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Report #EHQ 09-70

REPORT TO CORE AREA LIQUID WASTE MANAGEMENT COMMITTEE
MEETING OF WEDNESDAY 24 JUNE 2009

SUBJECT **PROCUREMENT ANALYSIS PLANNING: SCOPE AND OPTIONS – CORE AREA WASTEWATER MANAGEMENT PROGRAM**

PURPOSE

The purpose of this report is to present the first discussion paper of the proposed business case for the core area wastewater management program ("the Program").

BACKGROUND

In a letter dated 14 December 2007 the Minister of the Environment requested the Capital Regional District (CRD) to prepare a business case which includes a procurement analysis.

A discussion paper titled *Procurement Analysis Planning: Scope and Options* (Appendix A) defines the key scope items analyzed for the Program which will be included in the business case submitted to the provincial and federal governments for funding support. It also defines CRD goals and objectives for the Program, summarizes background research and analysis, and identifies various provincial and environmental legislation/guidelines that will be used to evaluate service delivery options used in the Program.

The discussion paper reviews the following areas:

- The scope of work included in the Program and its major components.
- Fundamental planning criteria including capacity requirements, phasing, wet weather flow peaking, and wastewater chemistry issues.
- The wastewater regulatory framework relating to health and safety requirements.
- Environmental and sustainability regulations and guidelines to be considered during the planning of the Program.
- Key issues and challenges that must be managed by the CRD as it moves forward with procurement planning.

It does not make specific recommendations on service delivery options or procurement methodologies. Such recommendations will be made in subsequent work and the final business case. This discussion paper is mainly designed to summarize the key issues the CRD has been managing to date and provide a basis upon which future business case analysis will be built.

FINANCIAL IMPLICATIONS

Ernst & Young consulting work, which has a current estimated cost of $450,000 is funded through the core area wastewater treatment capital fund and is cost-shared with the provincial and federal governments.

SUMMARY

The Minister of Environment has directed the CRD to prepare a business case which includes a procurement analysis. The CRD has engaged Ernst & Young to prepare a business case to comply with this requirement.

RECOMMENDATION

That the Core Area Liquid Waste Management Committee receive for information the discussion paper titled *Procurement Analysis Planning: Scope and Options* (Appendix A).

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SBM:hr:jta
Attachment: 1

DISCUSSION PAPER

Capital Regional District

Core Area Wastewater Management Program

Procurement Analysis Planning: Scope & Options

Prepared by: ***Ernst & Young Orenda Corporate Finance Inc.***
June 10, 2009

Objective

The primary objective of this discussion paper is to consolidate all recent research/analysis completed by the Capital Regional District (CRD) for the Core Area Wastewater Management Program (the "Program"), and to establish a foundation upon which a business case can be prepared for submission by the CRD to the Provincial and Federal governments in support of the Program.

This discussion paper defines the goals and objectives of CRD for the Program, summarizes background research and analysis prepared by CRD for the Program, and also identifies various Provincial and environmental legislation/guidelines that will be used to evaluate service delivery options used in the Program. This discussion paper will generally be used as "Part A" of the business case[1] submitted to the Provincial and Federal governments for funding support.

Importantly, the scope and goals of the Program described here will be subject to change as the CRD refines its plans throughout 2009 and completes further due diligence. Also, the plans described herein may be updated based upon feedback received from senior levels of government and other stakeholders.

This discussion paper reviews the following areas:

- The breadth of the scope of work included in the Program and its major components,
- Fundamental planning criteria including capacity requirements, phasing, wet weather flow peaking, and wastewater chemistry issues,
- The wastewater regulatory framework relating to health and safety requirements,
- Environmental and sustainability regulations and guidelines to be considered during the planning of the Program, and
- Key issues and challenges that must be managed by CRD as it moves forward with procurement planning.

The purpose of this discussion paper is not to make specific recommendations on service delivery options or procurement methodologies. Such recommendations will be made in subsequent work and the final business case. This discussion paper is designed to summarize the key issues CRD has been managing to date and provide a basis upon which future business case analysis will be built.

[1] A business case to support a major funding request to the Provincial government normally has four main sections: (A) Scope and Objectives Definition, (B) Service Delivery Assessment, (C) Procurement Options and Value for Money Assessment, and (D) Procurement Implementation Plan. This discussion paper includes most of Part A along with certain details of Part B.

Overview

CRD has completed extensive engineering analysis for the Program to date. The following aspects of this research are summarized in this report and procurement planning issues are identified for each:

- Design flow planning and capacity requirements of the system.
- Inflow and Infiltration (I/I) estimates and wet weather flow management.
- Technology options available for wastewater treatment plants.
- Water chemistry and regulatory treatment requirements.
- Resource recovery options.

The scope of the Program will include the following:

- The main functional components of CRD's wastewater system.
- Resource recovery components of the system.
- Source-separated wet organics including fats, oils and greases and other source-separated wet organics (e.g. kitchen wastes).
- Drinking water conservation efforts.
- Regional source control programs for contaminants entering the wastewater system.
- Coordinated efforts between client municipalities for reduction of inflow and infiltration.
- Plans to reduce usage of septic tanks by unsewered households.

CRD is formalizing these integrated plans into a Community Sustainability Plan.

CRD's plans will reflect the Province's goals and objectives from the following climate change and sustainability plans and related legislation, including:

- B.C.'s Climate Action Plan
- Living Water Smart Plan
- B.C. Energy Plan
- B.C. Bioenergy Strategy
- B.C. Air Action Plan

CRD has identified a number of service delivery strategies to satisfy Program scope requirements. Three general strategies were short-listed:

- Strategy 1: Resource Recovery on a Regional Basis – the Fewest Plants.
- Strategy 2: Resource Recovery on a Combined and Local Basis.
- Strategy 3: Resource Recovery on a Local Scale – Largest Number of Plants.

CRD has chosen to pursue Strategy 1. Three service delivery options (Option 1a, 1b and 1c) for implementation of Strategy 1 will be reviewed in future business case analysis. Detailed assessment of these options is ongoing.

Summary of Procurement Planning Issues

Looking beyond the business case to actual procurement planning and implementation, this discussion paper identifies a number of issues CRD is working on to ensure successful Program delivery. These procurement issues include:

- As procurement planning moves forward, more detailed (and measurable) Program goals and objectives will be developed by CRD. Such plans will also include specific resource recovery targets and BC climate change legislation.
- Wastewater volume estimates are based upon a large number of assumptions underpinned by regional population growth assumptions. CRD has generally used a conservative approach to such estimates to ensure adequate capacity is procured.
- Inflow and infiltration of rain water and groundwater into CRD's sanitary sewers is resulting is significant peak flows during wet weather winter months (November to February). This is a major issue for CRD to manage and has a material impact of cost and capacity planning requirements. CRD has documented the following I/I issues:
  - Currently 95% to 99% of wastewater flows at Macaulay Point and Clover Point are below 2xADWF.
  - Flows between 2xADWF and 4xADWF occur at Clover Point for approximately 90 hours per year (on average).
  - Flows over 4xADWF only occur for a few hours each year and such flows would be composed of a substantial amount of rainwater.
- CRD is planning to use a staged approach to capacity planning with "just in time" delivery of infrastructure to meet expected demand.
- Data gathering and analysis is ongoing to ensure effective pre-design work for procurement planning, particularly for wet weather flows and water chemistry issues, as well as resource recovery requirements.
- CRD will likely provide guidance on capacity plans to prospective suppliers to allow a competitive procurement process.
- CRD anticipates it will have secured all required land sites for WWTPs and biosolids processing prior to commencement of procurement.
- If procurement of WWTPs is phased over multiple years (possibly using successive procurement competitions), a plan for the integration of technologies and operations management across WWTPs over multiple years will be defined by CRD.
- CRD may structure the final procurement to be independent of the technology deployed as long as such technologies satisfy CRD's strict performance requirements and regulatory standards. Thus the technology decision is not expected to be finalized until completion of the procurement process for one or more WWTPs.
- CRD will include Provincial climate change plans in the Program, however it is important to note that such climate plans will likely evolve and change over the design horizon of the Program. If CRD enters into a long-term arrangement for operations and maintenance of facilities then agreements must be established to ensure flexibility to meet future climate goals.

- CRD is committed to carbon neutrality. There may be room for CRD to view carbon emissions of the Program in context of the full carbon cycle when planning for carbon neutrality – separating biogenic carbon from fossil-fuel generated carbon (this approach appears to be in-line with the BC Bioenergy Strategy).
- If CRD implements aggressive water conservation programs with residents then wastewater volumes could be reduced by 15% per-capita (assuming a 50% compliance rate). Such initiatives impact capacity planning and procurement planning.

Acknowledgements

This discussion paper relies heavily on the extensive engineering work completed by CRD staff and CRD's engineering advisors Associated Engineering (BC) Ltd., CH2M Hill Companies Ltd. and Kerr Wood Leidal Associates Ltd. ("KWL") as well as the CRD's Peer Review Team. Ernst & Young Orenda Corporate Finance Inc. gratefully acknowledges the work of these parties and the use of their work in this report.

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Background

In the letter from the Ministry of Environment to CRD (MoE 2007), the Minister requested CRD to "*Examine the opportunity to save money, transfer risk, and add value through a public private partnership*". Successful public private partnership ("P3") procurements typically require a clear scope definition focussing on output specifications and performance requirements. This discussion paper defines the key scope items being analyzed by CRD for the Program and included in the business case submitted to the Province and Federal government.

The Core Area and West Shore of the CRD is a collaboration of seven local governments and two First Nation areas with a total land area of approximately 215 square kilometres that make up the majority of Greater Victoria. These communities include the Cities of Victoria, Langford and Colwood, the Districts of Oak Bay and Saanich, the Township of Esquimalt, and the Town of View Royal.

The CRD provides services that are regional in nature including the sewage system which serves a population equivalent of 320,000 in the Core Area. Other services and their integration into the overall Program are described below.

Prior to the formation of the regional district in 1966, each municipality designed its own sanitary collection system with, in some cases, multiple outfalls discharging at the low tide mark. Over the next few decades, the CRD then designed its system to intercept all of these outfalls and convey the wastewater to the Macaulay and Clover Point deep sea outfalls. However, environmental regulations of the day permitted the regional system to have some overflows during storm events at most of the original outfalls.

Sanitary Sewer System

Sanitary sewer collection systems receive wastewater from buildings (i.e., from sinks, toilets, showers, washing machines, etc.) and convey it through a series of collection sewers to the marine outfalls. Within the Core Area of the CRD, the collection system is generally defined and operated as follows:

- Sewer laterals convey wastewater from buildings to the municipal sewers. Individual private property owners are 100% responsible for the portion of the lateral that is located on their property and, with the exception of Oak Bay, the remainder of the lateral from the property line to the public sewer is owned and maintained by the municipality. In Oak Bay's case, the entire lateral from the building to the public sewer main is often the private property owner's responsibility.
- Collection sewers gather flows from sewer laterals and transport the sewage to a larger trunk sewer, municipal pump station or regional sewer. Collection sewers are usually located under the street on one side of the storm drain. They should be capable of conveying the peak domestic, commercial, industrial, and institutional flows plus an allowance for inflow and infiltration (I/I) of the area they are intended to serve. Manholes are normally located at changes in direction, grade, pipe size, or at

intersections of collecting sewers. Each of the municipalities own and operate their own sanitary sewer system, including municipal sewer lines and pump stations.

- Regional trunk sewers are generally major pipelines that convey sewage across municipal boundaries and are expected to carry flows from the collector sewers to the point of treatment and/or disposal. These sewers are larger, deeper and generally installed on flatter grades. These regional conveyance systems are owned and operated by the CRD.

The Core Area sewerage system is primarily serviced by three separate regional trunk sewer collection systems:

- Northwest Trunk Sewer – Northern leg (NWT-N).
- Northwest Trunk Sewer – Western leg (NWT-W).
- Northeast Trunk / East Coast Interceptor (NET/ECI).

These trunk sewer systems have a total length of approximately 55 Km. Due to undulating topography and subsurface conditions, 12 pump stations (including Macaulay Point and Clover Point pump stations) provide service to the Macaulay and Clover Point service areas as shown on Figure 1. The other ten pump stations are Craigflower, Currie, Harling, Hood, Humber, Lang Cove, Marigold, Penrhyn, Rutland and Trent.

There are approximately 140 municipal pump stations located within the Core Area which are owned and operated by each respective municipality/district. Most of these municipally-owned pump stations are small.

