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ALEXANDRA DISTRICT ENERGY UTILITY - PHASE 3

Canadian Consulting Engineering Awards 2016

Submitted by:

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Richmond

Project Summary

The City of Richmond, a leader in reducing the use of carbon-based energy, retained Kerr Wood Leidal Associates Ltd. to design the Phase 3 expansion of the Alexandra District Energy Utility, which is the largest ambient heating and cooling district energy system in North America. It uses ground heat as an energy source and has an ultimate capacity of 13.4 megawatts of heating and 5.8 megawatts of cooling for 3.1 million square feet of space.

Innovation and Project Overview

The City of Richmond is leading municipalities in its commitment to mitigate climate change by implementing strategies to reduce the use of carbon-based energy sources and minimize the emission of greenhouse gases. The Alexandra District Energy Utility, the largest ambient heating and cooling district energy system in North America, was constructed for this purpose and offsets an estimated 1,300 tonnes of carbon equivalents annually. Running at its full capacity, the system can service 3.1 million square feet of floor space (or 3,100 residential and commercial units) from one single energy facility. The district energy system derives its heating and cooling energy from three sources. The source is two geoexchange fields exchanging heating and cooling with the earth by gathering renewable heat from 25 kilometres of buried pipe. Natural gas boilers provide back-up heat, and two cooling towers use ambient air and evaporation to provide peak cooling during the summer season. The ambient system also allows for cooling heat recovery and energy sharing between buildings; when one building is rejecting heat into the network, another connected building in need of heat can make use of it. The plant expansion was completed in two fully functional stages to meet seasonal heating and cooling needs. The first stage provided cooling capacity for the summer season allowing existing customers to enjoy the benefit of cooling during the summer of 2015, the hottest summer on record for North America. The second stage saw the continuation of a second geoexchange field and back-up boilers for the winter season. The plant layout, piping, power distribution, and controls were designed to make efficient use of the system during both construction stages. To keep utility costs low, a sophisticated plant control system prioritizes use of the geoexchange, moving on to the cooling towers or gas-fired boilers as necessary. This unique control system also allows for the system to operate without an operator on site. Alarms systems are communicated to the utility operators at a remote operation centre. The building is constructed of locally manufactured, cross-laminated timber panels or CLT, which act as structural members, which limit the use of high energy building materials such as carbon steel and concrete and reduced building erection time and associated construction energy and costs.

Complexity

The first stage of the Alexandra District Energy Utility was initiated several years earlier as a small system with a limited size. The existing plant had to be tripled in size to meet long-term needs, furthermore, the City required that the utility's expansion had to be carried out in two separate stages – first to meet cooling needs in the summer and then to meet heating needs in the winter. For cooling, a temporary interim stage was designed and constructed to reconfigure the existing plant and allow for the installation of two new cooling towers and associated piping and controls, as new buildings being connected would exceed the original cooling capacity of the system. Once this system was operating, construction of the heating component was implemented while the system was providing cooling needs to the connected units. Before the plant was commissioned, both stages required significant reconfiguration during the cooling-heating shoulder season incorporate both stages into one harmonized system. The construction activities of both stages had to be implemented in such a way to provide uninterrupted service to the system's existing users. With a two-stage approach, the building's appearance had to meet a suitable aesthetic for the park setting.

