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Report #EHQ 09-54

REPORT TO CORE AREA LIQUID WASTE MANAGEMENT COMMITTEE
MEETING OF WEDNESDAY 27 MAY 2009

SUBJECT **ADOPTION OF WASTEWATER MANAGEMENT STRATEGY – CORE AREA WASTEWATER TREATMENT PROJECT**

PURPOSE

To consider the selection of a refined distributed wastewater management strategy for the core area.

BACKGROUND

A distributed wastewater management strategy will ultimately provide secondary or better treatment for dry weather flows. This will also incorporate wet weather flow management and opportunities for resource recovery.

A distributed approach allows the Capital Regional District (CRD) to optimize existing sewerage infrastructure while setting the direction for more localized wastewater management with potential water reuse and energy recovery opportunities. The question is, how distributed should the strategy be? The consulting team approached this by developing an analysis of three options which contained three, five, and ten dry weather secondary plants, including a strategy for handling wet weather flows.

The locations of plants in the three options have been identified as optimum treatment sites to provide for wastewater treatment and extensive resource recovery. The entire core area was investigated to develop a database for evaluating distributed plant feasibility and siting. The work in the seven core area municipalities involved collecting and analyzing geotechnical, ecological, archaeology, heritage, and planned land use information.

In-depth analysis was completed to identify the potential demand for energy recovered from wastewater in the core area. This research was based on forecasting development in the years 2020 and 2065 using adopted and draft Official Community Plans, the Regional Growth Strategy and information collected from municipal and regional planners, developers, and institutional managers.

Floor areas of residential, commercial, institutional and other buildings were estimated, using plans and information from the British Columbia Assessment Authority, and floor area ratios were developed in consultation with local planners. Using energy demand consumption figures provided by BC Hydro, including future demand size reductions and the locations of hot water boiler heating systems, the future demand for energy was estimated and mapped in the core area.

Using the maps of future energy demand, the study team identified 39 energy recovery opportunity areas with the potential to use energy from wastewater to supply a portion of their space and water heat. These areas were subject to further review and assessment as part of the distributed plant study.

Each of the 39 areas having opportunity to use treated effluent to supply non-potable water needs were identified. Major water users in the core area – golf courses, playfields, and large institutions – were mapped. This information was used to support the analysis of water reuse potential. Using the energy recovery and waster reuse information along with the environmental and land use information, treatment plant sites were selected and grouped into three options, each option representing a decentralized wastewater treatment strategy.

The options were further evaluated using a Sustainability Assessment Framework (SAF), an enhanced triple bottom line (TBL) technique consisting of three distinct yet inter-dependent elements; a multi-objective alternative analysis (MOAA); a risk identification and analysis; and a decisions process. The MOAA is a technique used to evaluate both monetary and non-monetary attributed of alternatives in a balanced fashion rather than just financial. The consultant team used the MOAA to evaluate, screen and recommend a distributed wastewater treatment alternative.

The SAF was presented to the Core Area Liquid Waste Management Committee (CALWMC) to help evaluation of the three options presented at the committee meeting of 28 January 2009. Capital costs, operating costs and resource recovery revenues were provided at the meeting of 25 February 2009. Information has been provided to the public through a series of open houses, with specific input on the triple bottom line gathered and validated through public dialogue sessions. The updated SAF presented at the CALWMC meeting of 13 May 2009 incorporated these findings. The SAF "Weights and Ratings Input Sheet" was amended with input from that meeting and is attached as "Appendix A".

The sustainability assessment analysis illustrated that with equal rating of the environmental, social, and economic criteria, Option 1 is a preferred strategy. When the TBL weighting is stressed to favour either economic criteria or social / environmental criteria, Option 1 still ranked best. However, Option 2 also placed well and demonstrated a number of desirable social and environmental features. Therefore, it is recommended that heat recovery in James Bay, using in-line heat transfer technologies, be incorporated with Option 1. This will increase the social and environmental benefits of Option 1 at a lower capital and net present value.

<u>Peer Review</u>

The Peer Review Team (PRT) raised a number of key issues that warrant consideration as we move forward in the refinement of the treatment / resource recovery options.

1. Wastewater Treatment Process

Concern: The membrane bioreactor (MBR) process offers a small footprint and produces an excellent effluent quality for reuse; however, this is accomplished with higher energy consumption than with a conventional activated sludge plant and the effluent quality is far superior to that required for a marine discharge standard.