Liquid Waste Management in the CRD

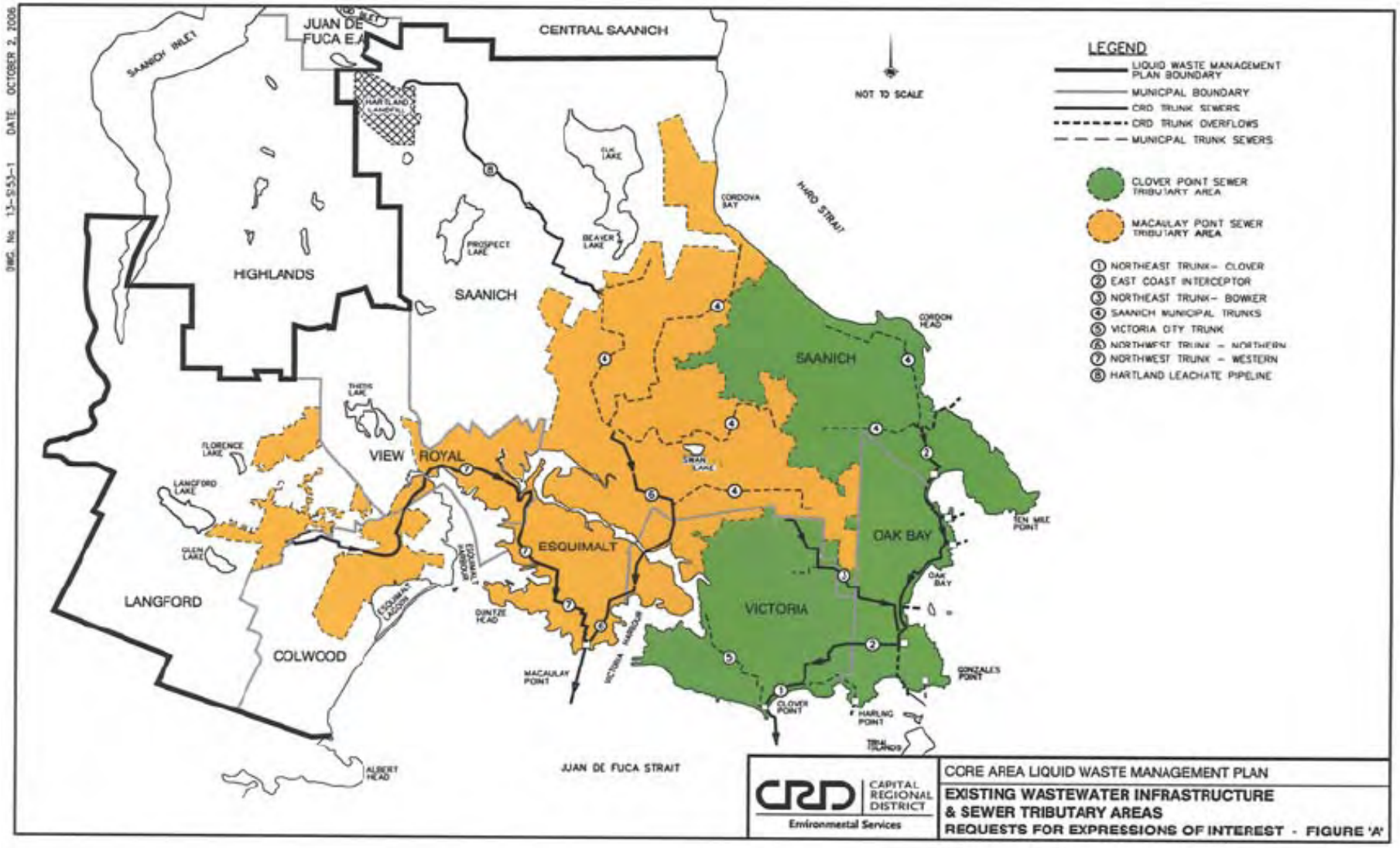
The CRD's wastewater system is operated under a Province of British Columbia Liquid Waste Management Plan[2] (LWMP). The LWMP authorizes the CRD to manage the wastewater collection, treatment and disposal system within a set of operating parameters and future environmental goals. Key features of the Plan include:

- A source control program for contaminants entering the collection system.
- An inflow and infiltration (I/I) reduction program.
- Preliminary wastewater treatment using 6 mm diameter fine screening.
- Effluent disposal to the marine environment through two major outfalls.
- A marine monitoring program.

CRD is in the process of updating the LWMP and is in consultation with MoE on its content and performance criteria. The updated LWMP will drive the overall Program goals and requirements.

[2] The LWMP is available online at www.crd.bc.ca/wastewater/lwmp/index.htm

Figure 1: Existing Wastewater Conveyance System and Two Major Catchment Areas



Liquid Waste Regional Source Control Programs

The CRD manages an extensive Regional Source Control Program (RSCP) to reduce the amount of contaminants that industries, businesses, institutions and households discharge into the region's sanitary sewer systems in order to protect sewage collection and treatment facilities, biosolids quality, public health and safety, and the receiving environment. The source control program is a key component of effective wastewater treatment and will form an integral part of the core area wastewater treatment strategy.

CRD's RSCP bylaw was approved in 1994 and implementation of a region-wide program began in 1995 with regulation of larger industries under a permit system, followed by adoption of the first regulatory codes of practice (COP) for commercial sectors in 1999. COP were developed, adopted and implemented by the end of 2005, to regulate discharges from approximately 2,200 businesses within 11 sectors.

The CRD has been tracking the performance of this legislation since 1990 and achievements include the following:

- Effluent trends for Clover and Macaulay Points over the period 1990 to 2008 include significant reducing trends in loads of metals, cyanide, organic compounds and oil and grease discharged to the environment at both outfalls.
- Studies also show continued reductions in priority metals loads (chromium, mercury, cadmium, lead, nickel, silver and zinc) ranging up to 26% decrease per year and significant reductions in loads of organic compounds, including 1,4-dichlorobenzene, tetrachloroethene (Perc), toluene and xylene ranging up to 18% decrease per year.
- Trends for metals levels in biosolids produced at the Saanich Peninsula wastewater treatment plant show significant decreases of such priority metals ranging up to 30% per year.
- Biosolids quality at Saanich Peninsula wastewater treatment plant continue to meet Class A criteria. Mercury concentrations in biosolids were maintained at a very low level, likely as a result of the continued implementation of the dental COP since 2001.

The "Medications Return Campaign", a new initiative under CRD's "Clean Water Begins at Home" residential outreach project, was launched in 2008 with goals of promoting awareness of the existing provincial medication return program and reducing the disposal of expired or unused pharmaceuticals into local sewers and solid waste streams. A follow-up survey showed that an estimated 745 kg of medications were collected and 57% of participating pharmacies registered an increase in the amount of medication returns.

Solid Waste Management in the CRD

The CRD became responsible for solid waste disposal in 1973 when the Province of BC directed all regional districts to take control of solid waste disposal within their borders. Hartland landfill was acquired by CRD in 1975 and CRD assumed operations of the site in 1985.

Solid waste management and disposal in the CRD is governed by the Solid Waste Management Plan[3] (SWMP). The original SWMP, which was approved in 1989, called for 10% waste diversion by 1993 and 15% by 1998. The SWMP was revised in 1995 to establish a 50% solid waste diversion goal. In 2006, the CRD Environment committee approved a draft Solid Waste Strategic Plan with the following waste diversion goals

- 60% of waste diverted from landfilling by 2012.
- 85% of waste diverted from landfilling by 2020.

Solid Waste Diversion and Resource Recovery Initiatives

All solid waste diversion programs are funded by tipping fees and the sale of recyclables (not municipal taxes). The CRD manages a number of diversion programs to reduce waste, including:

- Residential user pay garbage collection[4] (one bag per week allowable with additional bags requiring residents to purchase garbage tags).
- Landfill disposal charges. Tipping fees provide an incentive to reduce landfill disposal.
- Household hazardous waste collection. Hartland accepts HHW drop-offs including paints, pesticides, solvents and lubricating oil.
- Recycling programs. Curbside blue box/blue bag programs for more than 108,000 households and apartment buildings. Hartland is also experimenting with e-waste drop-off recycling initiatives and recycling of rigid plastic goods.
- Composting programs. The CRD adopted a landfill ban of yard and garden materials in June 2006. Source-separated yard and garden material is accepted for a fee at Hartland[5].
- Wet organics (i.e. kitchen wastes). The CRD recently implemented a pilot program in Oak Bay and View Royal to collect wet organics at the curb. CRD is evaluating the cost effectiveness of this program along with type of collection vehicle, technical reliability, indoor/outdoor collection containers, waste diversion, ease of implementation, participation, public acceptance, optimal collection frequency and outreach needs.
- Product stewardship programs. The CRD partners with a number of industry groups and associations for management and control of specific target waste issues, including:
    - Product Care Association to provide the region with waste paint, solvents, flammable liquids, gasoline and pesticides at its Hartland landfill recycling depot.
    - BC Used Oil Management Association manages an oil product stewardship program that provides financial incentives for the collection and recycling of used oil, oil filters and oil containers.

[3] The SWMP is available on CRD's website at www.crd.bc.ca/waste/managementplan.htm
[4] Garbage collection is not operated by the CRD and is provided by municipalities or private collection companies in areas not served by municipal collection.
[5] Yard and garden wastes are ground and used on-site at Hartland.

  - Return-It Electronics stewardship program, at the Hartland recycling area where a pilot program was recently implemented to collect end-of-life computers, including desktop servers, CPUs, monitors, mice and keyboards; printers; fax machines; photo printers and TVs.
  - Refundable beverage containers.
  - Other product stewardship programs in the region include refundable beverage containers, pharmaceuticals, tires and lead acid batteries.
  - Voluntary product stewardship programs for available for milk cartons, rechargeable batteries and cell phones.
- Landfill material bans/restrictions. Recyclable materials banned from disposal include drywall, corrugated cardboard, white goods, tires, directories, scrap metal, aggregate, concrete, asphalt, rubble, clean soil, paper fibres and yard and garden waste.

The CRD has won numerous awards for its management of the Hartland landfill, including community excellence awards from the Union of BC Municipalities and a landfill excellence award from the Solid Waste Association of North America for CRD's management of Hartland and the array of waste diversion programs implemented.

CRD Due Diligence Online

The CRD has conducted extensive due diligence investigations into wastewater management issues in recent years. Much of this work is available online at CRD's archival library:

www.WastewaterMadeClear.ca

www.wastewatermadeclear.ca/media/archived-documents

Direction from Ministry of Environment

The Ministry of Environment (MoE) has provided specific direction to the CRD to move forward with planning for the Program. The Province has also provided funding to assist CRD with such planning and due diligence work.

Details of this direction and guidance is summarized in Appendix A of this discussion paper.

Other Government Agencies

The CRD's Core Area Liquid Waste Management Committee (CALWMC) oversees the planning stages of the Program and liaises with other government representatives on major issues. The CALWMC is currently reviewing governance plans for implementation and ongoing project management of the Program. Such management plans will evolve as the Program progresses.

Several Provincial agencies and ministries are also working closely with CALWMC during the planning process, including:

- MoE. As noted above, MoE is providing guidance on objectives of the Program and the liquid waste regulatory framework CRD will follow. MoE also provides guidance on LWMP requirements.
- Ministry of Community Development (MCD). CRD is also working closely with MCD on this project. MCD will provide input to CRD and the Provincial government on the business case, funding matters, and the recommended service delivery option(s).
- Partnerships BC (PBC). Once the business case has been approved by CALWMC and MCD, it will be reviewed by the PBC Board of Directors prior to submission for funding to the Provincial government. The business case will be accompanied by a variation report (prepared by PBC), which will identify any deviations in the business case from PBC best practices, along with the materiality of such variances.
- The Provincial government will review the business case to determine the amount of funding to be provided for implementation of the Program and the terms of such funding.

Program Vision and Guiding Principles

The CRD prepared the following high level Program vision and guiding principles statement for the Program:

"The CRD Board has made a bold and innovative move to depart from a traditional centralized approach to wastewater treatment to a more distributed wastewater treatment strategy. This distributed approach allows the CRD to take best advantage of the existing sewerage infrastructure, while setting the direction for more localized wastewater management with potential water reuse and energy recovery opportunities. The scheme will see a new centralized secondary treatment plant near Macaulay/McLoughlin Point, one of the two existing major wastewater discharge locations. Two or more decentralized wastewater plants will be constructed in the upper reaches of the sewerage system.

The advantages of this distributed treatment approach are three fold. First, it reduces the size of the Macaulay/McLoughlin Point secondary plant, as the upstream water reclamation plants reduce the flows reaching the plant. Second, by strategically locating the upstream water reclamation plants, this approach creates local opportunities for future 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 wastewater flow – greatly reducing the frequency and volumes of the current sanitary sewer overflows (SSO). A wet weather flow relief point is required at the other major discharge point, Clover Point, to handle the surplus flows during wet weather periods prior to discharge to the ocean.

The real innovation of this strategy is the flexibility that it will provide the CRD in the 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. There will also not be the need to continually expand the central plant to handle higher wastewater flows due to growth - the decentralized water reclamation plants will handle growth in the outlying communities. These plants will utilize advanced treatment technologies to take advantage of phasing opportunities and "just in time" construction to accommodate needs.

This strategy will also allow the CRD to continue to incorporate new directions in overall community development. New or re-development projects, such as the Dockside Green development, fit well with the strategy adopted by the CRD Board in that they blend the advantages of local water reuse with reduced demands on the water infrastructure, while using the capacity of the community sewerage systems for the management of surplus wastewater flows and residuals management."

High Level Program Objectives

The CRD prepared the following primary goals and objectives for the Program:

"Goal 1 - Protect Public Health and the Environment

This is the fundamental goal of wastewater management. The CRD is committed to not only meeting the required regulations but also to planning ahead in a proactive manner to ensure that that emerging and future public health and environmental issues can be addressed in the decades to come.

Goal 2 - Manage Wastewater in a Sustainable Manner

Wastewater has traditionally been considered in the context of "disposal". The strategy adopted by the CRD has changed this approach. The CRD is committed to moving towards the goal of sustainable wastewater management during the detailed planning and implementation of the Program. A sustainable wastewater management approach will be one that continuously moves the CRD forward in terms of the integration of water, energy, waste and infrastructure management within the triple bottom line values of the community.

Goal 3 – Provide Cost Effective Wastewater Management

Cost effective wastewater management optimizes and capitalizes on the existing investment in wastewater infrastructure while thoughtfully moving ahead in the implementation of new strategies and infrastructure investments. The CRD will consider the best integration of public and private sector resources to deliver the wastewater management service in a manner that provides the best value to the community.

In order to achieve the goals, it is necessary to develop strategies. Strategies define the approach to be taken to accomplish the desired outcome or goal. A number of strategies may be pertinent to a goal and, in fact, strategies may overlap to achieve more than one goal.

The principal recommended strategies to accomplish the goals are:

Strategy 1 – Integrate community growth and development with wastewater management planning

Realistic projections of the rate of population growth and the location of this growth in the community are critical to making the best decisions on wastewater management infrastructure investment. Identifying how development or re-development will occur and, in particular, where opportunities may exist to achieve the desired distributed wastewater management strategy is also key in the development of the Program. Specific elements are:

- *Carry out a comprehensive study of the community development and population growth.*

- *Identify potential development or re-development areas that create opportunities for water reuse and resource recovery.*

Strategy 2 - Adopt a risk-based wet weather flow management plan

The CRD and its member municipalities face a significant challenge in managing the wet weather flow situation. The Program calls for a multi-faceted approach that includes water conservation, continued I/I reduction, optimization of existing capacity in the interceptors through a distributed treatment approach and selective treatment of wet weather overflows. It will take several decades to meet the Province's goals of SSO and CSO elimination. The CRD needs to tackle this issue based on a risk management approach that considers the triple bottom line impact and makes decisions for upgrading on a priority approach. Elements include:

- *Continue to analyze the existing situation in terms of actual and unit wastewaters flow and overflow volumes on return frequency basis, based on the severity of the wet weather flow event.*
- *Utilize the above information to predict future conditions based on the distributed wastewater management strategy.*
- *In concert with the Province, develop a wet weather flow management strategy that will achieve the goals over a period of time. Priorize upgrade projects, based on a risk assessment approach that considers the economics, the social impacts / benefits and the environmental benefits.*

Strategy 3 - Accommodate future growth through a distributed wastewater management strategy

Growth in the CRD will primarily be through re-development within the existing urban area or through new development, particularly in the West Shore communities. The distributed strategy calls for a centralized secondary treatment plant at Macaulay/McLoughlin Point, as well as two or more decentralized wastewater plants. Given the location of future growth and the gradual decrease in wet weather flows over time, it should be possible to limit any future expansion at the centralized plant and handle the majority of the flows from future growth at the decentralized plants. This has a number of advantages in terms of the neighborhood acceptance of the central plant and on the ability to use "just in time" construction in the decentralized plants. Critical to this strategy is proper planning in the Program Development phase. Key elements are:

- *Identify and evaluate sites for two decentralized wastewater plants – one in Saanich East and one in the West Shore communities. The attributes of these sites are that they should be near the existing interceptor trunk sewers, offer a potential opportunity for*

water reuse and recovery, offer an opportunity for neighborhood integration and allow the discharge of surplus effluent to the marine environment.

