CAPITAL REGIONAL DISTRICT
Environmental Services

STORMWATER QUALITY REPORT SOUTHERN GULF ISLANDS ELECTORAL AREA 2004 - 2006

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STORMWATER QUALITY REPORT
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2004 - 2006

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1.0 INTRODUCTION

The Southern Gulf Islands Electoral Area (SGI EA) is roughly 21,600 hectares in size and has a population of approximately 4,300. Land use is varied and includes agricultural, commercial, industrial, institutional and residential.

Development within the SGI EA continues to increase, as does the human influence on the land and its marine coastline. Increasing tourism, property development and expanding businesses and industry all have the potential to impact stormwater quality and freshwater and marine aquatic life. To minimize this impact, the flows from selected storm drains and watercourses along the SGI coastline continue to be monitored to ensure that the threats to public health and the environment are identified and dealt with.

The Capital Regional District (CRD) Stormwater Harbours and Watersheds program (SHWP) has been active on the SGI since 1997. Program activities are undertaken in consultation with the SGI EA Director (Rich Tamboline from 2003 to 2005 and Director Susan DeGryp from 2005 to present) and involve the monitoring of flows from storm drains and watercourses in the more heavily developed regions of North Pender, Saturna, Mayne and Galiano islands. This program works to identify and minimize the impacts of contaminated stormwater runoff on the environment and public health and protect potable water supplies and freshwater and nearshore marine ecosystems.

The authority to undertake this work is included in the Southern Gulf Islands Stormwater Quality Management Extended Service Establishment Bylaw No. 1, 1996. This bylaw allows the CRD to control pollution in stormwater runoff from land by investigating, monitoring and reporting on stormwater and sediment quality. It also allows the CRD to prioritize areas for investigation, carry out public education programs and coordinate stormwater quality management programs.

From 2004 to 2006, the CRD SHWP continued to provide services to the SGI EA. The program works to limit the impacts of contaminated stormwater runoff on the environment and protect public health. This report covers five main areas of activities:

1. Stormwater Flow Surveys
2. Upstream Investigations
3. Bennett Bay Monitoring
4. Monitoring of Major Watercourses
5. Special Projects

From 2004 to 2006, stormwater flow surveys were carried out along the more heavily settled portions of the SGI EA. Selected stormwater flows were sampled and analyzed for fecal coliform (indicator of the presence of sewage) and chemical contaminant levels (metals and polycyclic aromatic hydrocarbons (PAHs)). Stormwater flows entering the potable water supplies of Magic and Buck lakes on North Pender Island and Money Lake on Saturna Island were also sampled and analyzed for fecal coliform to protect public health.

In addition to point of discharge sampling, the catchment areas of flows having elevated or high fecal coliform counts were investigated upstream to determine the source(s) of bacteria contamination. The CRD does not have the authority to directly implement mitigative programs. This continues to be the responsibility of the Vancouver Island Health Authority (VIHA), First Nations and other government agencies.

Bennett Bay was monitored in 2005 and 2006 at the request of the SGI EA director. Stormwater flows entering the bay were included in the SGI coastline survey while six nearshore marine surface water stations were monitored for fecal coliform levels. This work was undertaken to provide information regarding the level of contamination entering the National Marine Park and any impact it may be having on this body of water.

In 2003, the SGI EA sampling program was expanded to assess water quality of selected creeks and streams. A monitoring program for these watercourses was initiated to assess fecal coliform, temperature, pH, dissolved oxygen, specific conductance and turbidity levels. In 2005, nitrate and phosphorus were added as monitoring parameters. This program is initiated to protect aquatic life in known fish-bearing streams and to monitor for change over time.

From 2004 to 2006, the SHWP continued to work towards opening shellfish beds on the SGI EA. Staff continues to work towards reducing/eliminating contaminants at the source through upstream investigations and public education.

The SHWP undertook a number of special projects within the CRD between 2004 and 2006 to aid in the protection of stormwater quality. Some of these projects provide information applicable to the SGI EA and were therefore discussed with the director. These special projects included:

- continued development of the Natural Areas Atlas
- promotion of the Model Storm Sewer and Watercourse Bylaw and development of codes of practice for various industries
- collecting Global Positioning System (GPS) coordinates for selected stormwater discharges in the SGI EA
- continued development of an enhanced education program to promote: contamination reduction and water conservation through displays and information handouts at community events; adoption of best management practices (BMPs) (strategies for preventing pollution); and reporting spills

Similar programs exist in the Juan de Fuca Electoral Area, District of Sooke, Saanich Peninsula, and in the seven core area municipalities of the CRD. These programs have been very successful in identifying and helping to eliminate stormwater pollution.

Other government agencies having direct or indirect involvement with stormwater quality issues include:

- Islands Trust
- Ministry of Transportation (MOT)
- Ministry of Environment (MOE)
- Ministry of Forests (MOF)
- Fisheries and Oceans Canada (DFO)

Appendix A discusses the roles and responsibilities of these agencies in regard to stormwater protection.

2.0 STORMWATER FLOW RATING SYSTEM

The CRD evaluates stormwater flows for public health and environmental concerns using a rating system for stormwater flows developed by the CRD titled *Stormwater Discharge Rating System for the Capital Regional District* (Drinnan, 1997). As part of the rating system, stormwater quality field technicians and community members evaluated the coastline for levels of public use, coastline habitat sensitivity and flushing characteristics of the receiving marine waters. Combined with the sampling results gathered each year, this information is used to determine a rating for flows on the SGI EA. These ratings prioritize areas where further action is required and allow the jurisdictions involved to better manage limited funds and undertake remedial measures where necessary. A brief explanation of the stormwater flow rating system follows.

2.1 Public Health Concern

The parameters used to assess the level of concern for public health are:

- fecal coliform concentrations in stormwater flows. Fecal coliform bacteria are found in the gut and feces of warm-blooded animals. These bacteria are indicators of contamination due to failing on site treatment systems, improper manure storage and human/animal presence in and around the watercourses
- flow rate
- location of the flow (above or below the high waterline or intertidal)
- public use of the shoreline (such as swimming, fishing, kayaking or beach use)

Each flow is then rated with a high, moderate or low level of concern for public health based on the parameters.

To determine the public health concern rating, a fecal coliform rating and a public use of the shoreline rating are calculated and totalled. The following briefly describes how the two ratings are assigned.

1. The categories for determining the fecal coliform rating are:

    - "1" if the fecal coliform count is consistently under the SHWP guideline of 200 fecal coliform per 100 millilitres (expressed as FC/100 mL) or if no flows exist
    - "2" if the fecal coliform count is between 200 and 5,000 FC/100 mL
    - "3" if the fecal coliform count is greater than 5,000 FC/100 mL

When determining the fecal coliform rating other factors such as flow rates and location of flow with respect to the high waterline are considered.

2. The categories for determining the public use rating are:

    - "1" for low public use such as beach walking
    - "2" for secondary contact such as fishing
    - "3" for primary contact such as swimming and scuba diving

These two ratings are totalled to determine the level of public health concern as shown in Table 1. The rating system is used as a guide and is sometimes modified to accommodate site specific or extenuating circumstances.

Table 1. Categories for Public Health Concern Ratings

Sum of Public Use and Fecal Coliform Ratings	Level of Concern	Recommendations
2 or 3	Low	No action required
4	Moderate	Surveillance required
5 or 6	High	Action required

Sampling is continued for flows rated high and moderate for public health concern until the problems are resolved and fecal coliform counts are confirmed to be low. Flows rated low usually do not require continued surveillance. Exception to this sampling protocol is streams with significant flow, which are sampled every year regardless of the public health concern rating due to the large size of the catchment areas. A stream with a large catchment area has an increased chance of developing new sources of pollution and the probability of human contact along the flow of a stream is higher. As well, flow sampling was concentrated in the more heavily developed areas of the SGI EA due to the potential for septic tanks and fields to fail. Continued monitoring of flows entering potable water supplies was carried out to protect human health. Flows rated low are sampled at least once every five years as part of a long-term strategy to monitor for possible changes in the future.

2.2 Environmental Concern

Environmental concerns are based on the level of contaminants in the sediment from stormwater flows. A contaminant rating is first determined by comparing the level of the eight metals and the two groups of organic contaminants (C_n) with the CRD marine sediment quality guidelines (MSQG or L_n). When the ratio (C_n/L_n) for a particular parameter exceeds 0.75, the parameter of concern is highlighted for further monitoring or investigation. These ratios (C_n/L_n) are then totalled to calculate the toxic equivalent unit (TEU) to account for potential additive effects. Table 2 provides the criteria for determining the contaminant rating.

Table 2. Criteria for Determining the Contaminant Rating

Contaminant Rating	Criteria for Determining the Contaminant Rating
Low	Sum of the individual ratios of C_n/L_n (TEU) is less than 1.0.
Moderate	Sum of the individual ratios of C_n/L_n (TEU) is greater than or equal to 1.0 but no individual parameter exceeds, or is equal to, a value of 0.75.
High	The ratio C_n/L_n is greater than, or equal to, 0.75 for any single parameter.

All flows monitored for environmental concern are sampled at least twice to confirm the contaminant concentrations and contaminant(s) of concern. Only a small number of stormwater related sediment samples can be analyzed each year due to budgetary constraints, therefore each flow selected for sampling can only be sampled once per year. Flows with a confirmed high contaminant rating require further investigations to determine the source(s). The priority in which flows with a high contaminant rating should be investigated is determined by calculating a habitat rating. This mitigative priority rating (high, moderate or lower) is calculated using a number of environmental factors which include habitat sensitivity, flow rates and marine flushing characteristics. The following briefly describes the rating criteria for the habitat rating:

1. The categories for determining the habitat sensitivity rating are:

    - "1" for lower productivity and less diverse habitats
    - "2" for areas of moderate productivity and diverse habitats
    - "3" for areas with high productivity or endangered or protected habitats

2. The categories for determining the flow ratings are:

    - "0.5" for flows less than 50 L/min.
    - "1.0" for flows between 50 to 500 L/min.
    - "1.5" for flows greater than 500 L/min.

3. The categories for determining the marine flushing ratings are:

    - "0.5" for areas of open shoreline with high flushing
    - "1.0" for partially enclosed areas with moderate flushing
    - "1.5" for very enclosed or embayed areas with poor flushing

These three ratings (habitat sensitivity, flow rates and marine flushing) are totalled to determine a habitat rating as shown in Table 3. The habitat rating assigned to each flow will allow limited resources to be spent in a prioritized manner.

Table 3. Criteria for Establishing the Habitat Rating

Habitat Rating and Mitigative Priority	Sum of Criteria (Habitat+Flow+Flushing)
Lower	2.0 - 3.0
Moderate	3.5 - 4.5
High	5.0 - 6.0

2.3 Other Concerns

There are a number of other concerns that are jointly reviewed and discussed by the SQP staff and staff from the jurisdictions involved when setting priorities for remediation of flows with a high level of concern for public health and/or the environment. These include:

- the cost of remediation
- the likelihood that the remediation will succeed
- compatibility with the priorities of the jurisdictions
- public interest

3.0 SAMPLING PROGRAM

3.1 Survey Area

The SGI survey area included portions of the coastline of North Pender, Saturna, Mayne and Galiano islands and selected inland areas. The 2004 to 2006 stormwater sampling program was designed in consultation with the SGI EA director. Figures 1, 2 and 3 in Section 4 provide an overview of the entire survey area.

Appendix B contains figures showing the location of each stormwater flow visited within the SGI EA study area. Figures P1 through P7 show the locations of stormwater flows visited on North Pender Island and Figures S1 through S7 on Saturna Island. Figures M1 through M4 show the locations of stormwater flows visited on Mayne Island and G1 through G3 on Galiano Island.

In addition, flows entering two lakes in Magic Lake Estates (Buck and Magic lakes) on North Pender Island (Figure P3 and P4) and flows entering Money Lake on Saturna Island (Figure S3) were sampled to measure fecal coliform levels entering the local potable water storage areas. Stormwater samples were also collected and analyzed for fecal coliform at the mouth of an unnamed creek (7004, flowing into Magic Lake on North Pender, Figure P4), Lyall Creek (7413, flowing into Lyall Harbour on Saturna Island, Figure S4) and Georgeson (Putter) Creek (7820, flowing into Whaler Bay on Galiano Island, Figure G2).

Sewage treatment in the study areas consists mostly of onsite septic tanks and fields or small sewage treatment plants (with in ground disposal). These systems, if they fail, have the potential to contaminant stormwater flows, potable water supplies and the marine environment. A large portion of the more densely developed Magic Lake Estates and Lyall Harbour area are serviced by sewage collection systems and sewage treatment plants. Appendix F provides results of sampling undertaken by CRD Operations division to monitor potable water supplies on North Pender and Saturna islands.

In addition, monitoring was initiated in the Bennett Bay area to establish baseline data and protect the marine park from potential contaminant sources (i.e., onsite sewage disposal, automobile deposition, etc.). Monitoring data is presented in Appendix G.

3.2 Fecal Coliform Sampling for Public Health Concern

Stormwater discharges are evaluated for public health concerns by sampling each discharge for fecal coliform and determining the public use of the shoreline (Section 2.1). Each discharge is rated high, moderate or low using this information and the CRD rating system. The rating system allows the jurisdictions involved to better manage limited funds and undertake remedial measures where necessary.

