McElhanney

APPENDIX F

CVRD
SEWAGE MASTER PLAN
RECENT EVOLUTION OF REGULATORY FRAMEWORK

DAYTON & KNIGHT MEMORANDUM

MEMORANDUM

TO: Ian Whitehead, P.Eng.
McElhanney Consulting Services Ltd.
495 Sixth Street, Courtenay, B.C., V9N 6V4

FROM: Dayton & Knight Ltd.

DATE: October 3, 2008

RE: CVRD Sewerage Master Plan Update Study
Recent Evolution of Regulatory Framework

1.0 DISCHARGES TO SURFACE WATER

Current regulatory criteria for treated wastewater discharges to surface waters are based on existing provincial regulations, which are set out in the Municipal Sewage Regulation (MSR) of the Environmental Management Act. Impending federal regulations for wastewater discharges are expected to be enacted in the near future. In addition, the B.C. Ministry of Environment intends to review and possibly revise the MSR.

Recent (2007) amendments to the MSR mere mainly matters of clarification and editing. A wide range of potential review and amendment items has been identified for the upcoming MSR review, including harmonization of the MSR with the new federal regulations and with the recently amended Ministry of Health Sewerage System Regulation, which applies to smaller wastewater discharges to ground disposal (see Section 2.0 of this Memorandum). The MSR review will consist of a five-step process, namely scoping, publication of a Policy Intentions Paper for Consultation, consultation with stakeholders and the general public, drafting of revisions for review by the Minister and Lieutenant Governor-in-Council, and implementation. The schedule for conducting the MSR review is not known at this time.

Information regarding the existing provincial regulations and the impending federal regulations for discharges of treated wastewater to surface water is summarized below.

1.1 Provincial Regulations and Guidelines

The Municipal Sewage Regulation (MSR) administered by the Ministry of Environment (MOE) applies to all discharges to surface water and to discharges to ground in excess of 22.75 m^3/d (MOE, 1999). The effluent criteria for discharges of treated wastewater to surface waters (based on the MSR) are summarized in Table 1-1. For the discharge from existing CVRD WWTP, the criteria for open marine waters are applicable.

TABLE 1-1
EFFLUENT REQUIREMENTS FOR DISCHARGES TO SURFACE WATERS

Parameter	Effluent Criteria for Discharges to Surface Waters[1]							
	Maximum Daily Flow 50 m^3/d or greater				Maximum Daily Flow less than 50 m^3/d			
	Streams, Rivers & Estuaries		Marine		Streams, Rivers & Estuaries		Marine	
	Dilution 40:1[2]	Dilution 10:1[2]	Open Marine Waters	Embayed Marine Waters	Dilution 40:1[2]	Dilution 10:1[2]	Open Marine Waters	Embayed Marine Waters
Treatment Requirement	Secondary	High Quality Secondary	Secondary	Secondary	Secondary	High Quality Secondary	Primary	Secondary
BOD_5 (milligrams/litre)	45	10	45	45	45	10	130	45
TSS (milligrams/litre)	45	10	45	45	45	10	130	45
pH	6.0-9.0	6.9-9.0	6.0-9.0	6.0-9.0	--	--	--	--
Disinfection	see[3]	see[3]	see[3]	see[3]	see[3]	see[3]	see[3]	see[3]
Total Phosphorus (mg P/L)	1.0[4]	1.0[4]	--	--	--	--	--	--
Orthophosphate (mg P/L)	0.5[4]	0.5[4]	--	--	--	--	--	--
Ammonia	see[5]	see[5]	see[5]	see[5]	--	--	--	--

1 Effluent quality standards for all receiving water discharges are based on the use of an outfall which provides a combination of depth and distance to produce a minimum 10:1 initial dilution within the mixing zone.

2 Dilutions less than 100:1 will require an environmental impact study to determine if effluent quality needs to be better than tabulated. Where the dilution ratio is below 40:1 and the receiving stream is used for recreational or domestic water extraction within the influence of the discharge, discharge will not be permitted unless an environmental impact study shows that the discharge is acceptable and no other solutions are available.

3 For discharges to recreational use waters, fecal coliform < 200 MPN/100 mL. Where domestic water extraction occurs within 300 m of a discharge, fecal coliform < 2.2 MPN/100 mL with no sample exceeding 14 MPN/100 mL. Where chlorine is used, dechlorination will be required. Wherever possible alternate forms of disinfection to chlorine should be implemented.

4 The total and orthophosphate criteria may be waived if it can be shown from an environmental impact study that receiving waters would not be subject to an undesirable degree of increased biological activity because of the phosphorus addition. Alternatively, an environmental impact study may show that lower effluent concentrations than are tabulated are necessary, or that a mass load criteria may be needed.

5 The allowable effluent ammonia concentrations at the "end of pipe" must be determined from a back calculation from the edge of the initial dilution zone. The back calculation must consider the ambient temperature and pH characteristics of the receiving water and known water quality guidelines.

Table 1-2 shows the allowable concentrations of microbiological indicators in accordance with the Ministry of Environment Water Quality Guidelines (British Columbia Approved Water Quality Guidelines, 2006 Edition) for recreational use and for the protection of shellfish waters.

TABLE 1-2
WATER QUALITY GUIDELINES FOR MICROBIOLOGICAL INDICATORS

Indicator Organism	Number of Organisms per 100 mL			
	Aquatic life – shellfish harvesting [1]		Recreation, secondary contact, crustacean harvesting	Recreation, primary contact
	90th percentile	median	geometric mean [2]	geometric mean [2]
Escherichia coli	< 43	< 14	< 385	< 77
Enterococci	< 11	< 4	< 100	< 20
Fecal coliforms	< 43	< 14	none applicable	< 200

[1] Measured outside the initial dilution zone.

[2] The geometric mean is a type of mean or average, which indicates the central tendency or typical value of set of numbers. The n numbers are multiplied and then the nth root of the resulting product is taken, where n = count of numbers in the set.

The following toxicity standards are based on the MSR, Part 4 Standards for Effluent Reuse and Discharges to the Environment.

9 (1) A person must not discharge effluent, unless

(a) the discharge passes a 96 hour LC50 bioassay test as defined by Environment Canada's Biological Test Method: Reference Method for Determining Acute Lethality of Effluents to Rainbow Trout, Reference Method, EPS 1/RM/13, or

(b) if the discharge fails a bioassay test described in paragraph (a), the discharge passes a test conducted as a follow up according to requirements set out in Schedule 6 of the MSR.

(2) Subsection (1) does not apply if

i. the discharge is to ground,

ii. the discharge quality meets a maximum BOD_5 not exceeding 10 mg/L and a maximum TSS not exceeding 10 mg/L,

iii. the discharge does not exceed a maximum daily flow of 5,000 m^3/d and the discharger demonstrates to the satisfaction of a director that the discharge does not adversely affect the receiving environment,

iv. the discharge is to open marine waters,

v. the discharge is diluted such that at the outside boundary of the initial dilution zone the dilution ratio exceeds 100:1 and the discharger demonstrates to the satisfaction of a director that the discharge does not adversely affect the receiving environment,

vi. reclaimed water is being provided or used in accordance with this regulation, or

vii. the discharger demonstrates to the satisfaction of a director that the discharge does not adversely affect the receiving environment.

(3) If subsection (1) applies, a person must not discharge effluent unless the discharge is monitored for toxicity in accordance with the requirements of Schedule 6, Table 3 in the MSR.

1.2 Federal Regulations and Guidelines

The Canadian Council of Ministers of the Environment (CCME) is developing a Canada-wide Strategy for the Management of Municipal Wastewater Effluent. As discussed at the beginning of Section 1.0, the B.C. Ministry of Environment intends to review the Municipal Sewage Regulation (MSR) with a view to harmonizing the provincial MSR with the CCME strategy. The CCME strategy focuses on effluents released from wastewater treatment systems and overflows from sewer collection systems. National performance standards will be regulated under the Fisheries Act and in provincial and territorial regulatory instruments. The following discharge levels are expected to be defined in the federal regulations:

- BOD_5 maximum effluent average discharge level 25 mg/L
- TSS maximum effluent average discharge level 25 mg/L
- residual chlorine maximum 0.02 mg/L
- acute toxicity include specific requirements and timelines to identify and reduce toxicity in cases of acute toxicity test failure

- ammonia — include specific requirements if acute toxicity test failure is due to ammonia that would authorize discharge of ammonia in effluent based on receiving environment considerations.

Monitoring of the environment and timelines to achieve effluent discharge levels are based on risk while considering elements such as sensitivity of the receiving environment, size and composition of the effluent release. In the long-term, the wastewater effluent discharge levels require wastewater treatment systems equivalent in performance to secondary treatment with advanced treatment if required.

The strategy also includes source control measures to preventing the entry of pollutants into the wastewater system (see Section 5.0 of this Memorandum). An action plan for wastewater systems on how to manage overflows from the combined sewers and how to achieve the effluent discharge levels within a 30 year timeline would be required.

1.3 Combined Sewer and Sanitary Sewer Overflows

Requirements for control of combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs) are set out in the MSR, Schedule 1, Parts 15 and 16, respectively. The requirements are that an SSO (or CSO) shall not be allowed to occur during storm or snow melt events with less than a 5-year return period.

1.4 Control of Inflow and Infiltration

The B.C. Municipal Sewage Regulation (MSR) specifies that, where the maximum daily flow at treatment facilities exceeds two times the average dry weather flow during storm or snowmelt events with less than a 5-year return period, inflow and infiltration (I&I) to the collection system is deemed excessive and specified actions must be taken to reduce I&I must be taken.

1.5 Pumping Stations

The B.C. Municipal Sewage Regulation (MSR) includes the following design standards for wastewater pumping stations:

- minimum of 2 pumps with each pump capable of pumping peak design flows;
- for larger stations with multiple pumps, the station must have sufficient capacity to pump peak design flows with the largest pump out of service;
- for two-pump stations, a receptacle for a portable generator must be provided;
- for multiple-pump stations, an on-site generator must be provided; and
- provision must be made so that standby power is activated prior to the hydraulic capacity of the pump station being exceeded.

1.6 Canadian Shellfish Sanitation Program

The federal, provincial and municipal governments are currently engaged in an initiative to strengthen the Canadian Shellfish Sanitation Program (CSSP), which will result in enhanced food safety for consumers of shellfish harvested from areas that may be affected by failures of wastewater treatment plants. Where operational failures of wastewater treatment plants can occur and potentially contaminate nearby harvest areas, it is critical that timely and effective response measures are in place to prevent any affected shellfish from reaching domestic and international companies.

The CSSP partners are developing an implementation protocol with the following key elements:

i) the development of area-specific "management plans," which will outline collective responsibilities and a process for timely failure detection, notification, and response; and
ii) enhanced food safety controls by shellfish processing plants.

The protocol will be implemented in a step-wise, area-by-area manner across Canada. Eight harvest areas, including three in British Columbia (around the Ladysmith, Crofton and Chemainus wastewater treatment plants), are scheduled for implementation before the end of 2008 as the first phase of the initiative.

1.7 Summary of Surface Discharge Criteria

As described in the preceding sections, minimum standards for secondary treatment are set out in provincial and (impending) federal legislation. The provincial regulation will be reviewed and possibly revised in the near future. For the purpose of this study, the provincial and federal standards for secondary treatment (whichever is the more stringent) are proposed as a minimum for discharges to surface water. Disinfection to meet the recreational and shellfish standards set out in the Provincial Municipal Sewage Regulation, the British Columbia Approved Water Quality Guidelines (criteria), and the Canadian Shellfish Sanitation Program may also be necessary, depending on the location of the outfall discharge. Advanced treatment such as effluent filtration and/or nutrient removal may also be required if discharges to sensitive receiving waters (e.g., streams, embayed marine waters) is contemplated.

2.0 DISCHARGES TO LAND

Disposal of treated wastewater effluent to land is normally accomplished by the use of a network of buried, perforated pipes (commonly referred to as drain fields, disposal fields, or tile fields) that allow the effluent to seep into the surrounding soil. This type of system is designated "onsite", since wastewater is treated and disposed of within individual lots or parcels. The level of treatment required prior to ground disposal depends on the nature of the site and on the sensitivity of the receiving environment (e.g., the potential for groundwater contamination). Treatment systems vary in complexity from simple septic tanks to small off-the-shelf treatment facilities (commonly called "package plants").

2.1 Ground Disposal Systems Regulated under the Health Act

Ground disposal systems with design flows of less than 22.75 m^3/d (i.e., single home systems and community systems servicing up to about 50 or 60 homes) are administered by local Health Authorities under the Health Act. In 2005 the Sewerage System Regulation (SSR) replaced the old Sewage Disposal Regulation. The SSR requires that "authorized" (properly qualified and certified) persons certify that certain actions have been done or will be done in accordance with "standard practice", where standard practice is defined to mean "a method of constructing and maintaining a sewerage system that will ensure that the sewerage system does not cause, or contribute to, a health hazard." This differs from the former approach under the Sewage Disposal Regulation, in that the new SSR transfers responsibly for certification of systems design and construction to industry, where the Ministry of Health was responsible for monitoring and enforcement under the old regulation.

The SSR refers to the the Sewerage System Standard Practice Manual (SPM) recently published by the Ministry of Health. The SPM contains guidelines to be followed by authorized persons for design, installation, operation and maintenance of ground disposal systems that are administered under the Health Act. The SPM, first introduced in 2005 as V1, is periodically updated and revised by the B.C. Onsite Sewage Association (BCOSSA) Technical Review Committee for the Ministry of Health. The most recent version of the SPM (V2) was published in 2007. Alternative forms of standard practice other than those set out in the SPM can be undertaken to meet the requirements of the SSR, provided that the alternative practices are certified by authorized persons.

The old Sewage Disposal Regulation set out requirements for ground disposal based on soil percolation rates and total length of drain pipe; an area for a standby (redundant) disposal field was also required. The new Sewerage System Regulation is based on an evaluation of soil characteristics and soil hydraulic conductivity as well as soil percolation rate, to determine the allowable soil hydraulic loading rate, (i.e., infiltration trench bottom area), rather than on drain pipe length; in addition, the soil linear loading

rate (i.e., movement of effluent away from the discharge area) must be evaluated under the new regulation. No standby disposal field is required under the new Regulation. Treatment standards are set out in the SPM, with the level of treatment required depending on site constraints. Monitoring of system performance and system maintenance requirements are identified in the SPM, where this was absent from the old Sewage Disposal Regulation.

2.2 Ground Disposal Systems Regulated under the Environmental Management Act

The Municipal Sewage Regulation (MSR) of the Environmental Management Act applies to discharges to ground that are equal to or greater than 22.75 m^3/d. The effluent class definitions for ground disposal systems according to the MSR are shown in Table 2-1. The minimum drainage pipe length for the designated effluent classes are shown in Table 2-2. As discussed above, the requirements for ground disposal systems set out in the MSR are based on soil percolation rate and are similar to the standards that were contained in the old Sewage Disposal Regulation (now replaced by the new Sewerage System Regulation). Similar to the old Sewage Disposal Regulation, the MSR requires that two disposal fields, each capable of handling the design flow, be installed and that a standby area for a third field be set aside. The impending review of the MSR may result in revision of the ground disposal requirements that are more closely aligned with those in the new sewage system regulation.

TABLE 2-1
EFFLUENT CLASS DEFINITION[1]

		Effluent Quality Parameters (maximum values)[2]				
Effluent Class	Description	BOD_5 (mg/L)	TSS (mg/L)	Fecal Coliform (number of fecal coliform organisms/100 mL)	Turbidity (NTU)	Nitrogen (mg/L)
A	High quality secondary (drinking water well within 300 m)	10	10	median 2.2 any sample 14	average 2 any sample 5	nitrate-N 10 total N 20
B	high quality secondary	10	10	[3]	N/A	N/A
C	secondary	45	45[5]	N/A[4]	N/A[4]	N/A[4]
D	typical septic tank	N/A[4]	N/A[4]	N/A[4]	N/A[4]	N/A[4]

1 from B.C. Municipal Sewage Regulation (1999), Schedule 4.
2 continuous effluent quality monitoring required for Class A and Class B.
3 A fecal coliform limit of 400/100 mL applies to discharges designed to meet the requirements of Row 2 to Table 5-5.
4 N/A means not applicable.
5 for lagoon systems the maximum TSS level must not exceed 60 mg/L.

TABLE 2-2
MINIMUM DRAINAGE PIPE LENGTH[1]

	Number of metres of drainage pipe for each 10 m^3/d of Maximum Daily Flow for percolation rates shown						
Percolation rate; minutes/25 mm	2[2,3]	5[2]	10	15	20[4]	25[4]	30[4]
Effluent Class Prior to Application: A, B or C	50	75	100	110	120	135	150
Effluent Class prior to Application: D	120	215	280	320	360	400	430

1 from B.C. Municipal Sewage Regulation (1999), Schedule 4.
2 for discharges equal to or greater than 37 m^3/d only, if the soils are well drained and if the depth to groundwater including any groundwater mounding effect is greater than 1.0 m below the bottom of the drainage trench, a qualified professional may design the ground disposal system with deeper narrower trenches and the drainage pipe length may be reduced to a value equal to the product of Table 5-4 pipe length and a factor of $1/H^{0.5}$ or 0.8 (whichever factor is greater), where H is the drainage trench depth below pipe invert in metres.
3 percolation rates less than 2 minutes per 25 mm are too fast for adequate renovation and drainfields will not be permitted, unless hydrogeological studies show that local groundwater quality can be met at the property boundary. For discharges of less than 37 m^3/d only, use of AMERICAN SOCIETY OF TESTING MATERIALS C33 sand mounding or AMERICAN SOCIETY OF TESTING MATERIALS C33 sand-filled trenches to reduce percolation is permitted if Class B or A effluent is discharged by pressure distribution.
4 percolation rates more than 20 minutes per 25 mm require the construction to be supervised by a qualified professional to have been carried out in a manner which has not reduced the trench wall permeability unless, for discharges less than 37 m^3/d only, the native undisturbed permeable soil depth exceeds 1.35 m.

2.3 Ministry of Community Services Requirements

The Ministry of Community Services requires that local governments meet the following requirements in order to be eligible for infrastructure funding assistance for wastewater projects from the Province:

- enact a bylaw which applies to all areas within the boundaries under jurisdiction of the applicant that requires community sewer service to all new lots of less than one hectare; or

- an approved (by Minister of Environment) Liquid Waste Management Plan (LWMP) for decentralized wastewater - the LWMP must address on-site sewage in a sustainable fashion, with the understanding that on-site sewage systems will be considered as permanent infrastructure - the LWMP must be supported by appropriate bylaws (OCPs, zoning, subdivision standards, etc.), and at a minimum, the LWMP will address:

    - where the recipient is proposing development of new properties that will not receive community sewer, and the cumulative hydraulic loading from onsite sewage disposal systems can be safely and sustainably handled by the overall soils environment,
    - a community plan for the management and maintenance of onsite septic systems,
    - a biosolids management plan, and
    - a septage collection plan.

3.0 RECLAIMED WATER

Historically in British Columbia, and generally throughout North America, the emphasis in wastewater management in the past has been to provide sufficient treatment to allow disposal of

effluent in order to protect public health and the environment. With the exception of some arid southern states in the U.S., the emphasis has been on disposal of effluent to water or to land. Treated wastewater is now being looked upon as a resource that should be beneficially reused where feasible. This evolving approach contrasts with wastewater disposal practices that currently prevail. An appropriate level of treatment and monitoring for various reuse applications is important for protection of public health and the receiving environment. With effective source control programs coupled with adequate and reliable treatment, effluent can be beneficially reused. Treatment plants designed for water reuse are more appropriately classified as water reclamation plants.

Standards for the use of reclaimed effluent in British Columbia were adopted in July 1999, and are administered by the Ministry of Environment (MOE) under the standards set out in the Municipal Sewage Regulation (MSR). The MSR standards for water reuse in British Columbia dictate that effluent used as reclaimed water must meet either of the two requirements described in Table 3-1, depending on the use of the reclaimed water. Environmental impact studies are required for both categories of reclaimed water. Use of reclaimed water must be authorized in writing by the local Health Authority having jurisdiction.

