Appendix 1

Capital Regional District

Core Area Wastewater Treatment Program

Business Case

September 7, 2016

Making a difference...together

partnerships British Columbia

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PURPOSE

The purpose of this document is to summarize the approach to the analysis and findings of the Capital Regional District's (CRD) Project Board (the Project Board), team of advisors, and Partnerships BC that led to the recommendation to proceed with the Core Area Wastewater Treatment Program as defined in this report.

1 EXECUTIVE SUMMARY

1.1 RECOMMENDATION

The recommended Core Area Wastewater Treatment Program (Program) responds to the needs of the region by providing tertiary sewage treatment for the Core Area by 2020, with a revised design that is intended to be responsive to the interests of the surrounding community and neighbourhoods. The Program includes a process to develop an integrated resource management solution for the region's waste. It also includes a commitment to advance studies for a wastewater treatment proposal in Colwood.

Wastewater Treatment

1. The CRD build a single 108 megalitre/day wastewater treatment plant (WWTP) for the secondary and tertiary treatment of wastewater on the site owned by the CRD at McLoughlin Point in Esquimalt, and submit for approval to the Ministry of Environment an amendment to the Liquid Waste Management Plan to that effect.

2. The CRD proceed with the procurement of the WWTP on the basis of a revised design from the developer identified in the competitive procurement process of 2013/2014; the revised design aligns with existing zoning and design guidelines and is responsive to what the Project Board understands to be the concerns of Esquimalt. The schedule anticipates reaching a final agreement with the developer by January 2017. The agreement would include a schedule for the Plant to be in operation by December 2020 to comply with federal law.

3. The CRD operate the WWTP, as it does other wastewater treatment facilities in the CRD.

4. The developer participate in the municipal development permit process and an allowance of $5 million be included in the Program budget to accommodate any recommendations to alter the exterior of the WWTP building or landscaping that may arise during the permit process.

5. The CRD enter into an agreement to lease Rock Bay in Victoria from the Esquimalt and Songhees First Nations for use by the contractor during construction for a laydown area, to facilitate barging to the WWTP site, reducing the impact of construction in Esquimalt.

6. The WWTP incorporate amenities valued at approximately $20 million, including an annual payment to Esquimalt of $55,000 or equivalent value.

7. The CRD commit to advance studies for a wastewater treatment proposal in Colwood, including up to $2 million to complete the required technical studies and environmental impact assessments.

Conveyance

8. The collection system be upgraded, including improvements to the existing building and landscaping at the Macaulay Point pump station; a conveyance system consistent with previous plans be used to pump residual solids from the wastewater plant to Hartland Landfill.

Treatment of Residual Solids

9. The CRD start a new procurement for a new Biosolids Treatment Facility at Hartland Landfill using a Design-Build-Finance-Operate-Maintain (DBFOM) model, such facility to be in place to receive residual solids by December 2020; the contract will be performance based, with payment tied to the production of treated biosolids that meet regulatory thresholds for Class A biosolids.
10. The CRD store the class A biosolids at Hartland Landfill on an interim basis, recover and treat leachate and recover biogas.
11. The CRD engage in a comprehensive planning and consultation process to develop a waste policy, including management of its municipal solid and biosolid waste streams as part of an integrated resource management plan. This process would culminate in a submission to the Ministry of Environment of an integrated resource management program by 2020; it may include an amendment to the CRD Solid Waste Management Plan.
12. In parallel the CRD issue a Request for Expressions of Interest (RFEOI) for the processing of waste (including solid waste and biosolids) to determine the level of interest on the part of developers and investors. The RFEOI would specifically request input on the integrated resource management policy and regulations required to support their prospective investment. This will inform the planning process and policy.

Other

13. The CRD review its sewage collection and treatment facilities and develop a plan to implement improvements to the appearance of the facilities to mitigate their impacts on the host municipalities.

1.1.1 Benefits of Recommended Solution

The recommended Program, as shown in the triple bottom line assessment, optimizes economic, social, and environmental benefits over the long term. The recommended Program also takes into account the results of the extensive community consultation undertaken by the CRD over the past ten years. The Project Board is recommending a Program that will accommodate an innovative resource recovery system in the future once market demand for recovered resources has been established and the CRD has completed integrated planning and implemented supporting policies and procedures.

The recommended Program meets the goals established for the Project Board, as detailed in the Project Board's Terms of Reference.

Table 1: Project Board Recommendation

Goal	Measure
Will exceed federal regulations for secondary treatment by December 31, 2020, ending the discharge of raw wastewater into the marine environment.	The recommended Program with tertiary treatment will exceed federal regulations.
Minimizes costs (lifecycle) to residents and businesses.	The expected capital cost of the recommended Program is approximately $765 million; the proposal meets the deadline for Federal funding, minimizing the risk of losing senior government funding. The expected lifecycle cost of the recommended Program is $927 million; approximately $85 million lower than under the Seaterra Program.
Optimizes opportunities for resource recovery and greenhouse gas reduction	The recommended Program includes a smaller investment than prior plans in the treatment of residual solids and supports future investment in integrated resource management, following a planning and consultation process and ongoing assessment of market interest. The recommended Program reduces greenhouse gas emissions by 5-10 per cent, when compared with previous plans which included driers, pelletizing of biosolids, and hauling pellets to cement plants and other end users, who would be paid to take the product.
Adds value to the surrounding community and enhances the livability of neighbourhoods	The recommended Program recognizes that the wastewater and biosolids treatment facilities have external impacts: • Rather than co-locating the facilities, they are separated: one in Esquimalt; one in Saanich, and the impacts of conveyancing are shared. • The impact of construction is distributed; a laydown area is in Rock Bay, Victoria, to facilitate barging to the site, reducing truck traffic in Esquimalt. • The Program includes significant revisions to the wastewater plant design in response to public commentary and to align with existing zoning, and includes an allowance for further design revisions. • The Program includes neighbourhood amenities including a walkway, road improvements and a

Goal	Measure
	recreational area. • The Program recommends a program to improve the appearance of CRD sewage collection and treatment facilities, mitigating their impact on the host communities.

The scope of the Program also includes all the elements required in the Project Board Terms of Reference. The design capacity will meet federal and provincial requirements, treatment will exceed the minimum effluent quality standards, biosolids treatment will allow for a range of beneficial uses in the future, and the scope includes an amenity package that will include positive measures to integrate the new infrastructure within the host municipality.

1.1.2 Control Budget for Recommended Program

The table below contains the all in budget (Control Budget) of the recommended option. Note that the funding sources and allocations are based on the previously signed funding agreements, which need to be confirmed by senior governments.

Table 2: Recommended Program Control Budget, Tertiary Treatment

Program Costs (millions)	Wastewater	Biosolids	Conveyance	Total Costs
Total Capital Costs [A]	$ 350	$ 170	$ 179	$ 699
Owner's Program Management and Land Costs [B]	$ 35	$ 19	$ 13	$ 66
Total Program Costs	**$ 385**	**$ 189**	**$ 192**	**$ 765**
Sources of Funding				
PPP Canada [c]		$ 36		$ 36
Building Canada Fund [D]	$ 120			$ 120
Green Initiative Fund [E]			$ 50	$ 50
Provincial Government [F]	$ 128	$ 62	$ 63	$ 248
Total Federal and Provincial Funding	**$ 248**	**$ 98**	**$ 113**	**$ 454**
Capital Regional District [G]	$ 137	$ 91	$ 79	$ 311
Total Funding	**$ 385**	**$ 189**	**$ 192**	**$ 765**

Notes: Funding sources and allocations are based on the previously signed funding agreements. The funding amounts and allocations will require further confirmation.

A. Total Capital Costs include: construction costs; construction contingency, engineering costs; administration and program management costs; Contractor's bid development and special purpose vehicle set-up costs; risk adjustment; Owner's interim financing costs; inflation to the mid-point of construction in Year 2019; Contractor's interest during construction, financing fees and debt service reserve account ("DSRA") funding for the Biosolid Treatment Facility.

B. Owner's Program Management and Land Costs include: additional land purchases; impact consideration and mitigation allowance; development and due diligence costs; Owner's procurement costs; risk adjustment for retained risks; and land.

C. PPP Canada contributions would be released in a single payment upon the Project's Substantial Completion.

D. Building Canada Fund contributions would be released upon the approval of annual progress and performance reports and audits.

E. Green Initiative Fund contributions would be released upon the approval of quarterly and annual progress and performance reports and audits.

F. Provincial Government funding would partly be released in a single payment upon the Project's Substantial Completion and partly as payments during construction.

G. Contribution from the CRD is assumed to be the remaining balance of costs that would not be funded by the aforementioned federal and provincial governments' contributions.

1.2 RATIONALE FOR THE PROGRAM

The CRD Core Area is comprised of seven communities in Greater Victoria, including Saanich, Oak Bay, Victoria, View Royal, Esquimalt, Langford, and Colwood. There are also two First Nation communities, Esquimalt and Songhees, served by the Core Area wastewater treatment system.

All wastewater from these communities is conveyed to existing preliminary treatment consisting of screening at Clover Point and Macaulay Point prior to marine discharge. Current preliminary treatment is provided by 6 mm fine screen to remove rocks/solids, plastic, and floatable materials which are then disposed at the Hartland Landfill. No other wastewater treatment occurs prior to the wastewater being discharged into the marine environment at the two outfalls at Clover Point and Macaulay Point.

The CRD is the last major coastal community in North America discharging untreated sewage into the marine environment.

In 2006, the Ministry of Environment requested the CRD to amend the Core Area Liquid Waste Management Plan to describe how and when the CRD would start treating wastewater. The CRD must also meet the requirements, described below, including being in compliance with federal law by December 31, 2020.

1.3 PROGRAM VISION AND GOALS

The following Program vision and goals are outlined in the Project Board Terms of Reference as approved by resolution by the CRD Board of Directors on May 25, 2016 (Bylaw 4109, the CRD Core Area Wastewater Treatment Project Board Bylaw No. 1, 2016).

1.3.1 Vision

The Project Board will deliver a sewage treatment and resource recovery system that is innovative, achievable and optimizes benefits - economic, social and environmental (including climate change mitigation) - for the long term.

The Project Board will approach the project from the perspective that waste materials should be treated as resources and managed as such, with a long term objective to create a system that supports the principles of Integrated Resource Management (IRM).

The Project Board will give consideration to, and reflect, public input received with an objective of being responsive to community values and concerns.

1.3.2 Goals

The Project Board has the following goals to support achieving the vision:

1) Meet or exceed federal regulations for secondary treatment by December 31, 2020.
2) Minimize costs to residents and businesses (lifecycle costs) and provide value for money.
3) Optimize opportunities for resource recovery and greenhouse gas reduction.
4) Deliver a solution that adds value to the surrounding community and enhances the livability of neighbourhoods.

1.4 PROGRAM REQUIREMENTS

The Project Board defined the following requirements as a function of legislation and the Project Board's terms of reference.

1) Meet or exceed the regulatory requirements;

- Federal Wastewater Systems Effluent Regulations (*Fisheries Act*), including mandatory minimum effluent quality standards that can be achieved through secondary wastewater treatment; and
- B.C. Municipal Wastewater Regulation (*Environmental Management Act*), including effluent quality regulations.

2) Has the capacity to effectively accommodate the future population growth;
   - Wastewater flows of Average Dry Weather Flow (ADWF) of 108 MLD; and
   - Peak Wet Weather Flow (PWWF) of 384 MLD.
3) Suggested technology, or process, that satisfies the following definition of Proven Technology;
   - A high rate, small footprint wastewater technology or process related to primary wastewater treatment, secondary wastewater treatment, tertiary treatment, pumping, residual solids storage, and biosolids treatment that is installed at a wastewater treatment facility and where the technology or process is currently in operation and has been continuously operating reliably for a reasonable period of time in a similar process configuration of similar scale or complexity under similar or less favorable influent wastewater quality conditions, and has been operating with process modules the same size or larger than those proposed, and at a process loading as great or greater than that proposed.
   - The continuous reliable performance of the plant should be verifiable from certified daily operational data for a reasonable period of time.
4) Necessary environmental approvals must be in place to enable completion of construction by December 31, 2020.

With respect to siting, the Project Board concluded that proposed sites must: if not owned by the CRD, be available to the CRD on reasonable terms and within a reasonable timeline, be able to accommodate the project's needs; and not require a new outfall, which would trigger the need for a new extended environmental review processes.

1.5 SERVICE DELIVERY OPTIONS ANALYSIS

The CRD has outlined key program principles that should be included in the recommended service delivery option. These principles are:

1) Wastewater treatment process design capacity to meet Provincial Municipal Wastewater Regulation (MWR) requirement for sewage flows with an average dry weather flow of 108 MLD.

2) WWTP capacity, redundancy and process reliability to meet the MWR effluent quality regulations.

3) WWTP meets the federal Wastewater Systems Effluent Regulations (WSER) mandatory minimum effluent quality standards that can be achieved through secondary wastewater treatment.

4) Biosolids treatment that allows for a range of beneficial uses and provides a robust and reliable treatment process.

5) Positive measures to integrate the infrastructure within the host municipality or municipalities.

1.5.1 Wastewater Treatment Analysis

The wastewater treatment options analysis employed a multi-phased approach that started with option evaluation and screens based on established criteria and ended with a triple bottom line (TBL) assessment. The final selection was made based on cost and schedule impacts to the local ratepayers as well as consideration of environmental and social criteria.

The phase one screen tested each option's ability to meet the mandatory technical and functional requirements of the Program such as, meeting federal and provincial regulations and meeting the CRD's dry and wet weather capacity requirements.

The phase two screen tested each remaining option's ability to implement the Program in a timely manner, using screening criteria such as site considerations and the need for an Environmental Impact Study (EIS) for a new outfall or a modified outfall at existing outfall locations.

The options that made it through the two screening phases were then ranked in accordance with factors such as project whole lifecycle costs, environmental impact, and community and First Nations impacts. This ranking supported taking ten options to the final TBL assessment.

The TBL assessment process considers economic, environmental, and social criteria to support a balanced approach to decision making. Economic criteria include the capital (engineering estimates) and whole life cycle costs for each option. Environmental criteria consider the environmental performance of the option by examining the options carbon footprint, flexibility for IRM, and other environmental criteria. Social criteria include items that directly impact the community, including criteria such as traffic impacts, odour, and noise.

A shortlist of three options was then taken forward for development of engineering Class C cost estimates. For each of these options, the costs for both secondary and tertiary treatment were estimated; all options assumed the original 2012 Energy Centre scope for biosolids treatment.

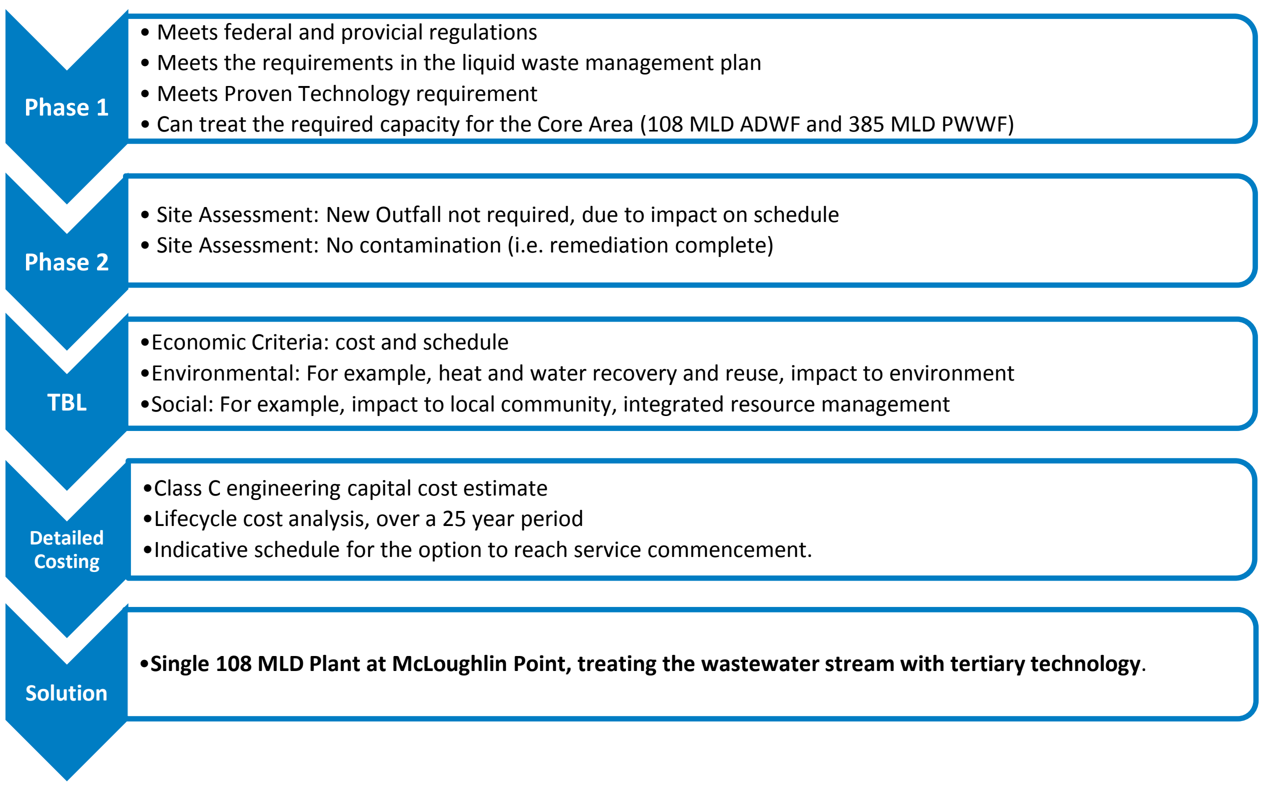
The shortlisted options, all options based on a total 108 MLD design capacity, were:

1) Single Plant at Rock Bay;

2) Single Plant at McLoughlin Point; and

3) Two plant solution, one at Rock Bay and one at McLoughlin Point.

Figure 1: Wastewater Treatment Options Analysis



1.5.2 The Colwood Proposal

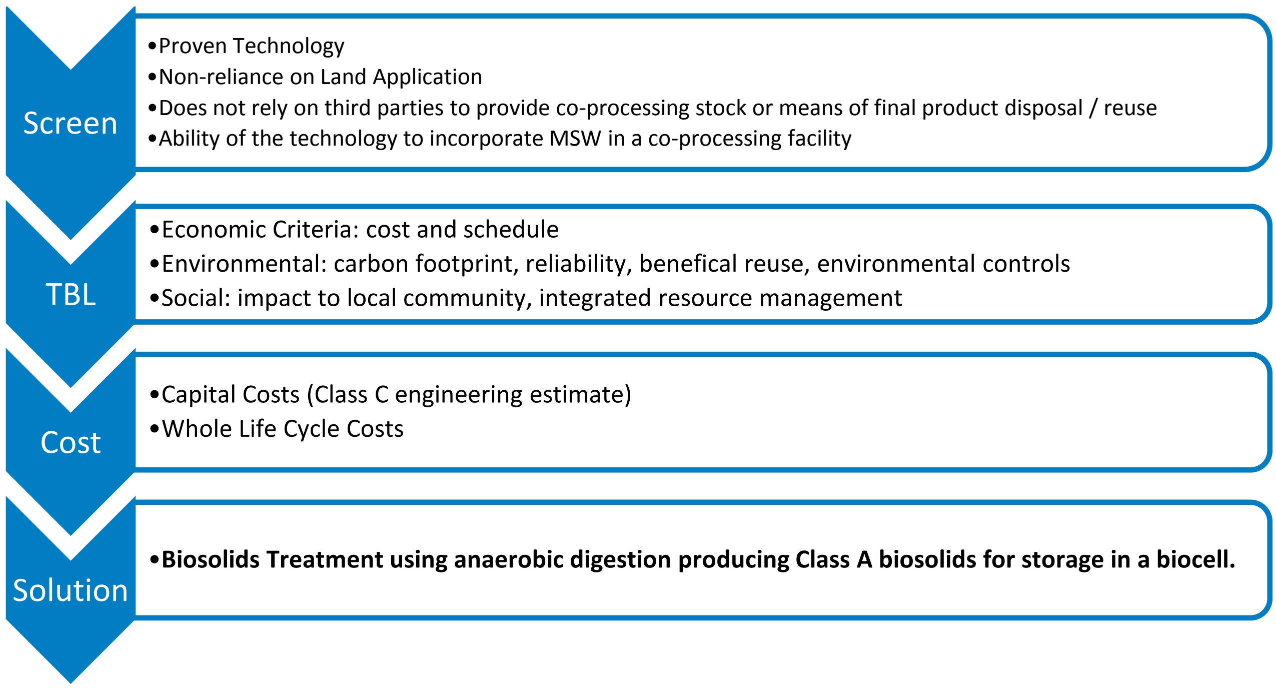
The Project Board received a presentation from a representative of the proponents of the Colwood proposal and engaged in a further review of the proposal including meeting with the proponent team.

The proponents describe the proposal as a "concept and cost estimate" to collect and treat wastewater from residents from Colwood and Langford and treat the wastewater to a quality that the proponents believe will be acceptable for discharge to the ground and reuse. The proposal does not include treatment of residual solids. Residual solids would be trucked to Hartland Landfill for treatment. There has been an interest in the region for decentralized wastewater treatment. This proposal is consistent with this interest and may work. The Project Board recommends funding the next stage of development which includes environmental impact assessments. Given that this proposal is at the concept stage, and there is risk that the technology of ground disposal for reuse and recharge may not be approved by the Ministry of environment, or may be approved with conditions that significantly increase the cost, the Project Board does not recommend changing the WWTP capacity of the recommended plant at McLoughlin Point.

1.5.3 Biosolids Treatment Options Analysis

Similar to the analysis undertaken for wastewater treatment, the biosolids treatment options analysis was also undertaken using a screening process followed by a TBL assessment and detailed cost analysis.