- *In concert with community development planning, evaluate the opportunities for additional decentralized water reclamation plants within the sewerage area. These opportunities will likely be focused on new development areas or larger re-development areas where integrated water management concepts can be utilized as part of the development planning.*
- *Further evaluate the concept of "liquid treatment only" water reclamation plants, where the residuals from the plants are discharged into the adjacent interceptor trunk sewer. The residuals are thus blended with the raw wastewater and processed at the central plant at Macaulay/McLoughlin Point.*
- *Carry out more detailed planning for a "wet weather flow only" plant at Clover Point, as part of the overall distributed wastewater treatment strategy.*

Strategy 4 – Consider wastewater as a resource

The strategy adopted will not only deal with the near term regulatory requirements for secondary treatment but will create an opportunity to consider wastewater as a resource, instead of a waste produced by society that requires disposal. Specific elements of this strategy are:

- *Evaluate local water reuse opportunities as part of the siting of the decentralized wastewater plants. This could include reuse for irrigation or non-potable urban or industrial reuse, as well as for wetlands or stream flow augmentation.*
- *Evaluate opportunities for heat recovery from the wastewater at both the centralized and decentralized plants.*
- *Carry out more detailed planning for residuals management at the centralized wastewater treatment plant at Macaulay/McLoughlin Point or an offsite location in the industrial area of Victoria. Review opportunities for additional processing at the site for energy recovery at the plant or with local partnerships.*
- *Continue planning for the Biosolids Management Facility at the Hartland Road site. Consider how this will integrate with residuals processing and transportation at the centralized plant or at other plants. Also consider opportunities for integration with solid waste management at the Hartland Road landfill.*
- *Evaluate opportunities for biosolids management utilizing land application. Consider these options in conjunction with biosolids processing technologies incorporating biogas and thermal energy recovery at the Facility.*
- *Consider the impacts and potential mitigation of the Program decisions on green house gas emissions and the overall impact and opportunities created by potential climate change.*

Strategy 5 – Adopt technologies that meet or exceed current requirements yet provide future flexibility

Wastewater technologies will continue to develop over the future decades. The lines between traditional definitions of "primary, secondary and tertiary" treatment are blurred. A critical part of the Program strategy is to recognize technology change and to make decisions that will allow technology change to be incorporated in the ongoing wastewater management program. The strategy needs to consider:

- *A blend of treatment technologies to meet the specific needs to the treatment application.*
- *Design treatment facilities to allow the retrofit of new technologies in the future that may allow greater performance, smaller footprint, energy optimization or lower cost.*
- *Plan and design the Biosolids Management Facility to consider the potential for future technological change or increased integration with solid waste management.*

Strategy 6 - Integrate wastewater management facilities into the community

The integration of the proposed wastewater treatment plants into the community creates both a challenge and a potential opportunity. The strategy should not be – how can these facilities be "hidden" but rather what decisions can be made to make them in tune with the neighborhoods. In planning these facilities, the key elements are:

- *Design the facility to blend with the surrounding land use. Select an appropriate architectural theme and develop the site with consideration of the desired greenspace and access requirements.*
- *Select stringent odour management targets appropriate to the setting. The targets may be no odour at the property line or no odour outside of the buildings, if the site has multiple uses.*
- *Consider the potential for both short term and long term water reuse and energy recovery in the local community in the plant planning and design.*
- *Consider the opportunities for multiple use of the site. For example, integration of learning or recreational facilities could be considered."*

As procurement planning moves forward, more detailed (and measurable) goals and objectives will be developed by CRD. Such plans will also include specific resource recovery targets and BC climate change legislation (described in Appendix B of this discussion paper).

Rationale for the Program: The Infrastructure Gap

The Current Situation

- CRD has minimal existing wastewater treatment infrastructure in the Core Area. Current preliminary treatment at Clover Point and Macaulay Point is composed of a 6mm fine screen to remove rocks/solids, plastic and floatable materials which are disposed at the Hartland landfill. No other treatment is conducted on wastewater prior to it being discharged into the marine environment at the two main outfalls.
- As noted in the MESL report contamination at the Clover Point and Macaulay Point marine outfalls is sufficient to warrant preliminary designation as contaminated sites under the Provincial Contaminated Sites Regulation. Water quality guidelines are not being met outside of the initial dilution zone at Macaulay Point (MoE, 2006).
- An average of 60 sanitary sewer overflows (SSOs) currently occur each year throughout the Core Area and West Shore.
- During stormflow events which lead to flows in excess of the system capacity a number of relief outfalls are used to discharge untreated wastewater directly into the ocean (predominantly in the Clover catchment area).
- The region continues to grow and added population will exasperate the situation (particularly for the Macaulay Point outfall which handles the West Shore's sewerage catchment area since the West Shore is forecast to grow more quickly than other parts of the region).
- CRD does not currently capture energy or other resources from the existing sewerage system. This may represent a missed opportunity.
- In a letter to CRD dated July 21, 2006, the Minister of Environment directed the CRD to provide an amendment to the CRD Core Area LWMP detailing a fixed schedule for the provision of sewage treatment.
- In a letter to CRD dated July 8 2008, the Minister of the Environment acknowledged the commitment to maintain a schedule for completion of wastewater treatment by the end of 2016.

Due Diligence to Date & Procurement Planning

CRD has completed extensive engineering analysis for the Program to date. Much of this research focuses the following key system dimensions:

- Design flow planning and capacity requirements of the system.
- Inflow and Infiltration (I/I) estimates and wet weather flow management.
- Technology options available for wastewater treatment plants.
- Water chemistry and regulatory treatment requirements.
- Resource recovery options.

Work on these issues is ongoing. Further work is required on phasing, procurement packaging, integration of multiple facilities, and wet weather flow management. The following sections summarize work to date along with issues that must be managed as CRD moves forward with procurement planning.

Capacity Requirements and Design Flows

Some of the most important aspects of the overall Program are decisions related to capacity planning and distribution of the proposed wastewater treatment plants, plus planning for the required conveyance and disposal facilities supporting such plants. During the industry and stakeholder consultation process conducted by Ernst & Young Orenda Corporate Finance Inc. (E&Y) in April 2008 (EY 2008), most respondents preferred CRD to provide guidance and direction on population growth assumptions and design flow rates for capacity planning purposes. Most, but not all, parties believed this risk/issue should not be left to the private sector service provider to determine. The following issues were identified during the market sounding process (EY 2008):

- Flow rates are a risk in this project (including I/I issues) that must be carefully investigated and managed,
- If multiple plants are used in system then detailed forecast on flow is required to allow capacity planning at each node,
- Flexibility in design can be integrated into plans even if CRD defines population growth and phasing requirements, and
- CRD is a dynamic region that is going to change significantly in coming years due to population growth and shifts in density (particularly on the West Shore).

The CRD and its engineering advisors (primarily Kerr Wood Leidal and Associated Engineering) have since conducted further investigations into system flow rates and design requirements. The following two discussion papers review these issues in detail and are included in the appendices of this report:

Appendix C: *Discussions Paper 033-DP-1: Wastewater Flow Management Strategy – Existing and Future Populations, ICI Equivalents, and I/I*
Appendix D: *Discussions Paper 033-DP-2: Design Flow Tables*

Population Estimates and Sources of Wastewater

Total flow estimates are based upon data reflecting:

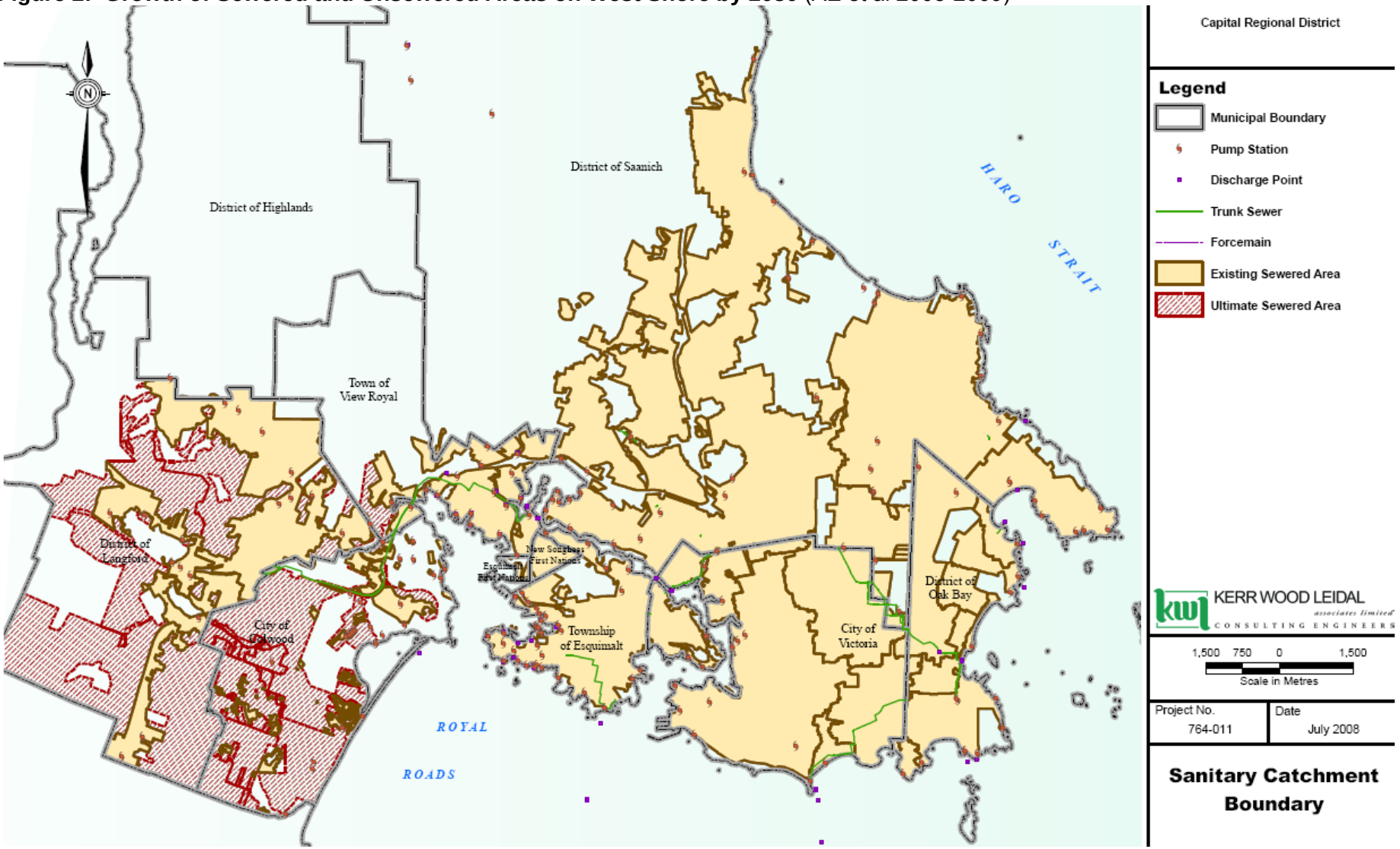
- Existing and future population estimates for each municipality;
- Existing and future population equivalent estimates, to account for industrial, commercial, and institutional loadings; and
- Inflow and Infiltration estimates, to account for excessive wet weather flows.

It is important to note that within the CRD not all residents are part of the sewered grid. A significant number of residents in Colwood and Langford are part of large unsewered areas. For capacity planning purposes, CRD's engineering analysis assumes these areas to be fully serviced by 2030 (per AE et al. 2008-2009, DP-033-1, pp. 5).

Table 1: CRD Total (Sewered and Unsewered) Populations Estimates
(AE et al. 2008-2009, DP-033-1)

	2006 Population	Avg. Annual Growth Rate (2006-2015)	2015 Population	Avg. Annual Growth Rate (2015-2045)	2045 Population	Avg. Annual Growth Rate (2045-2065)	2065 Population
Oak Bay	18,059	0.1%	18,222	0.1%	18,777	0.1%	19,175
Victoria	78,659	1.0%	86,028	0.5%	99,913	0.1%	102,032
Esquimalt	17,407	0.5%	18,206	0.5%	21,145	0.1%	21,593
Saanich	110,737	0.5%	115,821	0.5%	134,515	0.1%	137,368
View Royal	8,375	2.0%	10,009	1.5%	15,645	1.0%	19,280
Colwood	15,470	2.0%	18,488	1.5%	28,698	1.5%	39,506
Langford	22,229	5.1%	32,462	2.9%	60,851	1.5%	81,958
Total	**270,936**		**299,236**		**379,544**		**420,912**

Figure 2: Growth of Sewered and Unsewered Areas on West Shore by 2030 (AE et al 2008-2009)



Industrial, Commercial and Institutional Equivalents

Estimates for wastewater flows from industrial, commercial and institutional (ICI) facilities are based upon floor areas of each type of user. The following assumptions have been made to translate ICI floor area estimates into equivalent population estimates.

Table 2: Typical ICI Population Equivalents from Floor Area Estimates
(AE et al. 2008-2009, DP-033-1)

Land Use	Population Equivalent per Hectare
Industrial	25
Commercial	90
Institutional	50

Wastewater volume estimates are based upon a large number of assumptions underpinned by regional population growth assumptions. CRD has generally used a conservative approach to such estimates (that is, for the purposes of sewer infrastructure high-growth scenarios have been used).