TABLE 3-1
RECLAIMED WATER CATEGORY AND PERMITTED USES

Unrestricted Public Access Category	Restricted Public Access Category
EFFLUENT QUALITY REQUIREMENTS $6 \geq pH \leq 9$ $BOD_5 \leq 10$ milligrams/litre Turbidity ≤ 2 NTU Fecal coliforms ≤ 2.2/100 millilitres	EFFUENT QUALITY REQUIREMENTS $6 \geq pH \leq 9$ $BOD_5 \leq 45$ milligrams/litre TSS ≤ 45 milligrams/litre TSS Fecal coliforms ≤ 200/100 millilitres
URBAN - Parks - Playgrounds - Cemeteries - Golf Courses - Road Rights-of-Way - School Grounds - Residential Lawns - Greenbelts - Vehicle and Driveway Washing - Landscaping around Buildings - Toilet Flushing - Outside Landscape Fountains - Outside Fire Protection - Street Cleaning	AGRICULTURAL - Commercially processed food crops - Fodder, Fibre - Pasture - Silviculture - Nurseries - Sod Farms - Spring Frost Protection - Chemical Spray - Trickle Drip Irrigation of Orchards and Vineyards
AGRICULTURAL - Aquaculture - Food Crops Eaten Raw - Orchards and Vineyard - Pasture (no lag time for animal grazing) - Frost Protection, Crop Cooling and Chemical Spraying on crops eaten raw - Seed crops	URBAN/RECREATIONAL - Landscape Impoundments - Landscape Waterfalls - Snow Making not for skiing or snowboarding - Golf Courses (providing health and environmental issues resolved to manager's satisfaction) - remote areas of parks, school grounds during vacation period (providing health and environmental issues resolved to manager's satisfaction)
RECREATIONAL - Stream Augmentation - Impoundments for Boating and Fishing - Snow Making for skiing and snowboarding	CONSTRUCTION - Soil Compaction - Dust Control - Aggregate Washing - Making Concrete - Equipment Washdown
	INDUSTRIAL - Cooling Towers - Process Water - Stack Scrubbing - Boiler Feed
	ENVIRONMENTAL - Wetlands

According to the MSR, the use of reclaimed water requires the following:

- provide in addition to seasonal storage an alternative method of disposing of the reclaimed water or satisfy the manager that no such alternative is required to assure public health protection and treatment reliability.
- in the absence of seasonal storage, the provision of at least 20 days emergency storage (the storage volume may be reduced to 2 days if multiple treatment units are used);
- the system for conveying reclaimed water must incorporate safeguards to prevent cross connection with the potable water system;
- authorization in writing by the local health authority or the establishment of a local service area under which a municipality, or a private corporation under contract to a municipality, assumes responsibility for the system;
- the provision of user information when Unrestricted Public Access Category uses are proposed;
- where frequent worker contact with reclaimed water occurs, disinfection must achieve a fecal coliform level of <14/100 millilitres;
- the reclaimed water provider must demonstrate that reclaimed water does not contain pathogens or parasites at levels which are a concern to local health authorities;
- reclaimed water must be clean, odourless, non-irritating to skin and eyes, and must contain no substances that are toxic on ingestion;
- where available, agricultural (crop) limits must govern criteria for metals;
- high nutrient levels may adversely affect some crops during certain growth stages, consequently crop limits and season must govern nutrient application; and
- the reclaimed water provider must obtain monitoring results, and confirm that water quality requirements are met, prior to distribution.

According to definitions contained in the MSR, water-carried wastes from liquid or non-liquid culinary purposes, washing, cleansing, laundering, food processing or ice production (i.e., grey water) are classified as domestic sewage, regardless of whether or not toilet wastes (black water) are included. As such, the MSR standards for use of reclaimed sewage effluent apply to treated

and recycled grey water as well as to reclaimed sewage. According to the MSR, water reuse projects must be approved in consultation with the Ministry of Health (MOH). The MOH has allowed demonstration projects for grey water recycling (e.g., CK Choi Building and Quayside Village in North Vancouver). These projects required special permission from health authorities. Procedures and facilities must be in place to ensure that systems will be monitored and operated properly, so that it can be demonstrated that there is no danger to the public health. Each demonstration project is carefully considered on a case-by-case basis, before receiving approval.

4.0 SOURCE CONTROL

Regulation of waste discharges to sanitary sewers is essential for the protection of public health and the environment. These discharges may enter the system via service connections from buildings, or from pumper truck discharges at treatment facilities (e.g. septage and trucked liquid waste from private businesses). Toxic and hazardous materials that enter the sanitary system pose a risk to sewerage system workers, to the general public, to the collection and treatment works, and to the receiving environment. Toxic and hazardous materials in wastewater can upset biological treatment processes, heavy metals can accumulate in sediments and wastewater treatment plant residuals (biosolids), and waterborne contaminants can be discharged to surface waters; the result can be a negative impact on the environment from both liquid and solids discharges. Source control of trace metals is particularly important if the biosolids generated at wastewater treatment plants are to be used as a soil amendment/fertilizer now or in the future, since the use of biosolids in B.C. is restricted by the Provincial Organic Matter Recycling Regulation (OMRR) according to trace metals content and other factors.

Source controls can be implemented through either a regulatory or an educational approach, or a combination of the two. The regulatory approach is typically focused on non-domestic (i.e., commercial, industrial, and institutional) discharges through sewer use bylaws, also referred to as source control bylaws. A source control approach that includes a significant educational component is likely to be more effective than one of strict policing and enforcement. However, it must be emphasized that it is essential to prevent unauthorized discharges of industrial, toxic, and/or dangerous wastes to the wastewater collection and treatment system. Responsibilities for

inspection and enforcement of source control regulations should be clearly defined.

A bylaw regulating discharges to the sanitary sewer collection system is an essential component of a source control program. The Canadian Council of Ministers of the Environment (CCME) recently developed a Model National Sewer Use Bylaw. The national study reviewed existing provincial sewer use bylaws, completed an analysis of potential contaminants and parameters to be covered in the CCME Model Bylaw, and provided recommendations for federal, provincial, and territorial governments to develop and implement effective sewer use bylaws. Forty-one substances and physical parameters were recommended for inclusion in the bylaw. Hazardous substances are typically prohibited and therefore do not require concentration limits. The Supplemental List contains substances that are of potential concern for environmental release or human health, and can be implemented in the municipal bylaw depending on existing industries in the community. The focus of the CCME for the Model Sewer Use Bylaw is on wastewater; however, prohibited substances for stormwater are to be identified and best management practices to protect stormwater quality (construction erosion, sediment control, outdoor storage of materials) are required.

Many communities require a Waste Discharge Permit for Restricted Wastes, High Volume Discharges, Stormwater or Cooling Waste. A Permit typically will apply to non-domestic discharges from the industrial, commercial and institutional (ICI) sectors. Waste Discharge Permits typically include the following:

- limits and restriction on the quantity, frequency and nature of the discharge; and
- requirements of the Permit holder (discharger) to:
  - construct the pre-treatment works if needed to meet the specified discharge limits,
  - monitor the discharge and provide reports to District, and
  - operate and maintain the pre-treatment and monitoring facilities.

McElhanney

APPENDIX G

FIELD RECONNAISSANCE REPORTS

Comox Valley Regional District
Sewerage Master Plan
Preliminary Route Selection
Field Reconnaissance Report
Date: Dec 4, 2008

Sheet	11 of 18		
Route Option Number	1.1		
Route Description	SRW - Pump Station to Back Rd. via ALR		
MCSL Drawing Reference #	S-11		
Section Number			
From (Upstream)	Back Road		
To (Downstream)	Pump Station via Section 4		
Restoration Requirements	**Yes**	**No**	**Measure**
Green Field	Yes		
Paved Road	N/A	N/A	
Gravelled/Chip Sealed Road	N/A	N/A	
Pavement Condition	N/A	N/A	
Curbs	N/A	N/A	
Sidewalk	N/A	N/A	
Overhead Power	N/A	N/A	
Constructability	**Yes**	**No**	**Comment**
Traffic Volumes	None		
Appropriate Staging Areas			
Geotechnical Considerations			
Site Access			
Comments			
Additional Comments	Apparent Disadvantages - Very flat farmland, climbing at Back Road		

Comox Valley Regional District
Sewerage Master Plan
Preliminary Route Selection
Field Reconnaissance Report
Date: Dec 4, 2008

Sheet	12 of 18		
Route Option Number	1.2		
Route Description	SRW - Back Rd. to Sheraton Rd.		
MCSL Drawing Reference #	S-11		
Section Number			
From (Upstream)	Section 8 & 9		
To (Downstream)	Back Road		
Restoration Requirements	**Yes**	**No**	**Measure**
Green Field			
Paved Road			Crossing at Back Road
Gravelled/Chip Sealed Road	N/A	N/A	
Pavement Condition	N/A	N/A	
Curbs	N/A	N/A	
Sidewalk	N/A	N/A	
Overhead Power	N/A	N/A	
Constructability	**Yes**	**No**	**Comment**
Traffic Volumes	Ave.		At Back Road only
Appropriate Staging Areas			
Geotechnical Considerations			
Site Access	Poor		
Comments			
Additional Comments	Apparent Advantages - Steep uphill to Back Road and above Back Road. No houses except Glacier View Lodge		

Comox Valley Regional District
Sewerage Master Plan
Preliminary Route Selection
Field Reconnaissance Report
Date: Dec 4, 2008

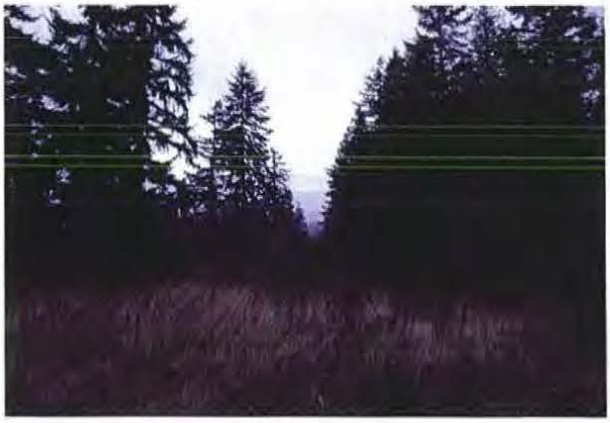
Sheet	13 of 18		
Route Option Number	1.3		
Route Description	Sheraton Rd. - S.R.W. to McDonald Rd.		
MCSL Drawing Reference #	S-11		
Section Number			
From (Upstream)	Sheraton Road		
To (Downstream)	Section 8 & 9 at Glacier View Lodge		
Restoration Requirements	**Yes**	**No**	**Measure**
Green Field			Open Hilly
Paved Road	N/A	N/A	
Gravelled/Chip Sealed Road	N/A	N/A	
Pavement Condition	N/A	N/A	
Curbs	N/A	N/A	
Sidewalk	N/A	N/A	
Overhead Power	N/A	N/A	
Constructability	**Yes**	**No**	**Comment**
Traffic Volumes	N/A	N/A	
Appropriate Staging Areas	N/A	N/A	
Geotechnical Considerations	N/A	N/A	
Site Access	N/A	N/A	
Comments			
Additional Comments	Apparent Advantages - Open with trees Apparent Disadvantages - Hilly		

Comox Valley Regional District
Sewerage Master Plan
Preliminary Route Selection
Field Reconnaissance Report
Date: Dec 4, 2008

Sheet	14 of 18		
Route Option Number	1.4		
Route Description	McDonald Rd. - Sheraton Rd. to Inverclyde Way extension		
MCSL Drawing Reference #	S-11		
Section Number			
From (Upstream)	MacDonald Road		
To (Downstream)	Sheridan		
Restoration Requirements	**Yes**	**No**	**Measure**
Green Field			
Paved Road		√	Paved walkway
Gravelled/Chip Sealed Road			
Pavement Condition	Good		
Curbs		√	
Sidewalk			Pathway paved
Overhead Power		√	
Constructability	**Yes**	**No**	**Comment**
Traffic Volumes	N/A	N/A	
Appropriate Staging Areas	N/A	N/A	
Geotechnical Considerations	N/A	N/A	
Site Access	N/A	N/A	
Comments			
Additional Comments	Apparent Disadvantages 0.5m waterline along Sheridan climbing toward Macdonald Road		

Comox Valley Regional District
Sewerage Master Plan
Preliminary Route Selection
Field Reconnaissance Report
Date: Dec 4, 2008

Sheet	15 of 18		
Route Option Number	1.5		
Route Description	Future McDonald Rd. extension - Inverclyde Way extension to Aspen Rd.		
MCSL Drawing Reference #	S-11		
Section Number			
From (Upstream)	Hector Road via Macdonald		
To (Downstream)	Sheridan Road		
Restoration Requirements	**Yes**	**No**	**Measure**
Green Field			
Paved Road	√		
Gravelled/Chip Sealed Road			
Pavement Condition	O.k.		
Curbs		√	
Sidewalk		√	
Overhead Power	√		
Constructability	**Yes**	**No**	**Comment**
Traffic Volumes	Light		Along MacDonald only
Appropriate Staging Areas			
Geotechnical Considerations			
Site Access			
Comments			
Additional Comments	Apparent Advantages - Paved from Sheridan Road to Guthrie, Paved from Guthrie 100m towards Hector. Through bush the rest of the way		



Comox Valley Regional District
Sewerage Master Plan
Preliminary Route Selection
Field Reconnaissance Report
Date: Dec 4, 2008

Sheet	16 of 18		
Route Option Number	1.6		
Route Description	Aspen Road - Future McDonald Rd. Extension to Idiens Way		
MCSL Drawing Reference #	S-11		
Section Number			
From (Upstream)	Aspen Road		
To (Downstream)	Hector Road via Plan 60685		
Restoration Requirements	**Yes**	**No**	**Measure**
Green Field	N/A	N/A	
Paved Road	N/A	N/A	
Gravelled/Chip Sealed Road	N/A	N/A	
Pavement Condition	N/A	N/A	
Curbs	N/A	N/A	
Sidewalk	N/A	N/A	
Overhead Power	N/A	N/A	
Constructability	**Yes**	**No**	**Comment**
Traffic Volumes			
Appropriate Staging Areas			
Geotechnical Considerations			
Site Access			
Comments			
Additional Comments			

Comox Valley Regional District
Sewerage Master Plan
Preliminary Route Selection
Field Reconnaissance Report
Date: Dec 4, 2008

Sheet	17 of 18		
Route Option Number	1.7		
Route Description	Idiens Way - Aspen Rd. to Ex. Sanitary		
MCSL Drawing Reference #	S-11		
Section Number			
From (Upstream)	Idiens Way		
To (Downstream)	Along Aspen		
Restoration Requirements	**Yes**	**No**	**Measure**
Green Field			
Paved Road			
Gravelled/Chip Sealed Road			
Pavement Condition			
Curbs			
Sidewalk			
Overhead Power			
Constructability	**Yes**	**No**	**Comment**
Traffic Volumes			
Appropriate Staging Areas			
Geotechnical Considerations			
Site Access			
Comments			
Additional Comments			

Comox Valley Regional District
Sewerage Master Plan
Preliminary Route Selection
Field Reconnaissance Report
Date: Dec 4, 2008

Sheet	18 of 18		
Route Option Number	1.8		
Route Description	S-11		
MCSL Drawing Reference #			
Section Number			
From (Upstream)	Idiens Way connection		
To (Downstream)	Idiens Way at Aspen		
Restoration Requirements	**Yes**	**No**	**Measure**
Green Field			
Paved Road	√		
Gravelled/Chip Sealed Road			
Pavement Condition	Good		
Curbs		√	
Sidewalk		√	
Overhead Power	√		
Constructability	**Yes**	**No**	**Comment**
Traffic Volumes	Light		Open Residential
Appropriate Staging Areas			
Geotechnical Considerations			
Site Access	O.k.		
Comments			
Additional Comments	Apparent Disadvantages - Crosses jet fuel pipeline, high traffic, possible utility conflict		

McElhanney

APPENDIX H

COST ESTIMATE SUMMARY SHEETS

OPTION 1 - ROUTE 1

Courtenay PS Q= 2.3
Jane St. PS Q= 0.4
CFB PS Q= 3.1
Dociddle PS Q= 0.4
Southern PS Q= 1.16

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600			900	900	1200	1200
Unit Rate	500	450	700	600			850	750	1000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	300/375	300/375	600	600	750	750	900	900	1200	1200
Unit Rate	650	550	900	750	1000	900	1200	1100	1600	1450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers Length	Gravity Sewers Diameter	Gravity Sewers Unit Rate	Gravity Sewers Total Cost	Pressure Sewers Length	Pressure Sewers Diameter	Pressure Sewers Unit Rate	Pressure Sewers Total Cost	Pump Station Costs	Notes	Total Estimated Construction Costs (no contingencies, engineering)
Core Area Servicing Route 1 - McDonald/Idiens	0	New Courtenay River Pump Station									20,000,000		20,000,000
	1	Courtenay PS to Back Rd, through Section 9				-	1,200	1200	1450	1,740,000			1,740,000
	2	Plan 35008, from Back Rd to Sheraton Rd.				-	690	1200	1450	1,000,500			1,000,500
	3	Sheraton Rd, from Plan 35008 to McDonald Rd				-	750	1200	1450	1,087,500			1,087,500
	4	McDonald Rd, from Sheraton Rd to Hector Rd				-	800	1200	1450	1,160,000			1,160,000
	5	Through Plan 60685 to Aspen Rd.	150	1200	900	135,000				-			135,000
	6	Aspen Rd to Idiens Way	400	1200	1000	400,000				-			400,000
	7	Idiens Way to Connection Point	60	1200	900	54,000				-			54,000
	8	South leg of the Greenwood trunk to Pritchard Rd.	2,350	1200	900	2,115,000				-			2,115,000
	9	Knight Rd, Pritchard to CFB gravity sewer	1,100	1200	900	990,000				-			990,000
	10	Re/Re existing CFB gravity sewer	2,250	1200	900	2,025,000				-			2,025,000
	11	Upgrade CFB pump station									5,000,000		5,000,000
	12	Twin CFB forcemain				-	1,600	1200	1450	2,320,000			2,320,000
	13	Upgrade Jane St Pump Station									1,000,000		1,000,000
	14	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	880	375	650	572,000			572,000
	15	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	375	650	247,000			247,000
	16	Gravity section, per CH2MHILL forcemain relocation report	1,160	600	600	696,000				-			696,000
	17	Inverted siphon, per CH2MHILL forcemain relocation report	940	600	600	564,000				-			564,000
		Total				**6,979,000**				**8,127,000**	**26,000,000**		**$ 41,106,000**
Ships Point / Area A		Ships Point Rd, from Tozer Rd to Hwy 19A					1,230	300	550	676,500			676,500
		Hwy 19A, from Ships Point Rd to Old Yake Rd.					1,730	300	550	951,500			951,500
		Hwy 19A, from Old Yake Rd to the Tsable River					1,920	300	550	1,056,000			1,056,000
		Hwy 19A, from the Tsable River to Buckly Bay Rd.					1,180	300	550	649,000			649,000
		Hwy 19A, from Buckly Bay Rd to Brean Rd					2,840	300	550	1,562,000			1,562,000
		Hwy 19A, from Brean Rd to Seymour St (Terminus of Route 1)					3,150	300	550	1,732,500			1,732,500
		Total				-				**6,627,500**	-		**$ 6,627,500**
Utility/ROW		Highway 19A, from Seymour St to Jones St.					1,790	500	750	1,342,500			1,342,500
		Highway 19A, from Jones St to Van West Logging Rd.					1,520	500	750	1,140,000			1,140,000
		Highway 19A, from Van West Loggin Rd. to Inverness Rd.					2,590	500	750	1,942,500			1,942,500
		Highway 19A, from Inverness Rd. to Herondale Rd.					1,140	500	750	855,000			855,000
		Highway 19A, from Herondale Rd to Gartley Rd.					1,900	500	750	1,425,000			1,425,000
		Highway 19A, from Gartley Rd. to Royston Rd future Pump station					1,650	500	750	1,237,500			1,237,500
		New Pump Station, Hwy 19A & Robston Rd									9,000,000		9,000,000
		Highway 19A, from Royston Rd future Pump Station to Courtenay Pump Station					5,600	700	900	5,040,000			5,040,000
		Total				-				**12,982,500**	**9,000,000**		**$ 21,982,500**
Cumberland	2.1	Pump Station at Constructed Wetland Treatment Facility				-				-	3,000,000		3,000,000
	2.2	CWTF to Inland Island Hwy				-	1,100	375	550	605,000			605,000
	2.3	Royston Rd, Inland Islans Hwy to BC Hydro ROW	1,900	600	600	1,140,000				-			1,140,000
	2.4	Royston Rd, BC Hydro ROW to Hwy 19A	2,850	600	600	1,710,000				-			1,710,000
		Total				**2,850,000**				**605,000**	**3,000,000**		**$ 6,455,000**
Outlying Areas North		Saratoga Beach Pump Station									2,500,000		2,500,000
		Saratoga Beach to Kitty Coleman					9,450	300	550	5,197,500			5,197,500
													-
		Kitty Coleman Pump Station									4,000,000		4,000,000
		Kitty Coleman to Greenwood trunk					13,630	375	550	7,496,500			7,496,500
		Total				-				**12,694,000**	**6,500,000**		**$ 19,194,000**
CFB Comox		Greenwood trunk (North)	4900	VARIOUS	600	2,940,000							2,940,000
		Total Gross				12,769,000				41,131,000	44,500,000		98,400,000

OPTION 1 - ROUTE 2

Courtenay PS Q= 2.3
Jane St. PS Q= 0.4
CFB PS Q= 0.8
Docliddle PS Q= 2.7
Southern PS Q= 1.16