Each year, SHWP staff samples the following:

- all flows with known high fecal coliform levels regardless of the public health concern rating
- stormwater flows with high or moderate levels of public health concern identified during the previous year
- high flow creeks and streams because of their exposure to contamination and the likelihood of people coming into direct contact with these flows
- approximately 20% of the stormwater discharges previously rated low as part of a longer term strategy to monitor for change

Between 2004 and 2006, 69 SGI EA stormwater flows were visited and rated for public health concern. Samples from these flows were collected as close as possible to the point of discharge to the marine environment. To avoid influence from waters not originating in the flows, such as salt water, some watercourses were followed upstream to the nearest location where representative samples could be collected. In addition, upstream samples were collected from flows entering Magic Lakes Estates (Magic and Buck lakes) on North Pender Island and Money Lake on Saturna Island to protect these potable water supplies from possible source(s) of contamination.

Samples were collected during wet weather and dry weather conditions (January to April and June to September respectively) to represent seasonal changes. Appendix C provides sampling data for flows monitored between 1998 and 2006 and Appendix D provides 2004 to 2006 public health concern ratings.

In addition to the coastline sampling program, upstream sampling investigations were carried out in the catchment areas of 11 stormwater flows between 2004 and 2006 to help narrow down the area and/or identify the source(s) of contamination. The results of these investigations are presented in Section 4.1.5.

A detailed description of stormwater sampling methods and associated quality assurance/quality control (QA/QC) methods is provided in Appendix E.

3.2.1 Bennett Bay Monitoring

Bennett Bay is a National Marine Park and in 2005 concern was expressed regarding possible contamination from the surrounding land entering the protected water body. Therefore SHWP, at the request of the 2005 SGI EA director (Rich Tamboline), collected stormwater samples from flows entering Bennett Bay which were analyzed for fecal coliform, temperature, dissolved oxygen, pH, specific conductance, turbidity, phosphorus and nitrate-nitrogen. Where applicable, samples were compared to the British Columbia Approved Water Quality Guideline (BCAWQG), Canadian Council of Ministers of the Environment (CCME) criteria or the Stormwater Harbours and Watersheds Program guideline (SHWPG) (refer to Table 4 for specific criteria).

Table 4. Water Quality Guidelines and Criteria

Parameter	Canadian Council of Ministers of the Environment Criteria	British Columbia Approved Water Quality Guideline	Stormwater, Harbours and Watersheds Program Guidelines
Fecal Coliform	na	14 FC/100 mL[1]	200 FC/100 mL[2]
Temperature	$\leq 15^{o}C$	$19^{o}C$	na
pH	6.5 – 9.0	6.5 to 9.0	na
Dissolved Oxygen	5.5 – 9.5 mg/L	6 mg/L	na
Specific Conductance	na	50 to 1500 µS/cm	na
Turbidity	≤5 NTU	8 NTU[3]	na
Nitrate[4]	2.95 mg/L NO_3-N	10 mg/L NO_3-N	na
Phosphorus	0.035 to 0.1 mg/L P[5]	0.010 mg/L[6]	na

1 MOE shellfish harvesting criterion requires that a minimum of five samples be collected over a 30-day period and the median fecal coliform concentration should not exceed 14 FC/100 mL.

2 VIHA assesses risk to health based on 30-day log mean averages of sample results taken from foreshore waters where there is an expectation that people will be swimming. These results are then compared to the Guidelines for Canadian Recreational Water Quality. The log mean must not exceed 200 FC/100 mL.

3 For watercourses with ambient levels below 80 nephelometric turbidity units (NTU).

4 Expressed as nitrate-nitrogen (NO_3-N).

5 This guideline is used by the province to protect raw water sources (i.e., lakes used for drinking water) and is expressed as phosphorus (P).

6 This criterion is used for lakes that serve as a potable water source.

Also in 2005, nearshore marine surface water samples were collected from the bay to assess the impact from onsite sewage disposal and other human activities in the area. All sampling results collected in 2005 and 2006 were compared against the BCAWQG and the SHWPG (refer to Table 4 for specific criteria). The information gathered will provide an assessment of existing impacts and allow for the monitoring of change over time.

3.2.2 Quality Assurance and Quality Control for Fecal Coliform Sampling

The QA/QC program included replicate samples (field splits) for 10% of all samples collected. A field split consisted of a single sample being inverted 30 times and then split into two sample bottles. A detailed explanation of the QA/QC methods and results are provided in Appendix E.

3.3 Chemical Contaminant Sampling for Environmental Concern

Stormwater discharges are evaluated for environmental concern. The level of environmental concern is based on the level of metals and organic contaminants found in the sediments associated with the stormwater discharge. Discharges rated high in chemical contaminants are then prioritized for action on the basis of environmental factors, including habitat sensitivity, discharge flow rate and the flushing characteristics of receiving waters. All discharges, which have a high contaminant rating for two consecutive years of data, require action beginning with a detailed investigation to locate the source of contamination.

Between 2004 and 2006, 23 sediment samples were collected from 15 SGI EA stormwater flows and analyzed for eight metals and PAHs to assess environmental concerns (refer to Appendix H for discharges sampled and Appendix B for sampling locations). The flows chosen were located near environmentally sensitive areas, in creeks or near heavily settled areas where there is a greater risk of pollution.

All chemical contaminant data collected from 1999 to 2006 were used to assess environmental concerns between 2004 and 2006. Data from previous annual reports were included in the assessment to allow continued reporting of flows previously recommended for action. Sampling is discontinued after low contaminant levels have been confirmed. This allows limited funds to be re-allocated for sampling other flows.

The CRD sampling protocols require sediment samples to be collected in the following order of preference to ensure samples are not influenced by other sources. Modifications were made to protocol on a site specific basis:

- from within the mouth of the discharge or within a watercourse above tidal influence
- from an obvious "delta" outside the mouth of a storm drain
- from material located between larger rocks within one metre of the mouth of the discharge

3.3.1 Analysis of Metals and PAHs

Each sample was analyzed for eight metals: arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), silver (Ag) and zinc (Zn) and LPAH and HPAH respectively. Detailed information on sampling methods and QA procedures are outlined in Appendix H and Gormican (2004, 2006 and 2007).

3.4 Monitoring of Major Watercourses

Between 2004 and 2006, samples were collected from three SGI EA watercourses and analyzed for fecal coliform, temperature, pH, dissolved oxygen, specific conductance and turbidity. Nitrate-nitrogen (NO_3-N) and phosphorus were introduced into the watercourse monitoring program in 2005. The results were then compared to provincial or CCME aquatic life criteria to help determine:

- the ability to sustain fish and other aquatic life
- the contribution of contaminants from each jurisdiction
- whether the health of watercourses is changing over time

These watercourses were sampled at the point of discharge only. Upstream sampling locations will be established when and where the need arises.

4.0 RESULTS

4.1 Fecal Coliform Sampling for Public Health Concern

4.1.1 North Pender Island

Between 2004 and 2006, selected stormwater flows along the North Pender Island coastline were sampled and analyzed for fecal coliform bacteria levels. In addition, major flows entering Buck and Magic lakes were monitored. Figures P1 through P7 in Appendix B provide all the sampling locations for the 2004 to 2006 North Pender Island survey area, as well as the public use of the shoreline ratings and public health concern ratings (explained in Section 2.1). Appendix C provides all of the fecal coliform sampling data from 1998 to 2006, including flows, fecal coliform counts, station descriptions and other relevant information. Tables 1, 2 and 3 in Appendix D provides the 2004, 2005 and 2006 public health concern ratings (respectively) for all monitored sampling stations based on the CRD rating system. Section 4.1.5 provides information regarding upstream investigations undertaken for flows with elevated fecal coliform levels.

In 2004, 11 North Pender Island stormwater flows were visited and sampled where flows allowed. All 11 flows were rated low in 2004. Seven of these 11 flows were recommended for resampling in 2005 (note: due to the low public health concern ratings, none of the North Pender flows will show up on Figure 1 as being of concern).

Of the 17 North Pender Island flows visited in 2005, one was rated high (7002A) due to a high fecal coliform count of 5,600 FC/100 mL, one was rated moderate (7001A) due to an elevated fecal coliform count of 2,200 FC/100 mL (both collected during the summer) and 15 were rated low (refer to Figure 2 for the location of flows of concern). Flows 7001A and 7002A, as well as seven flows rated low, were recommended for resampling in 2006 to confirm fecal coliform levels and/or monitor for change.

In 2006, one of the 11 North Pender Island flows monitored was rated high (7001A due to a high fecal coliform count of 6,000 FC/100 mL during the summer) and ten were rated low (refer to Figure 3 for the location of flows of concern). Flow 7001A and the nine flows rated low in 2006, are recommended for resampling in 2007.

CRD Operations and Local Services Activities – Buck and Magic Lake

CRD Operations and Local Services staff collect water samples for fecal coliform analysis (and other parameters) in Buck and Magic lakes as part of their monitoring program to protect these public drinking water supplies (data from 2004 to 2006 is provided in Appendix F). These samples were collected from the raw water intake systems which draw from well below the surface of the lakes to avoid nearshore and surface water contamination.

None of the fecal coliform samples collected from Magic and Buck lakes during the period of 2004 to 2006 exceeded the Guidelines for Canadian Recreational Water Quality of 200 FC/100 mL[1] (note: these samples were collected from the lakes prior to the water treatment process).

Water samples are also collected and analyzed for fecal coliform bacteria in the distribution system from the two lakes after treatment. All of the post treatment sampling results met the Canadian and British Columbia drinking water standards (M. McCallum, pers. comm.).

[1] *The Vancouver Island Health Authority's environmental health officer assesses risk to health based on 30-day log mean averages of sample results taken by the Health department from foreshore waters where there is an expectation that people will be swimming. These results are then compared to the Guidelines for Canadian Recreational Water Quality. The log mean must not exceed 200 FC/100 mL.*

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Figure 1
Southern Gulf Islands 2004 Stormwater Discharges of Concern

- High Public Health Concern
- Moderate Public Health Concern
- High Environmental Concern
- Moderate Environmental Concern
- First Nations Reserve
- Streams and Rivers
- Major Lakes
- Survey Area
- Southern Gulf Islands Electoral Area
- CRD

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Figure 2
Southern Gulf Islands 2005
Stormwater Discharges of Concern

- High Public Health Concern
- Moderate Public Health Concern
- High Environmental Concern
- Moderate Environmental Concern
- First Nations Reserve
- Streams and Rivers
- Major Lakes
- Survey Area
- Southern Gulf Islands Electoral Area
- CRD

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Figure 3
Southern Gulf Islands 2006
Stormwater Discharges of Concern

- High Public Health Concern
- Moderate Public Health Concern
- High Environmental Concern
- Moderate Environmental Concern
- First Nations Reserve
- Streams and Rivers
- Major Lakes
- Survey Area
- Southern Gulf Islands Electoral Area
- CRD

Technologist: KE - Jun 14/06 SGI_SWDConcern_2004-2006.mxd

4.1.2 Saturna Island

From 2004 to 2006, selected stormwater flows along the Saturna Island coastline were sampled and analyzed for fecal coliform bacteria levels. Also, flows entering and leaving Money Lake were monitored and rated to protect this potable water supply. Figures S1 through S7 in Appendix B provide the sampling locations for the 2004 to 2006 Saturna Island survey area, as well as the public use of the shoreline ratings and public health concern ratings (refer to legend on Figure 1 in Appendix B). Table 1 in Appendix C provides all the fecal coliform sampling data for 1998 to 2006, including flows, fecal coliform counts, station descriptions and other relevant information. Table 1, 2 and 3 in Appendix D provides the 2004, 2005 and 2006 public health concern ratings (respectively) for all monitored sampling stations based on the CRD rating system (described in Section 2.1). Section 4.1.5 provides information regarding upstream investigations undertaken for flows with elevated fecal coliform levels.

In 2004, 15 Saturna Island stormwater flows were visited and sampled where flows allowed. Two stations (7413 and 7413-1) are located along the same flow (Lyall Creek) and both were rated moderate in 2004 due to elevated fecal coliform counts during the summer (1,453 and 1,160 FC/100 mL respectively). Of the other 13 flows sampled in 2004, one (7407) was rated moderate due to an elevated fecal coliform counts during the summer (1,800 FC/100 mL) and 12 were rated low (refer to Figure 1 for the location of flows of concern). All flows rated moderate in 2004 and six of the discharges rated low were recommended for resampling to confirm contaminant levels and/or monitor for change.

Of the 18 Saturna Island flows visited in 2005, three were rated moderate (7407, 7411 and 7412) due to elevated fecal coliform counts (805 FC/100 mL during the summer, 600 FC/100 mL during the fall/winter and 1,600 FC/100 mL during the winter/spring respectively, refer to Figure 2 for the location of flows of concern) and 15 were rated low. The three flows rated moderate and nine flows rated low were recommended for resampling in 2006 to confirm fecal coliform levels and/or monitor for change.

In 2006, two of the 16 Saturna Island flows monitored were rated high (7407 and 7413-2) and 14 were rated low. Flows 7407 and 7413-2 (an upstream tributary for Lyall Creek) each had high fecal coliform counts during the summer (8,878 FC/100 mL and 92,000 FC/100 mL respectively, refer to Figure 3 for the locations of flows of concern). Both flows rated high and 10 flows rated low were recommended for resampling in 2007 to confirm fecal coliform levels and/or monitor for change.