Figure 2: Biosolids Treatment Options Analysis



1.6 SEATERRA PROGRAM COMPONENTS COMPARED WITH RECOMMENDED PROGRAM

Seaterra Core Area Program	2016 Recommended Core Area Program
108 MLD Secondary Treatment Plant at McLoughlin Point with a new marine outfall.	108 MLD Tertiary Treatment Plant at McLoughlin Point with a new marine outfall.
Energy Centre[1] to treat residual solids utilizing thermophilic anaerobic digestion to produce Class A biosolids, biogas for utilization, dewatering, drying, and pelletization of dried solids suitable for	Biosolids Treatment Facility utilizing thermophilic anaerobic digestion, biogas utilization, and dewatering to produce Class A biosolids for storage in a biocell at Hartland

[1] Energy Centre refers to the biosolids treatment plant from the Seaterra Program

Seaterra Core Area Program	2016 Recommended Core Area Program
Land Application.	Landfill. Biosolids to be stored until CRD implements IRM policy regarding integration of Class A biosolids with MSW with a supporting market demand for recovered resources.
The conveyance component of the Program includes: a. upgrades to the sewage collection system consistent with the Seaterra Program, including an attenuation tank in Saanich East, improvements to various pump stations and to the headworks at Macaulay Point and Clover Point; b. a new treated water outfall at McLoughlin Point and wet weather outfalls at Clover Point and Macaulay Point; and c. residual solids conveyance system, consisting of a pipeline and pump stations from the wastewater treatment plant to Hartland Landfill in Saanich.	
Scheduled Completion: April 2018	Scheduled Completion: December 2020

1.7 PROCUREMENT RECOMMENDATION

1.7.1 Wastewater Treatment at McLoughlin

Detailed business case planning, undertaken by the CRD in 2010, demonstrated that a Design-Build-Finance (DBF) approach to procurement for the wastewater treatment plant would result in value for money to the taxpayer. The scope of the project includes the wastewater treatment plant, the tunnel under the Victoria Harbour, and a new outfall at McLoughlin Point.

Under a DBF model, the CRD engaged an owner's engineer to develop design and construction performance specifications for the Project. The CRD then managed a competition to select a design-build team to arrange construction financing and undertake the detailed design and construction of the facility, based on the specifications prepared by the CRD's project team. The successful team remains prepared to enter into a fixed price contract with some milestone payments being made by the CRD during construction.

In this model, design and construction risk, along with the short term (two year) performance risk, is transferred to the design-builder, while the CRD retains long-term operational and maintenance risks. This risk transfer is anchored by the design-builder having capital at risk during the construction period and the first two years of operations.

The CRD will own and operate the wastewater treatment plant.

The CRD managed the procurement, described above, in 2013-14 and the successful proponent was Harbour Resource Partners (HRP). The successful design met the CRD's requirements, including the affordability threshold.

The recommended wastewater treatment plant at McLoughlin Point is, in the Project Board's view based on legal and technical advice, sufficiently similar to the plant required in the earlier procurement process that a new procurement is not required under applicable procurement laws and policies.

The Project Board has confirmed with HRP that HRP is prepared to be re-engaged for the McLoughlin Point wastewater treatment plant, with the changes described in this report, for the price that is included in the Control Budget.

HRP has also confirmed that the regulatory deadline of December 31, 2020 can be met.

1.7.2 Biosolids Treatment at Hartland

Partnerships BC reviewed the Biosolids Treatment Facility and considered whether this project could be delivered under a Design-Build-Finance-Operate-Maintain (DBFOM) model.

Under a DBFOM model, the private partner is responsible for design, construction, partial financing, operations and maintenance over a 20 year term. Private financing anchors the transferred risks during both the construction and operating periods. Payments to the private partner would be based on plant availability and performance. The CRD will own the Biosolids Treatment Facility.

As part of this exercise, Partnerships BC completed an early screen on the recommended Biosolids Treatment Facility. The Biosolids Treatment Facility received a score of 43 (out of a possible 50) in this early screen. This result indicates that the recommended Biosolids Treatment Facility has potential to generate value through a procurement using an appropriate public private partnership model.

Features of the Biosolids Treatment Facility that support a DBFOM approach to procurement include:

a) On time delivery and operational readiness, especially with regards to the WWTP being operational, is very important to the success of the Program;

b) The estimated capital cost of the Biosolids Treatment Facility is sufficiently large to encourage market participation;

c) The Biosolids Treatment Facility can be specified with a focus on performance requirements and outputs; and

d) The Biosolids Treatment Facility will be owned by the CRD and sited on public land (i.e. Hartland Landfill).

Partnerships BC believes that a DBFOM for the Biosolids Treatment Facility can be successfully structured and deliver value for money for the taxpayers. This is consistent with the CRD 2012 business case, which forecast the Energy Centre to deliver value for money as a DBFOM. Because the procurement for the Energy Centre did not conclude and the scope of the project differs from the earlier procurement, the Project Board has concluded that a fresh procurement process will be required for the Biosolids Treatment Facility.

The Project Board and Partnerships BC have engaged PPP Canada in discussions regarding continued support for the Biosolids Treatment Facility. PPP Canada has expressed strong interest in continuing to support the project, and is awaiting further documentation to continue its analysis and come to a definitive conclusion on its funding.

1.7.3 Conveyance

The scope of the conveyance system of the Program includes:

a) Sewage collection system, including headworks and pumping stations;

b) Treated wastewater and wet weather flow outflow; and

c) Residual solids conveyance to Hartland Landfill, including the biocell to be used for Class A biosolids storage.

The Project Board has concluded that: (1) procuring the majority of conveyance system in a conventional design-bid-build manner and operated by the CRD staff over the long term and (2) procuring the larger components of the conveyance system, pump station upgrades at Clover Point and Macaulay Point, under a design-build structure with long term operations by the CRD staff, will provide value to the taxpayer.

1.8 PROJECT SCHEDULE

1.8.1 Wastewater Treatment Plant

The Project Board estimates that four to five months will be required to finalize negotiations with HRP; in parallel, the development permit application process will occur.

Assuming that the Project Agreement can be executed in January 2017, the plant should be operational by December 31, 2020.

1.8.2 Biosolids Treatment Plant

The following schedule is dependent on the timing related to the approvals required to proceed to the procurement phase. These approvals include:

a) Approval of the business case by the CRD Board of Directors;

b) Successful confirmation of funding from senior governments; and

c) Approval of the LWMP Amendment 11.

Table 3: Estimated Procurement Schedule, Biosolids Treatment Facility

Milestone	Date
Approval of Business Case	September 14, 2016
Procurement Planning	September 2016 to January 2017
Release RFQ to Market	January 2017
Approval of Shortlist	April 2017
Release RFP to Market	April 2017
Technical Submissions Due	September 2017
Financial Submissions Due	November 2017
Preferred Proponent Announced	December 2017
Commercial / Financial Close	February 2018
Design / Construction / Commissioning of Facility	February 2018 – December 2020

1.9 GOVERNANCE

The Project Board Terms of Reference includes the requirement to oversee Project scope, schedule and budget as the Program progresses through the planning, procurement and implementation phases, with particular attention to risk identification and risk management.

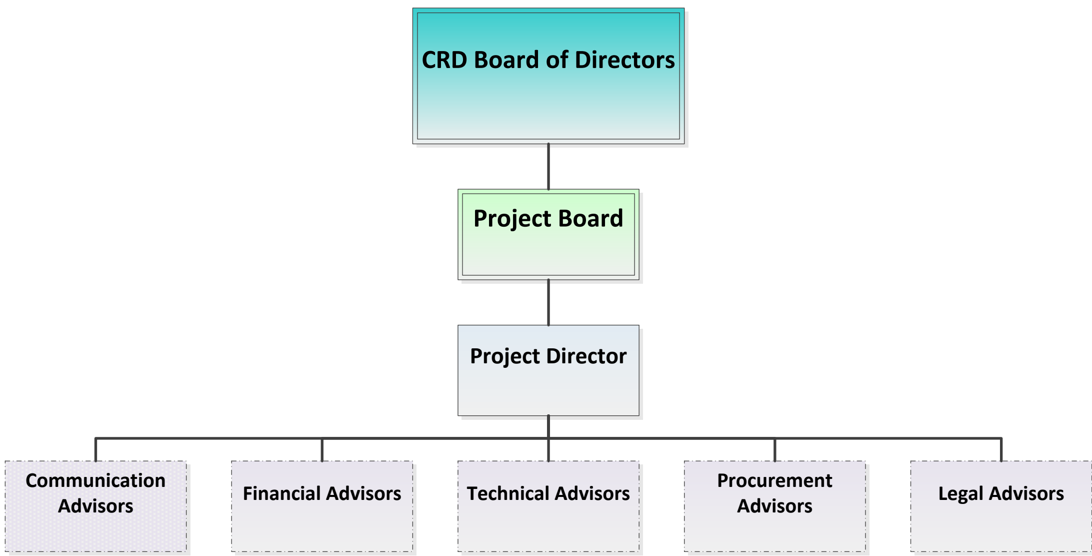
Role of Project Board Members

Project Board members will exercise their professional expertise and judgement to plan and implement to Project in accordance with the Project Vision and Goals.

Project Team

The Project Director will lead a Project Team to plan, procure and implement the Program. The Project Director will prepare a Project Management Plan to guide the work. The Project Team will include relevant expertise required for the Project, including financial, technical, estimating, communication and consultation, procurement and legal expertise. Membership of the team will reflect the requirements of the work at a particular time and may change over time.

Figure 3: Procurement Organization Chart



2 PURPOSE OF AND APPROACH TO BUSINESS CASE

2.1 PURPOSE OF THE BUSINESS CASE

The main purpose of the Program business case is to:

- Demonstrate the need and provide background information with respect to the Program;
- Describe in detail the planning process and recommended Program scope to meet the need;
- Recommend a service delivery option that meets regulatory and community needs; and
- Support the funding agreements with the Federal and Provincial Governments.

The document consists of the following main sections:

Part A - Rationale for the Program: Describes the need for the Program based on the current situation. This includes a description of the strategic context and an overview of the Program.

Part B - Delivery of the Program: Describes the analysis and selection criteria applied to select a recommended service delivery option, describes the recommended option and how that option meets the objectives of the CRD.

Part C – Procurement Review Describes the considerations reviewed and recommend a procurement strategy for the Program.

Part D – Recommendation and Implementation Summarizes the recommendations.

Part E - Decision Request: Summarizes the approvals required for Program implementation that the Project Board is seeking from the CRD.

2.2 APPROACH TO THE BUSINESS CASE

The business case has been developed by the project team, comprising members of the Project Board, Partnerships BC and advisory consultants. The analysis described in the business case proceeded according to the following approach:

(a) Develop an extensive list of options for analysis including earlier work considered by the CRD, including feedback from the extensive Eastside and Westside consultation exercises;

(b) Establish the analysis and selection criteria based on Program requirements to apply as a screen to the list of options to determine a short list of options for more detailed analysis;

(c) Consider delegations and presentations made to the Project Board in addition to meetings held with individual municipalities within the Core Area;

(d) Identify, on the basis of the screen, the most appropriate delivery option for the Core Area Wastewater Treatment Program in the CRD; and

(e) Provide a detailed description of the recommended options through the confirmation of the demand analysis, environmental considerations, site requirements, and other features impacting the scope of a wastewater treatment system that includes collection and conveyance, wastewater treatment, and discharge of treated effluent and biosolids treatment.

PART A – RATIONALE FOR THE PROGRAM

This section of the business case provides context for discussing development of the Program by presenting an overview of the challenges currently facing the CRD and the Core Area in particular.

This section concludes that the CRD must implement a wastewater treatment solution and, in accordance with federal law, have it operational by December 31, 2020.

3 PROGRAM DESCRIPTION AND NEED FOR INVESTMENT

The purpose of this section is to provide background to wastewater collection and discharge in the CRD, and demonstrate the need for developing the Program, including the regulations regarding wastewater treatment.

3.1 CAPITAL REGIONAL DISTRICT

The CRD was incorporated in 1966 as an order of government to provide regional decision-making, shared local government services and local decision-making in rural areas. The CRD's jurisdiction is the Southern tip of Vancouver Island and the surrounding 70 Gulf Islands. As a corporate entity the CRD is governed by a Board of Directors, made up of elected municipal and electoral area representatives from 13 municipalities and three electoral (unincorporated) areas. The CRD's administration is overseen by a Chief Administrative Officer and an Executive Leadership Team that are appointed by the Board as officers of the corporation.

The CRD is directly accountable to municipal partners and electoral areas for regional and sub-regional services and is the local government for the electoral areas, where it provides many sub-regional and local services. The CRD has a direct relationship with individuals, households, businesses, organizations and institutions that access regional utilities and services, and with communities that collaborate for regional services on behalf of their residents. The CRD also works collaboratively with First Nations and senior levels of governments.

The Core Area is a collaboration of seven local governments and two First Nations within the CRD with a total land area of approximately 215 km^2 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, the Town of View Royal, the Songhees and Esquimalt First Nations. The CRD provides services that are regional in nature including the sewage system which serves a population of approximately 320,000 in the Core Area.

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. The CRD was given the Letters Patent in 1975 giving it responsibility for trunk sewers, treatment and disposal. Over the next few decades, the CRD then designed its trunk sewer system to intercept all of these outfalls and convey the wastewater to the Macaulay Point and Clover Point deep sea outfalls. Environmental regulations of the day permitted the regional system to have some overflows during storm events at most of the original outfalls.

3.2 THE EXISTING CRD SANITARY COLLECTION SYSTEM

Sanitary sewer collection systems receive wastewater and convey it through a series of collection sewers to two marine outfalls located at Clover Point and Macaulay Point. Both of these outfalls receive tributary flows from their respective catchment areas (see figure below). Within the Core Area, the collection system is generally defined and operated as follows:

- Sewer laterals convey wastewater from buildings to the municipal collection sewers. Individual private property owners are responsible for the portion of the lateral that is located on their property.
- Collection sewers gather flows from sewer laterals and transport the sewage to a larger trunk sewer, municipal pump station or regional trunk system operated by the CRD. Each of the municipalities own and operate their own sanitary sewer collection system, including gravity sewer lines, pump stations and forcemains.
- The Regional system trunk generally consists of major gravity trunk sewers, siphons, large pump stations and forcemains 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 regional conveyance systems are owned and operated by the CRD.

The Core Area sewage 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).

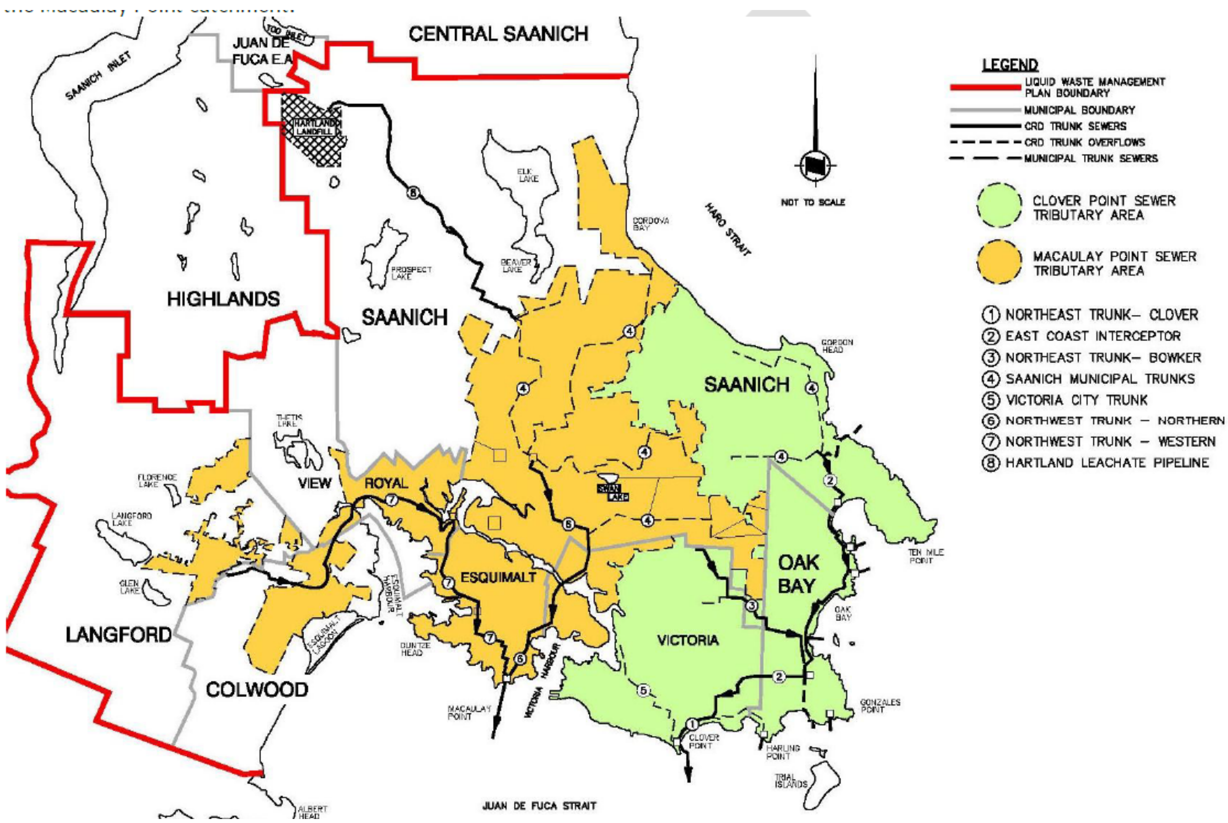
These trunk sewer systems have a total length of approximately 55 km. Due to undulating topography and subsurface conditions, 12 pump stations (including Macaulay Point and Clover Point pump stations) provide service to the Macaulay and Clover Point areas as shown below. The other ten pump stations are 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 generally smaller than the CRD pump stations.

The CRD does not intend to change this fundamental separation of ownership and maintenance responsibility. New wastewater treatment facilities will be owned by the CRD along with the main trunk sewers. Funding support resulting from this business case will be used to add treatment facilities to the trunk conveyance system and to reconfigure the conveyance as required for the proposed wastewater treatment strategy to fulfill the Program requirements.

The figure below illustrates the geographic boundaries of the CRD's two sewer tributary catchment areas – the Clover Point Area (green) and the Macaulay Point Area (orange). Each catchment area is served by major trunk sewers owned and operated by the CRD (smaller lateral and collections sewers are owned and maintained by each individual municipality in the region). The two catchment areas convey wastewater to the two main marine outfalls at Clover Point and Macaulay Point for discharge. Flows from the West Shore are also currently conveyed to the Macaulay Point catchment.

Figure 4: Existing Wastewater Conveyance System and Two Catchment Areas



3.3 EXISTING CHALLENGES IN THE CORE AREA

The CRD is planning for wastewater treatment to address the following challenges:

1. All wastewater from the Core Area communities is currently conveyed to existing preliminary treatment consisting of a 6mm screen to remove rocks/solids, plastic and floatable materials. No

other wastewater treatment occurs prior to the wastewater being discharged into the marine environment at the two main outfalls at Clover Point and Macaulay Point.

2. Contamination of seabed sediments at the Clover Point and Macaulay Point marine outfalls is sufficient to warrant preliminary designation as contaminated sites under B.C's *Environmental Management Act*: Contaminated Sites Regulation.
3. As many as 60 sanitary sewer overflows (SSO) currently occur each year throughout the Core Area during wet weather.
4. During significant rainfall 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 Point catchment area).
5. The region continues to grow; recent projections estimate an average annual population growth of 1.08 per cent. Added population will result in increased flows and loads, particularly for the Macaulay Point outfall which handles the West Shore[2]'s sewage catchment area since the West Shore is forecast to grow more quickly than other parts of the region.
6. CRD does not currently capture energy or other resources from the existing sewage system. This may represent a missed opportunity.
7. Investment in the Program will move the Core Area communities into compliance with Federal and Provincial effluent regulations, including the goals of the Canadian Council of Ministers of the Environment's (CCME) Canada-wide *Strategy for the Management of Municipal Wastewater Effluent.*

3.4 NEED FOR INVESTMENT

Wastewater is water that has been used in homes, industry, commercial, and institutional facilities in ways that diminish its quality. It is largely made up of human waste, oils, grease, chemicals, dirt and soaps from sinks, showers and washing machines and effluent from industries, commercial businesses and institutions. Wastewater also contains a component of infiltration and inflow from leakage in the sewer system or in some instances where combined sewers are used. In the CRD parts of the Clover tributary area do have combined sewers which carry stormwater and sanitary wastewater but a program is underway to separate these systems. High concentrations of pollutants from wastewater can have negative effects on fish, wildlife and the environment and can actually result in beach closures, public health concerns, and restrictions on shellfish harvesting.

[2] The West Shore includes the Cities of Langford and Colwood and the Town of View Royal.

In July 2006 based on two Macdonald Environmental Services Ltd. reports, commissioned by the B.C. Ministry of Environment (MOE), that noted the contamination of seabed sites near the outfalls, the Minister of Environment requested that the CRD amend its Core Area Liquid Waste Management Plan (LWMP) to describe how and when the CRD would implement secondary treatment.

In April 2016, the Mayor of Victoria received a letter from the Office of the Minister of the Environment (federal government). This letter explained the risk point system used by the federal government to determine when a municipality would have to comply with the new WSER of *The Fisheries Act* effluent quality standards. This approach uses a system of points that allocates the level of risk based on science criteria for effluent quality, quantity, and receiving environment considerations. If less than 50 points were allocated, the deadline to upgrade is December 31, 2040; if 50 to 70 points were allocated, the deadline to upgrade is December 31, 2030; and if more than 70 points are allocated, the deadline to upgrade is December 31, 2020.

Under this approach, the federal Ministry of Environment allocated 126 points to the Macaulay Point and 112 points to the Clover Point wastewater systems; therefore the deadline for meeting the WSER requirements for the Core Area has been confirmed as December 31, 2020. It is unlikely that the current transitional authorization under which the CRD is currently operating will be extended.

3.4.1 Summary of Senior Government Funding Contributions

Commitments to help fund the Program were made by the federal and provincial governments in 2012, the total maximum amount of funding support was $501.4 million.

The federal government departments have recently extended the deadline for their funding to September 30, 2016; however, the federal funding commitments are based on negotiations, including project scope and budgets, which commenced in 2010. The project scope and budgets will need to be updated to reflect the recommended option and amendments will be required to the federal contribution agreements. Therefore it is likely that the amount will change.

