

# Gulf Islands and Port Renfrew Wastewater and Marine Environment Program

## Annual Report 2009

Environmental Sustainability

Environmental Protection



Prepared by  
Marine Programs

Capital Regional District  
625 Fisgard Street, Victoria, BC V8W 2S6  
T: 250.360.3000 | F: 250.360.3079  
[www.crd.bc.ca](http://www.crd.bc.ca)

May 2010



**GULF ISLANDS AND PORT RENFREW  
WASTEWATER AND MARINE ENVIRONMENT PROGRAM  
2009 ANNUAL REPORT**

**EXECUTIVE SUMMARY**

This report summarizes the 2009 results of the Wastewater and Marine Environment program (WMEP) for the wastewater treatment plants (WWTP) operated by the Capital Regional District (CRD) in the Gulf Islands and Port Renfrew. The program includes regular monitoring as stipulated by the British Columbia Ministry of Environment (MOE), either through permits or under the Municipal Sewage Regulation (MSR). Two of these WWTP (Ganges Harbour and Schooner Way) discharged disinfected secondary treated effluent, two WWTP (Cannon Crescent and Port Renfrew) discharged undisinfected secondary treated effluent and one (Maliview Estates) discharged undisinfected secondary treated effluent mixed with fine screened effluent during high flows.

All WWTP discharges (effluents) were monitored for conventional parameters, including flow, total suspended solids (TSS), biochemical oxygen demand (BOD) and fecal coliform bacteria, and most for ammonia and pH. All treatment plant influents were monitored for TSS and total BOD (TBOD), and some for fecal coliform bacteria. Effluent toxicity was monitored at Ganges Harbour and Schooner Way. Influent and effluent priority substances and sludge quality were monitored at Ganges Harbour. Results were compared to regulatory requirements relevant to each facility.

Receiving waters at Maliview Estates and Schooner Way WWTPs were monitored for fecal coliform bacteria. Receiving waters at Ganges Harbour WWTP were not monitored for fecal coliform bacteria in 2009, but are subject to conditions included in their MSR registrations that may require monitoring in the future. Receiving water results have been compared with values set to protect people undertaking primary contact recreational activities.

## **GANGES HARBOUR**

### **Wastewater**

Flow to the Ganges Harbour WWTP was slightly less than 2008 levels. None of the daily flows exceeded the allowable maximum. Effluent quality conformed to permit requirements for TSS, CBOD and fecal coliform bacteria. Ammonia concentrations in the effluent from April to October of 2009 were similar to the elevated values observed during the last half of 2007 and first two months of 2008. Ammonia concentrations returned to normal levels for the remainder of the year. Disinfection efficiency was not as consistent as previous years, with two fecal coliform results exceeding 200 CFU/100mL. Monthly cleaning and annual replacement of ultraviolet tubes should continue to ensure effective disinfection. Effluent toxicity conformed to permit requirements, and influent/effluent priority substance concentrations were within the ranges expected for secondary treated effluent. Most substances in effluent were below the BC Water Quality Guidelines (BCWQG) even before the minimum initial dilution in the environment of 419:1. All predicted receiving environment concentrations of measured parameters were below applicable BCWQG after the initial dilution zone calculation was applied.

### **Sludge**

The 2009 results indicate that the Ganges Harbour WWTP sludge had concentrations generally well below the regulations for Class A biosolids. There were no mercury exceedences in 2009 and concentrations were significantly lower than 2008.

### **Surface Water**

Surface water fecal coliform monitoring is subject to conditions included in the MSR registration. None of the conditions that could trigger a re-instatement of a surface water monitoring component were met in 2008 or 2009. Therefore, monitoring was not required in 2009 and will not be required in 2010.

Monitoring requirements for 2011 will be determined following the collection and assessment of wastewater samples 2010.

### **Recommendations**

- Maintain effectiveness and reliability of the treatment and disinfection processes.
- Coordinate toxicity sampling with routine compliance and treatment plant performance sampling.

### **MALIVIEW ESTATES**

#### **Wastewater**

The Maliview Estates WWTP produces secondary treated effluent when flows are below 60 m<sup>3</sup>/day. For flows over 60 m<sup>3</sup>/day, the plant produces a final effluent that is a blend of secondary treated and fine-screened effluents. As such, there are different regulatory limits for this facility depending on whether the flows are above or below 60 m<sup>3</sup>/day. Total daily flow did not exceed the allowable maximum of 250 m<sup>3</sup>/day in 2009. Secondary effluent quality (when total flows were below 60 m<sup>3</sup>/day) exceeded the allowable maximum for TSS in 50% of the samples and for CBOD in 25% of the samples. Fine screened effluent quality (when total flows were greater than 60 m<sup>3</sup>/day) exceeded the allowable maximum for TSS in 67% of the samples. CRD Integrated Water Services staff continuously adjust the operation of this facility in attempts to minimize and prevent these exceedences in the future.

#### **Receiving Water**

The seven station, surface fecal coliform monitoring program was undertaken in January and July 2009. All results were less than 200 CFU/100mL. However, as a result of exceedences in 2008, two consecutive years (2009 and 2010) of surface water monitoring are required.

### **Recommendations**

- Review the regulatory threshold for high bypass events and consider revising it based on instantaneous peak rather than total daily flow.
- The BC MSR Registration for this facility requires quarterly sampling for this facility. However, it is recommended to continue the monthly wastewater sampling that was initiated in 2009 to better characterize wastewater quality and treatment plant performance. Monthly sampling also makes the sampling frequency consistent with the other treatment facilities discussed in this report
- Ensure that the winter shoreline surface water sampling event is undertaken when fine-screened effluent makes up a substantial portion of the total effluent flow.

### **SCHOONER WAY**

#### **Wastewater**

Total annual flow to the Schooner Way WWTP was slightly higher than in 2008. In 2009, 0.3% of the flows exceeded the allowable maximum. Effluent quality conformed to allowable maximums for TSS and CBOD, but exceeded the maximum for fecal coliforms in one of the samples. Disinfection efficiency was adequate, but occasionally deteriorated.

#### **Surface Water**

All 37 of the surface water receiving water stations around the Schooner Way outfall were below levels that could cause health effects related to primary contact recreational activities. The maximum fecal coliform concentration observed was 4 CFU/100mL.

Surface water monitoring for fecal coliforms is subject to conditions included in the MSR registration. Receiving water monitoring was triggered in 2007 and continued without meeting trigger conditions until November 2009 when there was an exceedance of the allowable maximum daily wastewater flow. As a result, receiving water monitoring must be continued in 2010 and 2011.

## **Recommendations**

- Coordinate toxicity sampling with routine compliance and treatment plant performance sampling.
- Continue surface water fecal coliform monitoring for 2010 and 2011, as per the conditions stipulated in the MSR registration.

## **CANNON CRESCENT**

### **Wastewater**

Total annual flow to the Cannon Crescent WWTP in 2009 was slightly higher than in 2008. Thirteen percent of the daily flows exceeded the allowable maximum. The inflow and infiltration program initiated in 2000 has reduced exceedences from 24%, which was observed in 2000. Effluent quality met all permit requirements, with no samples exceeding allowable maximums.

### **Recommendations**

- No specific recommendations.

## **PORT RENFREW**

### **Wastewater**

Total annual flow to Port Renfrew WWTP was 2% higher than in 2008. One percent of the daily flows exceeded the allowable maximum. Effluent quality was similar to last year and met all permit requirements.

### **Recommendations**

- No specific recommendations.



**GULF ISLANDS AND PORT RENFREW  
WASTEWATER AND MARINE ENVIRONMENT PROGRAM  
2009 ANNUAL REPORT**

**TABLE OF CONTENTS**

EXECUTIVE SUMMARY .....	i
1.0 INTRODUCTION .....	1
1.1 Wastewater Monitoring .....	1
1.1.1 Compliance and Treatment Plant Performance Monitoring .....	1
1.1.2 Toxicity Testing.....	1
1.1.3 Priority Substances.....	1
1.1.4 Treatment Plant Sludge.....	1
1.2 Receiving Water Monitoring.....	4
1.2.1 Receiving Water Monitoring Trigger Conditions.....	4
2.0 GANGES HARBOUR .....	5
2.1 Introduction .....	5
2.2 Methods .....	5
2.2.1 Wastewater Monitoring.....	5
2.2.2 Receiving Water Monitoring .....	6
2.3 Results .....	7
2.3.1 Wastewater Monitoring.....	7
2.4 Recommendations .....	17
3.0 MALIVIEW ESTATES .....	26
3.1 Introduction .....	26
3.2 Methods .....	26
3.2.1 Wastewater Monitoring.....	26
3.2.2 Receiving Water Monitoring .....	27
3.3 Results .....	27
3.3.1 Wastewater Monitoring.....	27
3.3.2 Receiving Water Monitoring .....	32
3.4 Recommendations .....	35
4.0 SCHOONER WAY .....	40
4.1 Introduction .....	40
4.2 Methods .....	40
4.2.1 Wastewater Monitoring Methods.....	40
4.2.2 Receiving Water Monitoring .....	41
4.3 Results .....	42
4.3.1 Wastewater Monitoring.....	42
4.3.2 Receiving Water Monitoring .....	43
4.4 Recommendations .....	46
5.0 CANNON CRESCENT .....	49
5.1 Introduction .....	49
5.2 Methods .....	49
5.2.1 Wastewater Monitoring.....	49
5.3 Results .....	50
5.3.1 Wastewater Monitoring.....	50
5.4 Recommendations .....	51
6.0 PORT RENFREW .....	54
6.1 Introduction .....	54
6.2 Methods .....	54
6.2.1 Wastewater Monitoring.....	54
6.3 Results .....	55
6.3.1 Wastewater Monitoring.....	55
6.4 Recommendations .....	56
7.0 REFERENCES.....	59

## LIST OF TABLES

Table 1.1	Summary of 2009 Wastewater and Surface Water Components of the Port Renfrew and Gulf Islands WMEP .....	3
Table 2.1	Ganges Harbour Treatment Plant WMEP .....	5
Table 2.2	Ganges Harbour WWTP 2009 Influent Flow Summary .....	7
Table 2.3	Ganges Harbour WWTP 2009 Compliance and Treatment Plant Performance Monitoring Annual Summary .....	8
Table 2.4	Wastewater Priority Substances 2009 Summary of Compounds Detected in Ganges Harbour Influent and Effluent.....	10
Table 2.5	Ganges Harbour WWTP 2009 Sludge Concentrations.....	14
Table 3.1	Maliview Estates Treatment Plant WMEP .....	26
Table 3.2	Maliview Estates WWTP 2009 Effluent Flow Annual Summary.....	28
Table 3.3	Maliview Estates WWTP 2009 Influent Flow Summary .....	28
Table 3.4	Maliview Estates WWTP 2009 Secondary Effluent Flow Annual Summary .....	29
Table 3.5	Maliview Estates WWTP 2009 Fine Screened Effluent Flow Annual Summary .....	30
Table 3.6	Maliview Estates WWTP 2009 Compliance Annual Summary .....	31
Table 3.7	Maliview Estates WWTP 2009 Shoreline Fecal Coliforms Summary .....	32
Table 4.1	Schooner Way Treatment Plant WMEP .....	40
Table 4.2	Schooner Way WWTP 2009 Flow Annual Summary .....	42
Table 4.3	Schooner Way WWTP 2009 Compliance Annual Summary.....	43
Table 4.4	Schooner Way WWTP 2009 Surface Water Fecal Coliforms Summary.....	44
Table 5.1	Cannon Crescent Treatment Plant WMEP.....	49
Table 5.2	Cannon Crescent WWTP 2009 Annual Flow Summary.....	50
Table 5.3	Cannon Crescent WWTP 2009 Compliance and Treatment Plant Performance Monitoring Annual Summary .....	51
Table 6.1	Port Renfrew Treatment Plant WMEP.....	54
Table 6.2	Port Renfrew WWTP 2009 Flow Annual Summary.....	55
Table 6.3	Port Renfrew WWTP 2009 Compliance and Treatment Plant Performance Monitoring Annual Summary .....	56

## LIST OF FIGURES

Figure 1.1	Ganges Harbour, Maliview Estates, Schooner Way, Cannon Crescent, and Port Renfrew Outfall Locations.....	2
Figure 2.1	Ganges Harbour WWTP Sludge Mercury Levels (1998 to 2009) .....	16
Figure 3.1	Maliview Estates WWTP 2009 Shoreline Fecal Coliform Monitoring Results.....	33
Figure 3.2	Maliview Estates WWTP Surface Water Fecal Coliform Time Series Data from 1985 to 2009.....	34
Figure 4.1	Schooner Way WWTP 2009 Surface Water Fecal Coliform Monitoring .....	45

## LIST OF APPENDICES

Appendix 2.1	Ganges Harbour WWTP 2009 Flow Data (m3/day) .....	18
Appendix 2.2	Ganges Harbour WWTP 2009 Compliance and Treatment Plant Performance Monitoring Data.....	19
Appendix 2.3	Wastewater Priority Substances Analyzed in Ganges Harbour Influent and Effluent 2009 .....	20
Appendix 3.1	Maliview Estates WWTP 2009 Flow Data (m3/day) .....	36
Appendix 3.2	Maliview Estates WWTP 2009 Secondary Effluent Flow Data (m3/day) .....	37
Appendix 3.3	Maliview Estates WWTP 2009 Fine Screened Effluent Flow Data (m3/d).....	38

Appendix 3.4	Maliview Estates WWTP Compliance and Treatment Plant Performance Monitoring Data for 2009 .....	39
Appendix 4.1	Schooner Way WWTP 2009 Flow Data (m3/day) .....	47
Appendix 4.2	Schooner Way WWTP 2009 Compliance and Treatment Plant Performance Monitoring Data.....	48
Appendix 5.1	Cannon Crescent WWTP 2009 Flow Data .....	52
Appendix 5.2	Cannon Crescent WWTP 2009 Compliance and Treatment Plant Performance Monitoring Data.....	53
Appendix 6.1	Port Renfrew WWTP 2009 Flow Data (m3/day).....	57
Appendix 6.2	Port Renfrew WWTP 2009 Compliance and Treatment Plant Performance Monitoring Data.....	58



**GULF ISLANDS AND PORT RENFREW  
WASTEWATER AND MARINE ENVIRONMENT PROGRAM  
2009 ANNUAL REPORT**

## **1.0 INTRODUCTION**

This report summarizes the 2009 results of the Wastewater and Marine Environment program (WMEP) for the wastewater treatment plants (WWTP) operated by the Capital Regional District (CRD) in the Gulf Islands and Port Renfrew. The program includes regular monitoring as stipulated by the British Columbia Ministry of Environment (MOE) either through a permit or under the Municipal Sewage Regulation (MSR). Two of these WWTP (Ganges Harbour and Schooner Way) discharge disinfected secondary treated effluent, two (Cannon Crescent and Port Renfrew) discharge undisinfected secondary treated effluent and one (Maliview Estates) discharges undisinfected secondary treated effluent mixed with fine screened effluent during high flows. Locations of these five facilities are presented in Figure 1.1.

### **1.1 Wastewater Monitoring**

Wastewater monitoring components are summarized in Table 1.1 and are discussed in the sections below. WWTP-specific regulatory compliance levels for applicable parameters, and associated sampling and analytical methodologies, are discussed in the individual WWTP sections of this report.

#### **1.1.1 Compliance and Treatment Plant Performance Monitoring**

All wastewater discharges (effluents) were monitored for the following conventional parameters: flow, total suspended solids (TSS), biochemical oxygen demand (BOD), and fecal coliform bacteria. All treatment plant influents were monitored for TSS and BOD. Total BOD (TBOD) was used for influents and primary effluents. Carbonaceous BOD (CBOD) was used for secondary and disinfected secondary effluents, as stipulated under the MSR. Some discharges were monitored for additional parameters, such as ammonia and pH.

#### **1.1.2 Toxicity Testing**

Effluent samples from the Ganges Harbour and Schooner Way WWTP were analyzed for potential toxicity to freshwater trout. This test was a requirement under the MSR registrations for both the Ganges Harbour and Schooner Way WWTP.

#### **1.1.3 Priority Substances**

Wastewater influent and effluent from the Ganges Harbour WWTP were analyzed for a list of priority substances as stipulated in the MSR registration for this facility. Influent and effluent priority substances are summarized in Table 2.4 and Appendix 2.3. These data were used to assess the quality of the final effluent and the effectiveness of both the Regional Source Control program (RSCP) and the treatment process.

#### **1.1.4 Treatment Plant Sludge**

The Ganges Harbour WWTP produces sludge with the objective of meeting Class A Biosolids guidelines, in accordance with the pathogen reduction and vector attraction reduction processes in the BC Ministry of Environment Organic Matter Recycling Regulations (OMRR) (BC MOE, 2002). Sludge is a by-product of sewage treatment, and at the Ganges Harbour plant, it is de-watered prior to monitoring.

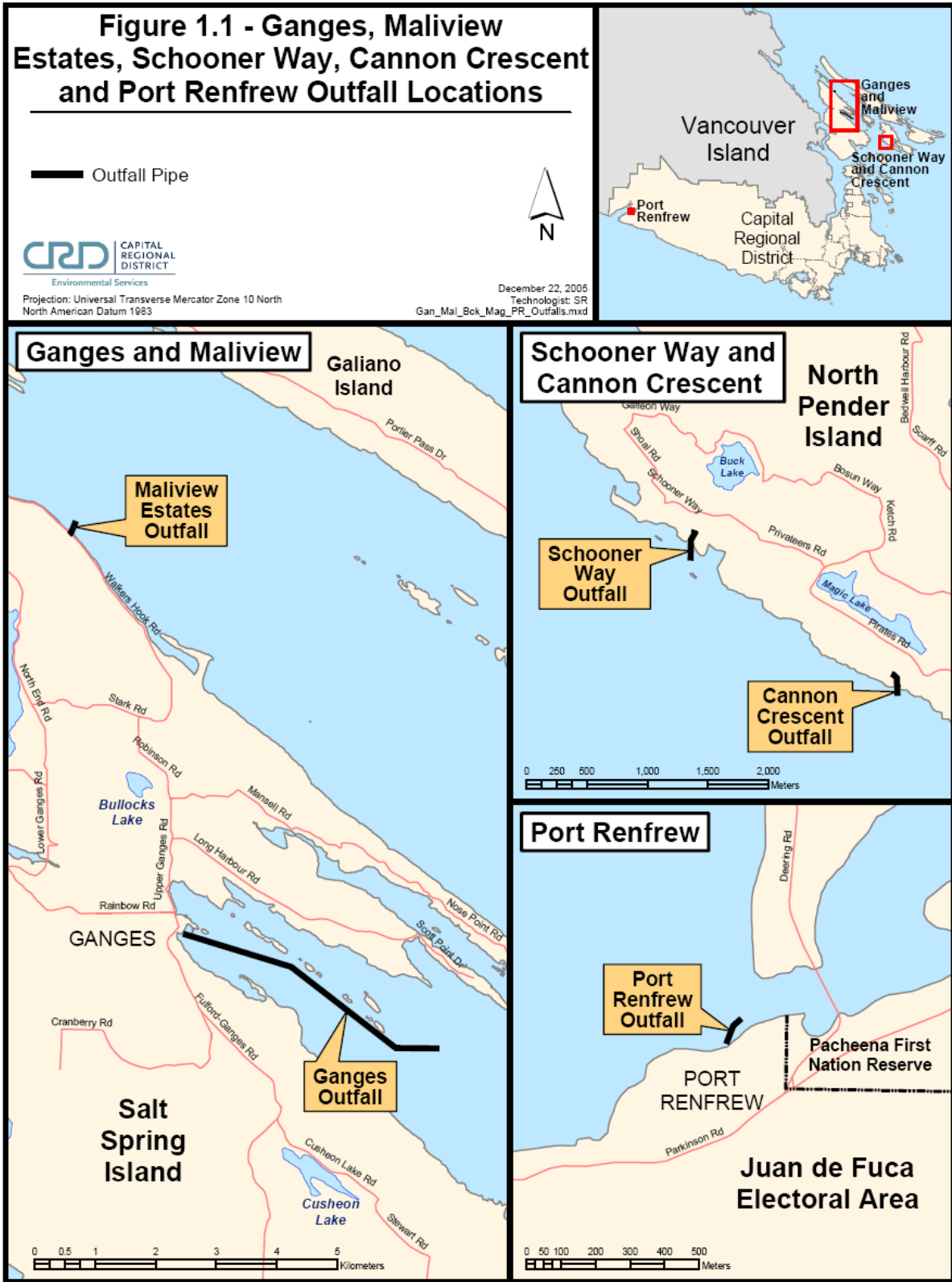


Figure 1.1 Ganges Harbour, Maliview Estates, Schooner Way, Cannon Crescent, and Port Renfrew Outfall Locations

**Table 1.1 Summary of 2009 Wastewater and Surface Water Components of the Port Renfrew and Gulf Islands WMEP**

Component	Parameter	Frequency and Stations
Wastewater	Flow	Daily: <b>Ganges Harbour, Maliview Estates, Schooner Way, Cannon Crescent, Port Renfrew</b>
	Compliance and treatment plant performance monitoring: <ul style="list-style-type: none"> <li>• Influent: TSS, TBOD, FC</li> <li>• Secondary Effluent: TSS, FC</li> <li>• Disinfected Secondary Effluent: TSS, TBOD, CBOD, FC, NH3, pH</li> </ul>	Once per month: <b>Ganges Harbour, Schooner Way</b>
	Compliance and treatment plant performance monitoring: <ul style="list-style-type: none"> <li>• Influent—TSS, TBOD</li> <li>• Secondary Effluent—TSS, TBOD, CBOD, FC, NH3, pH</li> </ul>	Once per month: <b>Maliview Estates</b>
	Fine Screened Effluent—TSS, TBOD, CBOD, FC, NH3, pH	Four times per year: <b>Maliview Estates</b>
	Compliance and treatment plant performance monitoring: <ul style="list-style-type: none"> <li>• Influent—TSS, TBOD</li> <li>• Effluent—TSS, TBOD, CBOD, FC, NH3, pH</li> </ul>	Once per month: <b>Cannon Crescent, Port Renfrew</b>
	Influent and effluent priority substances <sup>1</sup>	Once per year: <b>Ganges Harbour</b>
	Effluent toxicity	Once per year: <b>Ganges Harbour, Schooner Way</b>
Receiving Water	Surface water indicator bacteria (fecal coliforms)	<b>Ganges Harbour</b> <ul style="list-style-type: none"> <li>• Subject to trigger conditions</li> <li>• Not required in 2008 or 2009</li> </ul> <b>Maliview Estates</b> <ul style="list-style-type: none"> <li>• Twice per year</li> <li>• Started in 2008</li> <li>• Required in 2009 and 2010</li> <li>• Seven shoreline surface water stations</li> </ul> <b>Schooner Way</b> <ul style="list-style-type: none"> <li>• Subject to trigger conditions</li> <li>• Required in 2010 and 2011</li> <li>• 37 surface water stations</li> </ul>

**Note**

1 All priority substances are listed in Table 2.4

## **1.2 Receiving Water Monitoring**

Receiving water monitoring program components are summarized in Table 1.1.

