From Waste to Resource

Shifting Directions in Wastewater Management in the Capital Regional District

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Over the last few decades, when the words "Victoria" and "sewage" were used together, it was usually in reference to the debate on why one of Canada's major urban centers continues to discharge wastewater, with limited treatment, into the marine environment. This debate has been heated and emotional on both sides of the issue. Ironically, the delay in moving to wastewater treatment may have been a blessing in disguise. As planning now moves ahead, the Victoria region has the opportunity to look at wastewater management from a different point of view—not as a waste to dispose of, but as a resource to utilize.

The Capital Regional District (CRD) is the utility that provides wastewater management to residential, commercial, and industrial and institutional customers throughout the Core Area and West Shore communities of the Victoria region. This area encompasses a population of approximately 250,000 persons. The wastewater system is operated by the CRD under their Liquid Waste Management Plan (LWMP) that was originally approved by the Province of British Columbia in March 2003. Key features of the LWMP include a source control program, a program to reduce inflow and infiltration, preliminary wastewater treatment using fine screening, and effluent disposal to the marine environment through two major outfalls at Clover Point in Victoria and Macaulay Point, west of Victoria in Esquimalt.

Under the LWMP, the CRD's future decision and timing to upgrade the level of treatment were to be made

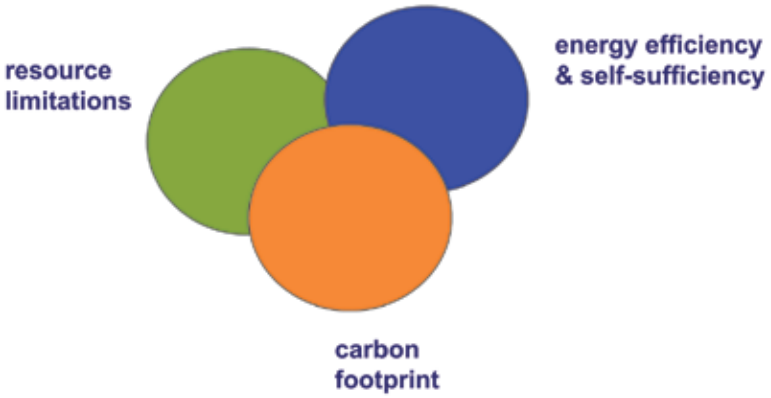

Figure 1: Principal drivers to viewing wastewater as a resource.

on the basis of a "trigger mechanism"—essentially, a change in the marine environment would signal the need for further treatment. In July 2006, as a result of continuing environmental studies on the impact of the discharges on the marine environment and a review by an independent scientific review panel, the CRD and the provincial government dropped the philosophy of a trigger mechanism to provide the impetus for wastewater treatment. The provincial Minister of Environment requested that the CRD provide an amendment to the LWMP, detailing a fixed schedule for the provision of wastewater treatment.

The Challenge is the Opportunity

The CRD complied with this request and embarked on developing a wastewater management strategy. The CRD Core Area Liquid Waste Management Committee worked with staff, a consulting team composed of the firms Associated Engineering, CH2M Hill and Kerr Wood Liedal, and an appointed Technical and Community Advisory Committee to develop a strategy for wastewater management over the next 60 years.

The Committee recognized that taking on the implementation of additional wastewater treatment at this scale in a developed urban region was, indeed, going to be challenging. They decided to take a "clean sheet" approach and started with a survey of worldwide trends in wastewater management. What they discovered was a shift in direction from the traditional view that wastewater was something to be disposed of as cheaply as possible; on the contrary, wastewater is a key component of urban resource management. With the help of their consultant team, the Committee reviewed the directions of other urban areas around the world. This included such examples as the NEWater program in Singapore, where wastewater is integrated into overall water resource management through an indirect potable reuse program and heat recovery from treated wastewater, a practice used by a number of Swedish communities.

Energy from Organic Solids

The organic solids from wastewater treatment processes have long been recognized as a source of "green" energy, principally through the anaerobic digestion of the solids and the production of a biogas that can be used to generate on-site electrical power. Current trends recognize that this biogas, in fact, has a higher value as a fuel, particularly in terms of greenhouse gas management. Technologies are now being developed to further refine this biogas to a quality that can be used to fuel vehicles or added to a natural gas grid. Biogas generation can be enhanced through the addition of other organic wastes such as food wastes from a source-separated municipal solid waste program.

Wastewater Heat Energy

The typical average temperature of wastewater is about 15°C. Heat exchange technologies are rapidly advancing to cost-effectively allow a portion of this heat to be extracted from the effluent prior to using the effluent for reuse or returning it to the environment. The heat recovered is typically used as a supplemental heat source in a centralized community heating system.