The provincial government has indicated that following consideration by the CRD it will consider the new business case for its contribution and will do so to accommodate the September 30, 2016 federal deadline.

At this point, the Project Board is assuming that the timing deadline will be met and that the federal and provincial funding, generally as previously committed will be confirmed.

3.5 LIQUID WASTE MANAGEMENT PLAN PROCESS

The *Environmental Management Act* allows local government to develop a LWMP for approval by the Minister of Environment. The approved LWMP authorizes local government, in accordance with operational certificates, to proceed with the measures in the approved LWMP without the need for a referendum so the management and disposal of treated waste is sufficiently protective of public health and the environment. Public and stakeholder consultation must be included in the LWMP process to ensure that multiple interests have been considered and that the LWMP is supported by the community.

3.5.1 CRD LWMP Amendments

The overarching planning framework for integrated liquid waste and resource management in the CRD is presented in the LWMP and its conditional amendments, including the most recent Amendment No. 10. This document sets out the CRD's vision, as well as goals, strategies, actions, and measures needed to achieve the vision.

The CRD's Core Area LWMP has been revised (Amendment #11) to reflect the recommendation and submitted in draft to the MOE. Following approval of the business case by the CRD Board of Directors (in accordance with its Terms of Reference and the provisions of Bylaw 4109, the CRD Core Area Wastewater Treatment Project Board Bylaw No. 1, 2016), the Project Board will submit Amendment #11 to MOE.

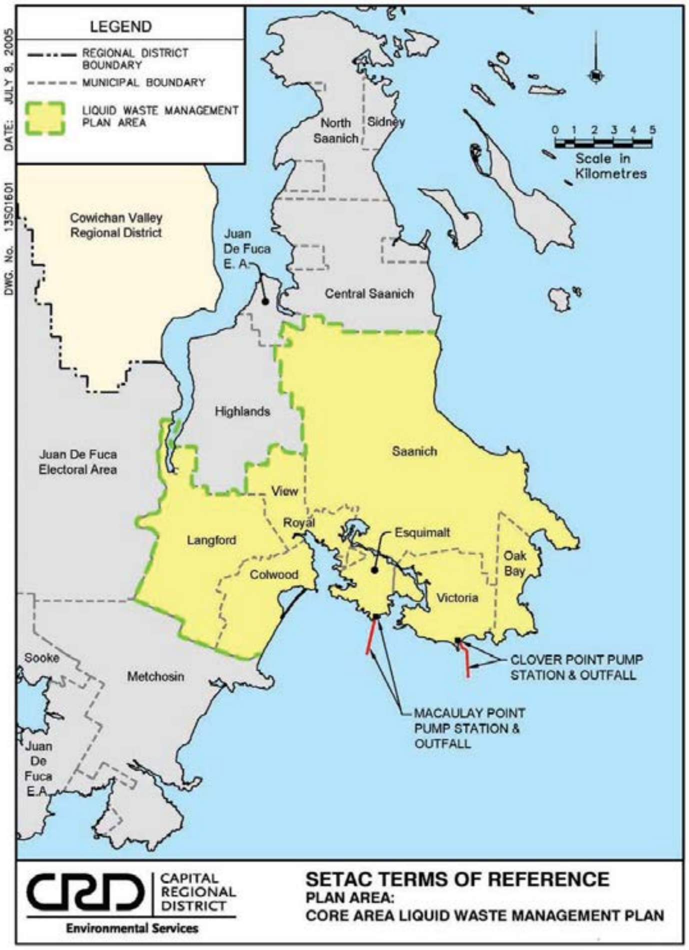
Table 4: Summary of LWMP Amendments Since 2006

LWMP Amendment	Summary of Content	Approval Status*
LWMP Amendment #6 Date: 2007	• Wastewater Treatment Strategy, Cost and Schedule • Approval by MOE December 2007	Approved
LWMP Amendment #7 Date: 2009	• Analysis of three options for systems configuration: Options 1A, 1B, and 1C • Development of a biosolids management plan • Incorporation of siting studies (Westland Resource Group) • Incorporation of the State 1 environmental impact study and pre-discharge monitoring work at the anticipated outfalls (Golder Associates) • Update on the procurement analysis, governance issues, funding options, risk analysis, and market sounding (Ernst and Young) • Approved by MOE February 2010	Approved
LWMP Amendment #8 Date: June 2010	• Proposed system configuration o Wet weather flow attenuation tanks in Saanich o Pump station at Clover Point to pump up to 3XADWF to McLoughlin Point o Pump station at Macaulay Point to pump up to 4XADWF to McLoughlin Point o Secondary treatment plant at McLoughlin Point	Approved

LWMP Amendment	Summary of Content	Approval Status*
	o Biosolids processing at Hartland Landfill o Primary treatment of any discharges over 4XADWF after 2030 • All flows up to two times average dry weather flow will receive secondary treatment • Wet weather flows (up to four times) will receive the equivalent of primary treatment and any flows over this level will be screened prior to discharge • Identification of sites needed for program • Final draft of operating certificates for selected treatment facilities • Updated public and First Nation consultation summary report • Copy of the business case, including results of the procurement options analysis • All systems will be in operation by the end of 2016 • Approved by MOE August 2010	
LWMP Amendment #9 Date: January 2014	• Schedule Program completion date changed from end of 2016 to end of 2018 • Initial storage volume at of the proposed Arbutus Road attenuation tank is reduced from 12,000 cubic metres to 5,000 cubic metres • New sewage screening facilities are proposed for both Clover Point and Macaulay Point pump stations • Biosolids processing to produce only dry fuel for cement kilns, pulp mills or waste-to- energy facilities is revised to include other beneficial uses that comply with CRD Board Policy. • There are a number of proposed wording changes in Amendment No. 9 intended to clarify ambiguities or to enable proponents to recommend innovative alternative technologies that may result in improved system performance or cost savings. • Approved by MOE July 2014	Approved
LWMP Amendment #10 Date: March 2016	• Placeholder for Amendment #11 • A secondary, advanced, or equivalent wastewater treatment plant at Clover Point, servicing all flows to Clover Point up to 2030 • A secondary, advanced, or equivalent wastewater treatment plant at McLoughlin Point or Macaulay Plain, servicing all flows to McLoughlin Point up to 2030 • Provision for Westside wastewater treatment plant	Conditional Approval received

LWMP Amendment	Summary of Content	Approval Status*
	for future growth • Wet weather flow attenuation tanks and pump station in Saanich • Primary treatment of any discharges over four-times ADWF after 2030 • New grit removal and screening facilities at the existing Clover Point and Macaulay Point pump stations. • Processing biosolids generated by the wastewater treatment process, while potentially integrating liquid and solid waste functions. Base site for this at Hartland. • Submitted to MOE for approval in March 2016	
LWMP Amendment #11 Date: Underway, anticipate completion by Sep 14	LWMP has been revised (Amendment #11) to reflect the recommendation and submitted in draft to the MOE.	

Figure 5: Physical Extent of Core Area LWMP



3.6 PLANNING HISTORY

The CRD has been planning wastewater treatment solutions for many years. In the last ten years a significant amount of work has been done to review treatment solution sets, assess siting alternatives, and review available and emerging technologies along with their respective capital and life cycle costs. The options reviewed have included multi-plant, decentralized and single plant treatment options for liquid and Residuals Solids treatment. Opportunities for resource recovery and integrated resource management have also been investigated.

From 2009 to 2013 planning work was completed for a variety of options including decentralized treatment. The CRD Board of Directors ultimately selected a single plant option at McLoughlin Point as it satisfied overall project and regulatory requirements and provided the best value for money for Core Area rate payers. Senior governments supported the Program as demonstrated by grant funding amounting to

$502 million; these funding agreements must be renewed prior to September 30, 2016. This level of senior government funding is amongst the highest for a wastewater treatment project in Canada.

A design–build–finance (DBF) procurement was undertaken for a regional wastewater treatment plant at McLoughlin Point and a preferred proponent was selected before procurement was cancelled in 2014 after the CRD was unable to obtain a zoning amendment from the Township of Esquimalt for McLoughlin Point.

In 2014 the CRD Board disbanded the Seaterra Program that had previously been given the responsibility for Program delivery. Site selection for the liquid and biosolids treatment facilities has been one of the most challenging issues facing the CRD and the Core Area Liquid Waste Management Committee[3] (CALWMC) felt that a new approach should be used to proceed with planning.

In October 2014, the CRD developed a new framework which will allow municipalities and First Nations that are participating in the Core Area LWMP to take a leading role in their communities to identify local opportunities as part of a holistic regional solution. This new framework provides an opportunity to have subcommittees work individually to develop and evaluate treatment options for their communities, conduct costing exercises and work with other municipalities to optimize existing conveyance infrastructure. Any subcommittee that is formed will report to the CALWMC and the CRD Board and will be supported by CRD staff. This new framework resulted in the creation of the East Side[4] and West Side[5] Select Committees. These Select Committees reviewed siting and technology options for wastewater treatment and have undertaken significant public consultation to solicit input from the public on the overall program and siting options.

Many technologies, both proven and emerging have been assessed by various consulting engineering firms over the past ten years. These engineering firms are:

- Urban Systems / Carollo Engineers (2015 to 2016)
- Stantec Consulting (2009-2015)
- CH2M / Associated / KWL (2006-2009)

Independent peer review panels and technical oversight panels have also been engaged to review the work completed by the consulting engineering firms and to offer additional suggestions for further

[3] CALWMC governs the Liquid Waste Management Planning exercise. See https://www.crd.bc.ca/about/how-we-are-governed/committees-commissions-appointments/regional-board-and-standing-committees/core-area-liquid-waste-management-committee for more information.
[4] Includes Victoria, Saanich and Oak Bay
[5] Includes Colwood, Esquimalt, Langford, View Royal, Songhees First Nation, and Esquimalt First Nation

investigation. The CRD wastewater treatment program has undergone more planning and evaluation than any other wastewater treatment project in British Columbia.

The CRD is now considering its wastewater treatment options which form this business case to support renewal of funding agreements for the Program. Because the scope and schedule of the Program have changed significantly since the last approval in 2012, the Province has advised the CALWMC that the Program is no longer in compliance with the terms and conditions of the original funding agreements. The Business Case must be completed by September of 2016 for confirmation of new funding agreements.

In May 2016, the CRD, with support from the Province of B.C., created a Project Board to develop a comprehensive business case to support a renewal of the Funding Agreements with senior governments.

3.7 PROJECT BOARD

The following Program vision and goals are outlined in the Project Board Terms of Reference as approved by resolution by the CRD Board of Directors on May 25, 2016 (Bylaw 4109, the CRD Core Area Wastewater Treatment Project Board Bylaw No. 1, 2016).

3.7.1 Purpose of the Project Board's Terms of Reference

The purpose of these Terms of Reference is to set out the role, responsibilities and function of the Project Board. The Terms of Reference provide a framework that includes the Project vision and goals, guiding principles and values, meeting protocols, confidentiality considerations and identifies those matters that must be referred to the CRD Board for approval.

3.7.2 Vision

The Project Board will deliver a sewage treatment and resource recovery system that is innovative, achievable and optimizes benefits - economic, social and environmental (including climate change mitigation) - for the long term.

The Project Board will approach the project from the perspective that waste materials should be treated as resources and managed as such, with a long term objective to create a system that supports the principles of IRM.

The Project Board will give consideration to, and reflect, public input received with an objective of being responsive to community values and concerns.

3.7.3 Goals

The Project Board has the following goals to support achieving this vision:

1) Meet or exceed federal regulations for secondary treatment by December 31, 2020.

2) Minimize costs to residents and businesses (lifecycle costs) and provide value for money.

3) Optimize opportunities for resource recovery and greenhouse gas reduction.

4) Deliver a solution that adds value to the surrounding community and enhances the livability of neighbourhoods.

3.7.4 Project Scope – Principles

1) The Project will include the following elements:

   a. WWTP design capacity to meet Provincial MWR requirement for sewage flows with an ADWF of 108 MLD.

   b. WWTP, capacity, redundancy and waste water overflow meet Provincial effluent quality regulations.

   c. WWTP meets the National WSER (Fisheries Act) mandatory minimum effluent quality standards that can be achieved through secondary wastewater treatment.

   d. Biosolids treatment that allows for a range of beneficial uses.

   e. Conveyancing system.

   f. Positive measures to integrate the infrastructure within the host municipality or municipalities.

The Business Case will consider options to include the following:

1) Enhanced secondary or tertiary treatment.

2) IRM elements (or IRM compatible).

3.7.5 Project Board Guiding Principles and Vision

The following principles and values will guide the Project Board's decision-making and actions:

1) The Project must be in full compliance with applicable federal and provincial legislation and regulations within the required timelines.

2) Option analysis will have regard for lifecycle costs (both capital and operating), the highest environmental standards, and IRM, within the context of the Program's schedule and budget constraints. Considerations and trade-offs between operating and capital costs, qualitative outcomes and schedule will be transparent in the business case analysis.

3) A range of contract delivery models will be explored, including publicly operated and maintained, performance-based models such as Design-Build-Finance-Operate-Maintain models and others, that would support innovation and the use of leading technologies.

4) The Project Board will work cooperatively with host municipalities on siting the facility or facilities.

5) The Project Board will work cooperatively with funding partners and will be full compliance with funding agreements.

Refer to Appendix A [Project Board Terms of Reference] for more detail.

PART B – PROGRAM DESCRIPTION AND INVESTMENT DECISION

This section outlines the goals and requirements for the Program, describes the requirements of for the specific Program components, identifies service delivery options to meet this capacity, describes the screening process, and concludes with a recommendation.

The recommended Program is:

1) Wastewater Treatment: a single regional plant at McLoughlin Point utilizing tertiary technology.
2) Biosolids Treatment: using anaerobic digestion which results in Class A biosolids that will be stored at the Hartland Landfill using biocell reactors.
3) Collection and Conveyance:
    - upgrades to the sewage collection system consistent with the Seaterra Program, including an attenuation tank in Saanich East, improvements to various pump stations and to the headworks at Macaulay Point and Clover Point;
    - a new treated water outfall at McLoughlin Point and wet weather outfalls at Clover Point and Macaulay Point; and
    - residual solids conveyance system, consisting of a pipeline and pump stations from the wastewater treatment plant to Hartland Landfill in Saanich.

The recommended solution will meet the CRD requirements under legislation and has the highest likelihood of being operational by December 31, 2020.

4 GUIDING PRINCIPLES AND PROGRAM REQUIREMENTS

4.1 PROGRAM REQUIREMENTS

The Program requirements are:

1. Meet or exceed the regulatory requirements;
   a. Federal WSER (*Fisheries Act*), including mandatory minimum effluent quality standards that can be achieved through secondary wastewater treatment; and
   b. BC MWR, including effluent quality regulations.
2. Has the capacity to effectively accommodate the demand;
   a. Wastewater flows of ADWF of 108 MLD; and
   b. PWWF of 384 MLD.
3. Suggested technology, or process, satisfies the following definition;
   a. A high rate, small footprint wastewater technology or process related to primary wastewater treatment, secondary wastewater treatment, tertiary treatment, pumping, residual solids storage, and biosolids treatment that is installed at a wastewater treatment facility and where the technology or process is currently in operation and has been continuously operating reliably for a reasonable period of time in a similar process configuration of similar scale or complexity under similar or less favorable influent wastewater quality conditions, and has been operating with process modules the same size or larger than those proposed, and at a process loading as great or greater than that proposed.
   b. The continuous reliable performance of the plant should be verifiable from certified daily operational data for a reasonable period of time.
4. Necessary environmental approvals must be in place to enable completion of construction by December 31, 2020.

With respect to siting, the Project Board concluded that proposed sites must: if not owned by the CRD, be available, to the CRD on reasonable terms and within a reasonable timeline, be able to accommodate the project's needs; and not require a new outfall, which would trigger the need for a new extended environmental review processes.

5 PLANNING PARAMETERS

5.1 STAKEHOLDER CONSULTATION

Since its formation in late May the Project Board has worked to understand the views of CRD residents. At their meetings they received correspondence and had presentations from residents, industry professionals, and a CRD Director. The Project Board Chair and Vice Chair also met with staff from the CRD and all of the Core Area municipalities, and with Esquimalt and Songhees Nations representatives. The Project Board also reviewed extensive public commentary from years of past discussion. They identified the following key concerns related to the wastewater treatment facility, in particular the site at McLoughlin Point, identified during previous phases:

1. Overall cost of the facility and cost to CRD taxpayers
2. The appearance of the facility/proximity to the shoreline/setbacks/integration into surrounding public space
3. Long-term planning and constraints of the site for future growth
4. Construction impacts and traffic management
5. Request for resource recovery/new technologies to be integrated in the facility
6. Odour/air quality

For the treatment of residual solids, in particular at the existing CRD landfill at Hartland, construction impacts and odour are important for Saanich and the Juan de Fuca Electoral Area including residents of Willis Point and other neighbourhoods near the landfill.

Public commentary and presentations to the Project Board also highlighted the following technical themes or issues:

1. Flow and Load
2. Outfall Permitting
3. Regulatory Requirements
4. Compounds of Emerging Concern (CECs)
5. Microplastics
6. Gasification

The Project Board researched these topics. The research informed the range of options and the development of the criteria to evaluate them. The results of the research are summarized below, supported by technical papers, appended to this business case.

Kirk & Co. reviewed the results of the public consultation on the Program between 2010 and 2016. A chronological synopsis of this information is provided in Appendix B [Summary of CRD Consultation].

5.2 FLOW AND LOAD

The Project Board asked the technical advisors to analyze data collected by the CRD and confirm whether the plant capacity (e.g. size of the plant) should remain at 108 MLD. The process used and results are contained in Appendix C [CRD Flows and Loads]. The following is the conclusion taken from this appendix.

Results of flow data indicate a decreasing average dry weather flow which appears to have flattened. The load has continued to increase as the population grows and the flows drop. Since secondary treatment sizing is based on load, the observed loads are consistent with values selected for the design of the secondary treatment facility.

For wet weather flow sizing, which is based on a multiple of the ADWF, it would theoretically be possible to slightly reduce the size of these facilities however there is an inherent risk with doing this given the age of the CRD sanitary sewer systems and the fact that the Macaulay and Clover catchments experience significant inflow and infiltration (I&I), higher than the multiples approved in the LWMP. Furthermore, wet weather flows are subject to winter rainstorms which are highly unpredictable.

Given the above considerations, the Project Board concludes that the Program be sized for an ADWF of 108 MLD and an influent BOD load of 28,080 kg/d.

5.3 OUTFALL PERMITTING

The technical memorandum, Appendix D [CRD Outfall Permit Requirements], provides a summary of the permitting requirements for a new or an existing modified outfall that would make up an integral part of any proposed liquid treatment facility. Discussion will mainly revolve around the requirements necessary for a new outfall, but some consideration will be given to the scenario where one of the CRD’s existing outfalls at Clover Point or Macaulay Point would be twinned to support higher effluent flows from a single liquid treatment facility.

The marine environment surrounding the CRD is expected to have a high assimilative capacity due to ocean volume and tidal action for mixing and dispersion, and presence of marine microorganisms and physicochemical processes for nutrient breakdown. However, the placement of a new or modified outfall still requires a lengthy process to be undertaken.

In consultation with professionals who regularly engage in the permitting and design of marine outfalls on Vancouver Island and elsewhere in British Columbia, the following approximate permitting timelines have been established:

- New outfall – 24 months minimum (McLoughlin Point outfall took 30 months)
- Twinning of existing outfall – 14 months assuming fast track approval

Each outfall application is reviewed in detail by the regulators. Provincial approvals can sometimes be fast tracked but Federal approvals usually control the overall schedule.

The main difference for the two options relates to the EIS process. It is assumed that the gathering of extensive receiving water quality background data will not be required for the twinned outfall option. This is assumed based on the existing data that should be available from when the first outfall was initially designed as well as ongoing water quality monitoring of the operational outfall.

5.4 REGULATORY ENVIRONMENT

The Program will need to comply with both Federal and Provincial wastewater regulations. Efforts are underway at both levels of government to harmonize these two regulations and thereby simplify the reporting requirements; however, in the interim compliance with each regulation is required.

In April 2012, the MOE implemented the new MWR, of B.C.'s *Environmental Management Act*, to protect public health and the environment. Compliance with the MWR provides local governments with authorization for treatment, reuse, and discharge of reclaimed water. The MWR prescribes the minimum standards of municipal wastewater quality for marine water, fresh water, or ground discharge.

The federal government regulates municipal discharges under the WSER of *The Fisheries Act*. The WSER specifies the conditions that must be met to deposit effluent containing deleterious substances, including requirements concerning toxicity, effluent monitoring, record keeping, and reporting. WSER requires a monthly average composite sample concentration of 25 mg/L or less for each of BOD_5 and TSS.

The CRD must meet the WSER requirements to cease discharge of "deleterious material" to the ocean by December 31, 2020. The discharges from Clover Point and Macaulay are classified as "high risk" discharges based on a formula based on flows and loads. Currently there is no treatment other than fine screening at the Clover and Macaulay Points outfalls. As previously reference in this business case, the in service requirement of December 31, 2020 has recently been reconfirmed in writing by the federal government.

5.4.1 Equivalency Agreement between Federal and Provincial Regulations

Given some inconsistencies between the federal WSER and provincial MWR, the Province of BC and the Government of Canada have been working to develop a Federal-Provincial Equivalency Agreement on Municipal Wastewater. This federal/provincial agreement enables dischargers to meet provincial requirements only, and having WSER “stand down” in deference to the equivalent provincial requirements in B.C.; thus avoiding regulatory duplication. To be deemed “equivalent-in-effect” to the WSER, the province must incorporate key aspects of the federal regulation into its regulatory framework.

Existing Operational Certificates must transition to the harmonized MWR, or the discharge will remain subject to both the federal WSER and the provincial MWR.

Discharges from a facility not currently capable of secondary treatment (Macaulay and Clover Points) would be deemed Transitionally Registered under the harmonized MWR. While transitionally registered, the discharger would continue to meet requirements in their former permit (or Operating Certificate) until the facility is upgraded, or the federal timeline is reached on December 31, 2020, whichever comes first. In other words, no other sections of the MWR would apply while the discharge is Transitionally Registered. Once the upgrade deadline expires, the discharge would be deemed registered under the harmonized MWR requiring compliance with the regulation. The CRD is currently operating their screened outfalls at Clover and Macaulay Point under a Transitional Authorization.

