Preliminary Engineering Feasibility Study for a Wastewater Treatment Facility at the University of British Columbia, Vancouver Campus

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August 2017

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Executive summary

This report was prepared for a research group at the University of British Columbia who are promoting the idea of building an Integrated Waste Management Living Laboratory at the University of British Columbia's Vancouver Campus. The analysis within consists of a technical feasibility study for a wastewater treatment facility at UBC, which is part of the larger project and is the catalyst and central theme of the Living Laboratory. The research group for this particular study consists of professors and a PhD student from Civil Engineering and UBC Engineering staff. The funding for the study was provided through UBC's Campus as a Living Laboratory program.

A literature review of similar facilities at other universities was conducted to understand the depth and degree of research being conducted elsewhere. Several WWTPs across North America and Europe operated by universities use their systems as operational units to supply the university with reclaimed water for non-potable re-use purposes. There are about half a dozen universities globally that have access to larger scale wastewater treatment facilities on campus where they can facilitate research with pilot systems.

The feasibility study consisted of analyzing the current wastewater flow and concentration data from various sources at UBC, and applying growth estimates to determine parameters for a conservative wastewater treatment design. The use of best available proven technology for a compact treatment design was a requirement due to space limitations on campus, and to meet spray irrigation effluent requirements for water re-use (Class A effluent), recover nutrients, and capture energy from the wastewater.

The wastewater flow rate from the UBC North and South catchments, and the population totals from 2013 to the end of 2016 were used to calculate the current UBC wastewater per capita value of 134 L/capita*day. Half the historical population growth values were used to estimate UBC's future population equivalent (PE). An estimate of 94,000 PE for 2035 and the current per capita flow value were used for design purposes for an average of 12,500 m^3/day of wastewater to be treated.

Currently there is only research data for the characteristics of the south wastewater, none for the north, and it is classified as low strength. Much work has been carried out at UBC to reduce excess water used in laboratories, and throughout the campus in replacing bathroom fixtures to low flow units. With noticeable wastewater strength increases in other municipalities a typical medium strength wastewater was agreed upon for conservative model calculations for both the north and south wastewater characteristics.

BioWin 5.2 was used to model a Membrane Enhanced Biological Nutrient Removal process with phosphorus recovery from the above design parameters. The headworks are of typical design with emphasis on equalization due to the extreme variations in flows experienced with such a large transient population. The bioreactors are arranged in a modular fashion to incorporate varying flows, facilitate maintenance, and to allow room for research. Anaerobic digestion is enhanced with thermal hydrolysis to produce methane, which can be used in various energy requirements for the facility. Considering the required space for a research lab, staff building, and a green belt, the total land required for the facility was estimated to be approximately 10,000 m^2.

The research and modeling process highlighted a few items that should be considered in the next stage of feasibility studies:

- The facility is not energy neutral according to this design, but energy neutrality is a goal for the project. Locating close to and utilizing waste heat from TRIUMF to provide an extra heat source for the anaerobic digester, or co-digesting food waste with sludge could improve the energy balance of the facility.
- Class A effluent may not be required for all water re-use requirements. Producing multiple classes of effluents for different uses could reduce the bioreactor footprints, and lower the energy demand of the facility. Further work is required to determine uses of reclaimed water for operational or research purposes.
- Sampling of the UBC north and south wastewater to benchmark current characteristics and compare to the conservative model would be beneficial for further refinement of the design and size of the facility.

With the data and results from this report a larger feasibility study could be carried out, and include the economical and operational aspects of the project.