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600	900	900	1200	1200
Unit Rate	500	450	700	600	850	750	1000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	500	500	900	900	1200	1200
Unit Rate	650	550	900	750	1200	1100	1600	1450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers Length	Gravity Sewers Diameter	Gravity Sewers Unit Rate	Gravity Sewers Total Cost	Pressure Sewers Length	Pressure Sewers Diameter	Pressure Sewers Unit Rate	Pressure Sewers Total Cost	Pump Station Costs	Notes	Total Estimated Construction Costs
Core Area Servicing Route 2 - Beaufort Ave	0	New Courtenay River Pump Station									17,000,000		17,000,000
	1	Dyke Rd. from Courtenay PS to Comox Ave at Rodello St.				-	3,330	1200	1600	5,328,000			5,328,000
	2	Rodello St. from Comox Ave to Beaufort Ave.				-	80	1200	1600	128,000			128,000
	3	Beaufort Ave, from Rodello St to Ellis St.				-	725	1200	1600	1,160,000			1,160,000
	4	Beaufort Ave, from Ellis St. to Stuart St.				-	790	1200	1600	1,264,000			1,264,000
	5	Stewart St. from Beaufort St. to Comox Ave.				-	80	1200	1600	128,000			128,000
	6	Comox Ave, from Stewart to end of Comox Ave.				-	610	1200	1600	976,000			976,000
	7	End of Comox Ave to Croteau				-	220	1200	1600	352,000			352,000
	8	New pump station at Dociddle and Croteau Rds.				-				-	17,000,000		17,000,000
	9	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	860	1200	1450	1,276,000			1,276,000
	10	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	375	650	247,000			247,000
	11	Gravity section, per CH2MHILL forcemain relocation report	1,160	1200	900	1,044,000				-			1,044,000
	12	Inverted siphon, per CH2MHILL forcemain relocation report	940	1200	900	846,000				-			846,000
		Total				1,890,000				10,859,500	34,000,000		$ 46,749,500
Ships Point / Area A		Ships Point Rd. from Tozer Rd to Hwy 19A					1,230	300	550	676,500			676,500
		Hwy 19A, from Ships Point Rd to Old Yake Rd.					1,730	300	550	951,500			951,500
		Hwy 19A, from Old Yake Rd to the Tsable River					1,920	300	550	1,056,000			1,056,000
		Hwy 19A, from the Tsable River to Buckly Bay Rd.					1,180	300	550	649,000			649,000
		Hwy 19A, from Buckly Bay Rd to Brean Rd.					2,840	300	550	1,562,000			1,562,000
		Hwy 19A, from Brean Rd to Seymour St (Terminus of Route 1)					3,150	300	550	1,732,500			1,732,500
		Total				-				6,627,500	-		$ 6,627,500
UBID/RID		Highway 19A, from Seymour St to Jones St					1,790	500	750	1,342,500			1,342,500
		Highway 19A, from Jones St to Van West Logging Rd.					1,520	500	750	1,140,000			1,140,000
		Highway 19A, from Van West Loggin Rd. to Inverness Rd.					2,590	500	750	1,942,500			1,942,500
		Highway 19A, from Inverness Rd. to Herondale Rd.					1,140	500	750	855,000			855,000
		Highway 19A, from Herondale Rd to Gartley Rd.					1,900	500	750	1,425,000			1,425,000
		Highway 19A, from Gartley Rd. to Royston Rd future Pump station					1,650	500	750	1,237,500			1,237,500
		New Pump Station, Hwy 19A & Rotston Rd									7,000,000		7,000,000
		Highway 19A, from Royston Rd future Pump Station to Courtenay Pump Station					5,600	700	600	3,360,000			3,360,000
		Total				-				11,302,500	7,000,000		$ 18,302,500
Cumberland	2.1	Pump Station at Constructed Wetland Treatment Facility				-				-	3,000,000		3,000,000
	2.2	CWTF to Inland Island Hwy				-	1,100	375	550	605,000.00			605,000
	2.3	Royston Rd. Inland Island Hwy to BC Hydro ROW	1,900	600	450.00	855,000				-			855,000
	2.4	Royston Rd. BC Hydro ROW to Hwy 19A	2,850	600	450.00	1,282,500				-			1,282,500
		Total				2,137,500				605,000	3,000,000		$ 5,742,500
Outlying Areas North		Saratoga Beach Pump Station									2,500,000		2,500,000
		Saratoga Beach to Kitty Coleman					9,450	300	550	5,197,500			5,197,500
													-
		Kitty Coleman Pump Station									4,000,000		4,000,000
		Kitty Coleman to Greenwood trunk					13,630	375	550	7,496,500			7,496,500
		Total				-				12,694,000	6,500,000		$ 19,194,000
CFB Comox		Greenwood trunk (North)	4,900	VARIOUS	600	2,940,000							2,940,000
		South leg of the Greenwood trunk to Pritchard Rd.	2,350	375	450	1,057,500				-			1,057,500
		Knight Rd, Pritchard to CFB gravity sewer	1,100	375	450	495,000				-			495,000
		Re/Re existing CFB gravity sewer	2,250	1200	900	2,025,000				-			2,025,000
		Upgrade CFB pump station									2,500,000		2,500,000
		Twin CFB forcemain				-	1,600	1200	1450	2,320,000			2,320,000
		Total				6,517,500				2,320,000	2,500,000		$ 11,337,500
[illegible]		[illegible]				[illegible]				[illegible]	[illegible]		[illegible]

OPTION 1 - ROUTE 3

Courtenay PS Q= 2.3
Jane St. PS Q= 0.4
CFB PS Q= 3.1
Dociddle PS Q= 0
Southern PS Q= 1.16

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600	900	900	1200	1200
Unit Rate	500	450	700	600	850	750	1000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	500	500	900	900	1200	1200
Unit Rate	690	550	900	750	1200	1100	1500	1400

Route 3

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers				Pressure Sewers				Pump Station Costs	Notes	Total Estimated Construction Costs
			Length	Diameter	Unit Rate	Total Cost	Length	Diameter	Unit Rate	Total Cost			
Core Area Servicing Route 3 - Block 71	0	New Courtenay River Pump Station									20,000,000		20,000,000
	1	Comox Rd, from Courtenay PS to HWY 19A				-	1,500	1200	1450	2,175,000			2,175,000
	2	HWY 19A, from Comox Rd. to Headquarters Rd.				-	850	1200	1600	1,360,000			1,360,000
	3	Headquarters Rd, from HWY 19A to Vanier Dr.				-	1,480	1200	1450	2,146,000			2,146,000
	4	Vanier Dr., from Headquarters Rd. to HWY 19A				-	1,160	1200	1450	1,682,000			1,682,000
	5	Veteran's Memorial Parkway, from HWY 19A to DD 12675-N (Block 71)				-	670	1200	1450	971,500			971,500
	6	Through DD 12675-N to Block 71				-	1,170	1200	1450	1,696,500			1,696,500
	7	Through Block 71 to Greenwood trunk				-	1,350	1200	1450	1,957,500			1,957,500
	8	Greenwood trunk (north)	5,600	1200	900	5,040,000				-			5,040,000
	9	Re/Re existing CFB gravity sewer	2,250	1200	900	2,025,000				-			2,025,000
	10	Upgrade CFB pump station									5,000,000		5,000,000
	11	Twin CFB forcemain				-	1,600	1200	1450	2,320,000			2,320,000
	12	Upgrade Jane St Pump Station									1,000,000		1,000,000
	13	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	880	375	650	572,000			572,000
	14	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	375	650	247,000			247,000
	15	Gravity section, per CH2MHILL forcemain relocation report	1,160	600	600	696,000				-			696,000
	16	Inverted siphon, per CH2MHILL forcemain relocation report	940	600	600	564,000				-			564,000
		Total				8,325,000				15,127,500	26,000,000		$ 49,452,500
Ships Point / Area A		Ships Point Rd, from Tozer Rd to Hwy 19A					1,230	300	550	676,500			676,500
		Hwy 19A, from Ships Point Rd to Old Yake Rd.					1,730	300	550	951,500			951,500
		Hwy 19A, from Old Yake Rd to the Tsable River					1,920	300	550	1,056,000			1,056,000
		Hwy 19A, from the Tsable River to Buckly Bay Rd.					1,180	300	550	649,000			649,000
		Hwy 19A, from Buckly Bay Rd to Brean Rd					2,840	300	550	1,562,000			1,562,000
		Hwy 19A, from Brean Rd to Seymour St (Terminus of Route 1)					3,150	300	550	1,732,500			1,732,500
		Total				-				6,627,500	-		$ 6,627,500
UBID/RID		Highway 19A, from Seymour St to Jones St					1,790	500	750	1,342,500			1,342,500
		Highway 19A, from Jones St to Van West Logging Rd.					1,520	500	750	1,140,000			1,140,000
		Highway 19A, from Van West Loggin Rd. to Inverness Rd.					2,590	500	750	1,942,500			1,942,500
		Highway 19A, from Inverness Rd. to Herondale Rd.					1,140	500	750	855,000			855,000
		Highway 19A, from Herondale Rd to Gartley Rd.					1,900	500	750	1,425,000			1,425,000
		Highway 19A, from Gartley Rd. to Royston Rd future Pump station					1,650	500	750	1,237,500			1,237,500
		New Pump Station, Hwy 19A & Rolston Rd									9,000,000		9,000,000
		Highway 19A, from Royston Rd future Pump Station to Courtenay Pump Station					5,600	700	500	2,800,000			2,800,000
		Total				-				10,742,500	9,000,000		$ 19,742,500
Cumberland	2.1	Pump Station at Constructed Wetland Treatment Facility				-				-	3,000,000		3,000,000
	2.2	CWTF to Inland Island Hwy				-	1,100	375	550	605,000			605,000
	2.3	Royston Rd, Inland Island Hwy to BC Hydro ROW	1,900	600	600	1,140,000				-			1,140,000
	2.4	Royston Rd, BC Hydro ROW to Hwy 19A	2,850	600	600	1,710,000				-			1,710,000
		Total				2,850,000				605,000	3,000,000		$ 6,455,000
Outlying Areas North		Saratoga Beach Pump Station									2,500,000		2,500,000
		Saratoga Beach to Kitty Coleman					9,450	300	550	5,197,500			5,197,500
													-
		Kitty Coleman Pump Station									4,000,000		4,000,000
		Kitty Coleman to Greenwood trunk					13,630	375	550	7,496,500			7,496,500
		Total				-				12,694,000	6,500,000		$ 19,194,000
CFB Comox		Greenwood trunk (south)	2,350	375	450	1,057,500							1,057,500
		Knight Rd, Pritchard to CFB gravity sewer	1,100	375	450	495,000				-			495,000
		Total				1,552,500				-	-		$ 1,552,500
		Total Costs				[illegible]				[illegible]	[illegible]		[illegible]

OPTION 1 - ROUTE 4

Courtenay PS Q= 2.3
Jane St. PS Q= 0.4
CFB PS Q= 0.6
Dociddle PS Q= 0
Southern PS Q= 1.15

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600	900	900	1200	1200
Unit Rate	500	450	700	600	850	750	1000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	500	500	900	900	1200	1200
Unit Rate	650	550	900	750	1200	1100	1600	1450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers Length	Gravity Sewers Diameter	Gravity Sewers Unit Rate	Gravity Sewers Total Cost	Pressure Sewers Length	Pressure Sewers Diameter	Pressure Sewers Unit Rate	Pressure Sewers Total Cost	Pump Station Costs	Notes	Total Estimated Construction Costs
Core Area Servicing Route 4 - Guthrie Rd.	0	New Courtenay River Pump Station									20,000,000		20,000,000
	1	Courtenay PS to McDonald at Back Rd, through ALR				-	1,700	1200	1450	2,465,000			2,465,000
	2	McDonald Rd. from Back Rd to Guthrie Rd.				-	900	1200	1600	1,440,000			1,440,000
	3	Guthrie Rd. from McDonald Rd to Anderton Rd.					1,100	1200	1600	1,760,000			1,760,000
	4	Guthrie Rd. from Anderton Rd to Pritchard Rd.				-	1,270	1200	1600	2,032,000			2,032,000
	5	Guthrie Rd from Pritchard Rd to Skeen Dr.				-	250	1200	1600	400,000			400,000
	6	Guthrie Rd, from Skeen Dr to Beckton Dr.	1,270	900	850	1,079,500				-			1,079,500
	7	Beckton Dr, from Guthrie Rd to Gardner Way	220	900	850	187,000				-			187,000
	8	Gardner Way, from Beckton to CH2MHILL Route	420	900	850	357,000				-			357,000
	9	Inverted Siphon	600	900	1000	600,000				-			600,000
	10	Upgrade Jane St Pump Station									1,000,000		1,000,000
	11	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	880	375	550	484,000			484,000
	12	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	375	550	209,000			209,000
	13	Gravity section, per CH2MHILL forcemain relocation report	1,160	1200	900	1,044,000				-			1,044,000
	14	Inverted siphon, per CH2MHILL forcemain relocation report	940	1200	900	846,000				-			846,000
		Total				**4,113,500**				**8,790,000**	**21,000,000**		**$ 33,903,500**
Ships Point / Area A		Ships Point Rd, from Tozer Rd to Hwy 19A					1,230	300	550	676,500			676,500
		Hwy 19A, from Ships Point Rd to Old Yake Rd.					1,730	300	550	951,500			951,500
		Hwy 19A, from Old Yake Rd to the Tsable River					1,920	300	550	1,056,000			1,056,000
		Hwy 19A, from the Tsable River to Buckly Bay Rd.					1,180	300	550	649,000			649,000
		Hwy 19A, from Buckly Bay Rd to Brean Rd					2,840	300	550	1,562,000			1,562,000
		Hwy 19A, from Brean Rd to Seymour St (Terminus of Route 1)					3,150	300	550	1,732,500			1,732,500
		Total				-				**6,627,500**	-		**$ 6,627,500**
UBI/BMID		Highway 19A, from Seymour St to Jones St					1,790	500	750	1,342,500			1,342,500
		Highway 19A, from Jones St to Van West Logging Rd.					1,520	500	750	1,140,000			1,140,000
		Highway 19A, from Van West Loggin Rd. to Inverness Rd.					2,590	500	750	1,942,500			1,942,500
		Highway 19A, from Inverness Rd. to Herondale Rd.					1,140	500	750	855,000			855,000
		Highway 19A, from Herondale Rd to Gartley Rd.					1,900	500	750	1,425,000			1,425,000
		Highway 19A, from Gartley Rd. to Royston Rd future Pump station					1,650	500	750	1,237,500			1,237,500
		New Pump Station, Hwy 19A & Robston Rd									9,000,000		9,000,000
		Highway 19A, from Royston Rd future Pump Station to Courtenay Pump Station					5,600	900	1100	6,160,000			6,160,000
		Total				-				**14,102,500**	**9,000,000**		**$ 23,102,500**
Cumberland	2.1	Pump Station at Constructed Wetland Treatment Facility				-				-	3,000,000		3,000,000
	2.2	CWTF to Inland Island Hwy				-	1,100	375	550	605,000			605,000
	2.3	Royston Rd, Inland Island Hwy to BC Hydro ROW	1,900	600	600	1,140,000				-			1,140,000
	2.4	Royston Rd, BC Hydro ROW to Hwy 19A	2,850	600	600	1,710,000				-			1,710,000
		Total				**2,850,000**				**605,000**	**3,000,000**		**$ 6,455,000**
Outlying Areas North		Saratoga Beach Pump Station									2,500,000		2,500,000
		Saratoga Beach to Kitty Coleman					9,450	300	550	5,197,500			5,197,500
													-
		Kitty Coleman Pump Station									4,000,000		4,000,000
		Kitty Coleman to Greenwood trunk					13,630	375	550	7,496,500			7,496,500
		Total				-				**12,694,000**	**6,500,000**		**$ 19,194,000**
CFB Corridor		Greenwood trunk (North)	4,900	VARIOUS	600	2,940,000							2,940,000
		South leg of the Greenwood trunk to Pritchard Rd.	2,350	375	450	1,057,500				-			1,057,500
		Knight Rd, Pritchard to CFB gravity sewer	1,100	375	450	495,000				-			495,000
		Re/Re existing CFB gravity sewer	2,250	1200	900	2,025,000				-			2,025,000
		Upgrade CFB pump station									2,500,000		2,500,000
		Twin CFB forcemain				-	1,600	1200	1450	2,320,000			2,320,000
		Total				**6,517,500**				**2,320,000**	**2,500,000**		**$ 11,337,500**
		Total Cities				13,481,000				46,139,000	42,500,000		102,120,000

OPTION 1 - ROUTE 5

Courtenay PS Q= 2.3
Jane St. PS Q= 0.4
CFB PS Q= 0.8
Dockiddle PS Q= 2.7
Southern PS Q= 1.16

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600	900	900	1200	1200
Unit Rate	500	450	700	600	850	750	1000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	500	500	900	900	1200	1200
Unit Rate	650	550	900	750	1200	1100	1000	1450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers				Pressure Sewers				Pump Station Costs	Notes	Total Estimated Construction Costs
			Length	Diameter	Unit Rate	Total Cost	Length	Diameter	Unit Rate	Total Cost			
Core Area Servicing Route 5 - Robb Rd.	0	New Courtenay River Pump Station									20,000,000		20,000,000
	1	Courtenay PS to IR, along Dyke Rd.				-	2,050	1200	1450	2,972,500			2,972,500
	2	Through IR, Dyke Rd to Robb Rd.				-	500	1200	1450	725,000			725,000
	3	Robb Rd, from IR to Condor St.				-	220	1200	1600	352,000			352,000
	4	Robb Rd, from Condor St. to Anderton Ave.	800	1200	1000	800,000				-			800,000
	5	Robb Rd, from Anderton Ave to Pritchard Rd.	1,380	1200	1000	1,380,000				-			1,380,000
	6	Prichard Rd, from Robb Rd to Balmoral Ave.	490	1200	1000	490,000				-			490,000
	7	Balmoral Ave, from Pritchard St to Croteau, to Croteau pump station.	860	1200	1000	860,000				-			860,000
	8	New pump station at Dockiddle and Croteau Rds.									17,000,000		17,000,000
	9	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	860	1200	1450	1,276,000			1,276,000
	10	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	360	375	550	209,000			209,000
	11	Gravity section, per CH2MHILL forcemain relocation report	1,150	1200	900	1,044,000				-			1,044,000
	12	Inverted siphon, per CH2MHILL forcemain relocation report	940	1200	900	846,000				-			846,000
		Total				**5,420,000**				**5,534,500**	**37,000,000**		$ **47,954,500**
Ships Point / Area A		Ships Point Rd, from Tezer Rd to Hwy 19A					1,230	250	550	676,500			676,500
		Hwy 19A, from Ships Point Rd to Old Yake Rd.					1,730	250	550	951,500			951,500
		Hwy 19A, from Old Yake Rd to the Tsable River					1,920	300	550	1,056,000			1,056,000
		Hwy 19A, from the Tsable River to Buckly Bay Rd.					1,180	300	550	649,000			649,000
		Hwy 19A, from Buckly Bay Rd to Brean Rd					2,840	300	550	1,562,000			1,562,000
		Hwy 19A, from Brean Rd to Seymour St (Terminus of Route 1)					3,150	300	550	1,732,500			1,732,500
		Total				-				**6,627,500**	-		$ **6,627,500**
US/DRIO		Highway 19A, from Seymour St to Jones St					1,790	450	750	1,342,500			1,342,500
		Highway 19A, from Jones St to Van West Logging Rd.					1,520	450	750	1,140,000			1,140,000
		Highway 19A, from Van West Loggin Rd. to Inverness Rd.					2,590	450	750	1,942,500			1,942,500
		Highway 19A, from Inverness Rd. to Herondale Rd.					1,140	450	750	855,000			855,000
		Highway 19A, from Herondale Rd to Gartley Rd.					1,900	500	750	1,425,000			1,425,000
		Highway 19A, from Gartley Rd. to Royston Rd future Pump station					1,650	500	750	1,237,500			1,237,500
		New Pump Station, Hwy 19A & Rotston Rd									9,000,000		9,000,000
		Highway 19A, from Royston Rd future Pump Station to Courtenay Pump Station					5,600	700	600	3,360,000			3,360,000
		Total				-				**11,302,500**	**9,000,000**		$ **20,302,500**
Cumberland	2.1	Pump Station at Constructed Wetland Treatment Facility				-				-	3,000,000		3,000,000
	2.2	CWTF to Inland Island Hwy				-	1,100	375	450	495,000			495,000
	2.3	Royston Rd, Inland Island Hwy to BC Hydro ROW	1900	600	600	1,140,000				-			1,140,000
	2.4	Royston Rd, BC Hydro ROW to Hwy 19A	2850	600	600	1,710,000				-			1,710,000
		Total				**2,850,000**				**495,000**	**3,000,000**		$ **6,345,000**
Outlying Areas North		Saratoga Beach Pump Station									2,500,000		2,500,000
		Saratoga Beach to Kitty Coleman					9,450	300	450	4,252,500			4,252,500
													-
		Kitty Coleman Pump Station									4,000,000		4,000,000
		Kitty Coleman to Greenwood trunk					13,630	375	450	6,133,500			6,133,500
		Total				-				**10,386,000**	**6,500,000**		$ **16,886,000**
CFB Comox		Greenwood trunk (North)	4,900	VARIOUS	600	2,940,000							2,940,000
		South leg of the Greenwood trunk to Pritchard Rd.	2,350	375	450	1,057,500				-			1,057,500
		Knight Rd, Pritchard to CFB gravity sewer	1,100	375	450	495,000				-			495,000
		Re/Re existing CFB gravity sewer	2,250	1200	900	2,025,000				-			2,025,000
		Upgrade CFB pump station									2,500,000		2,500,000
		Twin CFB forcemain				-	1,600	1200	1450	2,320,000			2,320,000
		Total				$ **6,517,500**				$ **2,320,000**	$ **2,500,000**		$ **11,337,500**
		[illegible]				**14,787,500**				[illegible]	[illegible]		[illegible]