Per-Capita Estimates

Per AE et al 2008-2009, DP-033-2, pp 5, flow monitoring results from previous studies of the CRD have typically shown per-capita wastewater volume estimates close to 225 L/p/day, except for Oak Bay which is closer to 250 L/p/day. These values have been used to estimate water volumes in CRD's "base case" scenario for capacity planning purposes. Forecasts have been made based on the following assumptions:

- Design Horizons of 2005, 2015, 2030, 2045, and 2065,
- Wet weather return periods of 2, 5, 10, 25, and 100 years,
- Base case I/I (i.e. constant I/I rates, no infrastructure decay or rehabilitation),
- Collection system topology is presented as it was in 2005, without future wastewater treatment plants or diversions such as the Trent Street Pump Station in place[6], and
- Separation of the combined sewer systems in the Humber and Rutland catchments in Oak Bay.

Inflow and Infiltration

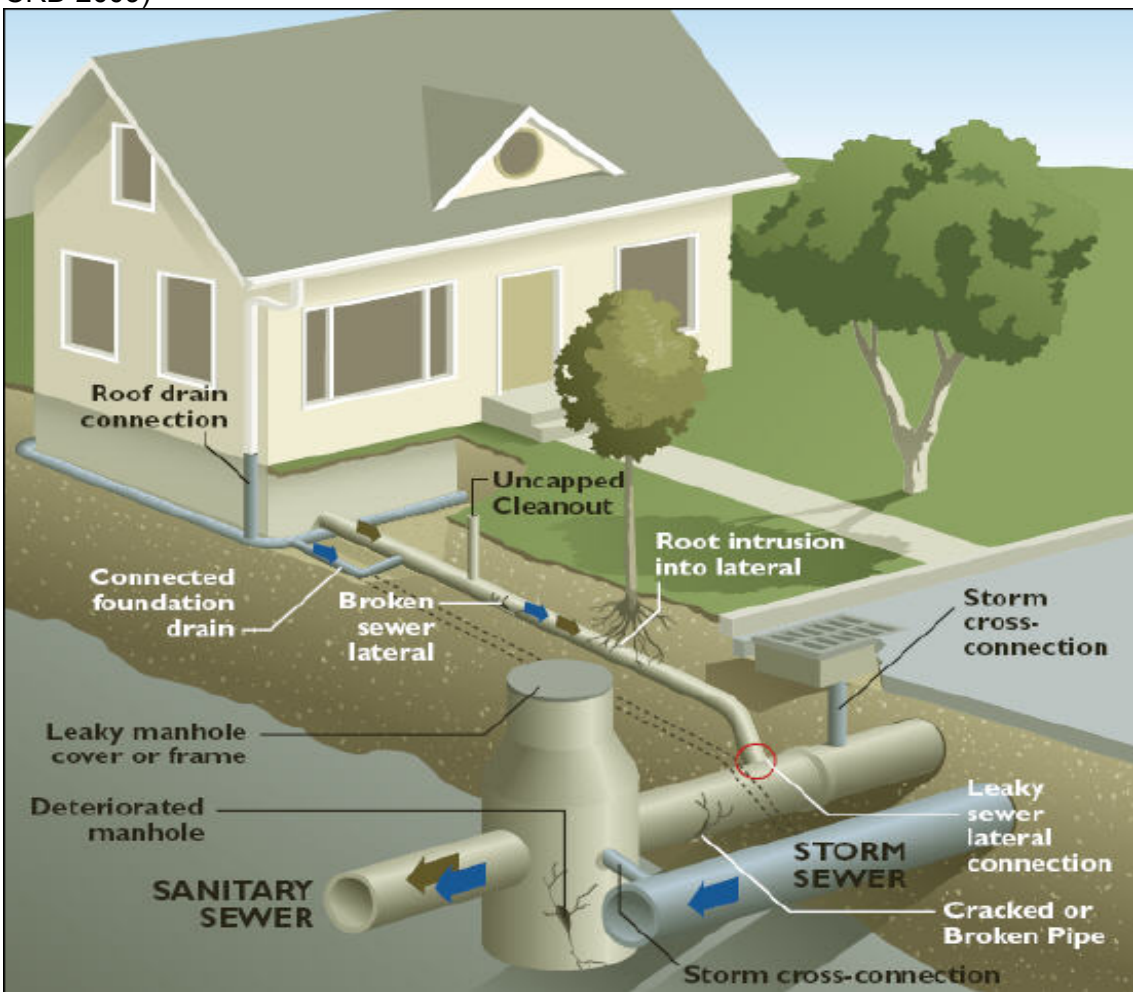
As documented in the CRD-published discussion paper "*Cost versus Benefit of Reducing Inflow and Infiltration"* inflow and infiltration refers to rainwater and groundwater that enters the sanitary sewer collection system. A certain amount of I/I is unavoidable and is accounted for in routine sewer design. However, when I/I exceeds design allowances, sewer capacity is consumed and usually results in overflows and increased conveyance costs or a reduction in the future population service capacity. The impact of peak flows on wastewater treatment plant (WWTP) performance can also be a problem. Hydraulic capacity must be closely managed to ensure

[6] These assumptions will be updated.

optimal WWTP operations. Major wet weather flow events have significantly different chemistry than normal flows (i.e. dilute flow, low cBOD5/TSS[7]) and can "wash out" biological treatment systems and cause problems for operators during days of peak wet weather flows.

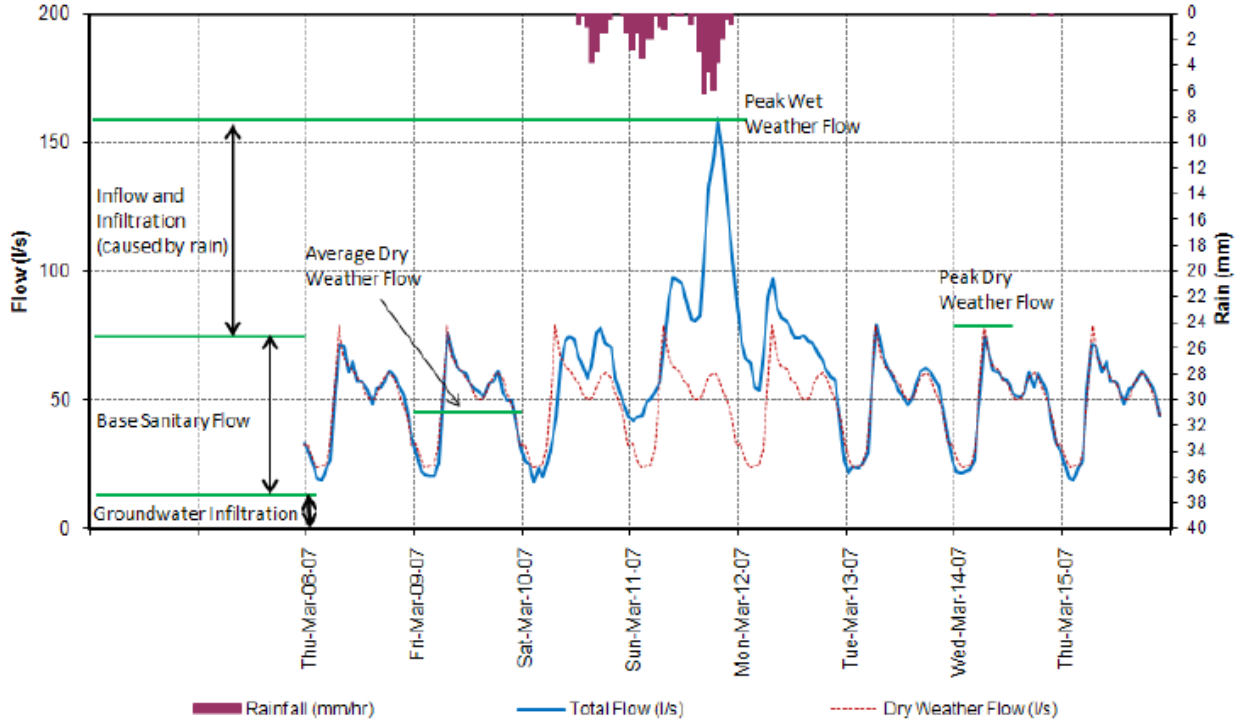
As illustrated in Figure 3, inflow and infiltration into the wastewater collection and conveyance system can be derived from a number of entry points.

Figure 3: Sources of inflow and infiltration into the collection and conveyance system (per CRD 2009)



[7] Appendix G contains a glossary of technical terms used in the discussion paper.

Figure 4: Example Hydrograph Showing Flow Definition (not to scale for CRD)
(per CRD 2009)



CRD must consider the following I/I challenges when developing a plan to manage I/I issues over the long-term (per EY 2008):

- I/I management requires wet weather peak flow management (for example using diversions and throttling of flows during major wet weather events).
- I/I risks and costs are unpredictable and difficult to estimate. Thus, if this risk is transferred to the private sector then bidders will likely add substantial risk contingencies to plans resulting in uncompetitive bids.
- CRD should seriously consider retaining responsibility for repairs of I/I itself rather than using an external private sector firm for management of this issue.
- If CRD is not careful then CRD will end up paying a substantial amount of money to simply treat (clean) rainwater. I/I also results in much higher pumping costs to convey water around the system.
- CRD may wish to consider providing a financial incentive to proponents to manage I/I and reduce peaking.
- If bids to provide the Program are allowed that vary flow assumptions then it will make comparison of proposals very difficult. CRD should consider specifying minimum capacity amounts and flow amounts.

Wastewater Flow Peaking at Clover and Macaulay Points

Most peak flows fall between 2xADWF volumes and 4xADWF at both Clover Point and Macaulay Point during the 4-5 wet weather months (November to February). It is notable that the CRD "throttles" peak flows reaching Clover Point to ensure peaking is manageable. CRD believes if such throttling was not performed then flows could exceed 4xADWF.

Table 3: Statistical Flow Data from Clover Point Pump Station
(per CRD 2009)

Flow Range	2006	2007	2008
Number of days flow did not exceed 2xADWF	345	349	362
Number of days flow was between 2xADWF and 4xADWF	20	16	3
Number of days flow exceeded 4xADWF	0	0	0
TOTAL	365	365	365

Table 4: Statistical Flow Data from Macaulay Point Pump Station
(per CRD 2009)

Flow Range	2006	2007	2008
Number of days flow did not exceed 2xADWF	357	358	365
Number of days flow was between 2xADWF and 4xADWF	8	7	0
Number of days flow exceeded 4xADWF	0	0	0
TOTAL	365	365	365

CRD estimates that 95% to 99% of wastewater flows at these locations are below 2xADWF. Furthermore, CRD estimates flows between 2xADWF and 4xADWF occur at Clover Point for approximately 90 hours per year (on average). Flows over 4xADWF only occur for a few hours each year and such flows would be composed of a substantial amount of rainwater.

Table 5: Clover Point and Macaulay Point Flow Data
(per CRD 2009)

	Clover Point Pump Station	Macaulay Point Pump Station
Maximum daily flow (2008)	118,600 m3/day	81,700 m3/day
Minimum daily flow (2008)	40,700 m3/day	37,400 m3/day
Average dry weather flow	52,000 m3/day	45,000 m3/day
Maximum pumping capacity	216,000 m3/day	151,200 m3/day

Both pump stations can handle 3-4 times average dry weather flows (ADWF) however there are times when these flows are exceeded and emergency discharge events occur.
CRD's engineering advisors have used several approaches to estimate I/I peak flow events. The base case is used here whereby I/I is assumed to remain constant (that is, repairs to the collection system are offset by deterioration in other components).

Impact of Climate Change on I/I Rates

The Federal government published a study of climate change impacts and adaption plans in 2007 for regions throughout Canada (CLIMATE 2007). Data for the Metro Vancouver region suggests extreme rainfall events, such as those which historically recurred every 25 years (4% probability per year) had increased such that the estimated recurrence is now every 10 years (10% probability per year). However the analysis concluded this increase in frequency correlated with the 1976 shift in the Pacific Decadal Oscillation (PDO). The PDO is a naturally occurring ocean-atmosphere phenomena that repeats every 20-30 years in mid-latitude north-eastern Pacific regions (similar to the El Nino cycle).

The CLIMATE 2007 report did identify statistically measurable increases in the overall rainfall intensity and volume (non-extreme events) and interpreted this as being a result of large scale climate change. Given the challenges CRD is facing with I/I, such rainfall growth trends and storm water management issues must be managed.

The *Water Use and Conservation Update* report produced by CRD in April 2008 (CRDWATER 2008) estimates an increase in winter and summer temperatures of 1-2 Celsius and summer precipitation to decrease significantly in the next three decades.

Analysis work completed in KWL 2008 on the Metro Vancouver sewerage area's susceptibility to climate change suggests "intense rainfall" in the Vancouver area could increase by 17% by 2050, and overall total annual rain could increase by 14% by 2050. Sea levels could increase by 0.26m by 2080. Similar weather pattern changes and precipitation increases may be expected in the CRD. However the impacts of higher rainfall on I/I over this period will be offset by rehabilitation work by municipalities to improve/replace existing infrastructure. Further work is required to clarify such offsetting trends to allow clearer capacity planning.

For procurement planning purposes, CRD is anticipated to provide specific guidance on design flow requirements. This issue is not expected to be left to possible service providers to determine (per industry market sounding process, EY 2008).

Just in Time Capacity Phasing

The appropriate design horizon for procurement purposes is still under review. CRD has prepared a long-term plan to 2065 with interim estimates at 2015, 2030 and 2045 (AE et al 2008-2009, DP-033-2).

CRD is using a staged approach to capacity planning with "just in time" delivery of infrastructure to meet expected demand.

Specific phasing and capacity targets are still under review.

Overall Capacity Planning

The CRD is conducting ongoing research into the region's capacity requirements and the impacts of the divergent factors identified above. Discussion Paper 033-DP-02 contains the most recent published estimates of design requirements for the conveyance system.

The CRD should expect to provide clear guidance on capacity plans to allow a competitive procurement process and also allow a reasonable basis for business case analysis.