5.4.2 Operating Certificate

The Province will issue an Operating Certificate for new wastewater treatment facilities. A draft Operating Certificate has been prepared as part of the LWMP and will be included in LWMP amendment No. 11. The Operating Certificate issued for new wastewater treatment plants are site specific and outline not to exceed concentrations or monthly average concentrations for various parameters depending on the location and sensitivity of the receiving environment.

5.4.3 Reliability and Redundancy Requirements

Another important area of compliance within the provincial MWR is the treatment facility’s reliability requirements (installed redundancy). The MWR defines reliability in one of three categories:

Category I - in respect of which short term effluent degradation could cause permanent or unacceptable damage to the receiving environment, including discharges near drinking water sources, shellfish waters or recreational waters in which direct human contact occurs;

Category II - in respect of which permanent or unacceptable damage to the receiving environment, including discharges to recreational waters and land, would not be caused by short term effluent degradation, but would be caused by long term effluent degradation; and

Category III – Plants that do not fall into either Category I or II.

The CRD wastewater facilities would fall under Category I because the previous modeling has indicated the effluent plume can surface during certain tide and current conditions and the waters in the vicinity of the outfall is used by wind surfers.

5.4.4 Potential for Penalties

Failure to meet the standards imposed under the WSER and the MWR could result in prosecution, fines, imprisonment, and other remedial penalties.

Under the *Fisheries Act*, fines can be imposed on individuals/corporations and officers, directors, and agents. For individuals/corporations, fines can range from $500,000 to $6,000,000 for the first offence and $1,000,000 to $12,000,000 for subsequent offences. For officers/directors/agents, fines can range from $15,000 to $1,000,000 for the first offence and $30,000 to $2,000,000 for subsequent offences. In addition, there may also be remedial action ordered and civil liability for harm to fisheries.

Under *the Environmental Management Act*, fines can be imposed up to $1,000,000 and possibly six months imprisonment. For intentional damage, the fines can go up to $3,000,000 and up to three years imprisonment.

Under both the federal and provincial legislation, each day would constitute a separate offence and multiple charges can be laid. Offences and penalties under other environmental protection legislation may be possible if there is harm to species at risk or migratory birds.

For more detail, refer to section two of Appendix J [Assessment of Liquid Wastewater Treatment Options].

5.5 COMPOUNDS OF EMERGING CONCERN

The Project Board asked the technical advisors produce a technical paper brief overview of the definition of compounds of emerging concern (CEC), and how they relate to wastewater treatment; this technical paper is attached as Appendix G [Compounds of Emerging Concern]. The following explanation is taken from this appendix.

CEC, or emerging contaminants, are constituents within domestic wastewater that are being considered for regulatory action pending the development of additional information on health and environmental impacts. They consist of synthetic or naturally occurring chemicals which have the potential to enter the environment and cause known or suspected adverse ecological or adverse health effects. There are numerous such compounds and they are described in broad categories including pharmaceuticals, personal care products, micro- plastics, plasticizers, flame retardants, herbicides, pesticides, and other industrial chemicals. These compounds are found in a variety of products including antibiotics, cosmetics, insect repellants and many other products used by the human population. There are thousands of these compounds and although some of these compounds are removed through conventional secondary and tertiary treatment processes many are not.

Several studies have been conducted to determine the degree of treatment required for removal of CECs. These studies typically examine the fate of a given compound or series of compounds in relation to the treatment process(es) used to treat the influent wastewater stream. Treatment of CECs occurs by a combination of three primary means: (1) adsorption, (2) volatilization and (3) degradation. The degree of treatment attained by each mechanism will depend on the nature of the CEC and the type of treatment processes used. As such, there are no hard and fast guidelines that dictate what form of treatment is best for the removal of the varying make-up of CECs. In addition the types of CECs differ from location to location.

A study published in 2015 entitled, Emerging Contaminant Removal In Wastewater Treatment Trains Under Canadian Conditions (Wayne Parker, University of Waterloo), compared the effectiveness of the most common treatment technologies to remove the more common CECs from wastewater including: activated sludge configurations, membrane bioreactors, and lagoons. The study determined that processes that had longer sludge ages (nitrifying activated sludge processes) tended to remove more CECs than conventional high rate activated sludge. The study also indicated that there was little difference in treatment efficiency between conventional activated sludge and the membrane bioreactor process.

Several options are available to the CRD to deal with CECs. One option would be to construct secondary treatment facilities and add the required facilities for CEC in the future to deal with the specific CECs that are identified in the effluent. A second option would be to add tertiary filtration at this time which would provide additional CEC removal and would also have other benefits such as producing a water quality suitable for water reclamation. Given the CRD's desire to provide leadership in this area, the CRD may wish to install tertiary filtration during initial construction of the plant. This would be the most cost effective approach. This can be accomplished quite by addition of tertiary filtration downstream of the secondary treatment process. The filtration process could use compact disc filters or sand filters. Similar type facilities are located at the tertiary treatment plants located in the BC Interior at Kelowna, Penticton and Westbank.

Tertiary treatment will provide benefits beyond CEC control for the CRD. These benefits include reducing the solids and BOD load to the receiving environment and producing a reclaimed water quality (with disinfection) that can be considered for other uses such as irrigation.

5.6 MICROPLASTICS

The Project Board asked the technical advisors produce a technical paper documenting the effects of micro-plastics in municipal wastewater; this technical paper is attached as Appendix H [Micro-plastics in Municipal Wastewater]. The following explanation is taken from this appendix.

Micro-plastics or micro-beads are synthetic polymer particles ranging in size from 0.1 microns to less than or equal to 0.5 mm in size. They are manufactured to be components of personal care products such as toothpaste, facial cleaners, and cosmetics. They are also components of industrial abrasives, textile printing, cleaning products and pharmaceutical products. They gain access to the municipal sewer system when discarded at residences or businesses. Micro-plastics can also result from the breakdown of larger plastic materials such as fibres from synthetic plastic clothing which are termed secondary micro-plastics. Their chemical composition varies but commonly they consist of polyethylene, polyester, polystyrene and numerous other polymers most of which take a long time to degrade by natural processes and remain in the aquatic environment for a long time.

Among the concerns raised with micro-plastics is that aquatic organisms such as fish, shellfish, zoo-plankton ingest them as potential food sources with significant impact on their physiology, reproduction, and health. There are also direct toxic effects due to ingestion and absorption.

Municipal wastewater effluents, storm runoff, industrial discharges are all sources of micro-plastics. Several studies have recently been undertaken which show that between 98 and 99 % of the micro-plastics contained in raw municipal wastewater are removed by secondary treatment processes such as settling, skimming and bio-flocculation (Fionn , Murphy et al 2016, Steve A Carr et al 2016) . They generally end up in the bio-solids. In spite of these removals, measurable quantities of micro -plastics are discharged. Another study of seven tertiary plants in Southern California indicated good removal of micro-plastics in tertiary treatment plants

For the CRD Program, as originally proposed in the LWMP, greater than 98 per cent of the micro-plastics would be removed because the BAF bioreactor provides a packed bed filter with a fine strainer underdrain system prior to discharge. If a tertiary disc filter is also added downstream of the BAF, small openings in the disc fabric combined with an operational filter organic layer will further polish the effluent and remove some additional micro-plastics.

5.7 GASIFICATION

The Project Board asked the technical advisors produce a technical paper describing gasification technology and its potential applicability to the Program, refer to Appendix I [Gasification Technology]. The following conclusion is taken from this appendix.

Successful use of gasification technologies for sludge/biosolids processing is limited at this time. The performance of gasification on biosolids applications has met with mixed results and many of the facilities have had operational difficulties and have been shut down. The financial viability of the gasification of residual solids has not been proven and many of the developers have gone out of business. Other options such as incineration / waste to energy have a longer term operations track record and better reliability.

Gasification facilities are operationally complex. Although the technology shows promise, further refinement will be required to make it a viable and reliable option for long-term biosolids treatment. At this time it is recommended that the CRD not consider gasification as there is no long term proven track record for the technology at the scale required for the biosolids treatment facility. Given that the installations to date have met with mixed results, there is significant risk to the CRD by utilization of this technology.

5.8 GENERIC DESCRIPTIONS OF TREATMENT PROCESSES

5.8.1 Primary Treatment

Primary treatment uses a process referred to as sedimentation where settleable solids are removed from the wastewater by gravity settling. In its simplest form it involves a tank and a sludge removal system. During high wet weather flows, such as those experienced at CRD, chemicals are often added to assist in settling of lighter suspended solids. This process is referred to as Chemically Enhanced Primary Treatment (CEPT). The solids removed from this process are referred to as primary sludge and are directed to biosolids treatment facilities. The primary treatment process typically removes 55 to 60 per cent of Total Suspended Solids (TSS) and approximately 25 to 30 per cent Biochemical Oxygen Demand (BOD) without CEPT[6]. The pollutants remaining after primary treatment must be treated by a secondary treatment process.

5.8.2 Secondary Treatment

Secondary treatment removes organic material from the wastewater using a biological treatment process with air addition to promote biological oxidation and reduce BOD in the wastewater. The most common secondary treatment process is activated sludge but significant site area is required for this process. There are also hybrid systems including moving bed bioreactors and biological aerated filters which occupy a smaller footprint than conventional activated sludge processes. These processes are suited to sites with limited land availability.

Secondary treatment is typically able to achieve a wastewater quality with a BOD_5 and TSS of 15 to 20 mg/L.

[6] CEPT operation increases the removal rates

5.8.3 Tertiary Treatment

The term tertiary treatment is an advanced treatment process beyond secondary treatment which typically produces a higher quality effluent. Tertiary treatment facilities are typically designed where nutrients such as phosphorus and nitrogen are detrimental to the receiving stream (e.g. fresh water) environment. Depending on the location, some tertiary plants are only designed to remove nitrogen or phosphorus. Where water reuse is required for irrigation, tertiary filtration is added but often nutrient removal is not practiced because nutrients are beneficial to plant growth. Tertiary treatment is rarely used when the discharge is to a marine environment (e.g. salt water).

Tertiary treatment can be achieved through the use of membranes or other filtration processes including disc filters or sand filters. Membranes have higher energy use in comparison to conventional filtration processes such as disc or sand filters. Tertiary treatment will remove most non-soluble CECs.

6 WASTEWATER TREATMENT TECHNOLOGY OPTIONS

All information contained in this sections six and seven of the business case was taken from sections five to eight of Appendix J [Assessment of Liquid Wastewater Treatment Options].

6.1 GENERAL

The CRD has been planning for wastewater treatment since 2006. During this time, a significant amount of work has been done to assess siting alternatives and review proven and emerging treatment technologies. The options reviewed have included decentralized and centralized treatment options for liquid and biosolids treatment. The availability of sites large enough for the liquid and/or biosolids treatment facilities has been the most challenging issue facing the CRD. Because of this factor, siting for the wastewater treatment has been decoupled from the biosolids treatment, which is assumed to occupy its own site.

6.1.1 Urban Systems / Carollo Work Summary (2015 – 2016)

The most recent planning on conceptual treatment options has been completed by Urban Systems and Carollo Engineers. The wastewater treatment technologies reviewed by Urban Systems/Carollo included tertiary treatment using membrane bioreactor (MBR) technology, and secondary treatment options using conventional activated sludge or moving bed bioreactor (MBBR) technology. The MBBR technology requires a smaller footprint than conventional activated sludge.

6.1.2 Stantec Consulting Work Summary (2009 – 2015)

In 2009, Stantec were retained to provide Program Management and Technical Planning services for the Program. Stantec refined the previous planning studies provided by CH_2M Hill / Associated Engineering / Kerr Wood Leidel (KWL) and evaluated 12 different centralized and decentralized treatment options. Stantec reviewed a variety of configurations, technologies and prepared cost estimates for each option.

6.1.3 CH_2M Hill / Associated Engineering / KWL Work Summary (2006 – 2009)

A comprehensive review of decentralized treatment options was undertaken by the CH_2M Hill / Associated Engineering / KWL team from 2006 -2009. This team focused on using membrane bioreactors (MBR) to provide distributed treatment and water reuse throughout the Core Area. This team also reviewed more conventional technologies such as activated sludge and biological aerated filters as part of their work.

6.2 PREVIOUS PLANNING WORK FOR WASTEWATER TREATMENT

The Project Board considered all treatment technologies, including siting considerations, in this analysis. The table below summarizes treatment technologies that have been reviewed during the various planning studies, the table also includes implementation considerations developed during the Project Board review as noted in Appendix J [Assessment of Liquid Wastewater Treatment Options].

Table 5: Summary of Treatment Technologies Assessed and Implementation Considerations

Technology	Implementation Considerations
Sequencing Batch Reactor	Large footprint. Not typically used for flows >20 MLD, could be considered for smaller capacity plants.
Modified Sequencing Batch Reactor`	Results in a large footprint; not typically used for flows in excess of 20 MLD.
Vertreat (Deep Shaft)	Unproven at scale and assessed to be a high risk option. Not suitable for wet weather flows.
Membrane Bioreactor (MBR)	Suitable for smaller sites as secondary clarifiers are eliminated. Capital and operating costs greater than secondary treatment solutions. Requires additional membranes to 2 x ADWF requirements. Effluent exceeds regulatory requirements and is suitable for water reuse.
Conventional Activated Sludge	Large footprint. Was evaluated for West Shore Regional Option in 2009 study. Can be considered for smaller capacity multi-plant options in sites with sufficient space.
High Rate Activated Sludge	Slightly smaller footprint than conventional activated sludge. Can be considered for smaller multi-plant options.
Electro Flocculation	Unproven technology. Eliminated because it is not proven in municipal wastewater treatment at the scale required for CRD.
Trickling Filter	Large footprint, require larger sites. Only suitable if larger sites can be obtained.
Trickling Filter / Solids Contact	Large footprint, require larger sites. Only suitable if larger sites can be obtained.
Moving Bed Bioreactor (MBBR)	Mid-size footprint suitable for smaller sites.
Biological Aerated Filter (BAF)	Secondary clarifiers not required. Small footprint suitable for smaller sites.
Actiflo wet weather treatment primary treatment	Small footprint and good performance. Higher operating cost for chemicals and sand media.
Densadeg wet weather primary treatment.	Small footprint. Higher operating cost for chemicals.

Technology	Implementation Considerations
Lamella Plate Settlers	Reduces primary sedimentation size. Suitable for smaller sites but requires chemicals during wet weather flow events.
Rotating Biological Contractor (RBC)	Not typical for flows >5 MLD. Not suitable for high wet weather flows. Eliminated because only typically suitable for small plants.
Co-Mag Wet Weather Primary Treatment	Suitable for smaller sites.
Bio-Mag Secondary Treatment	Small footprint, but not typically used for flows >20MLD. Technology is still embryonic and in development stage.
Ultra Violet (UV) Disinfection	Preferred disinfection technology for wastewater effluent.
Tertiary Oxidation (Ozone) for CEC	Suitable for oxidizing some CECs however Increased operations cost for power and peroxide.
Salsnes High Rate Fine Screening	Does not provide adequate BOD reduction and too many units would be required to manage the wet weather flows. Was piloted at CRD previously.
Activated Sludge Algae	Emerging Technology. Eliminated because not proven in similar scale to that required for CRD.
Primary Treatment Only	Will not meet regulatory requirements.
Extended Aeration Activated Sludge	Not suitable for wet weather because it does not have primary sedimentation and high flows can wash out biomass and impact treatment. Eliminated due to high wet weather flows encountered at CRD.
Integrated Fixed Film AS (IFAS)	Mid-size footprint suitable for consideration.

A number of the technologies outlined in the table above provide for secondary treatment but require large sites which are not available in the CRD.

6.3 REPRESENTATIVE SECONDARY TREATMENT TECHNOLOGIES

The following is a description of technologies that were considered by the Project Board during the assessment of wastewater treatment options.

To enable comparison of costs and assessment of siting; high rate, representative technologies for siting options have been selected for this evaluation. The representative technologies all use Proven

Technologies for secondary treatment that will meet the discharge objectives[7] and have been successfully implemented at numerous locations in North America and Europe. It is possible that the treatment process ultimately selected could be different that the representative technology assumed for this business case, this is dependent on the procurement process and final siting decisions. All of the sites in the CRD have limited available space so high rate technologies must be used. The following narrative describes these three technologies at greater length.

The representative secondary treatment technologies have the following, broad applications:

- High Rate or Conventional Activated Sludge (CAS) for sites with no space limitation.
- Biological Aerated Filters (BAF) for sites with space limitations.
- Membrane Bioreactor (MBR) activated sludge systems for locations where high effluent reuse potential exists.

Technology considerations are representative only for the purposes of establishing budgets for Proven Technology. The application will depend on the size of the sites ultimately made available for wastewater treatment facilities.

6.3.1 Conventional Activated Sludge (CAS)

The CAS system is the most widely used process for secondary treatment worldwide, is quite flexible for incorporation of future technology, and can be constructed for a reasonable capital cost and operated at an acceptable operating cost. It also has the advantage of being able to increase the future capacity without additional process tankage by placing membranes or floating media (MBBR) in the aeration tanks.

The issue with CAS is that it requires significant space which is not available at most of the plant sites under consideration. It may be a viable option for two or greater plant configurations due to their smaller capacity.

6.3.2 Membrane Bioreactor (MBR)

For an MBR process, a bioreactor tank will be followed by a membrane tank which will contain hollow fibre micro filtration acetate membranes which will achieve separation of the activated sludge (AS) from the liquid effluent by applying a vacuum across the semi permeable membranes. A portion of the separated sludge will be returned to the bioreactor as return activated sludge (RAS) to seed the biological processes. The remainder of the sludge referred to as waste activated sludge (WAS) will be wasted and pumped to Hartland for treatment.

[7] biological treatment capable of producing an effluent quality that meets Federal and Provincial standards for secondary treatment

The pore size on the membranes will be < 2 microns which will provide a physical barrier to organic and inorganic solids and even to microorganisms including bacteria. The MBR plant quality will be very high, 2 mg/L BOD and < 1 mg/L TSS. During storm flows up to 2 x ADWF, the combined MBR and chemically enhanced primary treatment (CEPT) effluent will easily meet the effluent requirements for discharge to the marine environment.

The MBR plant effluent will be suitable for reuse for irrigation on golf courses and parks and use for toilet flushing. That portion of the effluent used for these purposes would need to be disinfected using UV irradiation and probably chlorination to retain an appropriate residual chlorine level. MBRs are capable of producing high quality effluent, but their energy consumption is high and membranes must be replaced every eight to ten years at a significant cost.

6.3.3 Biological Aerated Filter (BAF)

A biological aerated filter (BAF) design provides the most compact design for smaller sites. There would be no requirement for secondary clarifiers saving space. BAF is an attached growth process where a polystyrene or shale filter bed in the order of three to four metres is used as a filter media. The reactor also uses compressed air which is introduced into the filter bed to satisfy oxygen demand of aerobic microorganisms.

The yield of excess sludge is similar to activated sludge with between 0.8 to 0.9 kg cells/ kg of BOD removed. In a typical design, multiple filter cells are used so that one can be backwashed approximately once every 24 hours. The backwash is directed to a dirty wash water tanks and solids are removed and directed to thickening facilities. The BAF process is capable of meeting provincial and federal effluent requirements. Tertiary effluent capable of 5:5 mg/L BOD / TSS can be achieved by adding filtration to the BAF process, which can be accomplished using disc filters.

BAF have been installed at numerous locations in Canada, USA, and Europe, and there are several suppliers to provide BAF process equipment. The BAF is an ideal candidate for smaller sites, but the filter tanks are quite deep and would likely result in higher capital costs due to the need for significant excavation.

7 WASTEWATER TREATMENT OPTIONS ANALYSIS

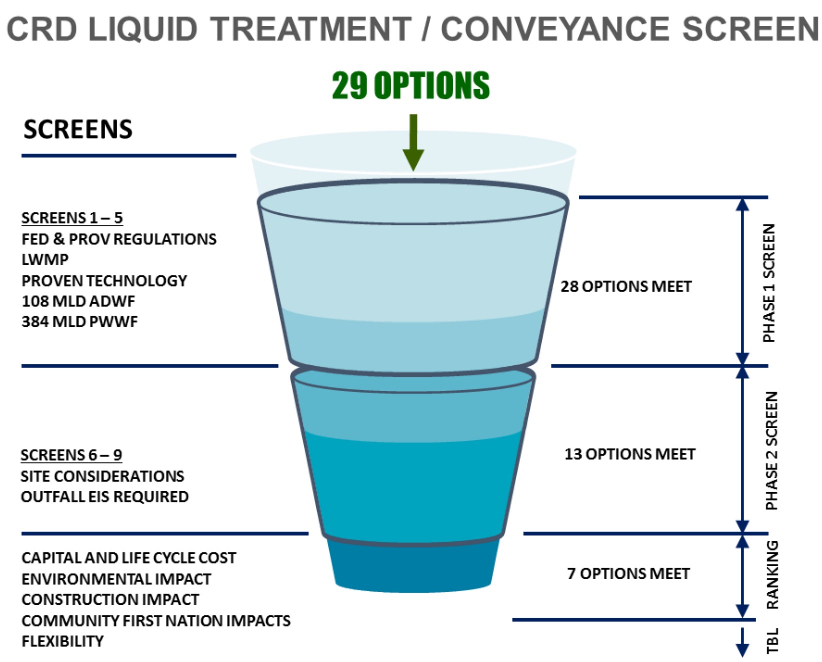
As referenced above, many studies have been completed by various consulting engineering firms to assess a variety of options for wastewater treatment in the CRD.

The Project Board requested a comprehensive summary of all treatment options that have been assessed to date for the Program. All options were to be considered and evaluated; in addition, new options that warranted further assessment were also to be considered.

The consulting team compiled a list of all previous work completed since 2006 including the most recent work completed as part of the Eastside and Westside Select Committees and the Technical Oversight Panel. A summary matrix was developed to outline the attributes of each option. A total of 29 options were considered as part of the evaluation process. The options ranged from multi-plant decentralized treatment options to single plant regional options.