OPTION 1A - ROUTE 1

Courtenay PS Q= 1.13
Jane St. PS Q= 0.4
CFB PS Q= 1.93
Dodiddle PS Q= 1.56
Southern PS Q= 1.16

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600			900	900	1200	1200
Unit Rate	500	450	700	600			850	750	1000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	300/375	300/375	500	500	750	750	900	900	1200	1200
Unit Rate	650	550	900	750	1000	900	1200	1100	1600	1450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers Length	Gravity Sewers Diameter	Gravity Sewers Unit Rate	Gravity Sewers Total Cost	Pressure Sewers Length	Pressure Sewers Diameter	Pressure Sewers Unit Rate	Pressure Sewers Total Cost	Pump Station Costs	Notes	Total Estimated Construction Costs
Core Area Servicing Route 1 - McDonald/Idiens	0	New Courtenay River Pump Station									17,000,000		17,000,000
	1	Courtenay PS to Back Rd, through Section 9				-	1,200	750	900	1,080,000			1,080,000
	2	Plan 35008, from Back Rd to Sheraton Rd.				-	690	750	900	621,000			621,000
	3	Sheraton Rd, from Plan 35008 to McDonald Rd.				-	750	750	900	675,000			675,000
	4	McDonald Rd, from Sheraton Rd to Hector Rd				-	800	750	900	720,000			720,000
	5	Through Plan 60685 to Aspen Rd.	150	900	750	112500				-			112,500
	6	Aspen Rd to Idiens Way	400	900	750	300000				-			300,000
	7	Idiens Way to Connection Point	60	900	750	45,000				-			45,000
	8	South leg of the Greenwood trunk to Pritchard Rd.	2,350	900	750	1,762,500				-			1,762,500
	9	Knight Rd, Pritchard to CFB gravity sewer	1,100	900	750	825,000				-			825,000
	10	Re/Re existing CFB gravity sewer	2,250	1200	1450	3,262,500				-			3,262,500
	11	Upgrade CFB pump station									5,000,000		5,000,000
	12	Twin CFB forcemain				-	1,600	1200	1450	2,320,000			2,320,000
	13	Upgrade Jane St Pump Station									1,000,000		1,000,000
	14	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	880	900	1100	968,000			968,000
	15	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	900	1100	418,000			418,000
	16	Gravity section, per CH2MHILL forcemain relocation report	1,160	1200	900	1,044,000				-			1,044,000
	17	Inverted siphon, per CH2MHILL forcemain relocation report	940	1200	900	846,000				-			846,000
		Total				8,197,500				6,802,000	23,000,000		$ 37,999,500
Ships Point / Area A		Ships Point Rd, from Tozer Rd to Hwy 19A					1,230	300	550	676,500			676,500
		Hwy 19A, from Ships Point Rd to Old Yake Rd.					1,730	300	550	951,500			951,500
		Hwy 19A, from Old Yake Rd to the Tsable River					1,920	300	550	1,056,000			1,056,000
		Hwy 19A, from the Tsable River to Buckly Bay Rd.					1,180	300	550	649,000			649,000
		Hwy 19A, from Buckly Bay Rd to Brean Rd					2,840	300	550	1,562,000			1,562,000
		Hwy 19A, from Brean Rd to Seymour St (Terminus of Route 1)					3,150	300	550	1,732,500			1,732,500
		Total				-				6,627,500	-		$ 6,627,500
UBID/RID		Highway 19A, from Seymour St to Jones St					1,790	500	750	1,342,500			1,342,500
		Highway 19A, from Jones St to Van West Logging Rd.					1,520	500	750	1,140,000			1,140,000
		Highway 19A, from Van West Loggin Rd. to Inverness Rd.					2,590	500	750	1,942,500			1,942,500
		Highway 19A, from Inverness Rd. to Herondale Rd.					1,140	500	750	855,000			855,000
		Highway 19A, from Herondale Rd to Gartley Rd.					1,900	500	750	1,425,000			1,425,000
		Highway 19A, from Gartley Rd. to Royston Rd future Pump station					1,650	500	750	1,237,500			1,237,500
		New Pump Station, Hwy 19A & Rolston Rd									9,000,000		9,000,000
		Submarine Crossing to Jane Street					4,550	900	1500	6,825,000			6,825,000
		Total				-				14,767,500	9,000,000		$ 23,767,500
Cumberland	2.1	Pump Station at Constructed Wetland Treatment Facility				-				-	3,000,000		3,000,000
	2.2	CWTF to inland Island Hwy				-	1,100	375	550	605,000.00			605,000
	2.3	Royston Rd, Inland Island Hwy to BC Hydro ROW	1,900	600	600	1,140,000				-			1,140,000
	2.4	Royston Rd, BC Hydro ROW to Hwy 19A	2,850	600	600	1,710,000				-			1,710,000
		Total				2,850,000				605,000	3,000,000		$ 6,455,000
Outlying Areas North		Saratoga Beach Pump Station									2,500,000		2,500,000
		Saratoga Beach to Kitty Coleman					9,450	300	550	5,197,500			5,197,500
													-
		Kitty Coleman Pump Station									4,000,000		4,000,000
		Kitty Coleman to Greenwood trunk					13,630	375	550	7,496,500			7,496,500
		Total				-				12,694,000	6,500,000		$ 19,194,000
CFB Comox		Greenwood trunk (North)	4900	VARIOUS	600	2940000							$ 2,940,000
		Total				13,987,500				41,496,000	41,500,000		$ 97,000,000

OPTION 1A - ROUTE 2

Courtenay PS Q= 1.13
Jane St. PS Q= 0.4
CFB PS Q= 0.8
Docliddle PS Q= 2.69
Southern PS Q= 1.16

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600			900	900	1200	1200
Unit Rate	500	450	700	600			850	750	1000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	300/375	300/375	500	500	750	750	900	900	1200	1200
Unit Rate	650	550	900	750	1000	900	1200	1100	1600	1450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers Length	Gravity Sewers Diameter	Gravity Sewers Unit Rate	Gravity Sewers Total Cost	Pressure Sewers Length	Pressure Sewers Diameter	Pressure Sewers Unit Rate	Pressure Sewers Total Cost	Pump Station Costs	Notes	Total Estimated Construction Costs
Core Area Servicing Route 2 - Beaufort Ave	0	New Courtenay River Pump Station									17,000,000		17,000,000
	1	Dyke Rd, from Courtenay PS to Comox Ave at Rodello St.				-	3,330	750	900	2,997,000			2,997,000
	2	Rodello St, from Comox Ave to Beaufort Ave.				-	80	750	1000	80,000			80,000
	3	Beaufort Ave, from Rodello St to Ellis St.				-	725	750	1000	725,000			725,000
	4	Beaufort Ave, from Ellis St. to Stuart St.				-	790	750	1000	790,000			790,000
	5	Stewart St, from Beaufort St. to Comox Ave.				-	80	750	1000	80,000			80,000
	6	Comox Ave, from Stewart to end of Comox Ave.				-	610	750	1000	610,000			610,000
	7	End of Comox Ave to Croteau				-	220	750	1000	220,000			220,000
	8	New pump station at Docliddle and Croteau Rds.								-	17,000,000		17,000,000
	9	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	880	1200	1450	1,276,000			1,276,000
	10	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	900	1100	418,000			418,000
	11	Gravity section, per CH2MHILL forcemain relocation report	1,160	1200	900	1,044,000							1,044,000
	12	Inverted siphon, per CH2MHILL forcemain relocation report	940	1200	900	846,000							846,000
		Total				1,890,000				7,195,000	34,000,000		$ 43,086,000
Ships Point / Area A		Ships Point Rd, from Tozer Rd to Hwy 19A					1,230	300	550	676,500			676,500
		Hwy 19A, from Ships Point Rd to Old Yake Rd.					1,730	300	550	951,500			951,500
		Hwy 19A, from Old Yake Rd to the Tsable River					1,920	300	550	1,056,000			1,056,000
		Hwy 19A, from the Tsable River to Buckly Bay Rd.					1,180	300	550	649,000			649,000
		Hwy 19A, from Buckly Bay Rd to Brean Rd					2,840	300	550	1,562,000			1,562,000
		Hwy 19A, from Brean Rd to Seymour St (Terminus of Route 1)					3,150	300	550	1,732,500			1,732,500
		Total				-				6,627,500	-		$ 6,627,500
UBIDRID		Highway 19A, from Seymour St to Jones St					1,790	500	750	1,342,500			1,342,500
		Highway 19A, from Jones St to Van West Logging Rd.					1,520	500	750	1,140,000			1,140,000
		Highway 19A, from Van West Loggin Rd. to Inverness Rd.					2,590	500	750	1,942,500			1,942,500
		Highway 19A, from Inverness Rd. to Herondale Rd.					1,140	500	750	855,000			855,000
		Highway 19A, from Herondale Rd to Gartley Rd					1,900	500	750	1,425,000			1,425,000
		Highway 19A, from Gartley Rd. to Royston Rd future Pump station					1,650	500	750	1,237,500			1,237,500
		New Pump Station, Hwy 19A & Royston Rd									9,000,000		9,000,000
		Submarine Crossing to Jane Street					4,550	900	1500	6,825,000			6,825,000
		Total				-				14,767,500	9,000,000		$ 23,767,500
Cumberland	21	Pump Station at Constructed Wetland Treatment Facility				-					3,000,000		3,000,000
	22	CWTF to Inland Island Hwy					1,100	375	550	605,000			605,000
	23	Royston Rd, Inland Island Hwy to BC Hydro ROW	1,900	600	600	1,140,000							1,140,000
	24	Royston Rd, BC Hydro ROW to Hwy 19A	2,850	600	600	1,710,000							1,710,000
		Total				2,850,000				605,000	3,000,000		$ 6,455,000
Outlying Areas North		Saratoga Beach Pump Station									2,500,000		2,500,000
		Saratoga Beach to Kitty Coleman					9,450	300	550	5,197,500			5,197,500
		Kitty Coleman Pump Station									4,000,000		4,000,000
		Kitty Coleman to Greenwood trunk					13,630	375	550	7,496,500			7,496,500
		Total				-				12,694,000	6,500,000		$ 19,194,000
CFB Comox		Greenwood trunk (North)	4,900	VARIOUS	600	2,940,000							2,940,000
		South leg of the Greenwood trunk to Pritchard Rd.	2,350	375	450	1,057,500							1,057,500
		Knight Rd, Pritchard to CFB gravity sewer	1,100	375	450	495,000							495,000
		Re/Re existing CFB gravity sewer	2,250	1200	900	2,025,000				-			2,025,000
		Upgrade CFB pump station									2,500,000		2,500,000
		Twin CFB forcemain				-	1600	500	750	1,200,000			1,200,000
		Total				6,517,500				1,200,000	2,500,000		$ 10,217,500
		Total Costs				[illegible]				[illegible]	[illegible]		$ [illegible]

OPTION 1A - ROUTE 3

Courtenay PS Q= 1.13
Jane St. PS Q= 0.4
CFB PS Q= 1.93
Dodiddle PS Q= 1.56
Southern PS Q= 1.16

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600			900	900	1200	1200
Unit Rate	500	450	700	600			850	750	1000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	300/375	300/375	500	500	750	750	900	900	1200	1200
Unit Rate	650	550	900	750	1000	900	1200	1100	1600	1450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers Length	Gravity Sewers Diameter	Gravity Sewers Unit Rate	Gravity Sewers Total Cost	Pressure Sewers Length	Pressure Sewers Diameter	Pressure Sewers Unit Rate	Pressure Sewers Total Cost	Pump Station Costs	Notes	Total Estimated Construction Costs
Core Area Servicing Route 3 - Block 71	0	New Courtenay River Pump Station									17,000,000		17,000,000
	1	Comox Rd, from Courtenay PS to HWY 19A				-	1,500	750	1000	1,500,000			1,500,000
	2	HWY 19A, from Comox Rd. to Headquarters Rd.				-	850	750	1000	850,000			850,000
	3	Headquarters Rd, from HWY 19A to Vanier Dr.				-	1,480	750	900	1,332,000			1,332,000
	4	Vanier Dr., from Headquarters Rd. to HWY 19A				-	1,160	750	900	1,044,000			1,044,000
	5	Veteran's Memorial Parkway, from HWY 19A to DD 12876-N (Block 71)				-	670	750	900	603,000			603,000
	6	Through DD 12676-N to Block 71				-	1,170	750	900	1,053,000			1,053,000
	7	Through Block 71 to Greenwood trunk				-	1,350	750	900	1,215,000			1,215,000
	8	Greenwood trunk	5,600	1200	900	5,040,000				-			5,040,000
	9	Re/Re existing CFB gravity sewer	2,250	1200	900	2,025,000				-			2,025,000
	10	Upgrade CFB pump station									5,000,000		5,000,000
	11	Twin CFB forcemain				-	1,600	1200	1450	2,320,000			2,320,000
	12	New pump station at Dodiddle and Croteau Rds				-				-	17,000,000		17,000,000
	13	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	880	900	1100	968,000			968,000
	14	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	900	1100	418,000			418,000
	15	Gravity section, per CH2MHILL forcemain relocation report	1,160	1200	900	1,044,000				-			1,044,000
	16	Inverted siphon, per CH2MHILL forcemain relocation report	940	1200	900	846,000				-			846,000
		Total				8,955,000				11,303,000	39,000,000		$ 59,258,000
Ships Point / Area A		Ships Point Rd, from Tozer Rd to Hwy 19A					1,230	300	550	676,500			676,500
		Hwy 19A, from Ships Point Rd to Old Yake Rd.					1,730	300	550	951,500			951,500
		Hwy 19A, from Old Yake Rd to the Tsable River					1,920	300	550	1,056,000			1,056,000
		Hwy 19A, from the Tsable River to Buckly Bay Rd.					1,180	300	550	649,000			649,000
		Hwy 19A, from Buckly Bay Rd to Brean Rd.					2,840	300	550	1,562,000			1,562,000
		Hwy 19A, from Brean Rd to Seymour St (Terminus of Route 1)					3,150	300	550	1,732,500			1,732,500
		Total				-				6,627,500	-		$ 6,627,500
UBID/RID		Highway 19A, from Seymour St to Jones St					1,790	500	750	1,342,500			1,342,500
		Highway 19A, from Jones St to Van West Logging Rd.					1,520	500	750	1,140,000			1,140,000
		Highway 19A, from Van West Loggin Rd. to Inverness Rd.					2,590	500	750	1,942,500			1,942,500
		Highway 19A, from Inverness Rd. to Herondale Rd.					1,140	500	750	855,000			855,000
		Highway 19A, from Herondale Rd to Gartley Rd.					1,900	500	750	1,425,000			1,425,000
		Highway 19A, from Gartley Rd. to Royston Rd future Pump station					1,650	500	750	1,237,500			1,237,500
		New Pump Station, Hwy 19A & Rolston Rd									9,000,000		9,000,000
		Submarine Crossing to Jane Street					4,550	900	1500	6,825,000			6,825,000
		Total				-				14,767,500	9,000,000		$ 23,767,500
Cumberland	2.1	Pump Station at Constructed Wetland Treatment Facility				-				0	3,000,000		3,000,000
	2.2	CWTF to Inland Island Hwy				-	1,100	375	550	605000			605,000
	2.3	Royston Rd. Inland Island Hwy to BC Hydro ROW	1,900	600	600	1,140,000				0			1,140,000
	2.4	Royston Rd. BC Hydro ROW to Hwy 19A	2,850	600	600	1,710,000				0			1,710,000
		Total				2,850,000				605,000	3,000,000		$ 6,455,000
Outlying Areas North		Saratoga Beach Pump Station									2,500,000		2,500,000
		Saratoga Beach to Kitty Coleman					9,450	300	550	5,197,500			5,197,500
													-
		Kitty Coleman Pump Station									4,000,000		4,000,000
		Kitty Coleman to Greenwood trunk					13,630	375	550	7,496,500			7,496,500
		Total				-				12,694,000	6,500,000		$ 19,194,000
CFB Comox		South leg of the Greenwood trunk to Pritchard Rd.	2,350	375	450	1,057,500				-			1,057,500
		Knight Rd, Pritchard to CFB gravity sewer	1,100	375	450	495,000				-			495,000
		Total				1,552,500				-	-		$ 1,552,500
		Total Costs				13,357,500				43,997,000	57,500,000		$ 114,855,000

OPTION 1A - ROUTE 4

Courtenay PS Q= 1.13
Jane St. PS Q= 0.4
CFB PS Q= 0.8
Dodiddle PS Q= 1.56
Southern PS Q= 1.16

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600			900	900	1200	1200
Unit Rate	500	450	700	600			850	750	1000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	300/375	300/375	500	500	750	750	900	900	1200	1200
Unit Rate	650	550	900	750	1000	900	1200	1100	1600	1450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers Length	Gravity Sewers Diameter	Gravity Sewers Unit Rate	Gravity Sewers Total Cost	Pressure Sewers Length	Pressure Sewers Diameter	Pressure Sewers Unit Rate	Pressure Sewers Total Cost	Pump Station Costs	Notes	Total Estimated Construction Costs
Core Area Servicing Route 4 - Guthrie Rd.	0	New Courtenay River Pump Station									17,000,000		17,000,000
	1	Courtenay PS to McDonald at Back Rd, through ALR				-	1,700	750	900	1,530,000			1,530,000
	2	McDonald Rd, from Back Rd to Guthrie Rd.				-	900	750	900	810,000			810,000
	3	Guthrie Rd, from McDonald Rd to Anderton Rd.				-	1,100	750	1000	1,100,000			1,100,000
	4	Guthrie Rd, from Anderton Rd to Pritchard Rd.				-	1,270	750	1000	1,270,000			1,270,000
	5	Guthrie Rd from Pritchard Rd to Skeen Dr.				-	250	750	1000	250,000			250,000
	6	Guthrie Rd, from Skeen Dr to Beckton Dr.	1,270	900	850	1,079,500				-			1,079,500
	7	Beckton Dr, from Guthrie Rd to Gardner Way	220	900	850	187,000				-			187,000
	8	Gardner Way, from Beckton to CH2MHILL Route	420	900	850	357,000				-			357,000
	9	New pump station at Dodiddle and Croteau Rds.				-				-	17,000,000		17,000,000
	10	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	880	900	1100	968,000			968,000
	11	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	900	1100	418,000			418,000
	12	Gravity section, per CH2MHILL forcemain relocation report	1,160	1200	900	1,044,000				-			1,044,000
	13	Inverted siphon, per CH2MHILL forcemain relocation report	940	1200	900	846,000				-			846,000
		Total				**3,513,500**				**6,346,000**	**34,000,000**		**$ 43,859,500**
Ships Point / Area A		Ships Point Rd, from Tozer Rd to Hwy 19A					1,230	300	550	676,500			676,500
		Hwy 19A, from Ships Point Rd to Old Yake Rd.					1,730	300	550	951,500			951,500
		Hwy 19A, from Old Yake Rd to the Tsable River					1,920	300	550	1,056,000			1,056,000
		Hwy 19A, from the Tsable River to Buckly Bay Rd.					1,180	300	550	649,000			649,000
		Hwy 19A, from Buckly Bay Rd to Brean Rd					2,840	300	550	1,562,000			1,562,000
		Hwy 19A, from Brean Rd to Seymour St (Terminus of Route 1)					3,150	300	550	1,732,500			1,732,500
		Total				-				**6,627,500**	-		**$ 6,627,500**
UBID/RID		Highway 19A, from Seymour St to Jones St					1,790	500	750	1,342,500			1,342,500
		Highway 19A, from Jones St to Van West Logging Rd.					1,520	500	750	1,140,000			1,140,000
		Highway 19A, from Van West Logger Rd. to Inverness Rd.					2,590	500	750	1,942,500			1,942,500
		Highway 19A, from Inverness Rd. to Herondale Rd.					1,140	500	750	855,000			855,000
		Highway 19A, from Herondale Rd to Gartley Rd.					1,900	500	750	1,425,000			1,425,000
		Highway 19A, from Gartley Rd. to Royston Rd future Pump station					1,650	500	750	1,237,500			1,237,500
		New Pump Station, Hwy 19A & Rotston Rd									9,000,000		9,000,000
		Submarine Crossing to Jane Street					4,550	900	1500	6,825,000			6,825,000
		Total				-				**14,767,500**	**9,000,000**		**$ 23,767,500**
Cumberland	2.1	Pump Station at Constructed Wetland Treatment Facility				-				-	3,000,000		3,000,000
	2.2	CWTF to Inland Island Hwy				-	1,100	375	550	605000			605,000
	2.3	Royston Rd, Inland Island Hwy to BC Hydro ROW	1,900	600	600	1,140,000				-			1,140,000
	2.4	Royston Rd, BC Hydro ROW to Hwy 19A	2,850	600	600	1,710,000				-			1,710,000
		Total				**2,850,000**				**605,000**	**3,000,000**		**$ 6,455,000**
Outlying Areas North		Saratoga Beach Pump Station									2,500,000		2,500,000
		Saratoga Beach to Kitty Coleman					9,450	300	550	5,197,500			5,197,500
													-
		Kitty Coleman Pump Station									4,000,000		4,000,000
		Kitty Coleman to Greenwood trunk					13,630	375	550	7,496,500			7,496,500
		Total				-				**12,694,000**	**6,500,000**		**$ 19,194,000**
CFB Comox		Greenwood trunk (North)	4,900	VARIOUS	600	2,940,000				-			2,940,000
		South leg of the Greenwood trunk to Pritchard Rd.	2,350	375	450	1,057,500				-			1,057,500
		Knight Rd, Pritchard to CFB gravity sewer	1,100	375	450	495,000				-			495,000
		ReRa existing CFB gravity sewer	2,250	1200	900	2,025,000				-			2,025,000
		Upgrade CFB pump station									2,500,000		2,500,000
		Twin CFB forcemain				-	1,600	500	750	1,200,000			1,200,000
		Total				**6,517,500**				**1,200,000**	**2,500,000**		**$ 10,217,500**
		Total Costs				[illegible]				[illegible]	[illegible]		[illegible]