Clover Point Wet Weather Flow Flexibility

It is notable that CRD is considering a wet weather treatment facility incorporating preliminary treatment plus high-rate chemically-enhanced primary treatment (CEPT) for flows in excess of 2xADWF at the Clover Point site. Solids removed from the treated wet weather stream would be passed on to the Macaulay Point/McLoughlin Point plant for processing. CRD is also considering wet weather flow treatment for surplus flows at Saanich East, McLoughlin Point and South Colwood.

Given the low frequency of peak flows, the challenges of expanding the Clover Point location, and the operational issues associated with bringing a CEPT on-line during a storm event, it appears an alternative solution should be considered to avoid the costs of substantial construction at Clover Point (likely requiring flexibility in the LWMP implementation). All such plans would be reviewed/approved by MoE officials in advance.

Selection of Treatment Sites

The CRD is currently considering a number of potential sites for the construction of new wastewater treatment facilities in addition to the installation of new treatment processes to augment the existing preliminary treatment systems at Macaulay Point and Clover Point and the disposal facilities at the Hartland Landfill.

Public consultations and First Nations consultations are ongoing. Discussions at Macaulay Point involve the Department of National Defence and Federal Governmental relations and are anticipated to be complex. Discussions at McLoughlin Point involve a brown field site but may proceed more quickly.

In January 2009 the CRD purchased a 6.5 acre site located in east Saanich at the corner of Arbutus Road and Finnerty Road for $6.5 million dollars. The CRD has acquired the property for the potential of developing secondary sewage treatment facilities on part of the site however

the siting process is in progress and no firm decisions around locating any kind of plant on the property has been made.

For procurement planning, CRD anticipates it will have secured all required sites for WWTPs and the biosolids processing prior to commencement of procurement.

Treatment Technologies

A number of treatment technologies have been reviewed for the WWTPs. Membrane bioreactors (MBR) provide a small footprint and high quality effluent, however they carry higher capital and operating costs. The CRD is investigating selective use of such technologies combined with more traditional conventional activated sludge (CAS) processes where land area permits.

Discussion paper No. 8 (March 21, 2007) conducted an extensive review of technologies available to CRD to wastewater treatment.

MBR has been selected by CRD's engineering advisors as an appropriate "representative technology" for analysis and decision-making purposes. No final decision on the choice of a technology has been made by CRD at this time.

For procurement planning purposes, CRD may structure the final procurement to be independent of the technology deployed ("technology agnostic") as long as it satisfies CRD's strict performance requirements and regulatory standards. Thus the technology decision is not expected to be finalized until completion of the procurement process for one or more WWTPs.

Operational Complexity

Importantly, as the number of WWTPs increases under a distributed management strategy, the number of failure points and complexity of operations management also increases (along with long-term lifecycle costs).

These issues may be mitigated through:

- reduction in number of WWTPs,
- uniform management of operations (a single operator across all WWTPs), and
- standardizations of technologies across WWTPs.

If procurement of WWTPs is phased over multiple years (possibly using successive procurement competitions) the integration of technologies and operations management across WWTPs must be included in the procurement plan.

Wastewater Characteristics

Appendix E contains a summary of wastewater chemistry and constituent concentrations. The only constituent that appears somewhat abnormal is the ratio of dissolved BOD to total BOD, which is above 33% for both dry weather flow and wet weather flow (per PRT 2009).

As noted in PRT 2009, further data gathering and analysis is required to enable effective pre-design work for procurement planning. Proponents require a deep and thorough understanding of water chemistry issues to allow effective planning for design and operations of WWTPs, as well as resource recovery.

Wastewater Regulations

The discharge of treated water to the marine environment as well as the disposal of biosolids residuals generated during the treatment process are regulated by both the Province of British Columbia and the Government of Canada regulations and guidelines. Appendix F contains a summary of relevant wastewater regulations applicable to CRD.

Regulations include the following:

- Provincial Environmental Management Act lists specific requirements for treated effluent under the “Municipal Sewage Regulations” (MSR).
- Effluent discharge to the “open marine” environment requires that secondary treatment (defined as effluent containing no more than 45 mg/L each of cBOD5 and TSS *at any time*) must be provided for all flows up to 2 x ADWF.
- There is flexibility for flows in excess of 2 x ADWF.
- Federal regulations include similar requirements.
- CRD requires a liquid waste management plan to document specific details of treatment level required.
- Reclaimed water requires special approval and monitoring.
- It is possible new regulations for special issues may be introduced over the design horizon of the Program and thus flexibility in technology choice will be required (for example odour controls, microconstituent removal, and nitrogren/phosphorus limitations).

For procurement planning these regulations are not anticipated to pose a problem. All professional engineering firms understand these regulations. It will be important for CRD to (i) establish a clear LWMP with MoE, (ii) obtain flexibility in such LWMPs to allow wet weather flow mitigation plans as well as the integration of new requirements for microconstituents etc., and (iii) ensure permit requirements for resource recovery initiatives are included in such MoE discussions.

Sustainability and Environmental Regulations

The CRD is reviewing the integration of goals and objectives from the following climate change and sustainability legislation into the business case assessment of service delivery options:

- B.C.'s Climate Action Plan
- Living Water Smart Plan
- B.C. Energy Plan
- B.C. Bioenergy Strategy
- B.C. Air Action Plan

Appendix B contains a summary of these regulations deemed relevant to Program. CRD is in discussion with the Province to ensure all key climate plans are included in the planning process for the Program.

From a procurement planning perspective, it is important to note that such climate plans will likely evolve and change over the design horizon of the Program. If CRD enters into a long-term arrangement for operations and maintenance of facilities then agreements must be established to ensure flexibility to meet future climate goals.

Greenhouse Gas Emissions

CRD is developing a GHG management strategy and is committed to the principle of achieving carbon neutrality. CRD has signed the Local Communities Climate Action Charter which pledges communities to:

- Become carbon neutral.
- Measure and report on their community's greenhouse gas emissions profile.
- Work to create compact, more energy-efficient communities.

From a procurement and operations planning perspective, there may be room for CRD to view carbon emissions of the Program in context of the full carbon cycle when planning for carbon neutrality. This would require fossil-fuel generated carbon emissions to be monitored and tracked separately from biogenic carbon emissions (a distinction that will be important when determining CRD's baseline measures of carbon emissions). This approach appears to be in-line with the BC Bioenergy Strategy.

CRD Integrated Resource Management

The CRD understands the Program and associated resource recovery initiatives are being viewed by the Province as a potential model for other jurisdictions to utilize when planning new wastewater projects and broader resource management initiatives. The Program is bigger than basic wastewater treatment.

The following dimensions of CRD's wastewater and associated other infrastructure components are under review by CRD as part of the Program:

1. The main functional components of CRD's wastewater system:
    a. Conveyance trunk sewers, pumping stations and forcemains,
    b. Wastewater treatment plants,
    c. Biosolids Management, and
    d. Marine outfalls.
2. Resource recovery components of the system including:
    a. Wastewater heat energy,
    b. Biosolids energy generation (e.g. methane, biodiesel),
    c. Water reuse,
    d. Flow energy management and pressure energy recovery,
    e. Greenhouse gas management and carbon credits,
    f. Nitrogen and phosphorus recovery, and
    g. Other niche resource recovery applications (e.g. microconstituents).
3. Source-separated wet organics including fats, oils and greases and other source-separated wet organics (e.g. kitchen wastes),
4. Drinking water conservation efforts,
5. Regional source control programs for contaminants entering the wastewater system,
6. Coordinated efforts between client municipalities for reduction of inflow and infiltration of groundwater and rain water into the wastewater collection system, and
7. Plans to reduce usage of septic tanks by unsewered households (particularly on the West Shore).

Capacity requirements and the regulatory framework of the main functional components of the Program were reviewed earlier in this discussion paper. The following sections focus on complimentary aspects of the main functional components of the wastewater treatment system including resource recovery, water conservation and other initiatives being pursued by CRD.

Resource Recovery Options

The CRD has conducted extensive due diligence, planning and analysis into its wastewater management requirements in recent years to ensure compliance with MoE expectations. The CRD and its engineering advisors reviewed a number of innovative wastewater management facilities around the world including 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. The CRD also visited the Swedish communities of Göteborg, Stockholm and Västerås to learn more about energy extraction from liquid and solid waste, the extent and practicality of district heating and various ways that solid and liquid waste-derived biogas is utilized in Sweden.

CRD research into resource recovery options has been documented in a series of discussion papers available in CRD's online archive.

Table 7: Resource Recovery Research Conducted by CRD

Area of Interest	Discussion Paper
Energy from Organics	Biosolids Management / Organic Residuals Energy Resource Recovery - 031-DP-3 Biosolids / Organics Residuals Strategy Evaluation 031-DP-9
Wastewater Heat Energy	Heat Recovery - 031-DP-6
Water Reuse	Water Reclamation and Re-Use - 031-DP-7
Nutrient Recovery	Phosphorus Recovery - 031-DP-5 Urine Separation - 031-DP-8
Other Niche Applications	Flow Energy Management and Pressure Energy Recovery - 031-DP-4
Greenhouse Gas Issues	Methodology to Assess GHG Management Performance - 032-DP-1
Resource Recovery Strategy Assessment	Identification and Evaluation of Resource Recovery Opportunities - 036-DP-1

Resource Recovery Market Sounding

CRD has retained E&Y to conduct an industry market sounding into resource recovery issues. E&Y will work with PBC on this assessment.

A key aspect of the market sounding will be the determination of risk transfer potential for resource recovery implementation projects, and more specifically the appetite for third parties to assume revenue risks related to the sale of resources recovered from wastewater and biosolids.

Source-Separated Wet Organics

Utilization of locally collected organics in the Core Area are under review for integration into interim digester capacity. The organics would predominantly be fats, oil and greases (FOG). The CRD is also considering locating the digesters off-site from the liquid treatment in the industrial area and may include a transfer station and organics digester into the Program.

Garden and yard wastes are anticipated to continue to be composted at homes or at municipal or commercial facilities.

I/I Rehabilitation Across Client Municipalities

The goal of the CRD and its municipal partners is to manage inflow and infiltration in a manner that will minimize total conveyance, treatment and disposal system costs, coincident with reduction of I/I induced overflows to acceptable levels. The joint commitments made by the CRD and participating municipalities to reach the goal, as noted in the LWMP, are as follows:

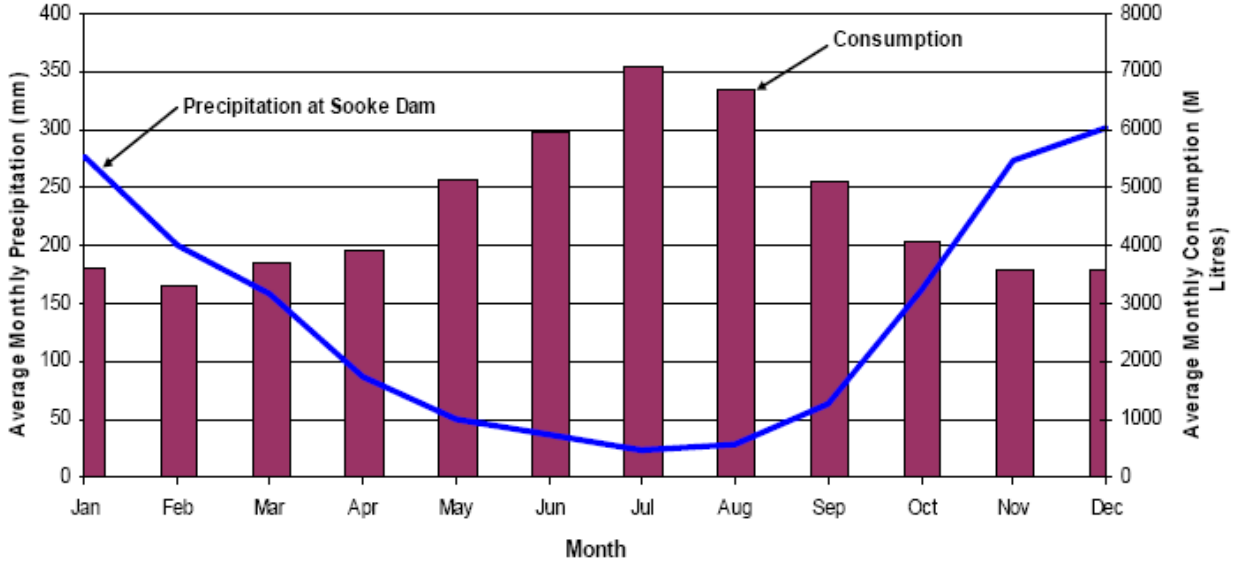
The CRD and the participating municipalities commit to:

- Develop implementation plans for staged reduction of inflow and infiltration over the 25-year life of the Liquid Waste Management Plan.
- Recommend to future councils that they commit funds for I/I reduction that are economically justified by avoidance of future costs to treat and convey inflow and infiltration.
- Measure flows before and after carrying out work on sewers to reduce I/I, to document I/I expenditures and achievements, and to use this information to refine cost benefit curves developed to optimize expenditures.

Potable Water Conservation Efforts & Demand Side Management

The water supply for the Greater Victoria area is comprised of Sooke Reservoir, the Goldstream Reservoirs (Butchart, Lubbe, and Goldstream) and Charters Reservoir plus supporting reservoirs like Fulton. Sooke Reservoir contains 90% of the available total storage capacity and the other sources are for back-up and emergency purposes. The basic principle of operation of the water supply is to collect precipitation runoff in the winter and store it for use during the summer and fall. Storage capacity in Sooke Reservoir is 92.7 Mm3 (20,400 mgal) while the Goldstream Reservoirs can store 9.8 Mm3 (2,150 mgal). Charters Reservoir has a maximum storage capacity of 19,000 m3 (4.2 mgal) the equivalent of 3 days' demand in Sooke.

Figure 5: Average Monthly Precipitation and Consumption of Potable Water in CRD (CRDWATER 2008)



Summer water consumption is a key challenge for CRD. There is a mismatch between water supply and consumption in the region during the summer and winter months with a winter surplus of 1226 mm and a summer deficit of 138 mm (per CLIMATE 2007). In 2002 the CRD increased the level of the Sooke Reservoir by 6 metres which resulted in a 78% increase in storage capacity. This increase is forecast to meet regional demand until approximately 2023.