The 29 options be screened using a Phase One high level screening process which did not consider the project cost or schedule to provide an objective evaluation of all options. Options that passed the Phase One screen were evaluated against the Phase Two screening criteria. Options which passed the Phase Two screening requirements were then ranked based on defined considerations. The top ranked options were then assessed using a TBL evaluation approach.

Figure 6: Wastewater Screening Process



7.1 TREATMENT OPTIONS IDENTIFICATION AND DESCRIPTION

As referenced above, the Project Board started the wastewater treatment analysis with a list of 29 options that included 8 single (regional) plant options, 10-two plant options, and 11 multi-plant options ranging from 3 to 10 plant distributed plant site options.

Refer to Appendix J [Assessment of Liquid Wastewater Treatment Options] for a detailed description of these options.

7.2 PHASE ONE SCREEN

Phase One of the screening process tested each options' ability to meet the following requirements:

1. Federal and Provincial Regulations – the ability of a given technology to meet the federal WSER and the provincial MWR;
2. LWMP – the ability of the given technology and site to fit within the guidelines outlined in the CRD's approved LWMP;
3. Proven Technology – the proposed technology must meet the Proven Technology test;
    - Proven Technology means a high rate, small footprint wastewater technology or process related to primary wastewater treatment, secondary wastewater treatment, tertiary treatment, pumping, residual solids storage, and biosolids treatment that is installed at a wastewater treatment facility and where the technology or process is currently in operation and has been continuously operating reliably for a reasonable period of time in a similar process configuration of similar scale or complexity under similar or less favorable influent wastewater quality conditions, and has been operating with process modules the same size or larger than those proposed, and at a process loading as great or greater than that proposed.
4. ADWF Capacity – the ability of the technology and related site(s) to be able to treat, at least a total combined capacity of 108 MLD ADWF; and
5. PWWF Capacity – the ability of the technology and related site to be able to treat at least 384 MLD PWWF.

After the first phase of screening, only one option was eliminated due to its inability to meet wet weather treatment capacity. This was to be expected, as the majority of options developed over the past ten years should have been capable of meeting these definitive goal posts, which are project absolutes.

7.3 PHASE TWO SCREEN

The Phase Two screen tested each remaining options' ability to meet the following requirements:

- Site Considerations – is the site large enough, what is the likelihood of securing an interest in the site, whether the site required significant remediation, and whether or not re-zoning of the site would be required.
- Outfall EIS Requirement – would a new EIS be required for the option's outfall(s) or could an option undergo a fast track approval where existing outfalls were being twinned to increase capacity.[8]

The 28 remaining options were then subjected to Phase Two of the assessment, where a further 15 options were eliminated leaving 13 for further evaluation. Many of the 15 options were eliminated due to unrealistic site availability considerations, the requirement for significant environmental remediation at the selected sites, or onerous EIS requirements for the outfall(s).

The required outfall environmental impact assessment is a significant consideration in the screening of the remaining viable options. Previous experience has indicated that new outfalls on Vancouver Island take at least 24 months to permit (the recent McLoughlin outfall EIS took 30 months). Options which used the Clover Point, Macaulay Point or proposed McLoughlin Point outfalls were considered more favourable because even if twinning an existing outfall to increase capacity was necessary, these options should be permitted more easily because there is a significant amount of historical monitoring data at the outfall sites and dispersion models are available.

While many of the options assessed would require that an EIA or at least an initial environmental screening assessment be undertaken, some of the options were viewed as having less onerous assessment requirements due largely to their favourable locations at existing outfall sites and the number of required outfalls.

Table 6: Options that Passed the Phase Two Screen

Option #	Title
2	Single Plant: Rock Bay Central Tertiary using MBR
4	Single Plant: Rock Bay Secondary
7	Single Plant: Holland Park Regional
8	Single Plant: McLoughlin Secondary Plant

[8] Refer to Appendix D [CRD Outfall Permit Requirements] for more information.

Option #	Title
10	Two-Plant: Clover Point and McLoughlin Tertiary using MBR
13	Two-Plant: East Saanich MBR and McLoughlin Point Secondary
16	Two-Plant: McLoughlin Point and Holland Park Secondary
17	Two-Plant: McLoughlin Point / Rock Bay Tertiary MBR
18	Two-Plant: McLoughlin Point / Rock Bay Secondary
19	Multi-plant: Rock Bay 80% secondary; 20% tertiary at Esquimalt
20	Multi-plant: Colwood/ Langford, Esquimalt Nation and Rock Bay 30% is tertiary sidestream, 70% secondary
21	Multi-plant: 2 tertiary plants McLoughlin and Rock Bay and 1 primary plant at Clover Point
22	Multi-plant: 3 plants at East Saanich, McLoughlin, and West Shore

7.4 RANKING THE REMAINING OPTIONS

The options that met the requirements of the Phase Two screen were ranked in accordance with the following factors:

1. Life Cycle Cost – an examination of the capital, operation and maintenance and life cycle costs. Life cycle costs were considered over a 25 year period and were calculated using a four per cent discount rate.
2. Environmental Impact – carbon footprint and resource recovery potential of the option;
3. Construction Impacts – short term impacts to residents and businesses during construction based on a hi, medium, or low assessment;
4. Community and First Nation Impacts – would the construction or operation have any community or First Nation impacts; and
5. Flexibility – ability of the option to meet changing regulatory and process requirements or undergone modification in the future should regulations change.

7.4.1 Screening Results

The13 short listed options were evaluated and the multi-plant options were removed from consideration due to their higher life cycle cost and greater construction and post-construction impacts, and as such, they did not make the short list of options for further evaluation. A description of the options not carried forward for further consideration and the rationale for elimination are discussed below:

Option 7 Holland Park Regional: The existing zoning was reviewed and current zoning of the property is R1-B which does not permit wastewater treatment facilities, this means that a rezoning would be necessary and could take an extended period of time. Since this option was not presented to the public in the 2016 public consultation program and because it is a park, it may face public opposition. The site would also likely require an EIS or at least a screening level environmental assessment.

Option 16 McLoughlin and Holland Park: Holland Park site has the same considerations as Option 7.

Option 19 Colwood / Langford, Esquimalt First Nation and Rock Bay Secondary: This option was eliminated because there are EIS requirements associated with outfalls as well as the new sites.

Option 20 Colwood / Langford Tertiary (MBR), Esquimalt First Nations (Secondary), and Rock Bay Secondary: same comments on Option 19.

Option 21 Clover Point (Primary), McLoughlin Tertiary MBR and Rock Bay Tertiary MBRs: This option was eliminated because there is limited space at Clover Point for primary treatment and it would likely have to be built underground.

Option 22 East Saanich, McLoughlin, West Shore: This three plant option was eliminated because only one of the three sites, McLoughlin Point, has an outfall EIS. The West Shore and East Saanich sites would require an EIS. The site availability for a new plant in East Saanich is also uncertain.

After the elimination of the options noted above the remaining options were advanced to the TBL assessment as discussed in section 11 of Appendix J [Assessment of Liquid Wastewater Treatment Options], and summarized below, to ensure that economic, environmental, and social considerations were factored into the overall assessment.

7.5 TRIPLE BOTTOM LINE ANALYSIS

TBL is an evaluation framework that incorporates three dimensions of performance: economic, environmental and social. Many organizations have adopted the TBL assessment framework to evaluate their performance in a broader perspective to create greater business value in consideration of non-monetary social and environmental criteria.

Municipal officials across Canada increasingly recognize that sustainability projects benefit not only the environment, but also the economy and society at large. For this reason, the Federation of Canadian Municipalities (FCM) promotes and measures Green Municipal Fund (GMF) project impacts using a triple bottom line approach — one that considers criteria from all three areas. The combined and often complementary effects of project benefits lead to tangible improvements at the community level — cleaner water, better municipal services, and more efficient use of resources such as energy.

Putting TBL into practice is challenged by the need to determine a measurement of social and environmental categories in some instances. The TBL framework nevertheless enables organizations to take a longer-term perspective on decisions and thus better evaluate potential future impacts.

A TBL assessment approach was proposed to assist in the selection of the preferred alternative. By understanding the economic, environmental and social implications of the alternatives and considering community values, the best long term sustainable decisions can be made.

Economic impacts are the direct costs to a public agency that are traditionally associated with an economic analysis. Capital costs and life cycle costs associated with ongoing operations and maintenance are considered. The ongoing operating costs are significant for a treatment facility and often exceed the overall initial capital investment over the life of the facility. Environmental criteria are the environmental implications of an agency's decisions that can impact utility customers. An example could include spending additional capital to produce tertiary effluent even though there is no demand for tertiary effluent reuse. Social impacts include those factors which are important to the community and may result in impacts such as increased traffic.

A TBL evaluation tool was developed to evaluate the short listed options in each of the social, environmental and economic criteria groups. Twenty-six (26) criteria were developed by members of the business case project team which included financial, technical, business and legal professionals.

7.5.1 Triple Bottom Line Criteria

The following table describes these criteria and the considerations for evaluation of criteria against the options in each of the economic, environmental and social categories.

Table 7: Economic Criteria and Description

Name	Description
EC-01 **Capital Costs**	Construction costs including both direct and indirect costs in 2016 dollars.
EC-02 **Whole Life Cycle Costs**	Operating and maintenance costs, expressed as a net present value cost using a 25 year life cycle cost and a 4% discount rate, added to capital costs.
EC-03	The current approved Program capital budget is $788 million. The draft

Name	Description
CRD Capital Cost Contribution	Federal/Provincial funding agreements total $502 million. The CRD share of the capital cost is calculated as the Option Capital Cost (EC-01) minus $502 million. This analysis did not include a detailed review of Eligible Costs relating to the $502 million; this means that the final amount of senior government funding could change based on the Eligible Cost review.
EC-04 **Schedule of Completion**	Impacts included in the estimated service commencement date, may include: • Timing needed for rezoning and permitting requirements (e.g. development permit) • Environmental permitting requirements • Procurement needs • Commissioning • Site conditions that may extend construction(i.e. piling, shoring)

Table 8: Environmental Criteria, Description and Considerations

Name	Description	Evaluation Considerations
EN-01 **Carbon Footprint**	• Net carbon dioxide equivalent (eCO_2) during the construction and operation of the treatment plant (tonnes/year). • Excludes consideration of the biosolids treatment	• Technology impacts to carbon footprint • Pumping and other conveyance impacts to carbon footprint
EN-02 **Heat Recovery Potential**	• Heat recovered from the wastewater treatment results in a low grade heat. • This criterion is defined as the options' estimated opportunity to earn revenue, or save operating costs, from heat recovery.	• Proximity of plant to potential existing customers • Proximity of plant o potential future customers
EN-03 **Water Reuse Potential**	• The options' estimated opportunity to earn revenue, or save operating costs, from water reuse. • Effluent reuse can be both internal to the treatment plant and external via an end product user. The use of treated water is based on provincial regulations that require tertiary treatment and disinfection.	• Proximity of option to potential existing customers • Proximity of option to potential future customers • Potential of option to produce water for reuse opportunities
EN-04 **Environmental Considerations for Site**	• Impacts to the local environment during construction of the treatment plant.	• Degree of remediation required to prepare site for construction • Disturbance of natural environment • Natural or disturbed site • Requirement for blasting • Requirements for shoring and piling • Disturbance of natural habitat and vegetation • Elevation of the proposed sites (e.g. need to build tsunami walls) • Potential impacts due to climate change (sea level rise)

Name	Description	Evaluation Considerations
EN-05 **Flexibility for Integrated Resource Management and Resource Recovery**	• Suitability of the products produced from the wastewater treatment for IRM with biosolids, organic waste and solid waste streams	• The potential for IRM resides principally with the Solids Management Plan rather than wastewater treatment • The ability of the option to accommodate an IRM planning process either now or in the future (e.g. future retrofits to accommodate different uses for waste products).
EN-06 **Wet weather treatment resiliency**	• Ability to modify the treatment plant's operating procedures to adjust to varying wet weather flow conditions.	• Ability of treatment technology to ramp up/down during wet weather flow events experienced in the CRD while maintaining effluent regulatory requirements.
EN-07 **Flexibility for more stringent treatment regulations in future**	• The flexibility to expand or readily modify the treatment process to meet future permits requirements.	• Ability of treatment process to be upgraded to meet higher treatment requirements. • Cost impacts of future modifications • Schedule impacts of future modifications • How does the future retrofit impact plant operations
EN-08 **Terrestrial vegetation and Inter-tidal impacts**	• Impact that a given site would have on existing terrestrial and inter-tidal habitat, and the degree of mitigation that may be required.	• Impact on the vegetation and habitat for terrestrial areas of the site during construction. • Degree of mitigation required for terrestrial and marine environment.
EN-09 **Environmental Performance**	• Whether and extent to which regulatory requirements meet or exceed regulatory requirements.	• Degree that the option's treatment technology exceeds current regulation requirements.

Table 9: Social Criteria, Description and Considerations

Name	Description	Evaluation Considerations
SO-01 **Operations Traffic**	• Amount of traffic nuisance caused to neighbouring residents post-construction.	• Classification of property in the affected area • Number, and types, of schools along the access route • Types of roads; for example, residential, arterial
SO-02 **Operations Impacts on local community**	• Potential for operational noise and vibration which can be heard and felt by the neighbouring residents during operation of the treatment facility.	• Impact of noise and vibration on local community • Classification of local community (e.g. residential or industrial) • Distance of neatest neighbour to source of noise and vibration (e.g. 25 m)
SO-03 **Odour Impacts on**	• Impact of nuisance odours on residents or business in close proximity to the plant.	• Proximity to local community (e.g. 25m) and classification of local community (e.g.

Name	Description	Evaluation Considerations
local community	• This covers nuisance odour related to opening tank covers during maintenance. • Locations closer to residents would have a higher probability of nuisance odours. • It is assumed that all plants would have odour control facilities for normal operations.	commercial, industrial, residential) • Potential odour due to fugitive emission • Degree of mission containment • Degree of odour control equipment • Dispersion specs and impact nearest residences
SO-04 **Visual Aesthetics**	• Aesthetic visual impact for neighbouring residents and visual impact from adjacent roadways.	• Impact of views from both land side and water side • Buffer zones of lawns and landscaping • Care and attention to architecture of buildings required • Care and attention to architectural treatment of tsunami walls
SO-05 **Amenities Potential**	• How the option can impact consideration of community integration opportunities.	• The opportunities for amenity enhancements such as public access, mixed use zoning, public art, waterfront access • The ability to facilitate (encourage) additional public amenities • Size of site to accommodate walking trails, etc. • Space to accommodate complimentary opportunities (e.g. educational facilities, research from UVic, learning centres for public on wastewater treatment)
SO-06 **Construction Impacts (Conveyance)**	• Impacts to the local community of the plant and along the conveyance route alignments during construction, including the alignments that pass through more environmentally sensitive areas.	• Consider the impacts (noise, dust and vibration) of conveyance construction to the local community (focusing on residential and commercial) • Impact to private property owners • Impacts to vegetation and property, including any costs of remediation • Possible damage to property(consider causes, e.g. blasting or vibration)
SO-07 **Construction Impacts (Plant)**	• Impacts to the local community of the plant during construction.	• Consider the impacts (noise, dust and vibration) of plant construction to the local community (focusing on residential and commercial) • Impacts to environmentally sensitive areas • Community impacts resulting from noise and dust • Impacts to vegetation and property, including any costs of remediation • Possible damage to property (consider causes, e.g., blasting or vibration)
SO-08 **Impacts to**	• Options' impact the community's ability to enjoy existing public amenities such as park	• Impacts on existing public amenities (e.g. parks, playgrounds, or access) during the construction and operations of the facility

Name	Description	Evaluation Considerations
existing public amenities	land, either existing or future.	• Impacts on municipality's revenue opportunities associated with the public amenities.
SO-09 **Compatibility with Official Community Plan**	• Does the option fit within the approved Official Community Plan or existing zoning?	• Compatibility with existing Official Community Plan • Requirement for rezoning or variance on zoning, including risk of receiving variance in a timely manner • Development permitting process, including risk of achieving DP in a timely manner • Anticipated opposition to rezoning by host municipality or impacted property owners
SO-10 **Archeological Findings**	• Risk of discovering archeological items during construction.	• Greenfield (undisturbed) vs. Brownfield (disturbed) • Consider archaeological studies completed to date.
SO-11 **Impact to local First Nations**	• How the option impacts local First Nations, either by providing benefits, or lack of consultation	• Has the local First Nations been consulted on the proposed sites? • Are there opportunities for the local First Nations to benefit through the development of the option?
SO-12 **Leading Development**	• Opportunity to be a catalyst for future development or improvements in existing development.	• Opportunity to enable further development or beautification of an area (e.g. project could bring in roads and utilities, which will encourage future development). • Opportunities to improve existing communities (e.g. through upgrades to off-site services)
SO-13 **Cultural and Heritage impacts**	• Ability to use and/or respect culture and heritage. This would include consideration of existing structures or features on the proposed sites.	• How the option respects and incorporates existing cultural or heritage structures, site, or artifacts

7.5.2 Assessment of the Qualitative Criteria

A qualitative assessment of each option was completed for each criterion in the environmental and social categories. Each of these criteria was assessed and a determination made as to each option's impact against that criteria.

As an example of how a social criterion was assessed, low construction impacts are considered preferable to moderate or high impacts. For construction impacts the characteristics of a particular option may be ranked (e.g. very good, good, average, fair, poor) based on characteristics such as noise, proximity to residential areas, requirements for transporting materials through residential or urban areas, need for blasting, excavation, etc. In this case little or no impact may be considered 'very good', whereas significant impacts may be considered 'poor', and therefore the low impact option would be ranked higher.

Each option was assessed against a listing of considerations and evidence provided to support the conclusions reached. The conclusions ranged from very good to poor, see the table below for the description of each of the rankings.

The conclusions were also assigned corresponding numerical result (e.g., from 1 – 5, corresponding to Poor to Very Good), to facilitate presenting the combined results. The assignment of a numerical equivalent is not meant to imply the analysis was quantitative, or that the combined results can be compared in a mathematical or quantitative way.

Table 10: TBL Assessment Legend

Very Good 5	Good 4	Average 3	Fair 2	Poor 1
The impact of the option is very favourable and far exceeds minimum expectations.	The impact of the option is favourable and clearly exceeds minimum expectations.	The impact of the option is acceptable and meets or somewhat exceeds minimum expectations.	The impact of the option barely meets minimum expectations.	Option fails to meet basic requirements of the criterion.

7.5.3 Summary of TBL Results

Table 11: TBL Results, Wastewater Treatment Options Analysis

Criteria	2	4	4a	8	8a	10	13	17	18	18a
EC-01	$1,159	$ 984	$1,004	$ 822	$ 842	$1,078	$ 995	$1,030	$ 980	$1,000
EC-02	$1,535	$ 1,248	$1,268	$ 1,058	$ 1,085	$1,434	$1,257	$1,386	$ 1,288	$1,308
EC-03	$ 657	$ 482	$ 502	$ 320	$ 340	$ 576	$ 493	$ 528	$ 478	$ 498
EC-07	May 2023	Mar 2023	Mar 2023	Dec 2020	Dec 2020	Dec 2023	Dec 2022	Mar 2023	Mar 2023	Mar 2023
Environmental Criteria										
EN-01	Poor	Average	Average	Good	Good	Fair	Average	Fair	Average	Fair
EN-02	Good	Good	Good	Average	Average	Fair	Average	Average	Average	Average
EN-03	Good	Poor	Good	Poor	Average	Average	Fair	Good	Poor	Average
EN-04	Fair	Fair	Fair	Average	Average	Average	Average	Average	Average	Average
EN-05	Good	Average	Good	Good	Good	Good	Average	Good	Average	Good
EN-06	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
EN-07	Very Good	Average	Average	Average	Good	Very Good	Average	Very Good	Average	Average
EN-08	Average	Average	Average	Good	Good	Good	Average	Good	Average	Average
EN-09	Very	Average	Good	Average	Good	Very	Average	Very	Average	Good

Criteria	2	4	4a	8	8a	10	13	17	18	18a
	Good					Good		Good		
Conclusion	**Average**	**Average**	**Average**	**Average**	**Good**	**Good**	**Average**	**Good**	**Average**	**Average**
Social Criteria										
SO-01	Good	Good	Good	Average	Average	Average	Average	Average	Average	Average
SO-02	Average	Average	Average	Very Good	Very Good	Average	Good	Good	Good	Good
SO-03	Average	Average	Average	Very Good	Very Good	Average	Good	Good	Good	Good
SO-04	Average	Average	Average	Average	Average	Average	Average	Average	Average	Average
SO-05	Good	Good	Good	Good	Good	Average	Average	Average	Average	Average
SO-06	Poor	Poor	Poor	Average	Average	Good	Average	Poor	Poor	Poor
SO-07	Average	Average	Average	Good	Good	Fair	Average	Average	Average	Average
SO-08	Very Good	Very Good	Very Good	Very Good	Very Good	Fair	Fair	Very Good	Very Good	Very Good
SO-09	Average	Average	Average	Very Good	Very Good	Poor	Fair	Average	Average	Average
SO-10	Good	Good	Good	Average	Average	Good	Good	Good	Good	Good
SO-11	Good	Good	Good	Average	Average	Average	Average	Good	Good	Good
SO-12	Good	Good	Good	Average	Average	Average	Average	Good	Good	Good

Criteria	2	4	4a	8	8a	10	13	17	18	18a
SO-13	Very Good	Very Good	Very Good	Average	Average	Average	Average	Good	Good	Good
Conclude	**Average**	**Average**	**Average**	**Good**	**Good**	**Average**	**Average**	**Average**	**Average**	**Average**
Environmental and Social Subtotal (245)	**169**	**159**	**167**	**179**	**186**	**155**	**151**	**176**	**161**	**165**

In reviewing and analysing the results of the TBL assessment, the Project Board carefully considered whether any of the options with higher costs were sufficiently superior in the qualitative categories to justify its inclusion in the short list instead of a lower cost option.

Based on the results of the TBL assessment, the following shortlisted options were selected and detailed Class C engineering estimates were developed.