OPTION 1A - ROUTE 5

Courtenay PS Q= 2.3
Jane St. PS Q= 0.4
CFB PS Q= 0.46
Dockiddle PS Q= 2.7

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600	900	900	1200	1200
Unit Rate	500	450	700	600	850	750	1000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	300/375	300/375	500	500	900	900	1200	1200
Unit Rate	650	550	900	750	1200	1100	1600	1450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers				Pressure Sewers				Pump Station Costs	Notes	Total Estimated Construction Costs
			Length	Diameter	Unit Rate	Total Cost	Length	Diameter	Unit Rate	Total Cost			
Core Area Servicing Route 5 - Robb Rd.	0	New Courtenay River Pump Station									17,000,000		17,000,000
	1	Courtenay PS to IR, along Dyke Rd.				-	2,050	1200	1450	2,972,500			2,972,500
	2	Through IR, Dyke Rd to Robb Rd.				-	500	1200	1450	725,000			725,000
	3	Robb Rd. from IR to Condor St.				-	220	1200	1600	352,000			352,000
	4	Robb Rd. from Condor St. to Anderton Ave.	800	1200	1000	800,000				-			800,000
	5	Robb Rd. from Anderton Ave to Pritchard Rd.	1,380	1200	1000	1,380,000				-			1,380,000
	6	Pritchard Rd. from Robb Rd to Balmoral Ave.	490	1200	1000	490,000				-			490,000
	7	Balmoral Ave. from Pritchard St to Croteau, to Croteau pump station.	660	1200	1000	660,000				-			660,000
	8	New pump station at Dockiddle and Croteau Rds.									17,000,000		17,000,000
	9	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	850	1200	1450	1,276,000			1,276,000
	10	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	375	550	209,000			209,000
	11	Gravity section, per CH2MHILL forcemain relocation report	1,160	1200	900	1,044,000				-			1,044,000
	12	Inverted siphon, per CH2MHILL forcemain relocation report	940	1200	900	846,000				-			846,000
		Total				**5,420,000**				**5,534,500**	**34,000,000**		**$ 44,954,500**
Ships Point / Area A		Ships Point Rd. from Tozer Rd to Hwy 19A					1,230	300	550	676,500			676,500
		Hwy 19A, from Ships Point Rd to Old Yake Rd.					1,730	300	550	951,500			951,500
		Hwy 19A, from Old Yake Rd to the Tsable River					1,920	300	550	1,056,000			1,056,000
		Hwy 19A, from the Tsable River to Buckly Bay Rd.					1,180	300	550	649,000			649,000
		Hwy 19A, from Buckly Bay Rd to Brean Rd					2,840	300	550	1,562,000			1,562,000
		Hwy 19A, from Brean Rd to Seymour St (Terminus of Route 1)					3,150	300	550	1,732,500			1,732,500
		Total				-				**6,627,500**	-		**$ 6,627,500**
UBIC/RID		Highway 19A, from Seymour St to Jones St					1,790	500	750	1,342,500			1,342,500
		Highway 19A, from Jones St to Van West Logging Rd.					1,520	500	750	1,140,000			1,140,000
		Highway 19A, from Van West Loggin Rd. to Inverness Rd.					2,590	500	750	1,942,500			1,942,500
		Highway 19A, from Inverness Rd. to Herondale Rd.					1,140	500	750	855,000			855,000
		Highway 19A, from Herondale Rd to Gartley Rd.					1,900	500	750	1,425,000			1,425,000
		Highway 19A, from Gartley Rd. to Royston Rd future Pump station					1,650	500	750	1,237,500			1,237,500
		New Pump Station, Hwy 19A & Rolston Rd									9,000,000		9,000,000
		Submarine Crossing to Jane Street					4,550	900	1,500	6,825,000			6,825,000
		Total				-				**14,767,500**	**9,000,000**		**$ 23,767,500**
Cumberland	2.1	Pump Station at Constructed Wetland Treatment Facility				-					3,000,000		3,000,000
	2.2	CWTF to Inland Island Hwy				-	1,100	375	450	495,000			495,000
	2.3	Royston Rd, Inland Island Hwy to BC Hydro ROW	1,900	600	600	1,140,000				-			1,140,000
	2.4	Royston Rd, BC Hydro ROW to Hwy 19A	2,850	600	600	1,710,000				-			1,710,000
		Total				**2,850,000**				**495,000**	**3,000,000**		**$ 6,345,000**
Outlying Areas North		Saratoga Beach Pump Station									2,500,000		2,500,000
		Saratoga Beach to Kitty Coleman					9,450	300	450	4,252,500			4,252,500
													-
		Kitty Coleman Pump Station									4,000,000		4,000,000
		Kitty Coleman to Greenwood trunk					13,630	375	450	6,133,500			6,133,500
		Total				-				**10,386,000**	**6,500,000**		**$ 16,886,000**
CFB Comox		Greenwood trunk (North)	4,900	VARIOUS	600	2,940,000							2,940,000
		South leg of the Greenwood trunk to Pritchard Rd.	2,350	375	450	1,057,500				-			1,057,500
		Knight Rd, Pritchard to CFB gravity sewer	1,100	375	450	495,000				-			495,000
		Re/Re existing CFB gravity sewer	2,250	1,200	900	2,025,000				-			2,025,000
		Upgrade CFB pump station									2,500,000		2,500,000
		Twin CFB forcemain				-	1,600	1,200	1,450	2,320,000			2,320,000
		Total				**6,517,500**				**2,320,000**	**2,500,000**		**$ 11,237,500**
		Total Route				14,787,500				40,130,500	15,000,000	$	169,940,500

OPTION 2 - ROUTE 1

Courtenay PS Q= 1.13
Jane St. PS Q= 0.4
CFB PS Q= 1.61
Dockside PS Q= 1.56
Southern PS Q= 1.16

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600			900	900	1200	1200
Unit Rate	500	450	700	600			850	750	1000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	500	500	750	750	900	900	1200	1200
Unit Rate	650	550	900	750	1000	900	1200	1100	1600	1450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers Length	Gravity Sewers Diameter	Gravity Sewers Unit Rate	Gravity Sewers Total Cost	Pressure Sewers Length	Pressure Sewers Diameter	Pressure Sewers Unit Rate	Pressure Sewers Total Cost	Pump Station Costs	Notes	Total Estimated Construction Costs
Core Area Servicing Route 1 - McDonald/Idiens	0	New Courtenay River Pump Station									17,000,000		17,000,000
	1	Courtenay PS to Back Rd, through Section 9				-	1,200	750	900	1,080,000			1,080,000
	2	Plan 35008, from Back Rd to Sheraton Rd.				-	690	750	900	621,000			621,000
	3	Sheraton Rd, from Plan 35008 to McDonald Rd.				-	750	750	900	675,000			675,000
	4	McDonald Rd, from Sheraton Rd to Hector Rd				-	800	750	900	720,000			720,000
	5	Through Plan 60685 to Aspen Rd.	150	900	750	112,500				-			112,500
	6	Aspen Rd to Idiens Way	400	900	750	300,000				-			300,000
	7	Idiens Way to Connection Point	60	900	750	45,000				-			45,000
	8	South leg of the Greenwood trunk to Pritchard Rd.	2,350	900	750	1,762,500				-			1,762,500
	9	Knight Rd, Pritchard to CFB gravity sewer	1,100	1,200	900	990,000				-			990,000
	10	Re/Re existing CFB gravity sewer	2,250	1,200	1,450	3,262,500				-			3,262,500
	11	Upgrade CFB pump station									5,000,000		5,000,000
	12	Twin CFB forcemain				-	1,600	900	1,100	1,760,000			1,760,000
	13	Upgrade Jane St Pump Station									1,000,000		1,000,000
	14	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	880	375	550	484,000			484,000
	15	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	375	550	209,000			209,000
	16	Gravity section, per CH2MHILL forcemain relocation report	1,160	600	600	696,000				-			696,000
	17	Inverted siphon, per CH2MHILL forcemain relocation report	940	600	600	564,000				-			564,000
		Total				**7,732,500**				**5,549,000**	**23,000,000**		$ 36,281,500
Ships Point / Area A		Ships Point Rd, from Tozer Rd to Hwy 19A					1,230	300	550	676,500			676,500
		Hwy 19A, from Ships Point Rd to Old Yake Rd.					1,730	300	550	951,500			951,500
		Hwy 19A, from Old Yake Rd to the Tsable River					1,920	300	550	1,056,000			1,056,000
		Hwy 19A, from the Tsable River to Buckly Bay Rd.					1,180	300	550	649,000			649,000
		Hwy 19A, from Buckly Bay Rd to Brean Rd					2,840	300	550	1,562,000			1,562,000
		Hwy 19A, from Brean Rd to Seymour St (Terminus of Route 1)					3,150	300	550	1,732,500			1,732,500
		Total				-				**6,627,500**	-		$ 6,627,500
UBID/R.D.		Highway 19A, from Seymour St to Jones St					1,790	500	750	1,342,500			1,342,500
		Highway 19A, from Jones St to Van West Logging Rd.					1,520	500	750	1,140,000			1,140,000
		Highway 19A, from Van West Loggin Rd. to Inverness Rd.					2,590	500	750	1,942,500			1,942,500
		Highway 19A, from Inverness Rd. to Herondale Rd.					1,140	500	750	855,000			855,000
		Highway 19A, from Herondale Rd to Gartley Rd.					1,900	500	750	1,425,000			1,425,000
		Highway 19A, from Gartley Rd. to Southern Treatment Plant (assumed to be at the intersection of Royston Rd and Hwy 19A					1,650	500	750	1,237,500			1,237,500
		Total				-				7,942,500	-		$ 7,942,500
Cumberland	2.1	Pump Station at Constructed Wetland Treatment Facility				-				-	3,000,000		3,000,000
	2.2	CWTF to Inland Island Hwy				-	1,100	375	550	605,000			605,000
	2.3	Royston Rd, Inland Island Hwy to BC Hydro ROW	1,900	600	600	1,140,000				-			1,140,000
	2.4	Royston Rd, BC Hydro ROW to Hwy 19A	2,850	600	600	1,710,000				-			1,710,000
		Total				**2,850,000**				**605,000**	**3,000,000**		$ 8,455,000
Outlying Areas North													
		Total				-				-	-		-
CFB Comox		Greenwood trunk (North)	4900	VARIOUS	600	2,940,000							$ 2,940,000
		Total				13,622,500				20,734,000	29,000,000		$ 63,356,500

OPTION 2 - ROUTE 2

Courtenay PS Q= 1.13
Jane St. PS Q= 0.4
CFB PS Q= 0.48
Dockiddle PS Q= 1.53
Southern PS Q= 1.16

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600			900	900	1200	1200
Unit Rate	500	450	700	600			850	750	1000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	500	500	750	750	900	900	1200	1200
Unit Rate	650	550	900	750	1000	900	1200	1100	1500	1450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers Length	Gravity Sewers Diameter	Gravity Sewers Unit Rate	Gravity Sewers Total Cost	Pressure Sewers Length	Pressure Sewers Diameter	Pressure Sewers Unit Rate	Pressure Sewers Total Cost	Pump Station Costs	Notes	Total Estimated Construction Costs
Core Area Servicing Route 2 - Beaufort Ave	0	New Courtenay River Pump Station									17,000,000		17,000,000
	1	Dyke Rd, from Courtenay PS to Comox Ave at Rodello St.				-	3,330	750	900	2,997,000			2,997,000
	2	Rodello St, from Comox Ave to Beaufort Ave.				-	80	750	1,000	80,000			80,000
	3	Beaufort Ave, from Rodello St to Ellis St.				-	725	750	1,000	725,000			725,000
	4	Beaufort Ave, from Ellis St. to Stuart St.				-	790	750	1,000	790,000			790,000
	5	Stewart St, from Beaufort St. to Comox Ave.				-	80	750	1,000	80,000			80,000
	6	Comox Ave, from Stewart to end of Comox Ave.				-	610	750	1,000	610,000			610,000
	7	End of Comox Ave to Croteau				-	220	750	1,000	220,000			220,000
	8	New pump station at Dockiddle and Croteau Rds.									17,000,000		17,000,000
	9	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	880	900	1,100	968,000			968,000
	10	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	375	550	209,000			209,000
	11	Gravity section, per CH2MHILL forcemain relocation report	1,160	1,200	900	1,044,000				-			1,044,000
	12	Inverted siphon, per CH2MHILL forcemain relocation report	940	1,200	900	846,000				-			846,000
		Total				**1,890,000**				**6,679,000**	**34,000,000**		**$ 42,569,000**
Ships Point / Area A		Ships Point Rd, from Tozer Rd to Hwy 19A					1,230	250	550	676,500			676,500
		Hwy 19A, from Ships Point Rd to Old Yake Rd.					1,730	250	550	951,500			951,500
		Hwy 19A, from Old Yake Rd to the Tsable River					1,920	300	550	1,056,000			1,056,000
		Hwy 19A, from the Tsable River to Buckly Bay Rd.					1,180	300	550	649,000			649,000
		Hwy 19A, from Buckly Bay Rd to Brean Rd					2,840	300	550	1,562,000			1,562,000
		Hwy 19A, from Brean Rd to Seymour St (Terminus of Route 1)					3,150	300	550	1,732,500			1,732,500
		Total				-				**6,627,500**	-		**$ 6,627,500**
Ulli/DRIO		Highway 19A, from Seymour St to Jones St					1,790	450	750	1,342,500			1,342,500
		Highway 19A, from Jones St to Van West Logging Rd					1,520	450	750	1,140,000			1,140,000
		Highway 19A, from Van West Loggin Rd. to Inverness Rd.					2,590	450	750	1,942,500			1,942,500
		Highway 19A, from Inverness Rd. to Herondale Rd.					1,140	450	750	855,000			855,000
		Highway 19A, from Herondale Rd to Gartley Rd.					1,900	500	750	1,425,000			1,425,000
		Highway 19A, from Gartley Rd. to Southern Treatment Plant (assumed to be at the intersection of Royston Rd and Hwy 19A					1,650	500	750	1,237,500			1,237,500
		Total				-				**7,942,500**	-		**$ 7,942,500**
Cumberland	2.1	Pump Station at Constructed Wetland Treatment Facility				-				-	3,000,000		3,000,000
	2.2	CWTF to Inland Island Hwy				-	1,100	375	550	605,000			605,000
	2.3	Royston Rd, Inland Island Hwy to BC Hydro ROW	1,900	600	600	1,140,000				-			1,140,000
	2.4	Royston Rd, BC Hydro ROW to Hwy 19A	2,850	600	600	1,710,000				-			1,710,000
		Total				**2,850,000**				**605,000**	**3,000,000**		**$ 6,455,000**
Outlying Areas North													
		Total				-				-	-		-
CFB Comox		Greenwood trunk (North)	4,900	VARIOUS	600	2,940,000							2,940,000
		South leg of the Greenwood trunk to Pritchard Rd.	2,350	375	450	1,057,500				-			1,057,500
		Knight Rd, Pritchard to CFB gravity sewer	1,100	375	450	495,000				-			495,000
		Re/Re existing CFB gravity sewer	2,250	1,200	900	2,025,000				-			2,025,000
		Upgrade CFB pump station									2,500,000		2,500,000
		Twin CFB forcemain				-	1,600	500	750	1,200,000			1,200,000
		Total				**6,517,500**				**1,200,000**	**2,500,000**		**10,217,500**
		Total Lines				**11,257,500**				**23,554,000**	**39,500,000**		**$ 73,654,000**

OPTION 2-ROUTE 3

Courtenay PS Q= 1.13
Jane St. PS Q= 0.4
CFB PS Q= 1.61
Dodidle PS Q= 0
Southern PS Q= 1.16

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600			900	900	1200	1200
Unit Rate	500	450	700	600			850	750	1000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	500	500	750	750	900	900	1200	1200
Unit Rate	650	550	900	750	1000	900	1200	1100	1600	1450

			Gravity Sewers				Pressure Sewers						
Route Option Number	Pipe Section Reference Number	Description	Length	Diameter	Unit Rate	Total Cost	Length	Diameter	Unit Rate	Total Cost	Pump Station Costs	Notes	Total Estimated Construction Costs
Core Area Servicing Route 3 - Block 71	0	New Courtenay River Pump Station									17,000,000		17,000,000
	1	Comox Rd, from Courtenay PS to HWY 19A				-	1,500	750	1,000	1,500,000			1,500,000
	2	HWY 19A, from Comox Rd. to Headquarters Rd.				-	850	750	1,000	850,000			850,000
	3	Headquarters Rd, from HWY 19A to Vanier Dr.				-	1,480	750	900	1,332,000			1,332,000
	4	Vanier Dr., from Headquarters Rd. to HWY 19A				-	1,160	750	900	1,044,000			1,044,000
	5	Veteran's Memorial Parkway, from HWY 19A to DD 12676-N (Block 71)				-	670	750	900	603,000			603,000
	6	Through DD 12676-N to Block 71				-	1,170	750	900	1,053,000			1,053,000
	7	Through Block 71 to Greenwood trunk				-	1,350	750	900	1,215,000			1,215,000
	8	Greenwood trunk	5,600	1,200	900	5,040,000				-			5,040,000
	9	Re/Re existing CFB gravity sewer	2,250	1,200	900	2,025,000				-			2,025,000
	10	Upgrade CFB pump station									2,500,000		2,500,000
	11	Twin CFB forcemain				-	1,600	1,200	1,450	2,320,000			2,320,000
	12	Upgrade Jane Street Pump Station				-				-	1,000,000		1,000,000
	13	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	850	375	550	484,000			484,000
	14	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	375	550	209,000			209,000
	15	Gravity section, per CH2MHILL forcemain relocation report	1,160	600	600	696,000				-			696,000
	16	Inverted siphon, per CH2MHILL forcemain relocation report	940	600	600	564,000				-			564,000
		Total				**8,325,000**				**10,610,000**	**20,500,000**		$ 39,435,000
Ships Point / Area A		Ships Point Rd, from Tozer Rd to Hwy 19A					1,230	250	550	676,500			676,500
		Hwy 19A, from Ships Point Rd to Old Yake Rd.					1,730	250	550	951,500			951,500
		Hwy 19A, from Old Yake Rd to the Tsable River					1,920	300	550	1,056,000			1,056,000
		Hwy 19A, from the Tsable River to Buckly Bay Rd					1,180	300	550	649,000			649,000
		Hwy 19A, from Buckly Bay Rd to Brean Rd					2,840	300	550	1,562,000			1,562,000
		Hwy 19A, from Brean Rd to Seymour St (Terminus of Route 1)					3,150	300	550	1,732,500			1,732,500
		Total				-				**6,627,500**	-		$ 6,627,500
UBID/RID		Highway 19A, from Seymour St to Jones St					1,790	450	750	1,342,500			1,342,500
		Highway 19A, from Jones St to Van West Logging Rd.					1,520	450	750	1,140,000			1,140,000
		Highway 19A, from Van West Loggin Rd. to Inverness Rd.					2,590	450	750	1,942,500			1,942,500
		Highway 19A, from Inverness Rd. to Herondale Rd.					1,140	450	750	855,000			855,000
		Highway 19A, from Herondale Rd to Gartley Rd.					1,900	500	750	1,425,000			1,425,000
		Highway 19A, from Gartley Rd. to Southern Treatment Plant (assumed to be at the intersection of Royston Rd and Hwy 19A					1,650	500	750	1,237,500			1,237,500
		Total				-				**7,942,500**	-		$ 7,942,500
Cumberland	2.1	Pump Station at Constructed Wetland Treatment Facility				-				-	3,000,000		3,000,000
	2.2	CWTF to Inland Island Hwy				-	1,100	375	550	605,000			605,000
	2.3	Royston Rd, Inland Island Hwy to BC Hydro ROW	1,900	600	600	1,140,000				-			1,140,000
	2.4	Royston Rd, BC Hydro ROW to Hwy 19A	2,850	600	600	1,710,000				-			1,710,000
		Total				**2,850,000**				**605,000**	**3,000,000**		$ 6,455,000
Outlying Areas North													
		Total				-				-	-		$ -
CFB Comox		South leg of the Greenwood trunk to Pritchard Rd.	2,350	375	450	1,057,500				-			1,057,500
		Knight Rd, Pritchard to CFB gravity sewer	1,100	375	450	495,000				-			495,000
		Total				**1,552,500**				-	-		$ 1,552,500
		Total Estimate				**11,727,500**				**18,735,000**	**23,500,000**		$ 54,062,500