CRD Operations Activities – Money Lake

CRD Operations and Local Services staff collect water samples for fecal coliform analysis (and other parameters) in Money Lake throughout the year as part of their monitoring program to protect this drinking water supply (data for 2004 to 2006 is provided in Appendix F).

Raw Lake water samples were collected at depth to avoid nearshore and surface water contamination. None of the Money Lake fecal coliform samples collected between 2004 and 2006 exceeded the Guidelines for Canadian Recreational Water Quality of 200 FC/100 mL[2].

Post treatment water samples were also collected to monitor water quality prior to distribution. All of the post treatment sampling results met the Canadian and British Columbia drinking water standards (M. McCallum, pers. comm.).

4.1.3 Mayne Island

From 2004 to 2006, selected stormwater flows along the Mayne Island coastline were monitored and assessed for public health concern. Figures M1 through M4 in Appendix B provide the sampling locations for the 2004 to 2006 Mayne Island survey area, as well as the public use of the shoreline ratings and public health concern ratings (refer to legend on Figure 1 in Appendix B). Table 1 in Appendix C provides

[2] *The Vancouver Island Health Authority's Environmental Health Officer assesses risk to health based on 30 day log mean averages of sample results taken by the Health department from foreshore waters where there is an expectation that people will be swimming. These results are then compared to the Guidelines for Water Quality. The log mean must not exceed 200 FC/100 mL.*

all the fecal coliform sampling data for 1998 to 2006, including flows, fecal coliform counts, station descriptions and other relevant information. Table 1, 2 and 3 in Appendix D provides the 2004, 2005, 2006 public health concern ratings (respectively) for all monitored sampling stations based on the CRD rating system (described in Section 2.1). Section 4.1.5 provides information regarding upstream investigations undertaken for flows with elevated fecal coliform levels.

Of the 20 Mayne Island flows monitored in 2004, one was rated high (7614) due to a very high fecal coliform count (116,800 FC/100 mL) collected during the winter and one was rated moderate (7,600) due to a slightly elevated fecal coliform count (338 FC/100 mL) collected during the summer (refer to Figure 1 for flows of concern). Eighteen of the 20 flows visited in 2004 were rated low for public health concern. The flows rated high and moderate and 11 flows rated low were recommended for resampling in 2005 to confirm contaminant levels and/or monitor for change.

In 2005, 15 Mayne Island flow were monitored and assigned a public health concern rating. Two of the 15 flows were rated high (7613 and 7614), three were rated moderate (7600, 7615 and 7627) and 10 were rated low (refer to Figure 2 for flows of concern). Flow 7613 and 7614 had high fecal coliform counts during the winter (2,200 and 7,200 FC/100mL respectively). Flows 7600, 7615 and 7627 had fecal coliform counts of 1,200 FC/100 mL during the summer and 640 and 2,200 FC/100 mL during the winter respectively. The two flows rated high, the three flows rated moderate and four of the 10 flows rated low were recommended for continued surveillance in 2006 to confirm contaminant levels and/or monitor for change.

In 2006, eight Mayne Island flows were monitored. Of these eight flows, two were rated high (7613 and 7614) due to high fecal coliform counts during the winter (5,200 and 5,600 FC/100 mL respectively) and two were rated moderate (7600 and 7615) due to slightly elevated counts (600 FC/100 mL during the summer and 780 FC/100 mL during the winter respectively, refer to Figure 3 for flows of concern). Four flows were rated low. All eight flows monitored in 2006 will be revisited in 2007 to confirm contaminant levels and/or monitor for change.

4.1.4 Galiano Island

From 2004 to 2006, selected stormwater flows along the Galiano Island coastline were monitored and assessed for public health concern. Figures G1 through G3 in Appendix B provide the sampling locations for the 2004 to 2006 Galiano Island survey area, as well as the public use of the shoreline ratings and public health concern ratings (refer to legend on Figure 1 in Appendix B). Table 1 in Appendix C provides all the fecal coliform sampling data for 1998 to 2006, including flows, fecal coliform counts, station descriptions and other relevant information. Table 1, 2 and 3 in Appendix D provides the 2004, 2005 and 2006 public health concern ratings (respectively) for all sampling stations based on the CRD rating system (described in Section 2.1). Section 4.1.5 provides information regarding upstream investigations undertaken for flows with elevated fecal coliform levels.

Three stormwater flows were monitored on Galiano Island in 2004. Of these three flows, two were rated low (7800 and 7810) and one (7820) could not be rated. Flow 7820 could not be accessed during the winter and was dry in the summer. Therefore, no rating could be assigned. This flow and one of the flows rated low were recommended for resampling to confirm contaminant levels and/or monitor for change.

Two Galiano Island flows (7800 and 7820) were monitored in 2005. One flow was rated high (7800) due to a high fecal coliform count of 2,000 FC/100 mL during the winter and the other was rated low (refer to Figure 2 for the location of flows of concern). Both flows were recommended for continued surveillance to confirm contaminant levels and/or monitor for change.

Three Galiano Island flows (7800, 7810 and 7820) were monitored in 2006. Two flows were rated low and and one was rated moderate (7810). Two of the three (7800 and 7820) were recommended for continued surveillance to confirm contaminant levels and/or monitor for change.

4.1.5 Bennett Bay Monitoring

In 2005, an investigation was initiated to identify the level of contaminants entering the Bennet Bay National Marine Park through stormwater flows. Four stormwater flows draining to Bennett Bay were monitored for fecal coliform, pH, temperature, dissolved oxygen, specific conductance, turbidity, phosphorus and nitrate-nitrogen levels (refer to Table 1 in Appendix G). This monitoring was undertaken to examine the level of contaminants entering the bay. As well, six Bennett Bay marine nearshore stations were monitored to identify fecal coliform levels in the bay itself (refer to Table 2 in Appendix G for monitoring data and Figure 4 for sampling locations).

Stormwater Sampling

In 2005 and/or 2006, eight samples were collected from the four Bennett Bay stormwater flows and analyzed for fecal coliform. Seven of these eight samples were collected during wet weather conditions. Only one sample could be collected during the summer (of 2006) due to the lack of flows. Of the eight samples collected, seven were above the provincial shellfish harvesting criteria of 14 FC/100 mL while three were above the SHWPG of 200 FC/100 mL (2,200 FC/100 mL from flow 7627 during the winter of 2005 and 282 and 210 FC/100 mL collected from flow 7627 during the winter and summer of 2006 respectively). Flow 7627 had the highest fecal coliform count (2,200 FC/100 mL collected during the winter of 2005). This flow was revisited late in 2005 to confirm counts and undertake upstream investigations. No samples, however, could be collected due to a lack of flows. Monitoring continued in 2006 and the winter count was considerably lower. This flow will continue to be monitored in 2007 to confirm lower counts.

Only two of the four Bennett Bay stormwater flows (flow 7626 and 7627) could be monitored for pH, temperature, dissolved oxygen, specific conductance, turbidity nitrate-nitrogen and phosphorus in 2005 and/or 2006. The following lists measurements which did not meet provincial and/or federal criteria levels:

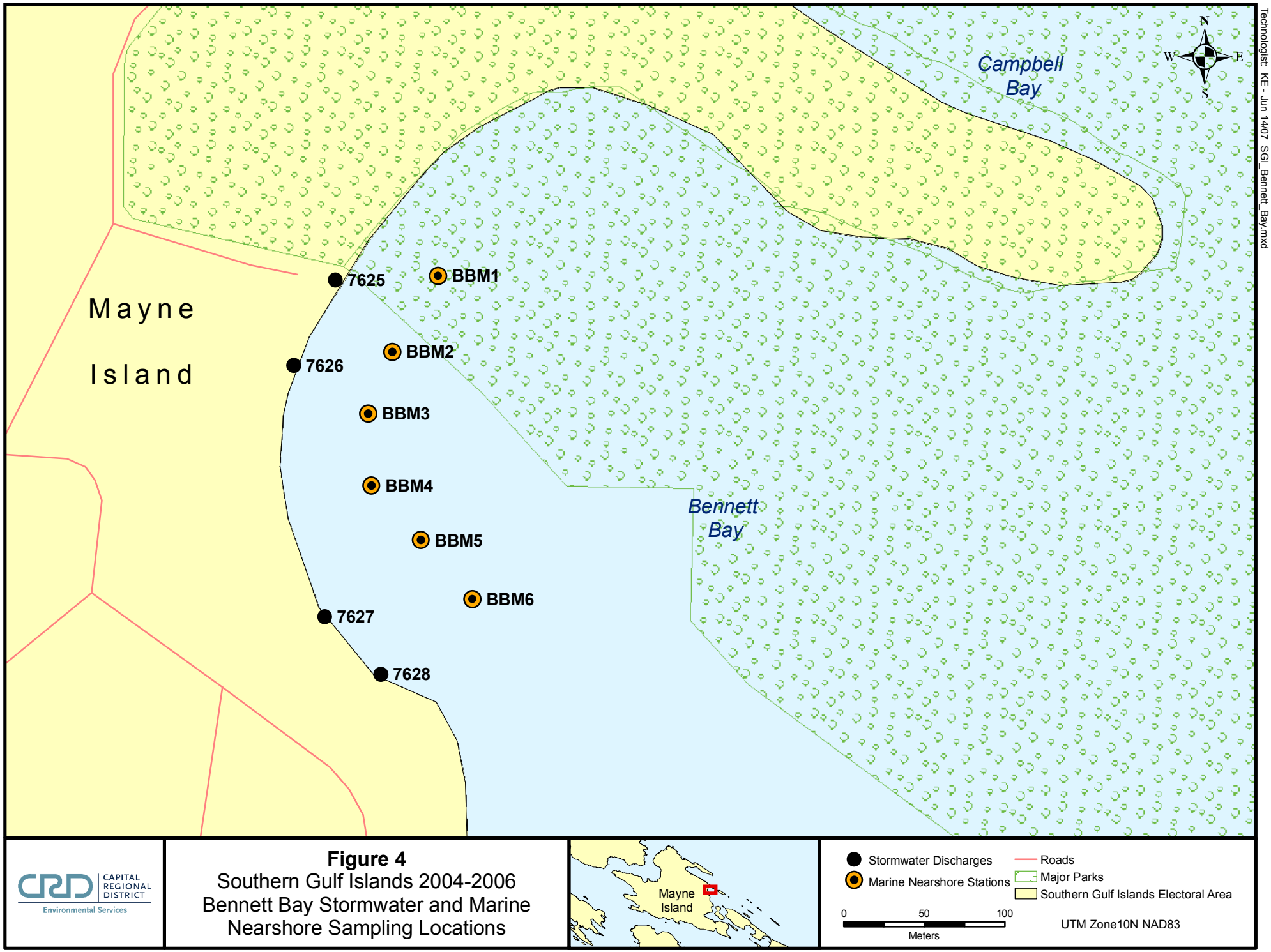
- Flow 7626
  - a dissolved oxygen measurement of 3.51 mg/L during the winter of 2006
  - a specific conductance measurement of 49.0 μS/cm during the winter of 2006
  - a turbidity measurement of 17.10 NTU during the winter of 2005
  - a phosphorus measurement of 0.42 mg/L during the winter of 2005

- Flow 7627
  - a specific conductance measurement of 3.2 μS/cm during the winter of 2006
  - turbidity measurements of 24.00 and 9.01 NTU during the winter of 2005 and 2006 respectively
  - a phosphorus measurement of 0.54 mg/L during the winter of 2005

Measurements not meeting the provincial and/or federal criteria levels may indicate the presence of contaminant sources in the catchment area. However, more data are required to properly assess these flows for the various parameters. These flows will continue to be monitored in 2007 to identify contaminants and possible trends.

Marine Sampling

Six nearshore surface water stations were monitored in 2005 and 2006 during wet weather and dry weather conditions. Monitoring was undertaken to determine the effect that proximal onsite sewage disposal was having on the marine receiving environment.


Campbell Bay
Mayne Island
7625
BBM1
BBM2
7626
BBM3
BBM4
Bennett Bay
BBM5
BBM6
7627
7628
N
W
E
S
Technologist: KE - Jun 14/07 SGI_Bennett_Bay.mxd
CAPITAL REGIONAL DISTRICT
Environmental Services
Figure 4
Southern Gulf Islands 2004-2006
Bennett Bay Stormwater and Marine
Nearshore Sampling Locations
Mayne Island
Stormwater Discharges
Marine Nearshore Stations
Roads
Major Parks
Southern Gulf Islands Electoral Area
0
50
100
Meters
UTM Zone10N NAD83

Of the 24 samples collected from the six sites, three were above the shellfish harvesting criteria of 14 FC/100 mL while two were also above the SHWPG of 200 FC/100 mL. Station BBM3, BBM4 and BBM6 each had elevated fecal coliform counts during the summer of 2006 (210, 224 and 27 FC/100 mL respectively). Birds and/or marine animals have not been ruled out as possible sources for the elevated counts. All Bennett Bay marine stations will be visited in 2007 and Bacterial Source Tracking (BST) samples collected if counts are elevated.