Whenever possible, comparisons have been made between 2009 results and comparable 2008 results reported by the CRD or from unpublished data provided by the CRD's Integrated Water Services department (previously Operations and Local Services). However, comparisons between small data sets (i.e. 12 or less samples) are of limited utility. Effluent quality fecal coliform results are highly variable, so year-to-year comparisons of effluent fecal coliform concentrations and loadings may not be able to infer consistent trends over time or space. Data published in previous years' monitoring reports (Olmstead and Warman 1989 and 1990; Pym 1991 to 2005 and CRD 2006 to 2009) were qualitatively examined to identify potential long-term trends in receiving water quality.

Results were compared to the value specified in the BC MOE Approved Water Quality Guidelines (BCWQG) for primary contact, as a means to assess potential for human health risks (BCMOE, 2007b). This guideline applies to primary contact recreational waters, such as beaches, where most human activities take place. The number of samples collected for the receiving water fecal coliform monitoring programs described in this report, as well as the timeframe for their collection, was developed in collaboration with the BC MOE. However, these receiving water samples do not allow for a direct comparison to this guideline as it was defined. The guidelines include the requirement that the geometric mean of five samples taken within 30 days must not exceed 200 colony forming units in 100mL (CFU/100mL). As such, within this report, 200 CFU/100mL acts only as a benchmark to assess potential human health risks related to primary contact.

### **1.2.1 Receiving Water Monitoring Trigger Conditions**

At Ganges Harbour and Schooner Way, receiving water monitoring trigger conditions are in place to assess the need for shoreline or surface water fecal coliform monitoring. Receiving environment monitoring may be required if specific conditions are met. Details are discussed in each individual WWTP section.

## 2.0 GANGES HARBOUR

### 2.1 Introduction

The Ganges Harbour wastewater treatment plant (WWTP) is located on the east side of Salt Spring Island (Figure 1.1). It discharges disinfected secondary treated effluent into Ganges Harbour through a 4800 metre long outfall at a depth of 16 metres below sea level.

The facility is regulated under BC MSR Registration RE-05521, dated 2005 April 28, with the following requirements:

Maximum daily flow	1,090 m <sup>3</sup> /d
Maximum CBOD	25 mg/L
Maximum TSS	25 mg/L
Maximum fecal coliforms	1000 CFU/100mL
Toxicity test	Pass 96 hour effluent toxicity test

This registration also contains receiving water monitoring trigger conditions that, if met, may require receiving water monitoring. The details of these conditions are discussed in Section 2.3.2.

This section reports the results from the Ganges Harbour treatment plant WMEP described in Table 2.1.

**Table 2.1 Ganges Harbour Treatment Plant WMEP**

Component	Parameter	Frequency and Stations
Wastewater	Flow	Daily
	Compliance and treatment plant performance monitoring: <ul style="list-style-type: none"> <li>Influent: TSS, TBOD, FC</li> <li>Secondary Effluent: TSS, FC</li> <li>Disinfected Secondary Effluent: TSS, TBOD, CBOD, FC, ammonia (NH<sub>3</sub>), pH</li> </ul>	Once per month
	Effluent toxicity	Once per year
	Influent and effluent priority substances <sup>1</sup>	Once per year
Surface Water	Indicator bacteria (fecal coliforms)	Not required in 2009 <sup>2</sup>

**Notes**

1 All priority substances are listed in Appendix 2.3

2 Subject to trigger conditions

### 2.2 Methods

#### 2.2.1 Wastewater Monitoring

##### COMPLIANCE AND TREATMENT PLANT PERFORMANCE MONITORING

Influent and effluent samples were collected as grab samples.

Laboratory analyses were conducted at the Saanich Peninsula Wastewater Treatment Plant (SPWWTP) Laboratory or Cantest (Victoria, BC). TSS was determined gravimetrically using glass fibre filters dried at 105°C (APHA, 1998). TBOD was determined by five-day oxygen depletion at 20°C using an oxygen meter (APHA, 1998). CBOD was determined by five-day oxygen depletion at 20°C with TCMP (2-chloro-

6-(trichloro methyl) pyridine) as a nitrification inhibitor and using an oxygen meter (APHA, 1998). Fecal coliforms were enumerated using 0.45 µm membrane filters incubated on mFC medium at 44.5°C for 24 hours (APHA, 1998). Ammonia was determined by distillation and Nesslerization colorimetry. Nitrite was determined by diazotization colorimetry. Nitrate was determined by cadmium reduction followed by diazotization colorimetry.

Means reported for fecal coliforms are geometric (logarithmic) means. Means for all other parameters are arithmetic. Mean daily loadings were calculated from mean concentrations and mean daily flows. Annual loadings were calculated from mean concentrations and total annual flows.

### **TOXICITY TESTING**

The effluent toxicity samples were collected by grab sampling. Effluent toxicity was determined by a 96-hour single concentration acute toxicity test using juvenile rainbow trout (*Oncorhynchus mykiss*). Ten test organisms were exposed to undiluted effluent and the number of organisms surviving at 96 hours was recorded. Fifty percent or greater survival is considered a pass, less than 50% survival is a fail.

### **PRIORITY SUBSTANCES**

At Ganges Harbour, bulk influent and effluent samples were collected as grab samples. The bulk samples were then split into smaller sample bottles for individual analyses and preserved before shipping to Maxxam Analytics (Burnaby, BC). Appendix 2.3 contains a full listing of parameters analyzed.

### **SLUDGE**

Dewatered sludge was sampled on a monthly basis and analyzed for 29 metals and moisture content. Results were compared to the BC OMR (BCMOE, 2002) biosolids limits. These regulations stipulate the land uses that are acceptable for the tested biosolids according to the concentrations of a select group of substances. The regulations are set to protect human and environmental health.

## **2.2.2 Receiving Water Monitoring**

### **SURFACE WATER FECAL COLIFORM**

Surface water fecal coliform monitoring was discontinued after the 2005 sampling year. The suspension of sampling was considered acceptable because the effluent is disinfected and the fecal coliform levels observed in the receiving waters from 1988 to 2005 were consistently very low.

Receiving water monitoring trigger conditions were established in 2006 to assess the future need for fecal coliform monitoring. Monitoring is to be re-instated if any of the following conditions are met:

- (A) Effluent fecal coliform concentrations exceed 200 CFU/100mL in two consecutive samples.
- (B) Effluent fecal coliform concentrations exceed 200 CFU/100mL in three samples within a reporting (calendar) year.
- (C) The maximum daily discharge exceeds 1,090 m<sup>3</sup>/day.
- (D) The ultraviolet disinfection unit is not functioning.

Should receiving water monitoring be triggered, the WWTP must not exceed conditions A through D for a period of two reporting years before it can be discontinued.

## 2.3 Results

### 2.3.1 Wastewater Monitoring

#### **COMPLIANCE AND TREATMENT PLANT PERFORMANCE MONITORING**

Flow data are summarized in Table 2.2 and the complete data set is presented in Appendix 2.1. In 2009 none of the daily flows to the Ganges Harbour WWTP exceeded the allowable maximum. Flow decreased approximately 1% from last year. Long term trends indicate that flow has been decreasing an average of 3% each year since 2007.

Compliance and treatment plant performance monitoring data are summarized in Table 2.3 and the complete data set is presented in Appendix 2.2. Effluent quality was consistent with the previous two years for all parameters. None of the samples exceeded the maximum allowable concentrations for TSS, CBOD or fecal coliforms. The treatment plant removed greater than 99% of the TSS, 99% of the CBOD and greater than 99% of the fecal coliform bacteria from the influent.

As none of the trigger conditions were exceeded in 2007 or 2008, surface water fecal coliform monitoring was not required in 2009. However, it is important to note that two samples (January and May) did exceed 200 CFU/100mL). This may be an indication that disinfection efficiency declined in 2009 due to ultraviolet tubes and/or treatment membranes requiring maintenance or cleaning.

Effluent ammonia concentrations at the Ganges Harbour treatment plant in 2005 and 2006 were consistent with ammonia concentrations reported at other CRD secondary treatment plants. An increase in ammonia concentrations was observed beginning in July 2007 through to February 2008, where they subsequently returned to historic levels. However, a second increase was observed from April 2009 to October 2009. The high ammonia concentration may be related to operational deficiencies during the anoxic treatment process. CRD staff will continue to investigate the potential cause of these ammonia spikes. Ammonia concentrations in the last two months of 2009 returned to historic levels.

**Table 2.2 Ganges Harbour WWTP 2009 Influent Flow Summary**

Month	Mean Flow (m3/d)	Minimum Flow (m3/d)	Maximum Flow (m3/d)	Total Flow (m3)	Number of Samples	Permit violations (number)	Permit violations (percent)
January	492	384	667	15 266	31	0	
February	441	386	525	12 341	28	0	0%
March	441	365	512	13 680	31	0	0%
April	439	388	561	13 163	30	0	0%
May	453	382	521	14 049	31	0	0%
June	446	389	490	13 379	30	0	0%
July	492	425	541	15 247	31	0	0%
August	521	448	570	16 138	31	0	0%
September	469	388	806	14 068	30	0	0%
October	428	335	523	13 259	31	0	0%
November	534	396	791	16 019	30	0	0%
December	434	298	571	13 461	31	0	0%
<b>Annual Totals</b>	<b>466</b>	<b>298</b>	<b>806</b>	<b>170 070</b>	<b>365</b>	<b>0</b>	<b>0%</b>

**Table 2.3 Ganges Harbour WWTP 2009 Compliance and Treatment Plant Performance Monitoring Annual Summary**

Date	Compliance Monitoring				Treatment Plant Performance Monitoring		
	Flow (m3/d)	TSS (mg/l)	CBOD (mg/L)	Fecal Coliforms (CFU/100mL)	TBOD (mg/L)	Ammonia (mgN/L)	pH (pH)
<b>Influent</b>							
Regulatory Limit	---	---	---	---	---	---	---
Mean	466	312	---	7 100 743	340	---	---
Minimum	298	62	---	2 900 000	220	---	---
Maximum	806	456	---	15 000 000	469	---	---
Permit violations	0%	---	---	---	---	---	---
Number of samples	365	12	---	12	12	---	---
<b>Secondary Effluent</b>							
Regulatory Limit	---	---	---	---	---	---	---
Mean	466	<1	---	74	---	---	---
Minimum	---	<1	---	15	---	---	---
Maximum	---	2	---	615	---	---	---
Percent Reduction	---	>99%	---	>99%	---	---	---
Permit violations	---	---	---	---	---	---	---
Number of samples	0	12	---	12	---	---	---
<b>Disinfected Secondary Effluent</b>							
Regulatory Limit	1090	25	25	1 000	---	---	---
Mean	466	<1	<4	14	<4	11.73	7.0
Minimum	298	<1	<4	<1	<4	0.02	6.7
Maximum	806	1	<4	600	<4	29.90	7.2
Percent Reduction	0%	>99%	---	>99%	---	---	---
Permit violations	0	0	0	0	---	---	---
Number of samples	365	12	11		11	11	12

**TOXICITY TESTING**

The effluent sample from July 21, 2009, passed the 96 hour acute toxicity test. Fifty percent of the Rainbow Trout survived in the undiluted effluent for the 96 hour duration of the test. All previous tests since 2004 have had 100% survival. The decreased survival for 2009 may be a result of the high ammonia concentrations. Ammonia on July 21 was 25.50mg/L, which is significantly higher than the recommended guideline of 16.9mg/L (pH 7.2 at 15<sup>o</sup> Celsius) from the BCWQG for the Protection of Aquatic Life (BC MOE, 2007).

**PRIORITY SUBSTANCES**

Table 2.4 contains a summary of priority substance results from influent and effluent samples collected on July 15, 2009. The full scope of parameters analyzed is listed in Appendix 2.3. Only those parameters that were detected in 2009 have been presented in Table 2.4. Most substances in the effluent were below the BCWQG before the predicted minimum initial dilution of 419:1, as determined by modeling (Seaconsult Marine Research Ltd, 1994). Five substances exceeded the established BCWQG in undiluted effluent: WAD cyanide, total copper, total iron, total zinc, and ammonia. Ammonia did not

exceed the guideline in 2008, but did in 2007. All predicted receiving environment concentrations were well below the BCWQG after the minimum initial dilution calculation was applied.

Most of the metal effluent concentrations were within their normal ranges relative to previous years, including arsenic, mercury and silver, which were qualitatively elevated in 1999. Of the 129 organics analyzed, only three were detected in effluent during 2009, which is down from the 11 that were detected in 2008. The organic substances detected were total phenols, diethyl phthalate, and trichloromethane. All of these compounds have been detected at least once in previous years.

## **SLUDGE**

Sludge data for 2009 are presented in Table 2.5. Data were compared to BC OMRR Class A Biosolids criteria to assess the quality of the sludge produced at the treatment plant. This class rating identifies biosolids as the highest quality that can be produced according to MOE requirements. Class A Biosolids can be used in land applications (limits are set to protect human and environmental health) with an approved land application plan. Class B criteria were used for chromium and copper, as no Class A criteria exist for these parameters.

The Ganges Harbour treatment plant sludge results show concentrations generally well below the criteria for Class A Biosolids. Mercury results were all below the Class A limit of 5.0 mg/kg and are the lowest recorded levels since regular sampling began in 2002. The 2009 annual mean for mercury ( $1.82 \pm 0.76$  mg/kg) was well below the limit and lower than the 2008 mean of  $4.17 \pm 0.68$  mg/kg. Short term trends indicate that mercury concentrations have been declining since a peak in 2006 where eight individual months and the annual mean were above the limit (Figure 2.1).

Mercury concentrations in 2002 peaked to levels nearly three times the historic average. The peak in 2002 was thought to be a result of implementation of the Regional Source Control dental code of practice (COP) in July 2001, potentially as a result of flushing of plumbing lines within dental offices prior to installing the required amalgam separators. This purging of accumulated amalgam (potentially containing high concentrations of mercury) may have contributed to the elevated mercury levels observed in Ganges sludge during 2001 and 2002. Particulate amalgam would tend to be retained within the plant, being incrementally reduced through subsequent sludge removals (CRD, 2009). The declining trend in 2009 mercury levels may be due to the ongoing and continued success of the code of practice.

Mercury concentrations continued to improve after July 2002 and had met the Class A criterion by the last quarter of 2005. Mercury values reached historically low levels during the last quarter of 2005 and remained below criteria until April 2006. Between May 2006 and January 2007, all values exceeded the Class A criterion and in July 2006 also exceeded the Class B criterion. During the rest of 2007 and all of 2008, the only values to exceed the Class A criterion occurred in September of 2007 and September of 2008; the 2009 data do not show any similar mercury spike in September. However, annual trend analyses will continue to determine if there is a consistent September spike and if so, a potential source investigation will be initiated.

**Table 2.4 Wastewater Priority Substances 2009 Summary of Compounds Detected in Ganges Harbour Influent and Effluent**

Parameter	MDL	Units	Influent	Effluent	Effluent at 419:1 Dilution	Effluent Loading (kg/yr)	BC Water Quality Guidelines			Comments
							Approved		Working	
							30 Day Average	Max		
<b>CONVENTIONALS</b>										
pH	0.1	pH	7.	7.5	0.0179	---				
Conductivity	1.	µS/cm	584.	512.	1.22	---				
Alkalinity	1.	mg/L	166.	136.	0.325	23100.				
Fecal Coliform	1.	CFU/100 ml	9000000.	7.	0.0167	---				
Total Suspended Solids	1.	mg/L	374.	< 1.0	0.00119	n/a				
BOD - Carbonaceous	5.	mg/L O2	283.	< 4.0	0.00477	n/a				
Biochemical Oxygen Demand	5.	mg/L O2	336.	< 4.0	0.00477	n/a				
Chemical Oxygen Demand	1.	mg/L O2	650.	21.	0.0501	3570.				
Total Organic Carbon	5.	mg/L	76.	88.	0.21	15000.				
Total Kjeldahl Nitrogen	0.003	mg/L	55.8	17.2	0.0411	2920.				
Nitrogen - Ammonia	0.003	mg/L	30.2	17.2	0.0411	2920.		2.5		
Nitrogen - Nitrite	0.003	mg/L	0.006	0.008	0.000019	1.36				
Nitrogen - Nitrate	0.003	mg/L	0.381	0.072	0.000172	12.2				
Sulphate (Dissolved)	0.5	mg/L	16.	16.2	0.0387	2750.				
Chloride	1.	mg/L	76.	56.	0.134	9 520.				
Wad Cyanide	0.0005	mg/L	0.002	0.0019	0.000005	0.323		0.001		
Sad Cyanide	0.0005	mg/L	0.0044	0.002	0.000005	0.34				
Oil & Grease, Mineral	2.	mg/L	7.	6.	0.0143	1020.				
Oil & Grease, Total	1.	mg/L	30.	5.	0.0119	850.				
Chromium VI	0.001	mg/L	< 0.001	< 0.001	0.000001	n/a				

continued

Table 2.4, continued

Parameter	MDL	Units	Influent	Effluent	Effluent at 419:1 Dilution	Effluent Loading (kg/yr)	BC Water Quality Guidelines			Comments
							Approved		Working	
							30 Day Average	Max		
<b>METALS (Total)</b>										
Hardness (as CaCO <sub>3</sub> )	0.5	mg/L	44.2	46.4	0.111	7890.				
Aluminum	0.0002	mg/L	0.908	0.116	0.000277	19.7				
Antimony	0.00002	mg/L	0.00017	0.00014	< 0.000001	0.0238				
Arsenic	0.00002	mg/L	0.00061	0.00032	< 0.000001	0.0544		0.0125		Interim
Barium	0.00002	mg/L	0.0284	0.00683	0.000016	1.16	0.5	1.	0.2	MR = 0.5; HA = 1.0; AB = 0.2
Beryllium	0.00001	mg/L	0.00001	< 0.00001	< 0.000001	n/a				
Calcium	0.05	mg/L	15.1	12.3	0.0294	2090.				
Chromium	0.0001	mg/L	0.000 8	0.000 3	< 0.000001	0.051				
Cobalt	0.000005	mg/L	0.003 08	0.000 176	< 0.000001	0.0299				
Copper	0.00005	mg/L	0.116	0.00816	0.00002	1.39	0.002	0.003		
Iron	0.001	mg/L	0.714	0.095	0.000227	16.2		0.05	0.3	MR = 0.05; HA = 0.3
Lead	0.000005	mg/L	0.00732	0.00116	0.000003	0.197	0.002	0.14		80% of values < 0.003
Magnesium	0.05	mg/L	4.58	3.67	0.00876	624.				
Manganese	0.00005	mg/L	0.0587	0.033	0.000079	5.61			0.1	
Mercury	0.00001	mg/L	0.00005	< 0.00001	< 0.000001	n/a	0.00002	0.002		
Molybdenum	0.00005	mg/L	0.00029	0.00007	< 0.000001	0.0119				
Nickel	0.00002	mg/L	0.00399	0.00193	0.000005	0.328				4DA = 0.0083; 1HR = 0.075
Phosphorus	0.002	mg/L	6.16	2.87	0.00685	488.				
Potassium	0.05	mg/L	15.7	14.4	0.0344	2450.				
Selenium	0.00004	mg/L	0.00031	0.00008	< 0.000001	0.0136	0.002			
Tin	0.00001	mg/L	0.00178	0.00074	0.000002	0.126				
Zinc	0.0001	mg/L	0.153	0.0537	0.000128	9.13		0.01		