CRD's 2004 *Strategic Plan for Water Management*[8] outlines key goals for limitations on future expansion of supply of potable water facilities including:

- No expansion of supply until 2023 with current Demand Side Management programs with a rapid growth in demand projection.
- No expansion of supply for 50+ years with current Demand Side Management programs with a slow growth in demand projection.
- Expansion of demand management programs, or of supply capacity, should be based on growth in water demand not on population growth (since water demand is growing at a slower rate than population growth, and per capita consumption levels are falling for both indoor and outdoor water demand).
- Rainwater recycling programs may be economic for intensive agricultural users.
- While in 2004 when the report was commissioned, grey water reuse was deemed uneconomic, technically complex, requiring skilled operators to ensure that public health is not put at risk, the plan concluded opportunities should be sought by CRD to

[8] The plan is available at the CRD website document library: www.crd.bc.ca/reports/water_/index.htm

facilitate installation of grey water recycling systems in the future in both the residential and ICI sectors when the technology becomes more user friendly, reliable and cost effective.

Water Restrictions

CRD has implemented a staged restriction regime for residents during summer months. Stage 1 watering restrictions (lawn watering permitted twice per week), which are implemented each year between May 1st and September 30th, save in the order of about 5% of monthly consumption when in effect. Stage 2 restrictions (lawn watering permitted once per week) save about 15% and Stage 3 restrictions (no lawn watering permitted) save in the order of about 30%. CRD also managed community education and training programs in the areas of water conservation, lawn care, water leak repairs and other water saving strategies.

As documented by Associated Engineering/CH2M Hill in discussion paper 033-DP-2, it is estimated that if aggressive water conservation programs were implemented with residents then wastewater volumes could be reduced by 15% per-capita (assuming a 50% compliance rate). However it is unclear if such programs could be widely implemented across the region during the current design horizon. Furthermore certain programs typically require enforcement or surcharges/incentives to be effective (e.g. low-flow washers and toilets) which is difficult when conventional washers and toilets are readily available throughout the region and surrounding areas.

Table 8: Possible Domestic Per-Capita Volume Reductions for Water Conservation Efforts
(AE et al. 2008-2009, DP-033-2)

Usage Component	"Current" Usage	"Future" Usage	Comments
Toilets	5 flushes/day @ 12L/flush = 60L	5 flushes/day @ 6L/flush = 30 L	Replace typical 12 L/flush toilets with 6 L:/flush models
Clothes Washer	0.37 washes/day @ 155L/wash = 55L	0.37 washes/day @ 50 L/wash = 19L	Replace typical washing machine with CEE Tier 3 Washers (50L/wash)
Baths/Showers	45 L/day	45 L/day	Fixtures difficult to enforce so assume no change
Faucets	41 L/day	41 L/day	Fixtures difficult to enforce so assume no change
Dishwasher	4 L/day	4 L/day	Small usage so ignore
Leaks	16 L/day	16 L/day	
Subtotal	221 L/cap/day	155 L/cap/day	
Assume 50% Compliance	221 L/cap/day	155 L/cap/day	

CRD already offers a financial incentive to residents who replace an old toilet with a more efficient low-consumption toilet. CRD offers all residents, landlords, property managers and plumbers a $75 rebate per bathroom for installing water efficient toilets (using 6 litres or flush or less). The rebate is available to households built before January 1, 2005. Old toilets must be recycled and residents are required to provide such recycling prior to applying for the rebate.

CRD also offers a $100 rebate for residents who purchase a hi-efficiency clothes washing machine (CRD's "Smart Wash" program). This program commenced January 1, 2009. Old washing machines must also be recycled and the program is only available to residential properties (not commercial washing machines).

Reduction of Septic Tanks and Unsewered Households

Working in cooperation with client municipalities and districts, CRD will support initiatives to reduce the number of unsewered households in the region. Septic tanks are a significant source of GHG emissions and thus elimination of such facilities will have a positive impact on CRD's greenhouse gas neutrality goals.

As noted above in Figure 2, a significant land area on the West Shore is currently unsewered.

Service Delivery Strategies

The CRD considered the following main strategies for evaluation of service delivery alternatives:

Strategy 1: Resource Recovery on a Regional Basis

- Three treatment plants for up to 2xADWF located at:
  1. Saanich East
  2. Macaulay Point/McLoughlin Point
  3. West Shore.
- Heat energy recovery opportunity from effluent of all three plants
- Wet weather flow plant for between 2xADWF and 4xADWF located at:
  1. Clover Point
  2. Macaulay/McLoughlin Point.
- Wastewater solids processing and phosphorus recovery at two plants:
  1. Macaulay/McLoughlin
  2. West Shore.
- Biosolids Management – anaerobic digestion with disposal/reuse plans still under review.
- Regional source control programs as described previously under section heading "Liquid Waste Regional Source Control Programs".
- I/I initiatives including extensive flow monitoring and sewer rehabilitation projects (ongoing implementation).
- Water conservation initiatives including watering restrictions, educational programs and financial incentives to reduce consumption of drinking water.
- Plans to reduce septic tanks and unsewered households in Colwood and Langford (such plans led by the municipalities and supported by the CRD).
- Wet organics integration which could be encompassed within an integrated solid waste and liquid waste management plan.

Strategy 2: Resource Recovery on a Combined and Local Basis

- Five treatment plants for up to 2.0 times ADWF located at:
  1. Saanich East
  2. Macaulay Point/McLoughlin Point
  3. Ogden Point
  4. West Shore
  5. Juan de Fuca.
- Heat energy recovery opportunity from effluent of all five plants.
- Wet weather flow plants at Clover Point and Macaulay/McLoughlin Point for between 2xADWF and 4xADWF.
- Wastewater solids processing and phosphorus recovery at Macaulay/McLoughlin
- Biosolids Management – anaerobic digestion with disposal/reuse plans still under review.

- Regional source control programs will be the same as in Option 1.
- I/I initiatives will be the same as in Option 1.
- Initiatives to reduce septic tanks and unsewered households same as in Option 1.
- Water conservation initiatives will be the same as in Option 1.
- Wet organics integration will be the same as in Option 1.

Strategy 3: Resource Recovery on a Local Scale

- Eleven treatment plants.
- Heat energy recovery opportunity from effluent of all 11 plants.
- Wet weather flow plants at Clover Point and Macaulay/McLoughlin Point for between 2xADWF and 4xADWF.
- Wastewater solids processing and phosphorus recovery at:
    1. Macaulay/McLoughlin
    2. Royal Roads.
- Aggressive water recycling at individual buildings.
- Biosolids Management – anaerobic digestion with disposal/reuse plans still under review.
- Regional source control programs will be the same as in Option 1.
- I/I initiatives will be the same as in Option 1.
- Initiatives to reduce septic tanks and unsewered households same as in Option 1.
- Water conservation initiatives will be the same as in Option 1.
- Wet organics integration will be the same as in Option 1.

CRD Preferred Service Delivery Strategy

In a special meeting of the CALWMC on June 2, 2009 the CRD approved moving forward with Strategy 1 on condition of further investigation of a number of components of the strategy including

a. Continued analysis of variation to Strategy 1 (investigation of implementation options for this strategy referred to as Option 1a, 1b and 1c) including an assessment of biosolids integration with solid waste activities and functions.
b. Investigation of a wastewater heat recovery system and delivery mechanism in James Bay.
c. Integration of inflow and infiltration management with appropriate phasing of the wet weather strategy at Clover Point.
d. Relocation of the solids processing from the liquid processing site to allow potential integration with solid waste activities and functions.
e. Further development of the biosolids management plan to reduce operational risks associated with biosolids end uses.
f. Complete siting investigations in Saanich East/North Oak Bay.
g. Investigation of opportunities for heat recovery and water reuse with the University of Victoria.
h. Research the possibility of a single larger site in the event that the McLoughlin Point site is not selected.
i. 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; and
j. Continuation of CRD's assessment of options for sewage treatment in the West Shore by working in cooperation with the Administrators and Engineers of Colwood and Langford.

These issues must be resolved prior to commencing a procurement process to ensure such procurement plans have a clear scope of work, particularly with regard to the biosolids management, heat recovery goals, site selection and West Shore plans.

CRD Service Delivery Options 1a, 1b and 1c

The following service delivery options will be analyzed in detail in the business case. The preferred option will then be reviewed for implementation procurement using a variety of contracting structures to determine which procurement methodology achieves CRD's risk transfer and value for money goals.

Option 1a

This option generally reflects all the assumptions identified by Discussion Paper 036-DP-2 Development of Distributed Wastewater Management Strategies (March 9, 2009) and includes all the aspects of Strategy 1 identified above.

A variety of alternatives for the location of the secondary treatment facilities are under consideration including McLoughlin Point as well as a gravel pit area on the West Shore.

Option 1b

This option assumes a more centralized facility using conventional, high rate non-nitrifying activated sludge treatment instead of MBR. For analysis purposes this option may also use conventional primary clarification rather than chemically-enhanced primary clarification. Such a plan would likely be located on the West Shore and would convey 2 x ADWF from the east service area via an underwater pipeline to the treatment facilities.

Intermittently operated high rate treatment facilities for wet weather flow events would remain at Macaulay Point and Clover Point for flows over 2 x ADWF.

The Saanich East plant would still be built in this option.

Option 1c

This option consolidates treatment facilities on the West Shore. All treatment for up to 4 x ADWF would be located on the West Shore in a single facility. Flows up to 4 x ADWF would be pumped from Macaulay Point and Clover Point to the West Shore via underwater pipeline.

Intermittently operated treatment facilities at Macaulay Point and Clover Point would be eliminated in this option.

The Saanich East plant would still be built in this option.

Procurement Planning

The CRD is embarking on an enormous procurement project – in terms of scale, scope and cost. Substantial progress has been made in recent years to clarify engineering, technical and resource recovery issues, and these issues are summarized in the following table.

Detailed Procurement Planning Issues

Looking beyond the business case and funding approvals, CRD is conducting work to ensure the Program moves forward successfully into the procurement phase. This table summarizes such issues and CRD's ongoing work.

Table 9: CRD Procurement Planning Issues

Issue	Current CRD Plans to Mitigate/Manage Issues During Procurement Implementation
1. Phasing and packaging of WWTPs during procurement and the structuring of funding plans as part of the phasing and packaging strategy	Subsequent analysis will review phasing and packaging options for procurement planning.
2. Selection of sites for WWTPs	As documented earlier in this discussion paper the site selection process is ongoing. Challenges have been identified for the Macaulay Point site, Clover Point site and McLoughlin site. Extensive public consultation is required for any site selected. Site selection will have a material impact on the cost of the project (since site limitations will influence WWTP technology choices as well as the level of biosolids processing on-site). Such issues are under review.
3. Selection of site for biosolids facility	This issue is under review. CRD is assessing the benefits/costs/risks of centralizing the biosolids facility versus having more treatment on-site at each WWTP.

	Centralizing the biosolids facility typically provides opportunities for resource recovery efficiencies however delivering such resources to end-users can be challenging since few people live near such facilities. Trucking of biosolids from the WWTPs to a centralized facility is an issue for effected municipalities within CRD. The impact of GHGs from such activities must also be considered.
4. Level of integration of biosolids processing and reuse on-site with WWTPs versus level of centralized processing offsite	CRD and its engineering advisors are reviewing the level of biosolids processing on-site at each WWTP. Floor area limitations on certain sites will limit the amount of on-site processing for some locations.
5. Operations/management integration of biosolids processing facilities with WWTP operations/management	This issue is under review. If CRD allows a different operator for WWTPs and the biosolids facility then either CRD must manage the interface risks between the parties or CRD must define the procurement to ensure the parties (WWTP operators and biosolids treatment plant operators) establish a clear commercial contracting arrangement whereby CRD risk is reduced. Clearly the latter approach is preferred.
6. Procurement of Resource Recovery Dimensions of Program	CRD is reviewing how the various resource recovery components of the Program can be procured to best achieve CRD's risk transfer goals. This may include treating such components as separate "building blocks" as suggested in PRT 2009. Separating such components would allow flexible partnering and financing structures to be established for each that are somewhat independent of the overall Program.

	One option under consideration is the use of a "base case" bid scope during procurement combined with the flexibility of bidders to submit "alternative bids" including innovative resource recovery technologies (as long as such alternative proposals meet CRD's specified resource recovery and risk transfer goals).
7. Revenue risks associated with resource recovery initiatives	If the actual value of various resource recovery initiatives is less than estimated in prior discussion paper analysis, how will this impact CRD? How can CRD mitigate this risk? This issue will be further investigated in an industry market sounding consultation.
8. Flexibility of WWTPs and biosolids facility to accommodate future technological innovations	CRD appreciates the importance of flexibility for WWTP planning and recourse recovery – both today and in future during the planning horizon of the project. Site size limitations may undermine this goal on certain sites.
9. Partnering strategies for CRD for resource recovery	CRD is reviewing its partnering strategy for resource recovery and other aspects of the Program. CRD's risk preference and risk transfer goals will influence this decision.
10. Capacity planning and design horizon considerations for WWTPs and conveyance system	This is a critical issue and will be clarified by CRD. When implementing the "just in time" approach to capacity planning, the plan must contemplate ability for CRD to scale both existing plant/equipment/technology and also to expand facilities as eventually needed.

11. Integration of CRD operations of conveyance system with the overall management of WWTPs	CRD has stated it will continue to manage conveyance, pumping stations and forcemains in the new Program. The interface between conveyance system operations and WWTP operations in the new Program must be managed.
12. Regulatory flexibility for wet weather flow allowance for Clover Point discharge and other locations	CRD has identified certain cost saving opportunities related to the Clover Point site and management of peak wet weather flows. Permitting flexibility is required to implement such plans including sufficient time for the I/I program to become effective in reducing flows.
13. Update of I/I estimates based upon research by KWL in multiple other jurisdictions on infrastructure deterioration rates	I/I investigations will be an ongoing issue at CRD for many years. CRD to provide clarification of overflow rates and volumes during wet weather events (particularly in the Clover catchment area). Oak Bay will separate their two combined sewer systems.
14. Impact of new Trent pump station on flow rates and design flow requirements	CRD's capacity requirements and peak flow estimates will be updated to reflect the impact of the new Trent Street pumping station.
15. Further details on water chemistry and constituent concentrations will allow more detailed planning and pre-design work	Current data is sufficient for business case purposes, however additional diligence would be extremely helpful for the actual procurement phase.
16. Back-up biosolids management plans	CRD is reviewing biosolids disposal plans including cement kiln fuel applications and use as fertilizer for a willow coppice. CRD is also investigating back-up alternative biosolids management plans in case such

	applications are not available in the long-term. Given the flexibility required for future biosolids management it is likely CRD will use thermophillic anaerobic digestion of solids prior to disposal/reuse to improve disposal options.
17. Willow Coppice land access	Clarification is required of the willow coppice plans. Access and ownership of such lands to be reviewed including the possibility of obtaining a license to use such lands for biosolids disposal.
18. Impact on employment in the region	CRD is reviewing the impact of the Program on employment reviewing both the construction phase and the operations phase.
19. Integration of West Shore requirements	The West Shore is growing faster than other parts of the region and has unique needs. Management of such needs in the Program are under review.