4.1.6 Upstream investigations

From 2004 to 2006, the SGI stormwater quality program continued to work towards identifying sources of fecal coliform contamination during upstream investigations. These efforts have been successful in identifying and often eliminating sources of elevated fecal coliform concentrations. Upstream investigations were undertaken based on the following criteria:

- trends in fecal coliform data from winter to summer that are often associated with failing onsite sewage disposal systems
- large amounts of vegetation often found in flows contaminated with fecal coliform bacteria
- in response to public concerns regarding odours and visual signs of stormwater contamination

The following flows had elevated fecal coliform levels in 2004, 2005 and/or 2006 and SHWP staff have carried out upstream sampling and investigations within the catchment areas to identify sources of contamination.

4.1.6.1 North Pender Island

Flows 7001A and 7002A (outflow and inflow for Buck Lake, see Figure P3 in Appendix B) had elevated fecal coliform counts during the summer of 2005 (2,200 and 5,600 FC/100 mL respectively). These flows were investigated in December 2005 and fecal coliform counts were low at both sampling stations. Flow 7001A also had a high fecal coliform count during the summer of 2006 (6,000 FC/100 mL) and will be investigated upstream during the summer of 2007. A BST sample will be collected to assist in determining the species responsible for the contamination. This will help focus attention in the appropriate direction. Flow 7002A had lower fecal coliform counts in 2006 and will be revisited in 2007 to monitor for change.

4.1.6.2 Saturna Island

Flow 7407 (Boot Cove, see Figure S1 in Appendix B) had elevated fecal coliform counts during the summer of 2004 (1,800 FC/100 mL). This flow was revisited in 2005 to confirm contaminant levels and had a slightly elevated count during the summer. Fecal coliform and BST samples were collected from the point of discharge to the marine receiving environment in order to identify the species responsible for the elevated counts. Although the fecal coliform count was low, the BST results indicated human and ruminant animals as the dominant species causing bacterial contamination.

In 2006, a high fecal coliform count (8,878 FC/100 mL) was again obtained during the summer. This flow was resampled to confirm contaminant levels and counts were much lower but still elevated (800 FC/100 mL). Samples for BST analysis were collected during the summer and fall. Ruminant animals were the dominant species in the summer while no bacteroides were found in the sample collected in the fall. Upstream investigations have narrowed down the area of contamination to a swampy area where birds and animals likely congregate. This discharge will be monitored in 2007 and further investigations undertaken if contamination levels remain high.

Flow 7411 (Lyall Harbour, see Figure S4 in Appendix B) had low fecal coliform counts during the winter and summer of 2005 but was resampled in December 2005 during an upstream investigation for flow 7412. Fecal coliform counts in December 2005 were slightly elevated (600 FC/100 mL). This flow was monitored in 2006 and winter counts were low while no flow was present during the summer. Monitoring of this flow will continue in 2007 to confirm lower contaminant levels and further upstream investigations undertaken if high fecal coliform levels are obtained.

Flow 7412 (Lyall Harbour, see Figure S4 in Appendix B) had an elevated fecal coliform count (1,600 FC/100 mL) during the winter of 2005. This flow was resampled in the spring of 2005 and counts were low. SHWP staff also visited this flow in December 2005 and collected samples for fecal coliform and BST analysis. Fecal coliform counts were slightly elevated (727 FC/100 mL) while BST results indicated the presence of both ruminant animals and humans with humans possibly as the predominant species. In 2006, the winter fecal coliform count was low while there was no flow during the summer. This flow will be monitored in 2007 and upstream investigations undertaken if contaminant levels are elevated.

Flows 7413-2 (tributary to Lyall Creek, see Figure S4 in Appendix B) had a very high fecal coliform count (92,000 FC/100 mL) during the summer of 2006. This flow was resampled later in the summer and counts were higher (437,200 FC/100 mL). A BST sample was collected from flow 7413-2 during the summer. However, no bacteroides were found in the sample to identify the species responsible for the contamination. A second sample was collected from Lyall Creek (7413-1) downstream of station 7413-2. This sample indicated ruminant animals as the dominant species. Pig and human bacteroides were also found in lesser amounts. VIHA staff were notified of the findings and will be dye-testing two properties in the catchment area in 2007 to ensure onsite sewage disposal systems are not contributing to the contamination. As well, further investigations will be undertaken by SHWP staff to identify the source(s).

4.1.6.3 Mayne Island

Flow 7600 (Deacon Creek, see Figure M1 in Appendix B) had an elevated fecal coliform count (1,200 FC/100 mL) during the summer of 2005. This flow was investigated in December 2005 and counts were low. In 2006, counts were slightly elevated (600 FC/100 mL) during the summer. This flow will be revisited in 2007 and a sample will be collected during the summer for BST analysis to help identify the species responsible for bacterial contamination during dry weather conditions.

Flow 7613 (Miner's Bay, see Figure M2 in Appendix B) had an elevated fecal coliform count (2,200 FC/100 mL) during the winter of 2005. This flow was revisited two more times in 2005 and counts were much lower. A sample collected from this flow during the winter of 2006 had a high fecal coliform count (5,200 FC/100 mL). This flow was revisited in the spring and counts were much lower. However, a sample collected during the summer had an elevated fecal coliform count (1,600 FC/100 mL). An upstream investigation undertaken in 2006 identified a possible source of contamination. SHWP and VIHA staff will undertake further investigations and dye-test the property in 2007. This flow will continue to be monitored in 2007.

Flow 7614 (Miner's Bay, see Figure M2 in Appendix B) had elevated fecal coliform counts during the winter and summer of 2004 (116,800 and 2,600 FC/100 mL respectively). VIHA were notified and dye-tested an onsite sewage disposal system located immediately upstream. The results of this dye-test were negative. Fecal coliform counts collected in 2005 and 2006 were high during the winter (7200 and 118,400 FC/100 mL respectively). In 2006, upstream investigations narrowed down the area of contamination and a possible source was identified. SHWP and VIHA staff will undertake further investigations and dye-test the property in 2007. This flow will continue to be monitored in 2007.

Flow 7627 (Bennett Bay, see Figure M3 in Appendix B) had an elevated fecal coliform count (2,200 FC/100 mL) during the winter of 2005. This flow was revisited two more times in 2005. However, samples could not be collected due to a lack of flow. In 2006, the winter fecal coliform count was low while no flows were present during the summer. This flow will continue to be monitored in 2007 and upstream investigations undertaken if counts are elevated.

4.1.6.4 Galiano Island

Flow 7800 (Georgeson Creek, see Figure G1 in Appendix B) had an elevated fecal coliform count of 2,000 FC/100 mL during the winter of 2005. An upstream investigation was undertaken and fecal coliform counts were low. Counts during the winter of 2006 were also low while no flows were present during the summer. Further upstream investigations will be undertaken in 2007 if counts are elevated.

4.1.7 Quality Assurance and Quality Control Results

The analysis of the fecal coliform QA/QC data from the laboratory were satisfactory. A detailed description of the results is provided in Appendix E.

4.2 Chemical Contaminant Sampling for Environmental Concern

From 2004 to 2006, 23 sediment samples were collected from 15 stormwater flows within the SGI EA (six flows on North Pender Island (7002, 7003, 7004, 7015, 7021 and 7022), four flows on Saturna Island (7402, 7407, 7411 and 7413), three flows on Mayne Island (7625, 7626 and 7627) and two flows on Galiano Island (7800 and 7820). The sediments from each flow were analyzed for eight metals and PAHs to determine a contaminant rating as described in Section 2.2.

Table 1 in Appendix H provides chemical contaminant concentrations for each sediment sample collected between 1998 and 2006. Chemical concentrations are compared to the CRD MSQG to identify the level of environmental concern. Table 2 shows calculated TEUs which are obtained by summing the concentration/MSQG ratio for each parameter. Shading in Table 1 and 2 in Appendix H indicates exceedence of 75% of the MSQG which is used as the threshold for environmental concern and criteria to determine environmental concern ratings. The contaminant ratings are then determined according to the magnitude of the TEU (refer to Section 2.2 for environmental concern rating guide). Table 3 in Appendix H provides a summary of the contaminant ratings and recommendations. Table 4 in Appendix H prioritizes the level of remedial action based on a habitat rating (high, moderate or low) to help determine which discharges should be addressed first. Flows rated moderate or high for environmental concern are shown on Figures 1, 2 and/or 3.

4.2.1 North Pender Island

All six flows (7002, 7003, 7004, 7015, 7021 and 7022) sampled for environmental concern on North Pender Island between 2004 and 2006 were rated low. The following discusses these flows:

- **Flow 7002** – enters the northern side of Buck Lake (a potable water supply) on North Pender Island (see Figure P3 in Appendix B). This flow was monitored for the first time in 2004 and received a low contaminant rating. This flow was monitored in 2005 to confirm lower contaminant levels and was again rated low. Monitoring will be discontinued for five years (2010) now that contaminant levels have been confirmed.

- **Flow 7003** – enters the southwestern side of Buck Lake (a potable water supply) on North Pender Island (see Figure P3 in Appendix B). This flow was monitored for the first time in 2004 and received a low contaminant rating. This flow was revisited in 2005 and 2006 and contaminant levels were also low. Monitoring will be discontinued for five years (2010) now that contaminant levels have been confirmed.

- **Flow 7004** – enters the northern side of Magic Lake (a potable water supply) on North Pender Island (see Figure P4 in Appendix B). This flow was sampled for the first time in 2004 and received a low contaminant rating. Contaminant levels were also low in 2005 and monitoring will be discontinued for five years (2010) now that contaminant levels have been confirmed.

- **Flow 7015** – located in the Bedwell Harbour on North Pender Island (see Figure P6 in Appendix B). This flow received a low contaminant rating in 2006 but was rated high in 2001 due to a high HPAH concentration and moderate in 2002 and 2003 based primarily on slightly elevated chromium and zinc concentrations. In 1999, this flow was rated low. Monitoring will continue in 2007 to confirm lower contaminant levels.

- **Flow 7021** – located in the Port Browning Harbour on North Pender Island (see Figure P7 in Appendix B). This flow received a low contaminant rating in 2006 and was also rated low in 1999. Sampling will be discontinued for five years (2011) now that lower contaminant levels have been confirmed.

- **Flow 7022** – located in the Port Browning Harbour on North Pender Island (see Figure P7 in Appendix B). This flow received a low contaminant rating in 2006 and was also rated low in 2001. Monitoring will be discontinued for five years (2011) now that lower contaminant levels have been confirmed.

4.2.2 Saturna Island

Three flows (7402, 7407 and 7411) were sampled for environmental concern along the Saturna Island coastline from 2004 to 2006. The following discusses these flows:

- **Flow 7402** – south end of Boot Cove on Saturna Island (see Figure S1 in Appendix B). Sampled for the first time in 2004, flow 7402 received a high contaminant rating due to a high zinc concentration. This flow was resampled in 2005 to confirm contaminant levels and was rated moderate primarily due to a slightly elevated zinc concentration. In 2006, this flow was once again sampled to confirm contaminant levels and was rated moderate due to slightly elevated zinc concentrations. Monitoring will be discontinued for five years now that contaminant levels have been confirmed.

- **Flow 7407** – east side of Boot Cove on Saturna Island (see Figure S1 in Appendix B). This flow was monitored in 2006 to confirm low contaminant levels identified in 2002 and was again rated low. Monitoring will be discontinued for five years (2011) now that contaminant levels have been confirmed.

- **Flow 7411** – eastern shores of Lyall Harbour on Saturna Island (see Figure S4 in Appendix B). This flow was sampled for the first time in 2005 and was rated moderate due to slightly elevated zinc. This flow was monitored in 2006 to confirm contaminant levels and was rated low. Further monitoring will be undertaken in 2007 to confirm contaminant levels.

4.2.3 Mayne Island

Five flows (7600, 7613, 7625, 7626 and 7627) were sampled for environmental concern along the Mayne Island coastline from 2004 to 2006. The following discusses these flows:

- **Flow 7600** – Deacon Creek in Village Bay on Mayne Island (see Figure M1 in Appendix B). This flow was monitored in 2006 to confirm low contaminant levels identified in 2002 and was again rated low. Monitoring will be discontinued for five years (2011) now that contaminant levels have been confirmed.

- **Flow 7613** – foot of Fernhill Road in Miner's Bay on Mayne Island (see Figure M2 in Appendix B). This flow was monitored in 2004 to confirm low contaminant levels identified in 2003 and was again rated low. Monitoring will be discontinued for five years (2009) now that contaminant levels have been confirmed.

- **Flow 7625** – foot of beach access off Wilkes Road in Bennett Bay on Mayne Island (see Figure M3 in Appendix B). Sampled for the first time in 2005, flow 7625 received a low contaminant rating. This flow was resampled in 2006 to confirm contaminant levels and also rated low. Monitoring will be discontinued for five years (2011) now that contaminant levels have been confirmed.

- **Flow 7626** – north of Bennett Bay Road in Bennett Bay on Mayne Island (see Figure M3 in Appendix B). Sampled for the first time in 2005, flow 7626 received a low contaminant rating. This flow was resampled in 2006 to confirm contaminant levels and also rated low. Monitoring will be discontinued for five years (2011) now that contaminant levels have been confirmed.

- **Flow 7627** – south of intersection of Cedarhill Road and Arbutus Drive in Bennett Bay on Mayne Island (see Figure M3 in Appendix B). Sampled for the first time in 2005, flow 7627 received a low contaminant rating. This flow will be resampled in 2007 to confirm contaminant levels.