continued

Table 2.4,continued

Parameter	MDL	Units	Influent	Effluent	Effluent at 419:1 Dilution	Effluent Loading (kg/yr)	BC Water Quality Guidelines			Comments
							Approved		Working	
							30 Day Average	Max		
<b>METALS (Dissolved)</b>										
Hardness (as CaCO <sub>3</sub> )	n/a	n/a	n/a	n/a	n/a	n/a				
Aluminum	0.0002	mg/L	0.0968	0.117	0.000279	19.9				
Antimony	0.00002	mg/L	0.0002	0.00015	< 0.000001	0.0255				
Arsenic	0.00002	mg/L	0.00057	0.00031	< 0.000001	0.0527				
Barium	0.00002	mg/L	0.00594	0.00679	0.000016	1.15				
Beryllium	0.00001	mg/L	< 0.00001	< 0.00001	< 0.000001	n/a				
Cadmium	0.000005	mg/L	0.000063	0.000036	< 0.000001	0.00612				
Calcium	0.05	mg/L	10.9	12.5	0.0298	2130.				
Chromium	0.0001	mg/L	0.0005	0.0003	< 0.000001	0.051				
Cobalt	0.000005	mg/L	0.00039	0.000169	< 0.000001	0.0287				
Copper	0.00005	mg/L	0.0619	0.00767	0.000018	1.3				
Iron	0.001	mg/L	0.415	0.09	0.000215	15.3				
Lead	0.000005	mg/L	0.00133	0.00114	0.000003	0.194				
Magnesium	0.05	mg/L	4.15	3.68	0.00878	626.				
Manganese	0.00005	mg/L	0.0372	0.0316	0.000075	5.37				
Mercury	0.00001	mg/L	0.00004	< 0.00001	< 0.000001	0.00085				
Molybdenum	0.000 05	mg/L	0.00031	0.00008	< 0.000001	0.0136				
Nickel	0.00002	mg/L	0.00312	0.00186	0.000004	0.316				
Phosphorus	0.002	mg/L	4.93	2.91	0.00695	495.				
Potassium	0.05	mg/L	15.6	14.4	0.0344	2450.				
Selenium	0.00004	mg/L	0.00031	0.00009	< 0.000001	0.0153	0.002			
Silver	0.000005	mg/L	0.000256	0.000041	< 0.000001	0.00697				
Tin	0.00001	mg/L	0.00156	0.00077	0.000002	0.131				
Zinc	0.0001	mg/L	0.0627	0.0525	0.000125	8.93				

continued

Table 2.4,continued

Parameter	MDL	Units	Influent	Effluent	Effluent at 419:1 Dilution	Effluent Loading (kg/yr)	BC Water Quality Guidelines			Comments
							Approved		Working	
							30 Day Average	Max		
<b>SEMI-VOLATILE ORGANICS</b>										
<b>Phenols - Non Chlorinated</b>										
Total Phenols	0.001	mg/L	0.04	0.003	0.000007	0.51				
Phenol	0.003	mg/L	0.008	< 0.003	0.000004	n/a				
<b>Phenols - Chlorinated</b>										
2,4,6-Trichlorophenol	0.0005	mg/L	< 0.0005	< 0.0005	< 0.000001	n/a		0.0053		Interim, at pH 7.2.
<b>Phthalates</b>										
Bis(2-Ethylhexyl)Phthalate	0.005	mg/L	0.011	< 0.005	0.000006	n/a				
Diethyl Phthalate	0.0003	mg/L	0.0024	0.0005	0.000001	0.085				
Dimethyl Phthalate	0.0003	mg/L	< 0.0003	< 0.0003	< 0.000001	n/a				
Di-N-Butyl Phthalate	0.003	mg/L	< 0.003	< 0.003	0.000004	n/a				
<b>VOLATILE ORGANICS</b>										
<b>Monocyclic Aromatic Hydrocarbons</b>										
1,4-Dichlorobenzene	0.0005	mg/L	< 0.0005	< 0.0005	< 0.000001	n/a				
Toluene	0.0005	mg/L	0.0039	< 0.0005	< 0.000001	n/a		0.33		
<b>Monocyclic Aromatic Hydrocarbons</b>										
Bromodichloromethane	0.001	mg/L	< 0.002	< 0.001	0.000001	n/a				
Chloroform (Tetrachloromethane)	0.003	mg/L	< 0.003	< 0.003	0.000004	n/a			0.0018	
Trichloromethane	0.001	mg/L	0.014	0.002	0.000005	0.34				
<b>Ketones</b>										
Dimethyl Ketone	0.02	mg/L	0.079	< 0.0	0.000024	n/a				
Methyl Ethyl Ketone	0.01	mg/L	< 0.01	< 0.01	0.000012	n/a				
<b>Terpenes</b>										
alpha-Terpineol	0.005	mg/L	0.009	< 0.005	0.000006	n/a				

**Notes**

MR = minimal risk. HR = hazardous; AB = adverse bivalve effects; 4DA = 4 day average, 1HR = 1 hour average.

**Table 2.5 Ganges Harbour WWTP 2009 Sludge Concentrations**

Regulated Parameters (mg/kg dry weight)	Class A Biosolids Limits (mg/kg)	29-Jan-09	25-Feb-09	25-Mar-09	21-Apr-09	25-May-09	30-Jun-09	30-Jul-09	19-Aug-09	30-Sep-09	29-Oct-09	25-Nov-09	15-Dec-09	Mean	Standard Deviation
Number of Replicates+		2	2	2	2	2	2	2	2	2	2	2	2		
<b>Metals</b>															
Arsenic	75	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	n/a	n/a
Cadmium	20	0.5	1.1	1.3	1.4	1.4	1.1	1.6	1.3	1.4	1.3	1.3	1.2	1.22	0.33
Chromium	1060*	11.7	11.2	11.3	11.6	10.7	8.8	10.6	8.4	9.7	10.7	11.2	11.1	10.55	1.1
Cobalt	150	<2	<2	2.0	2.1	<2	<2	2.4	2.1	2.1	2.2	2.3	2.5	1.7	0.6
Copper	2200*	793	829	809	852	762	598	695	578	544	546	605	685	691	114
Lead	500	27.0	27.8	24.3	40.7	42.9	45.7	60.2	47.9	72.5	69.0	65.4	52.7	48	16.4
Mercury	5	3.3	2.6	1.8	1.9	3.0	1.9	1.6	1.5	1.1	1.0	1.2	1.1	1.82	0.76
Molybdenum	20	4.9	5.1	4.8	5.1	5.3	4.5	4.3	7.3	4.6	4.2	3.6	3.9	4.8	0.94
Nickel	180	16.4	16.5	15.2	16.0	14.4	11.7	12.6	10.9	10.9	12.0	12.8	13.6	13.6	2.1
Selenium	<14	<4	<4	<5	<2	<4	<4	<5	<3	6	<7	<4	<5	n/a	n/a
Zinc	1850	304	317	285	317	322	274	323	320	362	372	409	412	335	44
<b>Unregulated Parameters (mg/kg dry weight)</b>	<b>Class A Biosolids Limits (mg/kg)</b>	<b>29-Jan-09</b>	<b>25-Feb-09</b>	<b>25-Mar-09</b>	<b>21-Apr-09</b>	<b>25-May-09</b>	<b>30-Jun-09</b>	<b>30-Jul-09</b>	<b>19-Aug-09</b>	<b>30-Sep-09</b>	<b>29-Oct-09</b>	<b>25-Nov-09</b>	<b>15-Dec-09</b>	<b>Mean</b>	<b>Standard Deviation</b>
<b>Conventionals</b>															
pH (pH units)	n/a	6.7	6.5	6.4	6.5	6.6	6.7	6.8	6.6	6.8	6.8	6.9	6.7	6.66	0.17
<b>Measurement</b>															
Moisture (%)	n/a	98.2	98.1	98.5	98.2	98.3	98.5	97.8	97.9	98.3	98.4	98.6	98.2	98.2	0.3
<b>Metals</b>															
Aluminum	n/a	3180	2960	2895	3090	2890	2490	2950	2515	3105	2975	3440	3575	3005	320
Antimony	n/a	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	n/a	n/a
Barium	n/a	135	122	135	138	119	120	120	94	151	143	132	153	130	16.4

continued

Table 2.5, continued

Unregulated Parameters (mg/kg dry weight)	Class A Biosolids Limits (mg/kg)	29-Jan-09	25-Feb-09	25-Mar-09	21-Apr-09	25-May-09	30-Jun-09	30-Jul-09	19-Aug-09	30-Sep-09	29-Oct-09	25-Nov-09	15-Dec-09	Mean	Standard Deviation
Beryllium	n/a	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	n/a	n/a
Bismuth	n/a	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	n/a	n/a
Calcium	n/a	11550	11750	11400	12200	11800	10165	11700	11550	11750	12200	12450	13650	11847	825
Iron	n/a	4235	4250	4140	4250	3885	3740	4015	3660	3650	3820	4245	4595	4040	299
Lithium	n/a	<2	<2	2.1	2.5	<2	<2	<2	<2	<2	<2	2.2	2.3	n/a	n/a
Magnesium	n/a	5215	5320	5245	5805	4805	4395	4640	4180	4490	4115	4600	4610	4785	511
Manganese	n/a	150	143	135	154	146	120	135	115	118	123	152	202	141	23
Phosphorus	n/a	22600	24750	22900	25750	21950	18150	19700	19750	20450	19000	17650	18050	20892	2666
Potassium	n/a	13800	13050	12950	14050	11850	10335	11200	9595	10600	11250	9460	10450	11549	1581
Silver	n/a	7	6	5	5	6	5	6	5	4	5	5	5	5.3	0.7
Sodium	n/a	3885	3570	3715	3975	5525	4120	4040	3785	4090	3660	3675	7150	4266	1026
Strontium	n/a	62.3	58.8	58.0	58.5	54.1	50.1	61.3	53.3	61.5	64.0	73.4	81.4	61.4	8.6
Thallium	n/a	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	n/a	n/a
Tin	n/a	22.8	23.5	22.1	23.8	22.4	20.7	24.3	22.2	25.4	26.7	25.5	26.9	23.8	2.1
Titanium	n/a	92.1	74.5	172.0	170.0	128.5	89.5	112.0	77.9	117.0	40.6	41.6	54.6	97.5	43.8
Vanadium	n/a	3.1	9.0	3.9	4.3	3.7	2.8	2.8	2.4	2.9	2.1	4.5	4.3	3.8	1.8

**Notes**

+ when the number of samples is greater than 1, the reported value represents the mean of field replicate samples

\* Class B limits were used for these substances as no limits included in Class A list

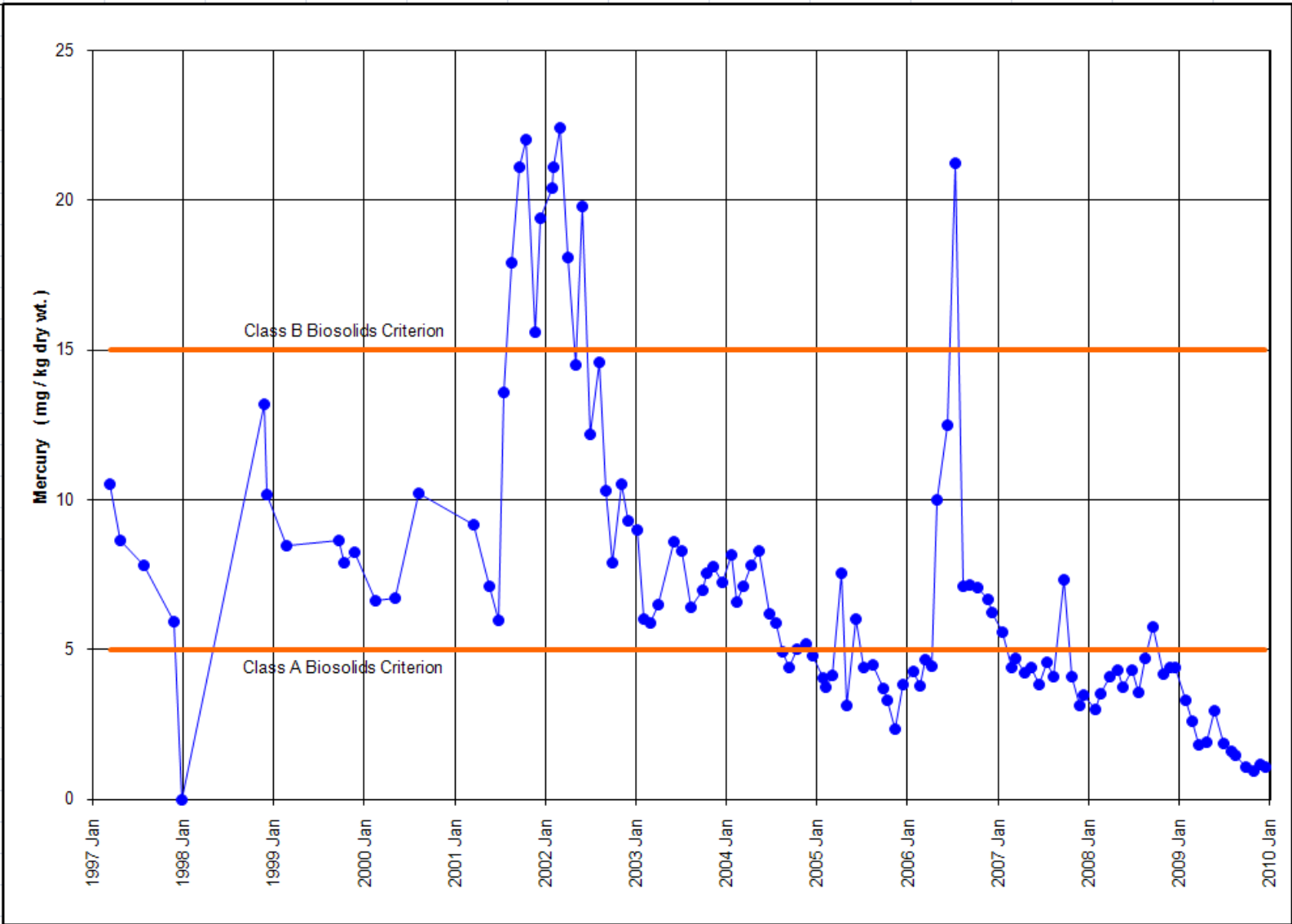


Figure 2.1 Ganges Harbour WWTP Sludge Mercury Levels (1998 to 2009)

## **2.4 Recommendations**

### **MAINTAIN EFFECTIVENESS AND RELIABILITY OF THE TREATMENT PROCESS**

Revised operating procedures may have eliminated the high ammonia concentrations which occurred from April to October 2009. However, this plant has shown previous occurrences of high ammonia concentrations, so ensuring consistent operation and proper maintenance is important to prevent reoccurrence.

### **MAINTAIN RELIABILITY OF THE DISINFECTION PROCESS**

Disinfection efficiency has improved over previous years. Disinfection efficiency was consistent for 2007 and 2008, but declined in 2009. Monthly cleaning and annual replacement of ultraviolet tubes, as well as required maintenance or repairs of membranes in the membrane bioreactor should continue in order to improve disinfection efficiency and avoid triggering costly receiving water monitoring.

### **COORDINATE EFFLUENT TOXICITY SAMPLING WITH COMPLIANCE AND TREATMENT PLANT PERFORMANCE SAMPLING**

Effluent toxicity sampling should coincide with either the priority substance sampling or the monthly compliance and treatment plant performance sampling. This will ensure that additional supporting data is available to help interpret the toxicity results and minimize sampling redundancy.

**Appendix 2.1 Ganges Harbour WWTP 2009 Flow Data (m<sup>3</sup>/day)**

JAN	FEB	MAR	Day	APR	MAY	JUN	Day	JUL	AUG	SEP	Day	OCT	NOV	DEC
635	396	401	01	444	494	389	01	469	545	456	01	436	441	472
547	408	422	02	486	458	425	02	434	555	538	02	453	396	456
530	454	445	03	482	457	431	03	483	501	479	03	428	451	437
449	458	484	04	445	382	403	04	499	492	474	04	387	436	457
467	403	461	05	400	442	442	05	526	564	489	05	365	407	459
575	457	462	06	408	442	455	06	437	523	482	06	422	492	413
573	443	453	07	485	438	483	07	474	533	468	07	459	538	370
587	389	429	08	414	457	411	08	493	558	435	08	421	590	414
667	393	392	09	447	441	449	09	489	542	536	09	426	474	426
518	455	445	10	402	431	460	10	505	498	806	10	420	532	382
506	461	458	11	430	391	443	11	476	529	545	11	374	538	450
491	498	425	12	391	457	476	12	464	570	499	12	347	419	395
516	487	512	13	402	441	465	13	425	508	457	13	335	473	376
513	457	468	14	447	430	454	14	460	551	397	14	417	483	348
433	418	432	15	427	501	394	15	507	552	428	15	425	415	396
502	399	432	16	457	512	485	16	473	559	436	16	425	425	498
479	452	510	17	431	521	458	17	515	495	433	17	484	756	571
441	442	497	18	465	492	414	18	530	522	445	18	496	791	565
423	386	441	19	430	454	469	19	488	508	439	19	386	593	465
442	406	475	20	388	462	455	20	497	518	486	20	389	786	426
461	420	478	21	430	406	429	21	487	519	388	21	420	737	555
428	396	430	22	453	462	408	22	466	555	417	22	419	505	520
447	391	390	23	400	463	441	23	494	496	425	23	445	659	467
457	503	457	24	418	438	435	24	514	487	428	24	479	537	449
413	514	465	25	444	405	490	25	504	520	446	25	387	548	429
384	525	417	26	427	436	488	26	518	510	451	26	403	629	298
431	486	404	27	395	476	483	27	521	511	451	27	470	583	345
442	444	396	28	481	449	470	28	531	505	409	28	452	507	375
599	---	390	29	561	485	421	29	516	507	459	29	480	454	398
453	---	365	30	473	488	453	30	511	448	466	30	523	424	429
457	---	444	31	---	438	---	31	541	457	---	31	486	---	420

**Appendix 2.2 Ganges Harbour WWTP 2009 Compliance and Treatment Plant Performance Monitoring Data**

Date	Influent			Secondary Effluent (Undisinfected)		Secondary Effluent (Disinfected)					
	TSS (mg/L)	TBOD (mg/L)	Fecal coliforms (cfu/100mL)	TSS (mg/L)	Fecal coliforms (cfu/100mL)	TSS (mg/L)	TBOD (mg/L)	CBOD (mg/L)	Fecal coliforms (cfu/100mL)	Ammonia (mg/L)	pH
2009 Jan 20	62	220	2900000	<1	418	<1	<4	<4	600	0.02	6.7
2009 Feb 17	296	334	5000000	<1	56	<1	<4	<4	<1	0.55	6.8
2009 Mar 17	242	283	5300000	<1	48	<1	<4	<4	<1	1.46	6.8
2009 Apr 21	258	272	6100000	<1	615	<1	<4	<4	61	16.00	7.1
2009 May 19	418	455	9100000	1	575	1	<4	<4	220	29.90	7.2
2009 Jun 16	456	469	14000000	<1	47	<1	<4	<4	93	16.70	7.1
2009 Jul 21	396	331	15000000	<1	31	<1	<4	<4	<1	25.20	7.2
2009 Aug 18	338	388	6500000	2	53	<1	---	---	19	---	7.1
2009 Sep 22	404	403	8000000	<1	35	<1	<4	<4	61	20.00	7.0
2009 Oct 20	296	351	6100000	<1	55	<1	<4	<4	<1	18.90	7.0
2009 Nov 17	292	292	5900000	<1	15	<1	<4	<4	<1	0.21	6.8
2009 Dec 15	290	284	9800000	1	29	<1	<4	<4	81	0.13	6.8
<b>Mean</b>	<b>312</b>	<b>340</b>	<b>7100743</b>	<b>1</b>	<b>165</b>	<b>&lt;1</b>	<b>&lt;4</b>	<b>&lt;4</b>	<b>14</b>	<b>11.7</b>	<b>7.0</b>
<b>Min</b>	<b>62</b>	<b>220</b>	<b>2900000</b>	<b>&lt;1</b>	<b>15</b>	<b>&lt;1</b>	<b>&lt;4</b>	<b>&lt;4</b>	<b>&lt;1</b>	<b>0.02</b>	<b>6.7</b>
<b>Max</b>	<b>456</b>	<b>469</b>	<b>15000000</b>	<b>2</b>	<b>615</b>	<b>1</b>	<b>&lt;4</b>	<b>&lt;4</b>	<b>600</b>	<b>29.9</b>	<b>7.2</b>
<b>N</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>11</b>	<b>11</b>	<b>12</b>	<b>11</b>	<b>12</b>
<b>Mean Daily Loading</b>	<b>kg/day</b>	<b>kg/day</b>		<b>kg/day</b>		<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>		<b>kg/day</b>	<b>kg/day</b>
	<b>145.5</b>	<b>158.5</b>		<b>0.6</b>		<b>0.5</b>	<b>1.9</b>	<b>1.9</b>		<b>5.5</b>	<b>---</b>
<b>Total Annual Loading</b>	<b>tonne/yr</b>	<b>tonne/yr</b>		<b>tonne/yr</b>		<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>
	<b>53.1</b>	<b>57.9</b>		<b>0.2</b>		<b>0.2</b>	<b>0.7</b>	<b>0.7</b>		<b>2.0</b>	<b>---</b>