OPTION 2 - ROUTE 4

Courtenay PS Q= 1.13
Jane St. PS Q= 0.4
CFB PS Q= 0.48
Dodiddie PS Q= 0
Southern PS Q= 1.16

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600			900	900	1200	1200
Unit Rate	500	450	700	600			850	750	1000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	500	500	750	750	900	900	1200	1200
Unit Rate	650	550	900	750	1000	900	1200	1100	1600	1450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers Length	Gravity Sewers Diameter	Gravity Sewers Unit Rate	Gravity Sewers Total Cost	Pressure Sewers Length	Pressure Sewers Diameter	Pressure Sewers Unit Rate	Pressure Sewers Total Cost	Pump Station Costs	Notes	Total Estimated Construction Costs
Core Area Servicing Route 4 - Guthrie Rd	0	New Courtenay River Pump Station									17,000,000		17,000,000
	1	Courtenay PS to McDonald at Back Rd, through ALR				-	1,700	750	900	1,530,000			1,530,000
	2	McDonald Rd, from Back Rd to Guthrie Rd.				-	900	750	900	810,000			810,000
	3	Guthrie Rd, from McDonald Rd to Anderton Rd.				-	1,100	750	1,000	1,100,000			1,100,000
	4	Guthrie Rd, from Anderton Rd to Pritchard Rd.				-	1,270	750	1,000	1,270,000			1,270,000
	5	Guthrie Rd from Pritchard Rd to Skeen Dr.				-	250	750	1,000	250,000			250,000
	6	Guthrie Rd, from Skeen Dr to Beckton Dr.	1,270	900	850	1,079,500				-			1,079,500
	7	Beckton Dr, from Guthrie Rd to Gardner Way	220	900	850	187,000				-			187,000
	8	Gardner Way, from Beckton to CH2MHILL Route	420	900	850	357,000				-			357,000
	9	Upgrade Jane Street Pump Station				-				-	1,000,000		1,000,000
	10	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	880	375	550	484,000			484,000
	11	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	375	550	209,000			209,000
	12	Gravity section, per CH2MHILL forcemain relocation report	1,160	600	600	696,000				-			696,000
	13	Inverted siphon, per CH2MHILL forcemain relocation report	940	600	600	564,000				-			564,000
		Total				**2,883,500**				**5,653,000**	**18,000,000**		**$ 26,536,500**
Ships Point / Area A		Ships Point Rd, from Tozer Rd to Hwy 19A					1,230	250	550	676,500			676,500
		Hwy 19A, from Ships Point Rd to Old Yake Rd.					1,730	250	550	951,500			951,500
		Hwy 19A, from Old Yake Rd to the Tsable River					1,920	300	550	1,056,000			1,056,000
		Hwy 19A, from the Tsable River to Buckly Bay Rd.					1,180	300	550	649,000			649,000
		Hwy 19A, from Buckly Bay Rd to Brean Rd					2,840	300	550	1,562,000			1,562,000
		Hwy 19A, from Brean Rd to Seymour St (Terminus of Route 1)					3,150	300	550	1,732,500			1,732,500
		Total				-				**6,627,500**	-		**$ 6,627,500**
UBID/RID		Highway 19A, from Seymour St to Jones St					1,790	450	750	1,342,500			1,342,500
		Highway 19A, from Jones St to Van West Logging Rd.					1,520	450	750	1,140,000			1,140,000
		Highway 19A, from Van West Loggin Rd. to Inverness Rd.					2,590	450	750	1,942,500			1,942,500
		Highway 19A, from Inverness Rd. to Herondale Rd.					1,140	450	750	855,000			855,000
		Highway 19A, from Herondale Rd to Gartley Rd.					1,900	500	750	1,425,000			1,425,000
		Highway 19A, from Gartley Rd. to Southern Treatment Plant (assumed to be at the intersection of Royston Rd and Hwy 19A					1,650	500	750	1,237,500			1,237,500
		Total				-				**7,942,500**			**$ 7,942,500**
Cumberland	2.1	Pump Station at Constructed Wetland Treatment Facility				-					3,000,000		3,000,000
	2.2	CWTF to Inland Island Hwy				-	1,100	375	375	412,500			412,500
	2.3	Royston Rd, Inland Island Hwy to BC Hydro ROW	1,900	600	600	1,140,000							1,140,000
	2.4	Royston Rd, BC Hydro ROW to Hwy 19A	2,850	600	600	1,710,000							1,710,000
		Total				**2,850,000**				**412,500**	**3,000,000**		**$ 6,262,500**
Outlying Areas North													
		Total				-				-	-		-
CFB Comox		Greenwood trunk. (North)	4,900	VARIOUS	600	2,940,000							2,940,000
		South leg of the Greenwood trunk to Pritchard Rd.	2,350	375	450	1,057,500				-			1,057,500
		Knight Rd, Pritchard to CFB gravity sewer	1,100	375	450	495,000				-			495,000
		Re/Re existing CFB gravity sewer	2,250	1,200	900	2,025,000				-			2,025,000
		Upgrade CFB pump station									2,500,000		2,500,000
		Twin CFB forcemain				-	1,600	500	500	800,000			800,000
		Total				**6,517,500**				**800,000**	**2,500,000**		**$ 9,817,500**
		Total (cont)				**12,251,500**				**21,435,500**	**23,500,000**		**$ 57,186,000**

OPTION 2 - ROUTE 5

Courtenay PS Q= 1.13
Jane St. PS Q= 0.4
CFB PS Q= 0.5
Dockiddle PS Q= 1.56
Southern PS Q= 1.16

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600			900	900	1200	1200
Unit Rate	500	450	700	600			850	750	1000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	500	500	750	750	900	900	1200	1200
Unit Rate	650	550	900	750	1000	900	1200	1100	1600	1450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers Length	Gravity Sewers Diameter	Gravity Sewers Unit Rate	Gravity Sewers Total Cost	Pressure Sewers Length	Pressure Sewers Diameter	Pressure Sewers Unit Rate	Pressure Sewers Total Cost	Pump Station Costs		Total Estimated Construction Costs
Core Area Servicing Route 5 - Robb Rd.	0	New Courtenay River Pump Station									17,000,000		17,000,000
	1	Courtenay PS to IR, along Dyke Rd.				-	2,050	750	900	1,845,000			1,845,000
	2	Through IR, Dyke Rd to Robb Rd.				-	500	750	900	450,000			450,000
	3	Robb Rd, from IR to Condor St.				-	220	750	1,000	220,000			220,000
	4	Robb Rd, from Condor St. to Anderton Ave.	800	900	850	680,000				-			680,000
	5	Robb Rd, from Anderton Ave to Pritchard Rd.	1,380	900	850	1,173,000				-			1,173,000
	6	Prichard Rd, from Robb Rd to Balmoral Ave.	490	900	850	416,500				-			416,500
	7	Balmoral Ave, from Pritchard St to Croteau, to Croteau pump station.	860	900	850	731,000				-			731,000
	8	New pump station at Dockiddle and Croteau Rds.									17,000,000		17,000,000
	9	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	880	900	1,100	968,000			968,000
	10	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	900	1,100	418,000			418,000
	11	Gravity section, per CH2MHILL forcemain relocation report	1,160	1,200	900	1,044,000				-			1,044,000
	12	Inverted siphon, per CH2MHILL forcemain relocation report	940	1,200	900	846,000				-			846,000
		Total				**4,890,500**				**3,901,000**	**34,000,000**		$ 42,791,500
Ships Point / Area A		Ships Point Rd, from Tozer Rd to Hwy 19A					1,230	250	550	676,500			676,500
		Hwy 19A, from Ships Point Rd to Old Yake Rd.					1,730	250	550	951,500			951,500
		Hwy 19A, from Old Yake Rd to the Tsable River					1,920	300	550	1,056,000			1,056,000
		Hwy 19A, from the Tsable River to Buckly Bay Rd.					1,180	300	550	649,000			649,000
		Hwy 19A, from Buckly Bay Rd to Brean Rd					2,840	300	550	1,562,000			1,562,000
		Hwy 19A, from Brean Rd to Seymour St (Terminus of Route 1)					3,150	300	550	1,732,500			1,732,500
		Total				-				**6,627,500**	-		$ 6,627,500
UBID/RID		Highway 19A, from Seymour St to Jones St					1,790	450	750	1,342,500			1,342,500
		Highway 19A, from Jones St to Van West Logging Rd.					1,520	450	750	1,140,000			1,140,000
		Highway 19A, from Van West Loggin Rd. to Inverness Rd.					2,590	450	750	1,942,500			1,942,500
		Highway 19A, from Inverness Rd. to Herondale Rd.					1,140	450	750	855,000			855,000
		Highway 19A, from Herondale Rd to Gartley Rd.					1,900	500	750	1,425,000			1,425,000
		Highway 19A, from Gartley Rd. to Royston Rd future Pump station					1,650	500	750	1,237,500			1,237,500
		Total				-				**7,942,500**	-		$ 7,942,500
Cumberland	2.1	Pump Station at Constructed Wetland Treatment Facility				-					3,000,000		3,000,000
	2.2	CWTF to Inland Island Hwy				-	1,100	375	550	605,000			605,000
	2.3	Royston Rd, Inland Island Hwy to BC Hydro ROW	1,900	600	600	1,140,000							1,140,000
	2.4	Royston Rd, BC Hydro ROW to Hwy 19A	2,850	600	600	1,710,000							1,710,000
		Total				**2,850,000**				**605,000**	**3,000,000**		$ 6,455,000
Outlying Areas North.													
		Total				-				-	-		-
CFB Comox		Greenwood trunk. (North)	4,900	VARIOUS	600	2,940,000							2,940,000
		South leg of the Greenwood trunk to Pritchard Rd.	2,350	375	450	1,057,500				-			1,057,500
		Knight Rd, Pritchard to CFB gravity sewer	1,100	375	450	495,000				-			495,000
		Re/Re existing CFB gravity sewer	2,250	1,200	900	2,025,000				-			2,025,000
		Upgrade CFB pump station									2,500,000		2,500,000
		Twin CFB forcemain				-	1,800	1,200	1,450	2,320,000			2,320,000
		Total				**6,517,500**				**2,320,000**	**2,500,000**		$ 11,337,500
		TOTAL				14,258,000				21,394,000	39,500,000		$ 75,552,000

OPTION 2A - ROUTE 1

Courtenay PS Q= 1.13
Jane St. PS Q= 0.4
CFB PS Q= 1.61
Dodiddle PS Q= 1.56
Southern PS Q= 1.16

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600			900	900	1200	1200
Unit Rate	500	450	700	600			850	750	1000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	500	500	750	750	900	900	1200	1200
Unit Rate	550	550	900	750	1000	900	1200	1100	1600	1450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers Length	Gravity Sewers Diameter	Gravity Sewers Unit Rate	Gravity Sewers Total Cost	Pressure Sewers Length	Pressure Sewers Diameter	Pressure Sewers Unit Rate	Pressure Sewers Total Cost	Pump Station Costs	Notes	Total Estimated Construction Costs
Core Area Servicing Route 1 - McDonald/Idiens	0	New Courtenay River Pump Station									17,000,000		17,000,000
	1	Courtenay PS to Back Rd, through Section 9				-	1,200	750	900	1,080,000			1,080,000
	2	Plan 35008, from Back Rd to Sheraton Rd.				-	690	750	900	621,000			621,000
	3	Sheraton Rd, from Plan 35008 to McDonald Rd.				-	750	750	900	675,000			675,000
	4	McDonald Rd, from Sheraton Rd to Hector Rd				-	800	750	900	720,000			720,000
	5	Through Plan 6D685 to Aspen Rd.	150	900	750	112,500				-			112,500
	6	Aspen Rd to Idiens Way	400	900	750	300,000				-			300,000
	7	Idiens Way to Connection Point	60	900	750	45,000				-			45,000
	8	South leg of the Greenwood trunk to Pritchard Rd.	2,350	900	750	1,762,500				-			1,762,500
	9	Knight Rd, Pritchard to CFB gravity sewer	1,100	1,200	900	990,000				-			990,000
	10	Re/Re existing CFB gravity sewer	2,250	1,200	1,450	3,262,500				-			3,262,500
	11	Upgrade CFB pump station									5,000,000		5,000,000
	12	Twin CFB forcemain				-	1,600	900	1,100	1,760,000			1,760,000
	13	Upgrade Jane St Pump Station									1,000,000		1,000,000
	14	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	880	375	550	484,000			484,000
	15	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	375	550	209,000			209,000
	16	Gravity section, per CH2MHILL forcemain relocation report	1,160	600	600	696,000				-			696,000
	17	Inverted siphon, per CH2MHILL forcemain relocation report	940	600	600	564,000				-			564,000
		Total				7,732,500				5,549,000	23,000,000		$ 36,281,500
Ships Point / Area A		Ships Point Rd, from Tozer Rd to Hwy 19A					1,230	300	550	676,500			676,500
		Hwy 19A, from Ships Point Rd to Old Yake Rd.					1,730	300	550	951,500			951,500
		Hwy 19A, from Old Yake Rd to the Tsable River					1,920	300	550	1,056,000			1,056,000
		Hwy 19A, from the Tsable River to Buckly Bay Rd.					1,180	300	550	649,000			649,000
		Hwy 19A, from Buckly Bay Rd to Brean Rd					2,840	300	550	1,562,000			1,562,000
		Hwy 19A, from Brean Rd to Seymour St (Terminus of Route 1)					3,150	300	550	1,732,500			1,732,500
		Total				-				6,627,500	-		$ 6,627,500
UBID/RID													
		Total				-				-	-		$ -
Cumberland													
		Total				-				-	-		$ -
Outlying Areas North													
		Total				-				-	-		$ -
CFB Comox		Greenwood trunk (North)	4,900	VARIOUS	600	2,940,000							$ 2,940,000
		Total				10,672,500				12,176,500	23,000,000		$ 45,849,000

OPTION 2A - ROUTE 2

Courtenay PS Q= 1.13
Jane St. PS Q= 0.4
CFB PS Q= 0.48
Dockiddle PS Q= 1.53
Southern PS Q= 1.16

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600			900	900	1200	1200
Unit Rate	500	450	700	600			850	750	1000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	500	500	750	750	900	900	1200	1200
Unit Rate	650	550	900	750	1000	900	1200	1100	1600	1450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers Length	Gravity Sewers Diameter	Gravity Sewers Unit Rate	Gravity Sewers Total Cost	Pressure Sewers Length	Pressure Sewers Diameter	Pressure Sewers Unit Rate	Pressure Sewers Total Cost	Pump Station Costs	Notes	Total Estimated Construction Costs
Core Area Servicing Route 2 - Beaufort Ave	0	New Courtenay River Pump Station									17,000,000		17,000,000
	1	Dyke Rd, from Courtenay PS to Comox Ave at Rodello St.				-	3,330	750	900	2,997,000			2,997,000
	2	Rodello St. from Comox Ave to Beaufort Ave.				-	80	750	1,000	80,000			80,000
	3	Beaufort Ave, from Rodello St to Ellis St.				-	725	750	1,000	725,000			725,000
	4	Beaufort Ave, from Ellis St. to Stuart St.				-	790	750	1,000	790,000			790,000
	5	Stewart St, from Beaufort St. to Comox Ave				-	80	750	1,000	80,000			80,000
	6	Comox Ave, from Stewart to end of Comox Ave.				-	610	750	1,000	610,000			610,000
	7	End of Comox Ave to Croteau				-	220	750	1,000	220,000			220,000
	8	New pump station at Dockiddle and Croteau Rds.									17,000,000		17,000,000
	9	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	880	900	1,100	968,000			968,000
	10	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	375	550	209,000			209,000
	11	Gravity section, per CH2MHILL forcemain relocation report	1,160	1,200	900	1,044,000				-			1,044,000
	12	Inverted siphon, per CH2MHILL forcemain relocation report	940	1,200	900	846,000				-			846,000
		Total				**1,890,000**				**6,679,000**	**34,000,000**		**$ 42,569,000**
Ships Point / Area A													
		Total				-				-	-		-
UBID/RID													
		Total				-				-	-		-
Cumberland													
		Total				-				-	-		-
Outlying Areas North													
		Total				-				-	-		-
CFB Comox		Greenwood trunk (North)	4,900	VARIOUS	600	2,940,000							2,940,000
		South leg of the Greenwood trunk to Pritchard Rd.	2,350	375	450	1,057,500				-			1,057,500
		Knight Rd. Pritchard to CFB gravity sewer	1,100	375	450	495,000				-			495,000
		Re/Re existing CFB gravity sewer	2,250	1,200	1,200	2,700,000				-			2,700,000
		Upgrade CFB pump station									2,500,000		2,500,000
		Twin CFB forcemain				-	1,600	500	500	800,000			800,000
		Total				**7,192,500**				**800,000**	**2,500,000**		**10,492,500**
		Total Costs				[illegible]				7,479,000	[illegible]		[illegible]

OPTION 2A - ROUTE 3

Courtenay PS Q= 1.13
Jane St. PS Q= 0.4
CFB PS Q= 1.61
Dociddle PS Q= 0
Southern PS Q= 1.16

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600			900	900	1,200	1,200
Unit Rate	500	450	700	600			850	750	1,000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	500	500	750	750	900	900	1,200	1,200
Unit Rate	650	550	900	750	1,000	900	1,200	1,100	1,600	1,450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers				Pressure Sewers				Pump Station Costs	Notes	Total Estimated Construction Costs
			Length	Diameter	Unit Rate	Total Cost	Length	Diameter	Unit Rate	Total Cost			
Core Area Servicing Route 3 - Block 71	0	New Courtenay River Pump Station									17,000,000		17,000,000
	1	Comox Rd. from Courtenay PS to HWY 19A				-	1,500	750	1,000	1,500,000			1,500,000
	2	HWY 19A, from Comox Rd. to Headquarters Rd.				-	850	750	1,000	850,000			850,000
	3	Headquarters Rd, from HWY 19A to Vanier Dr.				-	1,480	750	900	1,332,000			1,332,000
	4	Vanier Dr., from Headquarters Rd. to HWY 19A				-	1,160	750	900	1,044,000			1,044,000
	5	Veteran's Memorial Parkway, from HWY 19A to DD 12676-N (Block 71)				-	670	750	900	603,000			603,000
	6	Through DD 12676 N to Block 71				-	1,170	750	900	1,053,000			1,053,000
	7	Through Block 71 to Greenwood trunk				-	1,350	750	900	1,215,000			1,215,000
	8	Greenwood trunk	5,600	1,200	900	5,040,000				-			5,040,000
	9	Re/Re existing CFB gravity sewer	2,250	1,200	900	2,025,000				-			2,025,000
	10	Upgrade CFB pump station									2,500,000		2,500,000
	11	Twin CFB forcemain				-	1,600	1,200	1,450	2,320,000			2,320,000
	12	Upgrade Jane Street Pump Station				-				-	1,000,000		1,000,000
	13	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	880	375	550	484,000			484,000
	14	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	375	550	209,000			209,000
	15	Gravity section, per CH2MHILL forcemain relocation report	1,160	600	600	696,000				-			696,000
	16	Inverted siphon, per CH2MHILL forcemain relocation report	940	600	600	564,000				-			564,000
		Total				**8,325,000**				**10,610,000**	**20,500,000**		**$ 39,435,000**
Ships Point / Area A													
		Total				-				-	-		$ -
UBID/RID													
		Total				-				-	-		$ -
Cumberland													
		Total				-				-	-		$ -
Outlying Areas North													
		Total				-				-	-		$ -
CFB Comox		South leg of the Greenwood trunk to Pritchard Rd.	2,350	375	450	1,057,500							1,057,500
		Knight Rd, Pritchard to CFB gravity sewer	1,100	375	450	495,000							495,000
		Total				**1,552,500**				-	-		$ 1,552,500
		Total Costs				9,877,500				10,610,000	20,500,000		$ 41,000,000

OPTION 2A - ROUTE 4

Courtenay PS Q= 1.13
Jane St. PS Q= 0.4
CFB PS Q= 0.48
Dodiddle PS Q= 0
Southern PS Q= 1.16

GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600			900	900	1,200	1,200
Unit Rate	500	450	700	600			850	750	1,000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	500	500	750	750	900	900	1,200	1,200
Unit Rate	650	650	900	752	1,000	900	1,200	1,100	1,600	1,450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers Length	Gravity Sewers Diameter	Gravity Sewers Unit Rate	Gravity Sewers Total Cost	Pressure Sewers Length	Pressure Sewers Diameter	Pressure Sewers Unit Rate	Pressure Sewers Total Cost	Pump Station Costs	Notes	Total Estimated Construction Costs
Core Area Servicing Route 4 - Guthrie Rd	0	New Courtenay River Pump Station									17,000,000		17,000,000
	1	Courtenay PS to McDonald at Back Rd, through ALR				-	1,700	750	900	1,530,000			1,530,000
	2	McDonald Rd, from Back Rd to Guthrie Rd.				-	900	750	900	810,000			810,000
	3	Guthrie Rd, from McDonald Rd to Anderton Rd.				-	1,100	750	1,000	1,100,000			1,100,000
	4	Guthrie Rd, from Anderton Rd to Pritchard Rd.				-	1,270	750	1,000	1,270,000			1,270,000
	5	Guthrie Rd from Pritchard Rd to Skeen Dr.				-	250	750	1,000	250,000			250,000
	6	Guthrie Rd, from Skeen Dr to Beckton Dr.	1,270	900	850	1,079,500				-			1,079,500
	7	Beckton Dr, from Guthrie Rd to Gardner Way	220	900	850	187,000				-			187,000
	8	Gardner Way, from Beckton to CH2MHILL Route	420	900	850	357,000				-			357,000
	9	Upgrade Jane Street Pump Station				-				-	1,000,000		1,000,000
	10	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	880	375	550	484,000			484,000
	11	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	375	550	209,000			209,000
	12	Gravity section, per CH2MHILL forcemain relocation report	1,160	600	600	696,000				-			696,000
	13	Inverted siphon, per CH2MHILL forcemain relocation report	940	600	600	564,000				-			564,000
		Total				2,883,500				5,653,000	18,000,000		$ 26,536,500
Ships Point / Area A													
		Total				-				-	-		$ -
UBID/RID													
		Total				-				-	-		$ -
Cumberland													
		Total				-				-	-		$ -
Outlying Areas North													
		Total				-				-	-		$ -
CFB Comox		Greenwood trunk (North)	4,600	VARIOUS	600	2,840,000							2,940,000
		South leg of the Greenwood trunk to Pritchard Rd.	2,350	375	450	1,057,500				-			1,057,500
		Knight Rd, Pritchard to CFB gravity sewer	1,100	375	450	495,000				-			495,000
		Re/Re existing CFB gravity sewer	2,250	1,200	1,200	2,700,000				-			2,700,000
		Upgrade CFB pump station									2,500,000		2,500,000
		Twin CFB forcemain				-	1,600	500	500	800,000			800,000
		Total				7,192,500				800,000	2,500,000		$ 10,492,500
		Total Cost $				10,076,000				6,453,000	20,500,000		$ 37,028,500

OPTION 2A - ROUTE 5

Courtenay PS Q= 1.13
Jane St. PS Q= 0.4
CFB PS Q= 0.8
Doclddle PS Q= 1.56
Southern PS Q= 1.16

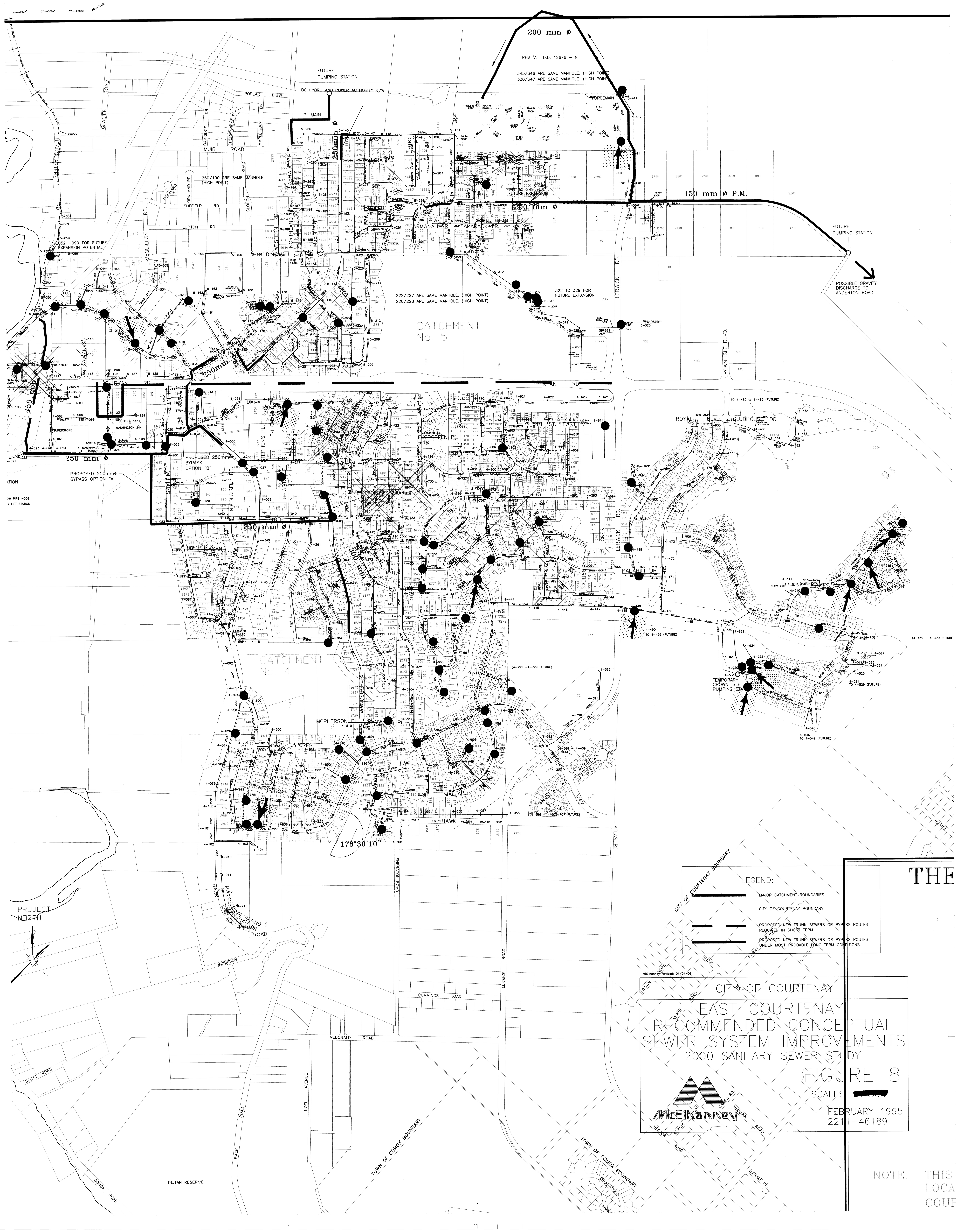
GRAVITY	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	600	600			900	900	1,200	1,200
Unit Rate	500	450	700	600			850	750	1,000	900
FORCEMAIN	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Size (mm)	375	375	500	500	750	750	900	900	1,200	1,200
Unit Rate	650	550	900	750	1,000	900	1,200	1,100	1,600	1,450

Route Option Number	Pipe Section Reference Number	Description	Gravity Sewers Length	Gravity Sewers Diameter	Gravity Sewers Unit Rate	Gravity Sewers Total Cost	Pressure Sewers Length	Pressure Sewers Diameter	Pressure Sewers Unit Rate	Pressure Sewers Total Cost	Pump Station Costs	Notes	Total Estimated Construction Costs
Option 5 - Robb Rd.	0	New Courtenay River Pump Station									17,000,000		17,000,000
	1	Courtenay PS to IR, along Dyke Rd.				-	2,050	750	900	1,845,000			1,845,000
	2	Through IR, Dyke Rd to Robb Rd.				-	500	750	900	450,000			450,000
	3	Robb Rd, from IR to Condor St.				-	220	750	1,000	220,000			220,000
	4	Robb Rd, from Condor St. to Anderton Ave.	800	900	850	680,000				-			680,000
	5	Robb Rd, from Anderton Ave to Pritchard Rd.	1,380	900	850	1,173,000				-			1,173,000
	6	Prichard Rd, from Robb Rd to Balmoral Ave.	490	900	850	416,500				-			416,500
	7	Balmoral Ave, from Pritchard St to Croteau, to Croteau pump station.	860	900	850	731,000				-			731,000
	8	New pump station at Doclddle and Croteau Rds.									17,000,000		17,000,000
	9	Forcemain section, per CH2MHILL forcemain relocation report (Croteau and Lazo)				-	880	900	1,100	968,000			968,000
	10	Forcemain section, per CH2MHILL forcemain relocation report (Jane st to Croteau pump station)				-	380	900	1,100	418,000			418,000
	11	Gravity section, per CH2MHILL forcemain relocation report	1,160	1,200	900	1,044,000				-			1,044,000
	12	Inverted siphon, per CH2MHILL forcemain relocation report	940	1,200	900	846,000				-			846,000
		Total				4,890,500				3,901,000	34,000,000		$ 42,791,500
Shipe Point / Area A													
		Total				-				-	-		$ -
UBI/O/R/D													
		Total				-				-	-		$ -
Cumberland													
		Total				-				-	-		$ -
Outlying Areas North													
		Total				-				-	-		$ -
CFB Comox		Greenwood trunk. (North)	4,900	VARIOUS	600	2,940,000							2,940,000
		South leg of the Greenwood trunk to Pritchard Rd.	2,350	375	450	1,057,500				-			1,057,500
		Knight Rd, Pritchard to CFB gravity sewer	1,100	375	450	495,000				-			495,000
		Re/Re existing CFB gravity sewer	2,250	1,200	900	2,025,000				-			2,025,000
		Upgrade CFB pump station									2,500,000		2,500,000
		Twin CFB forcemain				-	1,600	1,200	1,450	2,320,000			2,320,000
		Total				5,517,500				2,320,000	2,500,000		$ 11,337,500
		TOTAL				11,408,000				6,221,000	36,500,000		$ 54,128,500

McElhanney

APPENDIX I

CITY OF COURTENAY I&I REDUCTION MAPPING



CITY OF COURTENAY
EAST COURTENAY
RECOMMENDED CONCEPTUAL
SEWER SYSTEM IMPROVEMENTS
2000 SANITARY SEWER STUDY
FIGURE 8
SCALE: [redacted]
FEBRUARY 1995
2211-46189
McElhanney
McElhanney Revised: 01/04/06
LEGEND:
MAJOR CATCHMENT BOUNDARIES
CITY OF COURTENAY BOUNDARY
PROPOSED NEW TRUNK SEWERS OR BYPASS ROUTES REQUIRED IN SHORT TERM.
PROPOSED NEW TRUNK SEWERS OR BYPASS ROUTES UNDER MOST PROBABLE LONG TERM CONDITIONS.
CATCHMENT No. 5
CATCHMENT No. 4
200 mm ø
150 mm ø P.M.
250 mm ø
300 mm ø
450 mm ø
250mm
FUTURE PUMPING STATION
BC HYDRO AND POWER AUTHORITY R/W
P. MAIN
REM 'A' D.D. 12676 – N
345/346 ARE SAME MANHOLE. (HIGH POINT)
338/347 ARE SAME MANHOLE. (HIGH POINT)
FORCEMAIN
260/190 ARE SAME MANHOLE. (HIGH POINT)
052 -099 FOR FUTURE EXPANSION POTENTIAL
245 TO 249 FOR FUTURE EXPANSION
222/227 ARE SAME MANHOLE. (HIGH POINT)
220/228 ARE SAME MANHOLE. (HIGH POINT)
322 TO 329 FOR FUTURE EXPANSION
POSSIBLE GRAVITY DISCHARGE TO ANDERTON ROAD
PROPOSED 250mmø BYPASS OPTION "B"
PROPOSED 250mmø BYPASS OPTION "A"
PROPOSED 250mmø BYPASS OPTION "C"
TEMPORARY CROWN ISLE PUMPING STA.
TO 4-480 to 4-485 (FUTURE)
TO 4-499 (FUTURE)
(4-459 – 4-479 FUTURE)
4-521 TO 4-529 (FUTURE)
4-546 TO 4-549 (FUTURE)
(4-721 -4-729 FUTURE)
(4-389 – 4-409 FUTURE)
(4-069 – 4-079 FOR FUTURE)
178°30'10"
PROJECT NORTH
RYAN RD.
LERWICK RD.
ATLAS RD.
CROWN ISLE BLVD.
BACK ROAD
MORRISON
CUMMINGS ROAD
McDONALD ROAD
SHERATON ROAD
NOEL AVENUE
SCOTT ROAD
COMOX ROAD
INDIAN RESERVE
TOWN OF COMOX BOUNDARY
CITY OF COURTENAY BOUNDARY
THE
NOTE THIS LOCA COUF

LONG TERM UPGRADING
REQUIRED IF FIRST ST.
PRESSURE MAIN EXTENSION
NOT CONSTRUCTED AND/OR
I & I REDUCTION NOT SUCESSFUL

1st STREET
PUMPING STATION

UPGRADE ANDERTON
PUMPING STATION

POSSIBLE
PUMPING STATION (IF ARDEN NORTH
GRAVITY SEWER IMPRACTICAL)

RECOMMENDED FUTURE
ARDEN NORTH
TRUNK SEWER

EDGETT ROAD
PUMPING STATION

1ST. ST. PUMP
STATION PRESSURE
MAIN EXTENSION

ARDEN CENTRAL
TRUNK

1ST. ST. PUMP
STATION PRESSURE
MAIN EXTENSION

SHORT TERM UPGRADING REQUIRED
IF FIRST ST. PRESSURE MAIN
EXTENSION NOT CONSTRUCTED.

C.S.R.D. COURTENAY
PUMPING STATION

20th/21st STREET
TRUNK SEWER

RECOMMENDED FUTURE
ARDEN SOUTH
TRUNK SEWER

POSSIBLE FUTURE
PUMPING STATION

PUNTLEDGE
RIVER
COURTENAY
COMOX
HARBOUR
PROJECT
NORTH

CATCHMENT No. 1 — 12.0 Ha.
CATCHMENT No. 2 — 14.4 Ha.
CATCHMENT No. 3 — 9.58 Ha.

LEGEND:

- MAJOR CATCHMENT BOUNDARIES (EXISTING)
- PROPOSED NEW TRUNK SEWERS OR BYPASS ROUTES REQUIRED IN SHORT TERM.
- PROPOSED NEW TRUNK SEWERS OR BYPASS ROUTES UNDER LONG TERM FUTURE CONDITIONS.
- LEVEL 3
- LEVEL 2
- REPAIRED — FEBRUARY 1999 - JANUARY 2002
- REPAIRED CROSS CONNECTION

McElhanney REVISED: 01/05/22

CITY OF COURTENAY

WEST COURTENAY RECOMMENDED CONCEPTUAL SEWER SYSTEM IMPROVEMENTS

1995 SANITARY SEWER STUDY

FIGURE 7

SCALE: [redacted]

FEBRUARY 1995
2211-46189

McElhanney

APPENDIX J

TOWN OF COMOX I&I REDUCTION LETTER

TOWN OF COMOX

File No.: 0360-20
5200-01

January 14, 2008

VIA FAX 334-4388

Mr. Graeme Faris
Director of Environmental Services
Comox-Strathcona Regional District,
600 Comox Road
Courtenay, B.C.
V9N 3P6

Dear Mr. Faris:

RE: TOWN OF COMOX INFLOW AND INFILTRATION PROGRAM

The following is a brief summary of the actions taken to date by the Town of Comox to help reduce inflow and infiltration (I&I):

- The Town of Comox initiated a cross connection control program throughout the summer and fall of 1996. This program consisted of "smoke testing" of all sanitary mains and services, with dye testing of those services which the above testing procedure could not definitively determine as satisfactory. This program resulted in a total of eight (8) cross connections being located, all of which were immediately repaired.
- The Town of Comox Subdivision and Development Specifications were updated in 1997 to require the use of inspection chambers on all new sanitary connections. This allows the Town of Comox building department to ensure the absence of cross-connections and that all private service laterals are watertight.
- In 1998, all sanitary manhole covers were equipped with carriage bolts to reduce inflow into the system. Sanitary manholes located in the foreshore have been inspected and sealed to ensure no inflow at these critical locations. This requirement forms part of the Town of Comox Subdivision and Services standard.
- In 1998 the Town of Comox instituted a program to address manhole infiltration. A survey of all sanitary manholes was conducted to categorize the severity of infiltration present. This program is conducted on an annual basis during the months of December through February while groundwater is at the highest level. From this, a schedule for repair is developed to ensure the most severe breaches in the system are dealt with. A total of one hundred and twenty nine (129) sanitary manholes were noted to require attention all of which were dealt with through the period of 1998 through to 2001.

1809 Beaufort Avenue, Comox, British Columbia V9M 1R9 • Tel. (250) 339-2202 Fax (250) 339-7110 • Email: town@comox.ca

- To date a total of 1,453m of sanitary main contained in 17 individual lengths have been subjected to cured-in-place sanitary sewer lining. A further 263m of sanitary main has been replaced through traditional open excavation methods. The Town of Comox has also completed interface grouting on 46 service laterals and "spot" repairs in four separate locations.
- In 2004, the Town of Comox Council formalized an annual budget of $21,500 to fund an annual program of upgrades intended to reduce I&I. The same year general repairs to 18 sanitary manholes were completed.
- In 2005 the annual sanitary manhole inspection program resulted in a total of 16 manholes receiving repairs to address I&I. This program also evidenced two cross connections in which residences were discharging storm water into the sanitary system. Both cross connections have since been dealt with.
- In 2005 the Town of Comox retained the services of McElhanney Consulting Services Ltd. (MCSL) to complete a comprehensive computer analysis of the sanitary sewer system. This study was submitted in April 2006 and included a recommendation calling for a detailed I&I study to identify and quantify areas most prone to contributing I&I to the system at large.
- In 2006 the Town of Comox retained the services of MCSL to institute an I&I study including flow monitoring for the purposes of meeting the above noted recommendation. Through this study it was determined that an area of Comox generally located in the Northwest quadrant is exhibiting inordinately high I&I flow rates. This area will be the target of a more detailed examination, including the use of "smoke testing", to determine the nature of this I&I and the most effective way to reduce its volume.
- In 2007 a total of 735m of poorly constructed sanitary main was replaced as part of a general road upgrade. This same year the annual manhole inspection program highlighted 11 sanitary manholes which received repairs to address I&I.
- Our current five year capital plan calls for a further 1,760m of sanitary main involving 6 separate projects, to be replaced or subjected to cured-in-place lining.

Should you have any further questions regarding the above, please do not hesitate to contact our office.

Yours truly,

Glenn Westendorp
Public Works Superintendent

GW/ll

cc: R. Kanigan
D. Jacquest
Jim Elliott - CVWPCC

08 I&I Review

McElhanney

APPENDIX K

OPTIONS FOR WASTEWATER TREATMENT

DAYTON & KNIGHT MEMORANDUM

MEMORANDUM

TO: Ian Whitehead, P.Eng.
McElhanney Consulting Services Ltd.

FROM: Al Gibb, Ph.D., P.Eng.
Dayton & Knight Ltd.

RE: **Comox Valley Regional District Sanitary Sewerage Master Plan Update**
Options for Wastewater Treatment

DATE: December 22, 2008

1.0 INTRODUCTION AND BACKGROUND

This Memorandum provides an outline of concept options for wastewater treatment in the Comox Valley Regional District. Only wastewater treatment and disposal will be discussed in this memorandum. Sewage conveyance will be covered elsewhere.

2.0 CONCEPT OPTIONS FOR WASTEWATER TREATMENT

In general, the options for wastewater collection and treatment can be focused on a single central treatment plant, or a distributed treatment strategy that includes two or more plants located to serve specific areas of development. The distributed treatment strategy can include small "satellite" treatment plants located in areas that are remote from the central collection system, and/or that are designed to produce reclaimed water for local use (e.g., irrigation, toilet flushing, industrial process water, etc.).

The concept of Integrated Resource Management (IRM) has been proposed for wastewater collection and treatment in the Capital Regional District (CRD). The IRN concept is designed to maximize recovery and reuse of resources from wastewater treatment. Recent applications to the Building Canada Fund for senior government funding to support wastewater infrastructure projects required a discussion of how IRM would be addressed. Thus the potential for funding assistance from senior government currently appears to be connected to the potential of the proposed project to allow recovery of resources. Proposed methods of resource recovery may include the following:

- biosolids and organic residuals (e.g., anaerobic digestion for production and use of biogas, production of compost, energy recovery from combustion, land application as a fertilizer/soil conditioner);
- flow energy management and pressure energy recovery (e.g., locating treatment facilities at low elevations to minimize pumping needs, minimize static lift at pump stations by

maintaining high wet well water surface elevations, use of low flow fixtures to minimize wastewater volume, use of turbines to recover energy from the wastewater stream);

- phosphorus recovery (e.g., crystallization treatment of high-strength return streams within treatment facilities);
- heat recovery from wastewater (e.g., heat exchangers and heat pumps);
- water reclamation and reuse (e.g., irrigation, toilet flushing, fire protection, on-site use at wastewater treatment facilities); and
- urine separation (e.g., for use as a fertilizer).