Water Reuse

Treated effluent can be used in a beneficial manner in a number of ways: irrigation, industrial use, augmenting the flow in watercourses and non-potable urban applications such as toilet flushing. There are two potential directions for provision of reuse water. One is from a local or regional wastewater treatment plant. The second is from an internal wastewater treatment plant in a building complex. In the latter, water recycling, often with the integration of rainwater capture, is used to reduce the overall potable water use in the complex and to reduce the amount of wastewater transported off site for transmission and treatment.

Nutrient Recovery

Wastewater contains phosphorus and nitrogen. While the traditional goal has been the reduction of these nutrients in the effluent discharged to sensitive receiving environments, there is ongoing development of technologies to recover these nutrients for their resource potential. Phosphorus can be recovered through a crystallization process, producing a high-grade phosphate fertilizer. The majority of the nitrogen is contained in the ammonia in urine. Work is currently proceeding in Europe on the concept of urine separation at source in specially designed toilets. The "yellow" water can then be processed in a concentrated form, allowing the recovery of nitrogen for use as a fertilizer.

Figure 2: Membrane-based separation technology allows an increase in treatment performance and a much smaller footprint.

Based on their findings, the CRD decided to embrace additional wastewater treatment as an opportunity to integrate wastewater management into overall urban planning.

Wastewater as a Resource

The shift to viewing wastewater as a resource has three principal drivers—resource limitations, energy efficiency and self-sufficiency, and carbon footprint (Figure 1). While these are not new to the wastewater industry, they have taken on more significance in the past few years. These drivers create resource utilization or integration opportunities that fall into four main areas—energy from organic solids, wastewater heat energy, water reuse, and nutrient recovery (see sidebar).

Looking at wastewater management from a resource recovery approach can be coupled with how we look at overall urban water planning. Traditional thinking in urban areas is to configure the wastewater management system as a centralized system, where wastewater would be conveyed to a single large treatment facility, followed by disposal of the effluent, typically to a water body such as a river or ocean. While some elements of resource recovery, such as energy recovery from organic solids, benefit from a larger scale, other elements such as heat recovery or water reuse can be better achieved on a local basis. Combining the benefits of both a centralized approach with decentralized elements can thus lead to a distributed or "hybrid" approach to wastewater management.

An example of this is the use of an existing wastewater trunk system that serves as the backbone. Decentralized plants that provide local heat recovery or water reuse can be developed in the sewerage area, with the central plant at the end of the sewerage system focused on wet weather flow management and energy recovery from the organic solids.

All of these opportunities are significantly influenced by technology change in the wastewater industry. One of the major changes has been the development of membrane-based separation technology (Figure 2). In this approach, the traditional secondary clarifier that separates the solids from the treated liquid portion by gravity is replaced by a membrane process. This technology allows not only an increase in treatment performance, but also a much smaller footprint.

Setting the Direction

In the spring of 2007, the CRD planning team developed a series of options that spanned from a traditional centralized wastewater management approach to a more decentralized approach, which would see a larger number of wastewater treatment facilities throughout the

region. After a comprehensive triple bottom line analysis incorporating economic, environmental and social considerations, the Board adopted a distributed approach to long-term wastewater management.

The advantages of this distributed or hybrid treatment approach are threefold. First, it reduces the size of the downstream central plant, as the upstream decentralized plants reduce the flows reaching the plant. Second, by strategically locating upstream plants, this approach creates local opportunities for water reuse and heat recovery from the wastewater. Third, by reducing the existing wastewater flows in the lower portions of the sewerage system, capacity is freed up to handle a greater portion of the wet weather flow, greatly reducing the frequency and volumes of the current sanitary sewer overflows. The real innovation of this strategy is the flexibility that it will provide the CRD in future decades. The CRD will no longer need to build larger and larger pipes in the ground to transport the wastewater long distances to a central treatment plant site. They will no longer need to continually expand the central plant to handle higher wastewater flows due to growth; the decentralized plants will handle the growth in the outlying communities.

Completion of the Core Area Wastewater Management Program is expected for 2015, at an estimated cost of $1.2 billion. The Program is currently in the conceptual planning stage. This work involves further development of the strategy developed by the Board. This includes identification of the number and location of wastewater treatment plants to be constructed in both the short and long term, as well as the development of local heat recovery and water reuse opportunities. The planning also includes how the treatment of wastewater solids can be integrated with solid waste management. The concept planning is expected to be completed by June 2009.

Summary

The direction adopted by the CRD for future wastewater management is a bold change from traditional thinking. It considers wastewater as a resource that can be integrated into urban resource management planning. While not all of the ideas and opportunities for integrated resource management can or will be implemented in the short term, the key is that the CRD is planning for several decades in the future. The intent is to establish the fundamental concept and facility siting decisions, so that, over time, wastewater management truly becomes part of the water and energy resources in the community. ⊠

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