**Appendix 2.3 Wastewater Priority Substances Analyzed in Ganges Harbour Influent and Effluent 2009**

Parameter	State Code	Unit	Minimum Detection Limit	2009 Jul 15			
				Influent		Disinfected Secondary Effluent	
4-methyl-2-pentanone	Total	mg/L	0.01	<	0.01	<	0.01
1,1,1,2-tetrachloroethane	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
1,1,1-trichloroethane	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
1,1,2,2-tetrachloroethane	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
1,1,2-trichloroethane	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
1,1-dichloroethane	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
1,1-dichloroethene	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
1,2,4-trichlorobenzene	Total	mg/L	0.000 2	<	0.000 2	<	0.000 2
1,2-dichlorobenzene	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
1,2-dichloroethane	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
1,2-dichloropropane	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
1,2-diphenylhydrazine	Total	mg/L	0.000 05	<	0.000 05	<	0.000 05
1,3-dichlorobenzene	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
1,4-dichlorobenzene	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
2,4 + 2,5 Dichlorophenol	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
2,4,6-Tribromophenol	Total	%	1.	---	56.	---	102.
2,4,6-trichlorophenol	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
2,4-DDD	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
2,4-DDE	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
2,4-DDT	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
2,4-dinitrophenol	Total	mg/L	0.007	<	0.007	<	0.007
2,4-dinitrotoluene	Total	mg/L	0.000 3	<	0.000 3	<	0.000 3
2,6-dinitrotoluene	Total	mg/L	0.000 3	<	0.000 3	<	0.000 3
2-chloronaphthalene	Total	mg/L	0.000 3	<	0.000 3	<	0.000 3
2-chlorophenol	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
2-Fluorobiphenyl	Total	%	1.	---	85.	---	87.
2-methyl-4,6-dinitrophenol	Total	mg/L	0.003	<	0.003	<	0.003
2-methylnaphthalene	Total	mg/L	0.000 01	---	0.000 01	---	0.000 02
3,3-dichlorobenzidine	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
4,4-DDD	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
4,4-DDE	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
4,4-DDT	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
4-bromophenyl phenyl ether	Total	mg/L	0.000 05	<	0.000 05	<	0.000 05
4-chloro-3-methylphenol	Total	mg/L	0.001	<	0.001	<	0.001
4-chlorophenyl phenyl ether	Total	mg/L	0.000 3	<	0.000 3	<	0.000 3
acenaphthene	Total	mg/L	0.000 01	<	0.000 01	---	0.000 02
acenaphthylene	Total	mg/L	0.000 01	<	0.000 01	<	0.000 01
acrolein	Total	mg/L	0.003	<	0.006	<	0.003
acrylonitrile	Total	mg/L	0.004	<	0.004	<	0.004

continued

Appendix 2.3, continued

Parameter	State Code	Unit	Minimum Detection Limit	2009 Jul 15			
				Influent		Disinfected Secondary Effluent	
aldrin	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
Alkalinity - total - pH 4.5	Total	mg/L	1.	---	166.	---	136.
ALPHA CHLORDANE	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
alpha-endosulfan	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
alpha-HCH or alpha-BHC	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
alpha-terpineol	Total	mg/L	0.005	---	0.009	<	0.005
aluminum	Dissolved	mg/L	0.000 2	---	0.096 8	---	0.117
aluminum	Total	mg/L	0.000 2	---	0.908	---	0.116
anthracene	Total	mg/L	0.000 01	<	0.000 01	<	0.000 01
antimony	Dissolved	mg/L	0.000 02	---	0.000 2	---	0.000 15
antimony	Total	mg/L	0.000 02	---	0.000 17	---	0.000 14
arsenic	Dissolved	mg/L	0.000 02	---	0.000 57	---	0.000 31
arsenic	Total	mg/L	0.000 02	---	0.000 61	---	0.000 32
barium	Dissolved	mg/L	0.000 02	---	0.005 94	---	0.006 79
barium	Total	mg/L	0.000 02	---	0.028 4	---	0.006 83
benzene	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
benzidine	Total	mg/L	0.05	<	0.05	<	0.05
benzo(a)anthracene	Total	mg/L	0.000 01	<	0.000 01	<	0.000 01
benzo(a)pyrene	Total	mg/L	0.000 01	<	0.000 01	<	0.000 01
benzo(g,h,i)perylene	Total	mg/L	0.000 02	<	0.000 02	<	0.000 02
benzo(k)fluoranthene	Total	mg/L	0.000 01	<	0.000 01	<	0.000 01
beryllium	Dissolved	mg/L	0.000 01	<	0.000 01	<	0.000 01
beryllium	Total	mg/L	0.000 01	---	0.000 01	<	0.000 01
beta-endosulfan	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
beta-HCH or beta-BHC	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
bis(2-chloroethoxy)methane	Total	mg/L	0.000 3	<	0.000 3	<	0.000 3
bis(2-chloroethyl)ether	Total	mg/L	0.000 3	<	0.000 3	<	0.000 3
bis(2-chloroisopropyl)ether	Total	mg/L	0.000 3	<	0.000 3	<	0.000 3
bis(2-ethylhexyl)phthalate	Total	mg/L	0.005	---	0.011	<	0.005
BOD	Total	mg/L O2	5.	---	336.	<	4.
bromodichloromethane	Total	mg/L	0.001	<	0.002	<	0.001
Bromofluorobenzene	Total	%	1.	---	99.	---	100.
bromomethane	Total	mg/L	0.001	<	0.001	<	0.001
butylbenzyl phthalate	Total	mg/L	0.003	<	0.003	<	0.003
cadmium	Dissolved	mg/L	0.000 005	---	0.000 063	---	0.000 036
cadmium	Total	mg/L	0.000 005	---	0.000 215	---	0.000 044
calcium	Dissolved	mg/L	0.05	---	10.9	---	12.5
calcium	Total	mg/L	0.05	---	15.1	---	12.3
CBOD	Total	mg/L O2	5.	---	283.	<	4.
chloride	Total	mg/L	1.	---	76.	---	56.
chlorobenzene	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
chlorodibromomethane	Total	mg/L	0.001	<	0.001	<	0.001

continued

Appendix 2.3, continued

Parameter	State Code	Unit	Minimum Detection Limit	2009 Jul 15			
				Influent		Disinfected Secondary Effluent	
chloroethane	Total	mg/L	0.001	<	0.001	<	0.001
chloroethene	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
chloromethane	Total	mg/L	0.001	<	0.001	<	0.001
chromium	Dissolved	mg/L	0.000 1	---	0.000 5	---	0.000 3
chromium	Total	mg/L	0.000 1	---	0.000 8	---	0.000 3
chromium VI	Total	mg/L	0.001	<	0.001	<	0.001
chrysene	Total	mg/L	0.000 01	<	0.000 01	<	0.000 01
cis-1,2-dichloroethene	Total	mg/L	0.001	<	0.001	<	0.001
cis-1,3-dichloropropene	Total	mg/L	0.001	<	0.001	<	0.001
cobalt	Dissolved	mg/L	0.000 005	---	0.000 39	---	0.000 169
cobalt	Total	mg/L	0.000 005	---	0.003 08	---	0.000 176
COD	Total	mg/L O2	1.	---	650.	---	21.
conductivity	Total	µS/cm	1.	---	584.	---	512.
copper	Dissolved	mg/L	0.000 05	---	0.061 9	---	0.007 67
copper	Total	mg/L	0.000 05	---	0.116	---	0.008 16
d14-Terphenyl	Total	%	1.	---	73.	---	86.
d4-1,2-dichloroethane	Total	%	1.	---	99.	---	95.
d5-Nitrobenzene	Total	%	1.	---	75.	---	79.
d5-Phenol	Total	%	1.	---	33.	---	31.
d8-Toluene	Total	%	1.	---	98.	---	101.
Decachloro Biphenyls	Total	%	1.	---	68.	---	87.
delta-HCH or delta-BHC	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
dibenzo(a,h)anthracene	Total	mg/L	0.000 02	<	0.000 02	<	0.000 02
Dibromoethane	Total	mg/L	0.000 2	<	0.000 2	<	0.000 2
dibromomethane	Total	mg/L	0.000 9	<	0.000 9	<	0.000 9
dichloromethane	Total	mg/L	0.002	<	0.002	<	0.002
dieldrin	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
diethyl phthalate	Total	mg/L	0.000 3	---	0.002 4	---	0.000 5
dimethyl ketone	Total	mg/L	0.02	---	0.079	<	0.02
dimethyl phthalate	Total	mg/L	0.000 3	<	0.000 3	<	0.000 3
di-n-butyl phthalate	Total	mg/L	0.003	<	0.003	<	0.003
di-n-octyl phthalate	Total	mg/L	0.000 3	<	0.000 6	<	0.000 3
endosulfan sulfate	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
endrin	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
endrin aldehyde	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
endrin ketone	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
ethylbenzene	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
fecal coliform	Total	CFU/100 ml	1.	---	9 000 000.	---	7.
fluoranthene	Total	mg/L	0.000 01	---	0.000 01	<	0.000 01
fluorene	Total	mg/L	0.000 01	<	0.000 01	---	0.000 01
GAMMA CHLORDANE	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
hardness (as CaCO3)	Total	mg/L	0.5	---	44.2	---	46.4

continued

Appendix 2.3, continued

Parameter	State Code	Unit	Minimum Detection Limit	2009 Jul 15			
				Influent		Disinfected Secondary Effluent	
HCB (Synonym, use 153)	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
heptachlor	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
heptachlor epoxide	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
hexachlorobutadiene	Total	mg/L	0.000 009	<	0.000 3	<	0.000 3
hexachlorocyclopentadiene	Total	mg/L	0.000 02	<	0.000 3	<	0.000 02
hexachloroethane	Total	mg/L	0.000 01	<	0.000 3	<	0.000 3
indeno(1,2,3-c,d)pyrene	Total	mg/L	0.000 02	<	0.000 02	<	0.000 02
iron	Dissolved	mg/L	0.001	---	0.415	---	0.09
iron	Total	mg/L	0.001	---	0.714	---	0.095
isophorone	Total	mg/L	0.000 3	<	0.000 3	<	0.000 3
lead	Dissolved	mg/L	0.000 005	---	0.001 33	---	0.001 14
lead	Total	mg/L	0.000 005	---	0.007 32	---	0.001 16
lindane or gamma HCH or gamma BHC	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
m & p xylenes	Total	mg/L	0.001	<	0.001	<	0.001
magnesium	Dissolved	mg/L	0.05	---	4.15	---	3.68
magnesium	Total	mg/L	0.05	---	4.58	---	3.67
manganese	Dissolved	mg/L	0.000 05	---	0.037 2	---	0.031 6
manganese	Total	mg/L	0.000 05	---	0.058 7	---	0.033
mercury	Dissolved	mg/L	0.000 01	---	0.000 04	<	0.000 01
mercury	Total	mg/L	0.000 01	---	0.000 05	<	0.000 01
methoxychlor	Total	mg/L	0.000 01	<	0.000 1	<	0.000 01
methyl ethyl ketone	Total	mg/L	0.01	<	0.01	<	0.01
methyl tertiary butyl ether	Total	mg/L	0.004	<	0.004	<	0.004
mirex	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
molybdenum	Dissolved	mg/L	0.000 05	---	0.000 31	---	0.000 08
molybdenum	Total	mg/L	0.000 05	---	0.000 29	---	0.000 07
N - NH3	Total	mg/L	0.003	---	30.2	---	17.2
N - NO2	Total	mg/L	0.003	---	0.006	---	0.008
N - NO3	Total	mg/L	0.003	---	0.381	---	0.072
N - TKN	Total	mg/L	0.003	---	55.8	---	17.2
naphthalene	Total	mg/L	0.000 01	---	0.000 04	---	0.000 06
nickel	Dissolved	mg/L	0.000 02	---	0.003 12	---	0.001 86
nickel	Total	mg/L	0.000 02	---	0.003 99	---	0.001 93
nitrobenzene	Total	mg/L	0.000 3	<	0.000 3	<	0.000 3
N-nitrosodimethylamine	Total	mg/L	0.001	<	0.001	<	0.001
N-nitrosodi-n-propylamine	Total	mg/L	0.001	<	0.001	<	0.001
N-nitrosodiphenylamine	Total	mg/L	0.001	<	0.001	<	0.001
octachlorostyrene	Total	mg/L	0.000 005	<	0.000 05	<	0.000 005
Oil & grease, mineral	Total	mg/L	2.	---	7.	---	6.
Oil & grease, total	Total	mg/L	1.	---	30.	---	5.
o-xylene	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5

continued

Appendix 2.3, continued

Parameter	State Code	Unit	Minimum Detection Limit	2009 Jul 15			
				Influent		Disinfected Secondary Effluent	
PCB Aroclor 1016	Total	mg/L	0.000 05	<	0.000 5	<	0.000 05
PCB Aroclor 1221	Total	mg/L	0.000 1	<	0.001	<	0.000 1
PCB Aroclor 1232	Total	mg/L	0.000 05	<	0.000 5	<	0.000 05
PCB Aroclor 1242	Total	mg/L	0.000 05	<	0.000 5	<	0.000 05
PCB Aroclor 1248	Total	mg/L	0.000 05	<	0.000 5	<	0.000 05
PCB Aroclor 1254	Total	mg/L	0.000 05	<	0.000 5	<	0.000 05
PCB Aroclor 1260	Total	mg/L	0.000 05	<	0.000 5	<	0.000 05
PCP	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
pH	Total	pH	0.1	---	7.	---	7.5
phenanthrene	Total	mg/L	0.000 01	---	0.000 02	---	0.000 02
phenol	Total	mg/L	0.003	---	0.008	<	0.003
phosphorus	Dissolved	mg/L	0.002	---	4.93	---	2.91
phosphorus	Total	mg/L	0.002	---	6.16	---	2.87
potassium	Dissolved	mg/L	0.05	---	15.6	---	14.4
potassium	Total	mg/L	0.05	---	15.7	---	14.4
pyrene	Total	mg/L	0.000 01	---	0.000 02	---	0.000 01
SAD cyanide	Total	mg/L	0.000 5	---	0.004 4	---	0.002
selenium	Dissolved	mg/L	0.000 04	---	0.000 31	---	0.000 09
selenium	Total	mg/L	0.000 04	---	0.000 31	---	0.000 08
silver	Dissolved	mg/L	0.000 005	---	0.000 256	---	0.000 041
silver	Total	mg/L	0.000 005	---	0.000 264	---	0.000 039
styrene	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
sulfide	Total	mg/L	0.05	---	0.15	---	0.06
sulphate	Dissolved	mg/L	0.5	---	16.	---	16.2
sulphate	Total	mg/L	0.5	---	18.	---	16.
temperature	Total	°C	0.1	---	22.	---	22.
tetrabromomethane	Total	mg/L	0.05	<	0.05	<	0.05
tetrachloroethene	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
tetrachloromethane	Total	mg/L	0.003	<	0.003	<	0.003
thallium	Dissolved	mg/L	0.000 002	<	0.000 002	<	0.000 002
thallium	Total	mg/L	0.000 002	---	0.000 008	<	0.000 002
tin	Dissolved	mg/L	0.000 01	---	0.001 56	---	0.000 77
tin	Total	mg/L	0.000 01	---	0.001 78	---	0.000 74
TOC	Total	mg/L	5.	---	76.	---	88.
toluene	Total	mg/L	0.000 5	---	0.003 9	<	0.000 5
Total HMW-PAH's	Total	mg/L	0.000 02	---	0.000 03	<	0.000 02
Total LMW-PAH's	Total	mg/L	0.000 05	---	0.000 07	---	0.000 14
total PAHs	Total	mg/L	0.000 05	---	0.000 11	---	0.000 15
Total Pentachloro Biphenyls	Total	mg/L	0.000 1	<	0.001	<	0.000 1
total phenols	Total	mg/L	0.001	---	0.04	---	0.003

continued

Appendix 2.3, continued

Parameter	State Code	Unit	Minimum Detection Limit	2009 Jul 15			
				Influent		Disinfected Secondary Effluent	
toxaphene	Total	mg/L	0.000 2	<	0.002	<	0.000 2
trans-1,2-dichloroethene	Total	mg/L	0.001	<	0.001	<	0.001
trans-1,3-dichloropropene	Total	mg/L	0.001	<	0.001	<	0.001
tribromomethane	Total	mg/L	0.001	<	0.001	<	0.001
trichloroethene	Total	mg/L	0.000 5	<	0.000 5	<	0.000 5
trichlorofluoromethane	Total	mg/L	0.004	<	0.004	<	0.004
trichloromethane	Total	mg/L	0.001	---	0.014	---	0.002
TSS	Total	mg/L	1.	---	374.	<	1.
WAD cyanide	Total	mg/L	0.000 5	---	0.002	---	0.001 9
xylenes	Total	mg/L	0.001	<	0.001	<	0.001
zinc	Dissolved	mg/L	0.000 1	---	0.062 7	---	0.052 5
zinc	Total	mg/L	0.000 1	---	0.153	---	0.053 7

### 3.0 MALIVIEW ESTATES

#### 3.1 Introduction

The Maliview Estates wastewater treatment plant (WWTP) is located on the east side of Salt Spring Island (Figure 1.1). It discharges treated effluent into Trincomali Channel through a 213 metre long outfall at a depth of 14 metres below sea level. The original primary treatment plant was upgraded to a secondary treatment facility in July 2006.

The facility is registered under BC MSR Registration RE-00242, as amended in June 2007.

Flows up to 60 m<sup>3</sup> receive secondary treatment using a rotating biological contactor (RBC) and flows greater than 60 m<sup>3</sup> (greater than twice the average daily dry weather flow) receive preliminary treatment using fine screens. Both effluent streams are combined before discharge. Blending effluent streams is an option available under the MSR to deal with high effluent flows. Compliance requirements are as follows:

Maximum Daily Flow	250 m <sup>3</sup> /d	
	<b>Flows up to 60 m<sup>3</sup>/d</b>	<b>Flows over 60 m<sup>3</sup>/d</b>
Maximum BOD	45 mg/L (CBOD)	130 mg/L (TBOD)
Maximum TSS	45 mg/L	130 mg/L

This section reports the results from the Maliview Estates treatment plant WMEP described in Table 3.1.

**Table 3.1 Maliview Estates Treatment Plant WMEP**

Component	Parameter	Frequency and Stations
Wastewater	Flow	Daily
	Compliance and treatment plant performance monitoring <sup>1</sup> : <ul style="list-style-type: none"> <li>Influent: TSS, TBOD</li> <li>Effluent: TSS, TBOD, CBOD, fecal coliforms</li> </ul>	Four times per year
Surface Water	Indicator bacteria (fecal coliforms)	Two times per year 7 shoreline stations Required in 2009 <sup>1</sup>

<sup>1</sup> Subject to trigger conditions. Surface water fecal coliform monitoring will also be required in 2010 and 2011.

#### 3.2 Methods

##### 3.2.1 Wastewater Monitoring

##### **COMPLIANCE AND TREATMENT PLANT PERFORMANCE MONITORING**

Influent and effluent samples were collected as grab samples.

Laboratory analyses were conducted at either the Saanich Peninsula Wastewater Treatment Plant (SPWWTP) Laboratory or Cantest (Victoria, BC). TSS was determined gravimetrically using glass fibre filters dried at 105°C (APHA, 1998). TBOD was determined by five-day oxygen depletion at 20°C using an oxygen meter (APHA, 1998). CBOD was determined by five-day oxygen depletion at 20°C with TCMP (2-chloro-6-(trichloro methyl) pyridine) as a nitrification inhibitor and using an oxygen meter (APHA, 1998). Fecal coliforms were enumerated using 0.45 µm membrane filters incubated on mFC medium at 44.5°C for 24 hours (APHA, 1998).

Means reported for fecal coliforms are geometric (logarithmic) means. Means for all other parameters are arithmetic. Mean daily loadings were calculated from mean concentrations and mean daily flows. Annual loadings were calculated from mean concentrations and total annual flows.

### **3.2.2 Receiving Water Monitoring**

#### **SHORELINE SURFACE WATER FECAL COLIFORMS**

In 2008 a shoreline fecal coliform program replaced the offshore surface fecal coliform sampling that ran from 2005 to 2007.

The registration for this facility includes trigger conditions which influence the decision to implement or suspend shoreline surface water fecal coliform monitoring. The trigger conditions are as follows.

Shoreline fecal coliform monitoring may be discontinued if, during two consecutive calendar years:

- (A) all results from the two consecutive calendar years are below 200 CFU/100mL; and
- (B) the maximum daily flow does not exceed the registered maximum of 250 m<sup>3</sup>/d two or more times per calendar year.

Shoreline fecal coliform monitoring will be reinstated if:

- (C) the treatment plant changes to a different process; or
- (D) the maximum daily flow exceeds the registered maximum of 250 m<sup>3</sup>/d two or more times per calendar year.

Fecal coliform samples were collected at seven shoreline stations, twice in 2009. One station was located where the outfall crosses the shoreline. The remaining six stations were located 100, 200 and 400 meters northwest and 100, 200 and 400 meters southeast of the outfall. Samples were collected in sterile, wide-mouth bottles by rapidly submerging open, upright bottles to 0.3 metre depth where the water column was approximately 0.5 to 1.0m deep. Sampling frequency was twice per year (summer and winter) in coordination with the effluent sampling. Attempts were made to ensure that the winter period sampling occurred during a typical fine-screened effluent discharge event.