1) Option 4 – Single Treatment Plant at Rock Bay

2) Option 8 – Single Treatment Plant at McLoughlin Point

3) Option 18 – Two Treatment Plants; one at Rock Bay and the other at McLoughlin Point.

Refer to Appendix K [TBL Assessment Sheets Liquid Treatment] for more detail.

7.6 DETAILED COST ANALYSIS, WASTEWATER TREATMENT OPTIONS

Refer to section 10 in Appendix J [Assessment of Liquid Wastewater Treatment Options] for more information relating to the detailed cost analysis. The costs below are rounded, which may result in slight differences from the appendix.

Table 12: Detailed Class C Cost Estimates for Shortlisted Options (2016$, millions)

Option	Wastewater Treatment	Biosolids Treatment*	Conveyance	Total Capital	Whole Life Cycle Costs**
Option 4 Secondary	$ 367	$ 269	$ 335	$ 971	$ 1,177
Option 4a Tertiary	$ 381	$ 269	$ 335	$ 985	$ 1,192
Option 8 Secondary	$ 318	$ 269	$ 273	$ 860	$ 998
Option 8a Tertiary	$ 331	$ 269	$ 273	$ 873	$ 1,013
Option 18 Secondary	$ 537	$ 269	$ 243	$ 1,049	$ 1,291
Option 18a Tertiary	$ 552	$ 269	$ 243	$ 1.064	$ 1,309

* Note that these cost estimates are based on engineering estimates and all options assume the 2012 Energy Centre cost estimate as the placeholder for biosolids treatment.

** Life Cycle Cost based on 25 year period and 4% discount rate. Life cycle costs include liquid and biosolid treatment. Costs are engineer's estimate and do not include development costs of retained risk costs but do include some other indirect costs such as land and amenities. These costs will be established for the business case control budget. Total costs will vary depending on selected biosolids treatment program.

7.7 RECOMMENDED WASTEWATER TREATMENT OPTION

In reviewing and analyzing the results of the TBL assessment, the Project Board carefully considered whether any of the options with higher costs were sufficiently superior in the qualitative categories to justify its recommendation instead of a lower cost option.

Supported by the analysis described in section seven of this report, the Project Board concludes that option 8a, a single regional treatment plant at McLoughlin Point utilizing tertiary treatment technology be the recommended solution for wastewater treatment in the Core Area.

The benefits of the recommended solution are numerous. This is the solution that has the highest likelihood of being implemented and operational within the time frame required by the Federal Government as well as being assessed most favourably in the environmental and social categories of the TBL assessment.

In addition to being the one of the lowest cost options, both capital and lifecycle, for the local taxpayers, this option also provides the following benefits:

1. The EIS has been completed for the required work on the McLoughlin Point outfall; a screening level assessment was completed and approved for the plant site.
2. The plant can be designed to maximize heat recovery potential. Initially this recovered heat can be used for plant operations and could support a district heating system for any new development nearby.
3. Tertiary treatment using disc filter technology is the first step towards yielding effluent quality that is suitable for water reuse.
4. Use of biological aerated filters combined with disc filters will meet 5/5 mg/L BOD/TSS, which exceeds the federal and provincial regulatory requirements.
5. Impact of plant construction and operations on the local community is expected to be low due to the natural buffer between the plant and the neighbours.
6. The plan to pump residual solids to Hartland Landfill for treatment minimizes operations traffic to the plant; it is expected the delivery of bulk chemicals will only take place twice a month.
7. There are opportunities for amenity enhancements during the detailed design process for the plant.
8. The opportunity exists to use the Rock Bay site as a laydown and staging area for construction.
9. All wastewater and biosolids treatment facilities can be constructed to meet the regulatory compliance date of December 31,2020.
10. This option was assessed the highest in the TBL assessment for the environmental and social criteria.

7.8 COLWOOD PROPOSAL

The Project Board received a presentation from a representative of the proponents of the Colwood proposal. The Board engaged in a further review of the proposal including meeting with the proponent team in a closed meeting. As the Project Board understands it, the proposal is a wastewater treatment plant to collect and treat the wastewater from residents of Colwood and Langford. The proposed treatment plant would treat the wastewater to a quality which the proponents believe would be acceptable for discharge to the ground and reuse. The proposal does not include treatment of residual solids. Residual solids would be trucked to Hartland landfill for treatment.

The proponents describe the proposal as a “concept and cost estimate”. As is usually the case at the concept stage of development, there are a number of outstanding issues. These issues include the requirement for detailed studies of hydro geological conditions to develop accurate cost estimates and to evaluate the impacts of reuse and recharge on the water balance, water supply and stream flows. In addition, issues related to plant capacity, reliability and redundancy will need to be addressed. Environmental impact assessments have not yet been completed.

There has been an interest in the region for decentralized wastewater treatment. This proposal is consistent with this interest and may work. The Project Board recommends funding the next stage of development which includes environmental impact assessments.

The Project Board considered whether the proposal, given the stage of its development, affects the recommendations for a wastewater treatment plant at McLoughlin and residual solids treatment at Hartland. The proposal does not affect the Hartland recommendation, because the concept assumes residual solids from the Colwood plant would be treated at Hartland. Nor does it affect the conveyancing recommendation; the Colwood proposal assumes full integration with the upgraded collection system.

The remaining consideration is the Plant, and whether it should be reduced in size, because existing and future wastewater from Colwood and Langford would be treated at Colwood. The Project Board has concluded it should not, for the following reasons:

1. The Colwood proposal is a concept. There is considerable risk that the technology of ground disposal for reuse and recharge may not be approved by the MOE. Or, the approved process including required studies may take considerable time, pushing project completion beyond the federal regulatory deadline. It is also possible that the outcome of these studies or the conditions of approval result in materially increased costs. If these risks materialize, and the proposal does not proceed, Colwood and Langford will need to rely on the regional plant.

2. If, on the other hand, the risks do not materialize, and if the Colwood proposal is the lowest cost option for future regional growth, and it proceeds, then the plant at McLoughlin will have treatment capacity to allow for growth well into the future. This outcome is far preferable than building McLoughlin at lower capacity today and having to expand it at significantly higher costs in the future. It would also potentially allow for the entire cost at Colwood to be funded by new development.

8 BIOSOLIDS TREATMENT TECHNOLOGY OPTIONS

As part of the Program, consideration must also be given to the management of the residual produced by the wastewater treatment process.

The Project Board requested a comprehensive summary of all treatment options that have been assessed to date for the Program. All options were to be considered and evaluated; in addition, new options that warranted further assessment were also to be considered.

This section reviews planning work that has already been undertaken, outlines the regulatory framework, and alternatives for biosolids management and identifies economic, environmental and social factors that support recommendations of the most promising alternative(s) via a TBL assessment framework. Process technologies are reviewed along with examples from successful programs elsewhere in Canada, the U.S. and Europe. In reviewing the alternatives, flexibility and potential opportunities for phasing of facilities are considered. In addition the opportunities for integration of biosolids and MSW are identified in this report.

In previous work Hartland Landfill has been identified as the preferred biosolids treatment site. This site provides significant advantages with respect to IRM opportunities with Municipal solid and organic wastes ("MSW"). Developing IRM opportunities is an important CRD objective and is a key consideration common to all biosolids options. Biosolids represent about ten per cent by weight of the total combined biosolids and MSW streams.

All information contained in this sections eight and nine of the business case was taken from sections three to six of Appendix L [Assessment of Biosolids Treatment Options].

8.1 PREVIOUS PLANNING WORK FOR BIOSOLIDS TREATMENT

As part of the Program planning work that has been undertaken over the past ten years, several options for biosolids management have been reviewed by various consulting teams and advisory groups. A common theme of that planning work has been maintaining the ability to recover resources from the biosolids and having the ability to potentially integrate this waste stream with the management of the CRD's solid and organic wastes. The most recent planning work involved a biosolids management facility located at the Harland Landfill. Hartland Landfill is intended to receive and process pumped waste solids from the wastewater treatment plant(s). The waste solids would be thickened and then be made available for additional processing.

Once the new wastewater treatment facilities are commissioned, they will produce significant quantities of residuals solids (approximately 22,000 kg/day in 2020) that must be handled on a continuous basis so as to not impact the performance of the wastewater treatment facilities. Treatment options considered must provide reliable performance of both the wastewater and biosolids treatment processes. Any failure of the biosolids process will have significant impacts on the wastewater treatment process.

8.1.1 Proven Technology Considerations

Residual solids processing reliability is fundamental to successful operation of the wastewater treatment process. Even before developing a robust design, including redundant units to act as standby during required maintenance, the selection of well-proven technologies is required for system reliability.

In undertaking a major wastewater treatment program such as this, the CRD has reviewed many new and emerging technologies. While many of these technologies show promise, they are in the development stage and have no or limited operating history at the scale of facilities required for the CRD. This report assumes that viable technologies are those which are well proven in the industry and therefore present little if any risk (specifically, technologies must past the Proven Technology test).

For reference purposes, newer technologies which have been brought forward to the CRD by their developers were reviewed. Some of these technologies may show promise with further development and may warrant consideration in the future with integrated biosolids and MSW processing facilities. The intent is to provide the Project Board with an appreciation for some of the development challenges experienced by developers and users of these newer technologies.

8.1.2 CRD and Integrated Resource Management (IRM)

The CRD operates the Hartland Landfill. There is an opportunity to consider long term integration of residual solids with MSW. There are opportunities for synergies to be realized if the processing and end use of these waste streams are considered together. A goal of the Program is to optimize the integration of biosolids facilities with the current and future solid waste program. Identification of the potential for integration of the biosolids with MSW is timely because the CRD solid waste management staff has been engaged in feasibility studies that have examined the potential for developing a waste-to-energy facility for management of the residual solid wastes remaining after recycling and separation of organic waste. The MSW will be the governing consideration in developing an integrated approach to management of solid waste and biosolids. The biosolids stream only represents ten per cent of the waste stream in the CRD so Municipal solid waste processing options will be the primary consideration in development of a future MSW / biosolids integration plan.

8.2 BIOSOLIDS REGULATORY REQUIREMENTS

Regulatory requirements differ based on the biosolids treatment process. Depending on the treatment process and the resulting output, environmental approval under the federal *Canadian Environmental Assessment Act* (CEAA) may be required.

Environmental approvals may be required under the provincial *Environmental Assessment Act (EMA)* for the Biosolids Treatment Facility. If the Biosolids Treatment Facility does not use anaerobic digestion, and instead landfills or incinerates the residual solids, then the facility will need approval for landfilling or incineration under EMA. For land application of biosolids, a Land Application Plan must be prepared in accordance with the EMA, specifically, the Organic Matter Recycling Regulation (OMRR).

Land-based biosolids utilization is governed by the OMRR. This is perhaps the most relevant and applicable of the regulations and guidelines that apply to biosolids management in British Columbia. The OMRR was established in 2002 under the authority of the *Waste Management Act* and the *Health Act* and was revised in June 2016. The regulation governs the production, distribution, storage, sale, and use of biosolids and compost.

The regulations provide for two classes of biosolids, Classes A and B. 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 much less restrictive handling and land application requirements. The OMRR 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. A processing facility producing Class A or B biosolids must be built to certain specifications, and comply with mandatory standards for pathogen reduction, vector attraction, quality, and sampling and analysis in accordance with the OMRR.

Operational certificates or permits may be required for any discharges into the environment by the biosolids processing facility, including air emissions, liquid effluent discharge and ash disposal under the EMA.

The OMRR regulates the siting, design, operation and closure of landfills, and provides specifications on leachate and landfill gas management, prohibited wastes, open-burning restrictions and financial security aspects of landfill closure. “Emission Criteria for Municipal Solid Waste Incinerators” apply to the contaminant discharge limits, operating parameters and requirements for emission monitoring, facility reporting and operator training.

8.2.1 CRD Policy on Land Application of Biosolids

The CRD Board has adopted a Regional Biosolids Management Policy banning the application of treated biosolids to farm land and parks or the production of any products which are ultimately applied to land. The policy does not support shipping biosolids for land application outside the CRD. This report therefore concentrates on options which did not include land disposal. Future land application options would require a change to CRD policy.

This restriction limits the available options for disposal of biosolids for the CRD.

8.2.2 Solid Waste Management Plan

The existing CRD Solids Waste Management plan allows the storage of biosolids at Hartland Landfill.

8.3 BIOSOLIDS TREATMENT TECHNOLOGY OPTIONS

The CRD has been assessing biosolids treatment facilities as part of the Program analysis for some years. The footprint required to process wastewater and solid waste on a regional basis is such that a single site is impractical. Therefore the Project Board decided to decouple the biosolids treatment from the wastewater treatment and is assumed to occupy its own site at Hartland Landfill.

The Hartland Landfill, a 125 hectare site located in Saanich, is the regional solid waste disposal facility owned and operated by the CRD. Hartland landfill receives about 140,000 tonnes of municipal solid waste per year and offers operational synergies and IRM opportunities with biosolids processing.

The Project Board considered a wide spectrum of treatment technologies in this analysis. The table below summarizes biosolids treatment technologies that have been reviewed during the various planning studies, the table also includes implementation considerations developed during the Project Board review as noted in Appendix L [Assessment of Biosolids Treatment Options].

Table 13: Summary of Biosolids Treatment Technologies

Technology	Considerations and Comments
Anaerobic Digestion (Thermophilic)	Commonly used stabilization process in North American treatment facilities to produce a Class A biosolid.
Anaerobic Digestion (Mesophilic)	Most commonly used stabilization process in North American treatment facilities and is capable of producing a Class B biosolid.
Landfill Bio-cell Reactors (with or without MSW)	Approach is not regulated under OMRR, and would require permitting. Requires large land area.
In-Vessel Composting (Raw or Digested Solids)	Less commonly used for larger facilities and requires significant movement of materials. Due to restriction for Land Application in the CRD, the biosolids would have to be landfilled.
Sludge Drying (Pelletization)	Creates end product that can be utilized in combustion or gasification processes.
Sludge Drying (Fuel for Cement Kiln or Wood Drying Kiln)	Long term viability is subject to long run viability of end user’s business.
Digester Gas Utilization (Onsite Co-generation)	Becoming a commonly used approach for facilities with digestion.
Land Application or Mine Reclamation of Stabilized and Dewatered Biosolids	Approach used by Metro Vancouver, but long term viability may be limited due to site availability and hauling costs off-Island.

Technology	Considerations and Comments
Biosolids Vitrification	Embryonic technology that is not proven on larger scale applications.
Anaerobic Digestion (Thermophilic) - Soil Amendment	Challenge to find end user and goes against current CRD policy.
Residual solids WTE Incineration (Fluidized Bed or Mass Burn)	Effectively eliminates end product requiring disposal, but permitting may be onerous and require schedule extension beyond 2020.
Residual solids WTE Gasification (Synthetic Fuel Production)	Novel technology that is not proven on residual solids-only applications.
Residual solids Integration with MSW or Wood Waste WTE (Gasification)	Better use of the application relative to residual solids-only feed stock. There is also a concern of the long term availability and cost of the feed stock if wood waste is utilized.
Augmentation of Digester Input with Fat, Oil, Grease (FOG) and source separated organics	For enhanced biogas production, this is becoming a more commonly used approach at facilities with existing or planned digesters.
Pre-processing for Optimizing Anaerobic Digestion (Thermal Hydrolysis Process)	Typically used for facilities where available footprint is an issue. Technology adds a more complicated process to the overall solids management train. Footprint is not an issue at Hartland Landfill.
Land Application of Stabilized Biosolids – Willow Coppice (High Rate Wood Fuel Biomass Production)	Approach has had limited use and is subject to land availability and possible third party service provider. It also goes against current CRD policy.
Lime Stabilization - In Vessel Process	Process familiar to the CRD, but creates additional waste material that must be disposed of/utilized. Results in Class A biosolids.
Co-Composting Raw Biosolids with yard waste and/or source separated organics	Less commonly used for larger facilities and requires significant movement of materials.
Resource Recovery from Biosolids – Biomethane Optimization (Fleet Vehicles)	This approach is not commonly used for municipalities that have facilities with existing or planned digesters. It is often ruled out based on a business case evaluation and requirement to convert vehicles to biogas operation. Natural gas prices have been low for a number of years.
Clean up Biogas and Feed to Gas Utility	This approach is not commonly used for municipalities that have facilities with existing or planned digesters. It offers a significant carbon offset but is often ruled out based on the significant investment

Technology	Considerations and Comments
	required for cleaning up the biogas to a standard that is acceptable by the gas utility. Natural gas prices have been low and a forecast to be low for a number of years so it is difficult to justify from a business case perspective.
Geotube Dewatering and Storage	This technology works well for partially stabilized residual solids from lagoons, but would not be very practical for a facility of this size or for the use of residual solids. Difficult operationally.

A common thread amongst many of the processes outlined in the table above is their ability to either provide resource recovery or be part of IRM opportunities. In all of the processes that include anaerobic digestion, opportunities exist to generate, capture and utilize biogas. The utilization of biogas can include the production of heat for the overall solids management process by use as a fuel to fire boilers, cogeneration for the production of electricity that can either be used internally for the solids management process or can be sold to a utility, upgrading the biogas so it can be used to power fleet vehicles, and the scrubbing of the biogas to produce a quality suitable for mixing with utility pipeline quality natural gas.

Composting, anaerobic digestion and lime stabilization all produce an end product that can be used as a resource for the production of growing media, landfill cover, and media for mine and forest land reclamation. The current CRD policy restricting Land Application precludes the consideration of any of these options. Biosolids that are dried and made into pellets can also be used as a resource for fuel that can be utilized in kilns, incinerators or gasifiers.

The biggest opportunity for IRM at the CRD exists with the potential integration of the various waste streams that may be available at the Hartland Landfill. Hartland Landfill provides an excellent opportunity and location for such a facility. IRM can include any process which can combine MSW, FOG or source separated organics with the biosolids as a process feedstock. These combined streams could be incorporated into anaerobic co-digestion, co-composting, WTE, or gasification processes. Most of these processes will benefit from the added waste stream into the process feedstock, but each can also provide processing challenges and operating and commercial revenue risks.

9 BIOSOLIDS TREATMENT OPTIONS ANALYSIS

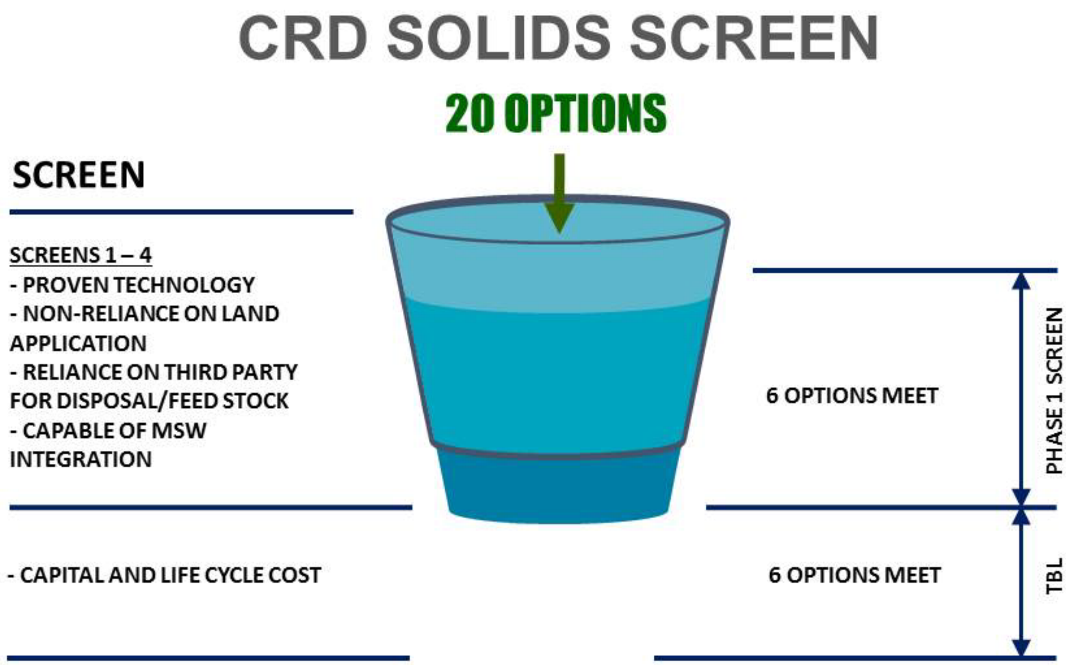
Using the same process as the wastewater treatment options analysis (see section 7 of this report), the biosolids treatment options were evaluated against a Phase One screen. The options that met that screen proceeded to a TBL assessment.

Since the biosolids treatment will be undertaken at the Hartland Landfill, the analysis for biosolids only considered technologies, as opposed to the technologies and siting options considered for wastewater treatment.

The Project Board evaluated 21 options when considering biosolids treatment, one option (Option 4a) was added to the analysis following the phase one screen.

Additional detail, including evaluation results, is contained sections Four and Six in Appendix L [Assessment of Biosolids Treatment Options]. The following sections are taken from this appendix.

Figure 7: Biosolids Treatment Options Analysis



9.1 PHASE ONE SCREEN

Phase One of the screen tested the options' ability to meet the following requirements:

1) Proven Technology – the proposed technology must be Proven;

a. The Project Board used the following definition: Proven Technology means a high rate, small footprint wastewater technology or process related to primary wastewater treatment, secondary wastewater treatment, tertiary treatment, pumping, residual solids storage, and biosolids treatment that is installed at a wastewater treatment facility and where the technology or process is currently in operation and has been continuously operating reliably for a reasonable period of time in a similar process configuration of similar scale or complexity under similar or less favorable influent wastewater quality conditions, and has been operating with process modules the same size or larger than those proposed, and at a process loading as great or greater than that proposed.

2) Land Application – technology that does not rely on land application as the sole means of final disposal to be in accordance with the CRD's policy on land application;

3) Feed Stock or Disposal – technology that does not rely on third parties to provide co-processing feedstock or means of final product disposal/re-use; and

4) Integration with MSW – ability of the technology to be integrated with future IRM strategy incorporating MSW in a co-processing facility.