4.2.4 Galiano Island

Two flows (7800 and 7820) were sampled for environmental concern along the Galiano Island coastline from 2004 to 2006. The following discusses these flows:

- **Flow 7800** – south of intersection of Georgeson Bay Road and Active Pass Drive on Galiano Island (see Figure G1 in Appendix B). This flow was rated high in 2001 due to a high zinc concentration and was resampled in 2002, 2003 and 2004 to confirm contaminant levels. From 2002 to 2004, this discharge was rated low. Monitoring will be discontinued for five years (2009) now that contaminant levels have been confirmed.

- **Flow 7820** – north of Cayzer Road in Whaler Bay on Galiano Island (see Figure M2 in Appendix B). This flow was monitored in 2005 to confirm low contaminant levels identified in 2001 and was again rated low. Monitoring will be discontinued for five years (2010) now that contaminant levels have been confirmed.

When elevated stormwater sediment contamination levels are identified in the various flows on the SGI EA and confirmed, upstream sampling will be undertaken to identify sources of contamination. Source(s) of stormwater pollution and methods for preventing stormwater pollution are provided in Appendix J.

4.2.5 Quality Assurance Results

The results of the QA analysis for the 2004 to 2006 sediment sampling program were considered acceptable for the purpose of assigning chemical contaminant ratings. A detailed discussion on the QA results is provided in *Assessment of Metals and PAHs in Sediments from Stormwater Discharges and Creeks 2004 Sampling Program* (Gormican, 2005), *Assessment of Metals and PAHs in Sediments from Stormwater Discharges and Creeks 2005 Sampling Program* (Gormican, 2005) and *Assessment of Metals and PAHs in Sediments from Stormwater Discharges and Creeks 2006 Sampling Program* (Gormican, 2007). Refer to Appendix H for sampling procedure and analysis information.

4.3 Monitoring of Major Watercourses

Since 2003, three SGI watercourses (Buccaneer Creek - 7004 on North Pender Island, Lyall Creek - 7413 on Saturna Island and Putter Creek - 7820 on Galiano Island) have been monitored for the protection of aquatic life. This information is used to assess water quality and to monitor for change over time.

Results from fecal coliform analysis were compared to SHWPG of 200 FC/100 mL and the BCAWQG of 14 FC/100mL. Temperature, pH, dissolved oxygen, specific conductance and turbidity measurements were compared to 19°C, 6.5 to 9.0 pH units, 6.0 mg/L, 50 to 1500 μS/cm and 8.0 NTU respectively which were taken from guidelines established by the MOE for the protection of aquatic life (http://www.env.gov.bc.ca/wat/wq/BCguidelines/approv_wq_guide/approved.html). The nitrate-nitrogen (NO_3-N) criterion and the phosphorus eutrophication trigger range were taken from the CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQPAL) (http://www.ccme.ca/assets/pdf/wqg_aql_summary_table.pdf) and were 2.95 mg/L and 0.035 to 0.1 mg/L respectively.

All three SGI EA watercourses were monitored at the point of discharge as part of the Monitoring of Major Watercourses program (refer to Figure 5 for monitoring stations and Appendix I for parameter descriptions and sampling results).

The following summarizes data collected for the SGI EA monitoring of major watercourse program by creek.

CAPITAL REGIONAL DISTRICT
Environmental Services

Figure 5
Southern Gulf Islands 2004-2006
Monitoring of Major Watercourses

First Nations Reserves
Streams and Rivers
Major Lakes
Sewered Areas
Watersheds
Major Parks
Southern Gulf Islands Electoral Area
CRD

0 0.5 1 2
Kilometers
UTM Zone10N NAD83

Technologist: KE - June 14, 2007 SGI_Watersheds_2004-2006.mxd

Buccaneer Creek (Flow 7004)

Buccaneer Creek is located on North Pender Island and flows into Magic Lake (Figure P4 in Appendix B) and has a catchment area of approximately three hectares. Land use in the catchment area is residential, institutional and recreational. Magic Lake is stocked with Rainbow Trout by the provincial government. It is likely that these fish may also be found in flow 7004. Sculpins and stickleback are also likely present; however, there is limited literature available regarding known fish species in this watercourse.

Since 2004, there have been five fecal coliform sample collected from the inflow to Magic Lake. All five samples were below the SHWPG of 200 FC/100 mL. Three of these five samples were also below the MOE criteria of 14 FC/100 mL. The highest fecal coliform count (134 FC/100 mL) was collected during the summer of 2005.

Between 2004 and 2006, five temperature, pH, dissolved oxygen, specific conductance and turbidity measurements were collected. One of the five temperature measurements was above and one of the five dissolved oxygen measurements was below the provincial criteria (19.6^{o}C and 5.37 mg/L collected during the summer of 2004 respectively). All other measurements collected for pH, specific conductance and turbidity were within acceptable levels for the protection of freshwater aquatic life.

Nitrate-nitrogen and phosphorus measurements were monitored in Buccaneer Creek for the first time in 2005 and three measurements were collected between 2005 and 2006. None of the nitrate-nitrogen or phosphorus measurements were above the CCME criteria of 2.95 mg/L for nitrate-nitrogen or BCAWQG trigger range of 0.035 to 0.1 mg/L for phosphorus. More data, however, is required to properly assess this creek for these criteria.

Lyall Creek (Flow 7413)

Lyall Creek is located on Saturna Island and flows to Lyall Harbour (Figure S4 and S7 in Appendix B). This creek has a catchment area of approximately 730 hectares. Land use in the catchment area is agricultural, commercial, recreational and residential. The Lyall Creek Salmon Enhancement Group is currently working on this watercourse to re-establish fish populations. Presently, this creek is host to chum and coho salmon and Sea Run Cutthroat Trout.

Six fecal coliform samples were collected from Lyall Creek between 2004 and 2006. Three of the six samples were above the MOE criteria of 14 FC/100 mL while only one (1,453 FC/100 mL collected during the summer of 2004) was also above the SHWPG of 200 FC/100 mL. Upstream investigations have been undertaken within the catchment area of this flow and the source(s) of contamination narrowed down. Vancouver Island Health authority staff will be dye-testing several possible sources in 2007.

All temperature, dissolved oxygen, specific conductance and turbidity measurements collected between 2004 and 2006 were within acceptable levels for the protection of freshwater aquatic life.

One of the six pH measurements collected between 2004 and 2006 was above the provincial criteria range of 6.5 to 9.0. A measurement of 9.34 was collected during the winter of 2005. Although elevated, neither the specific conductance nor the dissolved oxygen measurements collected on the same day were affected indicating that an instrument error in the pH meter might have occurred.

Nitrate-nitrogen and phosphorus measurements were monitored in Lyall Creek for the first time in 2005. Four measurements were collected between 2005 and 2006. None of the nitrate-nitrogen measurements were above the CCME criterion of 2.95 mg/L while two of the four phosphorus measurements were above the trigger range of 0.035 to 0.1 mg/L. Phosphorus measurements of 0.15 and 0.14 mg/L were collected during the winter and summer of 2006. More data, however, is required to properly assess this creek for these criteria.

Putter Creek (Flow 7820)

Putter Creek is located on Galiano Island and flows into Georgeson Bay (Figure G2 in Appendix B). The catchment area for this creek is approximately 284 hectares in size. Land use in this area includes agricultural, commercial, institutional, recreational and residential.

Two fecal coliform samples were collected from Putter Creek between 2004 and 2006. Both of these samples were above the MOE criteria of 14 FC/100 mL while neither was above the SHWPG of 200 FC/100 mL. The highest fecal coliform count (56 FC/100 mL) was collected during the winter of 2005.

All temperature, pH, dissolved oxygen and specific conductance measurements collected between 2004 and 2006 were within acceptable levels for the protection of freshwater aquatic life.

One of the two turbidity measurements collected between 2004 and 2006 was above the provincial criteria of 8.0 NTU. A measurement of 12.20 NTU was collected during the winter of 2005 while a measurement collected during the winter of 2006 was lower.

Nitrate-nitrogen and phosphorus measurements were collected from Putter Creek for the first time in 2005. Four measurements were collected between 2005 and 2006. None of the nitrate-nitrogen measurements were above the CCME criterion of 2.95 mg/L while two of the four phosphorus measurements were above the trigger range of 0.035 to 0.1 mg/L. Measurements of 0.15 and 0.14 mg/L were collected during the winter and summer of 2006. More data, however, is required to properly assess this creek for these criteria.

4.4 Shellfish Bed Closure Areas

Shellfish along the SGI EA coastline included in the 2004 to 2006 study area (North Pender, Saturna, Mayne and Galiano islands) are an important food source to First Nations people and the community. Many of the recreational shellfish harvesting closure areas are located in close proximity to wharves, marinas and heavily settled foreshore areas using on site sewage treatment disposal. These conditions can result in the contamination of marine shellfish growing waters and are some of the more common reasons for closure postings.

In similar areas CRD staff have identified five primary methods by which fecal coliform bacteria is transmitted to land based stormwater flows and the marine environment. They are:

- failing septic tanks and fields
- problems with sewage collection systems
- poor agricultural practices
- sewage discharge from vessels
- non-point source pollution (recreational vehicle discharges, animals and birds)

CRD staff is working with the jurisdictions involved to address sources of pollution through the SGI EA Stormwater Quality program.

DFO, Environment Canada (EC) and the Canadian Food Inspection Agency (CFIA) are involved with regulating and monitoring shellfish harvesting. DFO is the lead agency in the administration of the Canadian Shellfish Sanitation program (CSSP) and is responsible for:

- opening and closing shellfish growing areas
- posting, patrolling and enforcing molluscan shellfish closures
- controlling shellfish cleaning operations

Shellfish can be harvested from closed areas under a special federal licence. They must be treated through depuration or other cleaning processes before being sent to market. Depuration is the process of

cleaning shellfish to reduce the level of bacteria and viruses that can accumulate as a result of filtering food from the surrounding water.

EC is the lead agency responsible for the survey and classification of shellfish growing areas, which includes:

- carrying out sanitary and bacteriological water quality surveys of the molluscan shellfish growing areas
- determining the sources of pollution, the degree and extent of contamination, and recommending the location of closure lines

The CFIA is the lead agency in the administration of the CSSP with regard to the handling, processing, import and export of shellfish and the marine biotoxin monitoring program. This agency is also responsible for recommending closure of harvesting areas to DFO because of unacceptable marine biotoxins.

Shellfish growing waters are closed for a variety of reasons including:

- high concentrations of fecal coliform bacteria; poisonous and deleterious substances to the extent that consumption of the shellfish might be hazardous
- existence of high levels of biotoxins (e.g. red tide)
- reduced population levels of shellfish (for conservation)
- proximity to (within 125 metres of) any structure used for boat moorage or any permanently anchored floating structure such as float homes
- proximity to other point and non-point pollution sources such as sewage outfalls and agricultural runoff

The specific criteria used for determining closures based on fecal coliform bacteria concentrations in the SGI EA are as follows:

- the area is contaminated with fecal material, poisonous and deleterious substances to the extent that consumption of the shellfish might be hazardous
- a minimum of 15 samples are collected at each site. The time period over which these samples are collected vary. The median fecal coliform concentration of the water is calculated and must not exceed 14 FC/100 mL, and/or more than 10% of the samples exceed a fecal coliform concentration of 43 FC/100 mL

Figure 6 provides the location of shellfish beds closed for recreational harvesting in the SGI EA. These areas can only be harvested under special license.

EC's Shellfish Growing Water Quality Protection program is designed to identify and evaluate all actual and potential sources of pollution to growing and harvesting areas. The SHWP works to assist this federal program through fecal coliform sampling of stormwater flows entering the marine receiving environment and upstream investigations to identify source(s) of contamination.