Fecal coliforms were enumerated using 0.45 µm membrane filters incubated on mFC medium at 44.5°C for 24 hours (APHA 1998).

Results were compared to the value specified in the BCWQG for primary contact, as a means to assess potential human health risks (BC MOE, 2007b). This guideline includes one component: the geometric mean of five samples taken within 30 days must not exceed 200 CFU/100mL. This guideline applies to primary contact recreational waters, such as beaches, where most human activities take place. The number of samples collected for the Maliview Estates surface fecal coliform monitoring program, as well as the timeframe for their collection, was developed in collaboration with the BC MOE. However, the twice yearly surface water samples do not allow for a direct comparison to this guideline as defined, which requires collecting five weekly samples in 30 days. As such, the 200 CFU/100mL value acts only as a benchmark to assess potential human health risks related to primary contact.

### **3.3 Results**

This section reports the results from the Maliview Estates treatment plant WMEP described in Table 3.1.

#### **3.3.1 Wastewater Monitoring**

##### **COMPLIANCE AND TREATMENT PLANT PERFORMANCE MONITORING**

Flow data for the entire facility are summarized in Table 3.2 (effluent) and Table 3.3 (influent) and the complete data set is presented in Appendix 3.1. In 2009 total effluent flows discharged from the Maliview Estates treatment plant did not exceed the allowable maximum of 250 m<sup>3</sup>/d on any of the days sampled.

**Table 3.2 Maliview Estates WWTP 2009 Effluent Flow Annual Summary**

Month	Secondary Effluent		Fine Screened Effluent			Total Plant Flow	
	Total Flow ( m <sup>3</sup> )	Exceeded Regulatory Maximum	Total Flow ( m <sup>3</sup> )	Preceded Regulatory Threshold	Exceeded Regulatory Maximum	Total Flow ( m <sup>3</sup> )	Exceeded Regulatory Maximum
January	1 574	13%	948	84%	0%	2 522	0%
February	1 280	39%	906	61%	0%	2 186	0%
March	1 738	6%	1 107	87%	0%	2 845	0%
April	1 486	3%	693	97%	0%	2 179	0%
May	1 389	0%	437	100%	0%	1 826	0%
June	1 095	0%	182	100%	0%	1 277	0%
July	983	0%	108	100%	0%	1 091	0%
August	968	0%	96	68%	0%	1 064	0%
September	1 067	0%	25	70%	0%	1 092	0%
October	1 366	26%	145	35%	0%	1 511	0%
November	3 102	100%	407	0%	0%	3 509	0%
December	2 018	84%	798	16%	0%	2 816	0%
<b>Annual</b>	<b>18 065</b>	<b>22%</b>	<b>5 850</b>	<b>68%</b>	<b>0%</b>	<b>23 915</b>	<b>0%</b>

**Table 3.3 Maliview Estates WWTP 2009 Influent Flow Summary**

Month	Mean Flow (m3/d)	Minimum Flow (m3/d)	Maximum Flow (m3/d)	Total Flow (m3)	Number of Samples	Permit violations (#)	Permit violations (%)
January	81	21	156	2522	31	0	0%
February	78	65	105	2186	28	0	0%
March	92	66	142	2845	31	0	0%
April	73	45	114	2179	30	0	0%
May	59	44	81	1826	31	0	0%
June	43	36	49	1277	30	0	0%
July	35	13	43	1091	31	0	0%
August	34	21	46	1064	31	0	0%
September	36	24	49	1092	30	0	0%
October	49	0	111	1511	31	0	0%
November	117	78	220	3509	30	0	0%
December	91	61	170	2816	31	0	0%
<b>Annual</b>	<b>66</b>	<b>0</b>	<b>220</b>	<b>23 915</b>	<b>365</b>	<b>0</b>	<b>0%</b>

A new flow meter was installed in July 2005 at the same time as the new RBC treatment plant works. The flows recorded by the new flow meter are significantly higher than previously recorded with the old flow meter. Therefore, comparison between 2009 flow data and data prior to July 2005 is not feasible. Short term trends indicate that flow has decreased an average of 7% per year since 2006.

Flow data for effluent discharged from the secondary treatment unit are summarized in Table 3.4 and the complete data set is presented in Appendix 3.2. Flow exceeded the allowable maximum of 60 m<sup>3</sup>/d on 22% of the days sampled.

**Table 3.4 Maliview Estates WWTP 2009 Secondary Effluent Flow Annual Summary**

Month	Mean Flow (m <sup>3</sup> /d)	Minimum Flow (m <sup>3</sup> /d)	Maximum Flow (m <sup>3</sup> /d)	Total Flow (m <sup>3</sup> )	Number of Samples	Permit violations (number)	Permit violations (percent)
January	51	16	98	1574	31	4	13%
February	46	0	75	1280	28	11	39%
March	56	43	61	1738	31	2	6%
April	50	35	62	1486	30	1	3%
May	45	40	50	1389	31	0	0%
June	37	26	45	1095	30	0	0%
July	32	12	38	983	31	0	0%
August	31	11	45	968	31	0	0%
September	36	24	48	1067	30	0	0%
October	44	0	101	1366	31	8	26%
November	103	73	172	3102	30	30	100%
December	65	52	87	2018	31	26	84%
<b>Annual</b>	<b>49</b>	<b>28</b>	<b>73</b>	<b>18 065</b>	<b>365</b>	<b>82</b>	<b>22%</b>

Flow data for effluent discharged from the fine screens (bypassing the secondary treatment unit) are summarized in Table 3.5 and the complete data set is presented in Appendix 3.3. Flow did not exceed the allowable maximum of 190 m<sup>3</sup>/d on any day during 2009. However, bypass events occurred when daily flow through the secondary treatment unit was less than the allowable threshold of 60 m<sup>3</sup>/d on 68% of the days sampled (Table 3.2).

The Maliview WWTP was not designed to treat the volume of effluent that it receives. In addition, there is a discrepancy between the flow splitting process, which responds to instantaneous peak flows, and the regulatory requirement, which specifies daily flows. As a result of these issues, frequent bypass events occur when the RBC unit is not operating at full capacity. The operating staff at this facility continually attempts to upgrade the splitting process while working within the budgetary and physical constraints imposed at this facility.

**Table 3.5 Maliview Estates WWTP 2009 Fine Screened Effluent Flow Annual Summary**

Month	Mean Flow (m <sup>3</sup> /d)	Minimum Flow (m <sup>3</sup> /d)	Maximum Flow (m <sup>3</sup> /d)	Total Flow (m <sup>3</sup> )	Number of Samples	Permit violations (#)	Permit violations (%)
January	31	0	102	948	31	0	0%
February	32	13	83	906	28	0	0%
March	36	21	82	1107	31	0	0%
April	23	6	58	693	30	0	0%
May	14	4	32	437	31	0	0%
June	6	3	10	182	30	0	0%
July	3	1	8	108	31	0	0%
August	3	0	13	96	31	0	0%
September	1	0	7	25	30	0	0%
October	5	0	24	145	31	0	0%
November	14	0	50	407	30	0	0%
December	26	0	99	798	31	0	0%
<b>Annual</b>	<b>16</b>	<b>4</b>	<b>47</b>	<b>5 850</b>	<b>365</b>	<b>0</b>	<b>0%</b>

Compliance and treatment plant performance monitoring data are summarized in Table 3.6 and the complete data set is presented in Appendix 3.4. Effluent discharged from the secondary treatment unit exceeded registration requirements for TSS in 8% of the samples; it did not exceed the registration requirements for CBOD in any of the samples. The secondary treatment unit removed 91% of the TSS, 87% of the TBOD and 93% of the fecal coliforms it received, which exceeds the 80% reduction that is expected from similar secondary treatment plants.

Effluent discharged from the fine screen unit exceeded regulatory requirements for TSS and TBOD in 33% and 100% of samples, respectively. The screens removed 66% of the TSS, 48% of the TBOD and 0% of the fecal coliforms, which is an improvement from 2008 (0% reduction for all parameters). Fecal coliform levels in the effluent were higher in the fine screened effluent than in the influent, indicating bacterial propagation prior to discharge. The fine screens are a form of preliminary treatment and are not expected to substantially reduce these parameters, although they should provide significant reduction of settleable solids, gross floatable solids and visual effects of the discharge in the receiving waters.

Since the final effluent at this facility is not directly accessible for sampling, final effluent quality was calculated by summing both secondary and fine-screened effluent results for each parameter. Overall, the final effluent from this facility removed 86% of the TSS, 79% of the TBOD and 87% of the fecal coliforms. These results indicate that lower levels of both TBOD and TSS are discharged relative to the influent.

An increase in sampling frequency was planned for 2009 in order to better evaluate plant performance and provide more consistent sample results and smooth out natural data variability for this facility. However, only three samples were collected during the first quarter of the year due to the difficulty in determining when bypass events are occurring. The three samples were collected during wet, winter months when bypass events frequently occur.

**Table 3.6 Maliview Estates WWTP 2009 Compliance Annual Summary**

Source	Compliance Monitoring				Treatment Plant Performance Monitoring		
	Flow (m3/d)	TSS (mg/l)	CBOD (mg/L)	Fecal Coliforms (CFU/100mL)	TBOD (mg/L)	Ammonia (mgN/L)	pH
<b>Influent</b>							
Regulatory Limit	250	---	---	---	---	---	---
Mean	66	322	---	2 875 115	317	---	---
Minimum	0	33	---	500 000	61	---	---
Maximum	220	1158	---	18 000 000	848	---	---
Permit violations	0%	---	---	---	---	---	---
Number of Samples	365	12.					
<b>Secondary Effluent</b>							
Regulatory Limit	60	45	45	---	---	---	---
Mean	49	29	23	202 181	42	25.72	7.2
Minimum	28	14	12	33 000	17	8.86	7.0
Maximum	73	77	39	1 300 000	87	37.90	7.3
Percent Reduction	---	91%	---	93%	87%	---	---
Permit violations	22%	8%	0%	---	---	---	---
Number of Samples	365.	12	12	12	11	12.	12.
<b>Fine Screened Effluent</b>							
Regulatory Limit	190	130	---	---	130	---	---
Mean	16	110	121	5 012 900	165	35.53	7.9
Minimum	4	90	112	1 900 000	132	29.90	7.7
Maximum	47	148	126	13 000 000	182	44.90	8.0
Percent Reduction	---	66%	---	0%	48%	---	---
Permit violations	0%	33%	0%	---	100%	---	---
Number of Samples	365	3	3	3	3	3	3
<b>Discharged Effluent</b>							
Mean	66	45	43	384 246	68	27.7	7.3
Percent Reduction	---	86%	---	87%	79%	---	---

### 3.3.2 Receiving Water Monitoring

#### **SHORELINE SURFACE WATER FECAL COLIFORMS**

Receiving environment monitoring for shoreline surface water fecal coliforms was initiated in 2008 as a replacement for the more extensive offshore surface fecal coliform sampling program that occurred from 2005 to 2007. This program is subject to trigger conditions as described in section 3.2.2.

Shoreline surface water fecal coliform data are summarized in Table 3.7 and Figure 3.1. Seven shoreline surface water stations were sampled for fecal coliforms in the winter and summer of 2009. Results were compared to the value used in the BC primary contact recreational guideline (BC MOE 2007b).

**Table 3.7 Maliview Estates WWTP 2009 Shoreline Fecal Coliforms Summary**

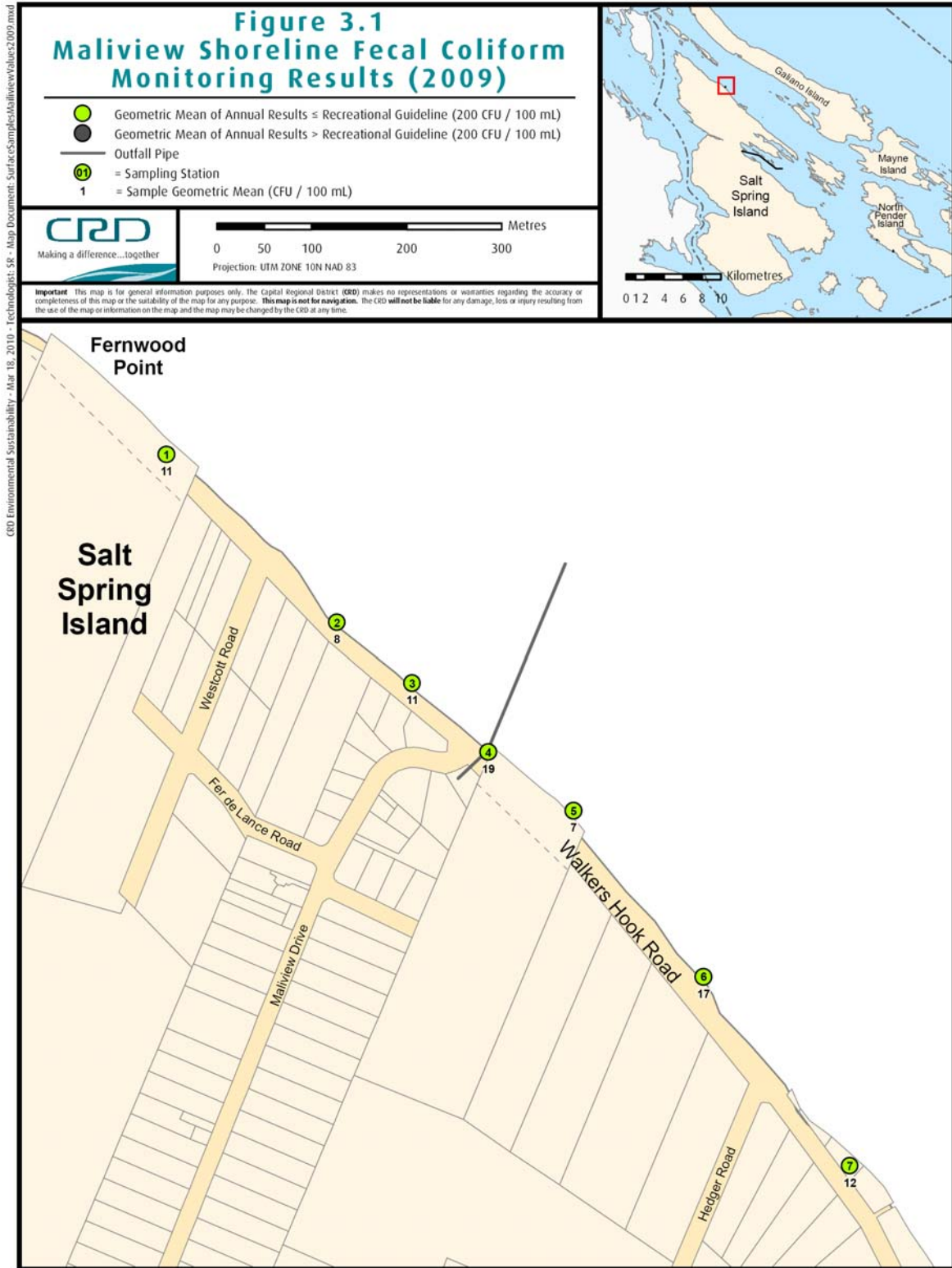
Station	Fecal Coliforms (CFU/100mL)		
	Geometric Mean	20/01/2009	21/07/2009
Mal-01	11	7	17
Mal-02	8	9	7
Mal-03	11	8	16
Mal-04	19	19	20
Mal-05	7	10	5
Mal-06	17	14	20
Mal-07	12	---	12

Of the six samples analyzed in January, the maximum fecal coliform value was 19 CFU/100mL. In July seven samples were analyzed; the maximum fecal coliform value was 20 CFU/100mL. All 13 samples in 2009 had a geometric mean less than 200 CFU/100mL (maximum geometric mean was 19 CFU/100mL).

#### **SHORELINE TIME SERIES ANALYSIS**

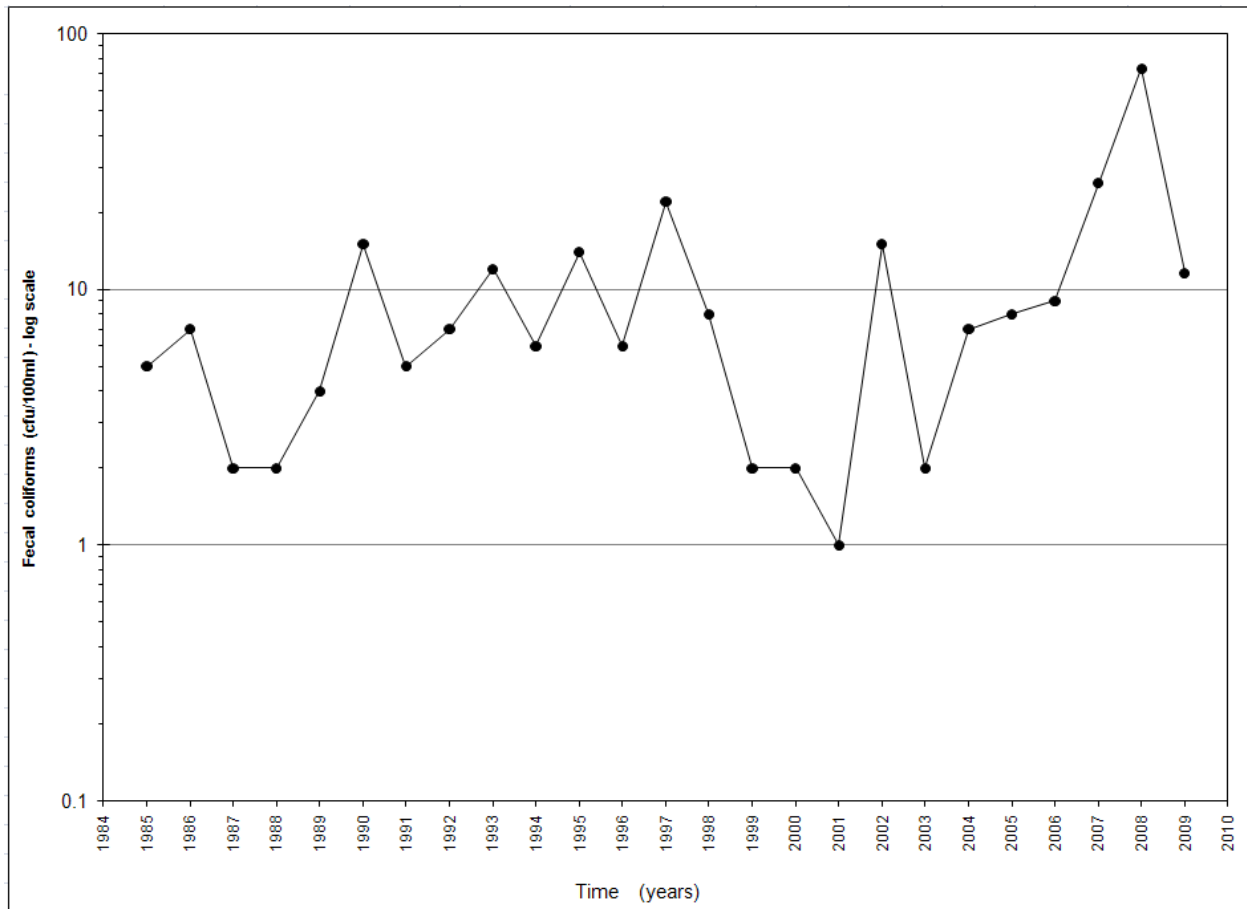
Data published in previous annual reports (Olmstead and Warman 1989 and 1990; Pym 1991 to 2006, CRD 2007 to 2008) were examined to determine long-term trends in receiving water quality near the shoreline adjacent to the Maliview Estates outfall. Figure 3.2 displays annual geometric mean fecal coliform values (on a log scale) from 1985 to 2008 for grouped stations near the shoreline and within 100 metres of where the outfall crosses the shoreline (shoreline stations Mal-S-01, Mal-S-02 and Mal-S-03 from 1985 to 2005, surface water stations Mal-06 and Mal-13 from 2006 to 2007 and shoreline stations Mal-03, Mal-04 and Mal-05 from 2008 and 2009). These stations were used to provide comparable data from the old shoreline (1985 to 2005), offshore surface water (2005 to 2007) and new shoreline (2008/09) fecal coliform monitoring programs.

Shoreline receiving waters near the Maliview Estates outfall have normally produced fecal coliform concentrations below 20 CFU/100mL. During 1996, concentrations were higher than normal due to a leak in the outfall near the shoreline. This leak was repaired in 1997, and the 1997 to 2006 data indicate concentrations returned to low levels. The 2007 and 2008 data show an increase in shoreline fecal coliform concentrations. In contrast, the 2009 geometric mean of 12 CFU/100mL is lower than the previous two years and conforms to historic levels.



**Figure 3.1 Malview Estates WWTP 2009 Shoreline Fecal Coliform Monitoring Results**

The data includes annual geometric mean of 12 samples from four sampling events per year during 1985 to 2005, four samples from two events during 2005 to 2006, and six samples from two events during 2007 to 2009. It is important to note that these small data sets produce more variable statistical results than larger data sets with more sample sites. In addition, changes in the sampling program have the potential to introduce a bias into this type of time series analysis. However, future results will be examined closely to determine how the levels of shoreline fecal coliform contamination are changing over time.