References

1. CRD, 2000. Capital Regional District Core Area Liquid Waste Management Plan, Stage 3, July 2000.

2. MoE, 2006. Letter dated July 21, 2006 to the Capital Regional District from the Minister of Environment.

3. MoE 2007. Letter dated December 14, 2007 to the Capital Regional district from the Minister of environment.

4. SETAC, 2006. Scientific and Technical Review, CRD Core Area LWMP, Society of Environmental Toxicology and Chemistry North America, Capital Regional District, July 12, 2006.

5. AE 2006. *The Path Forward*, April 30, 2007 prepared for the CRD by Associated Engineering (BC) Ltd.

6. AE et al. 2008-2009. Discussion Paper numbers 030-1 to 030-9, 032-1, 033-1 to 033-3, and 036-1.

7. KWL 2008. *Vulnerability of Vancouver Sewerage Area Infrastructure to Climate Change*, Kerr Wood Leidal Associates Limited, March 2008.

8. CRD 2009. CRD-published discussion paper "*Cost versus Benefit of Reducing Inflow and Infiltration*", March 2009.

9. EY 2008. Market Sounding & Stakeholder Consultation, April 2008, prepared by Ernst & Young Orenda Corporate Finance Inc.

10. PRT 2009. Peer Review Team Report, May 6, 2009.

11. CLIMATE 2007. *From Impact to Adaptation: Canada in a Changing Climate 2007*. A report prepared by Lemmen et al for the Federal Government, 2007.

12. CRDWATER 2008. *Water Use and Conservation Update* report produced by CRD in April 2008.

APPENDIX A

RECENT HISTORY AND DIRECTION FROM THE MINISTRY OF ENVIRONMENT

As previously documented by Associated Engineering Ltd. (AE, 2006), the current LWMP utilizes a "target based" approach using marine environmental indicators to assist in the determination on the requirement for wastewater treatment upgrades (CRD, 2000). In 2004, the CRD approached the Society of Environmental Toxicology and Chemistry (SETAC) to carry out an independent review of the Core Area LWMP. The SETAC Panel completed their report in July 2006. The Panel acknowledged the benefits of treatment and suggested additional wastewater treatment was essentially a risk management decision for CRD.

During the same period, the Ministry of Environment retained MacDonald Environmental Services Ltd. (MESL) to evaluate the sediment quality data associated with the two major outfalls at Macaulay Point and Clover Point. The study found that, based on the available monitoring data, contamination at the two outfalls is sufficient to warrant preliminary designation as contaminated sites under the Provincial Contaminated Sites Regulation. The study also showed that water quality guidelines are not being met outside of the initial dilution zone at Macaulay Point (MoE, 2006).

Based on the above two reports, in a letter dated July 21, 2006 the Minister of Environment requested the CRD provide an amendment to the Core Area LWMP, detailing a fixed schedule for the provision of wastewater treatment (MoE, 2006). In the letter, the Minister encouraged the CRD to consider new technologies and alternative financing and delivery options in order to ensure value for the taxpayers.

In a subsequent letter from the Minister of Environment dated December 14, 2007, the Minister acknowledged the work completed to date by CRD and identified six specific objectives of stakeholders in the project:

1. Meet the regulatory standard for liquid waste,
2. Minimize total project cost to the taxpayer by maximizing economic and financial benefits, including beneficial reuse of resources and generation of offsetting revenue,
3. Optimize the distribution of infrastructure based on number 2 above,
4. Aggressively pursue opportunities to minimize and reduce greenhouse gas (GHG) emissions (e.g., reduced requirement of energy for pumping purposes and beneficial reuse of energy),
5. Optimize 'smart growth' results (e.g., district services, density, 'Dockside Green' like innovation), and

6. Examine the opportunity to save money, transfer risk and add value through a public private partnership.

The Minister also requested a business plan demonstrating how to achieve these objectives plus an amendment to the LWMP documenting the following:

1. Decisions on the selected physical infrastructure model, selected resource recovery options and P3 approach (including supporting rationale) to demonstrate the above principles;
2. Identifying the site locations for sewage treatment facilities;
3. The results of environmental impact studies for each sewage facility (site assessment);
4. The results of environmental impact studies for each new discharge location;
5. Draft operational certificates for each sewage treatment facility/discharge location;
6. Class B detailed capital and operating costs to implement the plan, and costs per user, both with and without government funding; and
7. Consultation summary reports (public and First Nations).

On July 20, 2008 the Minister granted additional time to CRD to prepare the business plan and LWMP amendment so that work on integrated resource management, green house gas reduction, smart growth and resource recovery plans could be included in the wastewater treatment strategy as well as allowing additional time for First Nations and public consultations.

CRD has submitted a number of status reports to the Ministry of Environment over this period to ensure the Minister remains informed of CRD's progress.

APPENDIX B

SUSTAINABILITY AND ENVIRONMENTAL LEGISLATION

The CRD is reviewing the integration of goals and objectives from the following climate change and sustainability legislation into the business case assessment of service delivery options.

B.C.'s Climate Action Plan

Phase One of this plan was released on June 26, 2008. It outlines a set of comprehensive strategies and initiatives to reduce GHGs. The plan is based upon four key pillars:

- Firm targets for reducing GHGs.
- Policy measures to reduce carbon emissions including a revenue-neutral carbon tax, participating in regional cap-and-trade systems, emission standards on vehicles, landfill gas emission standards, fuel standards, and green community development.
- Strategies to assist BC communities adapt to the effects of climate change.
- Education and public awareness programs.

Specific components of the Climate Action Plan being reviewed for use by CRD during the evaluation of options and implementation of the Program include the following:

- **Carbon Neutrality**. CRD is committed to the principle of carbon neutrality. Details on GHG legislation and CRD plans are below.
- **Green Building Code**. On April 15, 2008, the government announced new Building Code requirements to increase energy and water efficiency. Commercial buildings must meet American Society of Heating, refrigeration and Air-Conditioning Engineers 90.1 (2004) standard. ASHRAE 90.1 is an internationally recognized standard for energy efficiency in buildings.
- **Water Efficiency**. Use of low-flow toilets (6 L) and other water-saving plumbing fixtures and fittings will become mandatory in BC for new construction and renovation projects. Other areas under review include greywater recycling.
- **Community Growth Plans**. New legislation requires local and regional growth plans to include GHG emission reduction targets, policies and actions. Local jurisdictions are encouraged to enable use of development cost charges to encourage more sustainable development and GHG reductions using new technologies.
- **Independent Projects**. Encouraging green developments that are self-sufficient and independent of municipal services (e.g. Dockside Green).
- **Landfill Waste Disposal**. A variety of initiatives are suggested under the Climate Action Plan including:
  - Keeping organic waste out of landfills. Using composting and diversion programs. CRD has an existing diversion program (described elsewhere in this discussion paper).

- Turning Waste into Energy. Capturing methane from landfills to generate electricity (which can be sold to BC Hydro) also directly reduces GHGs. Hartland Landfill has been successfully implementing this program for several years and has won awards for its initiatives.
- Composting. Using organic wastes for energy generation or composting by households.
- Packaging Controls and Source Reduction. Working with manufacturers to use more responsible packaging and other wastes created by their products, CRD has also recently implemented an e-waste program.
- BC Bioenergy Programs. The Climate Action Plan supports biofuel production using wastes as a way to also offset GHG production.

Appendix A of the Climate Action Plan includes a number of specific measureable targets that may be relevant to the implementation of the Program. CRD has identified the following specific items its believes require further assessment for integration into Program planning:

- Interim GHG targets in 2012 and 2016.
- All electricity produced in B.C. will be required to have net-zero greenhouse gas emissions by 2016.
- New cars purchased may be hybrids.
- New Green Cities Project will foster innovations that reduce our imprint on the planet through sustainable community planning.
- Province will work with the CRD and Union of BC Municipalities and the private sector to develop new incentives to encourage smaller lot sizes and smaller, more energy efficient homes that use less land, less energy, less water, and are less expensive to own.

Greenhouse Gas Emissions and Carbon Neutrality

CRD is developing a GHG management strategy and is committed to the principle of achieving carbon neutrality. The Integrated Resource Management Strategy identified a number of areas where GHG impacts of the Program are significant and should be managed. These include:

- Biosolids management and organic residuals energy recovery. There is a significant amount of energy contained in sludges and organic wastes from the solid waste stream. Such energy is often captured in the form of methane from anaerobic treatment of biosolids. Capturing such energy could off-set the use of other fossil-fuel based carbon sources (e.g. natural gas). Furthermore, some service delivery options require a significant amount of energy to transport materials from the WWTP to landfill or other applications, which in turn generate GHGs during transportation.
- Heat recovery from wastewater is another area of interest with a significant impact on the GHG strategy. Again, such heat generation could be used to offset fossil-fuel based carbon energy sources. The challenge for CRD is to ensure such efforts are feasible in moderately warm climate like the Victoria area.

There may be room for CRD to view carbon emissions of the Program in context of the full carbon cycle when planning for carbon neutrality. This would require fossil-fuel generated carbon emissions to be monitored and tracked separately from biogenic carbon emissions (a distinction that will be important when determining CRD's baseline measures of carbon emissions). This approach appears to be in-line with the BC Bioenergy Strategy described below.

The Province passed Bill 44 – *2007 Greenhouse Gas Reductions Target Act* in November 2007 and it came into effect January 1, 2008. Bill 44 – 2007 is the first of its kind in any North American jurisdiction to target greenhouse gas emissions in large public sector organizations. It requires Provincial school districts, colleges, universities, health authorities, government ministries, agencies and Crown corporations to be carbon neutral by 2010. By 2020, GHGs in such public sector organizations must be at least 33 per cent below 2007 levels, and 80% below 2007 levels by 2050. The Bill 44 – 2007 definition of carbon neutrality captures two key themes: (i) minimizing GHG emissions, and (ii) reducing net GHG emissions through emission offsets.

Bill 44 – 2007 does not presently contain GHG emission reduction targets for local governments outside of the Provincial government.

The Province has also tabled Bill 31 – *2008 Greenhouse Gas Reduction (Emissions Standards) Statutes Amendment Act*, 2008. This legislation, if and when enacted, would give the Province the means to develop regulations that could include specific reduction targets for GHG emissions from waste management facilities that could include wastewater management systems.

The Province has issued a *Landfill Gas Regulation Policy Intentions Paper for Consultation* (May 2008) that focuses on GHG emissions from landfill operations, where this regulation is intended to come into effect in 2009. However, nothing similar for wastewater systems has been proposed by the Province at this time.

Local Communities Climate Action Charter

CRD has signed the Local Communities Climate Action Charter which pledges communities to:

- become carbon neutral,
- measure and report on their community's greenhouse gas emissions profile, and
- work to create compact, more energy-efficient communities.

Living Water Smart Plan

Living Water Smart is the Provincial government's vision and plan to manage natural water resources over the long-term. The plan draws on a variety of policy 'tools' including planning, regulatory change, education, and economic incentives.

The following goals from the BC Living Water Smart plans are under review by CRD.

Doing Business Differently

Criteria	Usage by CRD in Program
1. By 2012, all land and water managers will know what makes a stream healthy, and therefore be able to help land and water users factor in new approaches to securing stream health and the full range of stream benefits.	CRD has ongoing educational projects for staff and public. Ongoing. No specific measurement criteria to be used in Program.
2. By 2012, water laws will improve the protection of ecological values, provide for more community involvement, and provide incentives to be water efficient.	Under review.
3. Government will require all users to cut back their water use in times of drought or where stream health is threatened.	CRD is already a leader in such initiatives. This criteria will not be used by CRD for Program evaluation.
4. Government will support communities to do watershed management planning in priority areas.	Under review.
5. By 2020, water use in British Columbia will be 33 percent more efficient.	This is an important goal for the Province and is under review for implementation by CRD.

Preparing Communities for Change

Criteria	Usage by CRD in Program
6. By 2012 new approaches to water management will address the impacts from a changing water cycle, increased drought risk and other impacts on water caused by climate change.	CRD is already implementing such planning.
7. Government will work with other provinces to share ideas and resources to improve water conservation and collectively help communities adapt to climate change.	Not relevant to CRD, however CRD actively works with other jurisdictions in both Canada and the USA to share experiences with resource management and water management.
8. Community development strategies will	Under review. CRD has already identified

be developed to recognize the importance of riparian zones (interface between land and stream) in adapting to climate change.	marine shoreline issues that must be managed at Macaulay Point.
9. Adapting to climate change and reducing our impact on the environment will be a condition for receiving provincial infrastructure funding.	As noted in this discussion paper, CRD is committed to the principle of carbon neutrality.
10. Green developments waiting for provincial environmental approvals will be fast-tracked and given priority.	Under review.
11. Government will develop new protocols for capital planning that will look at the lifecycle costs and benefits of buildings, goods and services.	CRD is using a lifecycle cost analysis in the evaluation of Program options.

Choosing to be Water Smart

Criteria	Usage by CRD in Program
12. Fifty percent of new municipal water needs will be acquired through conservation by 2020.	This is an important goal for the Province and is under review for implementation by CRD.
13. Government will look at new ways to help promising water conservation technology succeed.	CRD has been proactive in such reviews (see resource recovery discussion papers).
14. The Green Building Code will require water conservation plumbing fixtures such as low flush toilets.	CRD already implements such policies.
15. By 2010, government will mandate purple pipes in new construction for water collection and re-use.	Under review.

B.C. Energy Plan

The BC Energy Plan is designed to make the Province energy self-sufficient by 2016 while taking into consideration the natural environment and climate impacts. It includes both conservation efforts as well as use of innovative clean energy technologies. It aims to provide BC with secure, reliable and affordable long-term energy supplies.