After the first phase of screening, 14 of the 20 initial options were eliminated. This was to be expected, as the majority of the eliminated options rely on land application as the sole means of disposal. The options utilizing gasification were screened out as this technology is not considered proven in the context of using biosolids alone. While it is recognized that the technology has potential, it is not recommended that the CRD consider gasification as the only means of managing biosolids as there is no long term proven operating record for the technology at the scale required for this facility. If and when the technology performance and reliability improves as a result of further technology refinement and longer term operating experience, the CRD could consider gasification as an add-on process. The CRD could also consider thermal processing technologies such as WTE as part of an integrated MSW / biosolids solution. As noted below, potential for future use of this and other technologies to facilitate IRM was an important consideration of the Project Board in its final assessment of the options. Future changes in beneficial reuse policy by the CRD will enable options where beneficial products are produced to be reconsidered in the future.

Following the Phase One screen, a lower cost sub-option of Option 4, Option 4a, was developed for the options analysis as a cost savings measure.

The shortlist of seven options, described below, was carried forward for costing and triple bottom line analysis:

1) **Anaerobic digestion**, biosolids drying (pelletization for multiple uses), struvite recovery and biogas conditioning;

2) **Anaerobic Digestion** with sludge drying; no biogas conditioning or nutrient recovery;

3) **Residual solids drying** (pelletization);

4) **Anaerobic digestion / landfill biocell reactors** (biosolids with or without MSW);

4a) **Anaerobic digestion** (steel tanks) / landfill biocell reactors (biosolids with or without MSW);

5) **Undigested residual solids landfill biocell reactors** (residual solids with or without MSW); and

6) **Residual solids thermal destruction**.

9.2 TRIPLE BOTTOM LINE ANALYSIS

The TBL considers economic, environmental and social criteria to provide balanced decision making. The TBL framework evaluates options' performance in a broader perspective to create greater business value in consideration of nonmonetary social and environmental criteria.

Economic criteria include the capital, whole life cycle costs, and estimated service commencement date for each option. Environmental criteria are associated with the environmental performance of the specific option, including the ability to meet regulatory compliance and carbon footprint. Social criteria include items that have a social impact on the public, such as impact of construction, odour, and noise.

9.2.1 Triple Bottom Line Criteria and Descriptions

The following table describes these criteria and the considerations for evaluation of criteria against the options in each of the economic, environmental and social categories.

Table 14: Economic Criteria and Description

Name	Description
EC-01 **Capital Costs**	Construction costs including both direct and indirect costs in 2016 dollars. Expressed in millions.
EC-02 **Whole Life Cycle Costs**	Operating and maintenance costs, expressed as a net present value cost using a 25 year life cycle cost and a 4% discount rate, added to

Name	Description
	capital costs. Expressed in millions.
EC-05 **Schedule of Completion**	Estimated schedule for completion.

Table 15: Environmental Criteria, Description and Considerations

Name	Description	Evaluation Considerations
EN-01 **Carbon Footprint**	Net carbon dioxide equivalent (eCO_2) during the construction and operation of the facility, expressed in tonnes/year.	• Construction carbon footprint • Operations carbon footprint • Pumping and other conveyance impacts to the carbon footprint.
EN-02 **Exceed Regulatory Requirements**	Degree to which the treatment process exceeds current regulatory requirements	
EN-03 **Redundancy**	Does the option meet the reliability criteria specified in the MWR?	• Comparison with Table 1 [Component and Reliability Requirements] from the BC Municipal Wastewater Regulations • The remaining capacity with the largest unit process out of service must be at least 50% of the design maximum flow
EN-04 **Resource Recovery Beneficial Reuse**	Do recovered resources have flexibility for beneficial reuse?	• Type of resources that will be recovered by this Option (i.e. biosolids, phosphorous, energy) • Quantities of resources that will be recovered by this Option
EN-05 **Future potential for IRM with MSW**	Suitability of the solids treatment process to integrate with IRM system.	• The potential for IRM via the Biosolids Management Strategy rather than the wastewater treatment portion of the project • The ability of the option to accommodate an IRM planning process either now or in the future (e.g. future retrofits to accommodate different uses for waste products).
EN-06 **Permitting Requirements**	Complexity of permitting and approvals processes.	• Compliance with the LWMP • Compliance with approved Solid Waste Management Plan (SWMP) • Need for EIS • Compliance with Federal/Provincial

Name	Description	Evaluation Considerations
		regulatory requirements • Need for Air Emissions Permit • Anticipated public support/opposition to technology.
EN-07 **Energy Recovery**	Does the process recover reusable energy – biogas / methane / syngas or heat?	• Energy Balance o Gross energy recovery (biogas/heat) GJ/year o Process energy consumption GJ/year o Surplus biogas sale for revenue
EN-08 **Leachate / Wastewater production**	Degree that the option produces leachate or wastewater, which must be treated	• Quantity and quality of leachate generated by this Option • Quantity and quality of wastewater generated
EN-09 **Environmental Controls (Air)**	Does this option require advanced air emission controls?	• Complexity of environmental emissions control for the option under consideration.
EN-10 **Track Record of Performance**	Does process have a proven track record of performance as specified in the draft PPP Canada agreement	• Does the Option meet the P3 Canada requirement of 5 years of continuous operation under similar operating conditions?
EN-11 **Terrestrial Impacts**	Impact that a given site would have on existing terrestrial habitat.	• Impact on the vegetation and habitat for terrestrial areas of the site during construction • Degree of mitigation required for terrestrial environment)

Table 16: Social Criteria, Description and Considerations

Name	Description	Evaluation Considerations
SO-01 **Operations Traffic**	The impact of the traffic during the operations period of the option has on local communities.	• Number of trucks per month • Classification of local community, e.g. residential, industrial, or commercial properties • Number, and types, of schools along the access route • Types of roads; for example, residential, arterial.
SO-02 **Operations Impacts on local community**	Potential for operational noise, dust and vibration impacts on the local community during operation of the treatment facility.	• Impact of noise, dust and vibration on local community • Classification of local community (e.g. residential or industrial)

Name	Description	Evaluation Considerations
		• Distance of neatest neighbour to source of noise and vibration (e.g. 25 m)
SO-03 **Odour Impacts on local community**	Impact of nuisance odours on the local community. This criterion assumes that the following design parameters have been followed: • Covered processes • Machines in buildings • Use of scrubbers • Requirement for no odour at the property line during normal operations.	• Proximity to local community (e.g. 25 m) and classification of local community (e.g. commercial, industrial, residential) • Potential odour due to fugitive emission • Degree of emission containment • Degree of odour control equipment • Dispersion specifications and impact nearest residences
SO-04 **Health and Safety – Workplace and Public**	Potential workplace and public health and safety concerns.	• Exposure to untreated residual solids that can cause various illnesses • Biological agents that are capable of causing disease and that are considered the greatest threat are called pathogens • Pathogens may be dispersed into the workplace and surrounding community by water or wind • Disbursement of pathogens outside of site (e.g. surrounding community)
SO-05 **Construction Impacts (Conveyance)**	Construction impacts to the community along the conveyance route.	• Consider the impacts (noise, dust and vibration) of conveyance construction to the local community (focusing on residential and commercial) • Interruption of "quiet enjoyment" of private property owners • Impacts to vegetation and property, including any costs of remediation • Possible damage to property(consider causes, e.g. blasting or vibration) • Pipeline is small diameter 250 mm and impacts are not anticipated to be significant
SO-06 **Construction Impacts (Treatment Facility)**	Construction impacts to the community.	• Consider the impacts (noise, dust and vibration) of plant construction to the local community (focusing on residential and commercial) • Impacts to environmentally sensitive areas • Interruption of "quiet enjoyment" of private property owners • Impacts to vegetation and property, including any costs of remediation • Possible damage to property (consider causes, e.g., blasting or vibration) • Daily construction truck traffic
SO-07 **Ease of**	Complexity of technology to maintain operational performance.	• Is the treatment technology robust and will respond favourably to changing feedstock

Name	Description	Evaluation Considerations
Operations		conditions • Does the treatment technology require frequent operator monitoring and intervention
SO-08 **Compatibility with Official Community Plan (OCP)**	Degree of planning activity to amend OCP, zoning, and development permitting	• Compatibility with OCP • Requirement for rezoning, or variance on rezoning, including risk of timely resolution • Development permitting process, including risk of achieving DP in a timely manner. • Anticipated opposition to rezoning by host municipality or impacted property owners
SO-09 **Archeological Findings**	Risk of discovering archeologic items during construction	• Consider archeological studies completed to date
SO-10 **Impact to local First Nations**	How the option impacts local First Nations, either by providing benefits, or lack of consultation?	• Can the option accommodate First Nation interests? • Has the local First Nations been consulted on the proposed sites? • Are there opportunities for the local First Nations to benefit through the development of the option?
SO-11 **Cultural and Heritage impacts**	Ability to use and/or respect culture and heritage. This would include consideration of existing structures or features on the proposed sites.	• How the option respects and incorporates existing cultural or heritage structures, site, or artifacts

9.2.2 Assessing the Qualitative Criteria

The methodology used to assess the economic, environmental and social criteria for biosolids treatment options was consistent with the wastewater treatment analysis; refer to section 7.5 for detail as required.

9.2.3 Summary of TBL Results

Table 17: Biosolids Processing Options Analysis

Criteria	1	2	3	4	4 a	5	6
	Anaerobic Digestion & Dryer	Anaerobic Digestion & Dryer, No scrubbing or Nutrient Recovery	Dryer, Raw Solids	Biocell – Digested Solids	Biocell – Digested Solids (Bolted Steel Tank)	Biocell – Raw dewatered Solids	Thermal Destruction Raw Solids
Economic Criteria							
EC-01	$ 267	$ 224	$ 188	$ 166	$ 144	$ 104	$ 224
EC-02	$ 314	$ 287	$ 257	$ 207	$ 185	$ 159	$ 275

Criteria	1 Anaerobic Digestion & Dryer	2 Anaerobic Digestion & Dryer, No scrubbing or Nutrient Recovery	3 Dryer, Raw Solids	4 Biocell – Digested Solids	4 a Biocell – Digested Solids (Bolted Steel Tank)	5 Biocell – Raw dewatered Solids	6 Thermal Destruction Raw Solids
EC-03	Dec 31 2020	Dec 31 2020	Dec 31 2020	Dec 31 2020	Dec 31 2020	Dec 31 2020	Dec 31 2022
Environmental Criteria							
EN-01	Very Good	Good	Average	Good	Good	Poor	Fair
EN-02	Very Good	Good	Good	Good	Good	Poor	Average
EN-03	Good	Good	Good	Good	Good	Fair	Average
EN-04	Very Good	Good	Average	Good	Good	Fair	Average
EN-05	Very Good	Good	Average	Average	Average	Fair	Fair
EN-06	Very Good	Very Good	Average	Good	Good	Fair	Fair
EN-07	Very Good	Good	Fair	Average	Average	Fair	Fair
EN-08	Average	Average	Average	Fair	Fair	Fair	Average
EN-09	Good	Good	Fair	Average	Average	Fair	Fair
EN-10	Very Good	Very Good	Average	Good	Good	Fair	Good
EN-11	Good	Good	Good	Average	Average	Average	Good
Conclusion	**Very Good**	**Good**	**Average**	**Good**	**Good**	**Fair**	**Average**
Social (Health and Safety) Criteria							
SO-01	Good	Good	Average	Fair	Fair	Poor	Very Good

Criteria	1 Anaerobic Digestion & Dryer	2 Anaerobic Digestion & Dryer, No scrubbing or Nutrient Recovery	3 Dryer, Raw Solids	4 Biocell – Digested Solids	4 a Biocell – Digested Solids (Bolted Steel Tank)	5 Biocell – Raw dewatered Solids	6 Thermal Destruction Raw Solids
SO-02	Good	Good	Good	Good	Good	Good	Good
SO-03	Good	Good	Fair	Average	Average	Fair	Fair
SO-04	Good	Good	Average	Average	Average	Fair	Average
SO-05	Average	Average	Average	Average	Average	Average	Average
SO-06	Good	Good	Good	Good	Good	Good	Good
So-07	Average	Average	Average	Good	Good	Average	Good
SO-08	Average	Average	Average	Average	Average	Average	Poor
SO-09	Good	Good	Good	Good	Good	Good	Good
SO-10	Average	Average	Average	Average	Average	Average	Average
SO-11	Average	Average	Average	Average	Average	Average	Average
Conclusion	**Good**	**Good**	**Average**	**Average**	**Average**	**Average**	**Average**
Total Env & Social (235 pts maximum)	**196**	**183**	**147**	**162**	**162**	**108**	**136**

Refer to Appendix M [TBL Assessment Sheets for Biosolids Treatment Options] for more detail.

9.3 DETAILED COST ANALYSIS, BIOSOLIDS TREATMENT OPTIONS

Refer to section five in Appendix L [Assessment of Biosolids Treatment Options] for more information relating to the detailed cost analysis.

The Class C cost estimates (2016$) are summarized below.

Table 18: Detailed Class C Cost Estimates for Shortlisted Options

Option	Capital Cost	Annual Operations and Maintenance Cost	Life Cycle Costs*

Option	Capital Cost	Annual Operations and Maintenance Cost	Life Cycle Costs*
Option 1 – Anaerobic digestion, drying, gas recovery, nutrient recovery (previously funded case)	$ 267,000,000	$ 3,021,000	$ 314,200,000
Option 2 – Anaerobic digestion, drying (with no gas scrubbing for utility sale and no nutrient recovery)	$ 224,000,000	$ 4,060,000	$ 287,200,000
Option 3 – Residual solids drying (pelletization)	$ 188,252,000	$ 4,405,845	$ 257,080,000
Option 4 – Anaerobic digestion biocell reactors (with or without MSW)	$ 165,557,000	$ 2,631,000	$ 206,700,000
Option 4a – Anaerobic digester (steel tanks) / biocell reactors (with or without MSW)	$ 143,646,000	$ 2,631,000	$ 184,800,000
Option 5 – Undigested residual solids / biocell reactors (with or without MSW)	$ 104,153,000	$ 3,483,000	$ 158,600,000
Option 6 – Residual solids thermal destruction	$ 223,997,000	$ 3,259,030	$ 274,900,000

* Life Cycle Cost based on 25 year period and 4% discount rate. Costs are engineering estimates and do not include development costs or retained risk costs

9.4 RECOMMENDATION

In reviewing and analysing the results of the TBL assessment, the Project Board carefully considered whether any of the options with higher costs were sufficiently superior in the qualitative categories to justify its recommendation instead of a lower cost option.

The recommended solution for biosolids treatment is as follows:

- a Biosolids Treatment Facility at Hartland Landfill to treat residual solids to produce, with anaerobic digestion, Class A biosolids which would qualify for beneficial use, as defined by the MOE; and
- the CRD store the Class A biosolids at Hartland Landfill on an interim basis in a biocell; while recovering biogas and leachate.

There has been a longstanding interest in the region to move to IRM, which means integrating biosolids, organics and municipal solid waste. However, the CRD does not control the vast majority of its waste. It does control biosolids from the plants it operates, but biosolids represent less than ten per cent of the total waste stream. In order to have an effective IRM plan the CRD must implement policies and bylaws to control the flow and processing of the majority of its waste. The development of these policies will require analysis and extensive consultation with member municipalities, technology providers, existing private sector waste haulers and processors, other stakeholders and the broader public.

10 PART C - PROCUREMENT REVIEW AND RECOMMENDATION

10.1 WASTEWATER TREATMENT

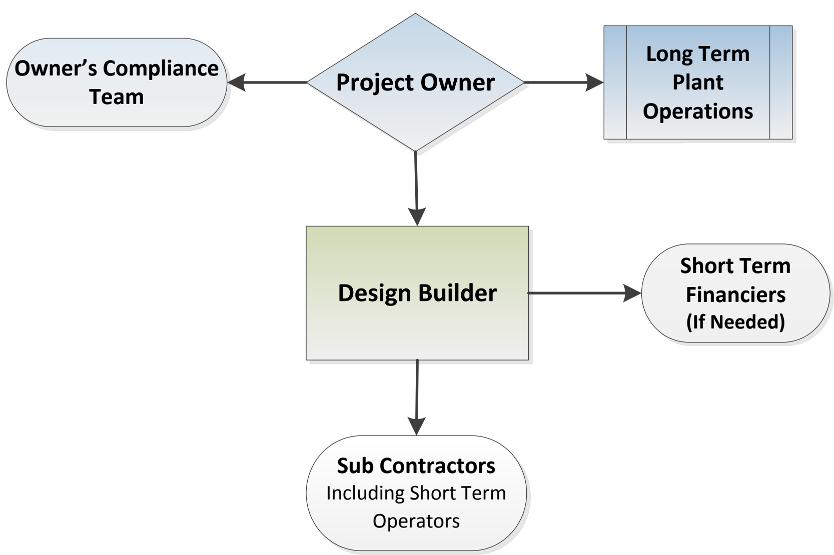
Detailed business case planning, undertaken by the CRD in 2010, demonstrated that a Design-Build-Finance (DBF) approach to procurement for the wastewater treatment plant would result in value for money to the taxpayer. The scope of the project includes the wastewater treatment plant, the tunnel under the Victoria Harbour, and a new outfall at McLoughlin Point.

Under a DBF model, the CRD engaged an owner's engineer to develop design and construction performance specifications for the Project. The CRD then managed a competition to select a design build team to arrange construction financing and undertake the detailed design and construction of the facility, based on the specifications prepared by the CRD's project team. The successful team is prepared to enter into a fixed price contract with some milestone payments being made by the CRD during construction.

In this model, design and construction risk, along with the short term (two year) performance risk, is transferred to the design builder, while the CRD retains long-term operational and maintenance risks. This risk transfer is anchored by having capital at risk during the construction period and the first two years of operations.

The CRD will own and operate the wastewater treatment plant over the long term.

Figure 8: Design Build Finance Contractual Structure



The deal structure for the CRD Program (wastewater treatment plant) includes the following:

(a) The design-builder would arrange construction financing for a portion of the McLoughlin Point WWTP capital cost sufficient to secure the risk transfer, which would be held back from the periodic payments to be made to the design-builder during construction;

(b) Upon substantial completion of the WWTP, the Owner would pay the balance of the fixed price to the design-builder in exchange for an irrevocable letter of credit in a sufficient amount to secure the risk transfer during the two year performance period;

(c) During the two-year performance period, the CRD would manage, operate and maintain the WWTP in accordance with the operating standards set out in the Project Agreement and the design-builder would train CRD staff and assist the CRD in optimizing the performance of the WWTP; and

(d) The design-builder would be responsible for the WWTP's performance during those first two years, including the need to make any adjustments to the process or implementing any changes to the plant's design if necessary to meet the contractual specifications and the warranties provided by the design-builder.

The CRD managed the procurement, described above, in 2013-14 and the successful proponent was Harbour Resource Partners (HRP). The successful design met the CRD's requirements, including the affordability threshold.

The recommended wastewater treatment plant at McLoughlin Point is, in the Project Board's view based on legal and technical advice, sufficiently similar to the plant required in the earlier procurement process that a new procurement is not required under applicable procurement laws and policies.

The Project Board has confirmed with HRP that it is prepared to be re-engaged for the McLoughlin wastewater treatment plant for the price that is included in the control budget.

HRP has also confirmed that the regulatory completion date of December 31, 2020 can be met

10.2 BIOSOLIDS TREATMENT

Partnerships BC reviewed the Biosolids Treatment Facility and considered whether this project could be delivered under a Design-Build-Finance-Operate-Maintain (DBFOM) model.

Under a DBFOM model, the private partner is responsible for design, construction, partial financing, operations and maintenance over a defined term (a 20 year term is recommended), private financing anchors the transferred risks during both the construction and operating periods. Payments to the private partner would be based on the availability and performance of the Biosolids Treatment Facility.

The level of capital at risk is typically optimized and the level of capital at risk is dependent on the riskiness of the project, especially regarding handback (i.e. end of term transfer to owner). For typical projects, the capital at risk can range between 40 and 60 per cent; the balance is funded by the public owner during the design and construction phase. Capital at risk can be in the form of project specific financing (e.g. debt and equity) or corporate financing (e.g. funds invested in the project from the private partner).

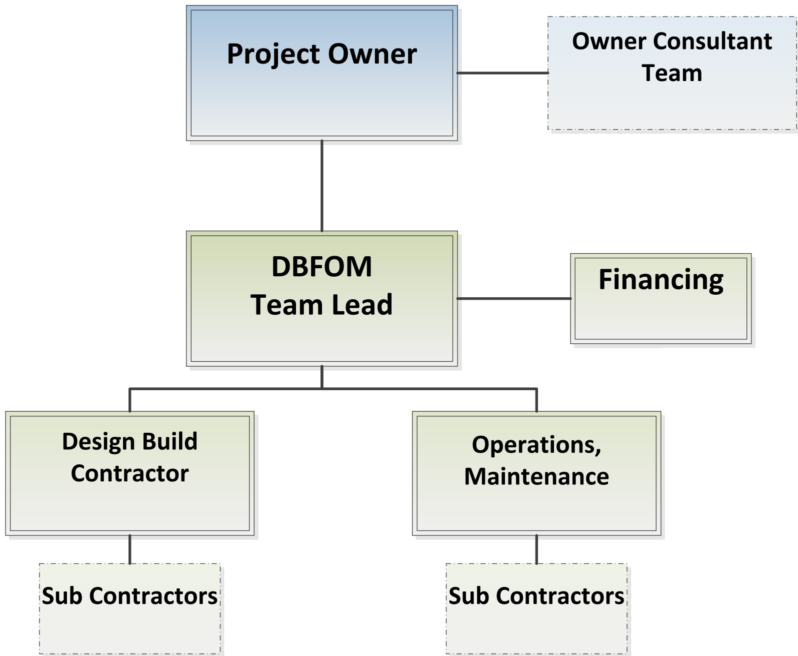
When the public owner funds their portion of construction, it can be done through construction periodic payments, a substantial completion payment, or a combination of both. Construction periodic payments will result in a lower cost (i.e. lower interest during construction); however, substantial completion payment anchors all construction risk transferred to the private partner.

After service commencement, service payments are made monthly to the private partner over the life of the agreement at a fixed rate determined at contract close. These service payments include capital repayment, operations, maintenance, and rehabilitation costs fixed by the private partner. The service payments only commence once the asset is completed in accordance to the contractual requirements.