Action: The key is that the MBR is not used in isolation. The flow in fact would be blended with primary effluent to meet Provincial and Federal criteria for biochemical oxygen demand and total suspended solids. It is this blending that allows the MBR processes to be downsized relative to the sizing of a conventional activated sludge plant. In addition, the MBR technology will not be used indiscriminately in all cases of wastewater treatment as the program moves into pre-design work. The PRT does support the approach and design process for the Saanich East facility. It will provide an example of technology and resource recovery methods for future satellite plants that fit into trends in market demand. Treating flow at a Saanich East plant will remove flow, thus relieving downstream sewers where capacity is sometimes exceeded in wet weather. It will also eliminate two steps of downstream pumping of the Saanich East flows. Depending on the procurement method selected, the final choice of treatment technology may rest with the design / construction consortium, providing it meets performance criteria developed by the CRD.

2. Biosolids Management

Concern: In view of the uncertainties associated with long term cement kiln option and a willow coppice program managed by the CRD, the PRT recommends a back-up alternative be included in the biosolids management plan.

Action: Planning completion through the next six months will include further development of the biosolids management plan, with focus on developing another option for biosolids disposal.

3. Plant Options

Concern: The PRT agrees that of the three options, Option 1 provides the most economical approach for meeting regulatory requirements today while providing flexibility for future challenges, new technology, and potential resource recovery. The PRT expressed some concern if the McLoughlin site is used and suggested two variations of Option 1 for evaluation, Option 1b and 1c.

The components of Option 1b would include a conventional, high rate, non-nitrifying activate sludge plant on the west shore to handle two times the average dry weather flow, with wet weather facilities at Macaulay and Clover points. The components of Option 1c would include a conventional, high rate, non-nitrifying activated sludge plant on the west shore to handle four times the average dry weather flow with no wet weather facilities at Macaulay and Clover points. The Saanich East plant is common to all options.

Action: It is recommended that further investigation of variations of the Option 1 strategy be undertaken, including separation of biosolids processing from the liquid process to allow more flexibility in the placement of the liquid stream, potentially at the McLoughlin site. An additional benefit would be the opportunity to create an energy "centre" where local source separated organic waste along with fats, oils and grease can be incorporated in the digestion process, increasing methane production. The biomethane could then be scrubbed and either placed in Terasen's gas line or processed further for vehicle fuel to provide revenue to the CRD. In addition, during completion of the siting in the west shore, the possibility of a large site for Options 1b and 1c, as suggested by the PRT, would be included.

4. Implementation Considerations

Concern: The main issue the PRT identified is the opportunity to reduce initial construction costs and allow future plant flexibility by phasing and staging some of the construction.

Action: In subsequent pre-design efforts, the consulting team will be directed to develop a staging approach that matches the growth in population served. This will have significant advantages, including: reduction of initial capital outlay; lowering of rate impact by providing capacity that meets demand; and avoidance of a 'bow wave' of future capital assets requiring upgrade and / or replacement in a very short period.

Phasing

1, Stage Saanich East Plant and Defer West Shore Plants

"Just in time" construction will yield the lowest costs and lower rate impact. At the Saanich East plant, this can be done through considering the initial and future loading and staging capacity to the extent practical. At McLoughlin Point and west shore plants, a more aggressive approach can be taken. In the original Option 1 (now termed Option 1a) strategy, it is assumed that both plants would be constructed in the first stage. A variation on this approach is to build only the McLoughlin Point plant in the first stage. Constructing both plants now for Langford and Colwood can be avoided by "borrowing" capacity from a McLoughlin plant until growth in these communities and McLoughlin capacity limits dictate the need for new plants. This would allow the plant in the west shore to be deferred potentially until 2025. More importantly it would provide time for planning treatment capacity for Langford and Colwood to meet their growth.

2. Defer Wet Weather Treatment at Clover Point

Under the current options it is assumed that primary treatment will be provided at Clover Point for the wet weather flows that exceed two-times average dry weather flow. By deferring primary treatment at this time, significant capital cost can be avoided while allowing better planning and integration of inflow / infiltration reduction at the municipal level with the need for end-of-pipe wet weather treatment at Clover Point. This deferment would not impact achieving the goal of reducing the sanitary sewer overflows to sensitive water bodies in the Clover Point sewerage area. The only difference is in the level of treatment to the wet weather flow discharged to the open ocean at Clover Point.

FINANCIAL IMPLICATIONS

The cost established by the consulting team for phase one is $1.2 billion; however, the financial estimate cannot be fine-tuned until after the variations of the Option 1 strategy are analyzed.

The phasing approach does have the potential to reduce the project cost below $1 billion. This would be subject to the scope of phasing considered by the CALWMC. The heat recovery system in the James Bay / downtown core would be an additional cost but is not anticipated to be substantial.

SUMMARY

The primary activity over the past year has been the development of a series of discussion papers intended to inform the CALWMC about the core area and west shore wastewater management project, including critical issues, technical information and possible strategies. This information has been used by the committee to select the wastewater management strategy for the project.