**Figure 3.2 Maliview Estates WWTP Surface Water Fecal Coliform Time Series Data from 1985 to 2009**

**CONCLUSIONS**

In 2008, three shoreline stations exceeded 200 CFU/100mL resulting in the continuation of shoreline monitoring through to 2010. None of the shoreline station fecal coliform results were greater than 200 CFU/100mL in 2009. If all results remain below 200 CFU/100mL in 2010, shoreline monitoring will be discontinued.

Shoreline results in 2009 were significantly lower compared to 2008. However, with such a limited number of samples and events, it is difficult to make a definitive statement regarding the fit of a single event in any historic trend. With only two sampling events per year, it may take some time before reliable estimates of how often this type of contamination occurs. Future data will be examined closely to determine if there are any long term trends.

### **3.4 Recommendations**

#### **HIGH FLOW BYPASS EVENTS**

The splitting equipment used to bypass the secondary treatment unit during high flows responds to instantaneous peak flows. However, the regulatory threshold for when a bypass event can occur is based on total daily flow. A revised regulatory threshold based on instantaneous peak flows, such as using the instantaneous capacity of the RBC unit, should be investigated.

#### **COMPLIANCE AND TREATMENT PLANT PERFORMANCE WASTEWATER SAMPLE COLLECTION**

Quarterly sampling is required for this facility as per the requirements of the MSR Registration. Four samples per year were adequate for the former primary treatment plant at this location as it had no potential for operational modifications and less stringent effluent regulatory limits. However, the current Maliview Estates secondary treatment plant has complex operational requirements for both screened and treated effluent streams, and more stringent effluent regulatory limits. In addition, since the final effluent is not directly accessible for sampling, final effluent quality has to be calculated by combining secondary and fine screened effluent data. To maintain the accuracy of the performance and compliance results, and reduce sample variability, the monthly sampling frequency that was initiated in 2009 should be continued for 2010.

#### **RECEIVING WATER FECAL COLIFORM MONITORING**

The winter period sampling event should continue to take place during a typical fine-screened effluent discharge event, to capture events when fine-screened effluent represents a substantial portion of the total effluent flow.

**Appendix 3.1 Maliview Estates WWTP 2009 Flow Data (m<sup>3</sup>/day)**

JAN	FEB	MAR	Day	APR	MAY	JUN	Day	JUL	AUG	SEP	Day	OCT	NOV	DEC
156	70	92	01	74	51	47	01	39	36	40	01	35	116	92
120	93	112	02	74	50	36	02	37	37	37	02	33	102	92
76	83	118	03	114	54	45	03	41	34	35	03	33	85	88
21	81	142	04	94	63	42	04	40	35	33	04	37	78	87
35	68	119	05	90	53	46	05	38	29	34	05	33	78	80
65	71	98	06	88	63	45	06	40	46	32	06	37	78	80
78	75	89	07	86	57	45	07	36	37	36	07	33	114	82
59	78	85	08	76	63	49	08	35	37	40	08	30	145	77
155	78	89	09	77	61	47	09	36	38	40	09	33	123	75
68	65	85	10	72	58	43	10	40	46	49	10	2	113	69
48	74	66	11	76	64	41	11	38	35	43	11	46	109	68
51	77	77	12	78	64	40	12	43	36	35	12	35	100	67
110	78	67	13	76	61	41	13	38	38	33	13	41	91	64
120	74	78	14	73	57	45	14	40	35	37	14	32	90	67
96	79	81	15	74	81	44	15	37	33	40	15	33	89	61
96	82	92	16	67	78	44	16	37	34	34	16	37	105	119
90	75	122	17	70	71	43	17	37	35	36	17	49	116	162
91	69	111	18	69	72	42	18	34	37	36	18	56	103	100
87	72	100	19	76	74	41	19	33	21	33	19	0	100	107
87	70	97	20	76	64	40	20	33	24	49	20	0	220	100
77	75	94	21	72	58	41	21	35	36	46	21	104	171	170
79	73	95	22	60	55	46	22	35	33	38	22	44	122	130
81	79	96	23	79	53	44	23	33	31	36	23	43	206	109
78	89	88	24	48	58	41	24	34	32	30	24	82	140	100
74	73	85	25	45	58	41	25	36	32	33	25	75	127	99
76	105	80	26	82	52	38	26	35	34	32	26	67	148	87
67	92	78	27	63	52	42	27	40	32	38	27	103	146	82
70	94	76	28	47	48	38	28	13	33	41	28	85	98	80
67		79	29	53	44	38	29	20	32	24	29	70	103	77
76		81	30	50	46	49	30	32	34	30	30	111	99	75
71		80	31		49		31	35	39		31	100		76

**Appendix 3.2 Maliview Estates WWTP 2009 Secondary Effluent Flow Data (m<sup>3</sup>/day)**

JAN	FEB	MAR	Day	APR	MAY	JUN	Day	JUL	AUG	SEP	Day	OCT	NOV	DEC
54	56	61	01	52	44	39	01	38	33	39	01	34	110	76
45	26	61	02	52	42	26	02	34	33	37	02	33	98	63
59	0	60	03	56	43	36	03	35	29	35	03	33	82	80
18	0	60	04	56	42	36	04	35	31	33	04	36	76	87
18	24	59	05	54	43	39	05	34	26	34	05	33	75	80
16	31	60	06	54	49	40	06	34	45	32	06	37	75	66
39	46	59	07	52	46	37	07	34	37	35	07	33	112	65
39	62	57	08	52	49	39	08	32	36	39	08	30	136	64
98	62	55	09	51	47	38	09	33	38	39	09	33	113	63
61	53	56	10	52	45	37	10	37	38	42	10	2	110	61
48	61	43	11	51	46	35	11	36	34	41	11	45	104	62
37	63	56	12	52	46	36	12	36	35	35	12	33	97	64
75	63	43	13	52	46	39	13	33	35	33	13	36	87	57
62	37	57	14	52	45	38	14	36	34	34	14	32	88	58
56	62	56	15	54	50	36	15	35	33	40	15	33	84	56
56	25	57	16	53	49	38	16	34	31	34	16	37	101	70
56	0	59	17	50	48	37	17	34	29	35	17	45	96	75
55	24	60	18	48	48	37	18	32	31	35	18	40	87	55
54	46	58	19	48	48	37	19	30	11	33	19	0	100	66
54	44	58	20	46	48	36	20	28	24	48	20	0	172	63
51	62	57	21	46	46	36	21	32	36	43	21	100	137	72
52	59	59	22	40	46	37	22	31	33	38	22	39	95	52
51	58	58	23	56	44	36	23	30	31	36	23	37	156	63
50	66	56	24	38	46	35	24	30	32	30	24	77	123	62
49	54	57	25	35	45	36	25	32	32	32	25	61	108	62
50	75	57	26	62	42	35	26	31	21	32	26	54	126	61
51	64	56	27	46	42	37	27	32	32	38	27	79	126	62
55	63	54	28	37	41	36	28	12	33	37	28	68	83	64
55		52	29	45	40	34	29	16	30	24	29	67	79	66
56		52	30	44	40	45	30	31	26	30	30	101	73	66
43		54	31		41		31	33	28		31	86		65

**Appendix 3.3 Maliview Estates WWTP 2009 Fine Screened Effluent Flow Data (m<sup>3</sup>/d)**

JAN	FEB	MAR	Day	APR	MAY	JUN	Day	JUL	AUG	SEP	Day	OCT	NOV	DEC
102	14	31	01	22	7	8	01	2	3	2	01	1	6	16
75	68	52	02	22	9	10	02	4	5	0	02	0	5	30
17	83	58	03	58	11	9	03	6	5	0	03	0	3	9
3	81	82	04	38	21	7	04	5	4	0	04	1	3	0
17	44	60	05	36	10	7	05	4	3	0	05	0	3	0
49	40	38	06	34	15	5	06	7	2	0	06	0	3	14
39	29	30	07	34	11	8	07	3	0	2	07	1	2	17
20	16	29	08	24	14	10	08	3	1	1	08	0	10	14
57	16	34	09	26	14	9	09	4	0	1	09	0	10	12
7	13	30	10	20	13	6	10	3	9	7	10	0	3	8
0	13	24	11	25	18	7	11	3	1	2	11	1	6	6
14	14	22	12	26	19	4	12	7	1	0	12	2	3	3
35	15	25	13	24	15	3	13	5	3	0	13	5	4	7
58	37	21	14	21	12	7	14	4	1	3	14	0	2	9
40	17	25	15	20	32	8	15	2	0	0	15	0	5	5
40	58	35	16	14	29	7	16	3	4	0	16	0	4	49
34	75	63	17	20	23	6	17	3	6	1	17	4	20	87
36	46	52	18	21	24	5	18	2	6	1	18	16	16	45
33	26	42	19	28	27	4	19	3	11	0	19	0	0	42
33	26	39	20	30	16	4	20	5	1	1	20	0	48	37
26	13	37	21	26	13	6	21	3	0	3	21	4	34	99
27	15	36	22	20	10	10	22	4	0	0	22	5	27	78
30	21	39	23	23	10	8	23	3	0	1	23	6	50	47
28	24	32	24	10	12	6	24	4	0	0	24	5	18	39
25	19	28	25	10	13	5	25	5	0	1	25	15	19	37
26	31	24	26	20	10	4	26	4	13	0	26	14	23	27
16	28	22	27	17	10	5	27	8	0	0	27	24	21	21
15	31	23	28	10	7	3	28	1	0	4	28	17	15	16
12		27	29	8	4	4	29	4	2	1	29	3	25	11
20		29	30	6	6	4	30	1	8	0	30	10	27	10
17		27	31		9		31	2	11		31	14		11

**Appendix 3.4 Maliview Estates WWTP Compliance and Treatment Plant Performance Monitoring Data for 2009**

Date	Influent			Secondary Effluent (Undisinfected)						Fine Screened Effluent					
	TSS (mg/L)	TBOD (mg/L)	Fecal coliforms (cfu/100mL)	TSS (mg/L)	TBOD (mg/L)	CBOD (mg/L)	Fecal coliforms (cfu/100mL)	Ammonia (mg/L)	pH	TSS (mg/L)	TBOD (mg/L)	CBOD (mg/L)	Fecal coliforms (cfu/100mL)	Ammonia (mg/L)	pH
2009°Jan°20	246	205	500000	24	24	17	150000	22	7.3	148	182	124	5100000	45	8.0
2009°Feb°18	33	61	3200000	32	37	18	130000	24	7.2	90	182	126	13000000	32	7.9
2009°Mar°17	1158	848	2400000	20	>22	12	220000	14	7.2	91	132	112	1900000	30	7.7
2009°Apr°21	88	86	3400000	77	87	35	33000	22	7.1	---	---	---	---	---	---
2009°May°19	186	449	2200000	34	56	32	260000	29	7.2	---	---	---	---	---	---
2009°Jun°16	350	321	8800000	28	---	28	220000	38	7.2	---	---	---	---	---	---
2009°Jul°21	341	400	15000000	25	39	22	220000	31	7.1	---	---	---	---	---	---
2009°Aug°20	172	238	870000	16	51	19	95000	36	7.1	---	---	---	---	---	---
2009°Sep°22	254	263	18000000	20	>33	20	190000	30	7.0	---	---	---	---	---	---
2009°Oct°20	118	127	2100000	22	>33	24	360000	30	7.3	---	---	---	---	---	---
2009°Nov°17	644	491	890000	14	17	12	310000	9	7.2	---	---	---	---	---	---
2009°Dec°15	278	313	---	34	58	39	1300000	24	7.0	---	---	---	---	---	---
<b>Mean</b>	<b>322</b>	<b>317</b>	<b>2875115</b>	<b>29</b>	<b>42</b>	<b>23</b>	<b>202181</b>	<b>26</b>	<b>7.2</b>	<b>110</b>	<b>165</b>	<b>121</b>	<b>5012900</b>	<b>36</b>	<b>7.9</b>
<b>Min</b>	<b>33</b>	<b>61</b>	<b>500000</b>	<b>14</b>	<b>17</b>	<b>12</b>	<b>33000</b>	<b>9</b>	<b>7.0</b>	<b>90</b>	<b>132</b>	<b>112</b>	<b>1900000</b>	<b>30</b>	<b>7.7</b>
<b>Max</b>	<b>1158</b>	<b>848</b>	<b>18000000</b>	<b>77</b>	<b>87</b>	<b>39</b>	<b>1300000</b>	<b>38</b>	<b>7.3</b>	<b>148</b>	<b>182</b>	<b>126</b>	<b>13000000</b>	<b>45</b>	<b>8.0</b>
<b>N</b>	<b>12</b>	<b>12</b>	<b>11</b>	<b>12</b>	<b>11</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>Mean daily loading</b>	<b>kg / d</b>	<b>kg / d</b>	<b>kg / d</b>	<b>kg / d</b>	<b>kg / d</b>	<b>kg / d</b>	<b>kg / d</b>	<b>kg / d</b>	<b>---</b>	<b>kg / d</b>	<b>kg / d</b>	<b>kg / d</b>	<b>kg / d</b>	<b>kg / d</b>	<b>kg / d</b>
	<b>21.1</b>	<b>20.8</b>	<b>---</b>	<b>1.9</b>	<b>2.7</b>	<b>1.5</b>	<b>---</b>	<b>1.7</b>	<b>0.5</b>	<b>7.2</b>	<b>10.8</b>	<b>7.9</b>	<b>---</b>	<b>2.3</b>	<b>---</b>
<b>Total annual loading</b>	<b>t / yr</b>	<b>t / yr</b>	<b>t / yr</b>	<b>t / yr</b>	<b>t / yr</b>	<b>t / yr</b>	<b>t / yr</b>	<b>t / yr</b>	<b>---</b>	<b>t / yr</b>	<b>t / yr</b>	<b>t / yr</b>	<b>t / yr</b>	<b>t / yr</b>	<b>t / yr</b>
	<b>8</b>	<b>8</b>	<b>---</b>	<b>0.7</b>	<b>1.0</b>	<b>0.6</b>	<b>---</b>	<b>0.6</b>	<b>---</b>	<b>2.6</b>	<b>4.0</b>	<b>2.9</b>	<b>---</b>	<b>0.8</b>	<b>---</b>

## 4.0 SCHOONER WAY

### 4.1 Introduction

The Schooner Way wastewater treatment plant (WWTP) is located on the southwest side of North Pender Island (Figure 1.1). It discharges disinfected secondary treated effluent into Swanson Channel through a 198 metre long outfall at a depth of 8 metres below sea level.

The facility is regulated under BC MSR Registration RE-01693 dated November 15, 2000, with the following requirements:

Maximum daily flow	640 m <sup>3</sup> /d
Maximum CBOD	45 mg/L
Maximum TSS	45 mg/L
Maximum fecal coliforms	200 CFU/100mL
Toxicity test	Pass 96 hour effluent toxicity test

This registration also contains receiving water monitoring trigger conditions that assess the potential need for fecal coliform monitoring. Receiving environment monitoring is required if specified conditions are met (see Section 4.3.2).

This section reports the results from the Schooner Way treatment plant WMEP described in Table 4.1.

**Table 4.1 Schooner Way Treatment Plant WMEP**

Component	Parameter	Frequency and Stations
Wastewater	Flow	Daily
	Compliance and treatment plant performance monitoring: <ul style="list-style-type: none"> <li>Influent: TSS, TBOD, FC</li> <li>Secondary Effluent: TSS, FC</li> <li>Disinfected Secondary Effluent: TSS, TBOD, CBOD, fecal coliforms, NH<sub>3</sub>, pH</li> </ul>	Once per month <sup>1</sup>
	Effluent toxicity	Once per year
Surface Water	Indicator bacteria (fecal coliforms)	Required in 2009 <sup>2</sup> (37 stations)

#### Notes

- Parameters are analyzed once per month as part of registration requirements. However, additional samples are collected when a specific parameter(s) is above the allowable maximum. This information is used to assess whether the treatment process is functioning within specific parameters.
- Subject to trigger conditions. Surface water fecal coliform monitoring will also be required in 2010.

## 4.2 Methods

### 4.2.1 Wastewater Monitoring Methods

#### COMPLIANCE AND TREATMENT PLANT PERFORMANCE MONITORING METHODS

Influent and effluent samples were collected as grab samples.

Laboratory analyses were conducted at the Saanich Peninsula Wastewater Treatment Plant (SPWWTP) Laboratory or Cantest (Victoria, BC). TSS was determined gravimetrically using glass fibre filters dried at 105°C (APHA, 1998). TBOD was determined by five-day oxygen depletion at 20°C using an oxygen

meter (APHA, 1998). CBOD was determined by five-day oxygen depletion at 20°C with TCMP (2-chloro-6-(trichloro methyl) pyridine) as a nitrification inhibitor and using an oxygen meter (APHA, 1998). Fecal coliforms were enumerated using 0.45 µm membrane filters incubated on mFC medium at 44.5°C for 24 hours (APHA 1998). Ammonia was determined by distillation and Nesslerization colorimetry.

Means reported for fecal coliforms are geometric (logarithmic) means. Means for all other parameters are arithmetic. Mean daily loadings were calculated from mean concentrations and mean daily flows. Annual loadings were calculated from mean concentrations and total annual flows.

### **TOXICITY TESTING**

The effluent toxicity sample was collected by grab sampling on July 21, 2009. Whole effluent toxicity was determined by 96-hour single concentration acute toxicity test using juvenile rainbow trout (*Oncorhynchus mykiss*). Ten test organisms were exposed to undiluted effluent and the number of organisms surviving at 96 hours was recorded. Fifty percent or greater survival is considered a pass, while less than 50% survival a fail.

#### **4.2.2 Receiving Water Monitoring**

The registration for this facility includes trigger conditions which influence the decision to initiate or suspend surface water fecal coliform monitoring. Monitoring is to be re-instated if any of the following conditions are met:

- (A) Effluent fecal coliform concentrations exceed 200 CFU/100mL in two consecutive samples.
- (B) Effluent fecal coliform concentrations exceed 200 CFU/100mL in three samples within a reporting year.
- (C) The maximum daily discharge exceeds 640 m<sup>3</sup>/day.
- (D) The ultraviolet disinfection unit is not functioning.

Once monitoring is triggered, effluent must not exceed conditions (A) through (D) for a period of two reporting years, after which monitoring may be discontinued.

Samples were collected from a seven-metre research vessel positioned by differential global positioning system in February 2009 and August 2009. Samples were collected in sterile, wide-mouth bottles by rapidly submerging open, upright bottles to one metre depth. Samples were collected at a number of stations at fixed locations plus one or two stations at variable locations. The first variable station (station D1) represents the recovery point of a current drogue. The drogue was released at station 01 directly over the outfall diffuser at the outset of sampling. The second variable station (station 00) was only sampled if visual evidence of the discharge (e.g., a boil or extreme turbidity) was observed. Sampling is scheduled for periods of slack or low current, although weather delays sometimes result in sampling during moderate to high currents.

Fecal coliforms were enumerated using 0.45 µm membrane filters incubated on mFC medium at 44.5°C for 24 hours (APHA, 1998).

Results were compared to the value specified in the BC MOE Approved Water Quality Guidelines (BCWQG) for primary contact, as a means to assess potential for human health risks (BCMOE, 2007b). This guideline applies to primary contact recreational waters, such as beaches, where most human activities take place. The number of samples collected for the receiving water fecal coliform monitoring programs described in this report, as well as the timeframe for their collection, was developed in collaboration with the BC MOE. However, these receiving water samples do not allow for a direct comparison to this guideline as it was defined. The guidelines include the requirement that the geometric mean of five samples taken within 30 days must not exceed 200 colony forming units in 100mL (CFU/100mL). As such, within this report, 200 CFU/100mL acts only as a benchmark to assess potential human health risks related to primary contact.

## 4.3 Results

### 4.3.1 Wastewater Monitoring

#### COMPLIANCE AND TREATMENT PLANT PERFORMANCE MONITORING

Flow data are summarized in Table 4.2 and the complete data set is presented in Appendix 4.1. In 2009, 0.3% of the daily flows to the Schooner Way WWTP exceeded the allowable maximum, which is comparable to flows recorded in 2008 (0%) and 2007 (1%). Annual mean daily flow increased by approximately 8% from last year. Long term trends indicate that flow has decreased by an average of approximately 1% over the last 5 years.

Monthly compliance and treatment plant performance monitoring data are summarized in Table 4.3 and the complete data set is presented in Appendix 4.2. Effluent quality was similar to last year for TSS, CBOD and fecal coliforms. None of the samples exceeded the maximum allowable concentrations for TSS and CBOD. One sample (November 17) exceeded the maximum allowable fecal coliform concentration. The 2008 data showed no exceedence, whereas 2.5% of the 2007 samples were greater than 200 CFU/100mL. The treatment plant removed 96% of the TSS, 97% of the TBOD and greater than 99% of the fecal coliform bacteria it received.

Further explanation on receiving water monitoring and effluent fecal coliform results is discussed in Section 4.3.2.

#### TOXICITY TESTING

The undiluted effluent sample from July 22 passed the toxicity test with 100% survival indicating that the effluent was not acutely toxic to juvenile rainbow trout.