In order to receive full payment, the asset must meet defined and measurable performance and availability specifications in accordance with the agreement on a continuous basis. The inclusion of capital at risk provides a long-term commitment and a higher duty of care to the project that results in a degree of owner-type behaviour from the private sector.

Further, the contractually agreed performance deductions set out in the project agreement under a DBFOM are easily implemented by the owner. These deductions merely involve withholding pre-established amounts from the regular payments where performance is not achieved.

Figure 9: DBFOM Contractual Structure



As part of assessing the viability of a DBFOM approach, Partnerships BC completed an early screen on the recommended Biosolids Treatment Facility. The early screen is a tool that considers whether projects have features that are considered essential in a successful PPP approach. The Biosolids Treatment Facility received a score of 43 (out of a possible 50) in this early screen.

Features of the Biosolids Treatment Facility that support a PPP approach to procurement include:

a) On time delivery and operational readiness, especially with regards to the WWTP being operational, is very important to the success of the Program;

b) The CRD is legally able to enter into a DBFOM contract with a private partner;

c) The estimated capital cost of the Biosolids Treatment Facility is sufficiently large to encourage market participation;

d) The characteristics of the Biosolids Treatment Facility support a longer term contract (e.g. 20 years);

e) The Biosolids Treatment Facility can be specified with a focus on performance requirements and outputs; and

f) The Biosolids Treatment Facility will be owned by the CRD and sited on public land (i.e. Hartland Landfill).

These results indicate that the recommended Biosolids Treatment Facility has potential to generate value through a procurement using an appropriate public private partnership model.

Partnerships BC believes that a DBFOM for the Biosolids Treatment Facility can be successfully structured and deliver value for money for the taxpayers. This is consistent with the earlier CRD business case, which forecast the Energy Centre to deliver value for money as a DBFOM. Some scope elements of have been modified or removed, but at the core the current Biosolids Treatment Facility and the Energy Centre in the business case written for the CRD in 2012 both are premised on the need to safely and reliably treat the residual solids from the WWTP. It is reasonable to expect the Biosolids Treatment Facility to deliver value for money, just as the Energy Centre was forecast to in the earlier business case.

Because the scope of the project differs from the earlier procurement and the earlier procurement did not reach preferred proponent phase, the Project Board has concluded that a fresh procurement process will be required for the Biosolids Treatment Facility.

The Project Board and Partnerships BC have engaged PPP Canada in discussions regarding continued support for the Biosolids Treatment Facility. PPP Canada has expressed strong interest in continuing to support the project, and is awaiting further documentation to continue its analysis and come to a definitive conclusion on its funding.

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11 PART D - RECOMMENDATION AND IMPLEMENTATION PLAN

11.1 RECOMMENDATION

The recommended Core Area Wastewater Treatment Program (Program) responds to the needs of the region by providing tertiary sewage treatment for the Core Area by 2020, with a revised design that is intended to be responsive to the interests of the surrounding community and neighbourhoods. The Program includes a process to develop an integrated resource management solution for the region's waste. It also includes a commitment to advance studies for a wastewater treatment proposal in Colwood.

Wastewater Treatment

1. The CRD build a single 108 megalitre/day wastewater treatment plant (WWTP) for the secondary and tertiary treatment of wastewater on the site owned by the CRD at McLoughlin Point in Esquimalt, and submit for approval to the Ministry of Environment an amendment to the Liquid Waste Management Plan to that effect.

2. The CRD proceed with the procurement of the WWTP on the basis of a revised design from the developer identified in the competitive procurement process of 2013/2014; the revised design aligns with existing zoning and design guidelines and is responsive to what the Project Board understands to be the concerns of Esquimalt. The schedule anticipates reaching a final agreement with the developer by January 2017. The agreement would include a schedule for the Plant to be in operation by December 2020 to comply with federal law.

3. The CRD operate the WWTP, as it does other wastewater treatment facilities in the CRD.

4. The developer participate in the municipal development permit process and an allowance of $5 million be included in the Program budget to accommodate any recommendations to alter the exterior of the WWTP building or landscaping that may arise during the permit process.

5. The CRD enter into an agreement to lease Rock Bay in Victoria from the Esquimalt and Songhees First Nations for use by the contractor during construction for a laydown area, to facilitate barging to the WWTP site, reducing the impact of construction in Esquimalt.

6. The WWTP incorporate amenities valued at approximately $20 million, including an annual payment to Esquimalt of $55,000 or equivalent value.

7. The CRD commit to advance studies for a wastewater treatment proposal in Colwood, including up to $2 million to complete the required technical studies and environmental impact assessments.

Conveyance

8. The collection system be upgraded, including improvements to the existing building and landscaping at the Macaulay Point pump station; a conveyance system consistent with previous plans be used to pump residual solids from the wastewater plant to Hartland Landfill.

Treatment of Residual Solids

9. The CRD start a new procurement for a new Biosolids Treatment Facility at Hartland Landfill using a Design-Build-Finance-Operate-Maintain (DBFOM) model, such facility to be in place to receive residual solids by December 2020; the contract will be performance based, with payment tied to the production of treated biosolids that meet regulatory thresholds for Class A biosolids.

10. The CRD store the class A biosolids at Hartland Landfill on an interim basis, recover and treat leachate and recover biogas.

11. The CRD engage in a comprehensive planning and consultation process to develop a waste policy, including management of its municipal solid and biosolid waste streams as part of an integrated resource management plan. This process would culminate in a submission to the Ministry of Environment of an integrated resource management program by 2020; it may include an amendment to the CRD Solid Waste Management Plan.

12. In parallel the CRD issue a Request for Expressions of Interest (RFEOI) for the processing of waste (including solid waste and biosolids) to determine the level of interest on the part of developers and investors. The RFEOI would specifically request input on the integrated resource management policy and regulations required to support their prospective investment. This will inform the planning process and policy.

Other

13. The CRD review its sewage collection and treatment facilities and develop a plan to implement improvements to the appearance of the facilities to mitigate their impacts on the host municipalities.

11.2 IMPLEMENTATION PLAN

11.2.1 Implementation Schedule

Due to the similarity with the previous scope of work, the Project Board will resume negotiations with HRP, the preferred proponent from the earlier procurement, to reach agreement on the Project Agreement.

The Project Board estimates that four to five months will be required to finalize negotiations with HRP, undertake the design reviews, and execute the Project Agreement.

Assuming that the Project Agreement can be executed by the end of January 2017; the plant should be accepted and operational by December 31, 2020.

The Biosolids Treatment Facility will require a new procurement process and the schedule for this is provided below. The following schedule is dependent on the timing related to the approvals required to proceed to the procurement phase. These approvals include:

a) Approval of the business case by the CRD Board of Directors;

b) Successful confirmation of continued funding support by the senior governments; and

c) Approval of the LWMP Amendment 11.

Table 19: Estimated Procurement Schedule, Biosolids Treatment Facility

Milestone	Date
Approval of Business Case	September 15, 2016
Procurement Planning	September 2016 to January 2017
Release RFQ to Market	January 2017
Approval of Shortlist	April 2017
Release RFP to Market	April 2017
Technical Submissions Due	September 2017
Financial Submissions Due	November 2017
Preferred Proponent Announced	December 2017
Commercial / Financial Close	February 2018
Design/Construction of Facility	February 2018 – December 2020

11.2.2 Governance

The Project Board Terms of Reference includes the requirement to oversee Project scope, schedule and budget as the Program progresses through the planning, procurement and implementation phases, with particular attention to risk identification and risk management.

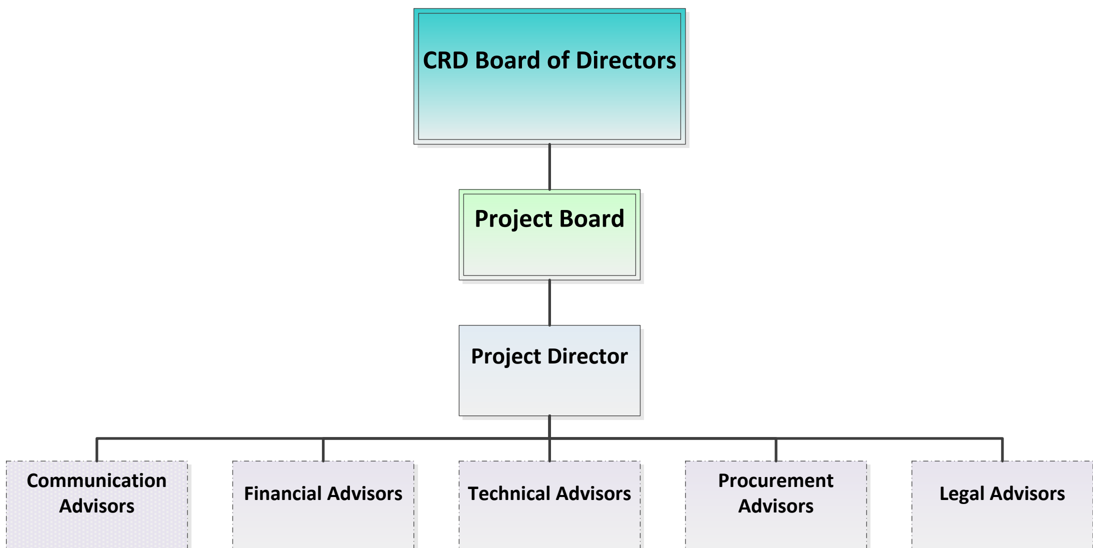
Role of Project Board Members

Project Board members will exercise their professional expertise and judgement to plan and implement to Project in accordance with the Project Vision and Goals.

Project Team

The Project Director will lead a Project Team to plan, procure and implement the Program. The Project Director will prepare a Project Management Plan to guide the work. The Project Team will include relevant expertise required for the Project, including financial, technical, estimating, communication and consultation, procurement and legal expertise. Membership of the team will reflect the requirements of the work at a particular time and may change over time.

Figure 10: Procurement Organization Chart



PART E – DECISION REQUEST

The Project Board asks that the CRD Board of Directors approve this business case. If approved, the provincial and federal governments will consider confirmation of their funding by September 30, 2016.

DEFINITIONS

Anaerobic Digestion is a common residual solids treatment process which is used to stabilize residual solids and reduce pathogen levels. The two most common types of anaerobic digestion include mesophilic digestion which operates at 35^oC and thermophilic digestion which operates at 55^oC. Mesophilic digestion is capable of producing a Class B biosolids while thermophilic digestion can produce a Class A biosolid.

Average Dry Weather Flow (ADWF) is often used to rate the capacity of a treatment plant. The ADWF is the average flow during periods of dry weather when the flows are not influenced significantly by infiltration and inflow (I&I). The ADWF measurement used in planning reports for the Core Area Wastewater Treatment Program (CAWTP) is mega litres per day or million litres per day, and is commonly abbreviated MLD. The ADWF period at CRD is from June 1 to August 31.

Biocell is a closed loop anaerobic / aerobic landfill cell in which biosolids and MSW are stored and treated. Resources can be recovered from the biocell including gas and material can be mined following a period of 5 to 7 years for beneficial use.

Biogas can be produced from anaerobic digestion or biocells. Biogas is a valuable resource and can be used for heating digesters and buildings, drying residual solids or it can be used to generate electricity in co-generation facilities.

Biosolids means residual solids which have undergone treatment to reduce the pathogens and stabilize the residual solids.

Biochemical Oxygen Demand (BOD_5) is the most widely used measure of organic pollution in wastewater. It is measured using a 5-day test where dissolved oxygen used by organisms in the biological oxidation of organic matter is determined. The common unit of measure for BOD is milligrams per litre (mg/L).

Capital Asset Management Framework (CAMF) means the provincial document that describes government's objectives and policies for planning and managing publicly-funded capital assets such as schools, hospitals, and transportation infrastructure.

Compounds of Emerging Concern (CEC) consist of synthetic or naturally occurring chemicals which have the potential to enter the environment and cause known or suspected adverse ecological or adverse health effects. There are numerous such compounds and they are described in broad categories including pharmaceuticals, personal care products, plasticizers, flame retardants, and pesticides. These compounds are found in a variety of products including antibiotics, cosmetics, micro–plastics, insect repellants, and many other products used by the human population. There are thousands of these compounds and although some of these compounds are removed or reduced through conventional secondary treatment processes, many are not. Tertiary treatment will remove non soluble CECs adsorbed onto to residual solids which are not removed from the secondary treatment process. Soluble compounds may not be removed from tertiary treatment.

Analytical capabilities have improved with technology advancement, and it is now possible to monitor many of these compounds down to the parts per trillion levels. CECs have existed for many years and with the advent of newer analytical technology their concentrations are only now being detected.

Significant research is being completed to determine the effects of CECs on human and ecosystem health. There is significant debate on the actual versus perceived impacts and the degree of exposure that is required to cause long term impacts to health and ecosystems. As of 2016 there are no Canadian regulations that require removal of CECs from the wastewater discharge. Most wastewater treatment operators have not implemented advanced treatment technologies to deal with CECs because the treatment process selection to deal with CECs is still uncertain, and available advanced technologies are costly to construct and operate. Many municipalities are promoting source control as a low cost method of CEC control.

Core Area is a collaboration of seven local governments and two First Nations within the CRD. These communities include the Cities of Victoria, Langford, and Colwood, the Districts of Oak Bay and Saanich, the Township of Esquimalt, the Town of View Royal, and the Songhees and Esquimalt First Nations.

Dewatering following digestion solids are dewatered to concentrate solids further to 20 to 30% solids concentration depending on the type of dewatering equipment utilized. The most common types of dewatering equipment in the municipal wastewater industry include belt filter presses, centrifuges and rotary presses.

Drying is a thermal process which is used to dry digested or undigested residual solids to reduce the volume of material that is handled. Drying can produce a Class A pellet which can be used for fertilizer or fuel feed stock for waste to energy facilities. The residual solids concentration will typically be in the 92-95% range after drying.

Dry Weather Flow is the flow in a sanitary sewer during periods of dry weather in which the sanitary sewer is under minimum influence of inflow and infiltration. CRD measures dry weather flow from June 1st to August 31st.

Effluent means the liquid resulting from the treatment of wastewater.

Fats, Oils and Grease (FOG) are products generated by local industries including restaurants are also recovered from the liquid treatment process. They offer beneficial value in the anaerobic digestion process and increase biogas production.

Freedom of Information and Protection of Privacy Act (FOIPPA) means the provincial legislation that gives the public a right of access to records that are in the control of the BC government.

Hartland Landfill is the municipal solid waste disposal site for the CRD area. It was purchased by the CRD in 1975 and has been directly operated by its Environmental Sustainability Department since 1985. It is located in the District of Saanich on top of a hill, between Victoria and Sidney, at the end of Hartland Avenue. There is a public waste drop-off area, a recycling centre, a household hazardous waste collection facility and an electricity generating station that utilizes landfill gas as a fuel source.

Inflow and Infiltration (I&I) means water that enters the sanitary sewer system from direct stormwater connection (inflow) or indirectly through land (infiltration), or both.

Integrated Resource Management (IRM) considers wastewater, solid wastes and other organic wastes as resources rather than wastes which must be discarded. By considering these waste streams in an integrated manner there are opportunities to recover energy, nutrients, heat, reclaimed water, fuel and other products while at the same time reducing greenhouse gas emissions. IRM is typically completed at the planning level where objectives are set for management of waste streams in an integrated manner. IRM has existed for many years; many communities in Europe and North America have integrated their biosolids, organic waste, solid waste, and water resources planning functions.

Liquid Waste Management Plan (LWMP) is a plan that allows municipalities to develop community-specific solutions for wastewater management to meet or exceed existing regulations. Final plans are approved by the Minister of Environment only after sufficient public and stakeholder consultation has taken place.

Municipal Wastewater Regulation (MWR), from the *Environment Management Act,* is a provincial regulation that prescribes the minimum standards of municipal wastewater quality for marine water, fresh water, or ground discharge.

Municipal Solid Waste (MSW) is solid waste and refuse that is produced by residents and business operations that is typically disposed of in landfills. This waste includes organic and non-organic wastes. Organic wastes are often incorporated into reuse programs. MSW can serve as a fuel for waste to energy facilities, in the CRD MSW is disposed of at Hartland Landfill.

Net Present Value (also referred to as Net Present Cost) means the difference between the present value of the future cash flows from an investment and the amount of investment.

Peak Domestic Flow (PDF) means the peak flow coming from the total population equivalents; specifically this excludes all sources of I&I. This is expressed as a short duration average (e.g. 15 minutes) suitable for use in hydraulic design.

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

Peak Wet Weather Flow (PWWF) is the flow experienced by the treatment plant during peak periods of inflow and infiltration during wet weather events. For CRD, this typically occurs from the wet months of October through March. Some of the sewers in the CRD are very old and experience high inflow and infiltration during wet weather. Portions of the collection system in Oak Bay have combined sewer systems that carry sanitary and storm flows. The CRD's LWMP requires the primary treatment of wet weather flows for up to 3x ADWF for the Clover Point outfall catchment and up to 4x ADWF for the Macaulay outfall catchment. Flows above this would be released at existing outfalls. The LWMP also requires that municipalities address their I&I problems to reduce their peak flow events. The PWWF is also measured in MLD. The PWWF is typically the governing criteria for sizing of wet weather primary treatment facilities.

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.

Proven Technology means a high rate, small footprint wastewater technology or process related to primary wastewater treatment, secondary wastewater treatment, tertiary treatment, pumping, residual solids storage, and biosolids treatment that is installed at a wastewater treatment facility and where the technology or process is currently in operation and has been continuously operating reliably for a reasonable period of time in a similar process configuration of similar scale or complexity under similar or less favorable influent wastewater quality conditions, and has been operating with process modules the same size or larger than those proposed, and at a process loading as great or greater than that proposed.

Residual Solids are produced as a by-product of liquid treatment. These residual solids include primary solids, secondary solids and tertiary solids. These solids are in their raw form and contain pathogens. Upon treatment the residual solids are commonly referred to as biosolids.

Resource Recovery explores opportunities for recovery of resources from the liquid and biosolids treatment train which provide some value or beneficial use. For wastewater treatment projects recovered resources typically include reclaimed water, heat, biogas, nutrients and soil stabilized biosolids.

Sanitary Sewer Overflows (SSOs) is a condition in which untreated sewage is discharged from a sanitary sewer into the environment prior to reaching sewage treatment facilities. When caused by rainfall it is also known as wet weather overflow.

Secondary Treatment suitable for discharge to a marine environment with little to no environmental impacts. The secondary treatment process will produce an effluent that meets the regulatory requirements of 25 mg/L TSS and 25 mg/L BOD. In practice many secondary plants will produce a wastewater with TSS and BOD of 15 mg/L. For the CRD, secondary treatment is sufficient to satisfy both the Federal and Provincial regulatory requirements. Secondary treatment sizing is governed by the pollutant load entering the plant. The pollutant load is the product of the flow in MLD times the concentration of the pollutant in mg/L. Enhanced secondary treatment in the context of the CRD project includes an additional unit process such as advanced oxidation to deal with CECs.

Similar or less favorable influent wastewater quality conditions means untreated raw wastewater which faces the same or greater treatment challenges with respect to wet weather influent variability, bio-chemical oxygen demand (BOD), total suspended solids (TSS), ammonia nitrogen, minimum temperature and pH effluent quality parameters as that anticipated for the Program

Tertiary Treatment involves the addition of filtration or a membrane solids separation process downstream of secondary treatment or integral to the secondary treatment. The tertiary treatment process is capable of producing an effluent with 5 mg/L TSS and 5 mg/L BOD and less depending on the final solid separation process. Tertiary treatment is typically practiced where the receiving stream has sensitive environmental requirements or if the effluent is to be reused for irrigation or groundwater recharge. Tertiary treatment can be designed to also include removal of nutrients such as nitrogen and phosphorus if the receiving environment is sensitive to these nutrients. For the CRD nutrient removal is not required because the discharge will be to a deep marine outfall.

Thermal Destruction is a thermal process where residual solids are reduced through the process of incineration. For the purposes of this report this process involves the thermal destruction of residual solids following dewatering.

Thickening is a process where residual solids produced by the liquid stream are thickened to concentrate solids prior to digestion. Various technologies can be used for thickening including gravity thickeners, gravity belt thickeners and rotation drum thickeners to name a few.

Total Population Equivalents 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.

Total Suspended Solids (TSS) is a measure of the colloidal solids in wastewater. The solids are usually measured using a settling test to determine the solids concentration in the wastewater. The common unit of measure for TSS is mg/L.

Vector Attraction Reduction Vectors include animals and birds which have the potential to transmit pathogens from unstabilized residual solids. Residual solids treatment processes typically require a volatile solids reduction of at least 38% to reduce the potential for vector attraction.

Waste to Energy Facility is a thermal process which is capable of producing electricity for use or sale.

Wastewater Systems Effluent Regulation (WSER), from *The Fisheries Act,* is a federal regulation that regulates municipal discharges. The WSER specifies the conditions that must be met to deposit effluent containing deleterious substances, including requirements concerning toxicity, effluent monitoring, record keeping, and reporting.

APPENDICES

APPENDIX A	Project Board Terms of Reference
APPENDIX B	Summary of CRD Consultation
APPENDIX C	CRD Flows and Loads, background technical paper
APPENDIX D	CRD Outfall Permit Requirements, background technical paper
APPENDIX E	Not used
APPENDIX F	Not used
APPENDIX G	Compounds of Emerging Concern, background technical paper
APPENDIX H	Micro-plastics in Municipal Wastewater, background technical paper
APPENDIX I	Gasification, background technical paper
APPENDIX J	Capital Regional District Core Area Wastewater Treatment Program Assessment of Liquid Wastewater Treatment Options, Stantec Consulting Ltd. September 6, 2016
APPENDIX K	Triple Bottom Line Assessment Sheets, Liquid Treatment
APPENDIX L	Core Area Wastewater Treatment Program Assessment of Biosolids Treatment and Integrated Resource Management Options, Stantec Consulting Ltd., September 6, 2016
APPENDIX M	Triple Bottom Line Assessment Sheets, Biosolids Treatment