Social and Economic Benefits

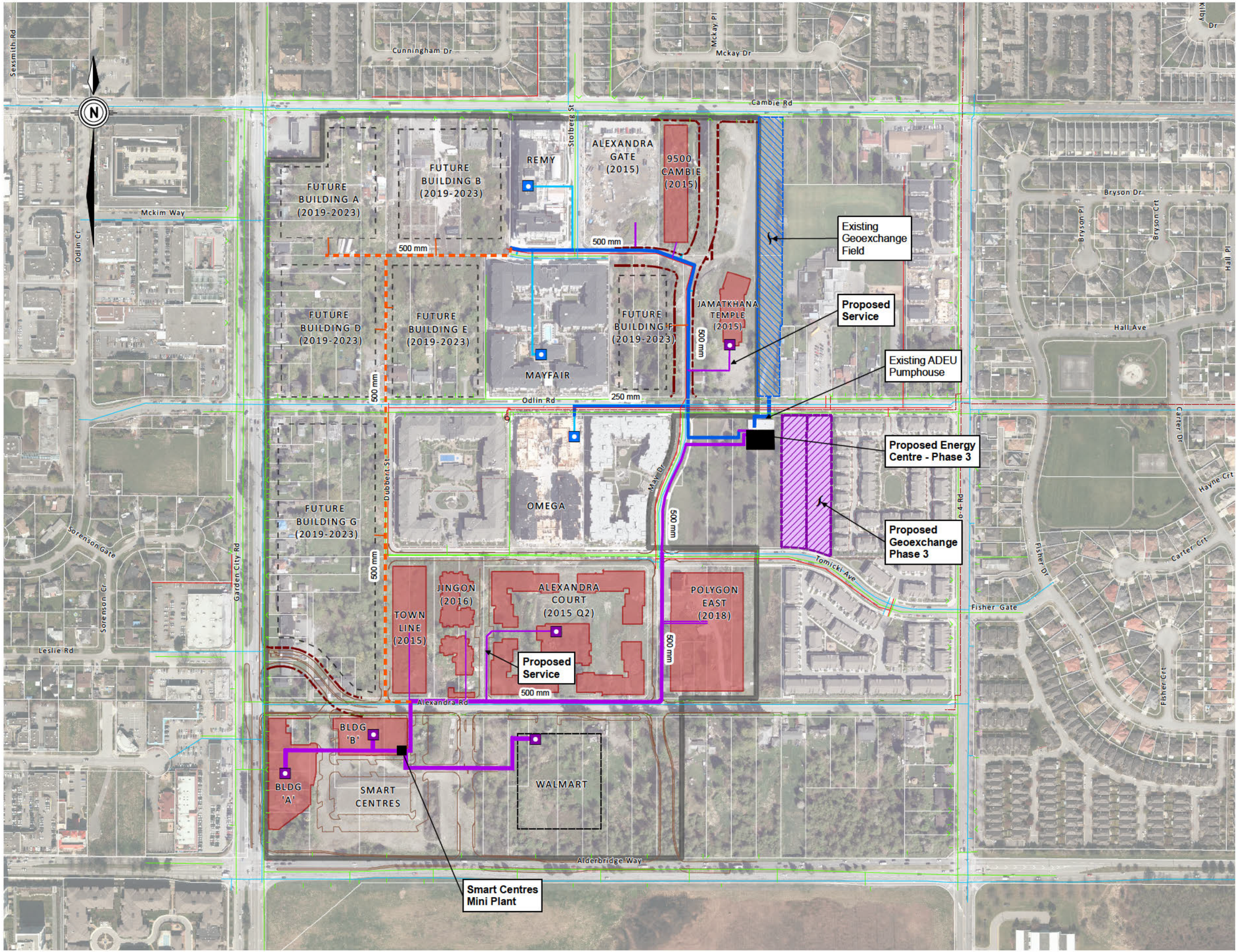
District energy utilities using geoexchange sources provide long-term energy cost stability as compared to hydro- or carbon-based energy sources. This gives customers peace of mind since they can expect more stable energy costs over the lifetime of the system. To retain or improve the neighbourhood's attractiveness, the aesthetics of the building balances the beauty of its park surroundings with the industrial nature of the system. To further improve the look and feel of the building, the City invited an artist during the design process to incorporate public art into the building's façade. The building design and use of windows invites local customers and park goers to view and understand how their homes and businesses are heated and cooled. The open presentation of this heating system may encourage a younger generation to become engineers.

Environmental Benefits

The Alexandra District Energy Utility helps to mitigate climate change by the reduced use of carbon-based fuels. At build out, the GHG intensity of the ADEU energy is projected to be less than hydroelectricity in British Columbia. A sophisticated plant control system prioritizes the use of a renewable energy source, moving on to the cooling towers or gas-fired boilers as necessary. An owl nest was incorporated into the building's design when a barn owl was discovered to use the parkland as its hunting grounds. Barn owl populations are threatened by the loss of hunting ground habitat so incorporating the owl nest in the park was considered a high priority for the City. The CLT panels used for the building's construction are a local and renewable product that provides structural support and minimizes reliance on the use of high-energy, carbon-based building products such as concrete and carbon steel. The CLT panels and yellow cedar siding were fabricated from lumber that was harvested using only naturally fallen timber, which encourages a more sustainable and natural use of local resources. A green roof was incorporated into the building's design that is well-balanced with the park setting. The green roof provides many benefits such as mitigating the 'urban heat island effect'; improving air quality; attenuating storm water flows from the roof into the City's storm sewers; and improving building cooling particularly in the summer months.

Meeting Client Needs

The City set an ambitious schedule for having the system expansion in operation. This was necessary because developers were well into construction of three new buildings that had to be connected to the district energy system before they could obtain occupancy permits and meet their move-in commitments to the future tenants. To meet the City's schedule, the entire project was designed, constructed, and commissioned in 16 months from project award to operation. The project team maintained the City's design and construction schedule commitments and commissioned the plant on time and within the City's budget. The plant's two expansion stages integrated into the original building helping to create the appearance of a singular structure. Providing uninterrupted service to the system's customers was a high priority for the City. KWL developed a temporary back-up service to continue to provide heat to the system while the facility was taken offline to make necessary piping reconfigurations. The noise generated from the plant needed to meet and exceed the City's Noise Bylaw. A study was conducted to monitor night time noise – the most stringent noise limitation. KWL, in conjunction with an acoustical specialist, developed mitigation measures that included operational and physical changes to meet the noise bylaw.



City of Richmond
Alexandra District Energy Utility
Phase 3

Legend

- ADEU Service Area Boundary
- Future ROW
- Existing Watermain
- Existing Sanitary Pump Station
- Existing Sanitary Forcemain
- Existing Sewer Main
- Existing Storm Main
- Existing Culvert
- Existing Ditch
- Existing DEU Energy Transfer Station
- Existing District Energy Utility Main
- Existing District Energy Utility Service Connection
- Proposed ADEU Buildings
- Future ADEU Buildings
- Proposed DEU Energy Transfer Station
- Proposed District Energy Utility Main
- District Energy Utility Service Connection
- Proposed Future District Energy Utility Main
- Proposed Future District Energy Service Connection

Reference 2013 Orthophoto and GIS background data from the City of Richmond.

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Project No.	Date
651-083	November 2014

DEU Layout Plan

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