Of the above method of resource recovery, those commonly in use in North America include anaerobic digestion and composting of waste solids, flow energy management and to a lesser extent water reclamation and reuse. Phosphorus recovery and urine separation can be said to be in the developmental stages. Heat recovery is often considered for wastewater projects, but may not be implemented due to the relatively high cost to benefit ratio. For all methods of resource recovery, a local market for the resource is needed. This can present practical limitations in terms of seasonal demand for reclaimed water, local opportunities for use of waste solids, and potential users of recovered heat as well as the infrastructure needed to deliver the heat to end users.

The CVRD currently practices composting of the waste solids generated at the CVWPCC; this produces a marketable product, although at a net cost to the District (i.e., the market value of the compost is less than the cost of producing the compost). Anaerobic digestion of waste solids for biogas recovery is commonly used in British Columbia and throughout North America, but is typically only cost effective at relatively large treatment plants (i.e., those serving at least 20,000 people), due to the high capital cost of installing gas-tight anaerobic digesters. In some cases, recovery and combustion of biogas for generation of electricity and heat can generate a net positive financial gain (e.g., over a 20-year life cycle for the equipment).

Water reclamation and reuse in British Columbia is becoming more common. Successful large-scale irrigation projects using reclaimed water have to date been undertaken in the communities of Vernon and Armstrong, both of which are relatively arid areas with large agricultural land bases available. For the CVRD, there is potential for seasonal irrigation using reclaimed water, but 100% utilization of reclaimed water is unlikely within the forseeable future (i.e., large reservoirs for off-season storage or an alternative means of off-season disposal would be needed). Low water use fixtures to reduce wastewater volumes are now the standard for new development in B.C. One of the most cost effective uses of reclaimed water is on-site use at wastewater treatment facilities for non-potable applications (e.g., wash down water, process water, landscape irrigation), since the reclaimed water does not have to be pumped offsite to potential users; this application can generate a net financial gain over the life cycle of the project. For off-site uses of reclaimed water, the potential for a positive benefit to cost ratio depends in a large part on the proximity of potential end users and their water quality requirements.

Four options for wastewater collection, treatment, and reuse or disposal are outlined below. The options are based on the "most likely" growth scenario developed in Memo No.1. The options are evaluated on the basis of cost, technical feasibility, resource recovery potential, and environmental and social values.

The potential for use of heat recovered from the wastewater stream at pumping facilities and treatment plants depends on the proximity of potential users of the heat. For all of the options, heat could potentially be recovered at strategic points on the collection system as well as at the treatment facilities. At his level of analysis, no one option is considered to have advantage over the others in terms of heat recovery.

The potential options were also discussed with the Ministry of Environment (MOE), Nanaimo Office. The MOE strongly supports regional planning for wastewater management, and recommends the preparation of a Liquid Waste Management Plan. For the current regional wastewater master plan, the MOE noted that siting of new treatment facilities and outfall discharges is typically protested by local stakeholders, and expansion of the CVPCC may also likely be resisted by local residents. Secondary treatment for open marine discharges as proposed in the options described below meets the MOE requirements. Discharges into Baynes Sound are likely to encounter significant resistance. All marine discharges will require consultation with the local shellfish industry. The MOE supports connection of the Cumberland system to the central collection system, rather than local discharge to constructed wetlands.

It was assumed that properties outside of urban centres (i.e., in low-density rural areas) would continue to be served by onsite (ground disposal) systems. If necessary, properties in areas with poor conditions for ground disposal might require single-home treatment systems to enhance the quality of wastewater prior to ground disposal. The ultimate density of development in unserviced areas will depend in part on the local conditions for ground disposal (see report from EBA).

Flow projections used to size the treatment plants and outfalls were based on the analysis of flows at the CVWPCC (see Memo No.1 appendix C). These flows are:

- Average dry weather flow: 405 L/c/d
- Average annual flow: 474 L/c/d
- Maximum day flow: 971 L/c/d

2.1 Option 1: Centralized Treatment

Option 1 (see Figure O-1) would be to continue to route all wastewater flows from urban areas within the District to the existing CVWPCC. This would include decommissioning of the existing Cumberland STP and connecting this system the Courtenay collection system, as well as connection of other outlying communities (Saratoga/Miracle Beach, Ship's Point, Royston/Union Bay). The ultimate population for this option is about 180,000 people.

The total useable site area for construction of treatment facilities at the CVWPCC site is estimated at about 9 hectares, assuming a 30 meter buffer zone within the property boundary. This site could contain treatment facilities for the ultimate service population of 180,000 people, provided that a more space-efficient technology than the existing plug-flow activated sludge process were used.

A second outfall would be required. The plant would continue to meet secondary treatment standards for open marine discharge.

For Option 1, the current method of resource recovery (composting of waste solids) could continue into the future, although this option may become more difficult as the plant grows in size. Anaerobic digestion for production of biogas can be considered for the future (this would require the use of space-efficient technologies for liquid treatment to allow space on the site for construction of anaerobic digesters for a total service population of 180,000 people); the biogas could potentially be used for generation of electricity, firing boilers, or as a vehicle fuel (requires prior scrubbing of the gas). As the facilities are upgraded and expanded, on-site use of reclaimed water for non-potable applications at the plant should be maximized. Production of reclaimed water for off-site use would depend on the proximity of potential users; if markets are identified, part of the effluent from the secondary treatment facilities could be treated to reclaimed water standards as required.

Advantages of Option 1

- Lowest cost option (see Section 4.0).
- Maximizes use of existing infrastructure.
- Does not require siting of new treatment facilities or outfall.
- Allows future use of anaerobic digestion for recovery and use of biogas.

Disadvantages of Option 1

- Requires pumping of all wastewater flows from Courtenay River PS catchment and Royston/Union Bay area (where the majority of development is expected to take place) to Comox WWTP.
- Some odour sensitivity associated with existing treatment plant site .
- Some areas (e.g., Ship's Point, Saratoga Beach) are remote from the central collection system and will require long force or gravity mains to convey sewage to the CVWPCC.
- Potential for use of reclaimed water may be limited.

2.2 Option 1A: Centralized Treatment

From a treatment and cost standpoint Option 1A is essentially the same as Option 1, only with changes to sewage conveyance to the CVWPCC. Sewage conveyance is covered elsewhere.

2.3 Option 2: Decentralized Treatment

Option 2 would be to expand the existing CVWPCC and construct 3 new treatment plants, with 50-year tributary populations as shown in Table 1.

Table 1
Option 2 Treatment Plants

Plant	Tributary Areas	Service Population	Discharge	Treatment Standard
CVWPCC (existing plant expanded)	Comox, Courtney	114,300	Georgia Straight	Secondary for marine discharge
South STP (new plant)	Cumberland, RID, UBID, Ships Point (Area A)	48,600	Georgia Straight	Secondary for marine discharge
Kitty Coleman STP (new plant)	Kitty Coleman	2,800	Georgia Straight	Secondary for marine discharge
Saratoga STP (new plant)	Saratoga	14,400	Georgia Straight	Secondary for marine discharge
Total Population Served		180,000		

CVWPCC

The CVWPCC would continue to treat wastewater from Comox and Courtney. The total useable site area for construction of treatment facilities is estimated at about 9 hectares, assuming a 30 meter buffer zone within the property boundary. This site could contain treatment facilities for the ultimate service population of 114,300 people.

The outfall would require upgrading as flows increased.

South STP

For the purpose of this outline, it was assumed that a suitable site could be located for the South STP somewhere in the Royston/Union Bay area. Ideally, the new facility should be located in an area zoned for industrial development to avoid placing a treatment plant directly adjacent to residential development.

Treated sewage from the South STP would be pumped across the Comox Harbour to the existing CVWPCC outfall. A second outfall would be required as flows increase from both plants. The South STP would have to meet secondary treatment standards for open

marine discharge, unless reclamation of some or all of the effluent for irrigation or other purposes was planned.

An area of approximately 5 hectares would be required for this treatment plant. This includes a 30 m buffer.

Kitty Coleman and Saratoga STPs

Satellite treatment plans would be constructed in Saratoga and Kitty Coleman. Treatment would have to meet secondary treatment standards for open marine discharge, unless reclamation of some or all of the effluent for irrigation or other purposes was planned. Outfalls for each plant would extend out into the Georgia Straight. The new facility should be located in an area zoned for industrial use if possible.

Areas of approximately 2 hectare and 3 hectares would be required for Kitty Coleman and Saratoga respectively. These areas include a 30 m buffer.

For Option 2, the options for recovery and beneficial use of waste solids at the two larger plants (CVWPCC and South Plant) would be similar to those for Option 1 (i.e., continue with composting, and consider anaerobic digestion for the future). Space limitations at the CVPCC would be less restrictive for Option 2 (i.e., use of a more space-efficient technology for liquid treatment may not be required). Use of multiple plants would potentially access a wider market for use of reclaimed water.

Advantages of Option 2

- Maximize gravity flow to reduce energy demand for pumping.
- New South STP would be located in the area containing the majority of planned development.
- Satellite plants increase potential local water reuse options.
- Allows potential use of anaerobic digester at CVWPCC and new South treatment plant for production and use of biogass.
- Compatible with existing composting strategy for waste solids.

Disadvantages of Option 2

- Requires siting of three new treatment facilities and two new outfalls, which will require extensive public and stakeholder consultation.
- Operation of four treatment plants (three new plants plus existing CVWPCC) would be more costly than operation of a single plant (Option 1 and Option 1A).
- Some areas are remote from their treatment plants (e.g., Ship's Point is remote from the new South STP). Long forcemains and gravity mains will be required.
- More costly than Option 1 (see Section 4.0).

2.4 Option 2A: Decentralized Treatment

Option 2A would further decentralize treatment from the concept in Option 2 (see Table 2). The South STP in Option 2 would be split into 4 treatment plants: Cumberland STP, RID STP, UBID STP and Ships Point STP. Expansion of the CVWPCC and new treatment plants at Kitty Coleman and Saratoga would be required as in Option 2.

Table 2
Option 2A Treatment Plants

Plant	Tributary Areas	Service Population	Discharge Location/Reuse	Treatment Standard
CVWPCC (existing plant expanded)	Comox, Courtney	114,300	Georgia Straight	Secondary for marine discharge
RID STP (New plant)	RID	8,900	Baynes Sound and reuse	Reclaimed Water
UBID STP (New plant)	UBID	13,900	Baynes Sound and reuse	Reclaimed Water
Cumberland STP (New plant)	Cumberland	20,100	Maple Lake Creek and reuse	Reclaimed Water
Ships Point STP (New plant)	Ships Point	5,600	Baynes Sound and reuse	Reclaimed Water
Kitty Coleman STP (New plant)	Kitty Coleman	2,800	Georgia Straight	Secondary for marine discharge
Saratoga STP (New plant)	Saratoga	14,300	Georgia Straight	Secondary for marine discharge
Total Population Served		180,000		

CVWPCC

The CVWPCC would continue to treat wastewater from Comox and Courtney. The total useable site area for construction of treatment facilities is estimated at about 9 hectares, assuming a 30 meter buffer zone within the property boundary. This site could contain treatment facilities for the ultimate service population of 114,000 people.

A second outfall would be required as flows increase.

UBID, RID and Ships Point STPs

These three treatment plants would all be located adjacent to Baynes Sound. Baynes Sound is a significant shellfish farming area, and there is likely to be opposition to any sewage discharge into this water body. However, previous studies have found that there are no rivers or streams in the area that can provide sufficient year-round dilution for sewage discharge, so stream discharge is not considered a viable option. Conditions for ground disposal are poor for the most part in this area (based on the preliminary evaluation by EBA). It is possible that suitable sites for ground disposal fields might be located if more detailed study were undertaken, but these are unlikely to provide sufficient capacity to dispose of all wastewater produced by the three plants.

It is proposed that the new UBID, RID and Ships Point treatment plants would provide treatment to reclaimed water standards. The reclaimed water could potentially be used for local non-potable applications such as irrigation, toilet flushing, fire protection, etc. If the primary use of reclaimed water is to be irrigation, a wet-season storage reservoir may be required.

Outfalls into Baynes sound would be required for the three locations as it is very unlikely that all reclaimed water could be reused year round.

Approximately 3 hectares would be required for each of the treatment plants. These areas include a 30 m buffer.

Cumberland STP

The existing Cumberland STP is a partially-aerated lagoon facility with a service capacity of about 5,000 people that discharges to Maple Lake Creek. The current service population is estimated at about 2,500 people.

There are concerns with the existing Cumberland treatment facility, including insufficient dilution of the effluent discharge in Maple Lake Creek, and potential overflows of poorly treated wastewater directly to the Creek. The projected service population for the Cumberland area is about 20,000 people. If the Cumberland STP is to continue in service, a mechanical treatment plant producing an effluent that meets reclaimed water standards will be required. The reclaimed water could potentially be discharged to Maple Lake Creek (environmental impact studies and consultation with the MOE would be required), or used for local non-potable applications such as irrigation, toilet flushing, fire protection, etc. If the primary use of reclaimed water is to be irrigation, a wet-season storage reservoir may be required. Ground disposal for a discharge of this magnitude would not be practical.

Saratoga Beach and Kitty Coleman

Satellite treatment plans would be constructed in Saratoga and Kitty Coleman. Treatment would have to meet secondary treatment standards for open marine discharge, unless reclamation of some or all of the effluent for irrigation or other purposes was planned. Outfalls for each plant would extend out into the Georgia Straight. The new facility should be located in an area zoned for industrial use if possible.

Areas of approximately 2 hectare and 3 hectares would be required for Kitty Coleman and Saratoga respectively. These areas include a 30 m buffer.

For Option 3, the potential for biogas production from anaerobic would be more limited than for Options 1 and 2, since this would likely be cost effective only at the CVWPCC (however, waste solids from the satellite plants could potentially be transported to the CVPCC for digestion). Composting of waste solids from the smaller satellite plants could

continue, although consumption of fuel for transportation of the solids might increase compared to the more centralized options. Increasing the number of satellite plants may also increase the potential markets for reclaimed water use.

Advantages of Option 2A

- Avoids the need for a major pumping station and forcemain to connect flow from Saratoga/Miracle Beach area to the CVWPCC system.
- Avoids the need for a major pumping station and forcemain to connect flow from the Ships Point/UBID/RID area to the CVWPCC system.
- May increase potential for use of reclaimed water.

Disadvantages of Option 2A

- Requires siting of five new treatment facilities and outfalls, which will require extensive public and stakeholder consultation.
- Operation of an additional treatment plants would add to system complexity and operating costs for treatment.
- For the UBID, RID and Ships Point water reclamation plants, 100% use of reclaimed water difficult to achieve. Three new outfalls into Baynes sound will be required, and these are likely to meet public and stakeholder opposition. Discharge to Baynes sound will require environmental impact studies.
- For the Cumberland water reclamation plant, 100% use of reclaimed water difficult to achieve, unless discharge to Maple Lake Creek for stream augmentation is allowed. Discharge to Maple Lake Creek will require environmental impact studies and may encounter resistance from the community.
- Smaller satellite plnts are not large enough for cost-effective production of biogas.
- Much more costly than Options 1 and 2 (see Section 4.0).

3.0 INFLOW & INFILTRATION

3.1 Current I&I in the CVWPCC system

Infiltration can be divided into two components. Groundwater infiltration (GWI) enters the system through defects in pipes, which are located below the water table; GWI is relatively constant in intensity and is of long duration. Rainfall-derived infiltration (RDI) occurs during and immediately after rainfall events, and is caused by the seepage of percolating rainwater into defective pipes, which lie near the ground surface or through defective manholes or covers located in poorly graded pavement areas; RDI is typically of relatively short duration and high intensity, compared to GWI. Inflow can also be divided into two components. Dry weather inflow (DWI) results from surface water not caused by rain that enters the sewer system (e.g., street and vehicle washing). Stormwater inflow (SWI) results from the diversion of storm surface runoff into sanitary sewers (e.g., roof downspouts that are connected to the sanitary sewer).

The Municipal Sewage Regulation (MSR) states that, where the maximum day flow (MDF) exceeds 2 times the average dry weather flow (ADWF) and if the contributory population exceeds 10,000 persons, the discharger must address how I&I can be reduced.

At the CVWPCC the ADWF to MDF ratio varied from 2.0 to 2.9 in the years from 2003 to 2007 (see Memo No.1 Appendix C). Under the MSR an I&I reduction program would be required for the CWWPCC system.

According to USEPA Regulations, the total daily flow in the sanitary sewer during a storm should not exceed 1,050 L/c/d, and if the total flow significantly exceeds 455 L/c/d based on the highest 7 to 14 day average, the collection system is subject to "excessive" I&I. In the years 2003 to 2007 the MDF exceeded 1,050 L/c/d once. The average yearly 7 day maximum flow at the CVWPCC was 738 L/c/d from the years 2003 to 2007. This is significantly higher than the USEPA recommends. The system would benefit from additional reduction of I&I.

3.2 Effect of Inflow and Infiltration on Wastewater Treatment

In general, process units for which hydraulic criteria (peak flow or average flow) is the governing design factor may benefit from I&I reduction. With regard to the CVWPCC (and other typical treatment facilities) these include:

- Influent screens.
- Grit tanks.
- Primary sedimentation tanks.
- Secondary aeration basins, under some circumstances.
- Secondary clarifiers, under some circumstances.
- Effluent pump station.
- Outfall

The following process units would not typically benefit significantly from I&I reduction:

- Secondary (biological) treatment units (activated sludge tanks, etc.).
- Aeration blowers.
- Solids thickeners.
- Solids digestion facilities.
- Sludge holding tanks.
- Solids dewatering facilities.
- Solids pumping/handling.

In general, design of treatment units that are related to the organic loading on a treatment plant are not related to I&I reduction; this includes biological treatment reactors for secondary (and advanced) treatment, as well as virtually all of the solids treatment and handling facilities. These facilities can account for a large percentage of the total capital cost of treatment facilities. Therefore, I&I reduction may have a relatively small impact on the capital costs of treatment, depending on the nature of the treatment facilities.

However, I&I reduction can have a much more direct impact on operating costs for treatment, including power demand for pumping and chemical addition where practiced (e.g., chlorine for disinfection, chemical addition for enhanced treatment).

4.0 COST ESTIMATES

Capital Costs, Yearly O & M Costs and 50 year Net Present Value are shown in Table 3.

Capital and O & M costs have been taken from Dayton & Knight cost curves. These curves show costs vs. average annual flow for a number of treatment plants in North America. Best fit curves have been applied to the data points in order to allow estimation of capital and O & M costs.

The following class D cost estimates for the above options include the following:

- Construction of treatment facilities.
- Construction of outfalls, where required.
- Engineering and contingency.

The following are not included in the cost estimates:

- Raw sewage conveyance.
- Land purchase, where required.
- Biosolids treatment.
- Construction and O & M for infrastructure for water reuse.

The 50 year net present value costs assume that the full capital cost of construction will be met at year zero, and that O & M costs are constant throughout the 50 year period. It is important to emphasize that the costs shown are for treatment only, and do not include wastewater conveyance and pumping or solids reuse. The costs are all-inclusive and should not be used for budgeting purposes, but are considered adequate for the purpose of comparing options.

Table 3
Capital Costs, Yearly O & M Costs and 50 year Net Present Value (Millions of Dollars)

Option	Plant	Capital Cost	Yearly O & M	50 Year Net Present Value
Option 1	CVWPCC	$103.7	$5.9	$217
	Total	*$103.7*	*$5.9*	*$217*
Option 1A	CVWPCC	$103.7	$5.9	$217
	Total	*$103.7*	*$5.9*	*$217*
Option 2	CVWPCC	$61.7	$4.6	$150
	South STP	$54.2	$2.4	$100
	Kitty Coleman STP	$6.5	$0.3	$12
	Saratoga STP	$18.0	$1.1	$39
	Total	*$140.4*	*$8.3*	*$300*
Option 2A	CVWPCC	$61.7	$4.6	$150
	RID STP	$21.3	$1.5	$50
	UBID STP	$31.7	$2.2	$74
	Cumberland STP	$41.9	$3.2	$103
	Ships Point STP	$14.2	$1.0	$33
	Kitty Coleman STP	$6.5	$0.3	$12
	Saratoga STP	$18.0	$1.1	$39
	Total	*$195.2*	*$13.9*	*$461*

As shown in Table 3, Option 1 and Option 1A have the lowest capital cost (about $100 million) and annual O&M cost (about $6 million per year for the 180,000 population). Option 2 is more costly at about $140 million capital cost and $8 million per year O&M. Option 3 is much more costly at about $200 million capital cost and $14 million per year O&M. It is apparent that, due to economies of scale and efficient use of facilities and resources, the cost of treatment is less for a smaller number of relatively large facilities than for more numerous small facilities.