Under discussion paper 036-DP2, "Development of Distributed Wastewater Management Scenarios," three options series were developed:
Option 1 series - Resource recovery on a regional basis;
Option 2 series - Resource recovery on a combined regional and local basis; and,
Option 3 series - Resource recovery on a local scale.

All option series have the potential to fully utilize the available heat energy. The only difference is how each achieves these end points.

The Option 1 strategy would see the development of a distributed wastewater management system incorporating three secondary wastewater treatment plants – Saanich East, McLoughlin Point and the west shore – and a wet weather flow facility at Clover Point. Heat energy can be recovered from the effluent from the three secondary plants to provide supplement heat to local district energy systems. Local water reuse opportunities can also be developed, either now or in the future. Solids processing will occur at two of the three secondary plants, McLoughlin Point and the west shore. Solids from the liquid-treatment-only Saanich East plant will be transported to the McLoughlin Point plant through the interceptor system. The initial solids treatment will be by anaerobic digestion, with further processing of the biogas to biomethane. This will be used as a supplement fuel source in the local natural gas distribution system. The dewatered and digested biosolids will be managed through a multi-use zero waste strategy. A portion of the biosolids will go to a willow-coppice demonstration project. This is an emerging biosolids management approach that has significant benefits in terms of greenhouse gas management and production of a value-added final product. The remaining biosolids will be further dried for use as a green fuel. The initial target customer will be the cement manufacturing sector, where the current use of coal would be off-set by the use of dried biosolids fuel. In order to not fully rely on third-party contracts, the thermal destruction of the dried biosolids, either alone or in conjunction with solid waste residuals management will also be pursued.

A sustainability assessment framework approach was used to assess the three strategic directions from a triple bottom line perspective. Feedback from the public consultation process has been used to set and weight the criteria.

The Peer Review Team recommended that Option 1 be carried forward for further development and detailed evaluation, including consideration of alternative configurations for Options 1a, 1b and 1c.

RECOMMENDATIONS

That the Capital Regional District proceed with Option 1 with further investigation of variations on the strategy, including:

- Continued analysis of Options 1a, 1b and 1c through the triple bottom line analysis, including an assessment of biosolids integration with solid waste activities and functions.
- Investigation of a wastewater heat recovery system and delivery mechanism in James Bay.
- Integration of inflow and infiltration management with appropriate phasing of the wet weather strategy at Clover Point.
- Relocation of the solids processing from the liquid processing site to allow potential integration with solid waste activities and functions.
- Further development of the biosolids management plan to reduce operational risks associated with biosolids end uses.
- Complete siting investigations in Saanich East.
- Investigation of opportunities for heat recovery and water reuse with the University of Victoria.
- Phasing of west shore plant(s) by utilizing the initial capacity of the McLoughlin Point wastewater treatment plant.
- Completing siting investigations in the west shore including the possibility of a single larger site in the event that the McLoughlin Point site is not selected.
- Evaluation of the financial and rate impacts of the costs and revenues, including revenues and / or carbon tax benefits of resource recovery and use for each option.

Dwayne Kalynchuk, PEng
Project Director, Wastewater Treatment Project

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CRD Option Analysis

Weights and Ratings Input Sheet - scales and notes are found below *- May 27, 2009*

	Triple Bottom Line Goal	Environment - Protect Public Health and the Environment			Social - Manage Wastewater in a Sustainable Manner			Economic - Provide Cost Effective Wastewater Management		
	Goal Weight	0.333			0.333			0.333		
		E1	E2	E3	S1	S2	S3	F1	F2	F3
	Criteria	Compliance assurance in meeting regulatory targets	Minimize the impact of the facilities footprint with respect to environmental impacts to surroundings	Maximize use of strategic, flexible, and multi-faceted resource recovery	Ensure facilities are acceptable to fit into neighbourhoods (aesthetics, noise, odour)	Maximize adaptation and flexibility to current and future technology opportunities	Maximize opportunity to reduce the carbon footprint progressively and innovatively	Minimize lifecycle costs	Maximize phasing or staging potential to reduce rate impact)	Maximize revenue from resource recovery
	Criterion Weight	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.111
Option 1	Macaulay/Mcloughlin Clover Point (Wet Weather) Saanich East West Shore B Royal Roads (solids)	4.0	3.0	3.0	3.0	3.0	1.5	5.0	5.0	2.0
Option 2	Macaulay/Mcloughlin Clover Point (Wet Weather Screen) Saanich East West Shore B Royal Roads (solids) Ogden point (Victoria Harbor) JDF Recreation (STP Base Load, Outfall, No Solids)	3.0	3.0	4.0	3.0	3.0	4.0	2.0	2.5	4.0
Option 3	Macaulay/Mcloughlin Clover Point (Wet Weather Screen) Saanich East West Shore B Royal Roads (solids) Ogden point (Victoria Harbor) JDF Recreation (STP Base Load, Outfall, No Solids) West Shore C Bear Mountain	2.0	2.0	5.0	3.0	2.0	5.0	1.0	1.0	5.0