Appendix A of the BC Energy Plan includes a summary of 55 policy actions under consideration by the Provincial government. Most such policies are specific to senior levels of government, however the following are under review by CRD for application to the Program:

- Implementation of energy efficiency standards for new buildings by 2010.
- New provincial public sector buildings will be required to integrate environmental design to achieve the highest standards for greenhouse gas emission reductions, water conservation and other building performance results such as a certified standard.
- Increase the participation of local governments in the Community Action on Energy Efficiency Program and expand the First Nations and Remote Community Clean Energy Program.
- All new electricity generation projects will have zero net greenhouse gas emissions.
- Ensure the procurement of electricity appropriately recognizes the value of aggregated intermittent resources.
- Work with BC Hydro and parties involved to continue to improve the procurement process for electricity.

B.C. Bioenergy Strategy

Bioenergy is energy derived from organic biomass sources – such as trees, agricultural crops, food processing and agricultural wastes and wastewater. As noted in the BC Bioenergy Strategy, biomass such as organic waste, wood residues and agricultural fibre is considered clean or carbon neutral when used as energy because it releases no more carbon into the atmosphere than it absorbed during its lifetime. This recognizes the carbon cycle of organic wastes, including wastewater, and differentiates fossil-fuel based carbon sources from biogenic sources. When biomass is used to replace non-renewable sources of energy, bioenergy reduces the amount of GHGs released into the atmosphere.

Many aspects of CRD's resource recovery efforts revolve around utilization of biomass for various initiatives – from syngas to energy generation.

B.C. Air Action Plan

The goal of this plan is to improve air quality across BC. The plan focuses on clean transportation, clean industry and clean community planning. It focuses on particulate matter (PM) pollutants released into the atmosphere through burning of wastes or through secondary impacts from chemical reactions resulting from wastes burning (especially nitrogen dioxide, sulphur dioxide, solvents, gasoline, and ammonia).

CRD is in discussion with the Province to determine aspects of this plan relevant to the Program.

APPENDIX C

POPULATION AND SOURCE VOLUME ESTIMATES

Discussions Paper 033-DP-1: Wastewater Flow Management Strategy – Existing and Future Populations, ICI Equivalents, and I/I is hereby incorporated by reference.

This discussion paper may be found at:

www.WastewaterMadeClear.ca

www.wastewatermadeclear.ca/media/archived-documents

APPENDIX D

DESIGN FLOW TABLES

Discussions Paper 033-DP-2: Design Flow Tables is hereby incorporated by reference.

This discussion paper may be found at:

www.WastewaterMadeClear.ca

www.wastewatermadeclear.ca/media/archived-documents

APPENDIX E

WATER CHEMISTRY AND CONSTITUENT CONCENTRATIONS

These tables have been sourced from the Peer Review Team Report (final), dated May 6, 2009 (PRT 2009).

Table E-1: Clover Point Wastewater Constituent Concentrations
(PRT 2009)

Constituent	Average (mg/L)		Std Deviation (mg/L)	
	DWF	WWF	DWF	WWF
TSS	159	149	52.6	92.8
VSS	142	139	43.8	44.1
BOD tot	205	157	58.6	59.3
BOD diss	74.0	54.8	34.2	23.9
TKN tot	38.6	27.6	5.8	6.8
TKN diss	30.8	21.4	4.3	4.9
NH3-N tot	25.4	21.2	3.5	4.6
NH3-N diss	na	14.8	na	4.5
Alk-as CaCO3	144	151	37.1	28.8
P tot	5.71	3.64	1.34	1.15
P diss	na	2.08	na	0.82

[a] Constituent concentration data obtained between August 21 and September 6 2008 for the DWFs, and between January 4 and February 16, 2008 for WWFs

Table E-2: Macaulay Point Wastewater Constituent Concentrations
(PRT 2009)

Constituent	Average (mg/L)		Std Deviation (mg/L)	
	DWF	WWF	DWF	WWF
TSS	194	186	52.3	113
VSS	166	175	52.1	101
BOD tot	239	160	64.2	42.5
BOD diss	82.8	53.8	40.7	20.1
TKN tot	47.1	42.0	6.49	9.68
TKN diss	36.4	33.8	4.82	6.75
NH3-N tot	32.0	33.3.28	4.32	6.15
NH3-N diss	na	27.1	Na	7.04
Alk-as CaCO3	174	245	20.0	63.0
P tot	6.97	4.33	1.22	1.30
P diss	na	2	na	0.91

[a] Constituent concentration data obtained between August 21 and September 6 2008 for the DWFs, and between January 4 and February 16, 2008 for WWFs

Table E-3: Constituent Mass Loading Rates at Macaulay and Clover Points
(PRT 2009)

Constituent	Macaulay Point (kg/d)		Clover Point (kg/d)	
	DWF	WWF	DWF	WWF
TSS	7820	9780	8470	8760
VSS	6690	9210	7570	8170
BOD tot	9630	8420	10930	9230
BOD diss	3340	2830	3940	3220
TKN tot	1900	2210	2060	1622
Alk-as CaCO3	7010	12890	7680	8880

[a] Constituent concentration data obtained between August 21 and September 6 2008 for the DWFs, and between January 4 and February 16, 2008 for WWFs

APPENDIX F

WASTEWATER REGULATIONS

The discharge of treated water to the marine environment as well as the disposal of biosolids residuals generated during the treatment process are regulated by both the Province of British Columbia and the Government of Canada regulations and guidelines.

The discharge guidelines suggested by the Province will require the equivalent of secondary treatment for CRD's wastewater by 2016 prior to discharge to the marine environment.

As described in PRT 2009 and paraphrased here:

Provincial Regulations

- Provincial Environmental Management Act lists specific requirements for treated effluent under the "Municipal Sewage Regulations" (MSR).
- Effluent discharge to the "open marine" environment requires that secondary treatment (defined as effluent containing no more than 45 mg/L each of cBOD5 and TSS *at any time*) must be provided for all flows up to 2 x ADWF.
- Thus these target values should be interpreted as values that are never to be exceeded, regardless of the type or frequency of sample taken.
- If flows in excess of 2 x ADWF occur more than once every five years, a waste management plan or specific study must be undertaken to determine what treatment level is recommended for such occurrences.
- If the high flow does not occur more frequently than once every five years, then the equivalent of primary treatment is acceptable for that high flow period.
- In the CRD system, flows in excess of 2 x ADWF do occur more frequently than once every five years and therefore a LWMP is required.

Permitted Uses and Standards for Reclaimed Water

- Schedule 2 of the MSR lists "treatment requirements", "effluent quality requirements", and "monitoring requirements" for treated wastewater that is intended to be used as reclaimed water for a variety of end uses, including public access locations (parks, golf courses etc.) and restricted access locations (irrigation of orchards, commercial food crops, silvculture, industrial applications etc.)
- The specific treated effluent constituents listed are pH, cBOD5, TSS, fecal coliform organisms and some general conditions (e.g. set-backs). Any such uses being contemplated by the CRD will have to comply with Schedule 2.

Biosolids Regulations

- Biosolids regulations entitled "Organic Matter Recycling Regulation" have been issued under the Environmental Management Act and the Health Act.
- The regulations provide for two classes of biosolids, Class A and Class B, whose characteristics are summarized in Table 7 (below).
- Class A biosolids are processed to a higher degree than Class B biosolids, thus having a much lower pathogen concentration in the finished product and therefore have much less restrictive handling and land application requirements.
- The Organic Matter Recycling Regulation also specifies requirements for Classes A and B compost as well as the maximum allowable metal concentrations in biosolids, compost and soils following land application.

Table 6: Summary of Biosolids Classifications Requirements in BC's Organic Matter Recycling Regulations
(PRT 2009)

Characteristic	Class A Biosolids	Class B Biosolids
Pathogen Reduction Requirements	<1,000 MPN per gm (dry solid basis) to be produced by one of the pathogen reduction processes listed below	<2,000,000 MPN per gm (dry solids basis) or one of the pathogen reduction processes listed below
Acceptable Processes for Pathogen Reduction	Thermophilic aerobic digestion at ≥55° for at least 30 min	Aerobic digestion with mean cell retention time between 40 days at 20°C and 60 days at 15°C
	Thermophilic anaerobic digestion at ≥50° for at least 10 days	Anaerobic digestion with a mean cell retention time between 15 days at 35°C and 60 days at 20°C
	Exposure to time-temperature processing requirements according to arithmetical formulae given in the regulation depending on the total solids concentration of the biosolids	Air drying for >3 months, during which the ambient temperature must be >0°C for at least 2 months
	Alkaline stabilization by maintaining the pH within the biosolids >12 for 72 hours during which T >52°C for 12 hours followed by air drying to >50° total solids concentration	Lime stabilization such that the pH of the biosolids is raised to ≥12 after 2 hours of contact
Vector Attraction Reduction Requirements	Aerobic or anaerobic digestion resulting in >38% destruction of volatile solids mass or another acceptable criterion specified in the Regulation	Aerobic or anaerobic digestion resulting in >38° destruction of volatile solids mass or another acceptable criterion specified in the Regulation

Federal Regulations

The Canadian Council of Ministers of the Environment (CCME) is comprised of the environment ministers of the federal, provincial and territorial governments. On February 17, 2009 the CCME endorsed a Canada-Wide Strategy for the Management of Municipal Wastewater Effluent, known as "the CCME Strategy". The CCME Strategy establishes National Performance Standards to be considered minimum performance requirements for effluent quality from all municipal, community and government wastewater facilities that discharge municipal wastewater effluent to surface water. Standards relevant to CRD are expected to be:

- cBOD5 ≤25 mg/L (monthly average of at least five samples per week)
- TSS ≤25 mg/L (monthly average of at least five samples per week)
- Total residual chlorine ≤0.02 mg/L (testing is required only if chorine is used as a disinfectant in the treatment facility; testing to be done three times per day if required)

Other Regulations

Several other regulations may evolve during the design horizon of the Program and should be considered in design planning:

- Microconstituents. Microconstituents include hundreds of compounds, which encompass endocrine disrupting compounds, pharmaceutically-active compounds and Personal Care Products.
- Nitrogen and Phosphorus Limits of Treatment. Limits for these compounds are more likely to be required for discharge to fresh water environments before marine environments.
- Odour Emissions. Neither the BC Municipal Sewage Regulation nor the Organic Matter Recycling Regulation include specific requirements for odour control at this time.

APPENDIX G

GLOSSARY

These definitions are taken the Municipal Sewage Regulations as well as AE et al 2008-2009 discussion papers prepared by CRD's engineering advisors Associated Engineering Ltd. and CH2M Hill.

"**Average Annual Flow**" or "**AAF**" – an estimate of the total flow at a given site for an entire year, including both dry and wet periods.

"**Average Domestic Flow**" or "ADF" – the average flow coming purely from the "Total Population Equivalents", i.e. excludes all sources of I&I.

"**Average Dry Weather Flow**" or ADWF means the daily municipal sewage flow to a sewage facility that occurs after an extended period of dry weather such that the inflow and infiltration has been minimized to the greatest extent practicable and is calculated by dividing the total flow to the sewage facility during the dry weather period by the number of days in that period.

"**Biosolids**" means inorganic or organic solid residuals from a sewage facility, or septic tank sludge, resulting from a municipal sewage treatment process which has been sufficiently treated to reduce vector attraction and pathogen densities, such that it can be beneficially recycled.

"**BOD**" biochemical oxygen demand.

"**cBOD5**" carbonaceous 5-day biochemical oxygen demand.

"**CEPT**" chemically-enhanced primary treatment.

"**Effluent**" means the liquid resulting from the treatment of municipal sewage;

"**ICI Equivalents**" or "**ICI**" – an estimate of the contribution of flow from industrial, commercial, and institutional activities, expressed as a number of fulltime residential population equivalents.

"**Inflow & Infiltration**" or "**I/I**" means water that enters the sanitary sewer system from direct stormwater connection (inflow) or indirectly through the land (infiltration), or both. Can be expressed as a return period based value (i.e. 25-Year Return I&I).

"**Microconstituents**" include hundreds of compounds, which encompass endocrine disrupting compounds (EDC's), pharmaceutically-active compounds (PhAC's) and Personal Care Products (PCP's). These compounds are typically present in raw wastewater at ng/L to ug/L concentrations, 5 to 6 orders of magnitude less than the concentration of conventional pollutants.

"**Peak Domestic Flow**" or "PDF" – the peak flow coming purely from the "Total Population

Equivalents", i.e. excludes all sources of I&I. Expressed as a short duration average, (i.e. 15-minutes), suitable for use in hydraulic design.

"**Peak Dry Weather Flow**" is the peak daily flow that usually occurs once in the morning and then again in the evening.

"**Peak Wet Weather Flow**" is the peak flow rate that occurs at the height a rainfall or snowmelt event. "**PWWF**" = PDF + I&I. Expressed as a return period based value (i.e. 25-Year Return PWWF).

"**Per-Capita Rate**" – the average flow associated with each "Total Population Equivalent", expressed as L/pe/day.

"**Primary Treatment**" means any form of treatment, excluding dilution, that consistently produces an effluent quality with a BOD5 not exceeding 130 mg/L and TSS not exceeding 130 mg/L.

"**Septic Tank**" means a watertight vessel into which municipal sewage is continually conveyed such that solids within the municipal sewage settle, anaerobic digestion of organic materials occurs and an effluent is discharged;

"**Sewage**" or "**Base Sanitary Flow**" refers to water that is contaminated with waste matter of domestic, commercial, industrial, or natural origin. The average person uses almost 225 liters of water per day performing routine activities such as bathing, recreation and body waste elimination.

"**Secondary Treatment**" means any form of treatment, excluding dilution, that consistently produces an effluent quality with a BOD5 not exceeding 45 mg/L and TSS not exceeding 45 mg/L, except for lagoon systems for which the effluent quality is not to exceed a BOD5 of 45 mg/L and a TSS of 60 mg/L.

"**Total Population Equivalents**" = "Residential Population" + "ICI". Also known as "**Contributory Population Equivalent**" means the number of persons and equivalent commercial and industrial contribution connected to the municipal sewage collection system based on the most current census data.

"**Tributary Area**" or "Area" – the estimated sewered land area associated with a catchment.

"**TSS**" means total suspended solids or non-filterable residue.

"**WWTP**" wastewater treatment plant.