**Table 4.2 Schooner Way WWTP 2009 Flow Annual Summary**

Month	Mean Flow (m3/d)	Minimum Flow (m3/d)	Maximum Flow (m3/d)	Total Flow (m3)	Number of Samples	Permit violations (number)	Permit violations (percent)
January	275	155	473	8 533	31	0	0%
February	162	140	196	4 545	28	0	0%
March	177	138	241	5 475	31	0	0%
April	173	129	247	5 192	30	0	0%
May	164	132	228	5 084	31	0	0%
June	141	124	171	4 240	30	0	0%
July	155	39	202	4 800	31	0	0%
August	161	102	202	4 992	31	0	0%
September	145	117	182	4 344	30	0	0%
October	193	120	336	5 998	31	0	0%
November	345	184	698	10 364	30	1	3%
December	264	179	428	8 187	31	0	0%
<b>Annual</b>	<b>197</b>	<b>39</b>	<b>698</b>	<b>71 754</b>	<b>365</b>	<b>1</b>	<b>0.3%</b>

**Table 4.3 Schooner Way WWTP 2009 Compliance Annual Summary**

Date	Compliance Monitoring				Treatment Plant Performance Monitoring		
	Flow (m3/d)	TSS (mg/L)	CBOD (mg/L)	Fecal Coliforms (CFU/100mL)	TBOD (mg/L)	Ammonia (mgN/L)	pH
<b>Influent</b>							
Regulatory Limit	640	---	---	---	---	---	---
Mean	197	222	---	7 319 656	232	---	---
Minimum	39	92	---	2 700 000	84	---	---
Maximum	698	368	---	23 000 000	316	---	---
Permit violations	0.3%	---	---	---	---	---	---
Number of samples	365	12		12	12	---	---
<b>Secondary Effluent</b>							
Regulatory Limit	---	---	---	---	---	---	---
Mean	197	9	---	12 985	---	---	---
Minimum	39	4	---	900	---	---	---
Maximum	698	28	---	690 000	---	---	---
Percent Reduction		96%	---	>99%	---	---	---
Permit violations	---	---	---	---	---	---	---
Number of samples	365	12	---	12	---	---	---
<b>Disinfected Secondary Effluent</b>							
Regulatory Limit	640	45	45	200	---	---	---
Mean	197	9	5	13	7	0.41	6.7
Minimum	39	1	< 4	2	<4	0.03	6.4
Maximum	698	27	10	>200	19	3.20	7.0
Percent Reduction	---	96%	---	>99%	97%	---	---
Permit violations	0.3%	0%	0%	8%	---	---	---
Number of samples	365	12	12	12	12	12	12

#### 4.3.2 Receiving Water Monitoring

##### SURFACE WATER FECAL COLIFORMS

Receiving water monitoring was required in 2008 due to fecal coliform concentrations in effluent exceeding 200 CFU/100mL in three of 12 samples in 2007. Monitoring was originally initiated in 2006 due to a similar exceedence. All samples remained below 200 CFU/100mL during 2008 and 2009. However, one mean daily flow of 698m<sup>3</sup> in November 2009 exceeded the maximum allowable limit of 640m<sup>3</sup>, subsequently triggering receiving water monitoring for 2010 and 2011 (condition C).

Surface water fecal coliform data are summarized in Table 4.4 and Figure 4.1. Thirty-eight surface water stations were sampled in the winter and summer, for surface water fecal coliforms. Results were compared to the value used in the BC primary contact recreational guideline.

All surface water samples were less than 200 CFU/100mL in 2009. None of the 38 stations had geometric means exceeding 200 CFU/100mL, indicating a very low potential risk factor for humans. The maximum geometric mean observed was 2 CFU/100mL. The maximum observed value for both sampling events was 4 CFU/100mL.

During the winter sampling event in February, the current drogue traveled 40 meters to the east southeast (119 °T) at a rate of 1 cm/s. The maximum winter fecal coliform value was 4 CFU/100mL. During the summer sampling event in August, the current drogue traveled 210 meters to the east southeast (105 °T) at a rate of 7cm/s. The maximum summer fecal coliform value was 2 CFU/100mL.

**Table 4.4 Schooner Way WWTP 2009 Surface Water Fecal Coliforms Summary**

Station	Feb-17	Aug-27	Geometric Mean
Sch-01	< 1	1	1
Sch-02	< 1	< 1	<1
Sch-03	1	< 1	1
Sch-04	1	< 1	1
Sch-05	< 1	1	1
Sch-06	< 1	< 1	<1
Sch-07	2	1	1
Sch-08	1	< 1	1
Sch-09	< 1	< 1	<1
Sch-10	< 1	1	1
Sch-11	< 1	< 1	<1
Sch-12	< 1	< 1	<1
Sch-13	1	< 1	1
Sch-14	< 1	1	1
Sch-15	1	< 1	1
Sch-16	1	< 1	1
Sch-17	< 1	2	1
Sch-18	< 1	< 1	<1
Sch-19	< 1	< 1	<1
Sch-20	4	< 1	2
Sch-21	< 1	< 1	<1
Sch-22	1	< 1	1
Sch-23	< 1	1	1
Sch-24	< 1	< 1	<1
Sch-25	< 1	1	1
Sch-26	< 1	< 1	<1
Sch-27	< 1	< 1	<1
Sch-28	< 1	2	1
Sch-29	< 1	< 1	<1
Sch-30	< 1	< 1	<1
Sch-31	2	< 1	1
Sch-32	< 1	1	1
Sch-33	< 1	2	1
Sch-34	< 1	< 1	1
Sch-35	2	1	1
Sch-36	< 1	< 1	<1
Sch-37	1	< 1	1
Sch-D1	1	< 1	1

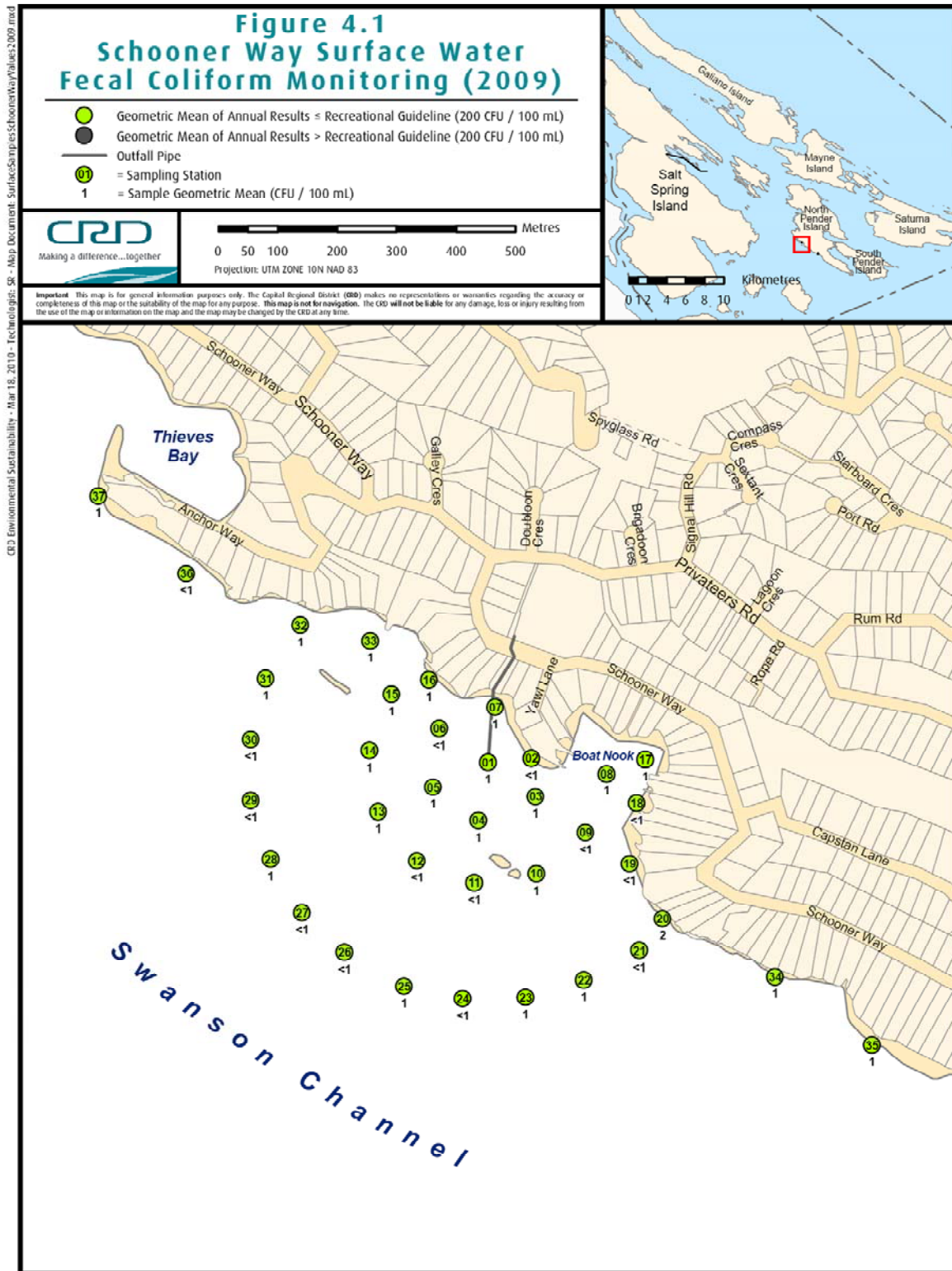


Figure 4.1 Schooner Way WWTP 2009 Surface Water Fecal Coliform Monitoring

#### 4.4 Recommendations

##### **COORDINATE EFFLUENT TOXICITY SAMPLING WITH COMPLIANCE AND TREATMENT PLANT PERFORMANCE SAMPLING**

Effluent toxicity sampling should continue to be conducted at the same time as monthly compliance and treatment plant performance sampling. This will provide supporting data to help interpret future toxicity test results.

##### **CONTINUE SURFACE FECAL COLIFORM MONITORING FOR 2010**

According to the receiving water monitoring trigger conditions, the treatment plant did achieve adequate disinfection during 2008 and 2009. Monitoring, however, must continue for two subsequent years due to one flow exceedence in 2009. If the plant can continue adequate disinfection and avoid high flow events, then receiving water monitoring may be discontinued in 2012.

**Appendix 4.1 Schooner Way WWTP 2009 Flow Data (m<sup>3</sup>/day)**

JAN	FEB	MAR	Day	APR	MAY	JUN	Day	JUL	AUG	SEP	Day	OCT	NOV	DEC
473	178	175	01	178	151	144	01	155	102	147	01	143	244	260
394	173	183	02	247	157	131	02	161	182	154	02	125	221	238
328	177	192	03	225	163	135	03	182	202	154	03	148	213	235
314	148	173	04	212	161	124	04	176	162	152	04	143	184	227
366	146	173	05	197	158	143	05	171	159	173	05	139	187	233
412	155	172	06	185	159	143	06	160	143	182	06	130	271	241
419	162	169	07	172	163	171	07	115	163	169	07	132	358	208
446	159	178	08	162	151	133	08	39	189	134	08	123	310	192
352	155	175	09	177	171	132	09	98	188	146	09	145	278	196
359	156	151	10	188	170	129	10	156	145	154	10	155	294	203
425	196	144	11	187	159	125	11	165	162	138	11	163	278	184
355	169	141	12	234	147	142	12	167	151	147	12	175	247	187
308	174	149	13	203	153	144	13	157	157	143	13	127	241	192
278	179	176	14	167	228	160	14	141	172	123	14	136	220	179
259	180	225	15	160	195	148	15	149	183	148	15	120	254	241
255	158	241	16	156	189	136	16	146	182	132	16	142	474	340
223	151	213	17	175	222	151	17	161	141	131	17	292	698	382
231	141	198	18	167	205	135	18	157	149	149	18	254	391	343
222	140	196	19	165	166	149	19	170	164	143	19	208	491	327
203	150	202	20	161	150	130	20	157	159	157	20	177	509	370
191	166	198	21	147	140	139	21	153	167	140	21	188	419	428
180	175	194	22	146	167	137	22	159	183	141	22	164	568	361
184	159	188	23	150	157	130	23	161	189	132	23	336	443	306
177	170	170	24	156	162	139	24	175	153	136	24	270	368	290
182	163	164	25	161	158	133	25	177	144	138	25	244	368	273
179	154	156	26	153	150	139	26	202	146	137	26	293	485	260
162	156	158	27	157	139	148	27	165	141	152	27	235	413	269
158	160	160	28	145	158	169	28	148	154	142	28	230	345	256
167	---	162	29	129	132	156	29	155	147	134	29	306	311	246
155	---	162	30	130	141	146	30	141	151	117	30	286	282	250
178	---	138	31	---	162	---	31	181	163	---	31	269	---	270

**Appendix 4.2 Schooner Way WWTP 2009 Compliance and Treatment Plant Performance Monitoring Data**

Date	INFLUENT			SECONDARY EFFLUENT (UNDISINFECTED)		Disinfected Secondary Effluent					
	TSS (mg/L)	TBOD (mg/L)	Fecal coliforms (cfu/100mL)	TSS (mg/L)	Fecal Coliforms (cfu/100mL)	TSS (mg/L)	TBOD (mg/L)	CBOD (mg/L)	Fecal coliforms (cfu/100mL)	Ammonia (mg/L)	pH
2009°Jan°20	92	94	2700000	12	330000	14	8.8	6	8	0.027	6.7
2009°Feb°17	172	196	4400000	5	19000	6	5.9	<4	2	0.036	6.9
2009°Mar°17	243	234	5100000	4	900	2	<4	<4	3	0.038	6.7
2009°Apr°21	280	267	6400000	10	6600	12	9.3	7.1	5	0.331	6.6
2009°May°19	228	296	23000000	13	25000	13	10	6.9	30	0.205	6.4
2009°Jun°16	368	308	15000000	4	59000	4.4	5.4	4	20	0.167	6.7
2009°Jul°21	168	203	9100000	5	19000	8.8	5.2	<4	8	0.225	6.8
2009°Aug°18	254	248	8300000	7	37000	1.2	5.3	4	32	0.213	6.8
2009°Sep°22	334	258	3600000	8	96000	6	5.3	4.8	55	0.213	6.6
2009°Oct°20	144	316	5100000	4	5300	5.2	<4	<4	52	0.152	6.7
2009°Nov°17	138	84	8500000	28	690000	27	19	9.6	>200	3.2	7
2009°Dec°15	246	284	>15000000	10	5500	4.8	<4	<4	14	0.112	6.8
<b>Mean</b>	<b>222</b>	<b>232</b>	<b>7319656</b>	<b>9</b>	<b>12985</b>	<b>9</b>	<b>7</b>	<b>5</b>	<b>13</b>	<b>0.4</b>	<b>6.7</b>
<b>Min</b>	<b>92</b>	<b>84</b>	<b>2700000</b>	<b>4</b>	<b>900</b>	<b>1.2</b>	<b>&lt;4</b>	<b>&lt;4</b>	<b>2</b>	<b>0.03</b>	<b>6.4</b>
<b>Max</b>	<b>368</b>	<b>316</b>	<b>23000000</b>	<b>28</b>	<b>690000</b>	<b>27</b>	<b>19</b>	<b>10</b>	<b>&gt;200</b>	<b>3.2</b>	<b>7.0</b>
<b>N</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>
<b>Mean Daily Loading</b>	<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>
	<b>142.2</b>	<b>148.7</b>	<b>---</b>	<b>1.8</b>	<b>---</b>	<b>1.7</b>	<b>1.4</b>	<b>1.0</b>	<b>---</b>	<b>0.1</b>	<b>---</b>
<b>Total Annual Loading</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>
	<b>51.9</b>	<b>54.3</b>	<b>---</b>	<b>0.7</b>	<b>---</b>	<b>0.6</b>	<b>0.5</b>	<b>0.4</b>	<b>---</b>	<b>0.03</b>	<b>---</b>

## 5.0 CANNON CRESCENT

### 5.1 Introduction

The Cannon Crescent wastewater treatment plant (WWTP) is located on the southwest side of North Pender Island (Figure 1.1). It discharges undisinfected secondary treated effluent into Swanson Channel through a 204 metre long outfall at a depth of 29 metres below sea level.

The facility is regulated by Waste Management Permit PE-00220 dated April 28, 1981 with the following requirements:

Maximum daily flow	68 m <sup>3</sup> /d
Maximum CBOD	45 mg/L
Maximum TSS	60 mg/L

This section reports the results from the Cannon Crescent treatment plant WMEP described in Table 5.1.

**Table 5.1 Cannon Crescent Treatment Plant WMEP**

Component	Parameter	Frequency and Stations
Wastewater	Flow	Daily
	Compliance and treatment plant performance monitoring <ul style="list-style-type: none"> <li>Influent: TSS, TBOD</li> <li>Secondary Effluent: TSS, TBOD, CBOD, fecal coliforms, NH<sub>3</sub>, pH</li> </ul>	Once per month

### 5.2 Methods

#### 5.2.1 Wastewater Monitoring

##### COMPLIANCE AND TREATMENT PLANT PERFORMANCE MONITORING

Influent and effluent samples were collected as grab samples.

Laboratory analyses were conducted at the Saanich Peninsula Wastewater Treatment Plant (SPWWTP) Laboratory or Cantest (Victoria, BC). TSS was determined gravimetrically using glass fibre filters dried at 105°C (APHA, 1998). TBOD was determined by five-day oxygen depletion at 20°C using an oxygen meter (APHA, 1998). CBOD was determined by five-day oxygen depletion at 20°C with TCMP (2-chloro-6-(trichloro methyl) pyridine) as a nitrification inhibitor and using an oxygen meter (APHA, 1998). Fecal coliforms were enumerated using 0.45 µm membrane filters incubated on mFC medium at 44.5°C for 24 hours (APHA, 1998). Ammonia was determined by distillation and Nesslerization colorimetry.

Means reported for fecal coliforms are geometric (logarithmic) means. Means for all other parameters are arithmetic. Mean daily loadings were calculated from mean concentrations and mean daily flows. Annual loadings were calculated from mean concentrations and total annual flows.

## 5.3 Results

### 5.3.1 Wastewater Monitoring

#### **COMPLIANCE AND TREATMENT PLANT PERFORMANCE MONITORING**

Flow data are summarized in Table 5.2 and the complete data set is presented in Appendix 5.1. In 2009, 13% of the daily flows to the Cannon Crescent WWTP exceeded the allowable maximum, up noticeably from 5% in 2008, but similar to 12% in 2007. Annual mean daily flow was approximately 22% higher than 2008. Long term trends indicate that flow has remained largely the same for the last five years, with the exception of 2008; annual average flow has varied between 47 and 48m<sup>3</sup> since 2004. Both the flow and number of exceedences declined between 1999 and 2002 due to an inflow and infiltration program initiated in 2000. Since then, flows appear to have stabilized as the five-year trend suggests. Though annual mean daily flows exceeded the maximum allowable daily flow, the plant remained in compliance with TSS and CBOD requirements.

Compliance and treatment plant performance monitoring data are summarized in Table 5.3 and the complete data set is presented in Appendix 5.2. Effluent quality was similar to last year, with no permit violations during 2009. The treatment plant removed 83% of the TSS, 91% of the TBOD and 98% of the fecal coliforms from the influent.

**Table 5.2 Cannon Crescent WWTP 2009 Annual Flow Summary**

Month	Mean Flow (m <sup>3</sup> /d)	Minimum Flow (m <sup>3</sup> /d)	Maximum Flow (m <sup>3</sup> /d)	Total Flow (m <sup>3</sup> )	Number of Samples	Permit violations (number)	Permit violations (percent)
January	68	39	133	2 117	31	12	39%
February	41	34	48	1 140	28	0	0%
March	46	35	66	1 428	31	0	0%
April	43	20	68	1 299	30	1	3%
May	42	30	60	1 290	31	0	0%
June	33	26	52	983	30	0	0%
July	38	21	50	1 180	31	0	0%
August	38	29	50	1 184	31	0	0%
September	33	16	42	1 000	30	0	0%
October	45	13	96	1 384	31	6	19%
November	85	38	136	2 555	30	22	73%
December	59	40	89	1 838	31	6	19%
<b>Annual</b>	<b>48</b>	<b>13</b>	<b>136</b>	<b>17 397</b>	<b>365</b>	<b>47</b>	<b>13%</b>

**Table 5.3 Cannon Crescent WWTP 2009 Compliance and Treatment Plant Performance Monitoring Annual Summary**

Date	COMPLIANCE MONITORING				TREATMENT PLANT PERFORMANCE MONITORING		
	Flow (m3/d)	TSS (mg/l)	CBOD (mg/L)	Fecal Coliforms (CFU/100mL)	TBOD (mg/L)	Ammonia (mgN/L)	pH
<b>INFLUENT</b>							
Regulatory Limit	---	---	---	---	---	---	---
Mean	48	90	---	666 053	120	---	---
Minimum	13	13	---	110 000	22	---	---
Maximum	136	214	---	15 000 000	255	---	---
Permit violations	13%	---	---	---	---	---	---
Number of samples	365	12	---	12	12	---	---
<b>SECONDARY EFFLUENT</b>							
Regulatory Limit	68	60	45	---	---	---	---
Mean	48	15	6	11 849	11	1.02	6.4
Minimum	13	6	<4	1 000	5	0.02	5.4
Maximum	136	46	12	74 000	18	7.10	7.1
Percent Reduction	---	83%	---	98%	91%	---	---
Permit violations	13%	0	0	---	---	---	---
Number of samples	365	12	12	12	12	12	12

#### 5.4 Recommendations

There are no specific recommendations at this time.

