create access for employees through the nearby Gold Bar Park. We got lucky with equipment access – we were fortunate to have the same contractor win the work at both ends of the plant based on the lowest evaluated tender. We were happy with the contractor in terms of the work and the way they accommodated the needs of an operating facility by coordinating between the two sites. They also had to incorporate many small 'upgrades on the fly' without interfering in plant operations."

The City of Edmonton is clearly showing foresight and leadership with the way they are tackling their CSO issues, and in doing so, it is providing other cities facing similar challenges with food for thought.

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