Southern Gulf Island Closures

There are 10 annual and two seasonal shellfish bed closures in the SGI EA stormwater quality program survey area at the time of the 2004 to 2006 survey. These closures include the following:

- Closure 17.E – The waters and intertidal foreshore of Montague Harbour, Galiano Island, inside a line drawn from the southeastern tip of Gray Peninsula northeasterly to the base of the overhead cable tower on the northeasterly foreshore of the harbour – May 31 to September 30

CAPITAL REGIONAL DISTRICT
Environmental Services

Figure 6
Southern Gulf Islands 2004-2006
Shellfish Harvest Closure Areas

First Nations Reserves
Streams and Rivers
Major Lakes
Shellfish Closure Areas
Major Parks
Southern Gulf Islands Electoral Area
CRD

0 0.5 1 2
Kilometers
UTM Zone10N NAD83

Technologist: KE - June 12/07 SGI_ShellfishClosure_2004-2006.mxd

- Closure 17.8 – The waters and intertidal foreshore of Montague Harbour, Galiano Island, inside a line drawn from Winstanley Point, thence northerly to the base of the overhead cable tower on the northeastern shore of the harbour – January 1 to December 31

- Closure 17.34 – The waters and intertidal foreshore of northwest Montague Harbour, Galiano Island, within 125 m of the point where public docks meet the land at 48º53.85' north latitude and 123º24.18' west longitude (NAD 83) – January 1 to December 31

- Closure 18.B – The waters and intertidal foreshore of reef Harbour, lying inside a line drawn from the northeastern tip of Tumbo Island at 48º47.90' north latitude and 123º04.45' west longitude to cabbage Island thence along the northern shoreline of Cabbage Island to a point at 48º48.00' north latitude and 123º05.25' west longitude, and thence southward to a point on Tumbo Island at 48º47.75' north latitude and 123º05.25' west longitude (NAD 27) – May 31 to September 30

- Closure 18.6 – The waters and intertidal foreshore of North Pender Island from a point on land at Thieves Bay at 48º46.38' north latitude and 123º18.80' west longitude, including the waters of thieves Bay, thence southeasterly along the North Pender Island shore to the eastern end of Oaks Bluff at 48º44.92' north latitude and 123º16.00' west longitude (NAD 27) – January 1 to December 31

- Closure 18.7 – The waters and intertidal foreshore of Bedwell Harbour, lying inside of a line drawn across the harbour from a point on land on the south-western shore of South Pender Island located at 48º45.25' north latitude and 123º14.73' west longitude thence south-easterly to a point on land at 48º44.70' north latitude 123º13.75 west longitude – January 1 to December 31

- Closure 18.8 – The waters and foreshore of Hope Bay, North Pender Island, lying inside, that is south of a line drawn from the land end of government dock to Auchteronie Point on the opposite side – January 1 to December 31

- Closure 18.10 – The waters and intertidal foreshore at the head of Horton Bay, Mayne Island, inside a line drawn from the rock outcrop located west of Aiken Point at 48º49.80' north latitude and 123º14.70' west longitude located west of the public dock (NAD 27) – January 1 to December 31

- Closure 18.11 – The intertidal foreshore of Village Bay, Mayne Island, lying inside a line drawn from a point on land 125 m north of the ferry dock to Crane Point – January 1 to December 31

- Closure 18.14 – The waters and intertidal foreshore of Boot Cove, Saturna Island, lying inside a line from a point on land at 48º47.72' north latitude and 123º12.03' west longitude (NAD 83) – January 1 to December 31

- Closure 18.21 – The waters and intertidal foreshore at the head of Port Browning, North Pender Island, inside a line drawn from the public wharf on the northern shore of Port Browning at 48°46.70' north latitude and 123°15.95' west longitude, thence southwesterly to the edge of the rocky shoal at 48º46.30' north Latitude and 123°16.35' west longitude (NAD 27) – January 1 to December 31

- Closure 29.5 – The waters and foreshore of Whaler Bay, Galiano Island, lying inside, that is southeastern of a line drawn 265° True from Cain point to the western shore of Galiano Island – January 1 to December 31

EC has collected samples in the project area from 1964 to present. EC's sampling surveys are done every three years with the last survey report completed covering October 2003 to January 2006. Samples will continue to be collected every three years unless additional sampling is requested (by DFO, First Nations, regional districts, municipalities or public interest groups) or evidence exists that remediation of pollution sources has been completed.

Table 4 provides the results of the most recent 15 samples collected for EC along the Southern Gulf Islands coastline (see Figure 7 for sampling locations). These samples are used to assess the bivalve molluscan shellfish growing areas to ensure that water quality meets approved federal standards for direct harvesting.

EC's Shellfish Growing Water Quality Protection program is designed to identify and evaluate all actual and potential sources of pollution to growing and harvesting areas. The SHWP works to assist this federal program through fecal coliform sampling of stormwater discharges entering the marine receiving environment and upstream investigations to identify source(s) of contamination.

4.5 Contaminated Sites

To help determine the location of potential threats to stormwater quality on the Southern Gulf Islands, a Manager's Site Registry Report, containing a list of contaminated sites, was obtained from the Ministry of Water, Land and Air Protection, Environmental Management branch on March 6, 2007. This list contains information on sites that have entered the MOE site assessment and remediation process and includes sites that:

- are suspected of being contaminated
- are under assessment
- are under remediation
- have been remediated

This list only includes sites MOE was aware of as of March 6, 2007 and new and/or unidentified sites may exist. The following are the site locations, the contaminating activity (if available) and their status based on the 2007 site registry inquiry.

North Pender Island

- Gasoline storage tank at RR1 Bedwell Harbour near Hope Bay – status is active and site is currently under remediation.

- Former Petrocan on Murdock Road – status is inactive and site has been remediated for complex contamination.

- Driftwood Properties on Bedwell Harbour Road – status is active and site is under remediation for simple contamination.

- Wood, pulp and paper product industry, Aimes Road - currently status is inactive with no further action required.

- Esso Bulk Plant on Hasson Road - status is inactive and remediation completed for simple contamination resulting from petroleum product wholesale bulk storage or distribution and petroleum natural gas stored in above or below ground tanks.

- Bulk Plant at Port Browning Pier – the status is currently unknown for petroleum product wholesale bulk storage or distribution and petroleum natural gas stored in above or below ground tanks, the Fire Commissioner has required the emptying and purging of all tanks and lines.

Saturna Island

- Saturna Island landfill, East Point Road near Lyall Harbour – status is inactive and according to the registry "has been satisfactorily restored" and there will be "no further action".

Galiano Island

- Galiano Island Highway Yard, Georgeson Bay Road – status is currently active and under remediation of BC Hydro Pole Storage Area for complex contamination.

- Chevron Bulk Plant on Sturdies Bay Road – status is active and under assessment for petroleum or natural gas storage in above or below ground tanks.

- Galiano Island landfill on Porlier Pass Drive – status is currently active and under assessment for contaminants, possible activities include batteries storage (lead acid/others), municipal waste storage, recycling, composting and landfilling.

Mayne Island

- 280 Village Bay Rd – status is inactive with no further action pending. A notice of completion of independent remediation has been submitted.

- Possible auto salvage/wrecking, battery recycling and wood, pulp and paper product industry on Fernhill Road – status is unknown with a site visit pending.

This information will be useful when determining sediment sampling sites for environmental concern in the future. Sampling data for the listed sites was not available on the electronic site registry and must be researched at the MOE Nanaimo office. This will be done as necessary and as funds allow.

Table 4. Environment Canada Marine Fecal Coliform Levels Along the Southern Gulf Islands Coastline

Sector	Description	Station	Number of Samples Collected	Number >14 FC/100 mL	Number >43 FC/100 mL	Per Cent >43 FC/100 mL
GI01	Mayne Island	GI001	15	0	0	0%
		GI002	15	2	0	0%
		GI017	12	1	0	0%
		GI018	15	2	0	0%
		GI020	15	2	1	7%
		GI021	15	0	0	0%
		GI023	15	0	0	0%
		GI047	15	5	1	7%
		GI123	15	0	0	0%
		GI131	15	1	1	7%
		GI142	12	2	1	8%
		GI151	10	0	0	0%
		GI152	10	0	0	0%
		GI153	10	0	0	0%
		GI160	5	0	0	0%
		GI161	5	0	0	0%
GI02	Galiano Island	GI025	10	0	0	0%
		GI027	7	1	0	0%
		GI028	15	0	0	0%
		GI030	15	2	0	0%
		GI031	15	1	0	0%
		GI032	15	1	0	0%
		GI147	14	1	1	7%
GI03	Pender Island	GI032	7	2	1	14%
		GI033	15	0	0	0%
		GI036	15	1	1	7%
		GI038	15	2	1	7%
		GI039	15	1	0	0%
		GI040	13	0	0	0%
		GI041	15	1	0	0%
		GI108	15	1	0	0%
		GI110	15	3	2	13%
		GI111	15	1	0	0%
		GI150	10	0	0	0%
		GI154	10	0	0	0%
GI04	Saturna Island	GI003	15	3	1	7%
		GI042	15	1	0	0%
		GI053	15	4	2	13%
		GI062	15	0	0	0%
		GI071	15	5	2	13%
		GI077	15	2	1	7%
		GI155	10	0	0	0%
		GI156	10	0	0	0%
GI05	Tumbo Island	GI045	15	1	0	0%
		GI133	15	4	1	7%

continued

Table 4 continued

Sector	Description	Station	Number of Samples Collected	Number >14 FC/100 mL	Number >43 FC/100 mL	Per Cent >43 FC/100 mL
GI06	Wallace and Secretary Islands	GI125	15	4	1	7%
		GI126	15	3	2	13%
		GI127	15	0	0	0%
		GI130	15	0	0	0%
		GI162	5	0	0	0%
GI07	Portland and Moreseby Islands	GI046	15	0	0	0%
		GI048	15	0	0	7%
		GI049	15	2	1	0%
		GI050	15	0	0	0%
		GI052	15	2	2	13%
		GI157	6	0	0	0%
		GI158	6	1	1	1%

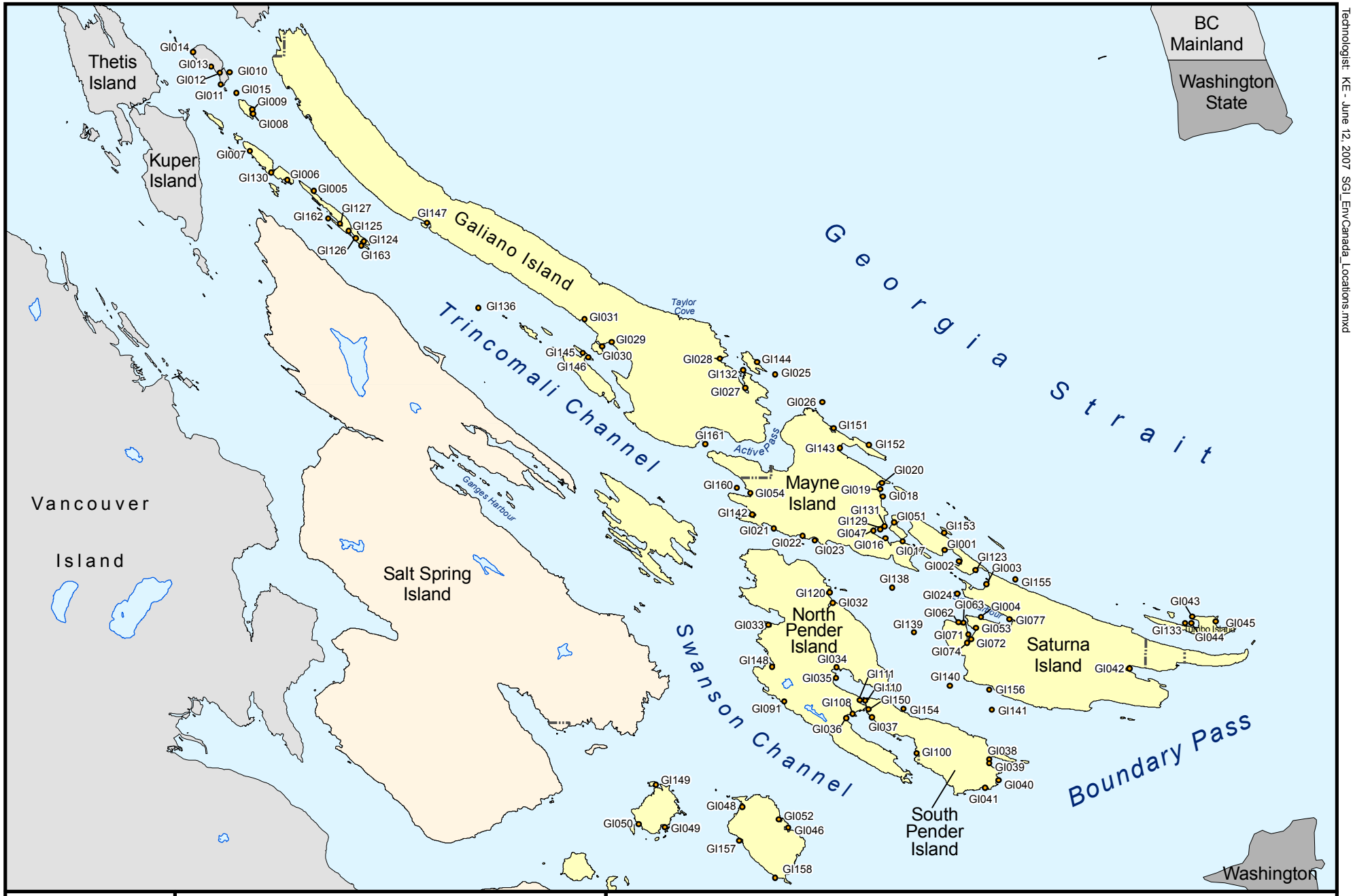


Figure 7
Southern Gulf Islands 2004-2006
Environment Canada Marine
Fecal Coliform Sampling Locations

CAPITAL REGIONAL DISTRICT
Environmental Services

- Environment Canada Marine Station Locations
- First Nations Reserve Boundaries
- Major Lakes
- Southern Gulf Islands Electoral Area
- CRD

N W E S

0 1 2 3 4 5
Kilometers
UTM Zone10N NAD83

Technologist: KE - June 12, 2007 SGI_EnvCanada_Locations.mxd

5.0 DISCUSSION AND CONCLUSION

5.1 Fecal Coliform Sampling for Public Health Concern

5.1.1 North Pender Island

From 2004 to 2006, selected stormwater flows on North Pender Island (refer to Figures P1 through P7 in Appendix B) were visited, sampled and assessed for public health concern. The following provides a more detailed discussion of the stormwater flows visited on North Pender Island.

In 2004, 11 North Pender stormwater flows were visited and sampled where flows allowed. All 11 flows were rated low. Seven of these 11 flows were recommended for continued surveillance to confirm contaminant levels and/or monitor for change.