**Appendix 5.1 Cannon Crescent WWTP 2009 Flow Data**

JAN	FEB	MAR	Day	APR	MAY	JUN	Day	JUL	AUG	SEP	Day	OCT	NOV	DEC
133	41	49	01	48	30	35	01	38	50	31	01	29	56	64
108	39	44	02	68	37	32	02	36	41	32	02	29	52	60
79	46	48	03	55	42	27	03	40	45	41	03	32	46	57
82	44	42	04	59	36	36	04	44	37	34	04	36	46	57
95	42	45	05	55	36	28	05	48	39	36	05	27	38	56
102	45	44	06	47	35	30	06	21	35	41	06	27	84	53
103	47	44	07	44	40	35	07	33	39	38	07	13	114	54
113	48	46	08	42	40	29	08	36	39	33	08	27	91	43
67	41	35	09	35	47	30	09	35	36	35	09	31	72	42
88	37	39	10	56	44	33	10	35	35	40	10	33	73	42
103	43	38	11	53	40	30	11	42	37	35	11	38	69	42
80	40	38	12	59	39	30	12	45	33	42	12	38	70	44
71	42	41	13	59	42	34	13	34	33	36	13	26	58	46
65	41	51	14	41	60	40	14	30	37	25	14	26	55	41
58	43	38	15	39	52	33	15	35	41	37	15	23	68	59
58	36	66	16	38	49	27	16	30	42	31	16	31	118	83
58	36	56	17	43	53	27	17	33	36	34	17	96	132	87
58	36	50	18	45	52	28	18	33	35	30	18	69	77	72
50	34	52	19	39	47	43	19	38	36	34	19	47	86	65
47	40	58	20	39	53	31	20	42	35	41	20	41	127	87
47	42	64	21	39	39	31	21	36	29	31	21	40	119	89
42	45	62	22	38	35	31	22	36	43	29	22	37	129	83
42	36	36	23	38	42	26	23	27	46	16	23	91	102	65
50	37	43	24	35	47	31	24	50	43	26	24	71	87	64
52	39	46	25	36	39	30	25	46	38	32	25	58	92	57
44	40	39	26	38	33	34	26	48	36	33	26	66	128	58
44	38	48	27	20	35	39	27	41	33	37	27	51	136	57
39	44	42	28	33	32	52	28	42	40	29	28	46	83	56
42	---	44	29	31	35	40	29	39	39	29	29	75	76	40
42	---	42	30	29	41	33	30	43	43	30	30	69	70	54
52	---	37	31	---	38	---	31	43	32	---	31	62	---	62

**Appendix 5.2 Cannon Crescent WWTP 2009 Compliance and Treatment Plant Performance Monitoring Data**

Date	Influent			Secondary Effluent (Disinfected)					
	TSS (mg/L)	TBOD (mg/L)	Fecal coliforms (cfu/100mL)	TSS (mg/L)	TBOD (mg/L)	CBOD (mg/L)	Fecal coliforms (cfu/100mL)	Ammonia (mg/L)	pH
2009 Jan 20	13	22	130000	11	18	7	18000	7.10	7.1
2009 Feb 17	70	70	560000	15	11	6	1000	0.02	6.5
2009 Mar 17	25	45	110000	17	13	7	19000	0.10	6.4
2009 Apr 21	32	59	250000	9	11	6	21000	0.15	6.8
2009 May 19	209	216	12000000	11	10	7	21000	0.03	6.7
2009 Jun 16	78	175	780000	6	7	<4	6800	0.06	6.2
2009 Jul 21	100	255	15000000	6	5	<4	22000	0.07	6.2
2009 Aug 18	80	115	1200000	8	5	<4	1400	0.16	5.4
2009 Sep 22	214	237	620000	46	17	12	45000	4.21	5.9
2009 Oct 20	26	58	270000	25	15	7	74000	0.14	6.1
2009 Nov 17	54	74	450000	15	8	4	5200	0.08	6.8
2009 Dec 15	179	112	300000	9	9	<4	14000	0.16	6.6
<b>Mean</b>	<b>90</b>	<b>120</b>	<b>666053</b>	<b>15</b>	<b>11</b>	<b>6</b>	<b>11849</b>	<b>1.0</b>	<b>6.4</b>
<b>Min</b>	<b>13</b>	<b>22</b>	<b>110000</b>	<b>6</b>	<b>5</b>	<b>&lt;4</b>	<b>1000</b>	<b>0.02</b>	<b>5.4</b>
<b>Max</b>	<b>214</b>	<b>255</b>	<b>15000000</b>	<b>46</b>	<b>18</b>	<b>12</b>	<b>74000</b>	<b>7.1</b>	<b>7.1</b>
<b>N</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>
<b>Mean Daily Loading</b>	<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>
	<b>4.3</b>	<b>5.7</b>	<b>---</b>	<b>0.05</b>	<b>0.2</b>	<b>0.2</b>	<b>---</b>	<b>0.05</b>	<b>---</b>
<b>Total Annual Loading</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>
	<b>1.6</b>	<b>2.1</b>	<b>---</b>	<b>0.3</b>	<b>0.2</b>	<b>0.1</b>	<b>---</b>	<b>0.02</b>	<b>---</b>

## 6.0 PORT RENFREW

### 6.1 Introduction

The Port Renfrew wastewater treatment plant (WWTP) is located on the southeast corner of Port San Juan on Vancouver Island (Figure 1.1). It discharges undisinfected secondary treated effluent into Port San Juan through an 81 metre long outfall at a depth of 3 metres below sea level.

The facility is regulated by Waste Management Permit PE-00312 dated April 15, 1992, with the following requirements:

Maximum daily flow	220 m <sup>3</sup> /d
Maximum CBOD	45 mg/L
Maximum TSS	60 mg/L

This section reports the results from the Port Renfrew treatment plant WMEP described in Table 6.1.

**Table 6.1 Port Renfrew Treatment Plant WMEP**

Component	Parameter	Frequency and Stations
Wastewater	Flow	Daily
	Compliance and treatment plant performance monitoring: <ul style="list-style-type: none"><li>Influent: TSS, TBOD</li><li>Effluent: TSS, TBOD, CBOD, fecal coliforms, NH<sub>3</sub>, pH</li></ul>	Once per month

### 6.2 Methods

#### 6.2.1 Wastewater Monitoring

##### **COMPLIANCE AND TREATMENT PLANT PERFORMANCE MONITORING**

Influent and effluent samples were collected as grab samples.

Laboratory analyses were conducted at the Saanich Peninsula Wastewater Treatment Plant (SPWWTP) Laboratory or Cantest (Victoria, BC). TSS was determined gravimetrically using glass fibre filters dried at 105°C (APHA, 1998). TBOD was determined by five-day oxygen depletion at 20°C using an oxygen meter (APHA, 1998). CBOD was determined by five-day oxygen depletion at 20°C with TCMP (2-chloro-6-(trichloro methyl) pyridine) as a nitrification inhibitor and using an oxygen meter (APHA, 1998). Fecal coliforms were enumerated using 0.45 µm membrane filters incubated on mFC medium at 44.5°C for 24 hours (APHA, 1998). Ammonia was determined by distillation and Nesslerization colorimetry.

Means reported for fecal coliforms are geometric (logarithmic) means. Means for all other parameters are arithmetic. Mean daily loadings were calculated from mean concentrations and mean daily flows. Annual loadings were calculated from mean concentrations and total annual flows.

## 6.3 Results

### 6.3.1 Wastewater Monitoring

#### **COMPLIANCE AND TREATMENT PLANT PERFORMANCE MONITORING**

Flow data are summarized in Table 6.2 and the complete data set is presented in Appendix 6.1. In 2009, 1% of the daily flows to the Port Renfrew WWTP exceeded the allowable maximum.

The new flow meter installed in 2007 produces significantly higher readings than the previous meter. Flows from 1997 to 2006 were consistently between 30 and 50m<sup>3</sup>/d. Since the installation of the flow meter, all annual mean flows have remained largely the same, ranging from 56 to 71m<sup>3</sup>/day. The recent high flows can be attributed to the new meter, as other CRD treatment facilities have experienced similar issues as a result of the installation of newer, more accurate, flow meters. As such, trend comparisons between 2009 flow data and older data are not feasible at this time.

**Table 6.2 Port Renfrew WWTP 2009 Flow Annual Summary**

Month	Mean Flow (m3/d)	Minimum Flow (m3/d)	Maximum Flow (m3/d)	Total Flow (m3)	Number of Samples	Permit violations (number)	Permit violations (percent)
January	100	31	570	3099	31	4	13%
February	49	31	107	1385	28	0	0%
March	65	33	117	2009	31	0	0%
April	52	30	166	1558	30	0	0%
May	48	32	96	1494	31	0	0%
June	36	28	48	1093	30	0	0%
July	42	35	55	1292	31	0	0%
August	46	29	60	1432	31	0	0%
September	50	37	128	1496	30	0	0%
October	59	36	150	1823	31	0	0%
November	95	42	154	2854	30	0	0%
December	47	0	101	1455	31	0	0%
<b>Annual</b>	<b>58</b>	<b>0</b>	<b>570</b>	<b>20 990</b>	<b>365</b>	<b>4</b>	<b>1%</b>

Compliance and treatment plant performance monitoring data are summarized in Table 6.3 and the complete data set is presented in Appendix 6.2. Effluent quality was similar to the previous two years with no permit violations. The treatment plant removed 86% of the TSS, 94% of the TBOD and greater than 99% of the fecal coliforms from the influent.

**Table 6.3 Port Renfrew WWTP 2009 Compliance and Treatment Plant Performance Monitoring Annual Summary**

Date	Compliance Monitoring				Treatment Plant Performance Monitoring		
	Flow (m3/d)	TSS (mg/l)	CBOD (mg/L)	Fecal Coliforms (CFU/100mL)	TBOD (mg/L)	Ammonia (mgN/L)	pH
<b>Influent</b>							
Regulatory Limit	---	---	---	---	---	---	---
Mean	58	144	---	2 602 287	163	---	---
Minimum	0	39	---	370 000	64	---	---
Maximum	570	275	---	20 000 000	265	---	---
Permit violations	---	---	---	---	---	---	---
Number of samples	365	12	---	12	12	---	---
<b>Secondary Effluent</b>							
Regulatory Limit	220	60	45	---	---	---	---
Mean	58	20	7	28 675	11	1.58	5.4
Minimum	0	5	<4	1 500	4	0.06	3.7
Maximum	570	39	18	100 000	25	4.50	6.5
Percent Reduction	---	86%	---	>99%	94%	---	---
Permit violations	0%	0%	0%	---	---	---	---
Number of samples	365	12	12	12	12	12	12

#### 6.4 Recommendations

There are no specific recommendations at this time.

**Appendix 6.1 Port Renfrew WWTP 2009 Flow Data (m<sup>3</sup>/day)**

JAN	FEB	MAR	Day	APR	MAY	JUN	Day	JUL	AUG	SEP	Day	OCT	NOV	DEC
128	56	57	01	121	35	38	01	39	39	41	01	54	67	38
31	56	86	02	102	34	34	02	43	44	40	02	68	57	56
150	107	93	03	87	41	37	03	41	43	39	03	52	53	50
73	62	66	04	50	36	40	04	42	48	44	04	51	47	42
71	52	55	05	44	41	37	05	43	29	46	05	41	42	40
155	42	47	06	41	57	36	06	42	52	53	06	37	81	41
235	41	40	07	35	54	35	07	46	42	68	07	36	83	41
570	44	53	08	39	96	33	08	42	45	62	08	37	79	54
257	43	37	09	40	55	34	09	47	49	50	09	44	76	41
128	35	33	10	35	50	30	10	41	49	128	10	40	104	39
307	42	41	11	36	44	29	11	39	60	73	11	37	95	38
130	31	34	12	74	69	37	12	44	48	49	12	37	123	38
84	39	34	13	166	62	43	13	41	45	41	13	37	63	42
64	32	41	14	73	61	39	14	39	45	41	14	40	71	43
51	37	97	15	50	69	41	15	38	49	39	15	61	65	48
40	34	106	16	40	55	36	16	37	52	39	16	66	138	74
46	36	117	17	43	55	28	17	36	54	44	17	137	132	12
35	38	93	18	49	53	37	18	44	49	40	18	150	98	0
37	34	106	19	42	50	40	19	43	58	46	19	72	128	0
41	38	100	20	45	43	33	20	38	49	62	20	56	148	67
37	39	96	21	38	35	32	21	36	44	51	21	47	132	101
40	42	77	22	36	64	33	22	38	50	45	22	52	104	100
41	47	57	23	34	35	33	23	43	49	39	23	47	118	66
33	76	70	24	33	42	35	24	55	43	40	24	79	110	54
39	68	88	25	34	44	48	25	47	42	39	25	63	93	47
43	102	56	26	35	34	45	26	49	40	39	26	63	154	45
41	59	50	27	31	48	35	27	43	39	37	27	78	103	43
51	53	39	28	35	39	36	28	44	40	44	28	54	70	47
45		39	29	30	34	36	29	40	43	47	29	44	109	50
46		34	30	41	33	44	30	35	47	70	30	56	115	45
51		68	31		32		31	38	47		31	89		55

**Appendix 6.2 Port Renfrew WWTP 2009 Compliance and Treatment Plant Performance Monitoring Data**

Date	Influent			Secondary Effluent (Undisinfected)					
	TSS (mg/L)	TBOD (mg/L)	Fecal coliforms (cfu/100mL)	TSS (mg/L)	TBOD (mg/L)	CBOD (mg/L)	Fecal coliforms (cfu/100mL)	Ammonia (mg/L)	pH
2009 Jan 21	77	162	1700000	39	20	18	65000	1.3	4.8
2009 Feb 17	68	134	1700000	10	10	6	100000	2.2	6.4
2009 Mar 17	212	148	1700000	5	4	<4	59000	0.1	6.5
2009 Apr 21	82	81	530000	8	5	<4	21000	0.2	6.1
2009 May 19	96	173	1000000	30	12	9	11000	1.1	6.2
2009 Jun 16	249	236	14000000	35	9	5	8800	2.2	3.8
2009 Jul 21	135	155	3200000	11	<4	<4	1500	2.9	3.7
2009 Aug 18	136	172	20000000	32	8	7	44000	4.5	3.8
2009 Sep 22	275	214	9500000	35	25	12	24000	4.0	5.8
2009 Oct 20	260	156	14000000	19	12	9	5600	0.2	6.4
2009 Nov 17	39	64	370000	5	8	<4	2400	0.1	6.3
2009 Dec 15	98	265	840000	13	9	5	1800	0.2	5.2
<b>Mean</b>	<b>150</b>	<b>163</b>	<b>2602287</b>	<b>20</b>	<b>11</b>	<b>7</b>	<b>13272</b>	<b>1.6</b>	<b>5.4</b>
<b>Min</b>	<b>39</b>	<b>64</b>	<b>370000</b>	<b>5</b>	<b>4</b>	<b>5</b>	<b>1500</b>	<b>0.1</b>	<b>3.7</b>
<b>Max</b>	<b>275</b>	<b>265</b>	<b>20000000</b>	<b>39</b>	<b>25</b>	<b>18</b>	<b>100000</b>	<b>4.5</b>	<b>6.5</b>
<b>N</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>12</b>	<b>8</b>	<b>12</b>	<b>12</b>	<b>12</b>
<b>Mean Daily Loading</b>	<b>kg/day</b>	<b>kg/day</b>		<b>kg/day</b>	<b>kg/day</b>	<b>kg/day</b>		<b>kg/day</b>	<b>kg/day</b>
	<b>8.6</b>	<b>9.4</b>	<b>---</b>	<b>1.2</b>	<b>0.6</b>	<b>0.4</b>	<b>---</b>	<b>0.1</b>	<b>---</b>
<b>Total Annual Loading</b>	<b>tonne/yr</b>	<b>tonne/yr</b>		<b>tonne/yr</b>	<b>tonne/yr</b>	<b>tonne/yr</b>		<b>tonne/yr</b>	<b>tonne/yr</b>
	<b>0.3</b>	<b>0.3</b>	<b>---</b>	<b>0.04</b>	<b>0.02</b>	<b>0.01</b>	<b>---</b>	<b>0.00</b>	<b>---</b>

## 7.0 REFERENCES

- APHA, 1998. Standard Methods for the Examination of Water and Wastewater, 20th Edition. American Public Health Association, Washington, DC.
- BCMOE (British Columbia Ministry of Environment). 2002. Environmental Management Act and Health Act, Organic Matter Recycling Regulation. Queens Printer, Victoria, BC Canada.
- BCMELP (British Columbia Ministry of Environment, Lands and Parks), 1999. Waste Management Act Municipal Sewage Regulation. Queen's Printer for British Columbia, Victoria, BC Canada.
- BCMWLAP (British Columbia Ministry of Water, Land and Air Protection), 2001. British Columbia Water Quality Guidelines (Criteria): 1998 Edition updated August 24, 2001. Queen's Printer for British Columbia, Victoria, BC Canada.
- CRD, 2005. Gulf Islands and Port Renfrew Wastewater and Marine Environment Program 2004 Annual Report. Capital Regional District Environmental Services, Victoria, BC Canada.
- CRD, 2006. Gulf Islands and Port Renfrew Wastewater and Marine Environment Program 2005 Annual Report. Capital Regional District Environmental Services, Victoria, BC Canada.
- CRD, 2007. Gulf Islands and Port Renfrew Wastewater and Marine Environment Program 2006 Annual Report. Capital Regional District Environmental Services, Victoria, BC Canada.
- CRD, 2008. Gulf Islands and Port Renfrew Wastewater and Marine Environment Program 2007 Annual Report. Capital Regional District Environmental Services, Victoria, BC Canada.
- CRD, 2008. Regional Source Control Program Annual Report 2008. Capital Regional District Environmental Services, Victoria, BC Canada.
- Olmstead, M.E. and R.W. Warman, 1989. Report on 1988 Waste Management Branch Permit Monitoring Data. Capital Regional District Engineering, Victoria, BC Canada.
- Olmstead, M.E. and R.W. Warman, 1990. Report on 1989 Waste Management Branch Permit Monitoring Data. Capital Regional District Engineering, Victoria, BC Canada.
- Pym, R.V., 1991. Report on 1990 Waste Management Branch Permit Monitoring Data. Capital Regional District Engineering, Victoria, BC Canada.
- Pym, R.V., 1992. Report on 1991 Waste Management Permit Monitoring for Outfalls Operated by the Capital Regional District of British Columbia, Canada. Capital Regional District Engineering, Victoria, BC Canada.
- Pym, R.V., 1993. Report on 1992 Waste Management Permit Monitoring for Outfalls Operated by the Capital Regional District of British Columbia, Canada. Capital Regional District Engineering, Victoria, BC Canada.
- Pym, R.V., 1994. Report on 1993 Waste Management Permit Monitoring for Outfalls Operated by the Capital Regional District of British Columbia, Canada. Capital Regional District Engineering, Victoria, BC Canada.
- Pym, R.V., 1995. Report on 1994 Waste Management Permit Monitoring for Outfalls Operated by the Capital Regional District of British Columbia, Canada. Capital Regional District Engineering, Victoria, BC, Canada.

Pym, R.V., 1996. Report on 1995 Waste Management Permit Monitoring for Outfalls Operated by the Capital Regional District of British Columbia, Canada. Capital Regional District Engineering, Victoria, BC Canada.

Pym, R.V., 1997. Report on 1996 Waste Management Permit Monitoring for Outfalls Operated by the Capital Regional District of British Columbia, Canada. Capital Regional District Environmental Services, Victoria, BC Canada.

Pym, R.V., 1998. Report on 1997 Waste Management Permit Monitoring for Outfalls Operated by the Capital Regional District of British Columbia, Canada. Capital Regional District Environmental Services, Victoria, BC Canada.

Pym, R.V., 1999. Report on 1998 Waste Management Permit Monitoring for Outfalls Operated by the Capital Regional District of British Columbia, Canada. Capital Regional District Engineering, Victoria, BC Canada.

Pym, R.V., 2000. Report on 1999 Waste Management Permit Monitoring for Outfalls Operated by the Capital Regional District of British Columbia, Canada. Capital Regional District Engineering, Victoria, BC Canada.

Pym, R.V., 2001. Report on 2000 Waste Management Compliance Monitoring for Outfalls Operated by the Capital Regional District of British Columbia, Canada. Capital Regional District Engineering, Victoria, BC Canada.

Pym, R.V., 2002. Report on 2001 Waste Management Compliance Monitoring for Outfalls Operated by the Capital Regional District of British Columbia, Canada. Capital Regional District Engineering, Victoria, BC Canada.

Pym, R.V., 2003. Report on 2002 Waste Management Compliance Monitoring for Outfalls Operated by the Capital Regional District of British Columbia, Canada. Capital Regional District Engineering, Victoria, BC Canada.

Pym, R.V., 2004. Report on 2003 Waste Management Compliance Monitoring for Outfalls Operated by the Capital Regional District of British Columbia, Canada. Capital Regional District Engineering, Victoria, BC Canada.

Seaconsult Marine Research Ltd., 1994. Wastewater Dilution and Dispersion for the Ganges Treatment Plant Outfall. Prepared for the Capital Regional District, Victoria, BC Canada.