	E1	E2	E3	S1	S2	S3	F1	F2	F3
Description	How well does the option meet regulatory targets for return of effluent to environment? How well will the option assure continued long-term regulatory compliance?	How well does the option minimize impacts at treatment plant sites and conveyance routes on plant and animal habitats?	How well does an option enable use of available energy and reclaimed water?	How well does an option reduce both construction phase and long-term impacts (odour, visual, noise, and traffic concerns) on residences and adjacent land-uses?	How well does the option present the opportunity for technological adaptation?	How well does the option minimize the carbon footprint?	Minimize net present value	Minimize Stage 1 capital costs	Maximize the availability and collection of revenue associated with resource recovery
Scale	1=likely non-compliance over time, 3=occurrence of non-compliance will be minimal, 5=high certainty of maintaining compliance over time: The more facilities to manage the compliance challenge increases.	1=likely significant reduction in habitat or taking of endangered species habitat 3=no taking of endangered species habitat and minimal impact to other habitat 5=no taking of endangered species habitat or other plants/animals habitat	1=Low existing demand, and continued low demand through 2020 3=Moderate existing demand, moderate growth after 2010 5=Low existing demand, substantial opportunity after 2010	1=Major disruption to residential activities during construction and long-term operation and minimal mitigation possibilities 3=Disruption during construction with minimal or mitigated long-term operational impacts 5=no noticeable impact from construction or operations	1=Facility structures are highly constrained and unique in design not allowing for future technological changes highest difficulty 3=Facility structures are not unique 5=Facility implementation is staged over time to capture developing technologies over long period	1=least carbon offset. 3=moderate carbon offset. 5=greatest carbon offset	1=highest 3=moderate 5=lowest	1=highest 3=moderate 5=lowest	1=highest 3=moderate 5=lowest
Notes	How well do the options assure compliance with regulatory requirements over time. All options will be designed to meet regulatory requirements. The question is, how well do each of the options assure maintaining compliance over time. Each of the options must manage wet weather flows. All options are designed to meet secondary treatment standard using a "blended approach". Assuring compliance over time with a large number of small plants is considered more difficult and problemmatic, hence a lower score for option 3. Historically, communities have moved away from large number of plants due to the operational cost and regulatory compliance.	Option one and two are nearly the same, with the exception of a plant in the James Bay area. Option three involves more communities with 10 plants and added conveyance facilities to be constructed. Option three involves similar plant foot print as option two, with the addition of more plants throughout the District hence having a very large regional footprint.	While each of the options is designed to capture all the heat available and the cost of doing so is calculated in the net present value, this criteria measures the extent to which an option will enable future heat recovery and water re-use. Results from environmental assessment of opportunity areas were used to create this rating. It is the average of the environmental performance of all the opportunity areas that are associated with each option.	Odor control and visual/aesthetic impacts are minimized through use of odor control technologies and application of low profile and/or architectural and landscape improvements. As configured option 1 has more traffic, is located near residential areas, is a large site and will require more mitigation. Options 2 and 3- smaller facilities provide the opportunity for fitting the structures within the community. However, more communities and residential areas will be affected requiring mitigation in each area. Traffic impacts will be more dispersed in option 2 and 3.	This criterion is a measure of how an option may allow for future technological improvements. Examples of improvements may include technology to increase removal of pharmaceutical products or constituents such as nutrients. The adaptation is limited by site constraints for each option (if a staged or phased approach adaptation will be enhanced). Option 3 is considered to have the least flexibility as any new technology would have to implemented at 10 different sites within smaller facilities.	Thousands of tons of reduced CO2 emissions translated to 1-5 scale Option 1 = - 483,000 t CO2e Option 2 = - 2,351,000 t CO2e Option 3 = - 2,873,000 t CO2e	This cost in $CDN translated to 1-5 scale. Total NPV in 2008 dollars for the Base Scenario for the 3 Options Option 1 = $1,174,000,000 Option 2 = $1,538,000,000 Option 3 = $1,666,000,000	Option 3 requires early build out of all facilities. Option one allows for staging of West Shore facilities on a "just in time" basis.	Based on direct correlation of revenue potential to scale sown above.

CRD Options Analysis

Weights times the normalized ratings produces these results

	Environment	Social	Economic
Option 1	0.22	0.17	0.27
Option 2	0.22	0.22	0.19
Option 3	0.20	0.22	0.16

Total Value Score
0.65
0.63
0.58