In 2005, 17 North Pender flows were monitored for public health concern. One was rated high (7002A), one was rated moderate (7001A) and 15 were rated low. Flows 7002A, 7001A and seven flows rated low were recommended for continued surveillance to confirm assigned ratings and/or to monitor for change.

Eleven North Pender flows were monitored for public health concern in 2006. One flow (7001A) was rated high and ten flows were rated low. Flow 7001A and nine flows rated low were recommended for continued surveillance to confirm the assigned rating and/or monitor for change.

CRD Operations staff collects water samples for fecal coliform bacteria (and other parameters) in both Buck and Magic lakes as part of their monitoring program for the drinking water supply. All pre-treatment samples met the Guidelines for Canadian Recreational Water Quality while the post treatment samples met the Canadian and British Columbia drinking water quality standards. CRD SHWP staff did not collect samples from the lakes to avoid duplication of effort.

5.1.2 Saturna Island

From 2004 to 2006, selected stormwater flows on Saturna Island were visited, sampled and assessed for public health concern (refer to Figures S1 through S7 in Appendix B). The following provides a more detailed discussion of the stormwater flows visited on Saturna Island.

In 2004, 15 Saturna Island stormwater flows were monitored for public health concern. One of these flows was sampled at two stations in 2004 and both were rated moderate. Of the other 13 flows sampled, one was rated moderate and 12 were rated low for public health concern. Both flows rated moderate and six flows rated low were recommended for resampling in 2005 to confirm contaminant levels and/or monitor for change.

In 2005, three of the 18 Saturna Island flows monitored were rated moderate and the rest were rated low. The three flows rated moderate and nine flows rated low were recommended for resampling to confirm contaminant levels and/or monitor for change.

Sixteen Saturna Island stormwater flows were monitored for public health concern in 2006. Two of these 16 flows were rated high (7407 and 7413-2) and 14 were rated low. Both flows rated high and 10 rated low are recommended for resampling to confirm contaminant levels and/or monitor for change.

CRD Operations staff collects pre and post treatment water samples for fecal coliform analysis (and other parameters) in Money Lake as part of their monitoring program for the drinking water supply. All pre-treatment samples met the Guidelines for Canadian Recreational Water Quality while the post treatment samples met the Canadian and British Columbia drinking water quality standards. SHWP staff did not collect samples from the lake to avoid duplication of effort.

5.1.3 Mayne Island

From 2004 to 2006, selected stormwater flows on Mayne Island coastline were sampled and rated for public health concern (refer to Figures M1 through M4 in Appendix B). The following provides a more detailed discussion of the stormwater flows visited on Mayne Island.

Twenty Mayne Island stormwater flows were monitored in 2004 for public health concern. Of these 20 flows, one was rated high (7614), one was rated moderate and 18 were rated low. The flows rated high and moderate and eleven flows rated low were recommended for resampling to confirm contaminant levels and/or monitor for change.

In 2005, 15 Mayne Island stormwater flows were monitored for public health concern. Two of the fifteen flows were rated high (7613 and 7614), three were rated moderate and 10 were rated low. The two flows rated high, three flows rated moderate and four of the 10 flows rated low were recommended for resampling to confirm contaminant levels and/or monitor for change.

Of the eight Mayne Island flows monitored in 2006, two were rated high (7613 and 7614), two were rated moderate and four were rated low. All eight flows will be revisited in 2007 to confirm contaminant levels and/or monitor for change.

5.1.4 Galiano Island

From 2004 to 2006, selected stormwater flows on Galiano Island coastline were sampled and rated for public health concern (refer to Figures G1 through G3 in Appendix B). The following provides a more detailed discussion of the stormwater flows visited on Galiano Island.

Three Galiano Island stormwater flows were visited in 2004. Of these three flows, two were rated low and one was not rated due to lack of access during the winter. The flow which was not rated and one flow rated low were recommended for resampling to confirm contaminant levels and/or monitor for change.

In 2005, two Galiano Island stormwater flows were monitored for public health concern. One was rated high (7800) and one was rated low. Both flows were recommended for continued surveillance to confirm contaminant levels and/or monitor for change.

Three Galiano Island stormwater flows were monitored for public health concern in 2006. All three flows were rated low and two of the three will be revisited in 2007 to confirm contaminant levels and/or monitor for change.

5.1.5 Bennett Bay Monitoring

In 2005, an investigation was initiated to identify the level of contaminants entering the Bennet Bay National Marine Park through stormwater flows. Four stormwater flows draining to Bennett Bay were identified and monitored for a number of different parameters to determine contaminant levels entering the bay. As well, six Bennett Bay marine nearshore stations were monitored to identify fecal coliform levels in the bay itself.

From 2005 to 2006, eight fecal coliform samples and four sets of measurements for temperature, pH, dissolved oxygen, specific conductance, turbidity, nitrate-nitrogen and phosphorus were collected from the four stormwater flows entering Bennett Bay. In general, no obvious gross contamination in the four stormwater flows has been identified to date. The following summarizes the results:

Flow 7625 - this flow could only be sampled during the winter of 2005 due to lack of flows in the summer of 2005 and winter and summer of 2006. A low fecal coliform level was obtained during the winter of 2005. Flow levels were too low to monitor for other parameters.

Flow 7626 - this flow was only sampled during the winter of 2005 and 2006 due to a lack of flow during the summer. It had an elevated turbidity and phosphorus measurements during the winter of 2005 and a low dissolved oxygen and specific conductance measurements during the winter of 2006.

Flow 7627 - this flow was only sampled during the winter of 2005 and 2006 due to a lack of flow during the summer. It had an elevated fecal coliform count and turbidity and phosphorus measurements during the winter of 2005 and the specific conductance measurement was low and the turbidity measurement was elevated during the winter of 2006.

Flow 7627 - this flow was only sampled during the winter of 2005 and 2006 due to a lack of flow during the summer. It had a slightly elevated fecal coliform counts during the winter and summer of 2006. Flow levels were too low in 2005 and 2006 to monitor for the other parameters.

Measurements not meeting the provincial and/or federal criteria levels may indicate the presence of contaminant sources in the catchment area. However, more data is required to properly assess these flows for the various parameters. These flows will continue to be monitored in 2007 as part of the SGI EA stormwater monitoring program and upstream investigations undertaken if elevated contaminant levels are obtained.

Of the 24 marine nearshore surface water samples collected from the six marine stations, three were above the provincial shellfish harvesting criteria while two were also above the SHWPG of 200 FC/100 mL. Station BBM3, BBM4 and BBM6 each had elevated fecal coliform counts during the summer of 2006 (210, 224 and 27 FC/100 mL respectively). These stations will be monitored in 2007 and if fecal coliform counts are elevated, BST samples will be collected to determine the species responsible for the contamination.

5.1.6 Upstream Investigations

Eleven upstream investigations have been undertaken in the SGI EA to date. The following provides the results of these investigations according to the specific island visited:

- two upstream investigations were undertaken on North Pender Island. Both investigations were inconclusive due to low fecal coliform counts. One flow (7001A) will be investigated upstream during the summer of 2007. The other flow (7002A) will be monitored in 2007 and an upstream investigation initiated if counts are elevated.

- four upstream investigations were undertaken on Saturna Island. The area of contamination was narrowed down and a possible source identified for one flow (7407) while upstream investigations for three flows (7411, 7412 and 7413-2) were inconclusive due to lower fecal coliform counts and/or inconclusive BST results. Further investigations will be undertaken for all four flows if fecal coliform levels remain elevated in 2007.

- four upstream investigations were undertaken on Mayne Island. The area of contamination was narrowed down for two flows. VIHA staff have been notified and will dye-test in 2007 to confirm these source(s) of contamination. Upstream investigations for two flows were inconclusive due to low fecal coliform counts. These flow will be monitored in 2007 and further investigations undertaken if fecal coliform levels remain elevated.

- one upstream investigation was undertaken on Galiano Island. The investigation for this flow (7800) was inconclusive due to low fecal coliform counts. This flow will be monitored in 2007 and further investigations undertaken if fecal coliform levels remain elevated.

5.2 Chemical Contaminant Sampling for Environmental Concern

From 2004 to 2006, sediment samples were collected from 15 stormwater flows within the SGI EA. The following provides the results of the environmental concern monitoring for each island.

5.2.1 North Pender Island

From 2004 to 2006, six flows on North Pender Island (7002, 7003, 7004, 7015, 7021 and 7022) were monitored for environmental concern. All six flows were rated low due to low contaminant levels.

- Flow 7002 (Figure P2 in Appendix B) is recommended for monitoring in 2011 as part of the five year resampling program (refer to Section 2.2) now that low contaminant levels have been confirmed. Low contaminant levels have also been confirmed for flows 7003, 7004, 7021 and 7022 (Figure P2 and P4 in appendix B) and these flows will be revisited in 2011.

- Flow 7015 (Figure P3 in Appendix B) was rated high in 2001 due to a high HPAH concentration. In 2002 and 2003, this flow was rated moderate due to slightly elevated chromium and zinc concentrations. This flow was rated low in 2006 and will be revisited in 2007 to confirm lower contaminant levels.

5.2.2 Saturna Island

From 2004 to 2006, three flows on Saturna Island (7402, 7407 and 7411) were monitored for environmental concern. The following discusses these flows:

- Flow 7402 (Figure S1 in Appendix B) was sampled for the first time in 2004 and was rated high for environmental concern due to a high zinc concentration. In 2005 and 2006, this flow was rated moderate due to a slightly elevated zinc concentration. Monitoring will be discontinued for three years (2009) now that contaminant levels have been confirmed.

- Flow 7407 (Figure S1 in Appendix B) was rated low in 2006. This flow was also rated low in 2002 and will be revisited in 2011 now that contaminant levels have been confirmed.

- Flow 7411 (Figure S4 in Appendix B) was sampled in 2005 and 2006 and was rated low for environmental concern in both years. This flow will be revisited in 2011 now that contaminant levels have been confirmed.

5.2.3 Mayne Island

Five flows on Mayne Island (7600, 7613, 7625, 7626 and 7627) were sampled for chemical contaminants from 2004 to 2006. The following discusses these flows:

- Flow 7600 (Figure M1 in Appendix B) was rated low for environmental concern in 2002 and was resampled in 2006 to confirm contaminant ratings. This flow was again rated low and sampling will be discontinued until 2011 now that contaminant levels have been confirmed.

- Flow 7613 (Figure M2 in Appendix B) was rated low in 2003 and was resampled in 2004 to confirm contaminant ratings. This flow was again rated low and sampling will be discontinued until 2009 now that contaminant levels have been confirmed.

- Flows 7625 and 7626 (Figure M3 in Appendix B) were rated low in 2005 and 2006. Monitoring will be discontinued for these two flows until 2011 now that contaminant levels have been confirmed.

- Flow 7627 (Figure M3 in Appendix B) was rated low for environmental concern in 2005. This watercourse will be monitored in 2007 to confirm low contaminant levels.

5.2.4 Galiano Island

Two Galiano Island flows (7800 and 7820) were sampled for chemical contaminants from 2004 to 2006. The following discusses these flows:

- Flow 7800 (Figure G1 in Appendix B) was rated low for environmental concern in 2004. This flow was also rated low in 2002 and 2003 but was rated high in 2001 due to a high zinc concentration. Monitoring will be discontinued until 2009 now that contaminant levels have been confirmed.

- Flow 7820 (Figure G2 in Appendix B) was rated low for environmental concern in 2001 and 2005. Monitoring will be discontinued until 2010 now that contaminant levels have been confirmed.

Appendix J provides sources of chemical contaminants. This appendix also provides methods for preventing pollution from entering stormwater flows.

5.3 Monitoring of Major Watercourses

All major watercourse sampling station locations are shown in Figure 5. The results of this work have been discussed with the SGI EA director.

Of the thirteen fecal coliform samples collected from the three watercourses investigated (Buccaneer Creek on North Pender, Lyall Creek on Saturna and Georgeson Creek on Galiano), seven were found to be above the provincial shellfish criteria of 14 FC/100 mL. Of the three creeks, Lyall Creek had the highest recorded fecal coliform counts (1,453 and 188 FC/100 mL during the summer of 2004 and 2006 respectively. Upstream investigations were undertaken within the catchment area, however, no source(s) of contamination have been identified to date. SHWP and VIHA staff continue to investigate possible sources of contamination identified in an upstream tributary.

Fecal coliform sampling results may vary from year to year due to changes in precipitation levels. When precipitation levels increase, septic fields can become saturated and overflow. As well, feces from domestic animal and/or wildlife can enter stormwater flows through ground water. Higher precipitation levels can also decrease fecal coliform levels, as dilution becomes a factor. In general, areas with high levels of human settlement are found to contribute to higher levels of fecal coliform bacteria.

In general, temperature levels in the three watercourses were found to be low. This is due in part to the relatively low level of development around most of the watersheds. Loss of overhead vegetation and stormwater flows originating from impervious surfaces can increase temperatures and adversely affect fish populations. All but one temperature measurement were within provincial criteria for the protection of aquatic life. A measurement of 19.6^{o}C was collected from Bucaneer Creek (7004-1) during the summer of 2004. This creek has very low flows during the summer and little overhead vegetation in the lower reaches.

Contaminants typically originating from commercial-industrial and development activities can affect pH levels. All but one pH measurement collected from the three watercourses were within the provincial criteria for the protection of aquatic life. A measurement of 9.34 was collected from Lyall Creek during the winter of 2005. Dissolved oxygen and specific conductance measurements collected from Lyall Creek at the same time were low. Therefore, the elevated pH reading may have been a measurement error rather than due to contaminants in the watercourse.

Fertilizers, organic wastes (such as leaves and other vegetation), and fecal matter from humans and animals can all decrease oxygen levels in watercourses. Only one of the dissolved oxygen measurements collected from the three watercourses was below the provincial criteria for the protection of aquatic life. A measurement of 5.37 mg/L was collected from Bucaneer Creek during the summer of 2004. A lack of fresh water input into the watercourse was likely the primary contributing factor to the lower oxygen level.

Specific conductance measurements can be affected by high sediment levels and other contaminants. Specific conductance levels in all three watercourses were within the provincial criteria for the protection of aquatic life.

Only one measurement collected from the three creeks was above the provincial criteria for turbidity. A value of 12.20 NTU was obtained from Putter Creek during the winter of 2005. Activities which can affect turbidity levels include construction and development, road deposition and vegetation removal.

Nitrate-nitrogen (NO_3-N) can be affected by decaying plant debris or untreated human, animal or bird waste. Monitoring for this parameter was initiated in 2005 and all measurement collected from the Bucaneer, Lyall and Putter creek were below the provincial criteria. More data, however, is needed to properly assess these watercourses for this parameter.

Phosphorus (P) measurements can be affected by sewage, fertilizers, toothpaste, detergents, pesticides, fireworks, explosives, friction matches and natural occurring processes. Monitoring for this parameter was initiated in 2005 and three measurements were above the CCME trigger range of 0.035 to 0.1 mg/L. These exceedences occurred in Lyall and Putter creek during the winter of 2006 (0.15 and 0.24 mg/L respectively) and Lyall Creek during the summer of 2006 (0.14 mg/L). More data, however, is needed to properly assess these watercourses for this parameter.

The Monitoring of Major Watercourses program will be updated as changes in land use and other relevant information comes to light. Continued sampling is required to properly assess water quality for these water courses.

5.4 Shellfish Closures

Stormwater flows are the major pathway for contaminants from the land to the marine environment. Sources of stormwater pollution can originate from residential, commercial, industrial and agricultural land uses. Contamination has resulted in the closure of many of the shellfish beds in the SGI EA for recreational harvesting. Figures 6 shows the shellfish bed closures within the study area, as well as the associated shellfish harvesting closure numbers. The SHWP is working toward reducing/eliminating sources of contamination which may eventually allow for the opening of shellfish beds in this area.

5.5 Contaminated Sites

In 2006, an enquiry was made to the MOE, Environmental Management branch in order to update SGI EA contaminated sites information for this report. This enquiry resulted in the identification of six contaminated sites on North Pender Island, one on Saturna Island, three on Galiano Island and two on Mayne Island (one is pending confirmation through a site visit by MOE staff). This information will be useful in selecting chemical contaminant sampling sites to assess environmental concern.

5.6 Special Projects

During the past several years the CRD SHWP has undertaken a number of special projects related to reducing/eliminating contaminants in watercourses and improving stormwater quality in the region. This section discusses some of the main projects undertaken that could be used by the SGI EA to protect stormwater quality within the jurisdiction.

Stormwater Source Control

The CRD SHWP has included stormwater source control as a major initiative since 2001. However, regulatory powers for stormwater source control rest with municipalities under the *Local Government Act* and the *Community Charter*. Therefore, municipal implementation of a model storm sewer and watercourse bylaw is the foundation for controlling stormwater contamination at the source.

An initial model bylaw titled, *A Bylaw to Regulate the Discharge of Waste into Storm Sewers and Watercourses*, was endorsed by the Board in 1995 and member municipalities were invited to adopt it. Since then the model stormwater bylaw has been updated a number of times to reflect changes in provincial regulations allowing better protection to municipal storm drain systems, increased enforcement capabilities and the incorporation of codes of practice (CoPs). As of 2005, version 12A of the Model Stormwater Bylaw, and six sector specific CoPs have been made available to all member municipalities for optional adoption or to be built into existing municipal regulations. The CoPs set out municipal requirements under which various business sectors will be required to operate to prevent the pollution of

stormwater. The Board also supported the creation of a Bylaw working group (BWG) comprised of municipal engineers and planners and CRD staff who work together to develop a coordinated approach to bylaw-related activities. The activities of the BWG are coordinated by SHWP staff.

Most municipalities in the core area of the CRD have adopted the earlier version of the model bylaw with the City of Victoria being the only municipality to adopt the latest version along with five of the six CoPs. By doing so, the City of Victoria's ability to protect municipal storm drain systems and the environment has increased.

Codes of Practice

CoPs provide sector specific guidance to help businesses become compliant with the bylaw. The CoPs are the primary tools to proactively prevent contaminants that can negatively impact stormwater quality and will establish a sector-wide level playing field for the management of stormwater quality and environmental protection.

SHWP staff developed the CoPs in partnership with municipalities, business owners, EC and the Georgia Basin Action Plan. Nine industry sectors have been initially identified and their attendant codes are being developed on a priority basis depending upon that business sector's potential to contaminate stormwater.

To date six CoPs have been completed and are ready for municipal adoption. These codes include:

1. Automotive and Parking Lot Operations
2. Construction and Development Activities
3. Recreation Facilities
4. Streets and Roads
5. Recycling Operations
6. Outdoor Storage Yard Operations

As each CoP is developed, SHWP staff will then begin to work with municipalities on an outreach program to inform and educate the affected business sectors. The codes will be available for municipalities to adopt as schedules to the enhanced bylaw.

The SHWP's source control activities, including CoP development, will be coordinated with the activities of the RSCP to ensure that the region takes an integrated approach to storm and sanitary sewer source control.

Best Management Practices

Stormwater contamination from a number of industry and business sectors cannot be addressed through CoPs. Therefore, best management practices (BMPs) are used as a source control measure. A BMP approach to stormwater source control uses the same methods and strategies as seen with CoP development, but without a regulatory mechanism for compliance. Industry consultation, educational outreach programs and continued feedback as to the effectiveness of the implemented BMPs are essential components of stormwater source control. Where appropriate and with direction from the BWG, the SHWP will develop and promote BMPs for certain industries and business sectors.

Two sector-specific BMPs completed in 2004 are ready for region-wide use. These BMPs are as follows:

1. Painting without Pollution
2. Power Washing without Pollution

It is hoped that municipalities will actively promote these BMPs by making these information sheets available to those involved in these two activities. SHWP will work with municipalities to identify and develop additional BMPs as the need arises.

Technical Assistance

The SHWP provides technical expertise and assistance to municipalities in the area of stormwater source control. Information on structural pollution prevention technologies, federal and provincial initiatives that involve stormwater quality, and changing environmental guidelines and regulations are some of the broad topics where the program provides advice to municipalities. The BWG provides a forum for the continued exchange of information relevant to stormwater source control. Guest speakers, such as governmental or business representatives, are arranged by the SHWP to address areas of concern or to provide information to the BWG.

Natural Areas Atlas

The Natural Areas Atlas is a comprehensive, web-based information tool about natural areas in the CRD. It is meant for use by anyone interested or involved in land use planning or stewardship in the region. The goal of the atlas is to promote and aid in well-informed land use decision making. This will, in turn, have positive and long-term effects on the protection and restoration of natural areas and terrestrial and aquatic habitat in the Capital Region.

The atlas project was initiated in January of 2000 by the CRD and DFO's Habitat Conservation and Stewardship program and has been made possible through support and funding from several organizations. The atlas project later received funding from the Urban Salmon Habitat program (through the former Fisheries Renewal BC) for website development and public outreach as well as Real Estate Foundation of BC. Most recently, the outreach for the Natural Areas Atlas website has been funded by the Georgia Basin Ecosystem Initiative (EC). Many of the atlas layers were updated in 2005 and 2006 and the CRD will continue to fund the updating of layers as new information comes available.

In the atlas, users will find environmentally significant information, including:

- cadastral information
- 2005 high-resolution colour aerial orthophotos
- road network
- lakes, rivers, streams and wetlands
- fish presence
- fish and wildlife habitats
- sensitive ecosystem inventory (SEI)
- important shoreline ecosystems
- watershed boundaries
- an updated parks layer and protected areas
- historical extents of Garry Oak ecosystems
- wells and aquifers
- civic sites

By highlighting the location of important natural areas, the atlas functions as an excellent flagging device informing municipal engineers, planners, developers and environmental groups that further study of a proposed development or activity may be required. The atlas can also provide essential background information for tasks such as describing the ecological sensitivity of a property or to compliment land use bylaws and official community plans.

A major component of this project has been the compilation of assorted datasets from a variety of sources. While a large number of environmental datasets that pertain to the CRD exist, they have been previously held in different formats and by different organizations. These organizations range from government agencies such as DFO, EC, the provincial Ministry of Sustainable Resource Management and the Ministry of Agriculture, Foods and Fisheries to academic and non-governmental organizations. Gathering all of this data continues to be a large undertaking that involves obtaining permission to use

data from numerous groups (by way of data sharing agreements or memorandums of understanding), acquiring the data and putting all of the different datasets into a standard format.

Using the Natural Areas Atlas is as simple as going to the website (http://www.crd.bc.ca/es/natatlas/) and using the tools and map functions provided. Access requires the use of Internet Explorer (version 5.5 or higher) or Netscape (version 4.5 or higher). A tutorial is available to familiarize new users with the basic controls. A full help system is also offered to assist users with common tasks as well as the more advanced functions.

Stormwater sampling data that is presented in this report is available to the public through the "Stormwater Sampling Locations" layer of the Natural Areas Atlas. Residents and professionals can quickly locate the sampling locations and see historic sampling data for each site. Each year's data is posted on the Natural Areas Atlas shortly after this annual report is available to the public.

The atlas can be used to promote well-informed and responsible land use decisions within the Southern Gulf Islands. This will in turn have a positive effect on the health of watercourses and the marine receiving environment. The Natural Areas Atlas can be viewed at http://www.crd.bc.ca/es/natatlas/.

Shellfish Closures

Stormwater flows are the major pathway for contaminants from the land to the marine environment. Sources of stormwater pollution can originate from residential, commercial, industrial and agricultural land uses. Fecal coliform sampling has focussed primarily on human health issues. However, there are shellfish beds in the SGI EA closed for recreational harvesting due to bacterial contamination. Currently, shellfish can be harvested for depuration in these areas with a permit from the Canadian Food Inspection Agency or DFO. The SHWP works toward opening shellfish beds for recreational harvesting through discharge and upstream investigations.

Public Education

The CRD SHWP includes a public education component for reducing contaminants flowing into storm drains. Part of public education includes promoting the use of BMPs by businesses and the community. It also involves educating community groups on stormwater quality issues and what can be done to reduce and/or prevent pollution. Articles have been placed in local newspapers outlining sources of contamination common to the SGI EA area and what residents can do to help reduce/eliminate them. As well, SHWP staff produced a quarterly newsletter outlining issues and activities relating to protecting stormwater quality in the CRD.

The program also emphasizes the importance of reporting spills that can cause harm to public health and/or the environment to the Provincial Emergency Program (PEP). PEP staff will then contact the appropriate agency for action (municipality, EC, MOE, fire department, etc.) or take action themselves. Educational initiatives will continue to promote stormwater contaminant reduction in 2007.

6.0 RECOMMENDATIONS

Public Health Concerns
The following recommendations are based on the results of the fecal coliform sampling:

1. that Stormwater, Harbours and Watersheds program staff continues to sample stormwater discharges along the Southern Gulf Islands Electoral Area coastline to monitor for fecal coliform levels.

2. that Stormwater, Harbours and Watersheds program staff continues to work with the Southern Gulf Islands Electoral Area director and Vancouver Island Health Authority staff to identify the sources of elevated fecal coliform concentrations in stormwater.

Environmental Concerns

The following recommendations are based on the results of the chemical contaminants survey:

1. that Stormwater, Harbours and Watersheds program staff continues to monitor discharges to determine source(s) of chemical contamination.

2. that Stormwater, Harbours and Watersheds program staff discontinues monitoring discharges where low contaminant levels have been confirmed.

3. that Stormwater, Harbours and Watersheds program staff evaluates the effectiveness of the current sediment sampling program and make changes as required to protect watercourses and the nearshore marine environment.

4. that Stormwater, Harbours and Watersheds program staff continues monitoring significant watercourses to assess water quality and to monitor for change over time.

Stormwater Source Control

1. that Stormwater, Harbours and Watersheds program staff continues to develop (as required) the regulatory framework of bylaws, codes of practice and best management practices for the protection of stormwater quality.

2. that the Southern Gulf Island Electoral Area considers adopting the Model Storm Sewer and Watercourse Protection Bylaw, associated codes of practice and best management practices.

General

1. that the Stormwater, Harbours and Watersheds program staff continues working with community groups and others to promote the protection of stormwater quality.

7.0 REFERENCES

Drinnan, R.W., 1997. *Stormwater Discharge Rating System for the Capital Regional District*. Prepared for the Capital Regional District Engineering department.

Gormican. S., 2005. *Assessment of Metals and PAHs in Sediments from Stormwater Discharges and Creeks 2004 Sampling Program*. Prepared for the Capital Regional District, Environmental Programs department.

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8.0 PERSONAL COMMUNICATIONS

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